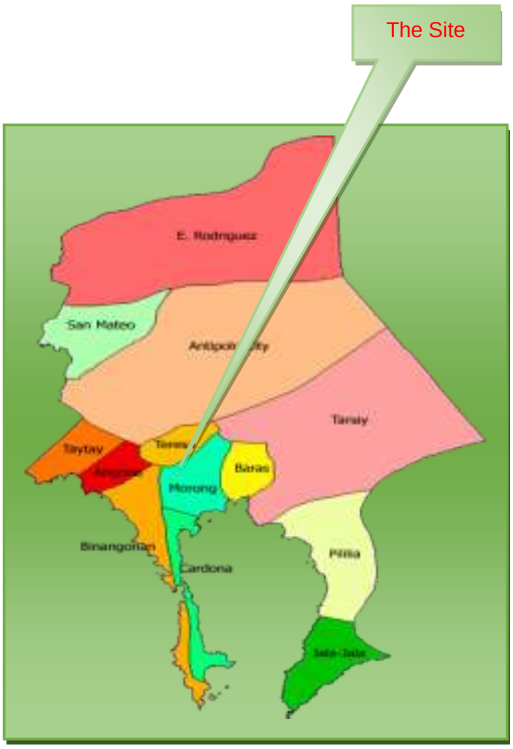
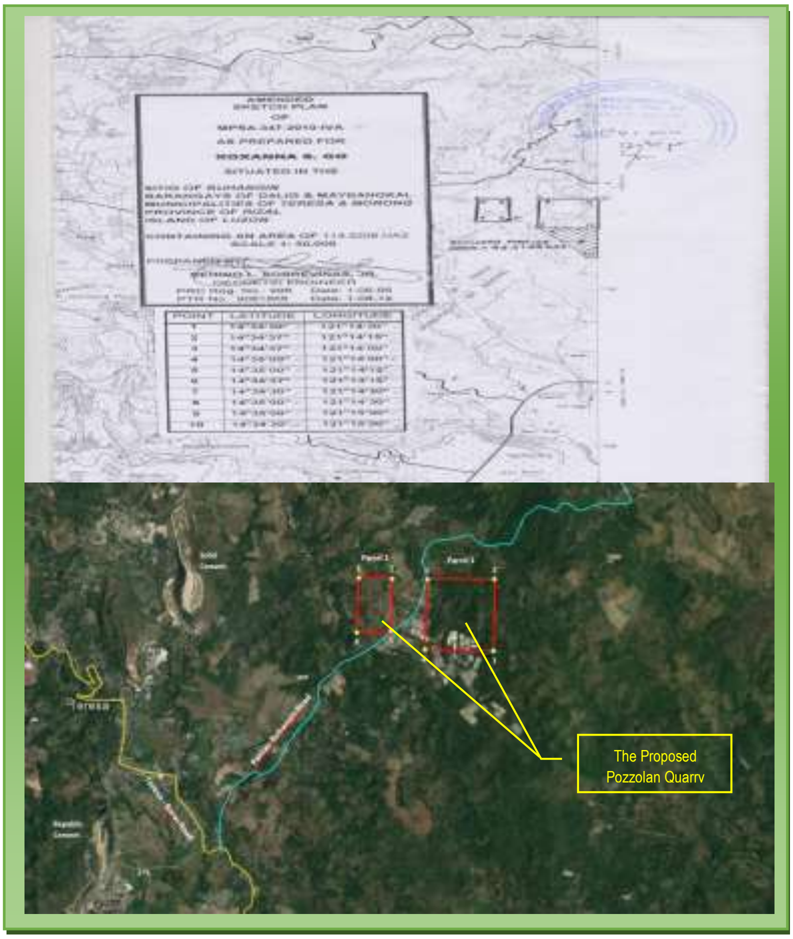
ENVIRONMENTAL IMPACT STUDY (EIS)

FOR THE PROPOSED

POZZOLAN QUARRY (MPSA 347-2010-IVA) PROJECT

BARANGAY MAYBANCAL, MUNICIPALITY OF MORONG AND BARANGAY DALIG, MUNICIPALITY OF TERESA, PROVINCE OF RIZAL





PREPARED FOR:

ROXANNA S. GO

OFFICE ADDRESS: NO. 167 SUMULONG HIGHWAY, ANTIPOLO CITY, RIZAL
SITE ADDRESS : BARANGAY MAYBANCAL, MUNICIPALITY OF MORONG AND BARANGAY DALIG, MUNICIPALITY OF TERESA PROVINCE O RIZAL

PREPARED BY:

CENSE TECHNICAL CONSULTANCY SERVICES

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SUBMITTED TO:

DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES
Environmental Management Bureau – Central Office
DENR Compound, Visayas Avenue, Diliman, Quezon City

DRAFT
SEPTEMBER 2020

ROXANNA S. GO

September 3, 2020

ENGR. WILLIAM P. CUŇADO
EMB Director
DENR-EMB Central Office
DENR Compound, Visayas Avenue,
Diliman, Quezon City

ATTENTION : ENGR. ESPERANZA A. SAJUL
CHIEF-EIA

SUBJECT : APPLICATION FOR ENVIRONMENTAL COMPLIANCE CERTIFICATE (ECC) FOR PROPOSED *'POZZOLAN QUARRY (MPSA 347-2010-IVA) PROJECT'* TO BE LOCATED AT BARANGAY MAYBANCAL, MUNICIPALITY OF MORONG AND BARANGAY DALIG, MUNICIPALITY OF TERESA, PROVINCE OF RIZAL

Dear Director Cuṅado:

Transmitting herewith for copy of the **Additional Information (AI) Matrix and Revised Draft Environmental Impact Study (EIS**) based on the Results of the First Technical Review conducted via Microsoft Teams on August 20, 2020 for the proposed '***POZZOLAN QUARRY (MPSA 347-2010-IVA) PROJECT'***.

We hope you find the above requirements in order and looking forward to your immediate kind attention on the application.

Thank you very much.

EIS Preparer:

CEnSE Technical Consultancy Services

By:

Engr. Venice V. Montemayor
Team Head

Very truly yours,

ROXANNA S. GO
MPSA-Holder

167 Sumulong Highway, Barangay Mayamot, Antipolo City
Landline: +63(2) 8 645 3915 emailadd: rcrdc@yahoo.com

A. PROJECT FACT SHEET

Table ES-1. Project Fact Sheet

Project Name	POZZOLAN QUARRY (MPSA 347-2010-IVA)
Project Location	Barangay Maybancal, Municipality of Morong and Barangay Dalig, Municipality of Teresa, Province of Rizal
Nature of Project and Project Category per EMB MC 2014-005	2.1 Mining and Quarrying Projects 2.1.3 Extraction of Non-Metallic Minerals ≥ 20 hectares production
Project Area	114.5206 hectares (MPSA Coverage) (Parcel 1 = 82.80 hectares and Parcel 2 = 31.7206 hectares) **Quarry Area = 46.6206 Hectares** Parcel 1 = 36.7000 hectares Parcel 1 = 9.9206 hectares **Excluded Area = 67.9000 hectares**
Project Capacity	1,000,000 MT/year of Pozzolan
Mineral Reserve	13.36 Million Metric Tons
Process Technology	Surface Mining Method
Proponent's Name	Roxanna S. Go
Proponent's Address	167 Sumulong Highway, Barangay Mayamot, Antipolo City
Proponent's Contact Person	**ROXANNA S. GO** President Landline: +63(2) 8 645 3915 Email add: rcrdc@yahoo.com Abner Padrique Representative-Manager Landline: +63(2) 8 645 3915
Consultant's Contact Person and Address	CEnSE Technical Consultancy Services Unit 405, Yrreverre Square, 888 Mindanao Avenue, Quezon City LL: (027)980.2776; ML:0917.7003008 Engr. Venice Montemayor EIS Team Head Mobile No.: 0927-5116742 Email add: cense_tech@yahoo.com.ph; cense.consultancy @gmail.com

Table ES-2 Project Components

Facilities	Project Components		
	No. of units	Area (sq.m)/ Capacity	Specification/ Description/ Remarks
Project Capacity	**3,205 MT/day; 83,333.33 MT/month; 1,000,000 MT/yr**		
Volume of Mineral Reserve	**13.36 Million Metric Tons**		
Project Area covered by MPSA for Parcel 1 and Parcel 2	**114.5206 has**		
Quarry Area	**46.6206 has (36.70 has for Parcel 1 and 9.9206 has Parcel 2)**		
MAJOR COMPONENT			
Quarry Operation	1	3,205 MT/day	The estimated daily quarry capacity of the project using conventional Surface Mining Method. The sequence of the quarry development are as follows: • Preparation of Access Roads • Topsoil / Waste Stripping • Drilling • Blasting • Loading and Hauling • Screening • Stockpiling
Mobile Crushing Plant	1	5,000 sqm	This serves as the area for crushing plant including raw materials
SUPPORTING FACILITIES AND UTILITIES			
Admin Support (Site Office, and Barracks/Quarters etc.)	2	100 square meters	The project shall be provided with admin and barracks for use of office and quarry and site personnel.
Motorpool, Equipment Workshop and Fuel Tank	2	200 square meters	The project shall be provided with two (2) units equipment workshop each for Parcel.
Water Supply	-	1.0 cu.m/day	Domestic Water Requirement to be supplied by Local Water District.
Drainage System	NA	Underground RCP	Properly designed surface run-off thru construction of drainage system to divert to the settling pond
Access Road	2 units	~ 200 meters length	Access Road is along Pantay-Buhangin Road with separate for Parcel 1 and Parcel 1 which shall be provided with width of 12.0 meters.
POLLUTION CONTROL FACILITIES			
Siltation Pond	4	300 sqm	Siltation pond shall be provided to control the silt and the run-off. Two (2) silt ponds shall be provided in Parcel 1 with volume capacity of 12,936.66 cum and two (2) silt ponds in Parcel 2 with volume capacity of 11,217.12 cum
Nursery	2	200 sqm	Both parcels shall be provided with nursery area in preparation for progressive rehabilitation activity.
Solid Waste Management Facility (MRF)	2	100 sqm	MRF shall be provided for each Parcel Area.
Toxic and Hazardous Waste Facility	2	100 sqm	Each parcel shall allocate an area for Toxic and Hazardous Waste Facility.
Domestic Wastewater Management Facility	2	50	Each parcel is provided with Three Chamber Septic Tank for primary treatment of domestic wastewater.
Buffer Zone	4 for each parcel	Parcel 1 N=20m, E=153m, W=63m S=421m Parcel 2 N=357m, E=166m, W=32m, S=25m	A minimum of 20-meters buffer zone will be established from major roads, residential, and agro-industrial areas
Excluded Area	2	Total of 67.90 has	Parcel 1 excluded is about 46.10 has while Parcel 2 is 21.80 has. Excluded area identified are with existing agro-industrial and settlement.

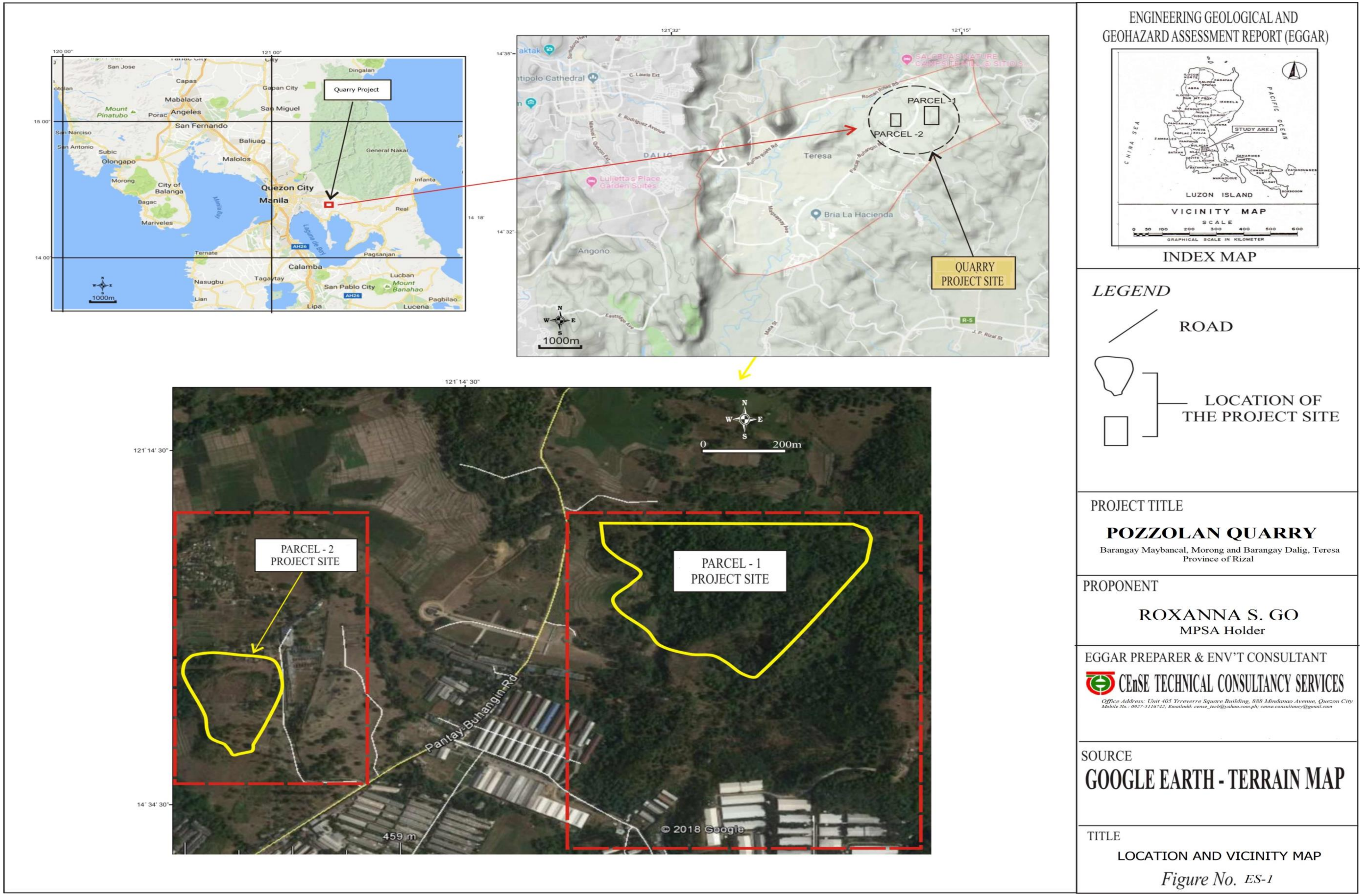

Figure ES-1 Location of the Project

B. PROCESS DOCUMENTATION

EIA Team

Table ES-3. EIA Team

NAME OF PREPARER's	FIELD OF EXPERTISE	EMB Registration No.
Engr. Venice Montemayor	Team Leader Report Integration, Socio-Economics and Water, EMP	IPCO No. 260
Engr. Ronald Pahunang	Air and Air Dispersion Modelling	IPCO No. 173
Engr. Rodel Olivares	Chemical, Hazardous, EMP, AIR	IPCO No. 132
Arnold Alvarez	Geology and Hydrogeology	None
Aileen Faith Redondo Ryan P. Dela Cruz	Terrestrial and Freshwater Ecology	IPCO No. 427 IPCO No. 428
Roxanna S. Go	Legal documents, Project Description, and Process	Proponent

EIA Study Area and Schedule

Based on the conduct of the study and pursuant to DAO 2017-15 on the identification and delineation of Direct Impact Area (DIA) and Indirect Impact Area (IIA), this report came up with the conclusion that the people, establishment, agro-industrial and institutional along Panta-Buhangin Road falls within the Direct Impact Area (DIA) Category regardless of its proximity to the proposed quarry site for its impact on air and people due road safety.

The EIA Study area focused on the Direct Impact Area (DIA) of the project area in 114.5206 hectares identified as the People from Barangay Maybancal, Morong and Barangay Dalig, Teresa, Province of Rizal were considered for IEC and Public Participation, impact on land for terrestrial ecology, the nearest surface water body and air and noise on the impact community.

Table ES-4. EIA Area and Schedule

EIA Aspect	EIA Study Area	Date conducted
Sampling of Outcrops	Four (4) in Parcel 1 and One (1) in Parcel 2- were collected to explore the lateral continuity of the pozzolanic material within MPSA 347. The samples were sent to Cement Testing Center at Bagong Ilog, Pasig City for laboratory tests, such as Pozzolanic Activity Index (PAI), SiO2, Al2O3 and Fe2O3 percentages, and specific gravity	Exploration Report 2018
Surface Water	Unnamed Creek – Three (3) Stations (Intermittent Creek)	August 9, 2019
Engineering Geological and Geohazard Assessment (EGGAR)	114.5206 hectare	July-August 2019
Terrestrial (Flora and Fauna) Sampling	Parcel 1 and Parcel 2 representative samples of the 114.5206 hectares. Using representative sample.	June 26 – 29, 2019
Air Sampling	Four (4) Sampling Stations: Pantay Elementary School – nearest School along Pantay-Buhangin Road Coral Farm – Inside Parcel 1 adjacent agro-industrial – will be excluded from the Quarry Area Quest Adventure Park- nearest recreational park in Parcel1 Ondoy Village – Nearest community in Parcel 2	August 9, 2019
People	Information Education Campaign (IEC) General Assembly: Barangay Maybancal, Morong Barangay Dalig, Teresa, Perception Survey Public Scoping	March 11, 2019 March 25, 2019 February – March 2019 July 9, 2019

Public Participation Activities

In compliance to DAO 2017-15, Public Participation for the Information Education Campaign (IEC) in a form of General Assembly and Consultation was conducted prior to the conduct of the Public Scoping. **Table ES-5 and Table ES-6** shows the summary of the Information Education Campaign and Public Participation conducted for Barangay Maybancal, Morong and Barangay Dalig, Teresa, Rizal:

General Assembly and Public Scoping/Consultation

Consultation in a form of General Assembly was conducted for each barangay. Public Scoping was conducted by the proponent to all identified stakeholders such as LGUs- Provincial and Municipal (Morong and Teresa), Barangays Maybancal, Morong and Dalig, Teresa, Industry, Non-Government Organization (NGO)'s and, Peoples Organization (PO) and community residents. The objective was to present the project prior to any construction and operation activity. The issues raised were the following: dust pollution, employment distribution, flood, health, social development plan and safety of transportation of materials.

Presented in ***Annex H.6a*** presents the documentation of the Information Education Campaign (IEC) and ***Annex H.6b*** presents the Public Scoping Report (PSR).

Perception Survey

The perception survey thru house-to-house was conducted to identify the present socio-economic profile of the pre-determined social impact areas and to know the level of awareness of the people, their personal view whether positive or negative opinion for the proposed quarry project and at the same time hearing the issues and concerns of the community not necessarily seeking the approval of the project. A total of Two-Hundred Thirty-Two (232) respondents distributed at One Hundred (100) for Barangay Maybancal, Morong and One Hundred Thirty-Two (132) for Barangay Dalig, Teresa, Province of Rizal on the perception survey.

Annex H.6c presents the Perception Survey Results.

Table ES-5. Summary Issues and Concerns in Barangay Maybancal, Morong during the General Assembly

ISSUES AND CONCERN	Stakeholders/Sector or Representative Who Raised the Issue/Suggestion	How It Was Addressed in the EIA Report
Project Description 1. Timetable of the project 2. Blasting component 3. In case DENR approves the project, when is the target date of operation	Efrocinia Concepcion – Resident Teresita N. Felix President of Maybancal Senior Citizens Association	1. The project operation is about 15 years as presented in the Chapter One - Project Description 2. Part of the component is blasting when necessary which shall be supervised by an Accredited blasting Contractors measures discussed in Chapter 3-Impact Management Plan 3. Chapter 1 - Project Description under 1.7 Development Plan, the proponent shall secure other permits governed from the Local Government Units before the project can start its operation.
A. Land 1. Impact on Blasting 2. In case problem arises, will the project leave it open and unattended	Rizalido M. Cruz Resident Emil Feliciano Lupon ng Barangay	1. Blasting is only used when hard rock is encountered using the latest technology under supervision with Licensed Blaster. In addition, the community thru the barangay office shall be notified prior to the conduct or scheduled blasting activity for proper information dissemination as presented in Chapter Three - Impact Management Plan. 2. In case violations committed, EMB or DENR shall require the proponent to perform corrective or mitigating measures as provided in the submitted Impact Management Plan
B. Water 1. Flooding during rainy days since we are already experiencing 2. Is the project approved by DENR	Amelia M. Gaerlan BHW Nelia B. Cuano Lupon ng Barangay	Part of the pollution control measures or devices as presented in Chapter One – Project Description under Project Components is the construction of the siltation pond both for Parcel 1 and Parcel 2 to control the surface run-off and prevent siltation of the low-lying areas. 2. The only permit approved was Mineral Production Sharing Agreement (MPSA) or the mineral present underneath the surface, as presented in Annex D.

3. What is the assurance that the project will not pose impact to the environment? Flooding/landslides		3. The proponent shall see to it that the Impact Management Plan (IMP) shall be properly implemented, Chapter Three of the EIS Report. In addition, Multi-Partite Monitoring Team (MMT) shall be formed composed of various agencies headed by Local Government Units (LGU) more particularly involving the host barangay, Chapter Six – Environmental Monitoring Plan.
D. People 1. What is the benefit of the project. 2. Who will give assistance or emergency response to the affected residents in case of flood. 3. Employment 4. Responsible person of the project in case of disaster/Safety of the people	Lourdes R. Alano BHW Eva Hilario BHW Gilda M. Ramos Lupon/Senior Citizen and V.P. Lily De Castro BHW Criselda Felix BHW	1. Under Republic Act No. 7942 (Philippine Mining Act of 1995), the Social Development and Management Program (SDMP) provides that contractors assistance in the development of the communities of Chapter XIV of DAO 2010-21 - the consolidated DENR Administrative Order for the Implementing Rules and Regulations (IRR) of R.A. 7942 which requires for the development of community. implementation of the SDMP will be provided by the MPSA Holder with an allotment of a minimum of 1.5% of the total operating cost annually, of which 75% shall be appropriated to implement the SDMP, 15% for the IEC. Chapter 5 - Social Development Plan of the EIS Report. 2. The proponent shall establish an Environmental Guarantee Fund (EGF) which shall be used in case of environment related issues and concern which shall validate first by EMB, DENR and MGB, Chapter Six – Environmental Monitoring Plan. 3. Part of the agreement and conditions is to provide employment and livelihood to host barangays which shall form part of the Social Development Plan, Chapter Six – Environmental Monitoring Plan. 4. The proponent shall be held liable if validated to be caused by the operation of the quarry.

Table ES-6. Summary Issues and Concerns in Barangay Dalig, Teresa during the General Assembly

ISSUES AND CONCERN	Stakeholders/Sector or Representative Who Raised the Issue/Suggestion	How It Was Addressed in the EIA Report
Project Description 1. If possible existing trucks to pass on the other access road not in Pantay Road. 2. Where is the exact location and boundaries of the project. 3. Timetable of the quarry operation	Gemma De Torres, Tanod Berna Bondal, Resident Jess Bongalos, SIPAD Inc.	Chapter 1 -Project Description discussed in Table 1-11 Description of the Pollution Control Device and Waste Management Measures During Construction under Road Safety and traffic. Discussed in Table 1-8 Project Size and Table 1-9 timetable of the project
A. Land 1. Once clearing operation started, what will happen to the wildlife like snakes, which will enter into our houses due to disturbance 2. Effect of blasting to our houses	Karen Castillo, Resident Richel Gentelis, Torres Farm	Discussed in Chapter 2.1.4.3 and 2.1.4.4 Discussed in Table ES-10. Controlled blasting shall be implemented and shall be supervised by Licensed Authority.
B. Water 1. What is the assurance of the creek/siltation pond is strong and safe in the event of landslide and flood	Rosalyn Beneza, Resident Rosalinda A. Pelayo, Resident	The siltation pond is placed at the lowest portion of the area to catch the surface runoff. The capacity of the siltation pond is designed to accommodate the maximum rainfall with estimated volume of 12,936.66 cubic meters for Parcel 1 and 11,217.12 cubic meters for Parcel 2, Chapter One-Project Description and Chapter 2- Assessment of Environmental Impacts.
C. Air 1. Dust - Imposition of speed limit to all truck passing along Pantay Road for safety of the children and community	Remma Castro, Resident	Discussed in Table 1-11 Description of the Pollution Control Device and Waste Management Measures During Construction under Road Safety and traffic. Included in the Chapter Three – Impact Management Plan is the imposition of speed limit to ensure safety of the people.
D. People 1.Benefits/ Employment of the project to Barangay Dalig	Jess Bongalos, SIPAD Inc. Teresa Curvi Resident	1. Under Republic Act No. 7942 (Philippine Mining Act of 1995), the Social Development and Management Program (SDMP) provides that contractors assistance in the development of the communities of Chapter XIV of DAO 2010-21 - the consolidated DENR Administrative Order for the Implementing Rules and Regulations (IRR) of R.A. 7942

		which requires for the development of community. The funds for the implementation of the SDMP will be provided by the MPSA Holder with an allotment of a minimum of 1.5% of the total operating cost annually, of which 75% shall be appropriated to implement the SDMP, 15% for the IEC. Chapter 5 - Social Development Plan of the EIS Report.
2. Safety of the Children during construction and operation phase.	Krissa Bautista Pantay Elementary School	1. The project shall implement speed limit and especially approaching the Pantay Elementary School to ensure safety of the children, Chapter Three – Impact Management Plan
3. Affect Health Issues	Jess Bongalos SIPAD Inc.	2. Quarry project is a dry process with no chemical involved during the operation activity, no impact identified for health issues.

Based on the result of the Information Education Campaign (IEC), Stakeholders identified during the conduct of the Public Scoping is presented in **Table ES-7** and the summary of issues raised during the Public Scoping is presented in **Table ES-8.**

Table ES-7. Identified Stakeholders and List of Invitees During the Public Scoping

		Potential Impact Area	Basis for Selection of Sector as a stakeholder of the Project	Sectors/Sub-sectors Identified by Proponents to be Likely Stakeholders of the Project	Specific Organizations/Entities Likely to be invited to IEC/Site Scoping as Representing the Sectoral Stakeholders
A.		*Direct Impact Area (e.g. barangays within the project area)*			
	1.	*Hon. Jhanda Sto. Domingo Barangay Chairman Barangay Dalig, Municipality of Teresa*	*The project is located in the barangay, Primary Impact as they are the host barangay*	*LGU - Barangay*	*Barangay Chairman and officials*
	2.	*Hon. Harold Ramos Barangay Chairman Barangay Maybancal, Municipality of Morong*	*The project is located in the barangay, Primary Impact as they are the host barangay*	*LGU - Barangay*	*Barangay Chairman and officials*
B.		*LGU with Political Jurisdiction over the project area (other than the barangays listed in A)*			
	1.	*Hon. Raul Palino Municipal Mayor Municipality of Teresa*	*The project is covered by the Municipality of Teresa*	*LGU - Municipal*	*Municipal Mayor*
	2.	*Hon. Jose Jeriel Villegas Municipal Vice Mayor Municipality of Teresa*	*The project is covered by the Municipality of Teresa*	*LGU - Municipal*	*Municipal Vice Mayor and Council*
	3.	*Municipal Planning and Development Office (MPDO) Municipality of Teresa*	*The project is covered by the Municipality of Teresa*	*LGU – Municipal Land Use*	*MPDO*
	4.	*Hon. Olivia de Leon Municipal Mayor Municipality of Morong*	*The project is covered by the Municipality of Moring*	*LGU - Municipal*	*Municipal Mayor I*
	5.	*Hon. Julian Joseph De Ungria Municipal Vice Mayor Municipality of Morong*	*The project is covered by the Municipality of Morong*	*LGU - Municipal*	*Municipal Vice Mayor and Council*
	6.	*Municipal Planning and Development Office (MPDO) Municipality of Morong*	*The project is covered by the Municipality of Morong*	*LGU - Municipal*	*MPDO*
	7.	*Hon. Rebecca Ynares Office of the Provincial Governor of Rizal*	*The project is covered by the Province of Rizal*	*LGU- Province*	*Provincial Governor*
	8.	*Hon. Reynaldo San Juan, Jr. Office of the Provincial Vice- Governor of Rizal*	*The project is covered by the Province of Rizal*	*LGU- Province*	*Provincial Governor and Council*
C.		*Other Evident pre-identified areas of potential impact (may be candidates for Indirect Impact Areas, subject to EIA Findings)*			
	1.	*Gilbert Gonzales Regional Executive Director*	*DENR Regional Jurisdiction*	*EMB 4A*	*DENR*

		DENR-4A			
	2.	*Ms. Noemi A. Paranada Regional Director EMB-Calabarzon*	*EMB Regional Jurisdiction*	*EMB 4A*	*EMB*
	3.	*Mr. Isidro L. Mercado, Ph.D. PENRO Province of Rizal*	*PENRO-Rizal*	*PENRO*	*DENR*
	6.	*Municipal Health Officer Municipality of Teresa, Rizal*	*Impacts on the heath*	*DOH*	*DOH*
	7.	*Municipal Health Officer Municipality of Morong, Rizal*	*Impacts on the heath*	*DOH*	*DOH*
	8.	*The Principal Pantay Elementary School*	*The nearest institution to be affected by the project*	*School - Institution*	*DePEd*
	9.	*The Principal Maybancal Elementary School*	*The nearest institution to be affected by the project*	*School - Institution*	*DePEd*
	10.	*Samuel T. Paragas, CESO IVs Regional Director Mines and Geosciences Bureau (MGB) Region 4A 6th Floor, DENR By The Bay Building, Roxas Boulevard, Manila*	*Quarry and Mining*	*National Office Regional*	*MGB*
	11	*Atty. Wilfredo G. Moncano Acting Director Mines and Geosciences Bureau (MGB) Central Office North Avenue, Diliman, Quezon City*	*Quarry and Mining*	*National Office Central*	*MGB*
	12	*The Manager, Coral Farm Dalig, Teresa, Rizal*	*Nearest Agro farm in the project*	*Representing Agro-Industrial*	*PO*
	9.	*Teresa Gospel Four Square Church Teresa, Rizal*	*Nearest Church in the Rae*	*PO*	*PO*
	13.	*Community Residents of Barangay Maybancal, Morong, Rizal*	*Stakeholders in the area*	*Resident, etc.*	*Stakeholders*
	14.	*Community Residents of Barangay Dalig, Teresa, Rizal*	*Stakeholders in the area*	*Resident, etc.*	*Private Sector*
	15.	*The Manager Robina Farm Teresa, Rizal*	*Stakeholder in the Area Southeast boundary of the project*	*Representing Industrial stakeholders*	*Private Sector*
	16.	*The Manager Quest Adventure Park Teresa, Rizal*	*Stakeholder in the Area Northeast boundary of the project*	*Representing Commercial stakeholders*	*Private Sector*
	17.	*HOA Unity Village Antipolo, Rizal*	*Stakeholder in the Area North boundary of the project*	*Representing Residential stakeholders*	*Private Sector*

Attach NAMRIA topographic map showing project areas/s and direct/indirect impact areas, with highlighted location (and/or boundaries, if available) of respective DIA and IIA sitios, barangay, municipality, province

Table ES-8. Summary of Issues During the Public Scoping

EIA MODULE	Issues/Suggestions Raised by the Stakeholders	Sector or Representative Who Raised the Issue/Suggestion	How It was Addressed in the EIA Report
A. Land 1. Apply reclassification from agricultural to mining/quarry Municipality on the last stage of the compliance	1. Apply reclassification from agricultural to mining/quarry Municipality on the last stage of the compliance	MPDO – Teresa, Rizal	The proponent shall comply and secure all necessary permit from the LGU.
B. Water 1. Is there flood control measures? Volume of water in Talaga Creek 2. Water quality – silica can affect the surface water which is currently used for irrigation 3. Flow of water from upstream if there is impact in our structures	Hydrology Study. Is there flood control measures? Volume of water in Talaga Creek 4. Water quality – silica can affect the surface water which is currently used for irrigation 5. Flow of water from upstream if there is impact in our structures	LGU- Morong, Rizal Quest Adventure Park	There are no active creeks or waterways in the area, creeks are considered intermittent creek. May-iba is the nearest waterbody which is about 3.0 aerial km southwest of the project. Discussed in Chapter 2.2.1.2 There will be no impact on the structures of the Adventure Quest since the project shall provide adequate buffer zone in the

			area with a minimum of 20-meter. Chapter One-Project Description Table 1-7 and the Pollution Control Facilities.
C. Air 1. Air pollution experience – can affect the community	1. Air pollution experience – can affect the community	LGU- Morong, Rizal	Will sprinkler water in the open and access area to prevent dust and street sweeper, Chapter Three – Impact Management Plan.
D. People 1. Existing Road and Pollution What will happen to the road, impact of additional trucks; 2. Can you regulate the time of hauling for safety of children and to prevent traffic	1. Existing Road and Pollution What will happen to the road, impact of additional trucks; Can you regulate the time of hauling for safety of children and to prevent traffic	Teresa Four Square Gospel Church	Imposition of speed limit and time along the Pantay Road and additional signages, Chapter Three – Impact Management Plan.

Figure ES-2 Map of Impact Area with Sampling Location

EIA Methodology

Table ES-9 shows the corresponding activities along with its methodology:

Table ES-9. EIA Methodology

SCOPE/ACTIVITIES	METHODOLOGY	DATE AND TIME CONDUCTED
LAND		
Soil	Diamond Core Drilling Pozzolanic Activity Index (PAI)	July-September 2016
Engineering Geological Geohazard Assessment Report (EGGAR)	Based on the MGB Available Hazard Maps	July-August 2019
Flora and Fauna	Actual Observation and Survey using the following methodology: Avifauna: Point count method, Key Informant Interviews (KII), Incidental surveys, and Mist-Netting. Volant Mammals: Mist-Netting. Non-Volant Mammals: Live traps Herpetofauna: Cruising methods or opportunistic sampling Terrestrial fauna: Transect plots measuring 20m x 20m were established in each station, transect- line method, in each station a 100 m line is laid across the sampling stations.	June 25-29, 2019
WATER		
Baseline Surface Water (Upstream and Downstream)	Based on DAO 2016-08	August 9, 2019
AIR		
Baseline Air Quality Sampling (4-Stations)	Based on DENR NAAQGV for Criteria Pollutants based on 1-hour averaging time	August 9, 2019
PEOPLE		
Public Participation	Based on DAO 2017-15 Perception Survey Conducted General Assembly – Barangay Maybancal, Morong and Barangay Dalig, Teresa Public Scoping	February – March 2019 March 11, 2019 March 25, 2019 July 9, 2019

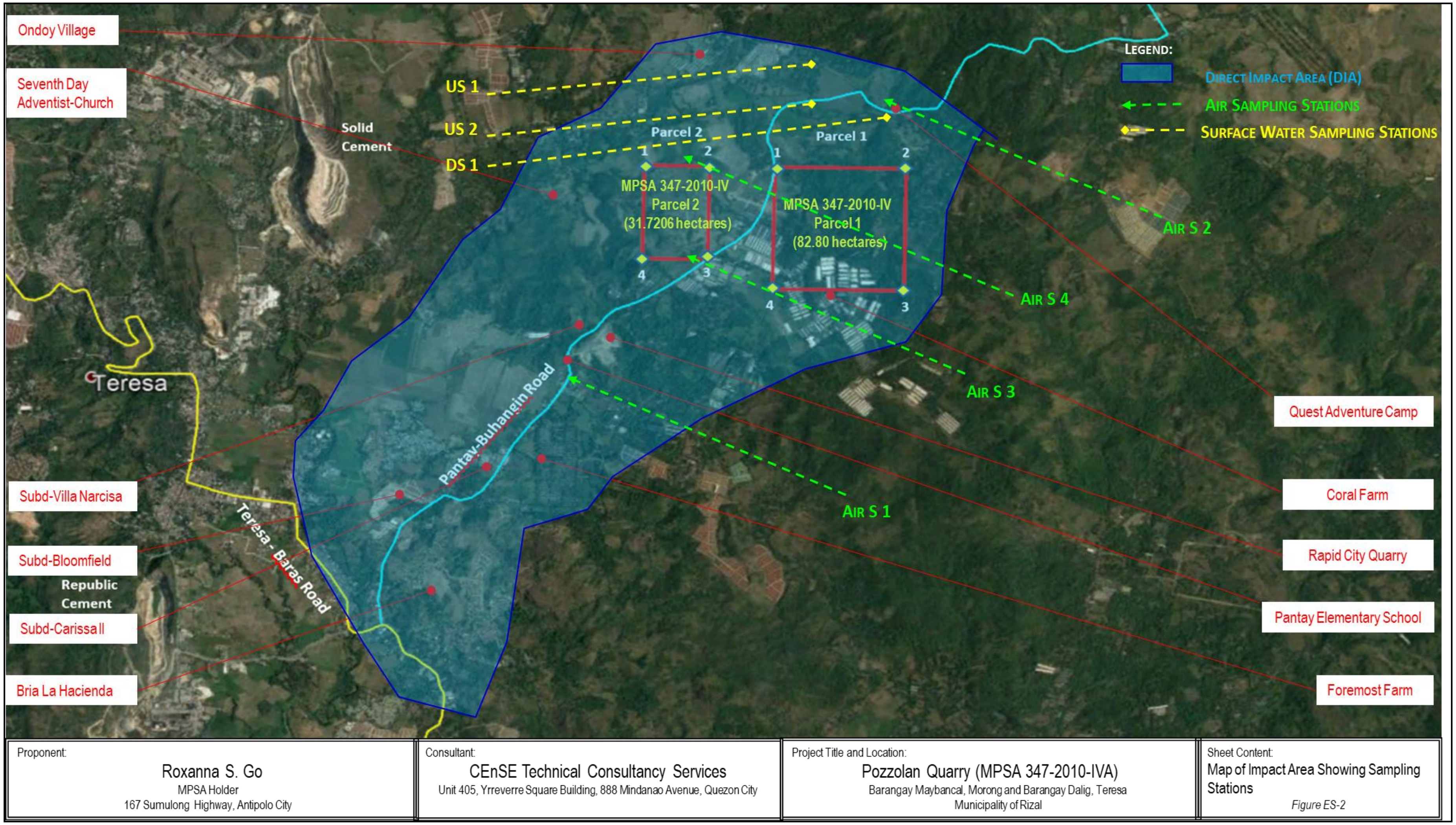

Figure ES-2 Map of Impact Area with Sampling Location

C. EIA SUMMARY

Summary of Alternatives In terms of Siting, Technology Selection/Operation Process and Design

Siting: Based on the Final Exploration Report (FER), the results of Pozzolanic Activity Index (PAI) tests, fineness tests and total SiO_2 + Al_2O_3+ Fe_2O_3 indicate that the tuff underlying MPSA 347 was suitable as natural pozzolan for blending with Portland cement.

No other siting locations were considered for the proposed quarry projects as this has been awarded a Mineral Production Sharing Agreement (MPSA). In addition, the specific area is not susceptible to any form of natural hazards such as liquefaction, earthquake, volcanic eruptions, storm surges, tsunami, but classified within Moderately susceptible to flooding for low-lying area and landslide due to improper quarry practice. These identified hazards can be mitigated thru implementation of protective measures.

Technology Option and Design: The project shall adopt the conventional Surface Mining Method using heavy equipment, and application of Controlled Blasting when hard rock is reached, Crushing and Hauling and Delivery. Only raw materials shall be produced by the project to the cement plant industries.

Summary of Key Baseline Findings and Integrated Summary of Impacts and Residual Effects After Mitigation

Table **ES-9a** presents the summary of key baseline findings while the summary of Impacts and Proposed Mitigation and Residual Effects is presented in **Table ES-10.**

Table ES-9a Summary of Key Baseline Findings

Baseline Information	Key Baseline Findings
THE LAND	
Land Classification	The quarry area is covered by MPSA 347-2010-IVA.
ECA	The project site is located in at least two ECAs: areas frequently visited or hard-hit by natural calamities and areas close to waterbodies that support wildlife. Secondary data showed that the site may be affected by earthquake generated by nearby faults
Geology and Geomorphology	The site is primarily underlain by the Diliman Tuff member of the Guadalupe Formation. Kinabuan Formation exposed within the MPSA consist of an alternation of shale, mudstone, siltstone and sandstone. The shales, mudstones and siltstones are greenish white to greenish blue, slightly metamorphosed, well indurated and siliceous. The sandstone is cream, fine-grained, slightly oxidized and weathers to brownish clayey material. The Province of Rizal is distinctly mountainous characterized by moderately- to highly-steep topography
Topography	The tenement of Roxanna S. Go is located in the western flank of the southern Sierra Madre mountain range (SSM). It is characterized by low relief with rolling topography. Several creeks and gullies in the area converge to the bigger Teresa River, draining into the Laguna de Bay. Based on the maps provided, the project area has gently sloping to rolling terrain ranging from 8-50% slope at elevations up to 170 meters
Land Cover and Terrestrial Ecology	Land cover map of the Municipalities of Morong and Teresa in relation to the MPSA site which shows that Parcel 1 land cover mostly perennial crop, grassland and built-up area while Parcel 2 land cover are built-up. Fragmented forest patches were observed in the area which were composed of agriculturally cultivated species mixed with degraded vegetation. There are disturbances within the forests like unpaved trails to meet the needs of the nearby residents. Along the edge of the forests lie structures for commercial and industrial purposes and houses of the residents in the area. Parcel 1 was mostly covered with cultivated species and agricultural plantation, with a mango plantation observed eastward of the sampling Site. There is less vegetation and forest cover in Parcel 2 as the area is adjacent to a dried and open rice field
GEOHAZARD ASSESSMENT	The project area is prone to hazard such as geologic hazards due to ground acceleration
THE WATER	
Hydrology	The quarry area has no identified water body. Run-off channel is present that generally runs northwest then turns westward to join May-iba River which is 2.3km southwest and eventually join Teresa and Morong River which eventually spills into Laguna de Bay

Freshwater	No identified endangered species found both for freshwater and marine ecology.
Surface Water Quality	Run-off Channel is the nearest drainage outfall in the area, water quality baseline was conducted last August 9, 2019 and September 11, 2020 both for Run-off Channel and downstream area. Monitoring during after the downpour is recommended.
THE AIR	
Air Quality	Baseline prior to development was conducted August 9, 2019 where at the scheduled sampling activity, rain poured. Sampling location done for the nearest receptors in the area such as institutions and agro-industrial farm and residents. Results showed that PM and NOx are within DENR Standards.
Contribution to Climate Change and Greenhouse Gas Emission	Based on the number of equipment and its corresponding rated power, fuel consumption and GHG emissions were the results of which are summarized as follows: Total estimated fuel consumption from vehicles/mobile sources = 626.38 cubic meter per year and Total estimated GHG emissions = 1676.398 metric tons per year. The total GHG emissions per year is relatively low as compared to other large mining projects. It is recommended, however, that GHG accounting program be implemented to determine the actual GHG emissions and to determine the appropriate measures to reduce said emissions
THE PEOPLE	
In-Migration and Displacement	The majority of which will be coming from the host Barangay thus will not affect influx if migrants. There are about 15-20 settlers that will be affected in Parcel 2 which was excluded from the quarry area, Parcel 1 has agro-industrial farm and cultivated farm in the area that part of the excluded area.
Health Profile	The barangay is only served by Barangay Health Centers. People seek medical assistance thru the scheduled Municipal Health Officer.
Infrastructure and Resource Competition	The barangay area is by served barangay hall, multi-purpose hall, etc. Domestic water is catered by Teresa Water District. Some Community is served by individual artesian well.
Sources of Income and Livelihood	Farming and livestock are the main sources of income in the barangay and multi-task vending is also dominant in the area
Perception Survey Results	The survey was conducted on February 17 to March 26, 2019 for Barangay Dalig, Teresa, February 20- March 11, 2019 from 6 am to 8 pm in Barangay Maybancal. The survey team was assisted by the Office of the Barangay thru the Barangay Health Workers (BHW) and Barangay Secretary on the conduct of one-on-one interview. All-in-all, a total of Two Hundred Thirty-Two (232) respondents were interviewed, distributed to one hundred (100) respondents distributed to Barangay Maybancal, Morong and about One Hundred Thirty-Two (132) for Barangay Dalig, Teresa, where the project will be located

Table ES-10. Summary of Impacts and Proposed Mitigation

Activity / Resource Likely	Potential Impact	Options for Prevention or Mitigation* or Enhancement	Target Performance/ Efficiency
CONSTRUCTION PHASE			
Clearing and Earthmoving	Dust pollution due to land preparation	• Immediate compaction of open areas. • Final Land use shall be in accordance to the land use and zoning ordinance of the municipalities which will happen after 10-years.	100% compliant to RA 8749 in terms of air quality standards
Construction of Access Road, and facilities and installation of Mobile Crusher	Dust pollution due to vehicle/equipment movements: -Along the road leading and the project area activities	▪ Sprinkling of water using water tanker at least four times a day along all possible roads leading quarry area, especially during dry season. ▪ Covering all loaded trucks properly/fully using tarpaulin throughout the hauling period. ▪ All trucks shall be road-worthy.	100% compliant to RA 8749 in terms of air quality standards
OPERATION PHASE			
	Land Hazard due to geological instability, soil erosion, change in landform/topography	▪ Implement phasing of activity and benching ▪ Immediate compaction of loose soil ▪ Reinforce slope material structures ▪ Rerouting surface towards silt pond	100% No soil erosion and 100% hazard free
	Land - impact to the nearby infrastructures/structures due to vibration during the blasting operation	• All blasting activities will be performed by a duly accredited blaster following Australian standard 2187.2-2006 on Ground vibration peak particle velocity f 10mm per sec and Airblast overpressure of not greater than 120cB (Linear) Peak at any	100% No damage free

Quarry Activity Including Blasting		time. However, with the advancement of blasting technology and the use of controlled blasting will help address this impact. • Observed distance of the blasting area to the nearest infrastructure	
	Loss of Vegetation Cover and Fauna Species	▪ Implement minimum of 25-meter buffer zone along the road, agro-industrial and residential area. ▪ Implement Progressive Rehabilitation and participate in the National Greening Program (NGP)	100% No Cutting of Trees with Permit and Replacement
	Water Pollution due to storm run-off. Possible Siltation	▪ Properly maintained siltation ponds and regular desilting ▪ Installation of sand bags at the overflow area ▪ Implement Zero discharge thru re-use and recycling of cleared water	100% Compliant to RA 9275 and DAO 2016-08 standards
	Air pollution emission of dust due to heavy equipment operation	• Sprinkling of water using water tanker at least four times a day within the project area especially during dry season.	100% compliant to RA 8749 in terms of air quality standards
	Noise pollution due to heavy equipment operation and blasting	• Controlled blasting shall be implemented and shall be supervised by Licensed Authority. • Proper information dissemination proper to the conduct of blasting activity Use of very efficient silencers on equipment and other noise dissipating device on all equipment to be used • Avoid use of heavy machinery during night hours. Activities should be strictly done from 8:00 AM to 5:00 PM only. • Installation of fences/noise barriers along the perimeter of the project area. Corresponding areas to be monitored shall be submitted to EMB.	100% compliant to RA 8749 in terms of air quality standards and 100% zero damaged to properties
	People - Health and Safety due to exposure to Construction Hazard	▪ Implement wearing of PPE's at all times when inside the project site ▪ Sufficient signages showing information on the active quarry area, equipment navigation and safety precautionary measures	100% compliant to PPEs and Zero accident
	Generation of untreated/ improper disposal of domestic wastewater	▪ Personnel stationed at the site will be provided with on-site portable toilets and washrooms. Collection and disposal will be done by an DENR accredited hazardous waste hauler and treater	100% Zero discharge of domestic waste
	Land pollution due to improper dumping of solid wastes and toxic substances	The proponent shall ensure that its contractors shall practice on-site segregation and establish storage facility of the following: • Construction debris • Hazardous wastes such as used oil, busted lamps, oily rags, etc. The above waste materials shall be hauled and disposed of by a DENR accredited hauler and treater. Biodegradable materials shall be used for composting. Compost materials shall be used for greening activities.	100% compliant to the following: • RA 9003 • DAO 1992-29 and DAO 2013-22 and its Revised Procedural Manual
	Land pollution effect on soil quality and fertility due to accidental release of toxic and hazardous wastes or potential oil spill and leaks	• All heavy equipment used during the construction and operation phase of the project will be pulled-out after project completion. • No overfilling of oil tanks to prevent spill; • Immediate containment and removal of land due to oil spill shall be done.	100% Zero Spill
Mobile Crushing plant operation	Air pollution emission of dust due to heavy equipment operation	• Sprinkling of water using water tanker at least four times a day within the project area especially during dry season. • Providing adequate water spraying device per hauling unit to water along all possible roads	100% compliant to RA 8749 in terms of air quality standards

		leading to the quarry area.	
	Noise pollution due crushing of rocks	• Use of very efficient silencers on equipment and other noise dissipating device on all equipment to be used • Avoid use of heavy machinery during night hours. Activities should be strictly done from 8:00 AM to 5:00 PM only.	100% compliant to RA 8749 in terms of air quality standards
Hauling of Materials	Air pollution emission of dust due to heavy equipment operation	• Providing adequate water spraying device per hauling unit to water along all possible roads leading to the quarry area. • Street sweeping along Pantay-Buhangin Rod	100% compliant to RA 8749 in terms of air quality standards
	Impact on Road Safety and Road damage due to number of Hauling Trucks passing along Pantay-Buhangin Road	• Adequate signages with proper scheduled hours will be posted on strategic places for easy access and provide personnel to manage or direct the vehicle going in and out of the premises. • Imposition of speed limit along Pantay-buhangin Road • Formulate an organization to all quarry operators using Pantay-Buhangin Road as their access road for a road users fee which shall be used in the event of road damage.	Compliant Road Safety of the LGU 100% Roadworthy

Risks and uncertainties relating to the findings and implications for decision making

Based on the assessment and findings relating to the findings and implications for decision making is presented in **Table ES-11**:

Table ES-11 Risks and Uncertainties and Implications for Decision Making

MODULE	RISK AND UNCERTAINTIES	IMPLICATION FOR DECISION MAKING
Land	Fragmented forest patches were observed in the area which were composed of agriculturally cultivated species mixed with degraded vegetation located in about 120-meter high elevation.	Operating cost implication due to desired final elevation. Acquisition of the surface rights Classified as agro-industrial zone and special permit for the quarry operation shall be secured from the Local Government Units.
Water	May contribute to increase in sediments and uncontrolled run-off	Construction of silt ponds for Parcel 1 and Parcel 2, capacity and volume shall follow the computation of the watershed area and run-off volume.
Air	Dust Pollution due to delivery and hauling trucks.	Regular maintenance of the trucks. Ensure delivery trucks are covered at all times and self-imposed speed limit at all times along Pantay-Buhangin Road.
People	Acceptance of the community on the perception of the quarry project	Implement Social Development Management Plan (SDMP) and regular consultation and strengthening of Information Education Campaign (IEC).

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1.0 PROJECT DESCRIPTION

1.1 Project Location and Area

The project area is located in the province of Rizal on the western flank of the southern Sierra Madre mountain range. Roxanna S. Go is the holder of MPSA-347-2010-IVA straddles Barangay Maybancal in the Municipality of Morong and Barangay Dalig in the Municipality of Teresa in the Province of Rizal, ***Annex C attached is General Information Sheet (GIS) showing that the holder is one of the Board of Directors of a corporation and Annex B attached is a draft of Operating*** **Agreement** subject to finalization and the approval of **Mines and Geosciences Bureau (MGB)** when all permits are secured. At the mining area, the site generally exhibits a low-lying hill to moderate rolling ridge with highest elevation reaching 180msal, ***Figure No. 1-1*** shows the vicinity of the project, ***Figure No. 1-1a*** and ***1-1b*** the Barangay Vicinity Map Showing Location of the propose project and ***Figure 1-2*** shows the Project Google Map of the area.

The MPSA covered is **114.5206 hectares (Table 1-1),** the area covered by Barangay Maybancal, Municipality of Morong is 22.50 hectares falls within Parcel 1 and area covered by Barangay Dalig, Municipality of Teresa is 92.0206 hectares falls both in Parcel 1 and Parcel 2, ***Figure 1-3 shows the Tenement Map of MPSA 347-2010-IV-A showing boundaries and coordinates of corners, MPSA attached in Annex D***.

The land covered by the Tenement No. MPSA-347-2010-IVA and are subject with this report is approximately centered along the intersection of ***14º 34' 51.02" north latitude and 121º 14' 44.67" east longitude and 14º 34' 44.27" north latitude and 121º 14' 10.52" east longitude (WGS 84) for Parcel - 1 and 2, respectively.*** **Table 1-2 and 1-3** shows the Technical Coordinates of MPSA 347-2010-IVA Parcel 1(82.80 hectares) and Parcel – 2 (31.7206 hectares) as follows:

Table 1-1. Area Covered by MPSA-347-2010-IVA

Coverage	Area, hectares
Parcel 1	82.8000
Parcel 2	31.7206
Total Area	**114.5206**

Table 1-2. Technical Coordinates, WGS 84 MPSA 347-2010-IV Parcel 1 (82.80 hectares)

Lot Corner No.	Latitude	Longitude
Corner 1	14° 35' 00.00"	121° 14' 30"
Corner 2	14° 35' 00.00"	121° 15' 00"
Corner 3	14° 34' 30.00"	121° 15' 00"
Corner 4	14° 34' 30.00"	121° 14' 30"

Table 1-3. Technical Coordinates, WGS 84 MPSA 347-2010-IV Parcel 2 (31.7206 hectares)

Lot Corner No.	Latitude	Longitude
Corner 1	14° 35' 00.00"	121° 14' 00.00"
Corner 2	14° 35' 00.00"	121° 14' 15.00"
Corner 3	14° 34' 37.00"	121° 14' 15.00"
Corner 4	14° 34' 37.00"	121° 14' 00.00"

Mining Tenement and Mineral Rights

MPSA 347-2010-IV was entered into and executed by and between the Philippine Government represented by the Department of Environment and Natural Resources (DENR) and Roxanna S. Go on June 25, 2010. It covers a total area of 164.1955 hectares contract area located in portions of the municipalities of Teresa and Morong, in the province of Rizal.

The tenement holder is mandated to undertake two years of exploration work from the date of signing up to June 24, 2012. The first renewal of the Exploration Permit was granted on February 4, 2015 valid up to February 3, 2017. On the same year, the MPSA was also amended to exclude the 49.67 hectares of Agro-Industrial Zone located in the southern portion of Parcel 1. Thus, the amended tenement area has been reduced to 114.5206 hectares.

Mineral Resource

Exploration activities were conducted to delineate suitable occurrences of pozzolan materials through geologic mapping, sample collection from outcrops and diamond core drilling. In addition, Pozzolanic Activity Index (PAI) tests and fineness of the pozzolanic materials in drill core and outcrop samples were also undertaken. Diamond core drilling that was undertaken by Ardex Geoservices from July to September 2016 included four drill holes within the MPSA namely DDH 8,9,10 and 11 with an average depth of 30m. and an aggregate meterage of 120m of NQ sizes (2.5 inches to 3.0 inches bot diameter). The results of PAI tests, fineness tests and total SiO_2 + Al_2O3 + Fe_2O_3 indicate that the tuff underlying the MPSA 347 is suitable as natural pozzolan for blending with Portland Cement, ***Drilling Report is attached in Annex H.2***.

Using a specific gravity of 2.4, the pozzolan resource within MPSA 347, based on the data available, amounts to the following in terms of million metric tons, with corresponding averages for Pozzolanic Activity Index (PAI) of 84.5 and total SAF (SiO_2 + Al_2O3 + Fe_2O_3) of 82.6. The PAI and SAF values are well above the acceptable lower limits for pozzolan.

Table 1-4. Mineral Resource of MPSA 347-2010-IVA

Resource	Measured (mMT)	Indicated (mMT)	Total (mMT)	PAI	SAF	Inferred (mMT)
Parcel 1	3.2	20.2	23.4	87	80.7	47
Parcel 2	4.4	14.7	14.7	82	84.4	38
Total	**7.6**	**30.5**	**38.10**	**84.50**	**82.6**	**83**

Source: Final Exploration Report, October 2018

The combined measured and indicated resource totaling 38.10 million metric tons could be sufficient for more than 30 years at an extraction rate of one million tons a year. Moreover, there is a likelihood that portions of the inferred resource of 83 million tons could be upgraded to measured or indicated resource as extraction of the pozzolan material proceeds in time.

Quarry Area

Despite of the large volume of resource, not all of them can be extracted due to the existence of private residential houses and livestock farms within the MPSA area. A minimum of 20 meters buffer zone will be established from major roads, residential, and agri-industrial areas.

The minable reserve for both Parcel 1 and Parcel 2 has a total volume of 13.3 million MT (7.2 million LCM) of pozzolan materials with Quarry Limit of approximately **32.70 hectares, Table 1-5a** for Parcel 1 and **9.0 hectares** for Parcel 2, presented in **Table 1-5b**. Quarry elevations were limited until Elev. 92m. and 76m. ASL for Parcel 1 and Parcel 2 respectively. Please see table below for the summary of minable reserve in MPSA 347.

Table 1-5. Mineral Reserve of MPSA 347-2010-IVA

Resource Reserve	Total (mMT)	PAI	SAF
Parcel 1	12.06	87	80.7
Parcel 2	1.30	82	84.4
Total	**13.36**	**84.50**	**82.6**

Source: Final Exploration Report, October 2018

Table 1-5a. Quarry Area Technical Coordinates, Parcel 1 MPSA 347

Lot Corner No.	Latitude	Longitude
Corner 1	14° 34' 59.50"	121°14' 32.10"
Corner 2	14° 34' 57.70"	121°14' 54.80"
Corner 3	14° 34' 44.00"	121°14' 54.90"
Corner 4	14° 34' 43.80"	121°14' 32.20"
Total Area	**36.70 Hectares**	

Source: Roxanna S. Go, RCRDC, February 2020

Table 1-5b. Quarry Area Technical Coordinates, Parcel 2 MPSA 347

Lot Corner No.	Latitude	Longitude
Corner 1	14° 34' 48.83"	121°14' 00.00"
Corner 2	14° 34' 48.83"	121°14' 09.40"
Corner 3	14° 34' 37.00"	121°14' 09.50"
Corner 4	14° 34' 37.80"	121°14' 00.00"
Total Area	**9.9206 Hectares**	

Source: Roxanna S. Go, RCRDC, February 2020

Figure 1-4 shows the Topographic Map of MPSA-347-2010-IV and vicinity (2m interval)

Figure 1-5 shows MPSA Boundaries and Quarry Area

Site Accessibility

Parcel 1 and 2 can be reached by any form of land transport vehicle from Cubao, Marikina, Pasig and the adjoining towns of Rizal through the Antipolo National Highway going to Teresa. The site is roughly 30 aerial kilometers from Manila. From the highway, 3.5 kilometers secondary road leads towards Sitio Pantay-Buhangin Road towards the project site traversing well paved to broken concrete road. Another alternate route eventually is passing along Roman Rojas Road coming from Sumulong Highway when all connecting bridges are completed. At the mining area, the site generally exhibits a low-lying hill to moderate rolling-ridge with highest elevation reaching 180msal.

1.1.1 Delineation of Impact Area

The Delineation of Direct Impact Area (DIA) and Indirect Impact Area (IIA) followed the provisions under Section 10, of DENR Administrative Order (DAO) 2017-15. Basically, all establishments passing along Pantay-Buhangin Road is considered Direct Impact Area (DIA) regardless of its distance from the proposed quarry site, ***Figure 1-6 Project Impact Map***. Below are the identifications of impact area:

- The EIA Study area is to be located in political of Barangay Maybancal, Municipality of Morong and Barangay Dalig, Municipality of Teresa, Province of Rizal. The project identified Direct Impact Area (DIA) is considered the entire MPSA area of 114.5206 hectares with some establishments such as portion of Coral Farm and Garden of La Pieta is located within the quarry claims;

- Barangay Maybancal, Morong Rizal is about 9.0 aerial kilometers Southeast while Barangay Dalig, Teresa, Rizal is about 3.5 km South of the proposed quarry project, respectively. Both barangays where the project is to be located is considered Direct Impact Area (DIA).

- Land Module, the identified Direct Impact Area (DIA) was due to removal of vegetation and alteration of the topography;

- Water Module, considered Direct Impact Area (DIA) the nearest identified surface water system is the May-iba River which is 5 km south from the proposed quarry site;

- Air Module, all establishment identified in Table 1-6 as Direct Impact Area (DIA) due to road disturbance and increase in TSP, PM, SOx and NOx brought about by the number of trucks passing along Pantay-Buhangin Road;

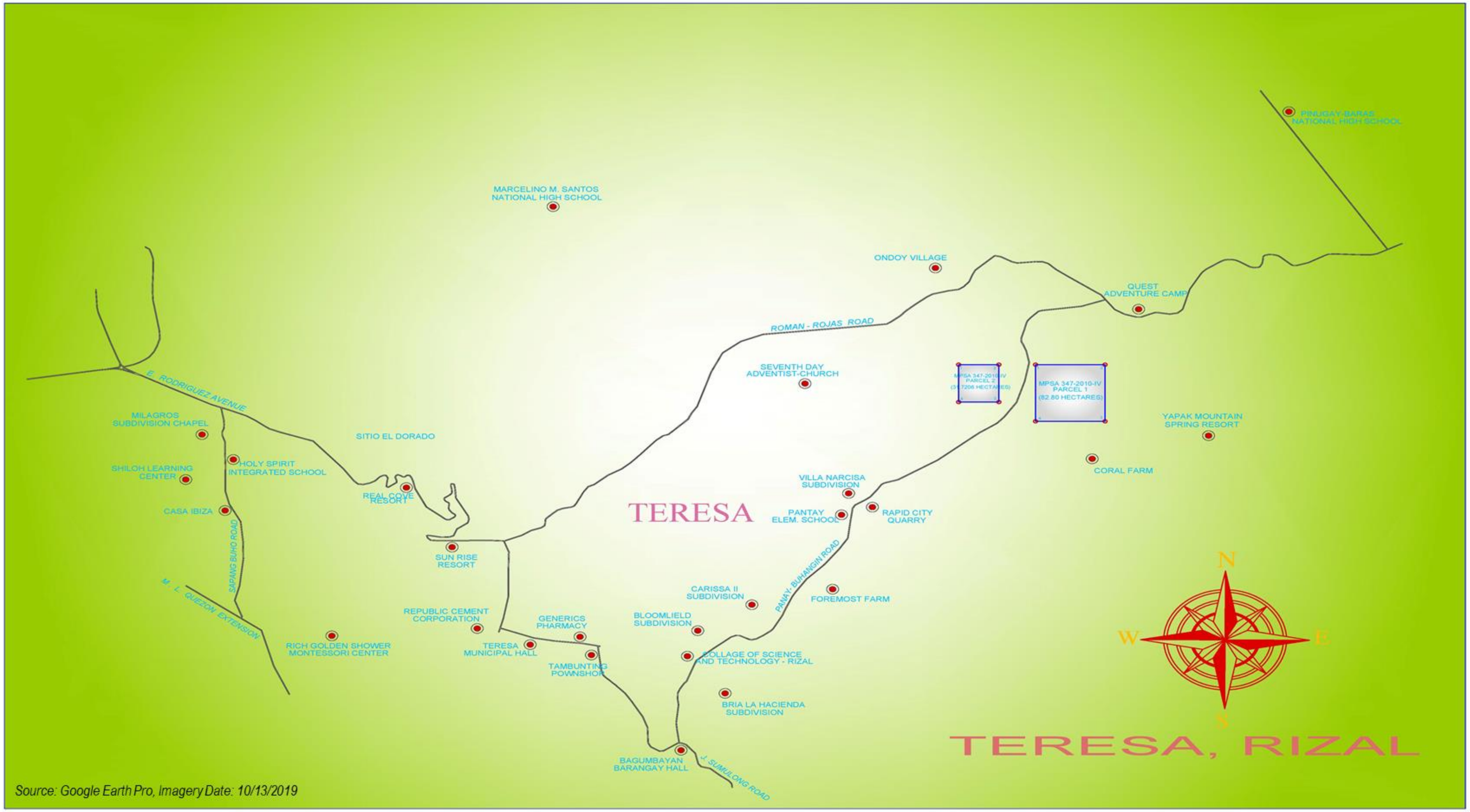
- Air pollution from quarrying operation such as:
  - Blasting Operation and Crushing Operation – For Parcel 1 impact identified is the Coral Farm and Quest Adventure Park and project area of 82.80 has while Parcel 2 impact identified is the agro-farm and scattered residences and project area of 31.7206 ha
  - Stockpiling, hauling and Loading- Both parcels covered area and the Pantay-Buhangin Road due to delivery of materials to the end users

- People Module, Barangay Maybancal, Morong Rizal and Barangay Dalig, Teresa, Rizal are the two (2) barangays considered as Direct Impact Area (DIA) which can be part as beneficiary to the Social Development and Management Plan (SDMP).

Table 1-6 Surrounding Description and Distance of the Impact Area at the Project Site

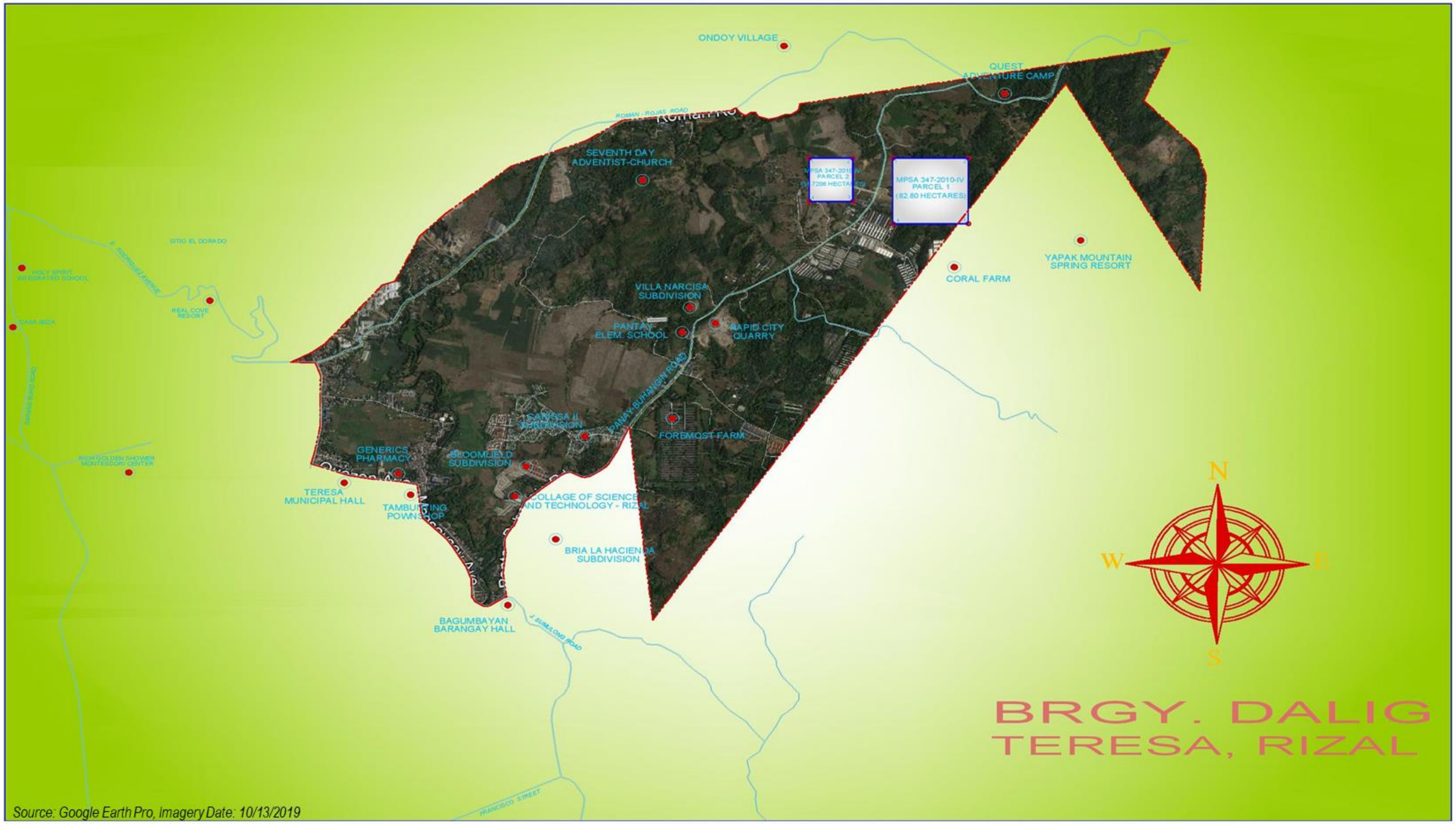
Description	Approximate Distance from the Site	Delineation
Coral Trucking	220 meters south of Parcel 1	Direct Impact Area (DIA)
Unity Village	700 meters north of Parcel 1	Direct Impact Area (DIA)
Pantay Elementary School Court	1.2 km South of Parcel 1 and Parcel 2	Direct Impact Area (DIA)
Christ the Answer Chapel	820 meters North of Parcel 1	Direct Impact Area (DIA)
Robina Farm	500 meters north of Parcel 2	Direct Impact Area (DIA)
Graceland Resort	490 northwest of Parcel 2	Direct Impact Area (DIA)
Foursquare Church	1.3 km southwest passing Pantay-Buhangin Road	Direct Impact Area (DIA)
Community near Quest	800 meters north of Parcel 1 and Parcel 2	Direct Impact Area (DIA)
Garden of La Pieta	Portion is inside Parcel 1 but will be excluded in Quarry Limit	Direct Impact Area (DIA)
Britmis Bodega	350 meters northwest of Parcel 2	Direct Impact Area (DIA)
Community Area	800 meters north of Parcel 1 and Parcel 2	Direct Impact Area (DIA)
Pantay Elementary School	1.2 km south of Parcel 1 and Parcel 2	Direct Impact Area (DIA)
Rapid City – Existing Quarry	950 meters south of Parcel 1	Direct Impact Area (DIA)
Quest Adventure Camp	250 meters north of Parcel 1	Direct Impact Area (DIA)
Four Square Chapel	2.2 km along Pantay-Buhangin Road	Direct Impact Area (DIA)
Sumilang Elementary School	670 meters north of Parcel 1 and Parcel 2	Direct Impact Area (DIA)
Carissa II	1.80 km south along Pantay-Buhangin Road	Direct Impact Area (DIA)
Bloomfield Teresa	2.6 km south along Pantay-Buhangin Road	Direct Impact Area (DIA)
Villa Narcisa	1.1 km south along Pantay-Buhangin Road	Direct Impact Area (DIA)
Rodriguez Training Camp	240 meters north of Parcel 2	Direct Impact Area (DIA)
Coral Farm	Portion is inside Parcel 1 but will be excluded in Quarry Limit	Direct Impact Area (DIA)
ACME	995 meters northwest of Parcel 1	Direct Impact Area (DIA)
Alzira de Sousa College	2.70 km south along Pantay-Buhangin Road	Direct Impact Area (DIA)
Coral Pabahay	Portion is inside Parcel 1 but will be excluded in Quarry Limit	Direct Impact Area (DIA)
Bria La Hacienda	2.90 km south along Pantay-Buhangin Road	Direct Impact Area (DIA)
Foremost Farms	1.5 km south along Pantay-Buhangin Road	Direct Impact Area (DIA)
Girlie Farm	200 meters west of Parcel 1	Direct Impact Area (DIA)
Birhen dela Paz Community	860 meters west of Parcel 2	Direct Impact Area (DIA)
Dalig Barangay Hall	3.4 km South of the Proposed Quarry	Direct Impact Area (DIA)
Maybancal Barangay Hall	9.0 km Southeast of the Proposed Quarry	Direct Impact Area (DIA)
Teresa Municipal Hall	2.5 km Southwest of the Proposed Quarry	Direct Impact Area (DIA)
Morong Municipal Hall	10.0 km South of the Proposed Quarry	Direct Impact Area (DIA)
Rizal Provincial Office	17.0 km West of the Proposed Quarry	Direct Impact Area (DIA)

Annex H.7 shows the Photographs of the Surrounding Area and the Status of the Area



Proponent:	Consultant:	Project Title and Location:	Sheet Content:
Roxanna S. Go MPSA Holder 167 Sumulong Highway, Antipolo City	CEnSE Technical Consultancy Services Unit 405, Yrreverre Square Building, 888 Mindanao Avenue, Quezon City	Pozzolan Quarry (MPSA 347-2010-IVA) Barangay Maybancal, Morong and Barangay Dalig, Teresa Municipality of Rizal	Vicinity Settlement Map *Figure 1-1*

Figure 1-1 Vicinity Settlement Map

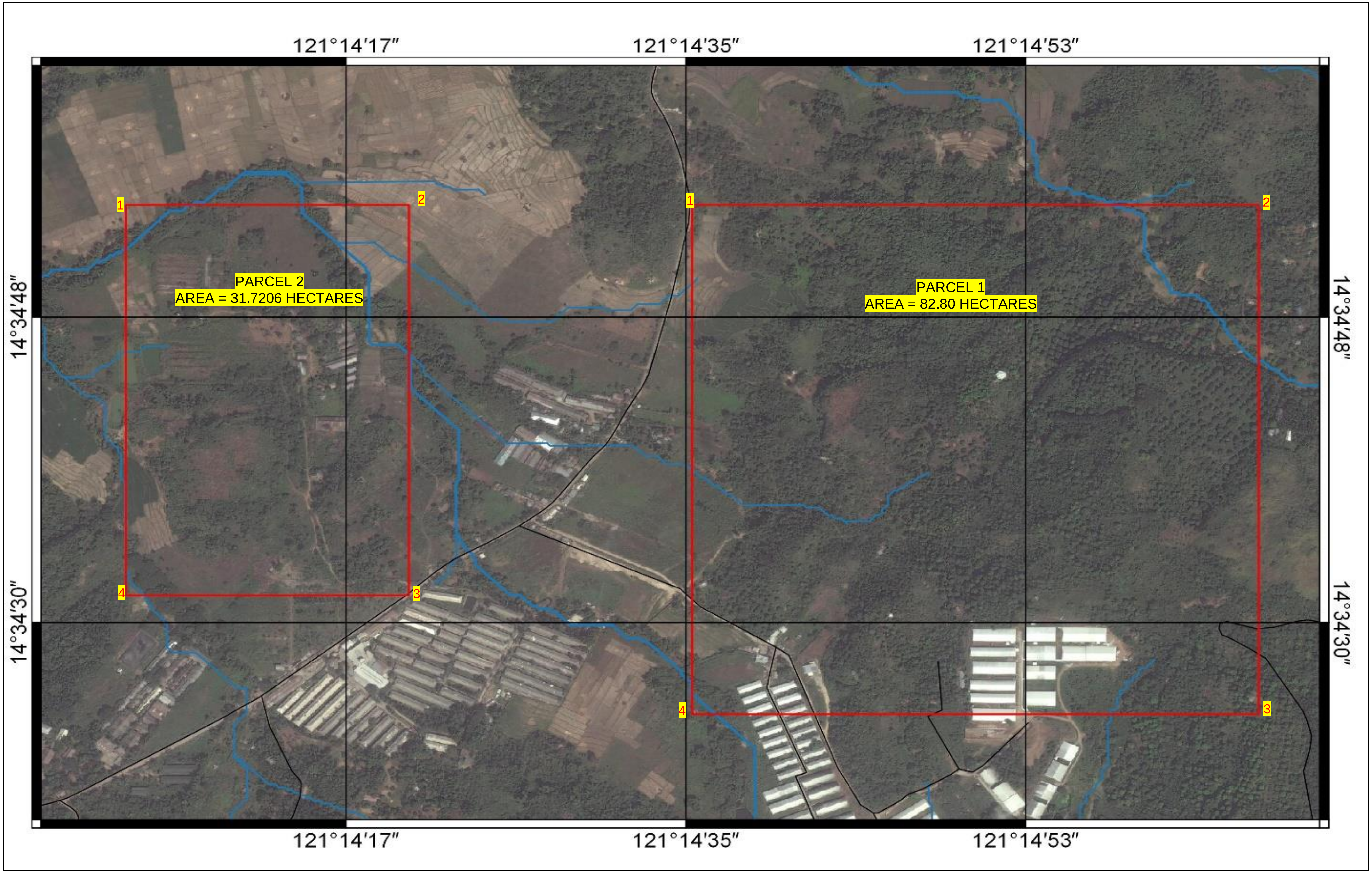


Proponent:	Consultant:	Project Title and Location:	Sheet Content:
Roxanna S. Go MPSA Holder 167 Sumulong Highway, Antipolo City	CEnSE Technical Consultancy Services Unit 405, 888 Yrreverre Square Building, Mindanao Avenue, Quezon City	Pozzolan Quarry (MPSA 347-2010-IVA) Barangay Maybancal, Morong and Barangay Dalig, Teresa Municipality of Rizal	Barangay Dalig, Teresa, Vicinity Settlement Map *Figure 1-1a*

Figure 1-1a Barangay Map of Dalig, Teresa, Rizal Showing Location of the Proposed Project

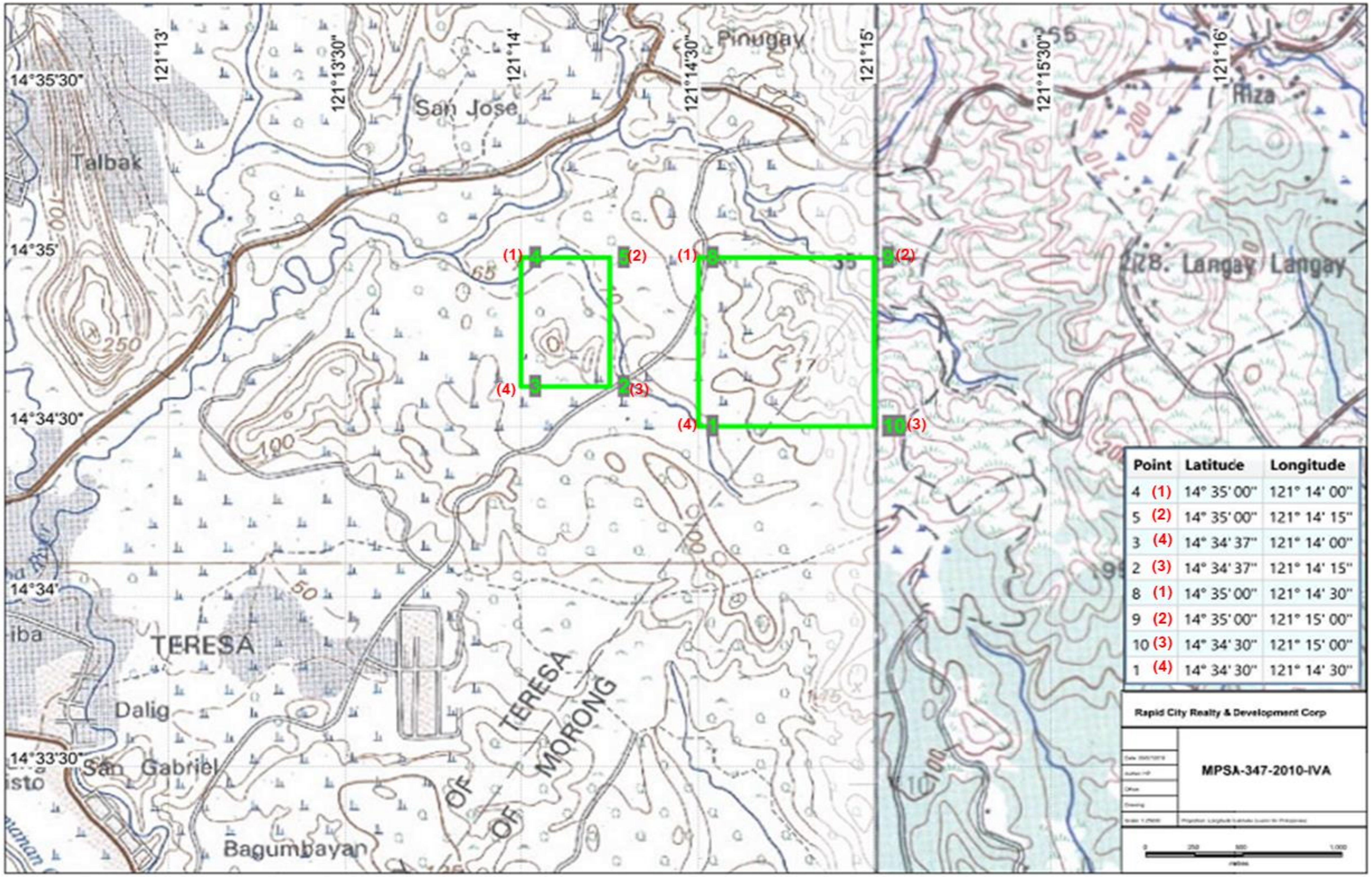
Proponent:	Consultant:	Project Title and Location:	Sheet Content:
Roxanna S. Go MPSA Holder 167 Sumulong Highway, Antipolo City	CEnSE Technical Consultancy Services Unit 405, 888 Yrreverre Square Building, Mindanao Avenue, Quezon City	Pozzolan Quarry (MPSA 347-2010-IVA) Barangay Maybancal, Morong and Barangay Dalig, Teresa Municipality of Rizal	Barangay Maybancal, Morong, Vicinity Settlement Map *Figure 1-1b*

Figure 1-1b Barangay Map of Maybancal, Morong, Rizal Showing Location of the Proposed Project



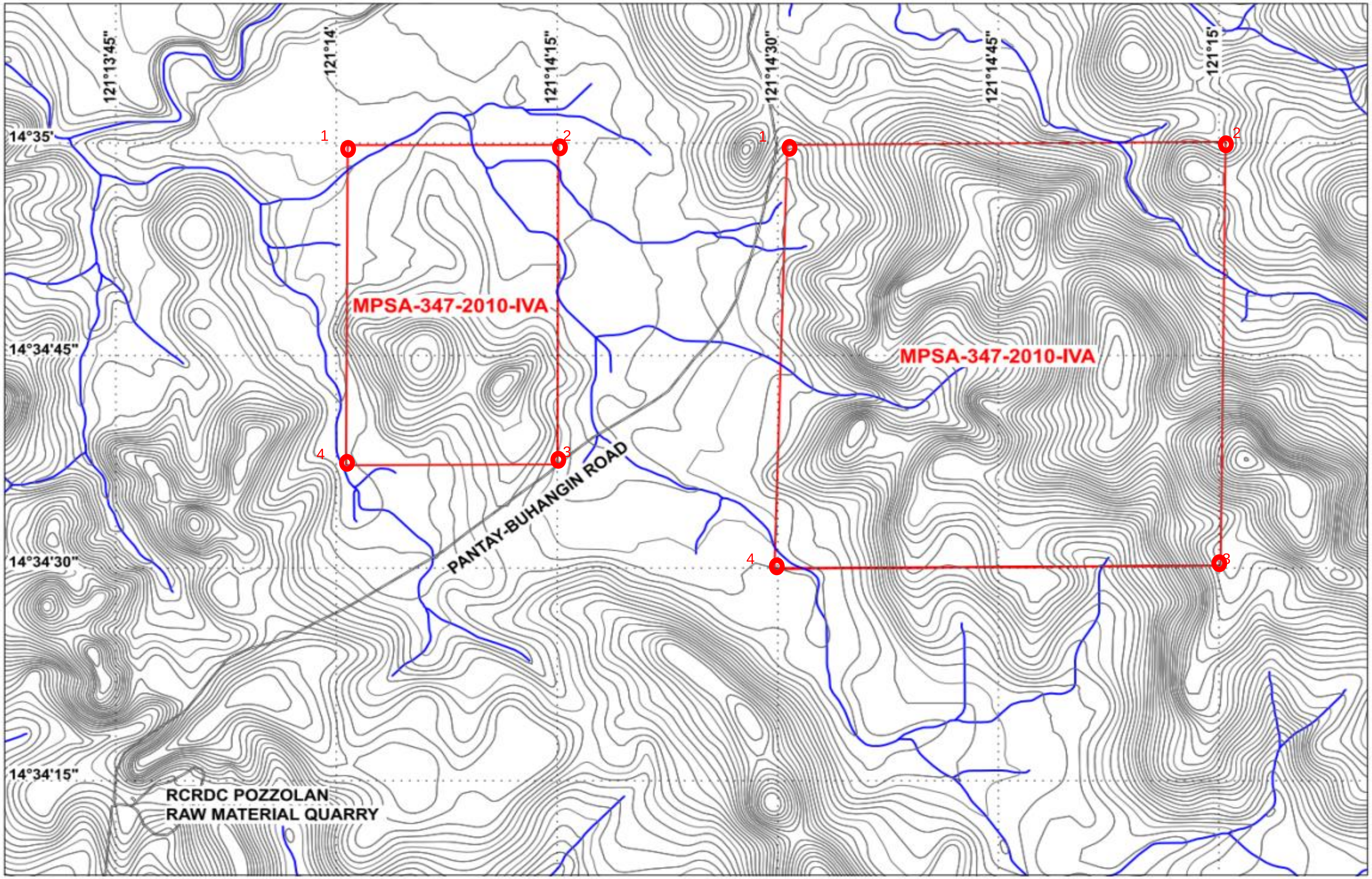
Source: Google Earth Pro, Imagery Date: 10/13/2019

Figure 1-2 Project Google Map



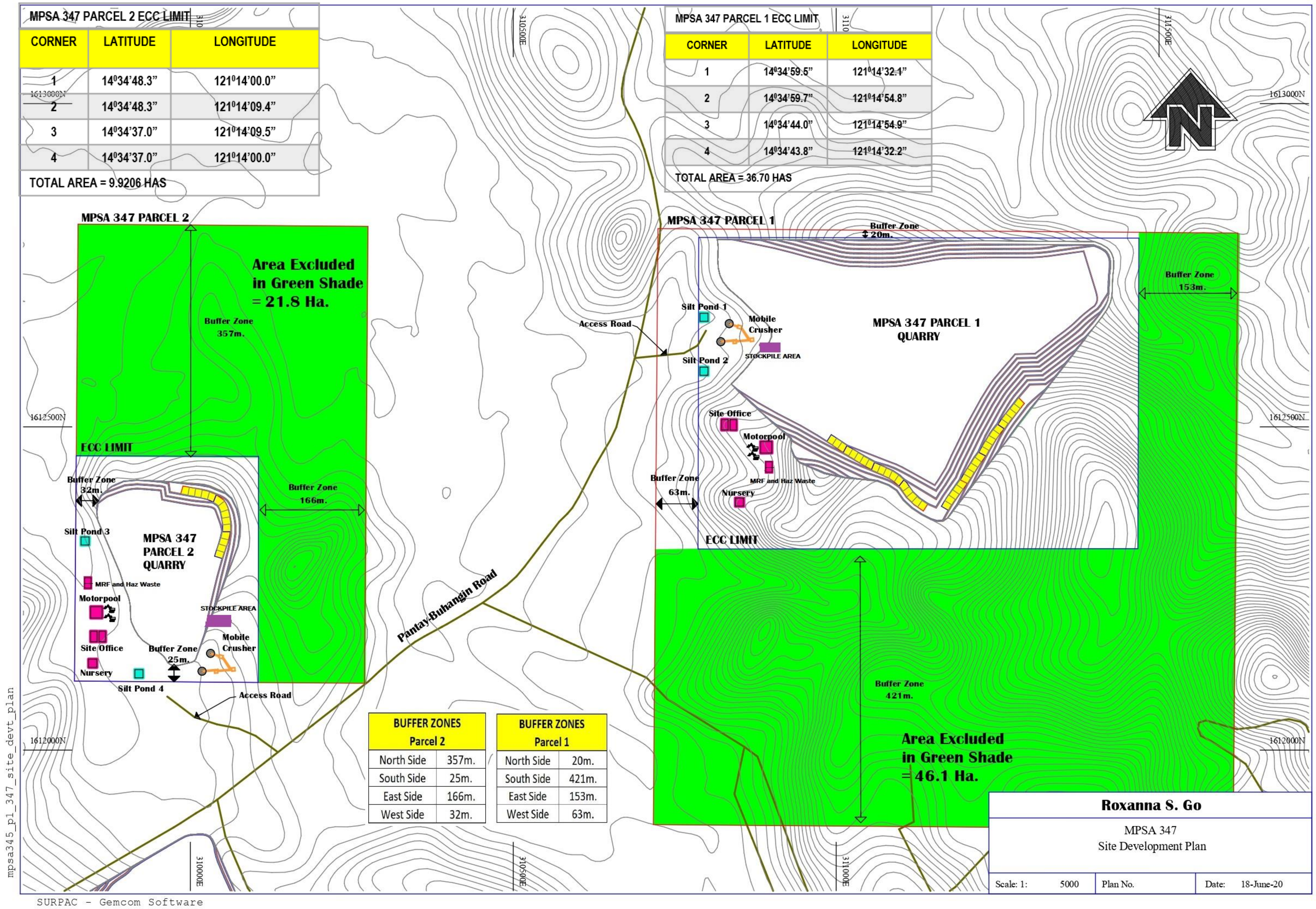
Source: NAMRIA, Final Exploration Report, Oct. 2018

Figure 1-3 Tenement Map



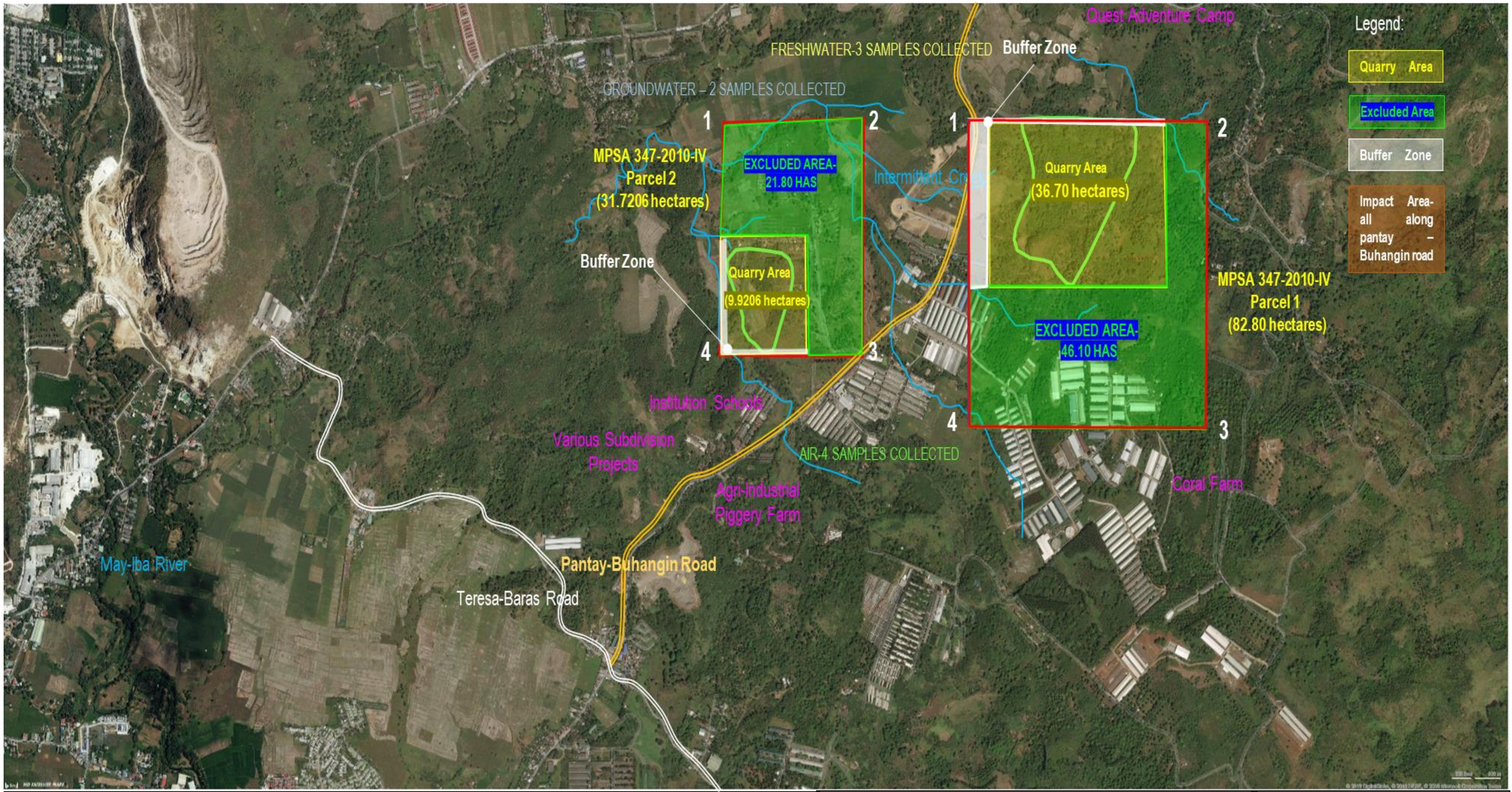
Source: Roxanna S. Go, June 2020

Figure 1-4 Topographic Map of MPSA-347-2010-IV and vicinity (2m interval)



Source: Roxanna S. Go, RCRDC, 9/02/2020

Figure 1-5 MPSA Boundaries and Quarry Area



Proponent:	Consultant:	Project Title and Location:	Sheet Content:
Roxanna S. Go MPSA Holder 167 Sumulong Highway, Antipolo City	CEnSE Technical Consultancy Services Unit 405, 888 Yrreverre Square Building, Mindanao Avenue, Quezon City	Pozzolan Quarry (MPSA 347-2010-IVA) Barangay Maybancal, Morong and Barangay Dalig, Teresa Municipality of Rizal	Project Impact Map *Figure 1-6* *Source: Google Earth Pro, Imagery Date: 10/13/2019*

Source: Google Earth Pro, Imagery Date: 10/13/2019

Figure 1-6 Project Impact Map

1.2 Project Rationale

The objective of the company is to be able to provide raw materials for cement industrials in Rizal Province and in other nearby Regions bringing the easy access to the fulfillment of government and private development.

The rationale in choosing the location was based on the results of the Final Exploration Report (FER) mostly of the pozzolanic materials consists of tuffaceous rocks that constitute the bulk of the Diliman Tuff member of the Pleistocene Guadalupe Formation in Rizal Province that overlies some of the older formations in the area. The pozzolanic tuff underlying MPSA 347 are located in portions of the municipalities of Teresa and Morong in the province of Rizal. The growth of the construction industry is an obvious index to the demand of the construction materials. The present development facilities being implemented by the Government towards the final goal of the country's industrialization caused for the high demand. The estimated volume capacity of the quarry site is approximately 13.36 M Million Metric Tons for MPSA 347-2010-IVA. This means that the proponent can provide for the cement industry needs of the industry for the next Fifteen (15) years. This will help patronize the local market supplies thus, preventing sourcing of imported materials.

Contribution to national and local share of taxes is also anticipated in the coming of this project, in addition to the by-product when consumers utilize the cement as raw materials and finished product.

The proposed project is predicted to have both beneficial and potentially adverse socio-economic and cultural impacts on the environment, workers and the community by way of mandatory implementation of Social Development and Management Program (SDMP) pursuant to Chapter XIV of DAO 2010-21 - the consolidated DENR Administrative Order for the Implementing Rules and Regulations (IRR) of R.A. 7942.

1.3 Project Alternatives

The project area is a potential site source for mineral extraction; however, the final land use plan of the proponent is a proposed subdivision land development to cater whether a farm lot sizes or a middles class lot cut sizes.

The proponent will develop and convert the area into a liveable community by following the engineering recommendations such as leveling of the steep slopes with proper mitigating measures.

a. Cite Criteria

Siting: The proposed project is located in a private property, no alternative is being considered in terms of site location, the current land use of the area is agro-industrial, however, the proposed land use of the area shall become a residential zone, which is in accordance to the final land use of the proposed quarry area. ***Annex D attached is the Mineral Map for Teresa and Morong.***

No other siting locations were considered for the proposed quarry project as this has been awarded a Mineral Production Sharing Agreement (MPSA) and based on results of the Final Exploration Report. In addition, based on the MGB Hazard Maps, the specific area is not susceptible to any form of natural hazards such as liquefaction, earthquake, volcanic eruptions, storm surges, tsunami, but classified within Moderately susceptible to flooding for low-lying area and landslide due to improper quarry practice. These identified hazards can be mitigated thru implementation of protective measures.

As to the decision in determination of the final land use of the area as proposed Residential Farm Lots, the bases in the selection of the final land use are as follows:

1. There are no naturally occurring hazards in the area. The area is not traversed by major active faults, it is not located within typhoon belt, it is not located in steep and landslide prone areas, etc. Hence, the area can be revegetated after the commercial life of the Project.
2. Level of environmental and social impacts cause by the operation. The environmental impacts of the project will not render the area unusable after the life of the project.
3. The productivity of the land surrounding the site. The surrounding areas are currently non-productive but could be made productive through the introduction of modern farming technology;
4. Surface rights to be operated are acquired and will be acquired by the MPSA Holder.

Technology Option: The project shall adopt the conventional Surface Mining Method using heavy equipment, and application of Controlled Blasting when hard rock is reached, Crushing and Hauling and Delivery. Only raw materials shall be produced by the project to the cement plant industries.

Resources: The project shall consider siltation pond as water collection for the implementation of environmental measures for re-use particularly sprinkling of water to open areas to control dust while domestic water requirement shall be provided by Local Water District.

Liquefaction:

Liquefaction hazard map of Rizal province, ***Figure 1-7***. Potential area susceptible to liquefaction was evaluated on the basis of the presence or absence of clay layers, depth of water table, thickness of saturated sand layers and to limited extend, grain size characteristic and distribution. As shown in their presented map, it clearly suggests indicates those areas that are prone or potential to liquefaction hazard since no color shading had been assigned and thus *the site is not susceptible to liquefaction hazard*.

Ground Shaking:

The ground shaking effects of an earthquake can be predicted using the works of Thenaus et. al. as shown in ***Figure 1-8, 1-9 to 1-10***. The concept particularly depicts a peak horizontal acceleration amplitude at different soil and rock mass for specific foundation material with a 10% exceedance in 50 years period. As shown thereof, the level of ground shaking in the study area is as follows; **for soft soil, 0.60, for medium soil, 0.39*g* *and for rock,* 0.22*g*.** Since the site exhibits a relatively thick layer of medium soil to hard rock, the ground shaking probability may range from **0.22*g to 0.39g,*** respectively.

On the other hand, to estimate ground motion hazard in the study area, the attenuation of acceleration of ground motion with epicentral distance from the project site was calculated. Since there were inadequate recordings of strong motion in the country, ground motion attenuation formula developed by Fukushima and Tanaka (1990, 1991) was used. It is an empirical deterministic approach relationship derived from regression analysis from major ground motion recordings from Japan and other parts of the US. This attenuation formula can be shown as follows:

$$\log_{10} A_{max} = 0.41M_s - \log_{10} (R + 0.032 \times 10^{0.41Ms}) – 0.0034R + 1.3$$

Where: A = maximum acceleration in gal (cm/sec^2);
M_s = surface wave magnitude; and
R = closest distance to the fault rupture in km

Assuming an earthquake is generated from the ***East Valley Fault (EVF),*** the nearest earthquake generator in the project area (approximately 16.70kms), with magnitude of 7.5, the ground acceleration at the project site would be ***0.415083833g and 0.2327573g*** with respect to the nearest and farthest seismogenic structures, which is the ***East Valley Fault (EVF) and the Philippine Trench (PT),*** respectively. It is also concluded that peak ground acceleration, *g* value, decreases with increasing distance from the study area and vice versa.

Ground Rupture:

Based on ***Figure 1-11 and 1-12*** hereof, no fault is shown passing directly through the project site. The segment of the ***Valley Fault System (VFS),*** which is considered to be the nearest active fault the most probable to cause ground rupture is estimated to be ***16.70km to the northwest*** of the project site.

Earthquake Induced Landslides

Landslide and flooding are closely related because both are associated to precipitation, runoff, and the saturation of ground by water. In addition to geostatic stress attributed to groundwater, man-induced stress could provide additional load such as that of the proposed structures. Excavation of slopes for access road and other structures may trigger landslide. With respect to general topographic configuration moderate to steep slope, amount of precipitation (annually the site receives about 1.7m of rainfall) may induced mass movement. Based on the published ***MGB's "Flooding and Landslide Susceptibility Map***" suggests the quarry area is ***not susceptible*** to any form of mass movement or landslide. ***Figure No. 1-13***.

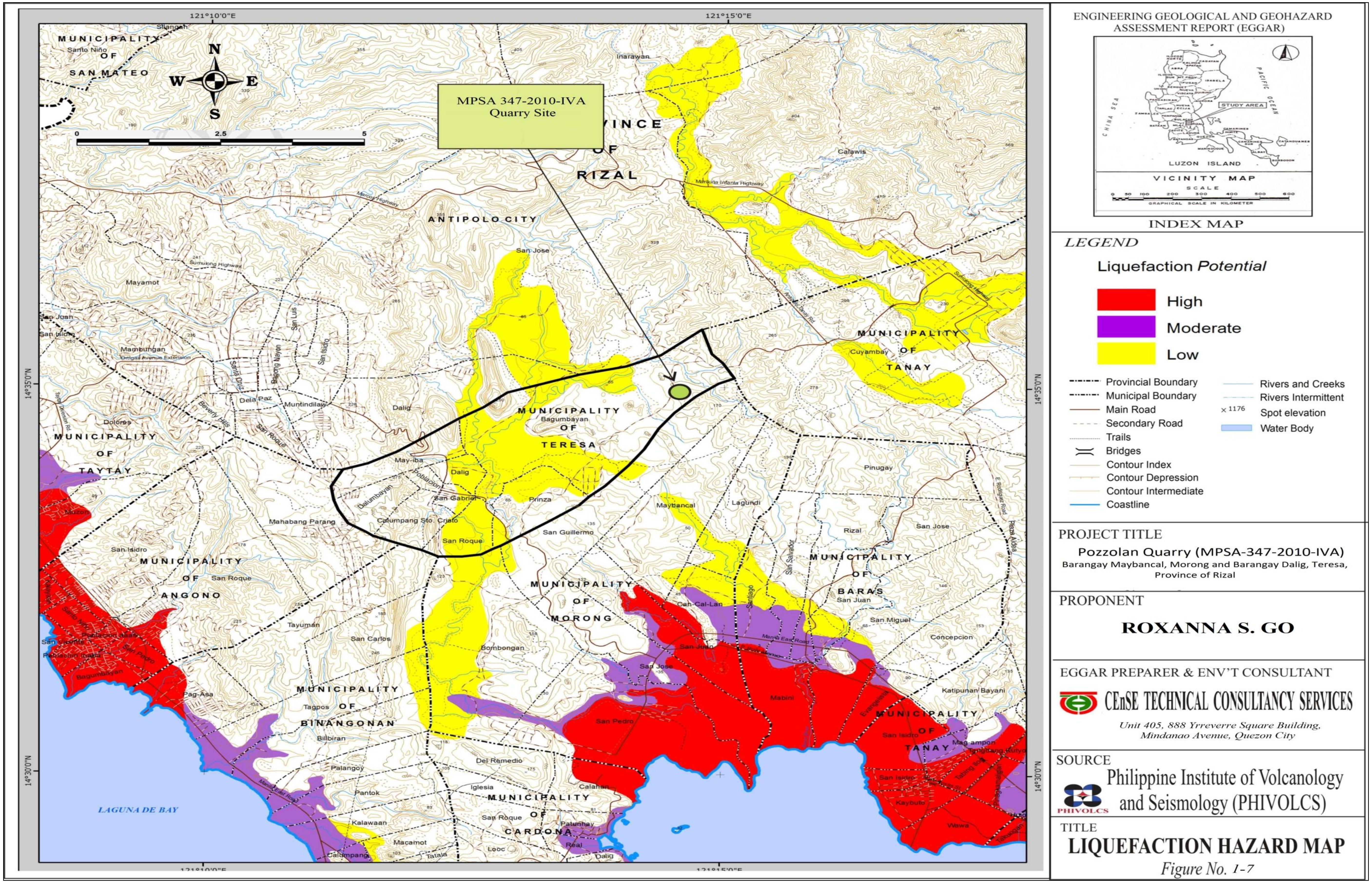
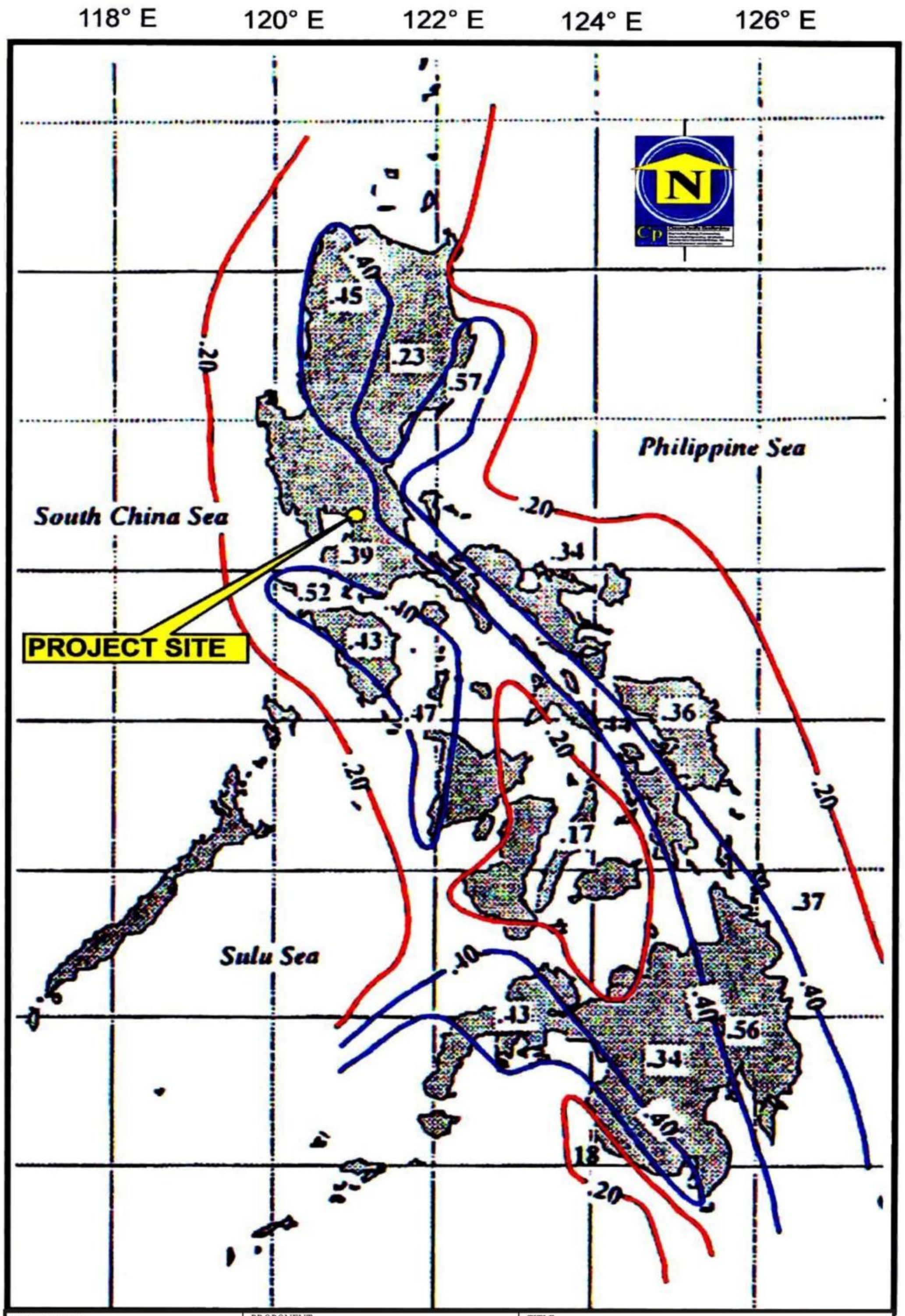


Figure 1-7 Liquefaction Map

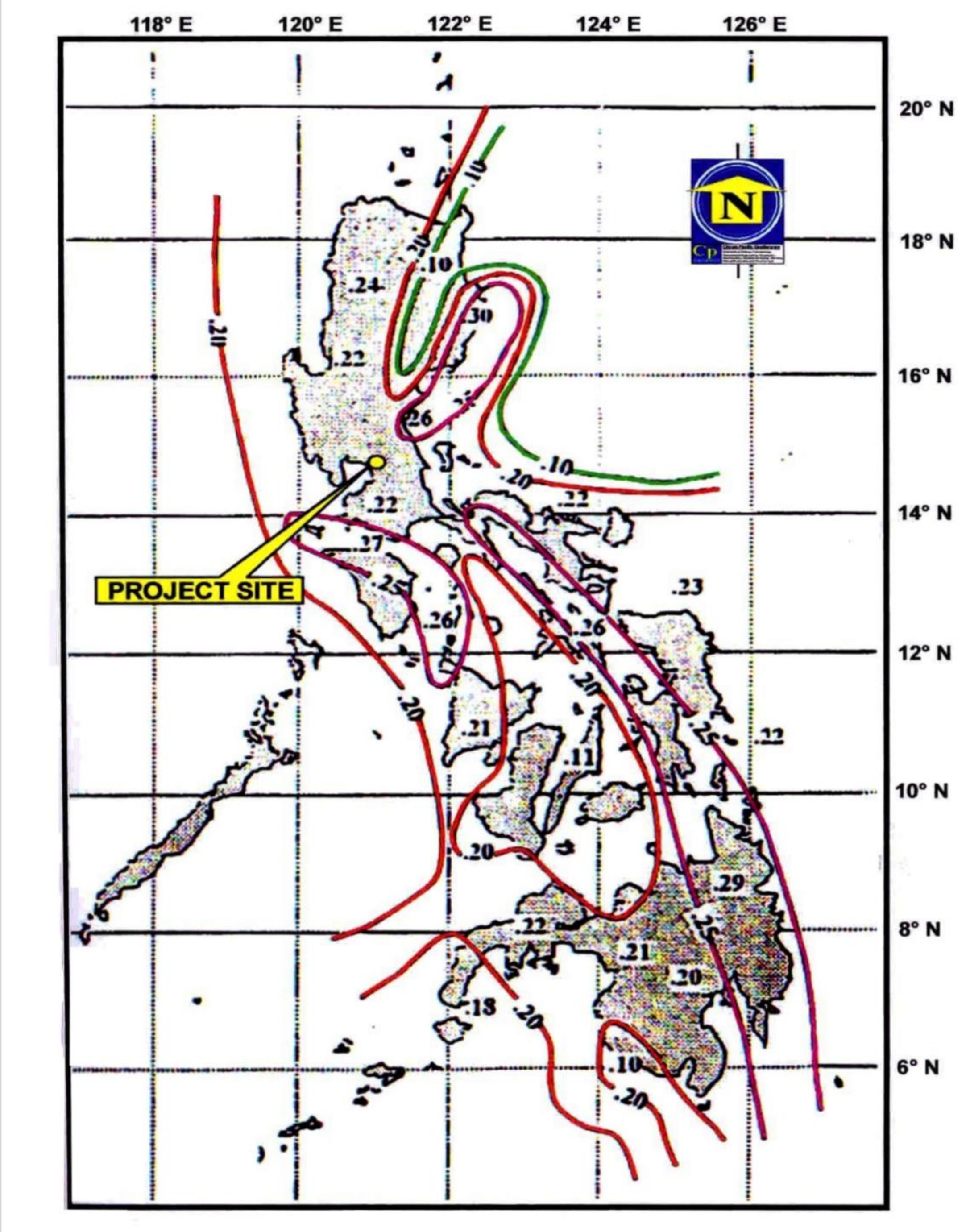


PROJECT TITLE	PROPONENT	TITLE
Pozzolan Quarry (MPSA 347-2010-IVA) Barangay Maybancal, Morong and Barangay Dalig, Teresa Province of Rizal	ROXANNA S. GO	PEAK HORIZONTAL ACCELERATION AMPLITUDES IN MEDIUM SOIL WITH 10% PROBABILITY OF EXCEEDANCE IN 50 YEARS Figure No. 1-8

CEnSE TECHNICAL CONSULTANCY SERVICES

Figure 1-8 Medium Rock

ENGINEERING GEOLOGICAL AND GEOHAZARD ASSESSMENT REPORT (EGGAR)

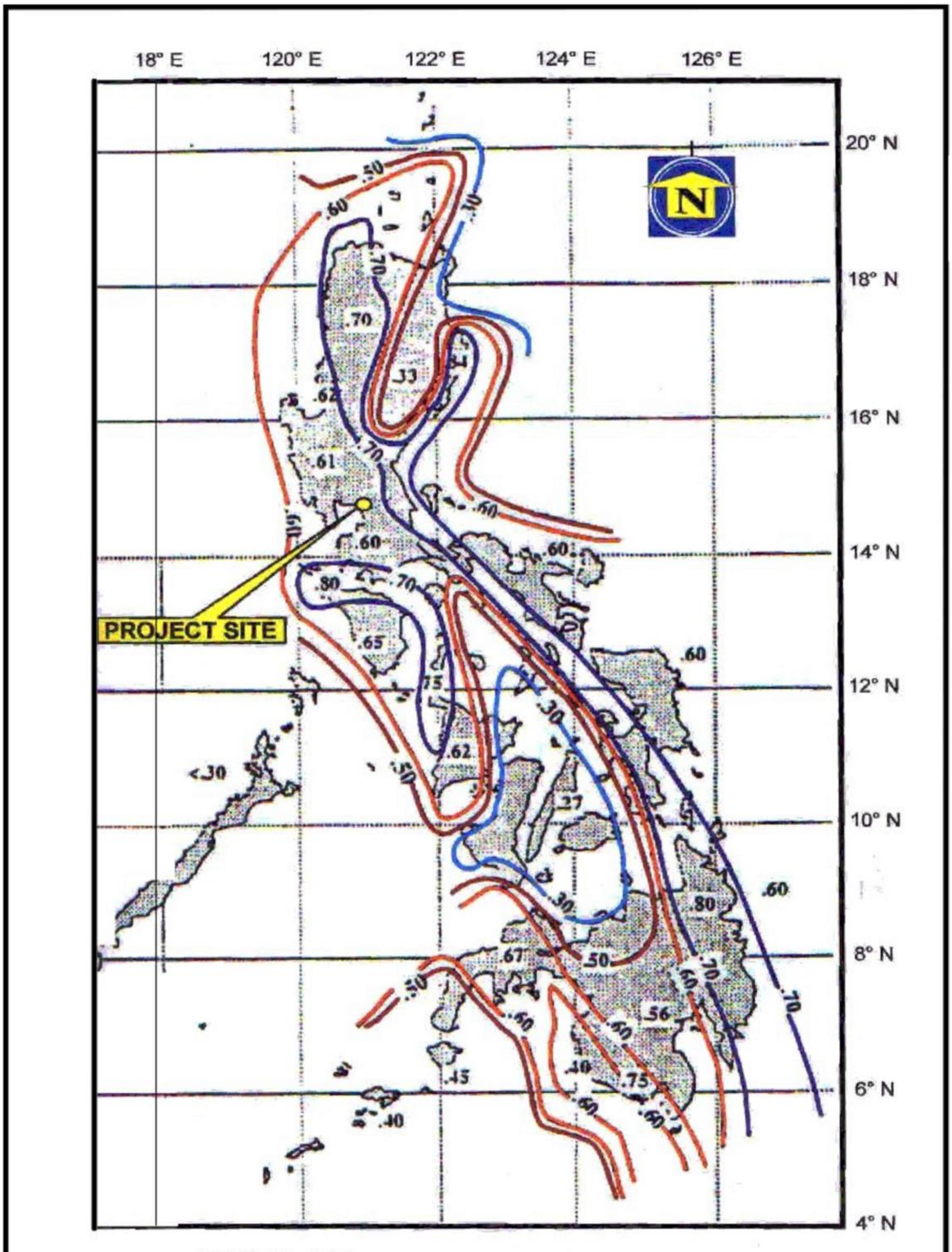


PROJECT TITLE	PROPONENT	TITLE
Pozzolan Quarry (MPSA 347-2010-IVA) Barangay Maybancal, Morong and Barangay Dalig, Teresa, Province of Rizal	ROXANNA S. GO	PEAK HORIZONTAL ACCELERATION AMPLITUDES IN HARD ROCK WITH 10% PROBABILITY OF EXCEEDANCE IN 50 YEARS *Figure No. 1-9*

CENSE TECHNICAL CONSULTANCY SERVICES
Unit 405, 888 Yrreverre Square Building, Mindanao Avenue, Quezon City
Emailadd: cense_tech@yahoo.com.ph; cense.consultancy@gmail.com

Figure 1-9 Hard Rock

ENGINEERING GEOLOGICAL AND GEOHAZARD ASSESSMENT REPORT



Source : PHIVOLCS, 1994

PROJECT TITLE	PROPONENT	TITLE
Pozzolan Quarry (MPSA 347-2010-IVA) Barangay Maybancal, Morong and Barangay Dalig, Teresa, Province of Rizal	ROXANNA S. GO	PEAK HORIZONTAL ACCELERATION AMPLITUDES IN SOFT SOFT WITH 10% PROBABILITY OF EXCEEDANCE IN 50 YEARS Figure No. 1-10

CEnSE TECHNICAL CONSULTANCY SERVICES
Unit 405, 888 Yrreverre Square Building, Mindanao Avenue, Quezon City
Emailadd: cense_tech@yahoo.com.ph; cense.consultancy@gmail.com

Figure 1-10 Soft Rock

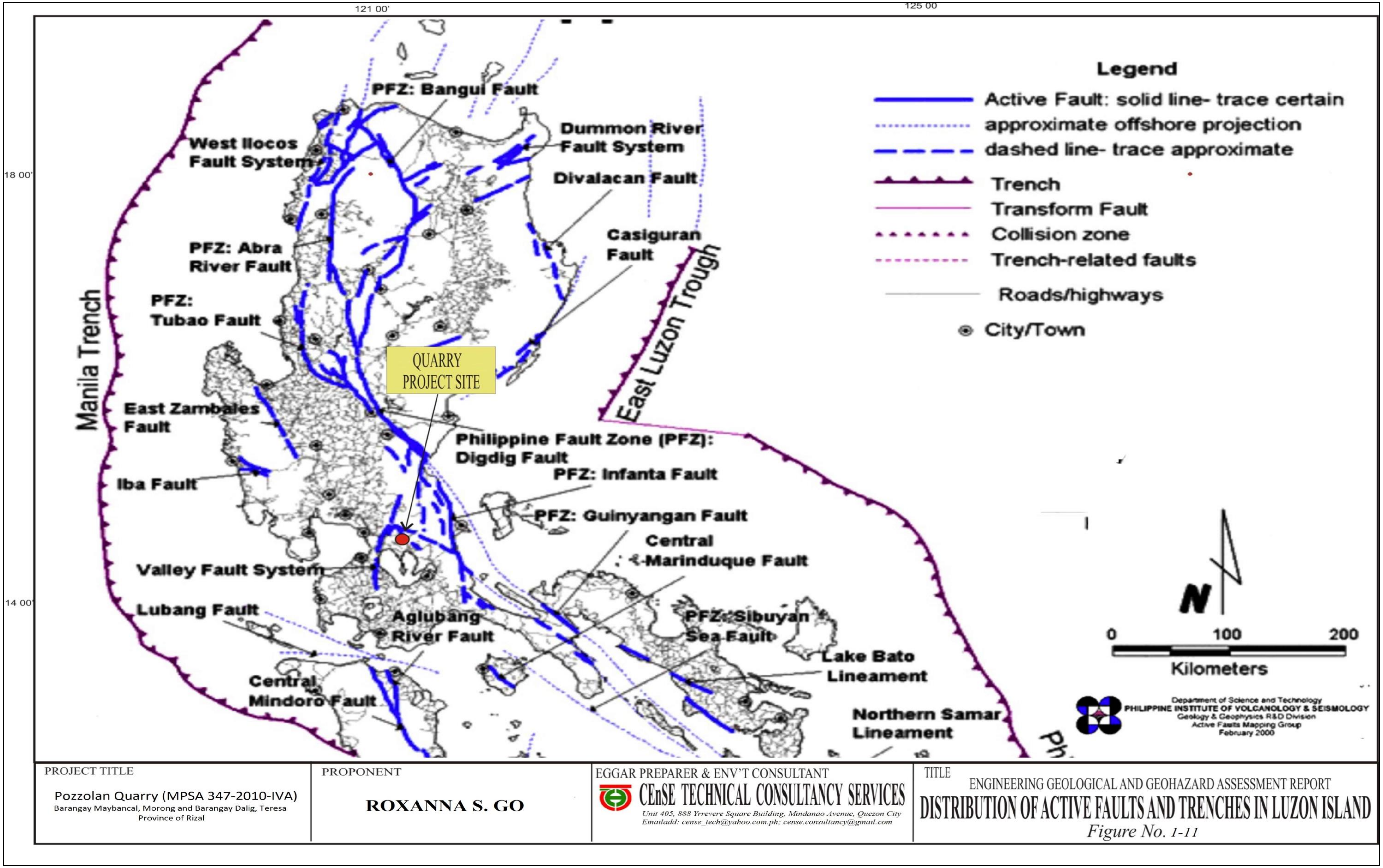
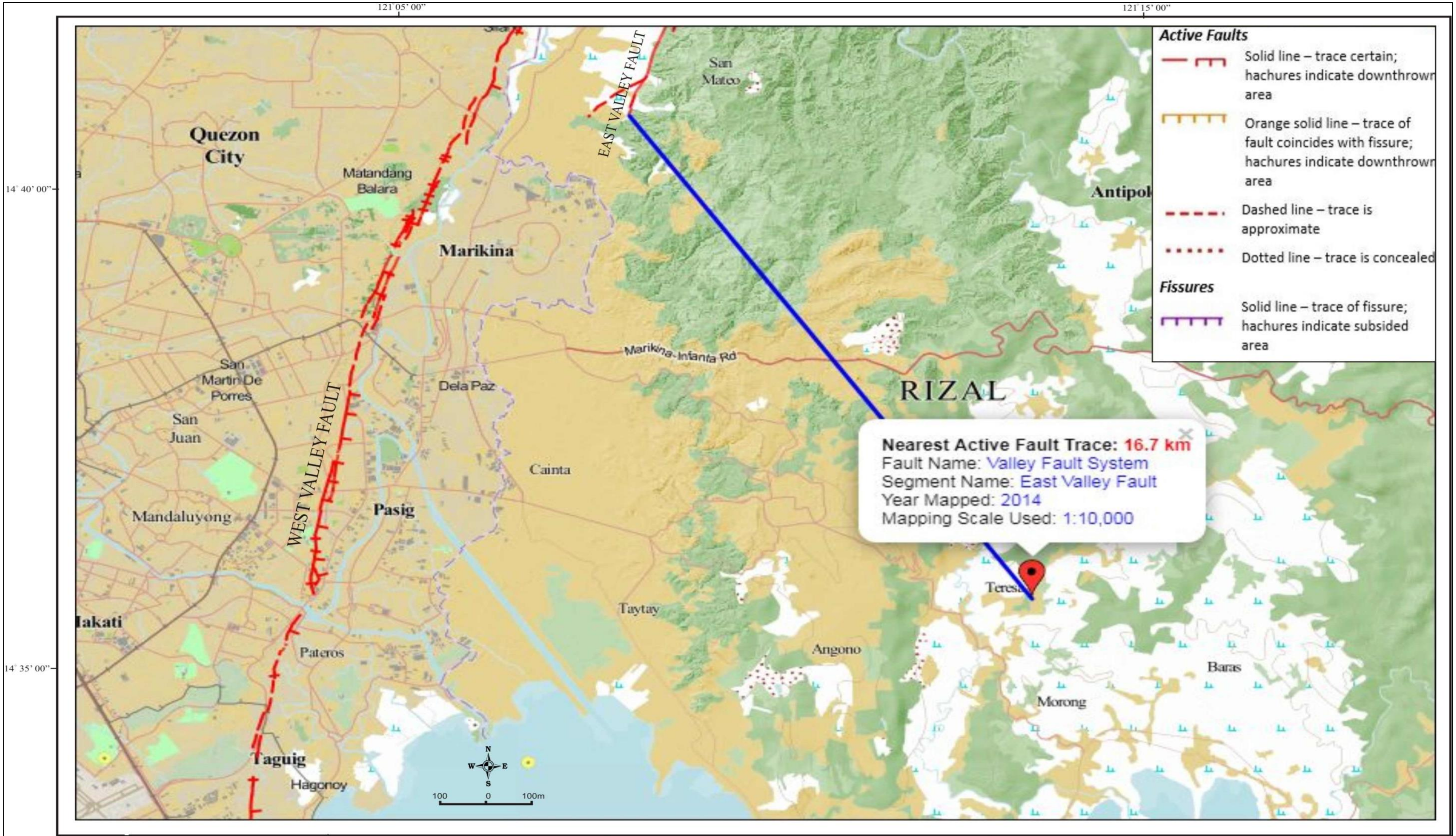


Figure 1-11 Fault Map



PROJECT TITLE	PROPONENT	EGGAR PREPARER & ENV'T CONSULTANT	TITLE
Pozzolan Quarry (MPSA 347-2010-IVA) Barangay Maybancal, Morong and Barangay Dalig, Teresa Province of Rizal	ROXANNA S. GO	CEnSE TECHNICAL CONSULTANCY SERVICES Unit 405, 888 Yrreverre Square Building, Mindanao Avenue, Quezon City Emailadd: cense tech@yahoo.com.ph; cense.consultancy@gmail.com	LOCATION OF THE PROJECT SITE TO THE NEAREST ACTIVE FAULT *Figure No. 1-12*

Figure 1-12 Nearest Active Fault

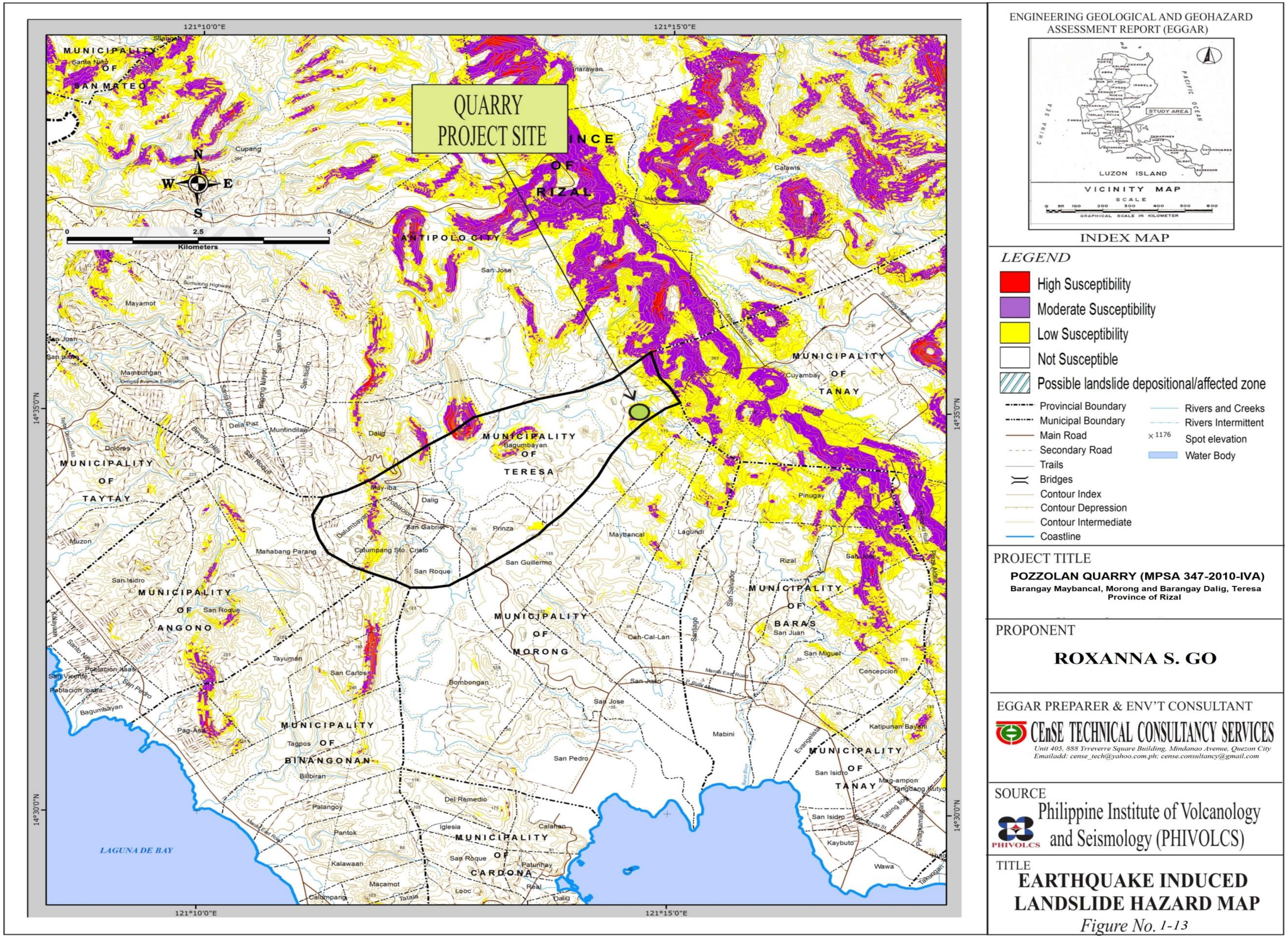


Figure 1-13 Earthquake Induced Landslide

b. Consequences of not proceeding the project

If the project will not push thru, possible shortage of cement products due to inadequate or shortage supply of pozzolan materials which is the one of the raw materials in the production of cement. Sustainability in the construction industry especially for infrastructure project of the government and private entities.

Based on the current land use plan of the municipality, the area is classified as agro-industrial zone which shall take effect for the next 5-15 years. The proposed land use thru updating of the Comprehensive Land Use Plan of the Municipalities shall become residential zone which shall be needing construction materials such as cement to develop the proposed land use. If the project will not push thru, developers may opt to change locations for development where sufficient supply of materials is available. Thus, effect in slow for economic growth for both municipalities would likewise occur.

Climate change can happen anywhere, typhoon and earthquake are expected at any time, and such scenarios are anticipated even without the occurrence of the project.

1.4 Project Components and Supporting Facilities

Table 1-7 presents the Project Components, Supporting Facilities and Utilities and Pollution Control Facilities.

Table 1-7. Project Components

Facilities	Project Components		
	No. of units	Area (sq.m)/ Capacity	Specification/ Description/ Remarks
Project Capacity	**3,205 MT/day; 83,333.33 MT/month; 1,000,000 MT/yr**		
Volume of Mineral Reserve	**13.36 Million Metric Tons**		
Project Area covered by MPSA for Parcel 1 and Parcel 2	**114.5206 has**		
Quarry Area	**46.6206 has (36.70 hectares for Parcel 1 and 9.9206 hectares Parcel 2)**		
MAJOR COMPONENT			
Quarry Operation	1	3,205 MT/day	The estimated daily quarry capacity of the project using conventional Surface Mining Method. The sequence of the quarry development are as follows: • Preparation of Access Roads • Topsoil / Waste Stripping • Drilling • Blasting • Loading and Hauling • Screening • Stockpiling
Mobile Crushing Plant	2	5,000 sqm	This serves as the area for crushing plant including raw materials
SUPPORTING FACILITIES AND UTILITIES			
Admin Support (Site Office, and Barracks/Quarters etc.)	2	100 square meters	The project shall be provided with admin and barracks for use of office and quarry and site personnel.
Motorpool, Equipment Workshop and Fuel Tank	2	200 square meters	The project shall be provided with two (2) units equipment workshop each for Parcel.
Water Supply	-	1.0 cu.m/day	Domestic Water Requirement to be supplied by Local Water District.
Drainage System	NA	Underground RCP	Properly designed surface run-off thru construction of drainage system to divert to the settling pond. Zero, implementing recycling, thus zero discharge shall be implemented.

Access Road	2 units	~ 200 meters length	Access Road is along Pantay-Buhangin Road with separate for Parcel 1 and Parcel 1 which shall be provided with width of 12.0 meters.
POLLUTION CONTROL FACILITIES			
Siltation Pond	2 units-Parcel 1 2 units-Parcel 2	300 sqm	Siltation pond shall be provided to control the silt and the run-off. Two (2) silt ponds shall be provided in Parcel 1 with volume capacity of 12,936.66 cum and two (2) silt ponds in Parcel 2 with volume capacity of 11,217.12 cum
Nursery	2	200 sqm	Both parcels shall be provided with nursery area in preparation for progressive rehabilitation activity.
Solid Waste Management Facility (MRF)	2	100 sqm	MRF shall be provided for each Parcel Area.
Toxic and Hazardous Waste Facility	2	100 sqm	Each parcel shall allocate an area for Toxic and Hazardous Waste Facility.
Domestic Wastewater Management Facility	2	50 sqm	Each parcel is provided with Three Chamber Septic Tank for primary treatment of domestic wastewater.
Buffer Zone	4 for each parcel	Parcel 1 N=20m, E=153m, W=63m S=421m Parcel 2 N=357m, E=166m, W=32m, S=25m	A minimum of 20-meters buffer zone will be established from major roads, residential, and agro-industrial areas
Excluded Area	2	Total of 67.90 has	Parcel 1 excluded is about 46.10 has while Parcel 2 is 21.80 has. Excluded area identified are with existing agro-industrial and settlement.

Site Development Plan showing components and buffer zone is presented in Figure 1-14.

1.5 Process/Technology

The process involve in the quarry operation are the following:

- Preparation of Access Roads
- Topsoil Stripping
- Drilling
- Blasting
- Loading and Hauling
- Screening
- Stockpiling
- Crushing

Process Flow of the Quarry Operation is presented in Figure 1-15

The main environmental issues associated with quarry operation are dust pollution, emission of SOx and NOx derived during earthmoving, excavation and blasting, crushing, noise pollution and removal of vegetation

There is no known hazardous chemical or material being used on the operation.

Waste Stream Analysis

The waste stream analysis for quarry operations generates waste during the quarry and crushing activity process identified as dust and noise. The machineries are expected to generated used oil for its regular maintenance use.

Waste Stream Diagram is presented in Figure 1-16

1.5.1 Pollution Control Facilities

1.5.1.1 Air Pollution Control Device

During the quarry process, regular sprinkling of water to open areas and access road along Pantay-Buhangin Road shall be implemented, in addition, sweeping of silts and soil may be done occasionally or during the scheduled hauling of materials to further control dust emission. In addition, Blasting shall conform with Australian Standards of 10 mm per second peak particle velocity at any time. Engine shut-off and no idling policy shall be strictly implemented during loading and unloading to mitigate Sox and NOx.

The mobile crushing plant machine is equipped with good exhaust system utilizing hoods and enclosure to capture and confine emission, ducting to convey the captured emission to a control device and the control device is provided with screening and filter materials for particulate removal prior to exhausting to the atmosphere.

Preventive maintenance of process equipment should be regularly planned and performed regularly.

1.5.1.2 Water Pollution Control Device

The project shall be provided with Two (2) Siltation Pond for Parcel 1 and Three (3) Siltation Pond for Parcel 3. The location of the silt pond is at the lowest elevation of the parcel where an intermittent creek traverses the existing road by means of existing two (2) 36 inches RCP pipes.

In terms of domestic wastewater generated by the workers which is estimated at 1.00 cubic meters per day, 90% of the total domestic water requirement or 0.90 cubic meters per day which shall be provided with three chamber septic tank. The septic tank to be constructed in accordance with the following minimum requirements:

a. It shall be generally rectangular in shape. When a number of compartments are used, the first compartment shall have a capacity from one-half to two-thirds of the total volume of the tank.
b. It shall be built of concrete, whether precast or poured in place. Brick, concrete blocks or adobe may be used.
c. It shall not be constructed under any building and within 25 meters from any source of water supply.

1.6 Project Size

Based on the Final Exploration Report dated October 2018, the total mineral covered by quarry area is 13.36 Million Metric Tons, **Table 1-8** shows the project size in terms of land area, type and production capacity, **Table 1-9** shows the Project Timeline and Table 1-10 for Production Schedule.

Table 1-8 Project Size

Land Area, square meter	Type	Capacity/Volume, MT per day
Product Total MPSA Area=114.5206 hectares **Quarry Area = 46.6206 hectares**	Pozzolan Quarry and Crushing Plant	3,205 MT/day; 83,333.33 MT/month; 1,000,000 MT/yr **Total Mineral = 13.36 Million Metric Tons**

Production Timeline

Table 1-9 presents the time table of the project from construction phase to operation phase. The operation phase shall only commence when all required permits and clearance have been secured.

Table 1-9 Timetable for the Project Phases

Activity	YR1				YR2	YR4	YR6	YR8	YR10	YR12	YR14	YR16	YR18	YR20
	1	2	3	4										
Construction														
Operation														
Progressive Rehabilitation														
Decommissioning and Final Rehabilitation														

Source: Final Exploration Report, October 24, 2018

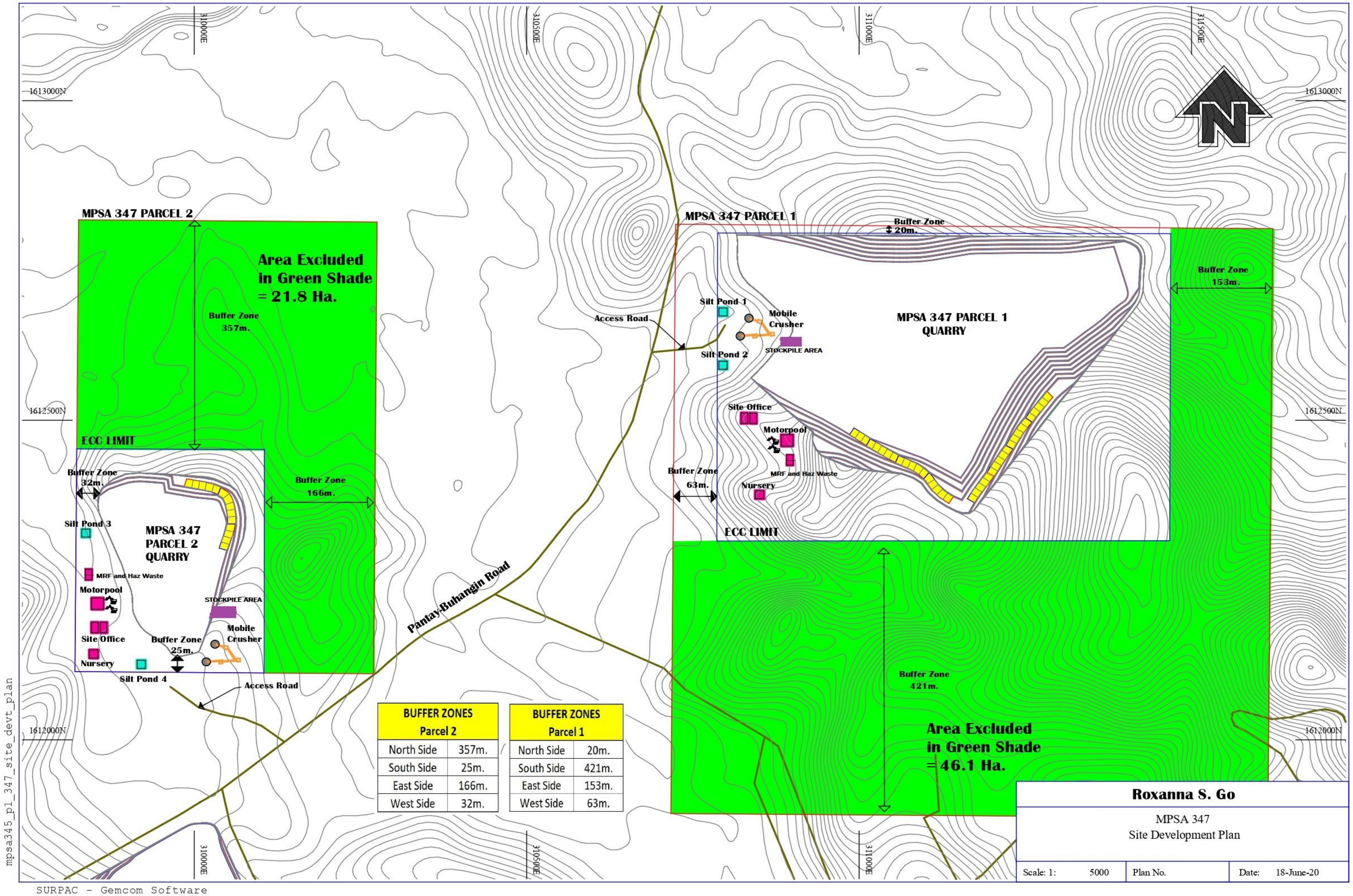
Production Schedule

The proposed project aims to produce 1,000,000 metric tons of pozzolan materials annually which is enough to sustain the remaining life of the quarry until year 2035. **Table 1-10** below shows the production schedule for the next 10 years. An initial production of 300,000 MT on the first year will be established and gradually increasing reaching its full production at 1,000,000 MT on the third year onwards.

Table 1-10 Ten (10)-Year Production Schedules

Activity	Reserved (MT)	YR1	YR2	YR3	YR4	YR5	YR6	YR7	YR8	YR9	YR10
Parcel 1	12,000,000	600,000	800,000	900,000	900,000	800,000	800,000	800,000	800,000	925,000	950,000
Parcel 2	1,300,000	75,000	100,000	100,000	100,000	200,000	200,000	200,000	200,000	75,000	50,000
Total	**13,300,000**	675,000	**900,000**	**1,000,000**	**1,000,000**	**1,000,000**	**1,000,000**	**1,000,000**	**1,000,000**	**1,000,000**	**1,000,000**

Source: Final Exploration Report, October 24, 2018



Source: Roxanna S. Go, September, 2020

Figure 1-14 Site Development Plan

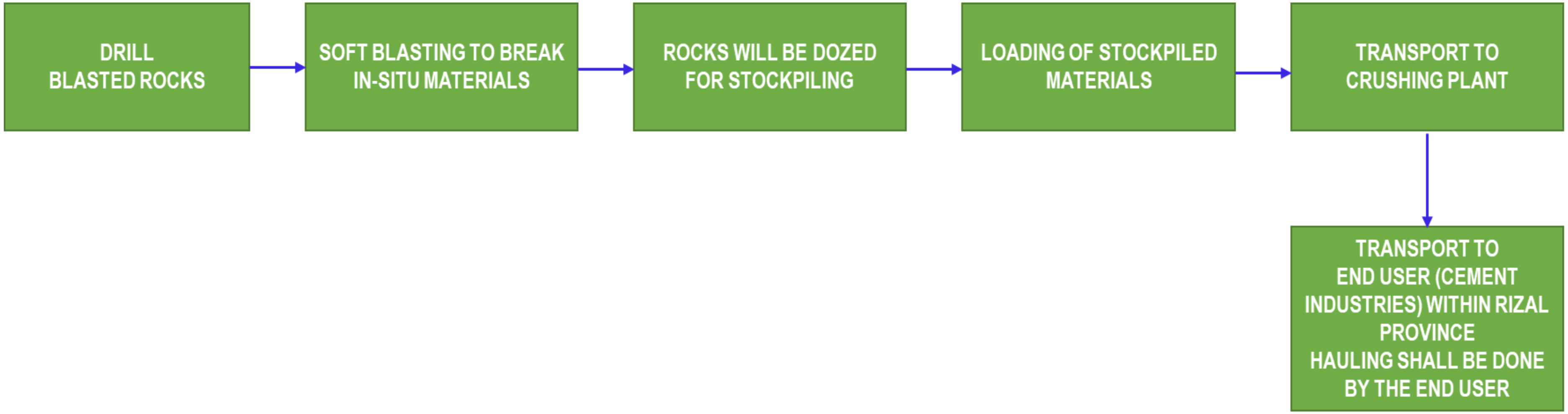


Figure 1-15 Quarry Operation

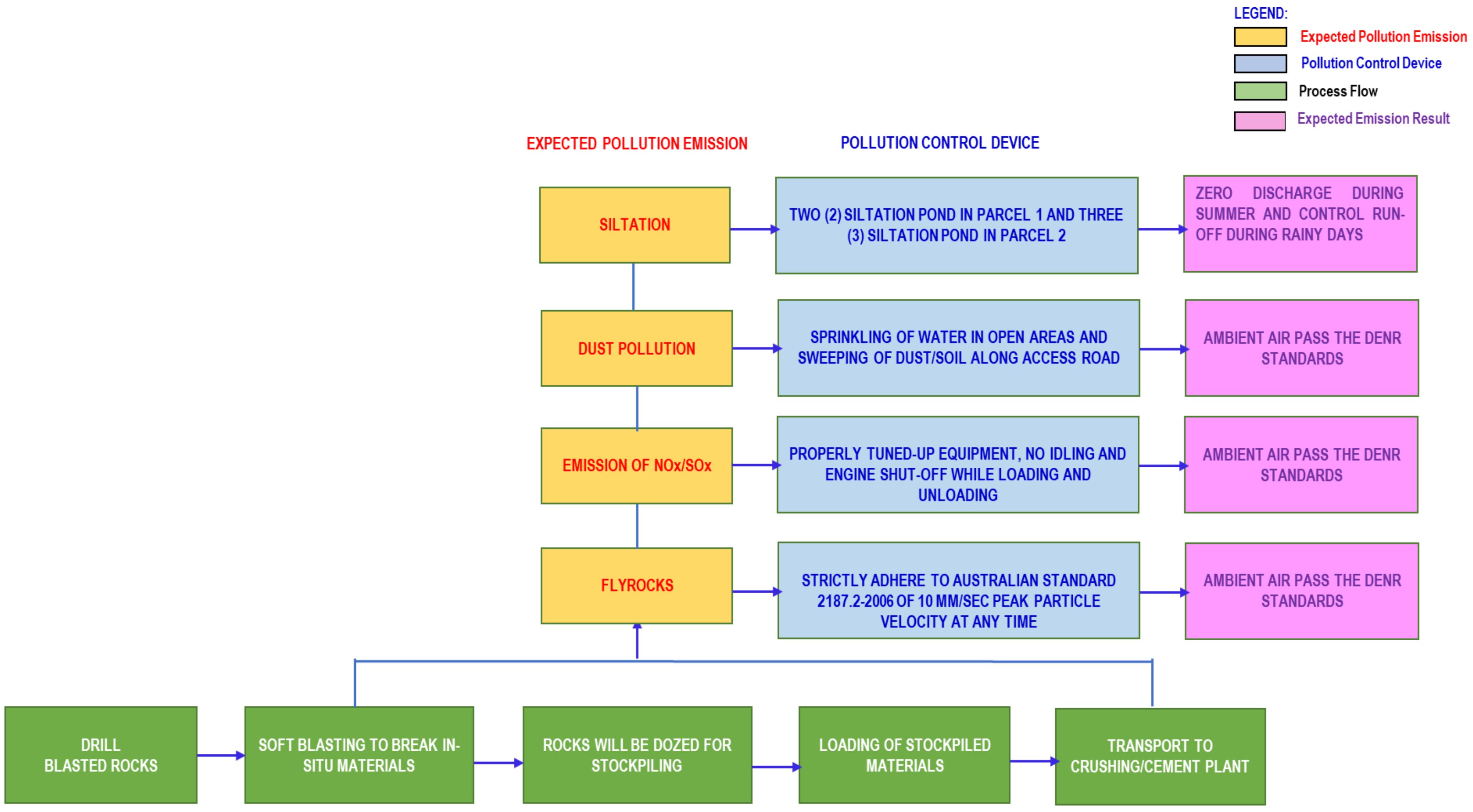


Figure 1-16 Waste Stream Diagram

1.7 Development Plan, Description of Project Phases and Corresponding Timeframes

1.7.1 Pre-Construction Phase

During pre-construction phase of the project, although the project covers already the MPSA, permits from other government agencies shall be secured by the proponent. These are the Environmental Compliance Certificate (ECC) and other Local Government Units (LGU) Permits from the Municipalities of Teresa and Morong and the Province of Rizal.

1.7.2 Construction Phase

a. Land Preparation (Clearing and Earthmoving)

Land preparation shall be done before the full operation of quarry or any mining activities are done. This includes staking of boundaries and buffer zones and removal of trees.

b. Construction of Access Road, construction of facilities and installation of Mobile Crusher

There will be access road for each Parcels along Pantay-Buhangin Road. Construction of main access road and sub-access road leading to the project shall be prepared with proper base coarse materials only. Access road shall of about 12-meter wide road while the sub-access road is about 8-10-meter wide road. All facilities such as office, motorpool is made up of container type and removable materials. Mobile crusher is likewise moveable and compact type of crusher.

Table 1-11 below illustrates the significant environmental aspect, impact and mitigation measure for some of the above-mentioned activities are taken into consideration as follow:

Table 1-11 Description of the Pollution Control Device and Waste Management Measures During Construction Phase

Key Environmental Aspects	Environmental Impact	Waste Management System
Earthmoving due to land preparation and construction of facilities and air pollution control device,	Sediments runoff from disturbed areas and dust pollution	• Conduct water spraying to suppress dust sources and sweeping soil and silt along Pantay-Buhangin road to further mitigate the dust.
	Removal of vegetation	• Implement progressive rehabilitation by participating in the National Greening Program (NGP) and establish a permanent planting area
	Possible Siltation	• Provision for two (2) units silt pond in Parcel 1 and three (3) units silt pond for Parcel 2
	Road Safety and Traffic	• Implementation of traffic management that is appropriate for the area • Road signs shall be placed at appropriate locations to alert motorist along the highway. • Traffic warden shall be stationed at strategic locations to guide traffic. • Imposition of speed limit along Pantay-Buhangin Road
	Dust Pollution and Increase in Noise Level	• Observed operating hours • Implement Controlled blasting • Regular Maintenance of equipment and vehicles

1.7.3 Operation Phase

Quarrying Activity Operation Phase including Blasting

The rock materials shall be quarried by Surface Mining Method (Benching Type). Quarrying will involve the following activities. All with the use of conventional surface mining equipment and machinery.

Quarry Design Parameters

The following design parameters are used in the determination of the final quarry limit of the deposit, **Figure 1-17.**

a) Bench height = 5 meters
b) Bench width = 5 meters
c) Working bench slope = 70°
d) Ramp width = 12 meters (inclusive of 2 meters safety berm with 0.5m height)
e) Ramp Gradient = 10%
g) The mining will be limited to the last free-drain elevation of the pit.

Parcel 1 has an elevation of 120 masl which shall be limited to 90 masl, while Parcel 2 has an elevation of 90 masl and shall be limited to final elevation of 76 masl.

Figure 1-18 shows Quarry Plan for Parcel 1, Figure 1-19 shows Quarry Plan for Parcel 1 – Section (A-A'), Figure 1-20 shows Quarry Plan for Parcel 2 and Figure 1-21 shows Quarry Plan for Parcel 2 - Section (A-A').

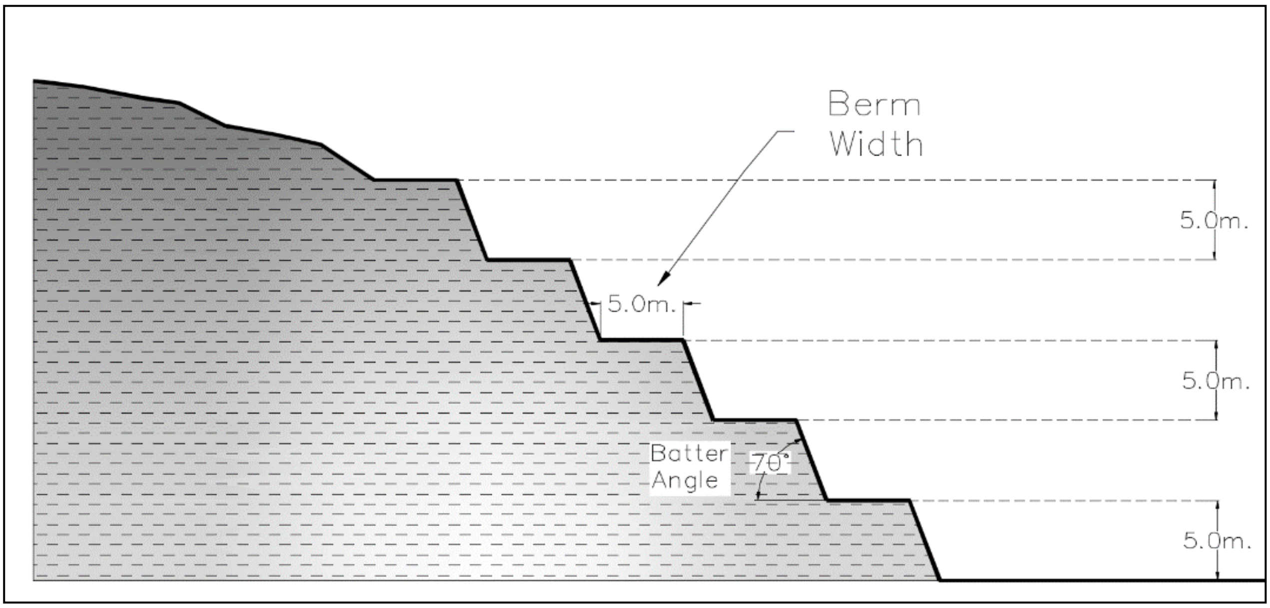


Figure 1-17 Quarry Design Parameters

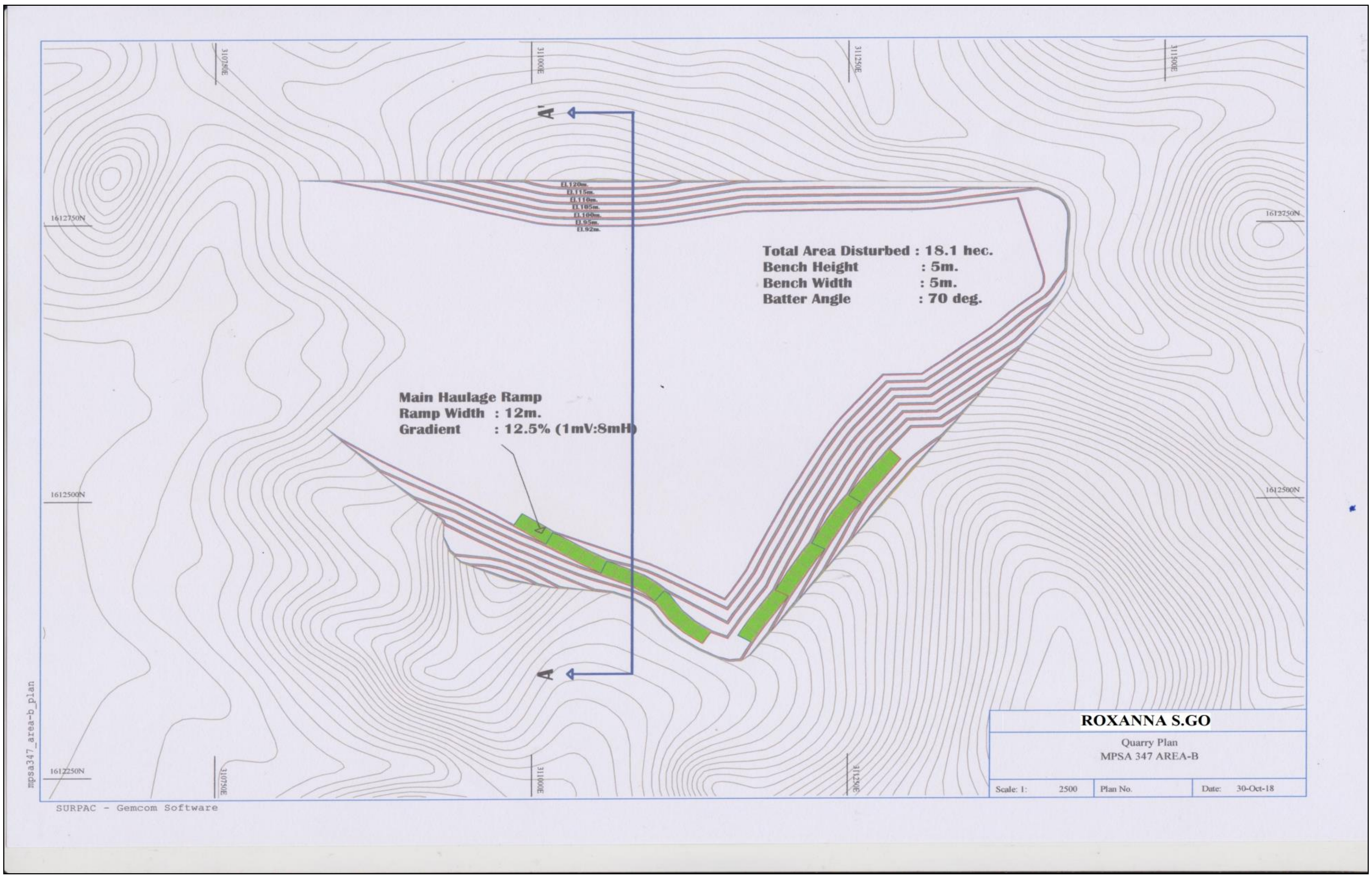


Figure 1-18 Quarry Plan for Parcel 1

Figure 1-19 Quarry Plan for Parcel 1-Section (A-A')

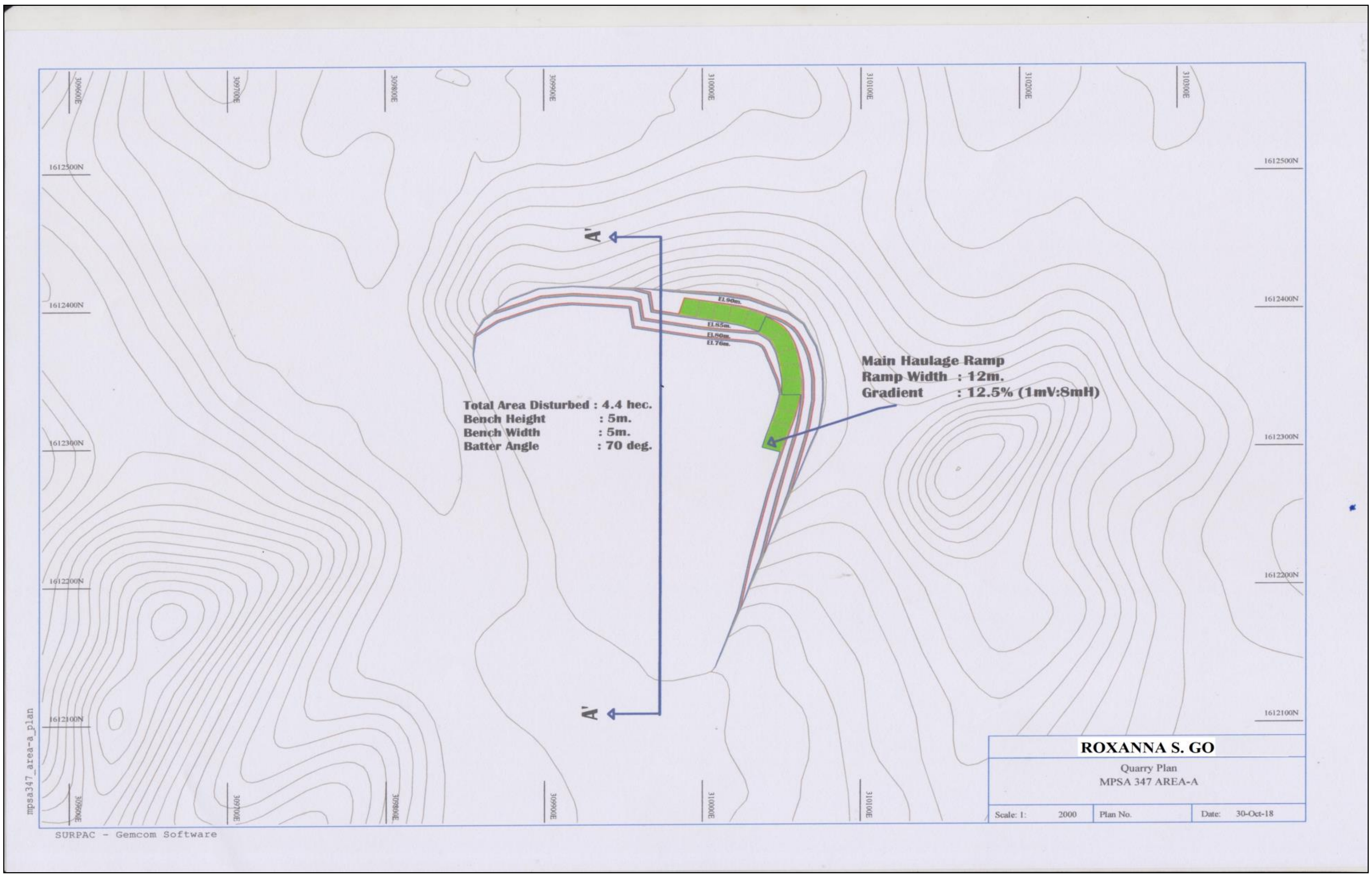


Figure 1-20 Quarry Plan for Parcel 2

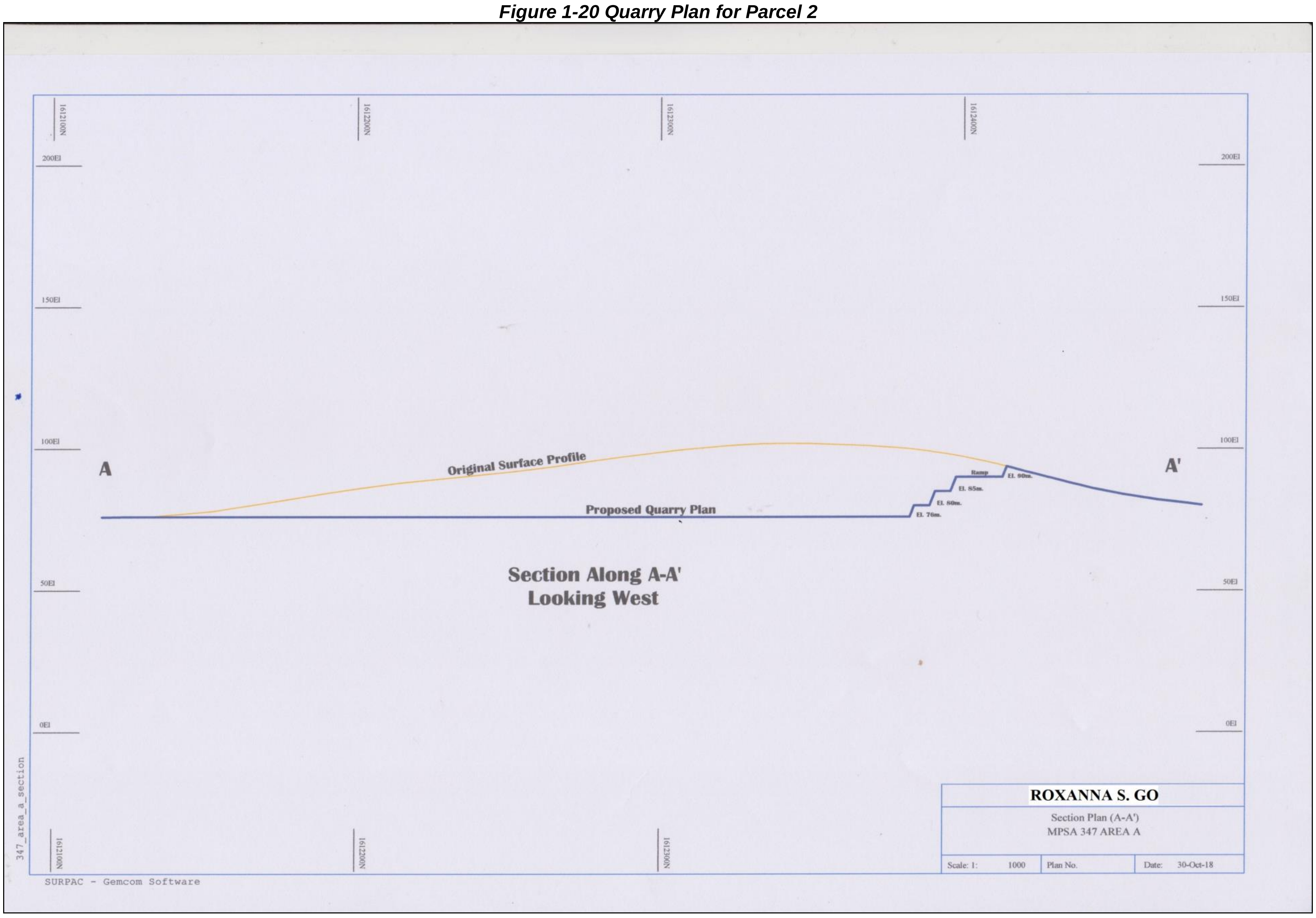


Figure 1-21 Quarry Plan for Parcel 2-Section (A-A')

Topsoil Stripping

Parcel 1 and Parcel 2 has a total area of 114.5206 hectares, but that does mean that the entire area shall be stripped and removed. Quarry area was established for both parcels to determine the extent of the operation, and the establishment of at least 20-meter buffer zones away from residential, roads and agri-industrial area.

Topsoil Stockpile Design Parameters

Topsoil materials will be temporarily transported to a designated stockpile area to be used for future rehabilitation. Typical thickness of topsoil ranges between 0.5m to 1.0m while overburden materials could reach up to 5.0 meters. Overburden or excess soil will not be disposed since this will be used for final grading of the project. Unlike in typical waste rock dump (WRD) in metallic mines were construction is in every 10-meter lift, construction is limited in 5-meter lifts due to being loose in nature of topsoil and overburden materials, **Figure 1-22**. To minimize suspended solids in run-off during heavy rains, slopes will be protected with rock facing. Large boulders will also be placed along the toe line increase stability.

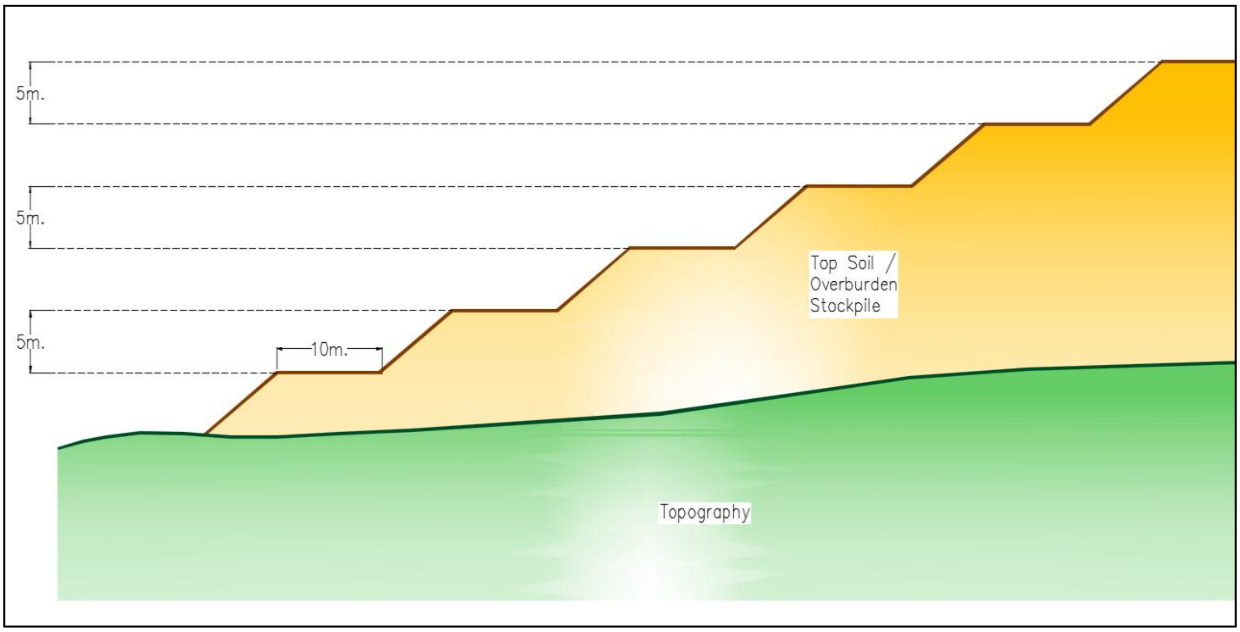


Figure 1-22 shows the design parameters for the topsoil / waste overburden stockpile.

Figure 1-22 Topsoil Stockpile Design

Drilling and Blasting

Production holes are drilled at vertical angle (90^0) while the batter holes are drilled with an inclination of 70^0 to achieve the designed bench slope angle. The pozzolan materials are considered medium to hard in strength. The burden and spacing used varies from 3.0m x 3.0m to 3.0m x 3.5m. Drilling depth is at 6m with 0.5m sub-drill. This sub-drill will address the problems related to hard toes after blasting and will create a smooth floor in preparation for the next cut.

Accredited blasting contractors using the latest technologies such as in-hole-delays will be commissioned. Using non-electronic delay detonators, the quantity of explosive fired in a given time is limited thus minimizing the production of ground vibration, heavy fly rocks and dust and sound emission. To stabilize the slopes of the final wall, controlled blasting will also be applied to every last row of holes along the final boundary of the quarry. In addition, the Accredited blasting contractors shall manage and handle the storage of explosive/magazines, thus, there is no explosive materials that will be stored within the project area.

The blasted materials are loaded onto 10-wheeler dump trucks by hydraulic excavators. These blasted rocks will then be dumped to the screen. The undersize will be sold to the buyers while the oversize materials will be fed to mobile crushers for final sizing.
Blasting shall conform with Australian Standards 2187.2-2006 of 10 mm per second peak particle velocity at any time to consider meteorological conditions, and distance from the blast location to the nearest structures. This should consider the proper timing and proper information dissemination prior to the blasting activity. Both parcels identified excluded area so as to maintain a permanent buffer and protection.

Proper recording for both vibration and the air pressure measurements shall be done to include location of the blast, air pressure level, peak particle velocity, meteorological data and distance from the nearest structures and community.

Dozing, Loading, Hauling and Stockpiling

Blasted rocks will be dozed for stock piling. A Wheel loader into incoming trucks will do loading of the stockpiled rock materials, after which the materials will be transported to the crushing plant.

Mobile Crushing Plant Operation

The mobile crushing plant shall be used only when crushing the over sizes materials.

Illustrates in **Table 1-12** are the significant environmental aspect, impact and mitigation measure during operation phase are taken into consideration as follows:

Table 1-12 Description of the Pollution Control Device and Waste Management Measures during Operation Phase

Key Environmental Aspects	Environmental Impact	Built-in Measure
Continuous quarry operation and Blasting	Sediments runoff from disturbed areas and dust pollution, SOx and NOx	• Conduct water spraying to suppress dust sources and sweeping soil and silt along Pantay-Buhangin road to further mitigate the dust. • No idling and engine shut-off during loading and unloading
	Removal of vegetation and fauna	• Implement progressive rehabilitation by participating in the National Greening Program (NGP) and establish a permanent planting area
	Possible Siltation	• Provision for two (2) units silt pond in Parcel 1 and three (3) units silt pond for Parcel 2
	Road Safety and Traffic	• Implementation of traffic management that is appropriate for the area • Road signs shall be placed at appropriate locations to alert motorist along the highway. • Traffic warden shall be stationed at strategic locations to guide traffic. • Imposition of speed limit along Pantay-Buhangin Road
	Dust Pollution and Increase in Noise Level	• Observed operating hours • Implement Controlled Blasting

		• Regular Maintenance of equipment and vehicles

Construction of Pollution Control Facilities

a. Construction of Siltation Pond and Erosion Control Measures

Erosion Control Measures shall be constructed prior to any land development preparation to ensure that the low-lying areas and nearby water body are protected from siltation. Erosion Control measures includes construction of siltation ponds, installation of sediment traps and sandbags. Two (2) silt ponds shall be provided in Parcel 1 and two (2) silt ponds in Parcel 2. The proponent shall include factor of safety of at least 20% of the total run-off computed for the capacity of the ponds. In addition, phasing operation shall be implemented to manage the quarry area.

Solid Waste Management Facility

In support to RA 9003, Otherwise known as 'Écological Solid Waste Management Act of 2000', the project shall put up a Material Recovery Facility (MRF) intended for the domestic solid waste temporary storage considered as common for the entire development of the company.

Toxic and Hazardous Waste Management Facility

In support to RA 6969 Otherwise known as 'Toxic and Hazardous Waste Management Act', the project shall put up a separate storage intended for the hazardous waste temporary storage considered as common for the entire development of the company.

Domestic Wastewater Management Facility

In support to RA 9275 Otherwise known as 'Clean Water Act of 2004', the project shall be provided with three chamber septic tank for primary treatment of domestic waste.

Buffer Zone

A minimum of 20 meters buffer zone shall be established from major roads, residential, and agri-industrial areas for both Parcel 1 and Parcel 2. Likewise, an area allocated for nursery or propagation of seedlings in preparation for a progressive rehabilitation.

Excluded Area

Parcel 1 has an excluded area of 46.10 has while Parcel 2 has about 21.80 has excluded area. This area shall remain as the permanent protection and buffer of quarry site.

Construction of Utilities

Construction of Drainage System

The drainage system is designed to connect or divert the surface run-off towards the siltation pond tower thru underground Reinforced Concrete Pipes (RCP).

Water Source and Waterline Distribution System

The project site has an estimated domestic water requirement of 1.00 cubic meters per day which shall be supplied by Local Water District.

Electrical Distribution System

The project site shall be supplied by MERALCO.

Operating Hours

Quarrying shall be carried at on (1) shift per day at ten (10) hours and three hundred (300) working days per year.

1.7.4 Abandonment Phase

Plans for Removal or Disposition of Temporary Structures and Facilities

All temporary facilities installed during the construction phase of the project shall be dismantled or removed from the project site once the building is completed.

Relocation and/or Termination Plans for Project Facilities

All heavy equipment used during the construction phase of the project will be pulled-out after project completion and some will be retained to be used in the operation phase. Hired workers except for the permanent personnel of the Project Contractor will be terminated or maybe relocated to other projects of the company.

After the Operation Phase

The quarry shall implement the Final Mine Rehabilitation Decommissioning Plan (FMRDP) such as development of final land use, stabilization of slopes and revegetation of open area in accordance to the planned final land use. The Project Proponent sees the area as a potential site for residential farm lots after the quarrying operation. The final land form will be developed into a farm lot subdivision in conformity with the land use classification of the area which is an agro-industrial use.

Therefore, it is expected that the proponent shall secure permits and clearance from the Local Government Units (LGU) in term of Development Permit and Housing and Land Use Regulatory Board (HLURB) in terms of License to Sell, ***Figure 1-23 and Figure 1-24 presents the schematic conceptual Farm Lots Subdivision plan as Final Land Use.***

1.8 Manpower and Equipment

A total of 27 workers will be needed for the Project presented in **Table 1-13**. The required manpower requirement shall be in close coordination with the Barangay Office for potential qualified available in host community and shared employment opportunities for Barangays Maybancal, Morong, Rizal and Barangay Dalig, Teresa, Rizal while **Table 1-14** for the list of equipment to be used.

Table 1-13 List of Manpower During Construction and Operation Phase

Workforce Project Component	Number
General Manager (Corporate)	1
SHESD / MEPEO Manager (Corporate)	1
Quarry Superintendent (Project Base)	1
SHESD Personnel (Project Base)	1
Heavy Equipment Operator (Project Base)	12
Checker (Project Base)	1
Screen Operator	1
Maintenance / Utility Crew	5
Guards (Project Base)	4
Total	**27**

Source: Final Exploration Report, October 24, 2018

Table 1-14 List of Equipment to be Used for Pozzolan Quarry

Equipment	Number
PC 350 Excavator or Equivalent	3

D155 Excavator or equivalent	1
Hyundai 470 Loader or equivalent	1
15 cum. 10- wheeler dump truck	4
Stationary Vibrating Screen	1
Mobile Crusher	1
5 cum. water truck	1
Total	**12**

Source: Final Exploration Report, October 24, 2018

1.9 Project Cost

The estimated capital cost of the project is Php 153,200,000.00 presented in **Table 1-15**.

Table 1-15 Project Capital Cost

Capital Expenditures	Cost
Exploration	Php 3,000,000.00
Permitting	Php 5,000,000.00
Land Acquisition	Php 25,000,000.00
Equipment	Php 100,500,000.00
Mine Development	Php 18,200,000.00
Surface Infrastructure	Php 1,500,000.00
Total	**Php 153,200,000.00**

Source: Final Exploration Report, October 24, 2018

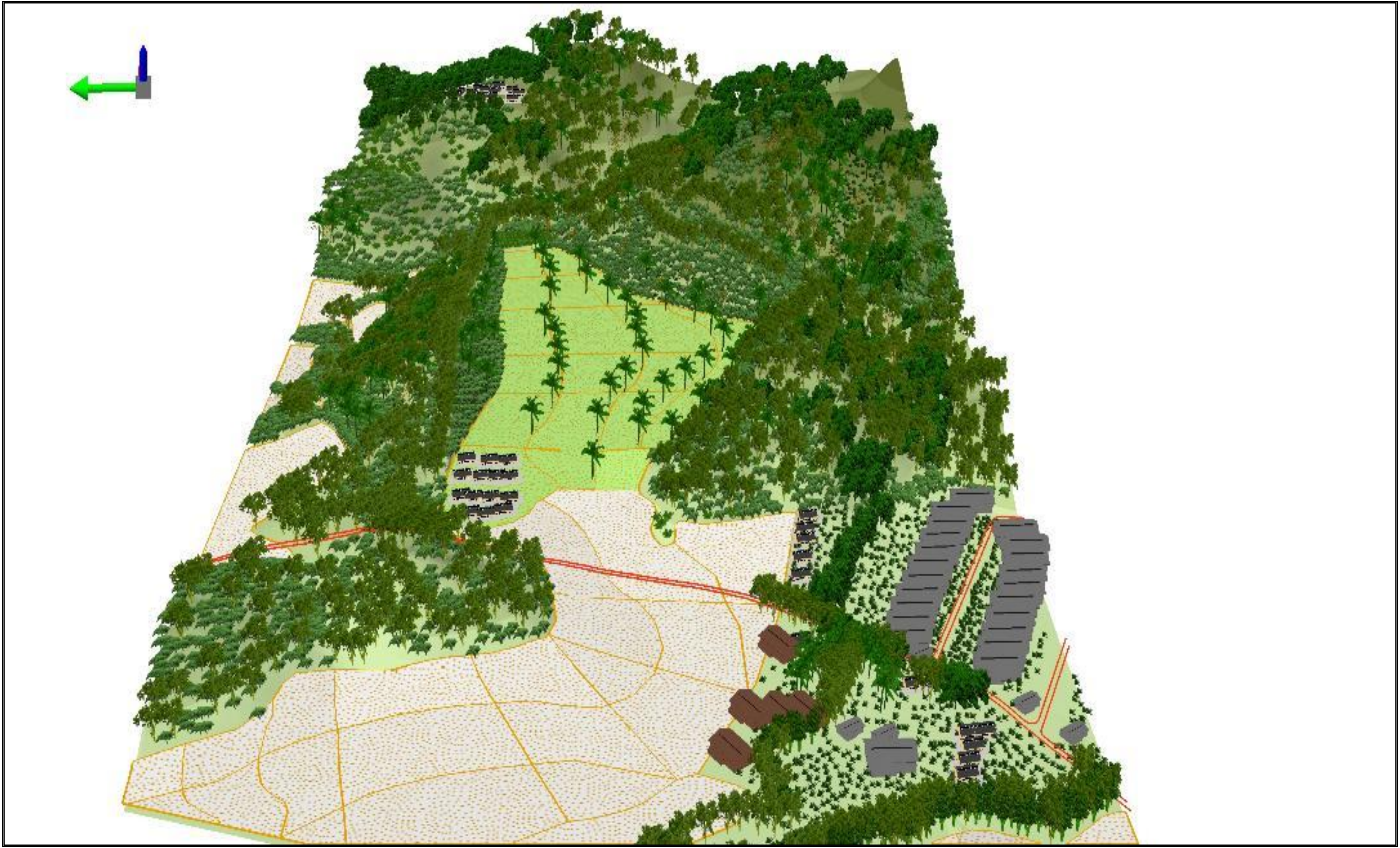
Photographs of the Project Site showing the current status presented in Photo 1a-1j.

Figure 1-25 presents the Google 3D representation for Parcel 1.

Figure 1-26 presents the Google 3D representation for Parcel 2.

Source: Roxanna S. Go January 2020

Figure 1-23 Conceptual Plan of the Final Land Use for Parcel 1 as Farm lot Subdivision



Source: Roxanna S. Go January 2020

Figure 1-24 Conceptual Plan of the Final Land Use for Parcel 2 as Farm lot Subdivision

***Photo 1a**: Aerial shot of Parcel 1 Showing Current Vegetation*

***Photo 1b**: Parcel 1 Looking West*

***Photo 1c**: Aerial shot of Parcel 2 Showing Current Vegetation*

***Photo 1d**: Parcel 2 Looking West*

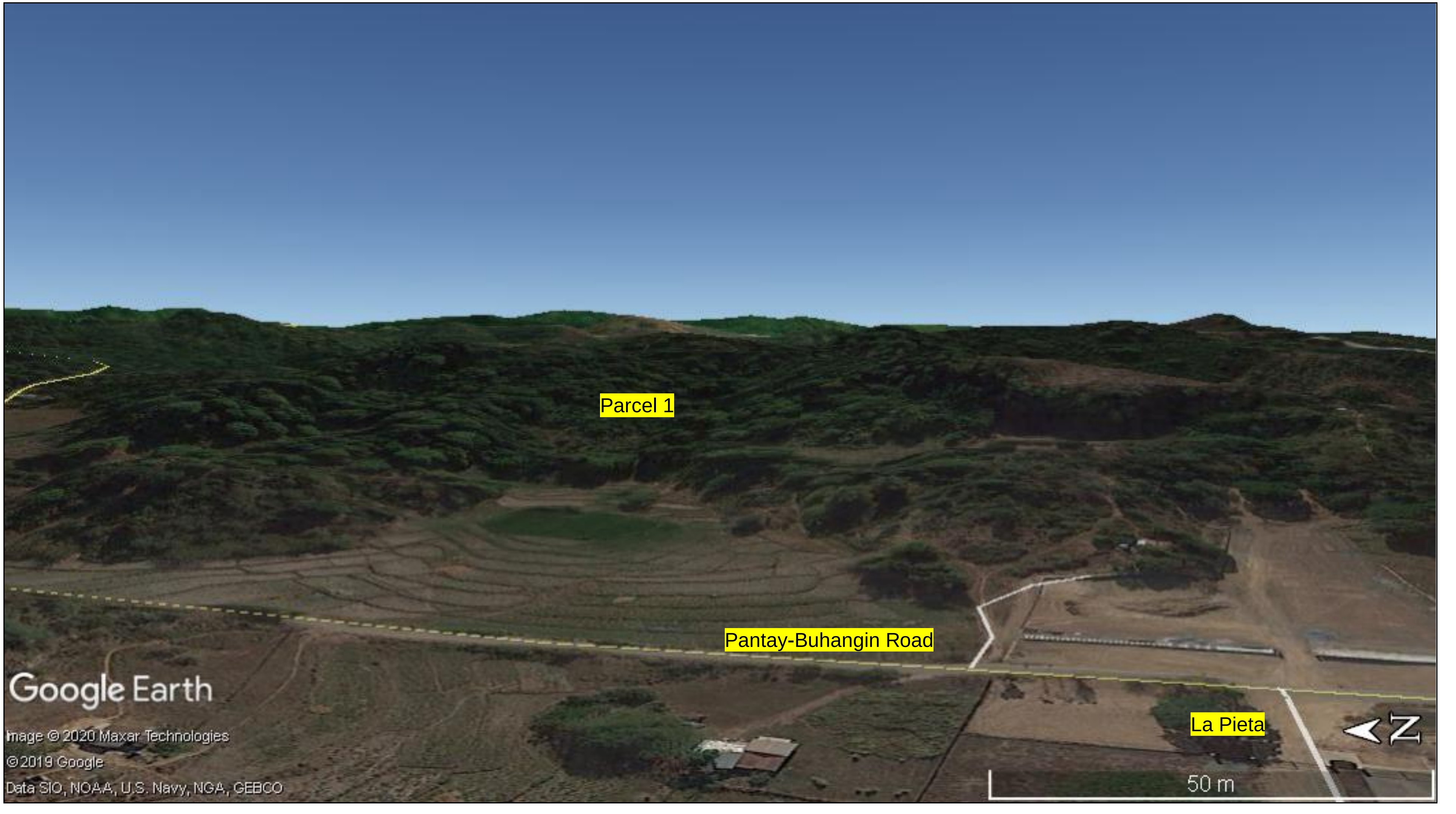


Figure 1-25. *Google 3D Representation of Parcel 1*

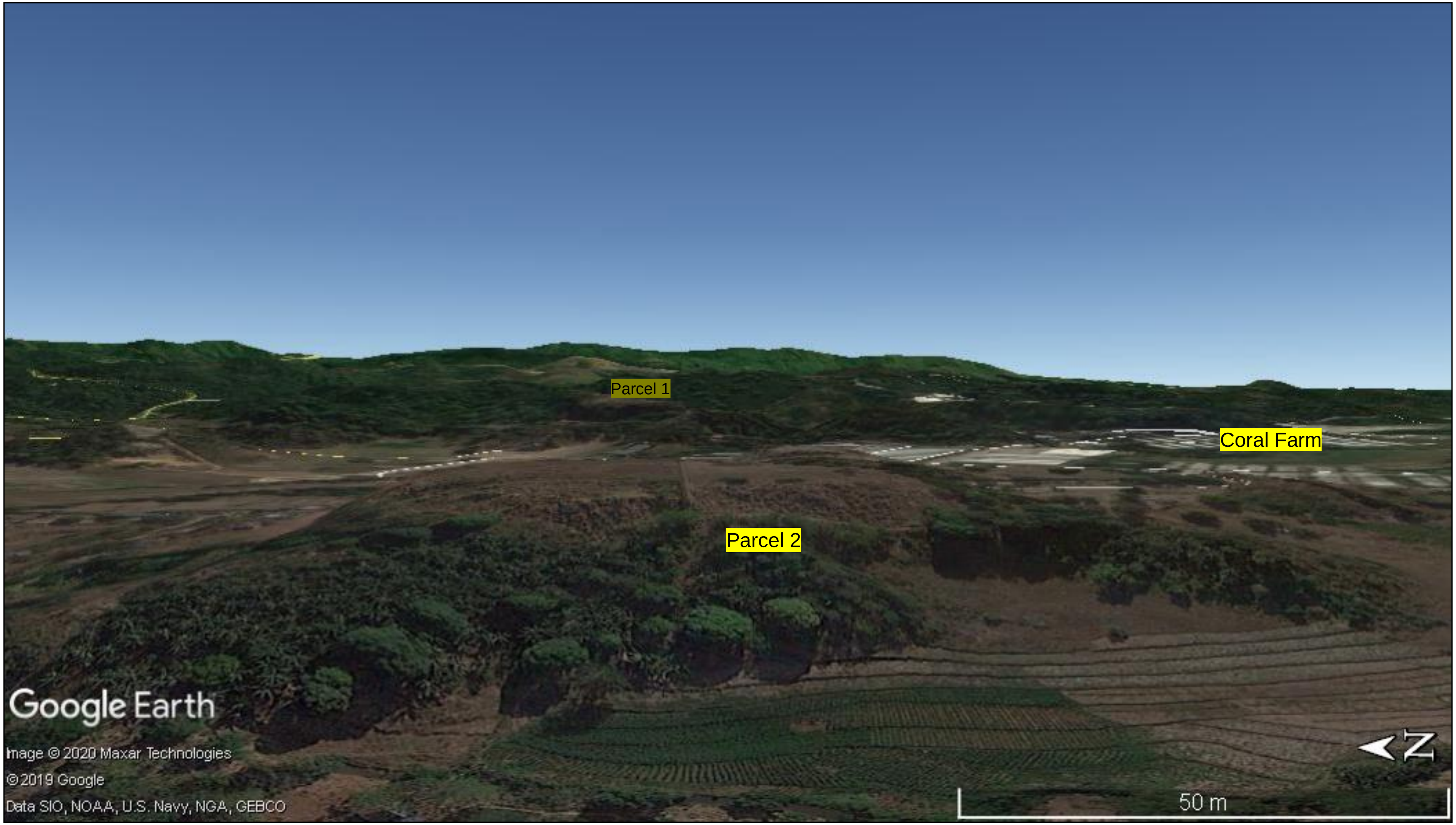


Figure 1-26. *Google 3D Representation of Parcel 2*

***Photo 1e**: Aerial Photo of MPSA 347-2010-IVA taken January 16, 2020*

***Photo 1f**: Junction between Sumulong Highway and Pantay-Buhangin Road access to MPSA 347-2010-IVA*

***Photo 1g**: Panoramic View of MPSA 347-2010-IVA Parcel 1 looking East. The site comprises of low-lying hilly terrain and slopes covered by various types of vegetation. Coordinates 14^{0}34'50.22" north latitude and 121^{0}14'42.26" east longitude, elevation varies from 106-130 masl*

***Photo 1h**: Panoramic View of MPSA 347-2010-IVA Parcel 2 portion along Pantay-Buhangin Road passing the narrow road. The site comprises of low-lying hilly terrain and slopes covered by various types of vegetation. Coordinates 14^{0}34'31.99" north latitude and 121^{0}14'20.29" east longitude, elevation- 82 masl*

2.0 ASSESSMENT OF ENVIRONMENTAL IMPACTS

2.1 LAND

This section presents the key baseline conditions of the project's site in terms of land use and classification, geology, geomorphology, geologic hazards and pedology. Important considerations in geology are lithology and geologic hazards, and in geomorphology are slope and alluvial processes.

The potential impacts of the project's activities during pre-construction, development, operations, and rehabilitation stage on these environmental aspects and their corresponding options for prevention, mitigation and enhancement are also assessed and discussed in this section.

2.1.1 Land Use and Classification

This section describes the existing land classification and land uses within the project site, the key impacts of the project, and the corresponding control measures. Present land tenure within the project site is also discussed in Environmentally Critical Areas (ECAs) within and surrounding the project are identified and located. According to Act No. 2874, otherwise known as the Public Land Act, lands of the public domain are classified into three main classifications: (A) Forestland, (B) Alienable and Disposable, and (C) Mineral Lands.

Forestland, also known as permanent forest or forest reserves, refers to those lands of the public domain which have been the subject of the present system of classification and declared as needed for forest purposes. Alienable and Disposable land refers to those lands which have been the subject of the present system of classification and declared as not needed for forest purposes or that are open to public disposition. They can be further classified according to the intended use or purpose such as agricultural, commercial, industrial, educational, charitable, reservations for town sites or public and quasi public uses. Mineral lands are lands in which minerals exists in abundance and there is enough justification to extract and utilize.

Though the project will imperceptibly impact and change the current land use, it is however, important to determine and understand the existing land use, and determine the legal classifications of the land by the local and national government.

Methodology

The following methodologies were used to determine the compatibility of the project with the existing land use and classification policies of the host municipality:

- Assessed the compatibility of the proposed project vis-à-vis actual land use and approved land use plans, classification, and presence of environmentally critical areas;
- Identified impact in terms of land tenure issues in relation to project implementation;
- Assessed impacts of project on visually significant landforms, terrestrial areas; and
- Identified and assessed impacts of the estimated generation of solid wastes in terms of amount and characteristics and other related issues on existing management scheme.

The study was based mainly on review of published literature and internal reports from Roxanna S. Go and Rapid City Realty and Development Corp. (RCRDC), including maps from various sources primarily the Comprehensive Land Use Plan (CLUP) and available documents from the Office of the Municipal Planning and Development Coordinator (MPDO) of Morong and Teresa where mining tenement is located. Information from walkthrough confirmation surveys specific to the project site was included in the evaluation of observed actual land use for comparison with relevant laws and legally designated land use.

These data and maps were digitized, encoded and georeferenced using Geographic Information Systems (GIS) with QGIS Valmeira version as the software.

Additional information was obtained from the National Mapping Resources Information Agency (NAMRIA) maps for base referencing of key areas within the project site. Presence and proximity to ancestral domains, Environmentally Critical Areas (ECA), and those covered by Heritage Laws were also examined and included in the assessment using the Philippine Geoportal, the National

Commission of Indigenous Peoples (NCIP), the Biodiversity Management Bureau (BMB), and the National Museum of the Philippines (NMP).

Assessment of key impacts and mitigating measures

The existing land classification and land use conditions at the host municipality were described by its areal distribution, land suitability and capability classification, and land use zoning. Currently, the area is classified as agro-industrial zone. The mining or quarrying activity to develop a certain parcel of land and is considered temporary and will not alter the current land use. This will dictate or describe on the final land use whether to adopt the same as agro-industrial or re-zone for new purpose. Conversion of land is only applicable for agricultural lands. The proponent shall still secure all necessary permit from National and Local in terms of re-zoning or special permit if so required.

2.1.1.1 Impact In Terms of Compatibility With Existing Land Use

Existing conditions

Municipality of Teresa

Teresa has a total land area of 1,860 hectares which is 1.42% of the total area of the province (**Table 2-1**). This figure was from the 2006 Environment and Natural Resource Statistics from the Department of Environment & Natural Resources (DENR). This was also based on the land area used for Internal Revenue Allotment (IRA) allocation.

Table 2-1. Land Area, Province of Rizal

City/ Municipality	Lad Area (in Hectares)	Share (in %)
Angono	2,600	1.99
Antipolo	30,608	23.38
Baras	2,340	1.79
Binangonan	7,270	5.55
Cainta	1,020	0.78
Cardona	3,120	2.38
Jalajala	4,930	3.77
Morong	**3,452.86**	**2.87**
Pililia	7,400	5.65
Rodriguez	31,728	23.90
San Mateo	6,489	4.96
Tanay	24,337	18.59
Taytay	3,880	2.96
Teresa	**1,860**	**1.42**
TOTAL	**130,892**	**100**

Source: Teresa CLUP, 2013

For the existing land use of the municipality (per 2013 data), agriculture areas are the most dominant land use with 674.106 hectares and Strategic Agriculture and Fishery Development Zone (SAFDZ) with 365.131 hectares **(Table 2-2**).

This is followed by grassland/open space with 286.91 hectares, residential areas covering 242.403 hectares, production forest with 201.333 hectares, agro-industrial areas accounting for 156.482 hectares, water use with 35.944 hectares, institutional with 12.058 hectares, commercial with 9.595 hectares, socialized housing with 7.448 hectares, parks and playground with 6.206 hectares, cemetery with 4.859 hectares and MRF with 0.393 hectares.

Quarry (non-metallic) areas which accounts to 75.99 hectares can be found in Barangay May-iba, Dulumbayan, and Dalig where mining companies are located. These companies include South Pacific Chemical Industries, Republic Cement Corporation, Rapid City Realty Development Corporation, and TMTC International Corporation. The current land use of the area is agro-industrial zone. For CLUP updating and this study, the total land area used is the computer-generated map area of 2,121.852 hectares.

Table 2-2. Existing Land Use of Teresa, 2013

Category	Area in Hectares (Has.)
Residential	242.403
Socialized Housing	7.448
Commercial	9.595
Institutional	12.058
Agricultural	674.106
Agricultural- SAFDZ	365.131
Agro-industrial	156.482
Industrial	42.923
Production Forest	201.333
Quarrying/Mining	**75.99**
Grassland/Open Space	286.981
Parks/Playgrounds	6.206
Cemetery	4.859
MRF	0.393
Water Use	35.944
Total	**2,121.852**

Source: Teresa CLUP

Municipality of Morong

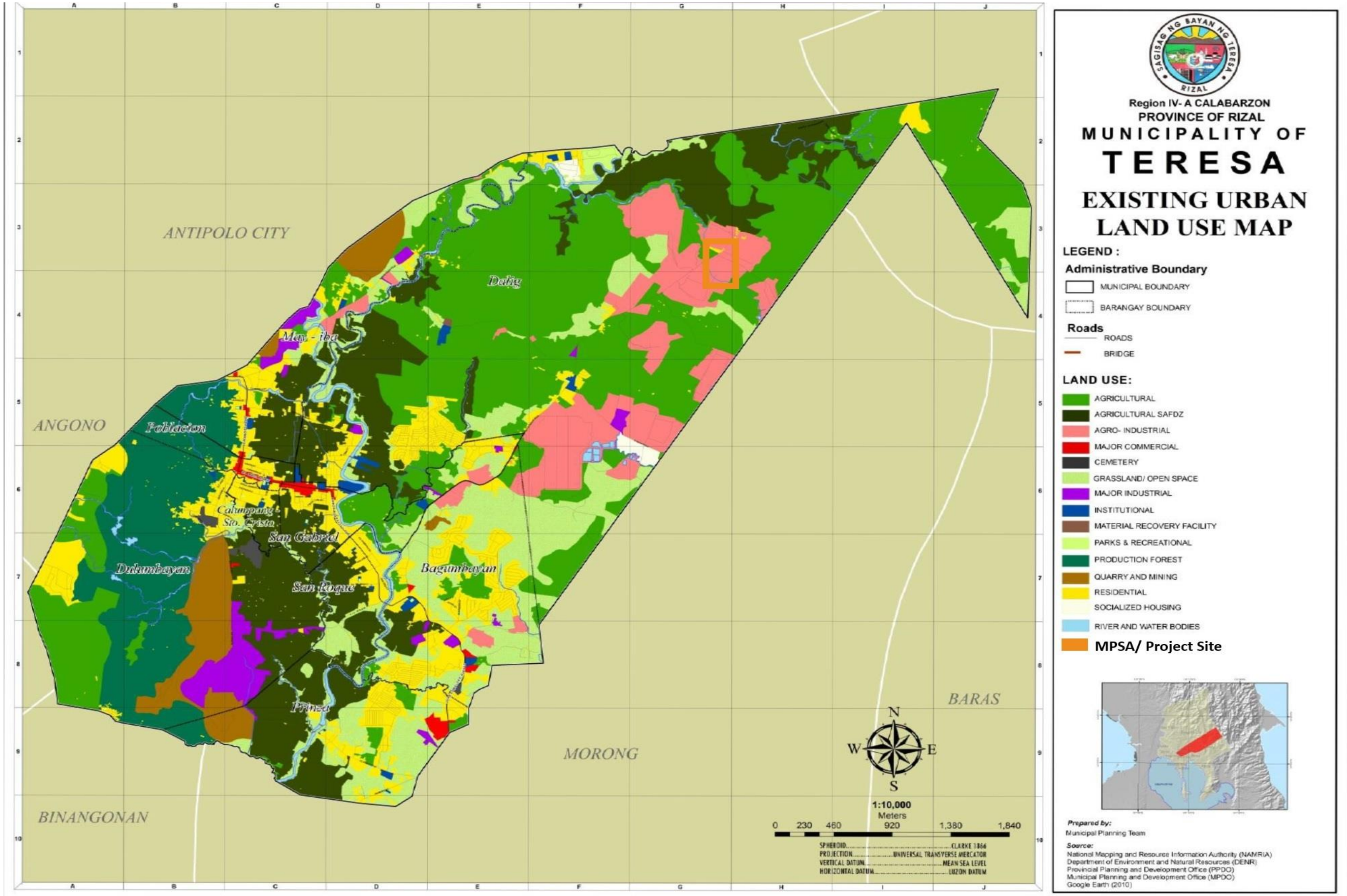
The municipality of Morong has a land area of 3,452.86 hectares comprising 2.87 percent of the total provincial land area of Rizal. See **Table 2-1**. About 83.51 percent (2,883.55 hectares) that comprise the land area of Morong are classified as open spaces. The rest (569.32 hectares) is classified as built-up space. Morong's distribution of open spaces is largely Agricultural area (46.35%). Protected agricultural areas called Strategic Agriculture and Fisheries Development Zone (SAFDZ) occupy 27.78 percent of total land area. All in all, the total agricultural land occupies roughly 74.13 percent of Morong's total land area. The land area allocation dictates that the municipality's built up area is dominantly residential (14.21%). Agri-industrial use occupy around 23.66 hectares, less than 1 percent of total land area. Institutional use will also take up less than 1 percent of total land area. **Table 2-3.**

Table 2-3. Existing Land Use, Morong

Land Use Classification	Land Area (in Hectares)	% to Total
BUILT-UP		
Residential	490.71	14.21
Agri-Industrial	23.66	0.69
Institutional	28.10	0.81
Commercial	26.05	0.75
Industrial	0.80	0.02
Sub-Total	**569.32**	**16.49**
OPEN SPACES		
Agricultural	1,600.42	46.35
Agricultural (SAFDZ)	959.06	27.78
Cemetery	6.24	0.18
Cropland/Orchard/Tree crop	30.39	0.88
Landfill	6.87	0.20
Parks and Recreation	5.01	0.14
Protected Land	246.91	7.15
Tourism	0.62	0.02
Water Bodies	28.02	0.81
Sub-Total	**2,883.55**	**83.51**
TOTAL	**3,452.86**	**100.00**

Source: Morong CLUP 2018-2027

The project site is located in two (2) host municipalities Teresa and Morong. With a total of 114.5206 has (mine footprint), the MPSA lies within an area classified under agricultural, production forest zone and agro-industrial use as shown in **Figure 2-1, Figure 2-2 and Figure 2-3.**



Source: Teresa CLUP, 2013

Figure 2-1 Existing Urban Land Use Map of Teresa

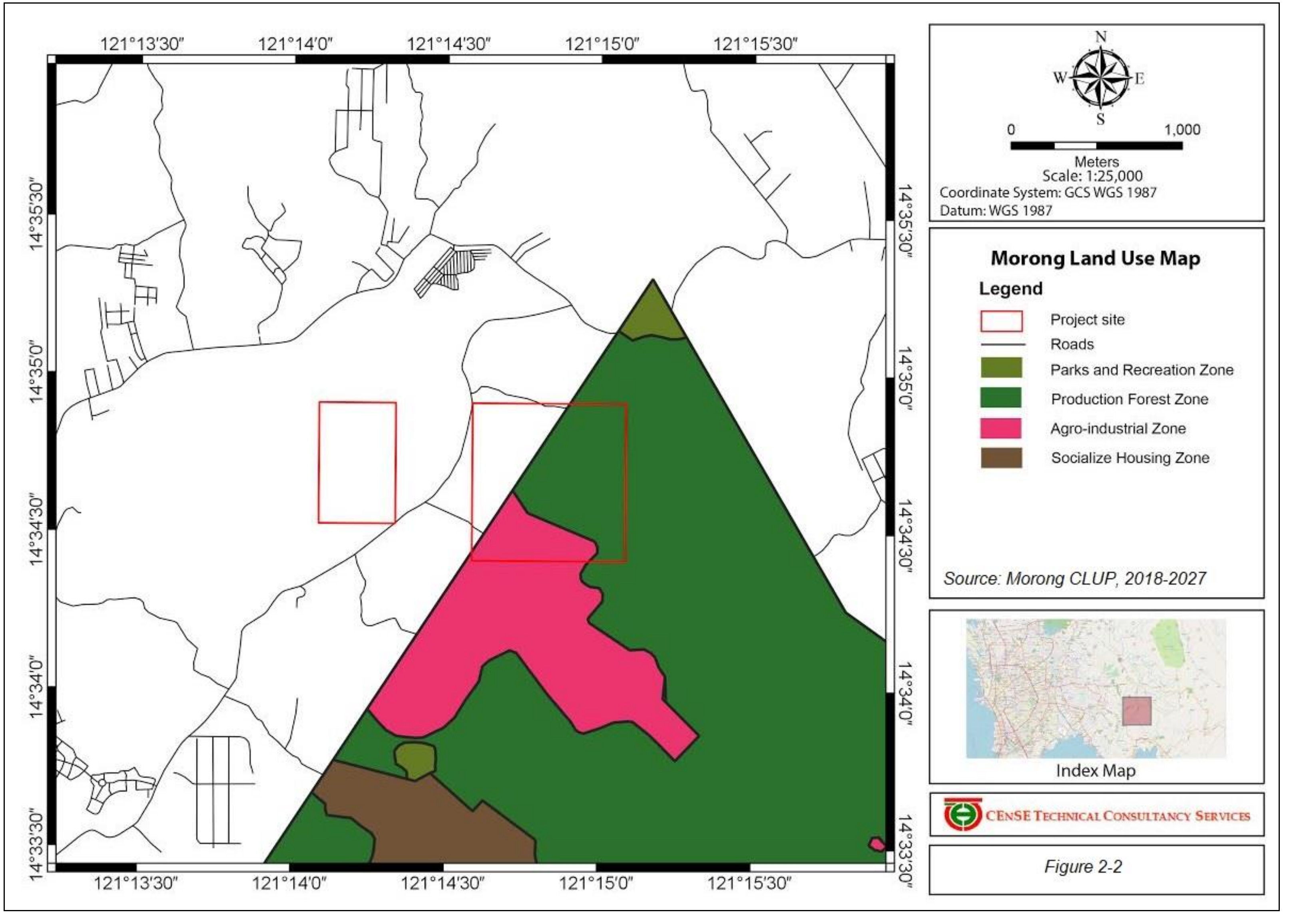
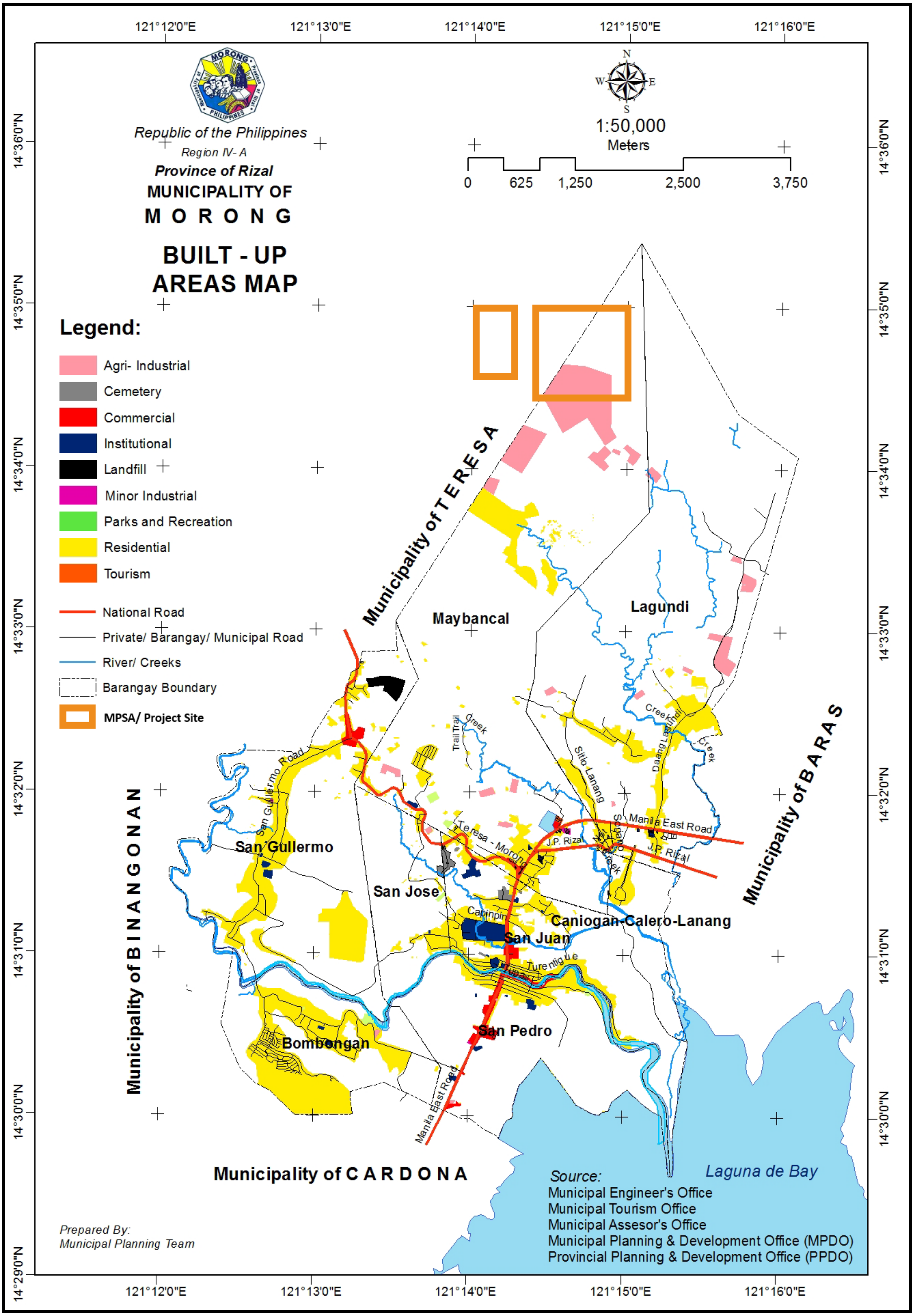


Figure 2-2 Land Use Map of Morong



Source: Morong CLUP

Figure 2-3 Built-Up Areas Map of Morong

IMPACT ASSESSMENT AND MITIGATION

Both parcels have rice farms on the low areas surrounding it. The proponent would stay within the boundaries of their MPSA, and would observe a quarry limit and 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 the proposed land use as farm lots, or other purposes approved by the LGU and the nearby communities. Meanwhile, any issue on land use change can be resolved through the DAR-Municipal Agrarian Reform Office (MARO) and municipal ordinance declaring the project area as mining/ quarrying or industrial zone. The proponent shall secure special permit or resolution from the LGU allowing the operation of the proposed quarry.

2.1.1.2 Impact on Compatibility With Classification As An Environmentally Critical Area (ECA)

Existing conditions

The Revised Procedural Manual for DENR Administrative Order No. 30, Series of 2003 (DAO 03-30) defined Environmentally Critical Areas (ECA) in twelve categories. An ECA is an environmentally sensitive area declared through Proclamation 2146 of 1981 where significant environmental impacts are expected if certain thresholds of proposed projects are located, developed, or implemented in it. Assessment of project's encroachment in ECAs is presented in **Table 2-4**. ***Figure 2-4*** shows locations of ECAs within and surrounding the project.

The project site is located in at least two ECAs: areas frequently visited or hard-hit by natural calamities and areas close to waterbodies that support wildlife. Secondary data showed that the site may be affected by earthquake generated by nearby faults. There are earthquake generators surrounding the province that have caused earthquakes in various intensities and magnitudes with three listed below considered as major earthquake generators in the region. Among these, the most prominent is the West Valley Fault, the Manila Trench, and the Philippine Fault. Please refer to **Geology Section** for detailed discussion.

2.1.1.3 Encroachment in Protected Area (NIPAS) and Other ECA Categories

Table 2-4 presents the types of ECAs within the vicinity pursuant to DAO 2003-30, MC 2014-005 and DAO 2019-05 (ENPAS).

Table 2-4 Types of ECAs within the vicinity of the project site

No.	ECA Category	Technical Description of ECA Category based on DAO 2003-30	Presence within the Project Site	Description (in aerial km)
1	Areas declared by law as national parks, watershed reserves, wildlife preserves, and sanctuaries	The laws referred to by this provision are Presidential Decree No. 705, as amended, otherwise called as the *Revised Forestry Code, Republic Act 7586* or the *NIPAS Act*, and other issuances including other proclamations, executive orders, local ordinances, and international commitments and declarations.	Not present within the project site.	**Upper Marikina River Basin Protected Landscape** under Proclamation 296 s. 2011 / E-NIPAS (RA-11038) Legislated ENIPAS (approx. 1.9 km distant) **Pamitinan Protected Landscape** under Pres. Proclamation No. 901/1996 (approx. 2 km distant) **Unnamed National Park, Wildlife Sanctuary and Game Preserve** under PD 1636 s. 1977 As Initial Component NIPAS (approx. 5 km distant)

No.	ECA Category	Technical Description of ECA Category based on DAO 2003-30	Presence within the Project Site	Description (in aerial km)
2	Areas set aside as aesthetic, potential tourist spots	Aesthetic potential tourist spots declared and reserved by the DOT or other appropriate authorities for tourism development.	Not present within the project site.	**Class II Cave: Yungib ni Ruben** in Brgy. Cuyambay, Tanay determined by BMB (approx 9.5 km from site) **Class II: Pamitinan Cave** in Sitio Wawa, Rodriguez, determined by BMB and DOT (approx. 20 km away from site)
3	Areas that constitute the habitat of any endangered or threatened species of indigenous Philippine wildlife (flora and fauna)	This refers to areas considered as wilderness areas and areas identified by the PAWB/BMB to be natural habitats of endangered or threatened, rare, and indeterminate species of flora and fauna, as defined by PAWB/BMB.		Refer to **Terrestrial Ecology Section**
4	Areas of unique historic, archaeological, geological, or scientific interests	This refers to areas that are more than 100 years old (now superseded by new law RA10066, reduced to 50 years old) and declared by the National Historical Institute, National Museum, or National Commission for Culture and the Arts, through national or local laws or ordinances as areas of cultural, historical, and scientific significance to the nation, (e.g., declared national historical landmarks, geological monuments, and paleontological and anthropological reservations).	Not present within the project site.	**Pamitinan Cave** in Sitio Wawa, San Rafael, Rodriguez, Rizal declared by the NHCP on June 21, 1996 as National Historical Site (R.A. 4846/1996). **Angono Petroglyphs Site Museum** in Binangonan, Rizal declared as National Cultural Treasure by NHCP (P.D. No. 260). **Montalban Gorge** in Wawa, Rodriguez, Rizal declared as National Geological Monument (E.O. No. 625/1980) by the National Committee on Geological Sciences.
5	Areas that are traditionally occupied by cultural communities or tribes	This refers to all ancestral lands of the National Cultural Communities in Section 1 of P.D. No. 410 and settlements designed, implemented, and maintained by the PANAMIN for national minorities (non-Muslim hill tribes referred to in Presidential Decree No. 719) as may be amended by R.A. 8371 or the Indigenous Peoples Rights Act of 1997 and its Implementing Rules and Regulations.	The project site is not located in any ancestral domain based on NCIP and MPDO data.	Nearest approved CADT is located in Sto. Nino and Daraitan, Municipality of Tanay (approx. 8 km away)
6	Areas frequently visited and/or hardhit by natural calamities	The area shall be so characterized if any of the following conditions exist:	Present within the project site.	

No.	ECA Category	Technical Description of ECA Category based on DAO 2003-30	Presence within the Project Site	Description (in aerial km)
	(geologic hazards, floods, typhoons, volcanic activity, etc.)	- Geologic hazard areas: This refers to all areas identified by the Mines Geosciences Bureau (MGB) as geologic hazard areas. - Flood-prone areas: This refers to low-lying areas usually adjacent to large active water bodies experiencing inundation of at least 2m, twice a year for the last five years prior to the year of reckoning. - Areas frequently visited or hard-hit by typhoons: This refers to all areas where typhoon signal No.4 was hoisted for at least twice a year during the last five years prior to the year of reckoning. - Areas prone to volcanic activities/ earthquakes: This refers to all areas identified as such by the Philippine Institute of Volcanology and Seismology (PHIVOLCS) (e.g., areas within permanent exclusion zones of active volcanoes or areas within the required minimum buffer zone of fault zones as determined by PHIVOLCS).		Moderately susceptible to flooding and landslide. High risk to typhoon as determined by Joint Typhoon Warning Center. No risk from volcanic hazards; moderate risk from earthquake and related hazards. Refer to **Geology Section**
7	Areas with critical slope	This refers to all lands with slopes of 50% or more classified as geohazard by MGB. Such slope conditions favor their natural susceptibility to geohazards such as landslides.	Not present within the project site.	Refer to **Geology Section**
8	Areas classified as prime agricultural lands	Prime agricultural lands refer to lands that can be used for various or specific agricultural activities and can provide optimum sustainable yield with minimum inputs and development costs as determined by the Department of Agriculture	Not present within the project site.	Not applicable.
9	Recharge areas of aquifers	Refers to sources of water replenishment where rainwater or seepage actually enters the aquifers. Areas under this classification shall be limited to all local or non-national watersheds and geothermal	Not present within the project site.	Refer to **Hydrology Section.**

No.	ECA Category	Technical Description of ECA Category based on DAO 2003-30	Presence within the Project Site	Description (in aerial km)
		reservations.		
10	Water bodies characterized by one or any combination of the following: tapped for domestic purposes; within the controlled and/or protected areas declared by appropriate authorities; which support wildlife and fishery activities.	Water bodies shall refer to waters that are tapped for domestic purposes or those which support wildlife and fishery activities within declared protected areas, including the buffer zones.	Present within the project site.	The waterbodies near the site is an unnamed creeks Northeast and West of the MPSA tapped for domestic purposes. Refer to **Hydrology Section**
11	Mangrove areas characterized by one or any combination of the following conditions: with primary pristine and dense young growth; adjoining mouth of major river systems; near or adjacent to traditional productive fry or fishing grounds; areas which act as natural buffers against shore erosion, strong winds and storm floods; areas on which people are dependent for their livelihood.	Mangrove areas shall be characterized by one or any combination of the following conditions: - With primary pristine and dense young growth - Adjoining mouth of major river systems; - Near or adjacent to traditional productive fry or fishing grounds; - Areas that act as natural buffers against shore erosion, strong winds and storm floods; and - Areas on which people are dependent for their livelihood, pursuant to and taking into consideration *Republic Act 7161*, which prohibits the cutting of mangrove species.	Not present within the project site.	Not applicable
12	Coral reefs characterized by one or any combination of the following conditions: - With 50% and above live coralline cover; - Spawning and nursery grounds for fish; - Act as natural breakwater of coastlines	Characterized by one or any combination of the following conditions: - With 50% and above live coralline cover; spawning nursery grounds for fish; and act as natural breakwater of coastlines.	Not present within the project site.	Not applicable

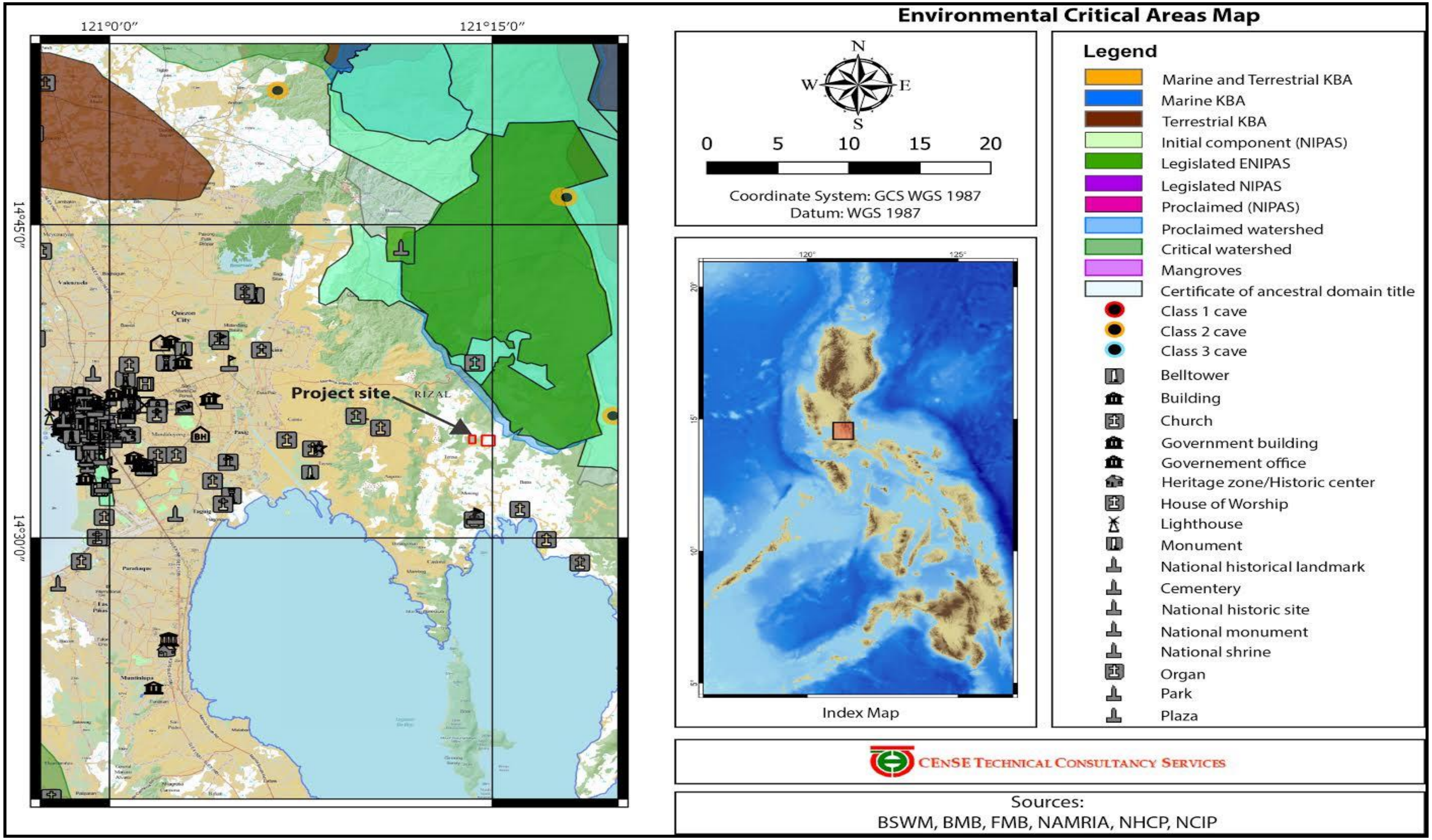


Figure 2-4 Environmental Critical Areas Map

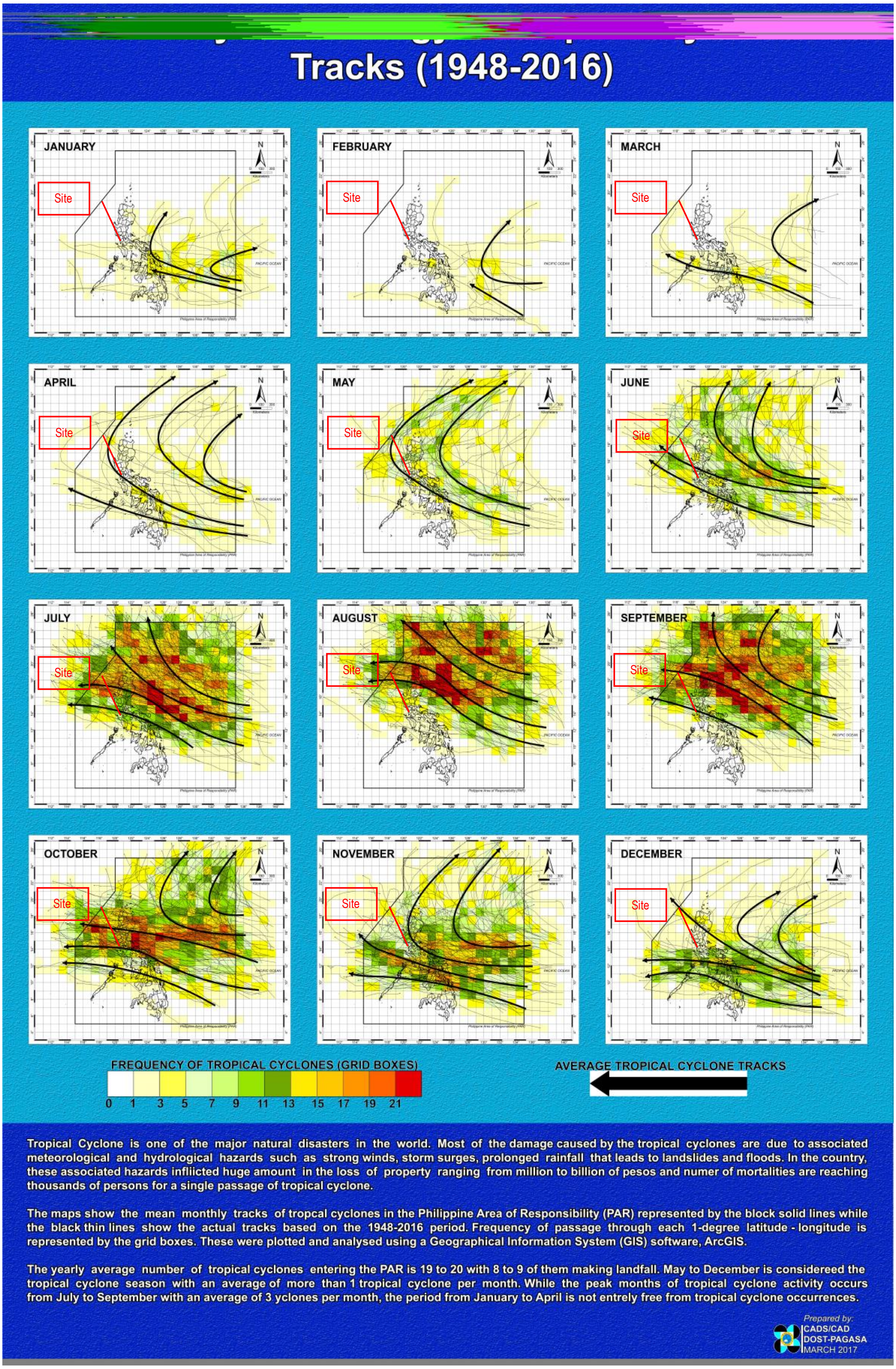


Figure 2-5 Typhoon Incidence Map of the Philippines

IMPACT ASSESSMENT AND MITIGATION

The quarry site may be potentially affected by ground movements caused by earthquakes, flooding and landslides. These projections along other geological hazards will be considered during the detailed planning and design stage.

In addition, quarrying involves extensive ground movement, and could cause disturbances to nearby creeks or tributaries going towards the river. Necessary measures will be taken to avoid this, like concentrating activities away from water sources, and providing proper drainage during torrential and heavy rains.

2.1.1.4 Impact In Existing Land Tenure Issue/s

Existing conditions

The Project covers the area within the Mineral Production Sharing Agreement (MPSA) denominated as MPSA-347-2010-IV amended located within the Barangays San Guillermo and Maybancal in the Municipality of Morong and Barangays Dalig and Bagumbayan in the Municipality of Teresa in Rizal Province.

MPSA 347-2010-IV was entered into and executed by and between the Philippine Government represented by the Department of Environment and Natural Resources (DENR) and Roxanna S. Go on June 25, 2010 and amended in 2017. It covers a total area of 114.5206 hectares contract area located in portions of the municipalities of Teresa and Morong, in the province of Rizal.

IMPACT ASSESSMENT AND MITIGATION

MPSA 347-2010-IV do not have any overlap with other mine tenements, Certificate of Ancestral Domain Titles (CADT) or Certificate of Ancestral Land Titles (CALT). Similarly, there are no Comprehensive Agrarian Reform Program (CARP) communities, Certificate of Ancestral Domain Claim (CADC) or Certificate of Ancestral Land Claim (CALC) other ancestral claims within or surrounding the project site as per MPDO and NCIP records.

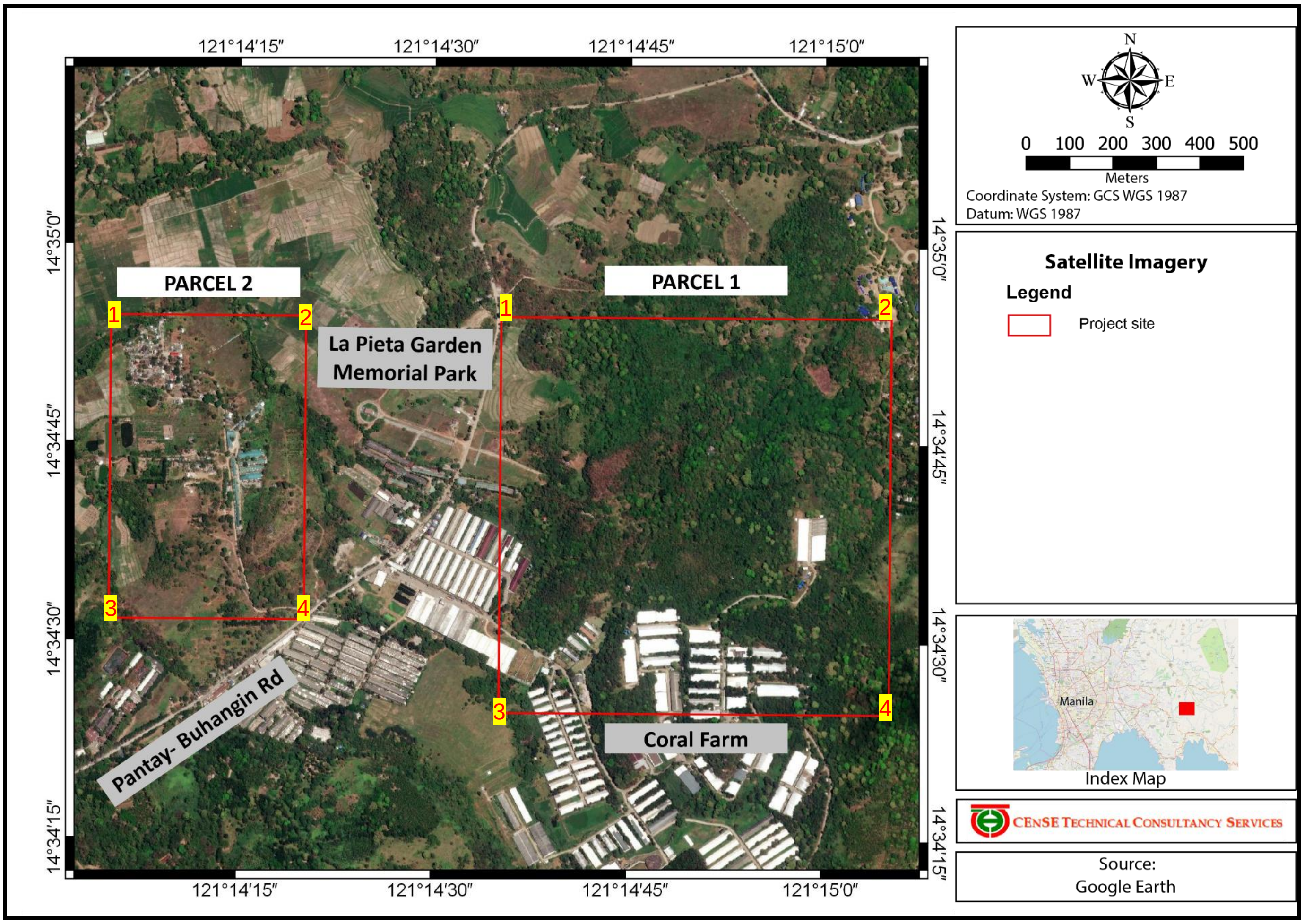
The proponent will continue to coordinate with key government agencies such as DENR and MGB to renew relevant permits. Potential overlaps with areas not covered by the existing MPSA will be secured through joint ventures or memorandum of understanding/agreements (MOU/MOA) with the legal owners or entities who have jurisdiction over the land parcels.

2.1.1.5 Impairment of Visual Aesthetics

Existing Conditions

The project site is located within the Municipalities of Teresa and Morong, Province of Rizal along the Pantay-Buhangin Road. The northern and eastern part of Parcel 1 is fronting several parcels of rain-fed rice farms. The western part is occupied by a private cemetery, the La Pieta. The succeeding area looking south is occupied by Coral Farm (livestock farm). In Parcel 2, the area is primarily covered with shrubs, grass and secondary growth of trees. Surrounding the area are parcels of croplands of rice and cassava.

The quarry area shall alter the existing topography of the area which is currently 120 masl for Parcel 1 and 90 masl for Parcel 2. The final land use with elevation of 92 masl and 76 masl, respectively, will be future farm lot project as presented Figure 1-23 for Parcel 1 and Figure 1-24 for Parcel 2 the preliminary schematic final land use plan.



Source: Google Earth Pro, Imagery Date: 10/13/2019

Figure 2-6 Aerial view showing MPSA boundaries

Photo 2a. *Perspective Facing South of Parcel 1: Livestock farm owned by Coral Farm.*

***Plate 2b**. Perspective Facing West of Parcel 2: Croplands planted in parts by cassava and rice.*

IMPACT ASSESSMENT AND MITIGATION

Pozzolan materials extraction requires quarrying, 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 proponent will maintain the project site's buffer areas. Figure 1-19 presents the section of Parcel 1 which shows the current elevation at 120 masl to target elevation of 92 masl while Figure 1-21 presents section of Parcel 2 shows the current elevation at 90 masl to target elevation of 76 masl.

Rehabilitation strategies and final land use based on the conceptual plan of the proponent is a farm lots as presented in Figures 1-23 for Parcel 1 and Figure 1-24 for Parcel 2. While the land impacted by the quarry will not be reverted to its original landform and use, consultations will be conducted with the stakeholders and further investigations will be conducted to determine the most feasible options to rehabilitate the area and convert these areas into landforms that will at least match the surrounding environment and will have alternative beneficial use.

2.1.1.6 Devaluation Of Land Value As A Result Of Improper Solid Waste Management And Other Related Impacts

Existing Conditions

There is no solid waste management system in place in the area as the major anthropogenic activities consists of agricultural activities.

Roxanna S. Go will be responsible for the management of the solid wastes. The proponent will implement the following waste management measures to comply with Republic Act No. 6969 and avoid contamination of land and water due to improper waste disposal:

- Strict implementation of rules and regulations on sanitation and waste disposal
- Provision of storage area for solid wastes and construction of a temporary MRF

Impact assessment and options for mitigation and/or enhancement

Contamination will be prevented through proper waste management and housekeeping measures (i.e. collection and containment of waste oil and lubricants from vehicles and equipment, strict implementation of solid and domestic waste management, strict containment and transport of hazardous wastes, and placement of disposal bins for biodegradable, non-biodegradable, and recyclable wastes in strategic locations within the mine development area).

2.1.2 Geology/Geomorphology

This section described the existing geology of the site and its immediate surroundings and potential geohazards that may affect the project. It also includes proposed mitigations for the identified significant adverse impacts.

Methodology

Secondary information for literature review and subsequent data interpretation are gathered from various sources. Discussions on the geology of the area are based on publications, technical reports and studies from the Mines and Geosciences Bureau (MGB) - Central Office and Roxanna Go.

Base maps for geomorphologic analysis were taken from the National Mapping Resource Information Administration (NAMRIA). Historical seismicity data were retrieved from the catalogue of PHIVOLCS-SOEPD (Seismological Observation and Earthquake Prediction Division) and the United States Geological Survey (USGS) while seismic hazard maps were adapted from PHIVOLCS- GGRDD (Geology, Geophysics Research and Development Division).

Maps adopted from various sources, such as NAMRIA, MPDO, PHIVOLCS, and MGB were imported into the QGIS Valmeira version software.

Geologic field surveys were conducted on August 11 and 25, 2019 to validate secondary information, document the existing geomorphology and geology, trace and identify geomorphologic and structural features, and conduct rapid geohazard assessment within the project site.

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

Existing Conditions

Geomorphology

The Province of Rizal is distinctly mountainous characterized by moderately- to highly-steep topography. It is bounded by several mountain ridges. From its north to south, a series of sloping ridges, hills and mountain ranges garnish most of the municipalities trending almost northward and attaining a maximum elevation of 1,469 -meters (Mt. Irid).

The gently rolling slopes comprises the Marikina River Valley, where water from higher elevations drains towards numerous rivers and tributaries at the southwestern portion of the region, elevations at these western lowlands ranges from 10 to 30 meters above sea level (masl). The western portion of the flatlands gently rises towards the east. These high elevations are drained by several major rivers, namely, Tanay, Puray, Teresa and Rodriguez Rivers. Generally, these rivers display dendritic to trellis patterns.

There were several land units that were identified on the basis of landform and rock materials as a result of both past and active geomorphological processes. The main features and spatial distribution of the different land units found in the vicinities of study area are as follows:

Lacustrine Landscape

This landscape is formed under the influence of the lake actions and mostly deposited with lacustrine materials. This unit is located in the lake front areas of Morong.

A. Narrow lake terraces

This unit includes the lake shore deposits and minor deltaic sandy deposits that form the lake terraces with lacustrine influence on a narrow strip of lakeshore along the lake periphery where inundation, sedimentation and recession processes are taking place as a consequence of deposition and lake action.

Alluvial Landscape

The general slopes of this landscape unit are level to gently sloping and most of the geomorphic features are commonly associated with rivers systems such as channel, scars and others. This landscape is subdivided into minor land units.

A. Minor alluvial plain
   This land unit is level to nearly level with meandering drainage pattern. This occurs mostly at the northern shore of Laguna de Bay.
B. Narrow mini-plain
   This unit is usually developed by artificially graded valley floor between hills. Slope varies from level to gently sloping collu-alluvial plain. This land unit can be seen at Teresa area.

Volcanic Foot Slopes

This landform was developed from mass movement of the transported materials on slopes under the influence of gravity without the aid of water or wind. This includes free rock falls to minor creep process on steep gradient. This unit is characteristic of land sectors going to Pinugay area.

A. Gently sloping volcanic foot slopes
   This unit falls under the denudational zone consisting of colluvial material, rotten rock and some boulders or hard rock outcrops. Slope range is nearly level to gently sloping. Elevation is from 30 to 80 meters above sea level.
B. Undulating slightly degraded tuffaceous plain
   This unit has a slope range of about 4 to 8 percent with subparallel drainage pattern. This unit is located at Parcel 2.
C. Undulating to rolling low tuffaceous plateau
   This land unit represents the lower plateau of the region. A big portion of the Poblacion and residential area is covered under this unit. Slope ranges from 5 to 15 percent.
D. Undulating to rolling hills and ridges with localized valleys
   This unit represents the low hills and ridges fringing the minor alluvial plain of Teresa. Elevation is 100 to 200 meters above sea level.
E. Undulating to rolling moderately dissected agglomerate plateau with concave slopes and convex ridges
   This unit represents the lower plateau along Morong Peninsula towards Talim Island with a slope ranging from 5 to 15 percent.

Volcanic Hills

This landform is subdivided into units. The main criteria in subdividing is according to slope, steepness, process activity and drainage dissection. This landscape ranging from low tuffaceous hills to very steep highly dissected upper hills.

A. Steep to very steep monoclonal agglomerate ridges
   This unit occurs on the southern most of Morong Peninsula area.
B. Low tuffaceous hills and ridges
   This unit represents northern to northeastern portion of Teresa and Morong. This is situated on the upper slope of the land unit alluvial fan terraces. Slope ranges from 8 to 65 percent.
C. Upper rounded hills and ridges
   This unit is found in the area closer to Pinugay which mostly the materials are shale. Slope gradient range from 15 to 40 percent.

In terms of slope, majority of the flat lands in Morong below 18 percent are concentrated on the central part of the municipality, while those with slopes above 18 percent are distributed along the borders of Brgys. Maybancal, Lagundi, Bombongan, San Jose and San Guillermo.

Meanwhile, forty eight percent (48%) of the total land area of Teresa has level to nearly level slope, 46.5% are undulating to rolling and 5.3% steep slope.

With regard to elevation, there is no area within Morong exceeding 200 meters above sea level. The north-to-northeast portion of the town has elevations ranging from 40 to 180 meters and the east to south portion has an altitude range of 2 to 40 meters. The rest have varying elevations from 10 to 120 meters.

Generally, the tenement of Roxanna S. Go is located in the western flank of the southern Sierra Madre mountain range (SSM). It is characterized by low relief with rolling topography. Several creeks and gullies in the area converge to the bigger Teresa River, draining into the Laguna de Bay. Based on the maps provided, the project area has gently sloping to rolling terrain ranging from 8-50% slope at elevations up to 170 meters. **Figure 2-7**, **Figure 2-8, Figure 2-9, Figure 2-10 and Figure 2-11** presents the topography, topography showing quarry limit, ground sectional profile, slope and elevation of the tenement and its vicinity.

IMPACT ASSESSMENT AND MITIGATION

The construction and development of the project will bring noticeable changes to the existing topography and surface landforms within the footprint of the project:

- The creation of new access roads that will serve as constructions routes will involve land grading and leveling of cleared roadways.

- A quarry pit will be developed to extract the pozzolan materials. The average working bench width is 20 meters with safety berm of about 2 m width, 0.5m height or half the diameter of the tire of the trucks used in the quarry operations. The bench height is between 10-12 meters. A 30 m buffer zone is provided to take care of the slope stability upon reaching the quarry limit.

- To minimize suspended solids in run-off during heavy rains, slopes will be protected with rock facing. Large boulders will also be placed along the toe line increase stability.

- Careful planning of mine development will ensure that only necessary disturbance will be made.

- An FMRDP will be prepared to provide an integrated approach in the geomorphic and topographic rehabilitation of disturbed land after mine closure.

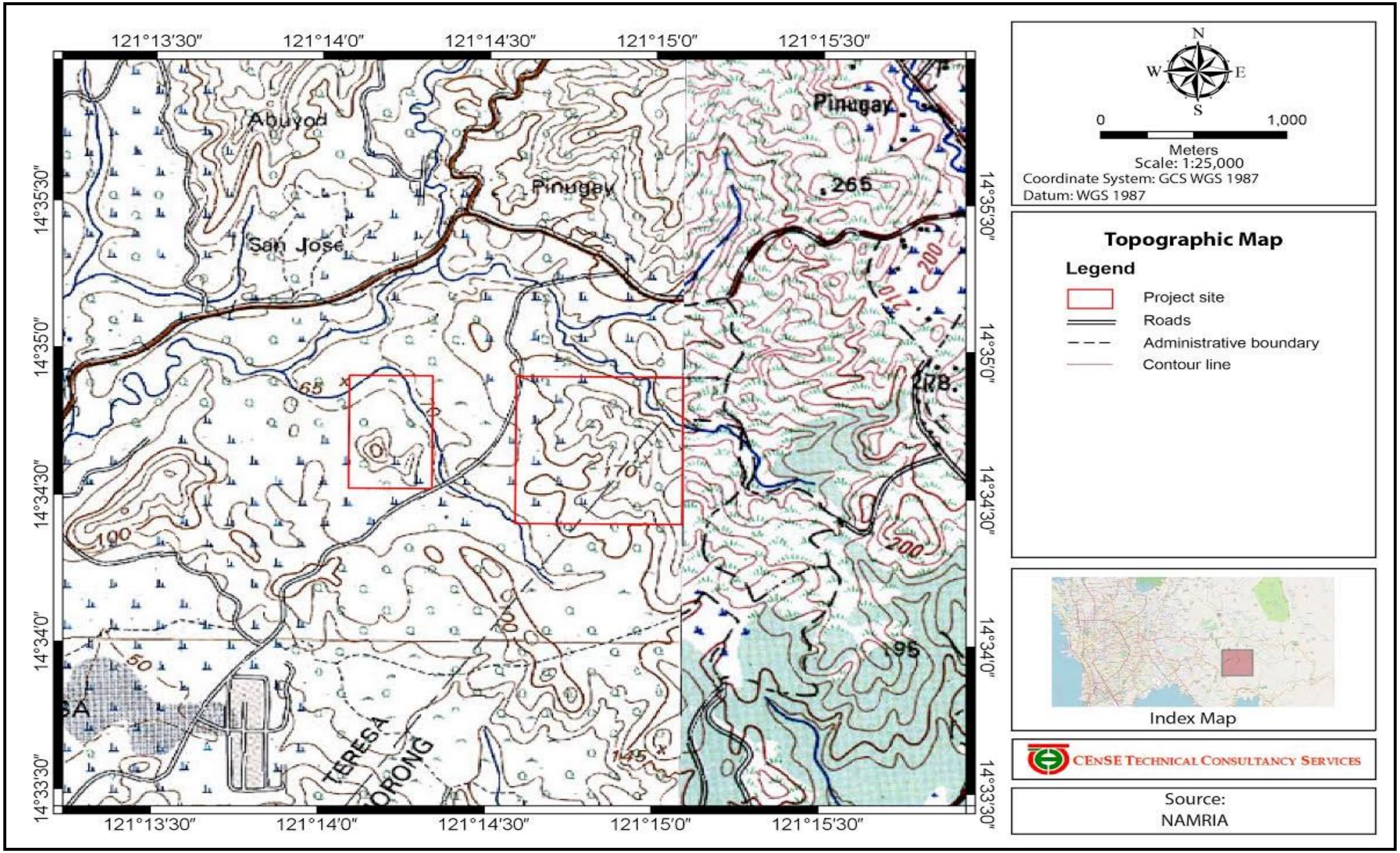


Figure 2-7 Topographic Map of the MPSA

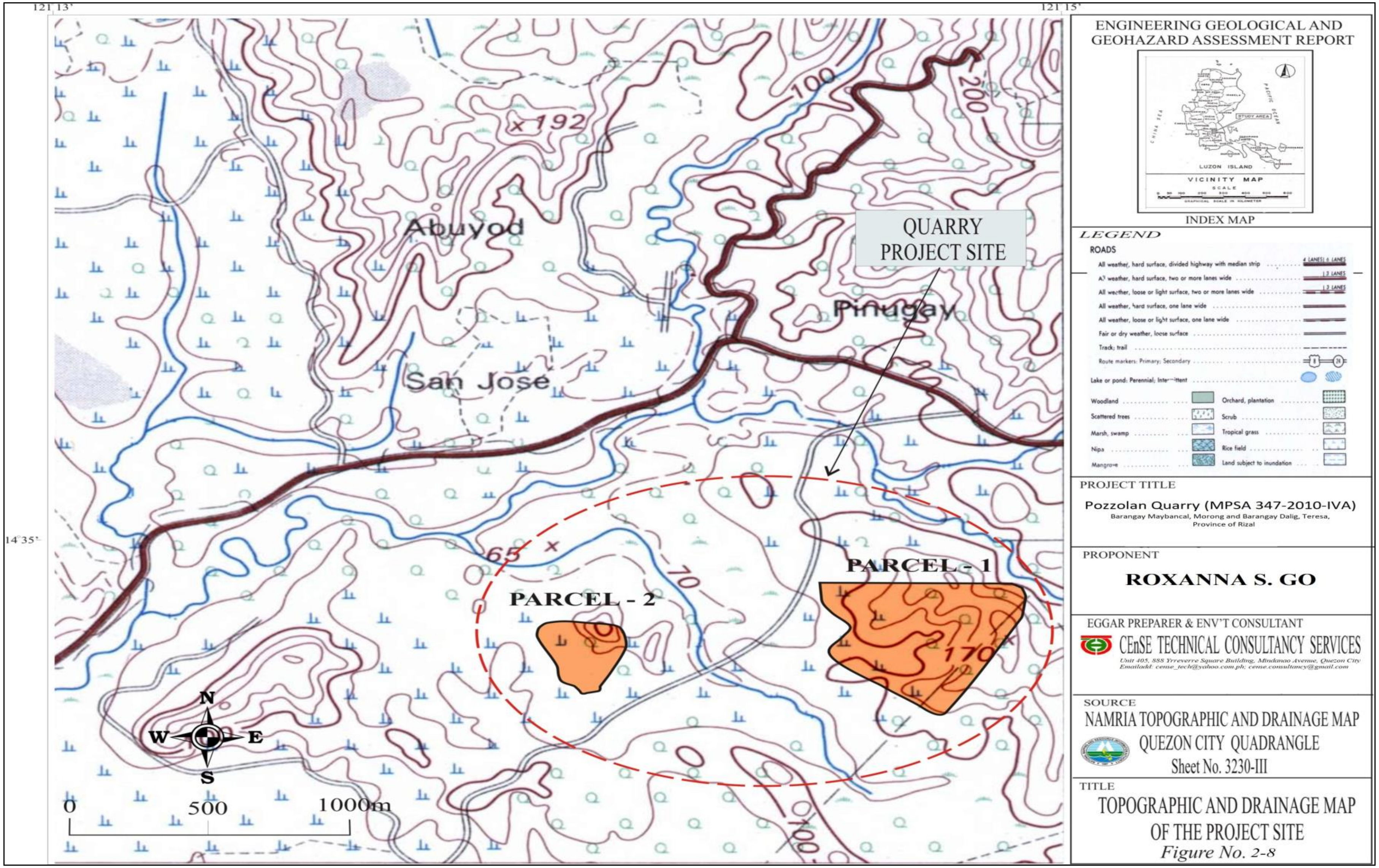
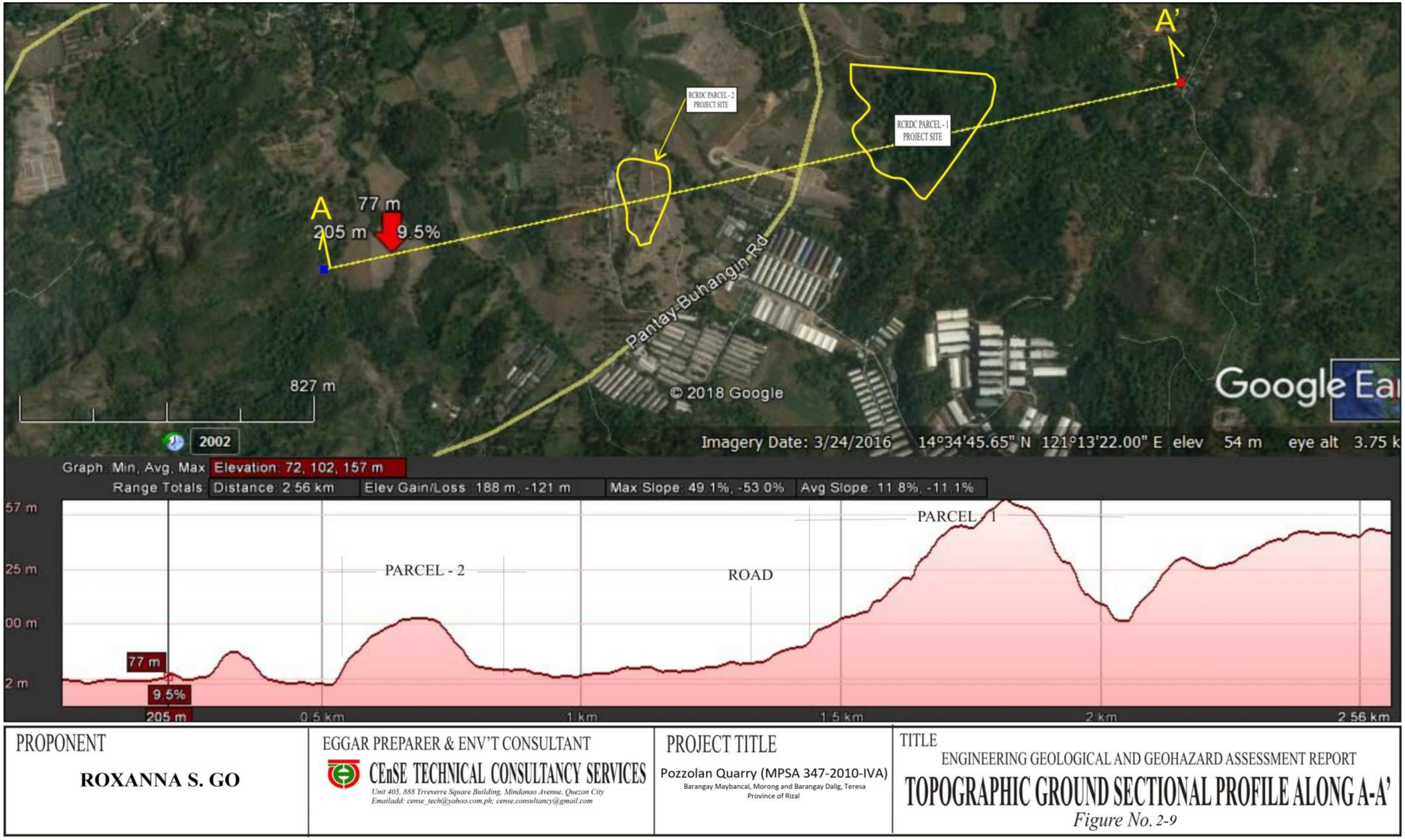


Figure 2-8 Topographic Map of the Quarry Limit for MPSA Parcel 1 and Parcel 2



Source: Google Earth Pro, Imagery date: 3.24/2016

Figure 2-9 Google Topographic Ground Sectional Profile

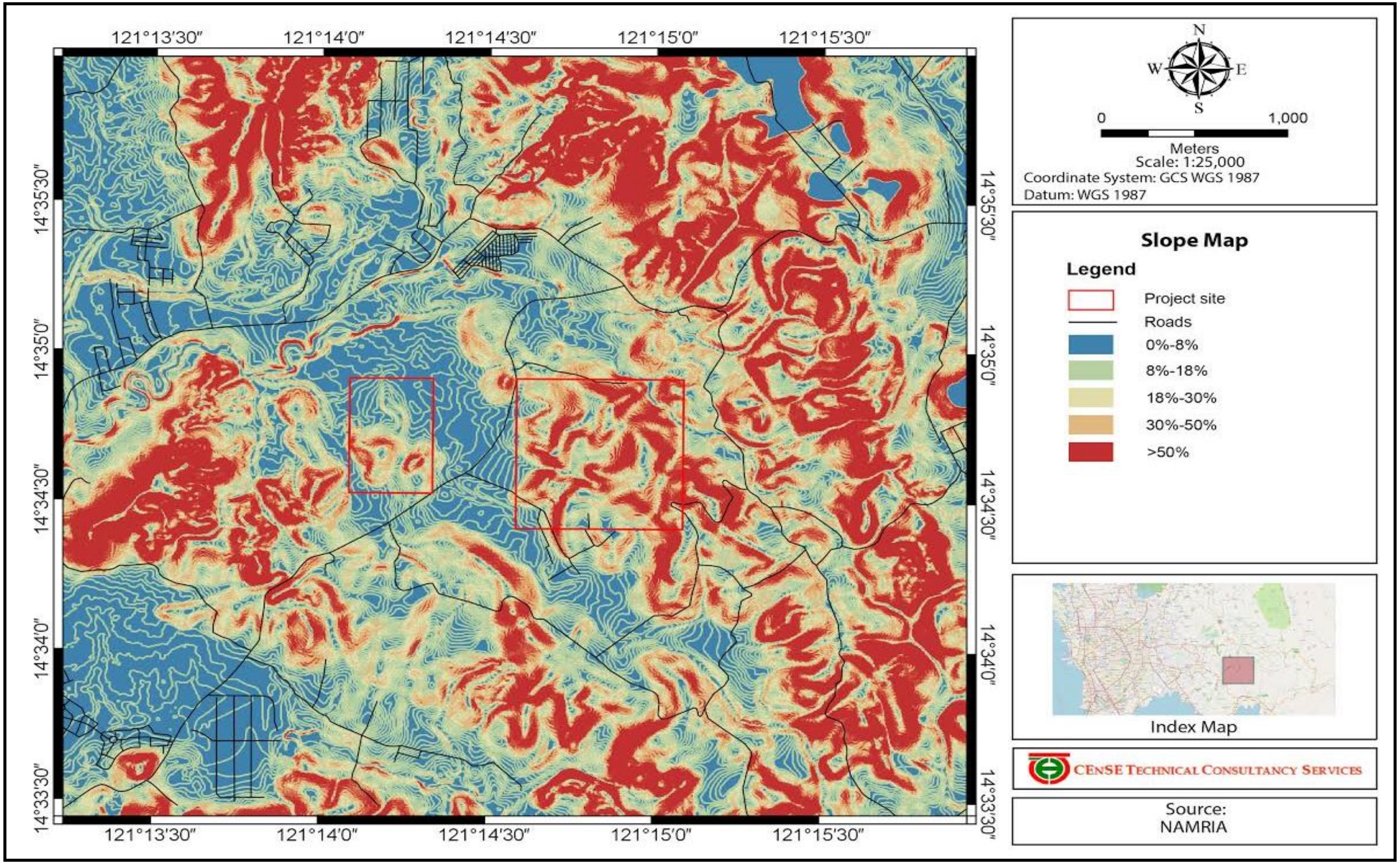


Figure 2-10 Slope Map of the MPSA

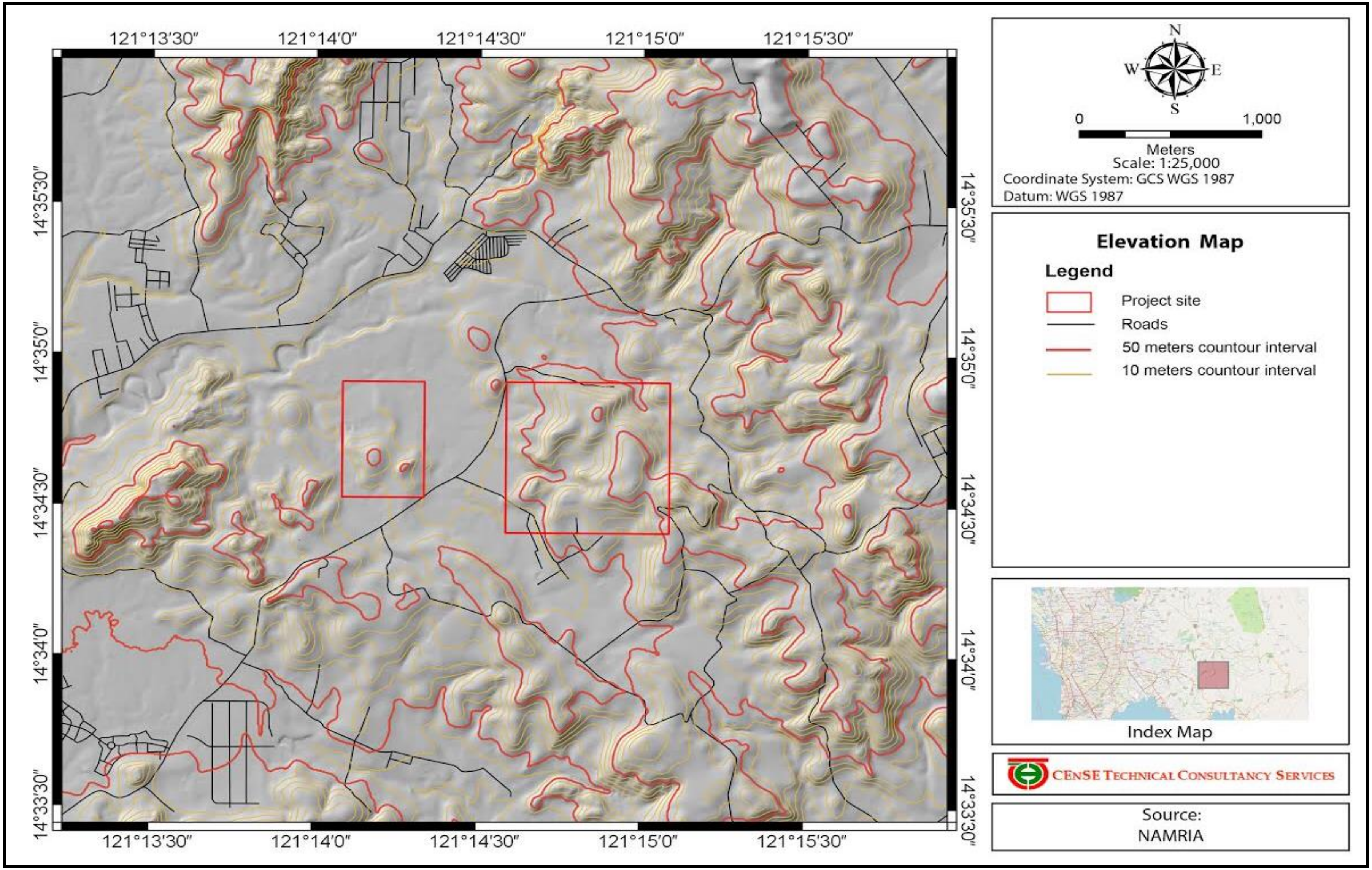


Figure 2-11 Elevation Map of the MPSA

2.1.2.2 Change in Sub-Surface Geology/Underground Conditions

Existing Conditions

Regional Geology

The oldest rock units within the province of Rizal consists of the Pre-Cretaceous metavolcanics in the vicinity of Daraitan, Tanay and the sheeted gabbro and pillow basalt in the Early to late Cretaceous Barenas-Baito Formation noted within the municipalities of Rodriguez, Cogeo, Taytay, and Angono. The Metavolcanics are overlain conformably by the upper Cretaceous Kinabuan Formation.

The Kinabuan Formation is typically exposed along Kinabuan Creek, North of Sta. Ines, Antipolo. It consists of a lower clastic sedimentary rock member and bedded limestone at the top. The clastic sedimentary rocks are thinly interbedded silty shales, mudstones, and medium to coarse-grained calcareous sandstone.

Conformable with the Kinabuan Formation is the Paleocene to Eocene Maybangin Formation typically exposed along Maybangin Creek in Tanay. This formation consists of two members; a limestone member called the Masungi Limestone and a clastic member. The limestone is massive to bedded and, in some places, recrystallized and was dated as of Paleocene to middle Eocene age. The clastic rocks are commonly shale, sandstone and chert with occasional interbeds of pyroclastic, volcanic and volcanoclastics.

The Antipolo Diorite intrudes the Maybangin Formation along the Antipolo-Teresa zigzag road. The diorite is also exposed in the vicinities of Sta. Ines, Tanay and Antipolo which was dated as Early Oligocene in age. The Antipolo Diorite is composed of hornblende diorite with minor quartz diorite, andesite dikes and hypabyssal intrusive.

The Binangonan Formation unconformably overlies the older rock units of Rizal province. This formation includes the Montalban Limestone, the Late Oligocene Binangonan Limestone and Teresa tuffaceous silt. Generally, the Binangonan Formation consists mostly of limestone with clastic sedimentary rocks.

The Angat Formation overlies the Binangonan Formation and Antipolo Diorite and is exposed in Puray, Wawa and Upper Mango Rivers in Rodriguez town and on a valley in Teresa. This formation consists of a minor lower clastic member and a major upper biohermal limestone member. The clastic member consists of basal conglomerate, sandstones, and thinly laminated calcareous to silty shale. The Angat Formation was dated as Early to Middle Miocene in age. Conformably overlying the Angat Formation is the Middle Miocene Madlum Formation which includes the Madlum Clastic, the Alagao Volcanic and the Buenacop Limestone.

The youngest formation within the province is the Pleistocene Laguna Formation. This formation is correlated to the Guadalupe Formation. Different facies of the Laguna Formation are the air fall tephra, welded and unwelded pyroclastic flows. The air fall tephra and lahar deposits are most widespread. This formation is extensively exposed from Antipolo towards the northern borders of Laguna de Bay.

Quaternary alluvial deposits cover the underlying rocks in Marikina valley and northern borders of Laguna de Bay.

Stratigraphy

The stratigraphic relationship of the various geologic formation occurring at and around the project site, together with their corresponding ages and description, is shown on ***Figure 2-12***. Based on such table, the Cretaceous Kinabuan Formation appears to be the oldest formation in the region and was intruded by the Antipolo Diorite during the Oligocene. The diorite body is overlain unconformably by the Angat Formation of Early Miocene age, which in turn conformably overlain by the Middle Miocene Madlum Formation. The Guadalupe Formation (which is the bedrock at the site) was deposited during the Pleistocene epoch and rest upon the Madlum with an unconformity between them. Recent alluvial deposits, or the so-called Quaternary Alluvium, are extensively developed in the coastal areas of Laguna de Bay, as well as along the floodplains of major streams. The various rock types underlain within the project area is shown in ***Figure 2-13.*** From the Geology and Mineral Resources of the Philippines, Volume 1 (BMG, 1982)***,*** the description of the various formations mentioned above re paraphrased below as follows:

Kinabuan Formation**:** is a flysch-like sedimentary deposits where the basal part of the sedimentary sequence is associated with underlying pillow basalts and basaltic breccias. The basalts represent the volcanic carapace of the ophiolite, whereas the pelagic sedimentary sequence constitutes the sedimentary cover of the Montalban Ophiolitic Complex. This sedimentary sequence consists of thinly interbedded silty shale and calcareous sandstone with tuffaceous and siliceous layers capped by steeply dipping thin beds of limestone. Outcrops of the Kinabuan can also be found in Tatlong K, Marcos Highway from Masinag to Foremost Farms, Pinugay (Philcomsat), Macaira, Sampaloc-Daraitan road and along Malinaw, Alas-Asin, Toyang and Mamuyao creeks. The sedimentary sequence of Kinabuan has an estimated thickness of 800 m. Although the formation has not formally been subdivided, it is clear that there is a lower volcanic member, middle sandstone-shale member and an upper limestone member.

Antipolo Diorite: The Cretaceous to Eocene sedimentary units intruded by diorite was designated by BMG (1981) as Antipolo Diorite, with type locality along the Antipolo-Teresa road. It is later renamed as Sta. Ines Diorite named by Antonio (1967) for the exposures at Mt. Masarat in barrio Sta. Ines, Tanay, Rizal. The diorite, which intrudes limestone and clastic rocks, is associated with pyro metasomatic deposits of iron ore. The diorite occurs as a stock measuring about 3 km along its length on the eastern and northeastern slopes of Mt. Masarat. A much bigger body, however, underlies Mt. Mayapa and Mt. Maon in Doña Remedios Trinidad and Norzagaray, Bulacan. Exposures of the diorite are also found around Mt. Retablo; at Putingbato and Kaybagsik, Antipolo; along upper Mangga Creek (tributary of Madlum River), Talaguio River and Ipunan Creek (tributary of Angat River), Singalong Creek and upper Maputi and Magsuong Rivers (Revilla and Malaca, 1987). The dominant rock type is medium to coarse grained hornblende diorite with local quartz diorite, gabbro and diabase facies. Diorite also occurs as dikes and sills intruding sedimentary rocks.

Angat Formation: This formation is composed of lower clastic facies and an upper limestone facies. The clastic facies, which comprise only a minor portion of the formation, consist of thin beds of calcareous shale and clayey sandstone with occasional lenses of sandy limestone and conglomerate. The limestone facies consist of an upper biohermal phase and a lower reef-flank-facies. The biohermal portion is white to buff, occasionally gray to pink, cavernous and partly crystalline. Skeletal remains of reef-building organisms, fragments of molluscan shells and bryozoan stems are abundantly associated. The lower bedded part is dominantly calcareous detrital and fine slime with interbedded fine siliceous materials.

Madlum Formation**:** The Madlum formation conformably rests on top of the Angat Formation. This rock unit is composed of sequence of shale, siltstone, wacke and conglomerate exposed along Madlum River close to barrio Madlum, San Miguel, Bulacan. They also included in this formation is the upper metavolcanic member of the Sibul Formation and upper tuffaceous member of the Quezon Formation of Corby and others (1951) exposed in the Angat River area. Madlum formation is subdivided into the Angat River Limestone, Alagao Volcanic and Buenacop Limestone members. Which are described below as follows;

Clastic Member: The Clastic Member is extensively distributed in an almost continuously exposed belt between Angat and Peñaranda rivers. It is a thick sequence of thin to thick bedded sandstone and silty shale with minor basal conglomerate and occasional limy sandstone interbeds. The sandstone is fine to medium grained, fairly well sorted, well-cemented and calcareous, with subangular to sub-rounded fragments of mafic rock detrita, quartz and feldspar cemented by fine clayey material. The shale, which occurs in thinner beds compared to the sandstone, is calcareous. The basal conglomerate is massive with well rounded cobbles and pebbles of mafic igneous rocks, chert and limestone dispersed in a coarse calcareous matrix.

Alagao Volcanic: The term Alagao Volcanics to designate the sequence of pyroclastic breccia, tuffs, argillites, indurated graywacke and andesite flows exposed in Alagao, San Ildefonso, Bulacan. The metavolcanic member of the Sibul Formation and the andesite-basalt sequence in the Rodriguez- Teresa area, Rizal, are included in this member. Generally, the rock unit is purplish gray in fresh surfaces but weathers into brick-red to purple shades. The pyroclastic breccia, the prevalent rock type, is massive and made up of angular to sub-rounded cobble to boulder sizes of andesite, basalt, chert and other volcanic rocks set in a matrix of andesite. The tuffaceous beds weather into bentonitic clay. The volcanic flows are massive, fine grained and vesicular. The vesicles are filled with calcite, chalcedony or chlorite. Along Bayabas River, the estimated thickness is about 175 m, although it could be thicker along Angat River further south.

Buenacop Limestone: The Buenacop Limestone was originally used by to designate the limestone sequence exposed at Barrio Buenacop, San Ildefonso, Bulacan with type section along Ganlang River. It also occurs as narrow discontinuous strips formed by a series of almost north-south aligned low ridges and several small patches between Sta. Maria and Sumacbao rivers. The limestone in the lower part is thin to medium bedded, crystalline, slightly tuffaceous, porous with numerous fragments of volcanic rocks, chert nodules, and detrital crystals of mafic minerals. This characteristic distinguishes it from the other limestones in the area. The upper part is massive, cavernous, with dispersed occasional andesite fragments, volcanic debris and fossils of reef-building organisms such as corals, algae, mollusks and foraminifera. Fossils indicate an age of Middle Miocene for this limestone member, which was probably deposited in a shelf area. The estimated thickness at the type locality is 150 m.

The Guadalupe Formation: This formation has two members: the lower Alat Conglomerate and the upper Diliman Tuff. The Alat Conglomerate is a sequence of poorly sorted, massive conglomerate, deeply weathered silty mudstone and tuffaceous sandstone. The well-rounded components of the conglomerate are mostly pebbles and small boulders of the underlying igneous rocks, Metamorphic and sedimentary rocks cemented by a coarse-grained sandy, calcareous matrix. The interbedded sandstone is massive to poorly bedded, fine to medium grained, loosely cemented and friable. The Diliman Tuff is thin to medium bedded and consists of fine-grained vitric tuff and welded volcanic breccias with subordinate amount of tuffaceous, fine to medium grained sandstone. Dark stubby minerals, apparently hornblende and small bits of pumiceous and scoracious materials are scattered all over the glassy tuff matrix.

Alat Conglomerate**.** The Alat Conglomerate was first mapped and named by Alvir (1929) after the marine littoral conglomerate exposed along Sapang Alat about 3 km north of the Novaliches reservoir near Novaliches town where it unconformably overlies Miocene lavas. The Alat consists of massive conglomerate, deeply weathered silty mudstone and tuffaceous sandstone. The most predominant rock type, the poorly sorted conglomerate, consists of well-rounded pebbles and small boulders of the underlying igneous, metamorphic and sedimentary rocks cemented by a coarse-grained, calcareous sandy medium grained, loosely cemented, friable and exhibits cross bedding. The mudstone is medium to thin bedded, soft, sticky, silty and tuffaceous. The maximum estimated thickness of this member is 200 m.

Diliman Tuff: The Diliman Tuff exposed in Diliman, Quezon City and large portions of Makati, Pasig, Paranaque and adjoining areas, consists of volcanic ejecta with subordinate amounts of tuffaceous, fine to medium-grained sandstone. It also underlies areas between Sta. Maria and Bulu rivers in Bulacan. Fossil plant leaves of the genus Euphorbliaceae, deer and elephant teeth, and bits of wood recovered in Guadalupe and Novaliches suggest a Pleistocene age. The whole sequence is flat-lying, medium to thin bedded and consists of fine-grained vitric tuffs and welded pyroclastic breccias with minor fine to medium grained tuffaceous sandstone. Dark mafic minerals and bits of pumiceous and scoriaceous materials are dispersed in the glassy tuff matrix. The thickness of the Diliman Tuff is 1,300-2,000 m. More recent work in the area suggests that the **Laguna Formation** of Schoell and others (1985) is equivalent to the Guadalupe Formation. Schoell and others (1985) defined several facies of the Laguna Formation, as follows: a) air fall tephra, b) pyroclastic flow deposits, c) lahars, d) stream deposits, e) lake deposits and f) basalt flows.

Quaternary Alluvium: This is made up of recent alluvial, fluvial deposits covering the underlying rocks along major rivers and in the coastal, flat lowland. It is composed of unconsolidated, unsorted silt, sand, pebbles, cobbles and small boulders derived from older, pre-existing rock types. This is the original surficial deposit at the site.

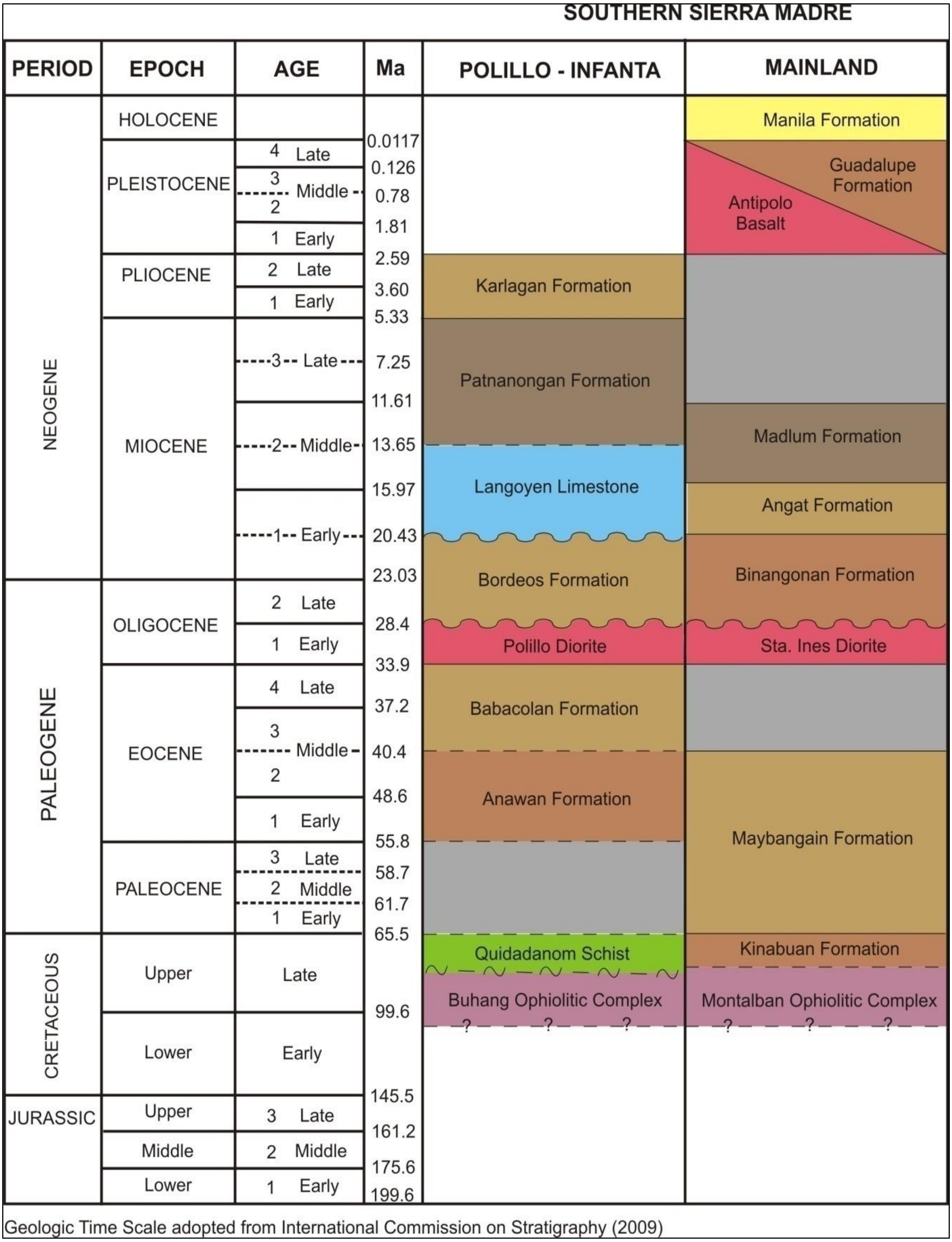


Figure 2-12. Stratigraphic Column of Southern Sierra Madre Mainland. Adapted after Mines and Geosciences Bureau-Geology of the Philippines, 2010

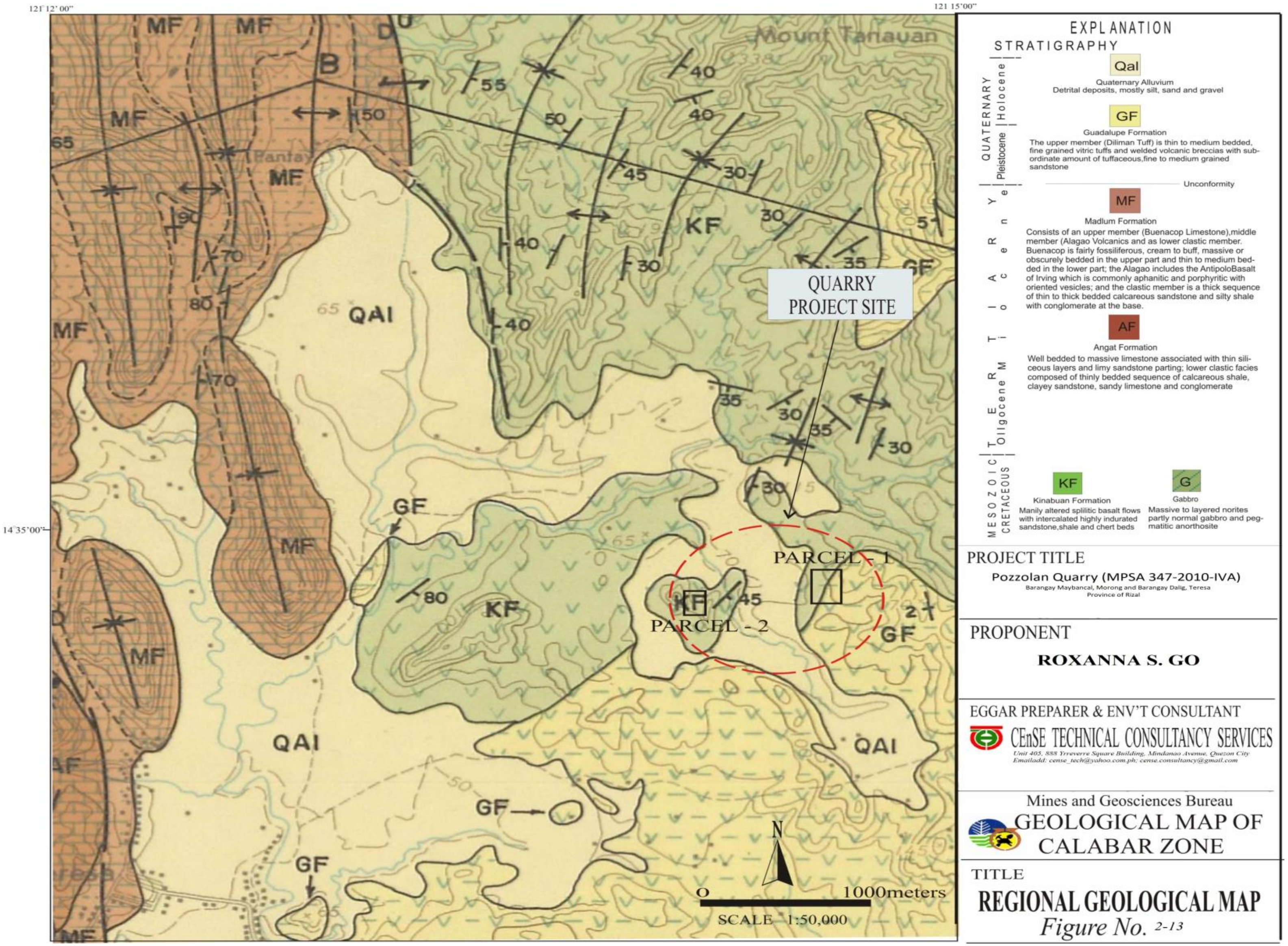


Figure 2-13. Regional Geologic Map

Tectonic Structures

Structures in the region are mainly influenced by the subduction of the Philippine Sea Plate (PSP) along the Philippine Trench in the east, and by the Philippine Fault in the west. Fold axes of synclines and anticlines are oriented north-south. The major faults in the region are represented by a segment of the Philippine Fault and the Valley Fault System.

The segment of the Philippine Fault that traverses southern Luzon runs almost north-south offshore parallel to the coastal strip of Quezon province. The Valley Fault System consists of two northeast trending strike-slip faults that are well demarcated along the edges of the Marikina Valley.

Mapped at around three (3) kilometers northeast of the MPSA is a northwest trending 5.1 km unnamed active fault. **(Figure 2-15)**

Site Geology

The site is primarily underlain by the Diliman Tuff member of the Guadalupe Formation. ***Figure 2-14***. The member unit is composed of fine grained vitic tuffs and welded pyroclastic breccias, with minor fine-grained to medium-grained sandstones. Pumiceous and scoriaceous materials are dispersed in the glassy tuff matrix. This layer is overlain by the Manila Formation which is composed of unconsolidated clay, silt, gravelly sand and tuffaceous silt.

The tuffs are generally flat lying and apparently thick. Stratigraphically, below are conglomerates alternating with medium grained sandstone. The constituents of the sedimentary rocks are derived mostly from volcanic materials.

Mesoscopic examination of tuffaceous unit reveals glassy and it consists of light grayish to light brownish welded masses of pumiceous matrix embedded with scattered various sizes of scoria. The material retained much of tiny vesicles suggesting rapid cooling upon ejection from a volcanic source.

In addition, rocks of Kinabuan Formation exposed within the MPSA consist of an alternation of shale, mudstone, siltstone and sandstone. The shales, mudstones and siltstones are greenish white to greenish blue, slightly metamorphosed, well indurated and siliceous. The sandstone is cream, fine-grained, slightly oxidized and weathers to brownish clayey material. Slightly folded beds and a large number of faults and joints were observed, Photos 2c and 2d represents the present outcrops.

Outcrop Photos

Photo 2c. *Outcrop consist of alternating siliceous clastic (shale, mudstone, siltstone, sandstone) exposed north of Parcel 1*

Photo 2d. *Tuffaceous sandstone-siltstone and underlying breccia units outcropping within Parcel 1.*

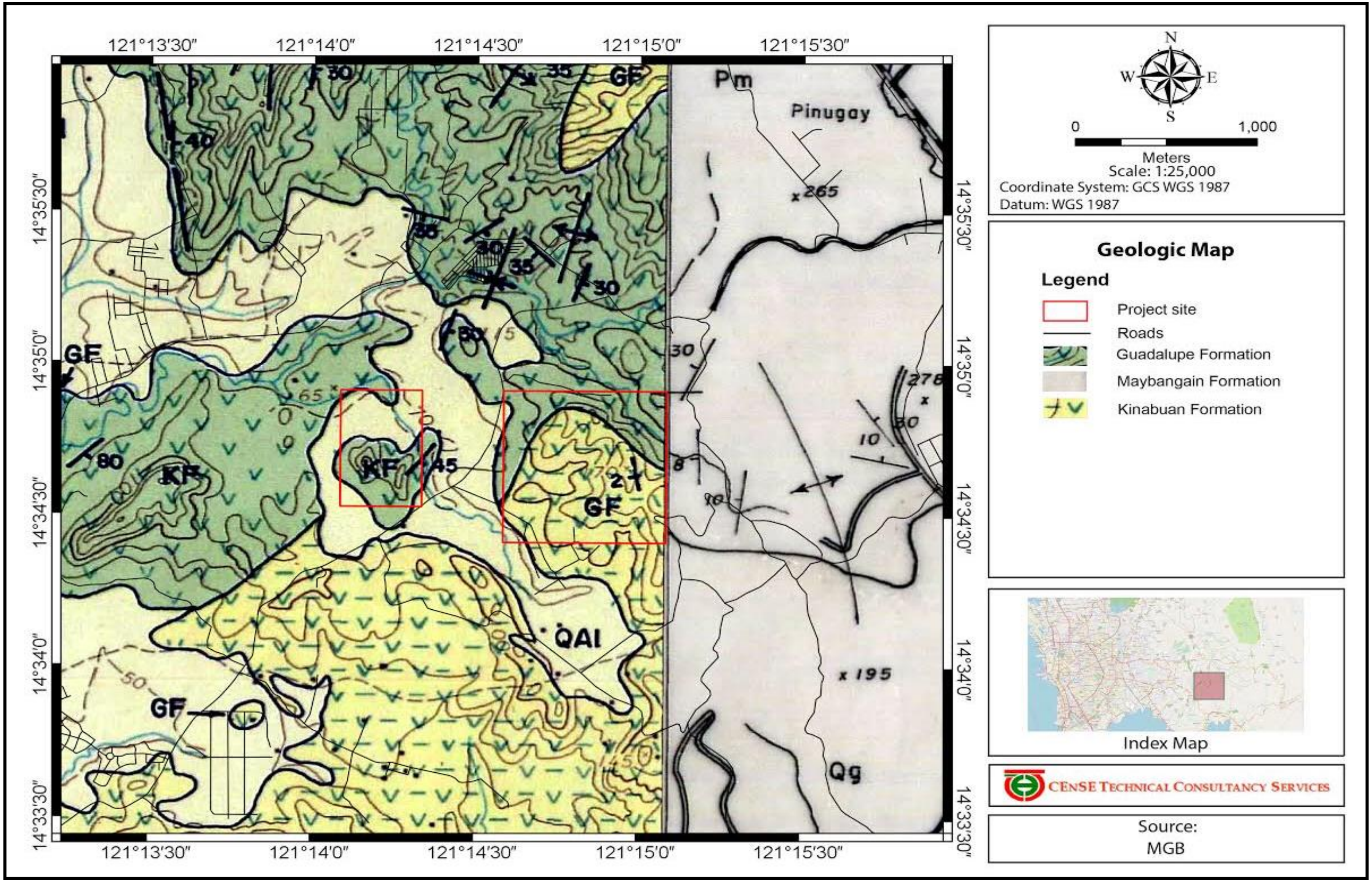


Figure 2-14 Geologic Map of the MPSA

IMPACT ASSESSMENT AND MITIGATION

Aside from the noticeable changes the project will bring to existing surface conditions of the geophysical environment of the project site, underground conditions will also be impacted by the construction and operation of the different quarry components:

- Excavation works for the development of the quarry pit and the siltation ponds as well as construction works for foundation-laying of the other quarry components, exposes buried geologic materials to the surface. This increases vulnerability to oxidation, solar radiation, hydrolysis, etc. which could alter the chemical and mechanical properties of the substrate.

- The development of the quarry pit, siltation ponds will alter underground distributions within the immediate vicinity of these components. The formation of a void resulting from pozzolan extraction in the pit builds up release in the direction of the void, increasing the risk of slope failure.

Progressive and systematic land stripping or excavation would minimize exposure of the soil or rock to the elements. Rock and soil piles using that will be subsequently used for slope rehabilitation or vegetation cultivation will be protected to preserve quality.

In the construction of quarry components, buried pipelines or lined access roads, materials different from the original substrate will be introduced to the ground. To minimize risk of contamination or chemical alteration of the soil or rock, appropriate materials will be used for these components. These materials will be carefully selected to make sure that these are able to withstand stress conditions on the ground so incidences like leakage or seepage of contaminants will be prevented.

Benches with appropriate heights and slope angles will be maintained to prevent failure. When deemed necessary, the installation of slope stabilization fixtures such as shotcrete, geotextile, weep holes, gabions, etc. will be considered. Dewatering pumps and runoff canals and galleries will be installed to control water accumulation inside the quarry pit.

2.1.2.3 Inducement of Subsidence, Liquefaction, Landslides, Mud/Debris Flow, Etc.

The Philippines is one of the most natural hazard prone countries in the world. The social and economic cast of natural disaster in the country is increased by population growth, change in-land use patterns, unplanned urbanization, environmental degradation and global climate change. The impact of climate change is considered to be one of the current pressing issues in the country. Some these impacts include increased in the frequency and severity of natural disasters, sea level rise, extreme rainfall, global warming, resource shortage, and environmental degradation (USAID, 2017). This hazard resulted in gradual if not have serious effects in water, energy, infrastructures and human health.

Geohazards

Existing Conditions

The existing conditions to assess the impacts were discussed by presenting the potential geohazards that may affect the project and the site.

Earthquake-Related Hazards

The most prominent geohazard recognized in the project site and vicinity is the seismic hazard (**See Annex H.1: Earthquake Hazards Assessment from PHIVOLCS-GGRDD**) due to the presence of active faults such as the following ***(Figure 2-15)***:

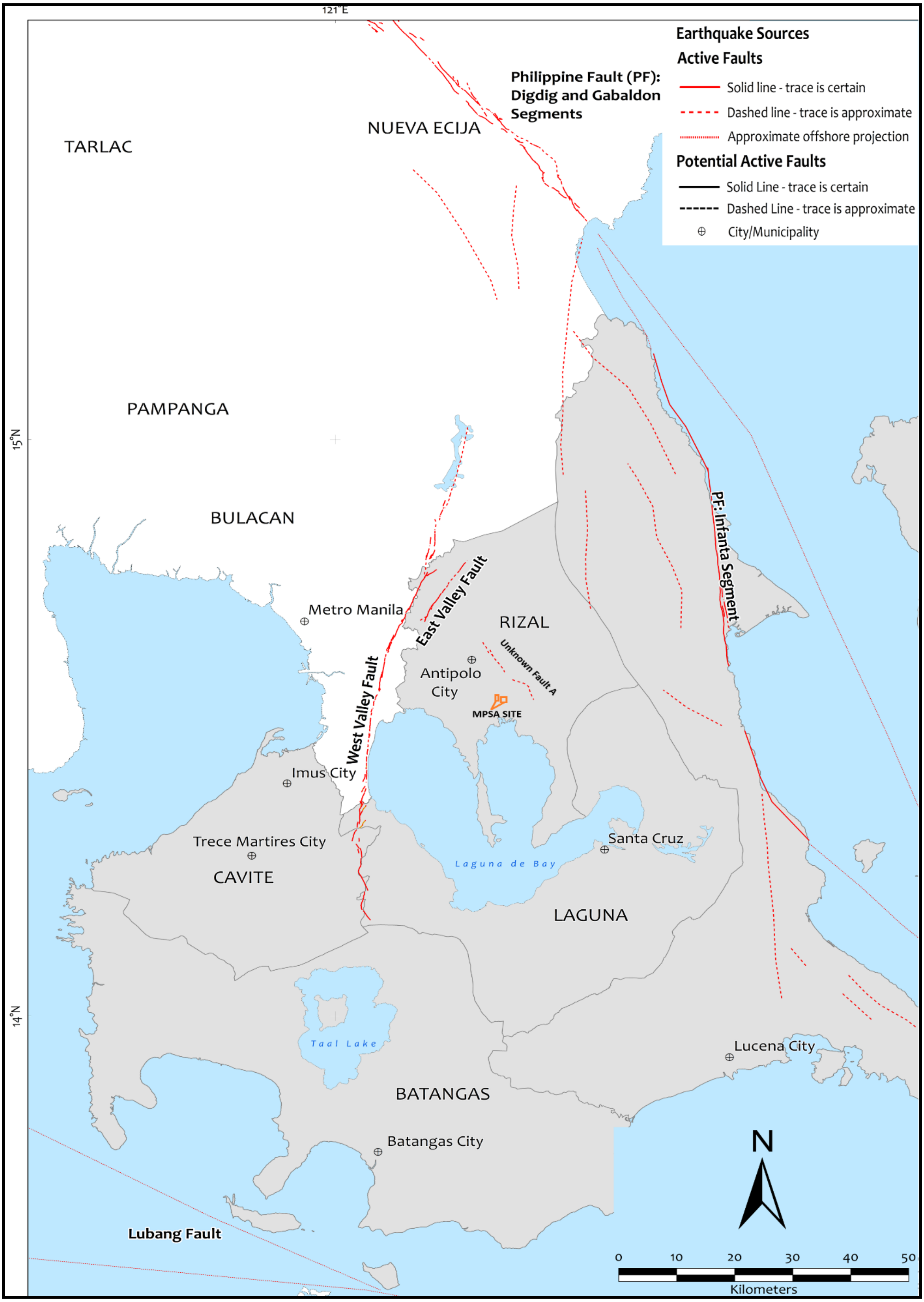
- **Unknown Fault:** 2 aerial-km northeast of site
- **East Valley Fault:** 16.7 aerial-km north-northwest of site
- **West Valley Fault:** 20 aerial-km west of site
- **PF-Infanta Segment:** 30 aerial-km east of site
- **Manila Trench:** 200 aerial-km west of site

The possibility exists that a strong, near surface earthquake may be generated from the above faults and may cause some impact to the tenement and vicinities. This is considered in the hazard assessment under Ground Acceleration. Other earthquake related hazards such as ground shaking, ground rupture, liquefaction, and subsidence, and their direct impact on the project site are discussed in the succeeding sections.

In the past, the Seismological Observation and Earthquake Prediction Division of the Philippine Institute of Volcanology and Seismology (PHIVOLCS-SOEPD) have recorded multiple minor, light, moderate and strong earthquakes within and surrounding the area.

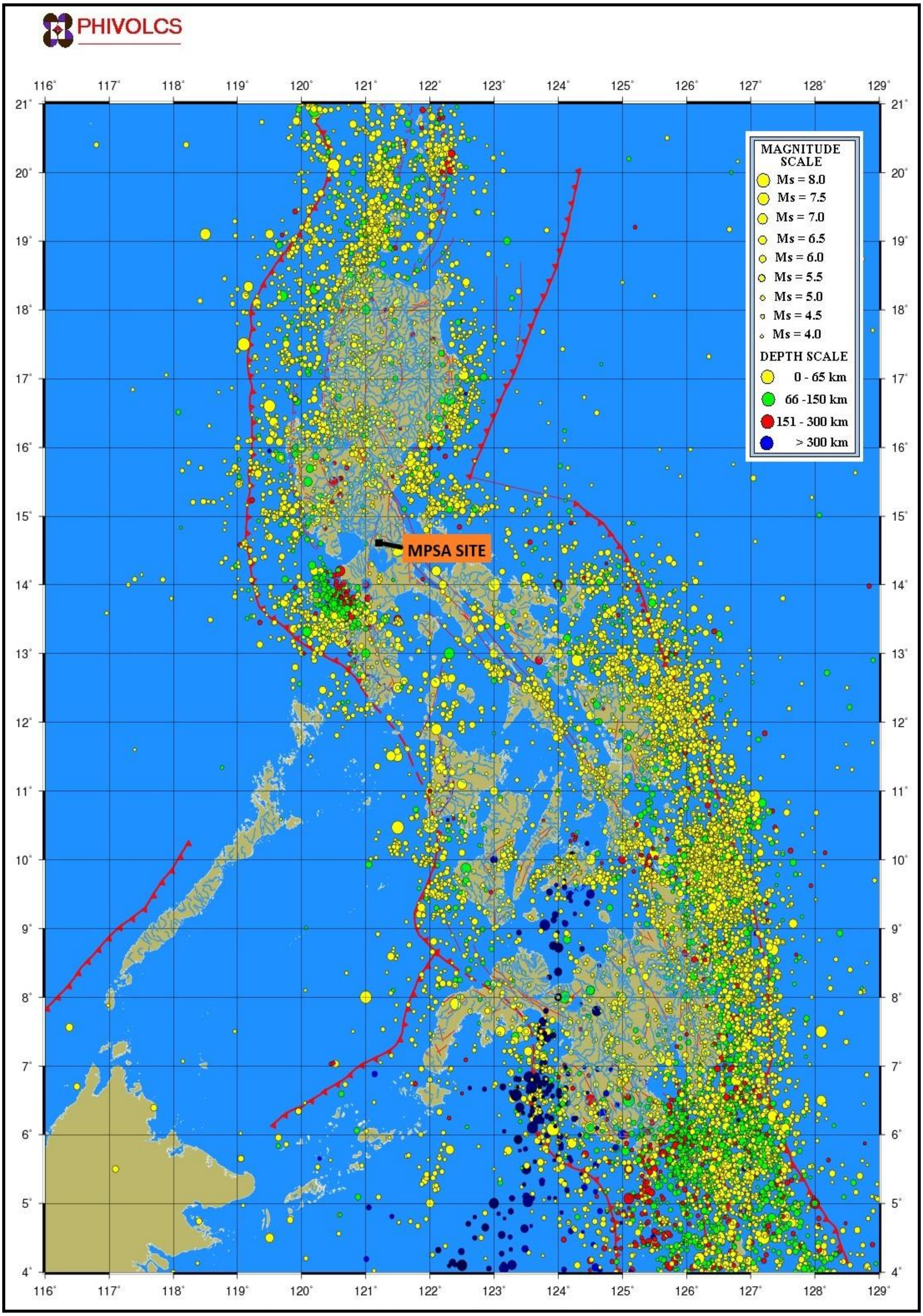
Figures 2-16 and ***2-17*** show historical earthquake locations from 1907 to 2016 with magnitude greater than 4.0 and above in the Philippines and the Province of Rizal.

Figure 2-18 shows the Philippine earthquake density map generated by the USGS- Global Seismic Hazard Assessment Program (USGS-GSHAP) and PHIVOLCS-SOEPD which shows the average annual occurrence of >M5.0 events over 100 km by 100 km parcels throughout the Philippines, from 1973 (oldest instrumental seismicity records available) to the present (USGS NEIC; PHIVOLCS-SOEPD). In Rizal, the map indicates an average of 0-1 greater than M5.0 earthquake events have occurred yearly for the past 40 years. This range represents the lowest density of earthquakes anywhere in the Philippines within a year.



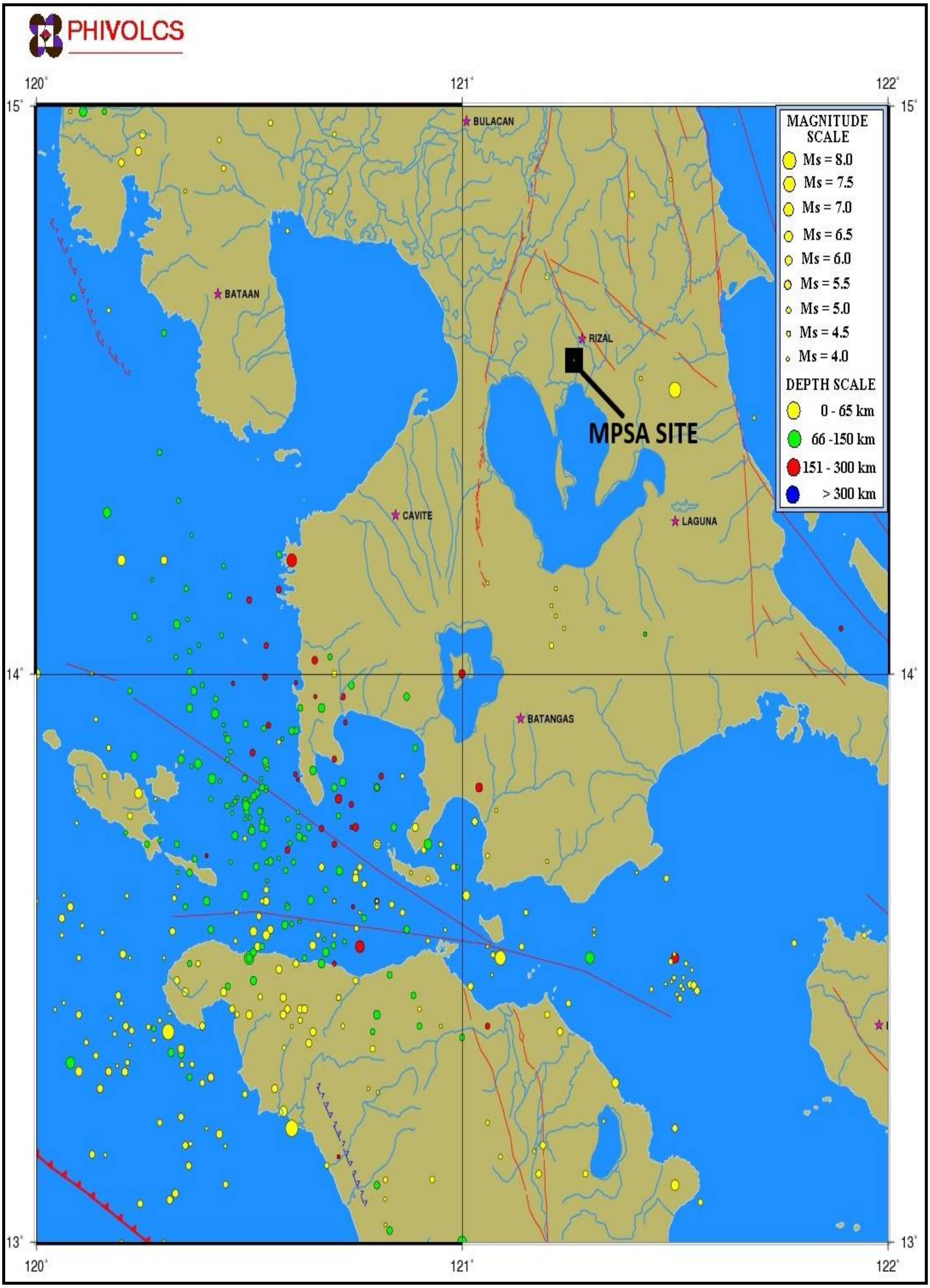
Source: PHIVOLCS

Figure 2-15 Active Faults Map of Region 4A



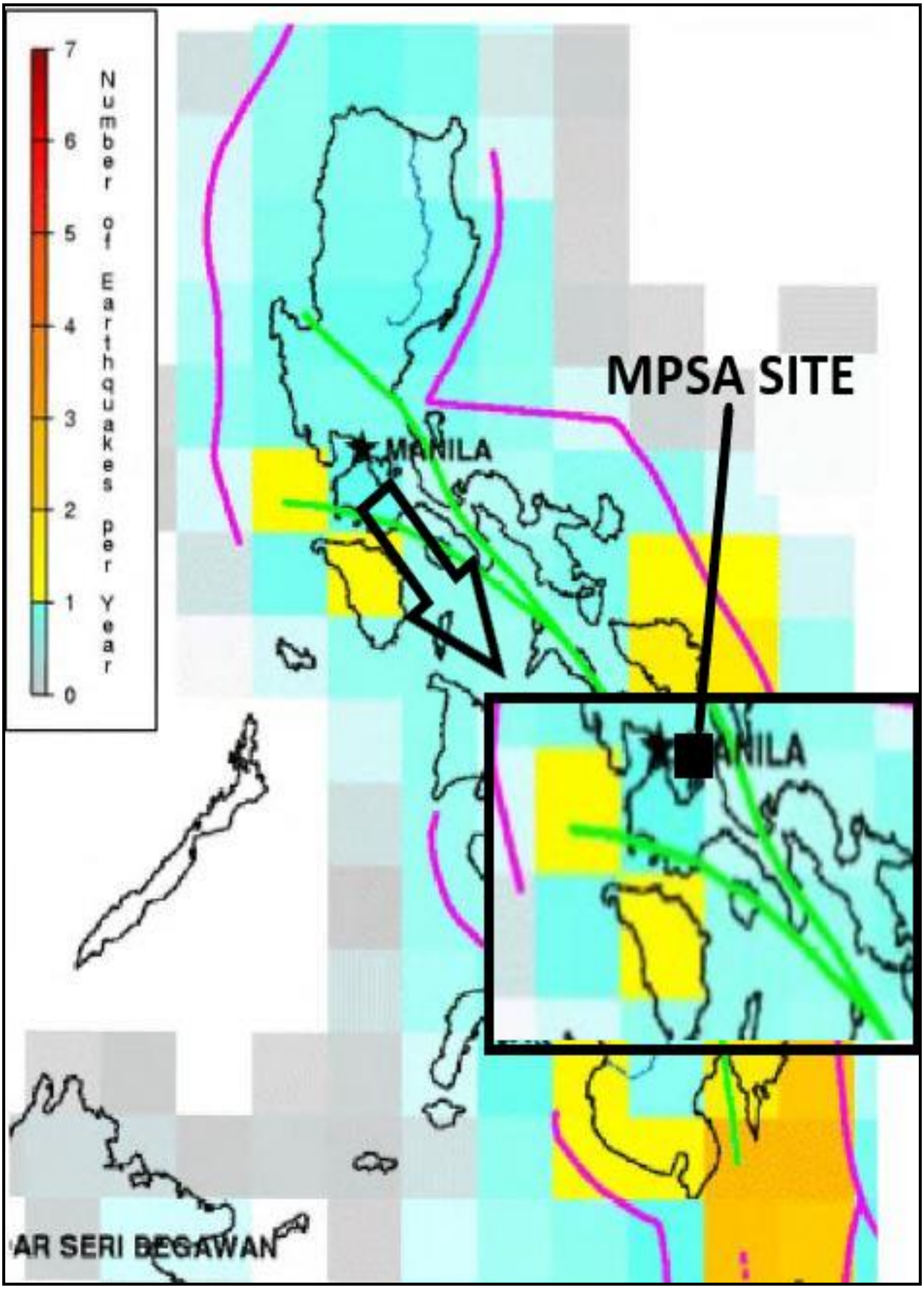
Source: PHIVOLCS-SOEPD

Figure 2-16 Seismicity Map of the Philippines 1907-2016 Magnitude 4.0 and above



Source: PHIVOLCS-SOEPD

Figure 2-17 Seismicity Map of Rizal 1907-2016 Magnitude 4.0 and above



Source: USGS-NEIC; PHIVOLCS- SOEPD

Figure 2-18 Earthquake Density Map of the Philippines

Ground Acceleration

The ***peak acceleration*** is the largest increase in velocity recorded by a particular station during an earthquake. It is the measure of how hard the earth shakes at a given geographic point. Moreover, areas with expected PGA values higher than 0.4 are classified as very high damage risk zone as per National Structural Code of the Philippines (NSCP), 2015.

For the Unknown Fault northeast of the site and the Infanta segment of the Philippine Fault, a probable M7.0 was assigned, M7.2 for the two segments of the Valley Fault System and the Manila Trench correspondingly. A method of calculating aseismic design value is the deterministic approach using the attenuation relationship equation developed by Fukushima and Tanaka in 1990. A design earthquake is assumed to occur at a point along the causative fault that is nearest to the site. Since this formula calculates peak acceleration at the surface, correction is required when this formula is applied to estimating ground motion on bedrock. Correction factors are applied to the mean peak acceleration depending on the type of foundation material: rock, 0.6; hard soil, 0.87; medium soil, 1.07; and soft soil, 1.39. The results of the computation of peak ground acceleration is summarized in **Table 2-5**.

The ***Deterministic Method*** developed by Fukushima and Tanaka (1990) was used to assess the worst-case scenario of ground shaking:
$Log10A = 0.41M – \log_{10} (R + 0.32 \times 10^{0.41M}) – 0.0034R + 1.30$

Where: A = mean peak acceleration (cm/sec2)
R = shortest distance between site and fault (km)
M = surface-wave magnitude

Table 2-5. Peak Ground Acceleration Values based on Fukushima and Tanaka (1990)

Seismic Source			g	Calculated PGA (g) Values				A (cm/sec²)
Fault	Magnitude (M)	Distance (km), R		g Rock	g Hard Soil	g Medium Soil	g Soft Soil	
Unknown Fault	7.0	2	0.577	0.346	0.502	0.617	0.802	566.104
East Valley Fault	7.2	17	0.349	0.210	0.304	0.374	0.485	342.565
West Valley Fault	7.2	20	0.320	0.192	0.278	0.342	0.445	313.980
PFZ: Infanta Segment	7.0	30	0.222	0.133	0.193	0.237	0.308	217.695
Manila Trench	7.2	200	0.017	0.010	0.014	0.018	0.023	16.323

For a M7.0 earthquake along the Unknown Fault which is approximately 2 kilometers away from the MPSA site, calculations resulted to a peak ground acceleration of 566.104 cm/sec^2 and an aseismic value of 0.577 g. On the other hand, for a magnitude 7.2 earthquake, whose trace to the MPSA site is approximately 17 and 20 km away, resulted to a peak ground acceleration of 342.565 cm/sec^2 and 313 cm/sec^2, the aseismic values are 0.349 g and 0.320g. The seismic source the Infanta Segment of the Philippine Fault which can generate a magnitude 7.0 earthquake, with a distance of about 30 km from the project site, resulted to a peak ground acceleration of 217.695 cm/sec^2 and an aseismic value of 0.222 g. Likewise, the Manila Trench which is 145 kilometers away has resulted to an aseismic value of 0.017 g.

Based on results derived from the computation (**Table 2-5**), average peak ground acceleration values computed for a M7.0 MCE generated by the Unknown Fault can potentially generate the strongest shaking in the project area site ranging from 0.346 (rock) to 0.802 (soft soil) *g*. Historically though, the Infanta Segment of the Philippine Fault is the nearest tectonic structure with documented activity, and computation using formula results in potential 0.133 (rock) to 0.308 (soft soil) *g* shaking from a M7.0 MCE event. The pga values indicate that tectonic activity in the area is very low. Peak horizontal acceleration amplitudes in rock, medium soil and soft soil for the Philippines. Acceleration values have a 10 percent probability of exceedance in 50 yrs, ***Figure 2-19.***

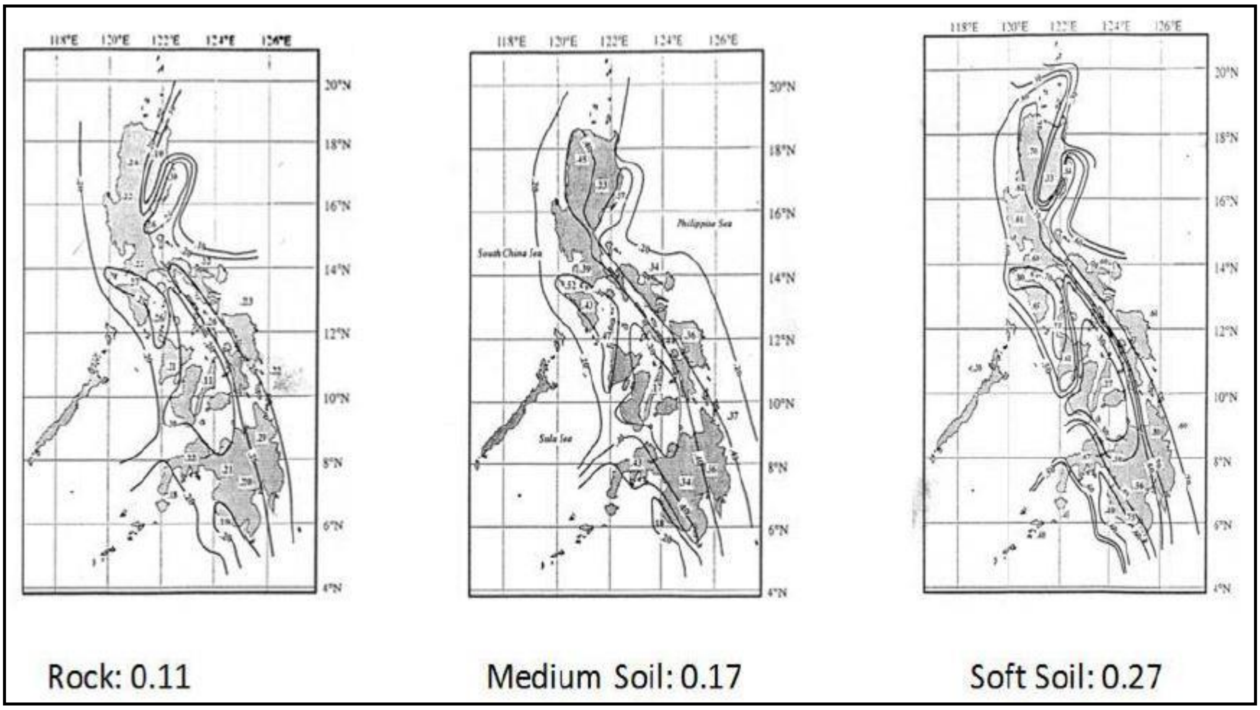


Figure 2-19. Peak Horizontal Acceleration Amplitudes of the Philippines. Modified after Thenhaus, 1994.

Ground Shaking

Ground shaking is caused by seismic waves and is the primary hazard associated with earthquakes. During large earthquake events, seismic waves can either radiate underground as body waves, or move aboveground as surface waves. Typically, the ground motion felt in earthquakes are body waves, which are described as the kind of shaking where furniture moves laterally and unstable objects fall to the ground. Even more destructive are surface waves, wherein ground moves in a wavelike manner, briefly changing the shape of the surfaces they pass through, resulting in extreme damages (Punongbayan and Torres, 1990).

The most serious direct effect of an earthquake in terms of buildings and structures is ground shaking (F.G. Bell, 2002). In this aspect, the ground conditions, such as the surface and bedrock geology, of the foundation of the buildings must be investigated. Previous studies have found out that earthquake intensities vary in areas which have different geology. The intensity decreases in areas where harder rocks, such as granite and basalt, are prevalent. Conversely, the intensity increases in areas where loose and wet sediments are common.

Susceptible are the steep and moderate slopes few kilometers away from the site, while the lowland plains where the project area is located has no present risk to ground movements except for minor shaking that pose no direct hazard to structures and buildings.

Figure 2-20 shows project area and vicinity in relation to the maximum ground shaking scenario of the fault systems in the region generated by PHIVOLCS. The site falls under PEIS Intensity VIII: destructive ground shaking.

Ground Rupture

A ground rupture occurs along a fault that cuts through the surface. Depending on the type of fault, this rupture may have a vertical, horizontal, or oblique displacement that is likely to cause considerable damage to structures built on it. The amount of displacement and length of rupture depends on the earthquake magnitude, distance of site from the fault or fault zone, and ground conditions.

The project site is blanketed by thick residual soil cover followed by units of marl and moderate to highly weathered limestone. Although apparent ground rupturing and tension cracks caused by strong earthquakes in the past were not observed at the site, any strong earthquake related to the segments of the Valley Fault System and nearby Unknown Fault could cause breakage in the competence of the underlying bedrock.

Liquefaction

Liquefaction occurs when certain types of water-saturated sands and muds substantially lose strength due to sudden ground-shaking, turning it into a slurry substance with liquid-like consistency (Kusky 2008). Any structure built on liquefied sediments can suddenly sink as if it were resting on thick fluid. The occurrence of liquefaction is influenced by the magnitude of the earthquake, ground acceleration, distance from the epicenter, duration of the shaking, relative density of sediments, seismic history, and age of the deposit (Seed 1979; Torres et al. 2001).

Liquefaction susceptibility map released by PHIVOLCS shows that only sparse areas within the region are actively prone to liquefaction. Note that these areas are found in the coastal zone and known active tributaries where loosely consolidated alluvial materials are most present. The MPSA site, however, is generally not prone to liquefaction based on available data from the PHIVOLCS **(Figure 2-21)**.

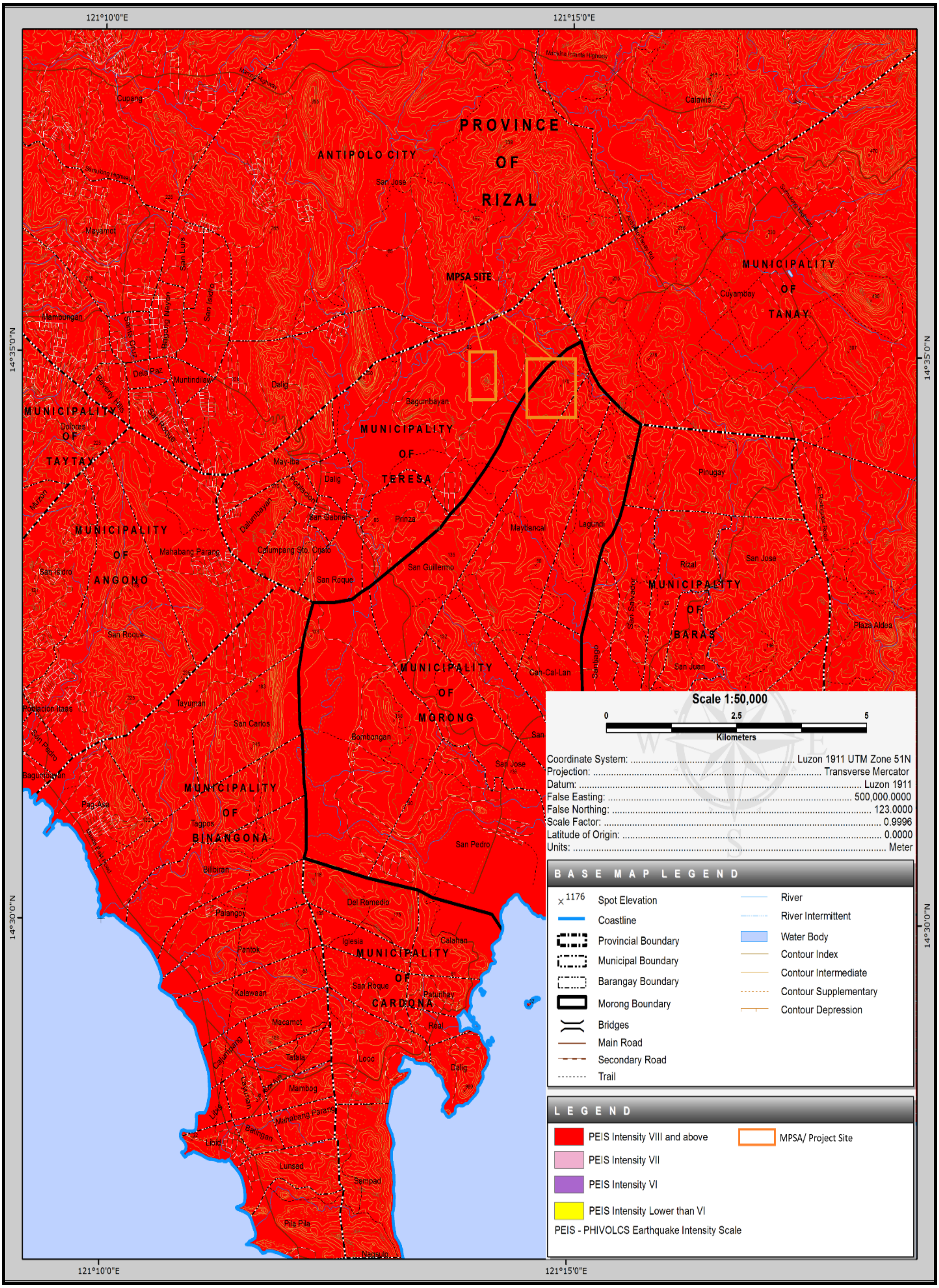
Earthquake-Induced Landslide

Based on the map provided by PHIVOLCS **(Figure 2-22),** Parcel 1 of the MPSA has low susceptibility from any earthquake- induced mass movement or mass wasting (falling, creeping, and sliding of earth materials) hazards being located on a relatively slightly sloping to rugged terrain.

Differential Settlement

Areas underlain by fine-grained soil and clay are subject to settlement and differential compaction. Those areas with low-density silts and clays associated with fluvial depositional environments are subject to this type of hazard. The extent of compaction may range from a few centimeters to several meters in depth. The potential for differential compaction is highest during large earthquakes.

Subsurface materials within the project site are susceptible to differential compaction settlement hazards. Proper compaction should be made if there would be earth filling at the site. Compaction of the ground prior to the construction of a structure would further reduce the risk from differential ground settling.



Source: PHIVOLCS

Figure 2-20 Ground Shaking Hazard Map of Municipalities of Morong and Teresa

Flooding

Flooding generally occurs when water inundates a dry land. The causes for this natural hazard include the following: (1) rivers or streams overflow their banks, (2) excessive rain, (3) ruptured dam or levee, etc. Floods can develop quickly (flash floods) or may take hours or days which can give residents time to evacuate the area. MPSA area is slightly to moderately susceptible to flooding **(*Figure 2-23*)**.

Volcanic Hazards

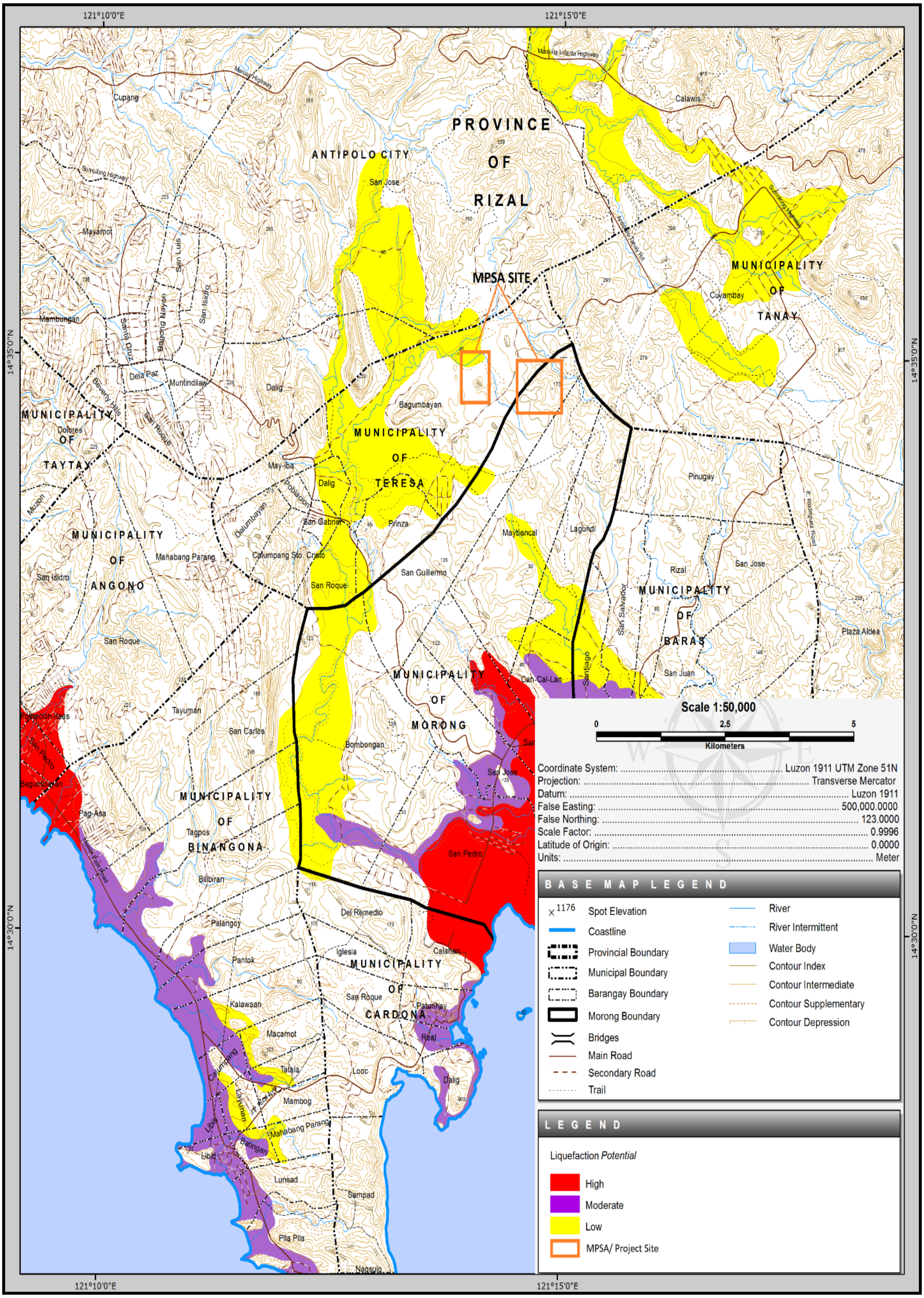
The nearest active volcanoes, Mt. Taal in Batangas and Mt. Banahaw in Laguna about >100 km to the south and southeast of the MPSA exposes the proposed project site to volcanic hazards in the form of tephra or ash falls, depending on the prevailing wind (***Figure 2-24***). Although predicting the eruption probabilities of these volcanoes is difficult, eruption of these in the future cannot be totally ruled out.

Tsunami

Tsunamis are a series of waves caused by the sudden displacement of a large volume of water by natural phenomenon such as earthquakes, volcanic eruptions, underwater landslides or meteorite impacts. The waves can travel across open waters at vast distances and great speeds, building into shorter period but higher amplitude waves as they approach shallow bathymetries near the coast. Once on land, tsunamis can crash into buildings and structures, and incorporate the resulting debris to form destructive slurries that can travel several kilometers inland.

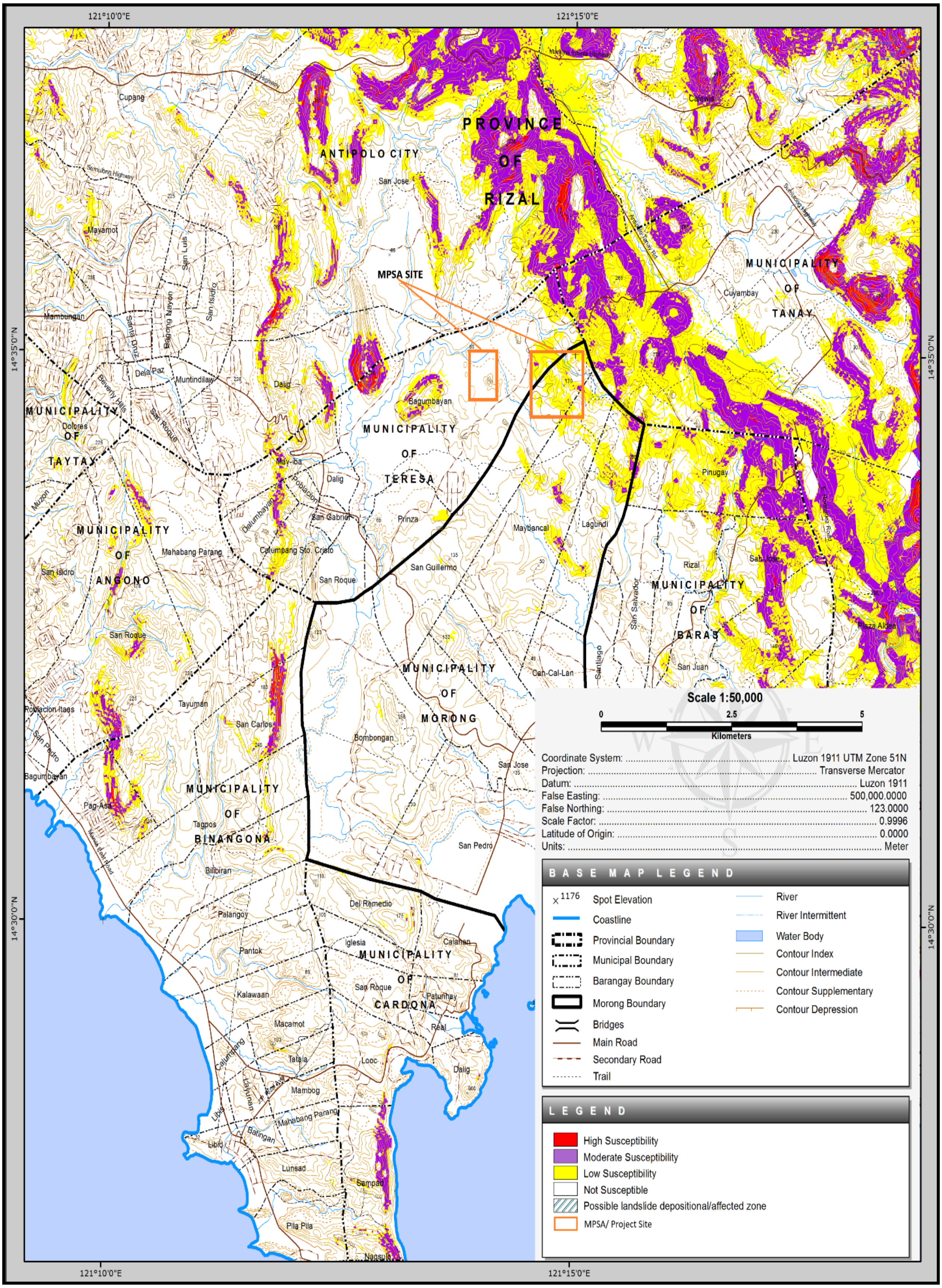
Tsunami hazard is not limited to coastal areas. Coastlines surrounding large lakes are also exposed to this hazard, with greater risk in lakes bordered by landslide-prone slopes or those that lie on top of active fault zones.

Laguna de Bai (Laguna Caldera Lake), which is proximate to the project site, could also generate tsunamis either from displacement along the West Valley Fault System that borders the western up to the southern coast of the lake, or from huge landslides from the mountainous areas of Talim Island.



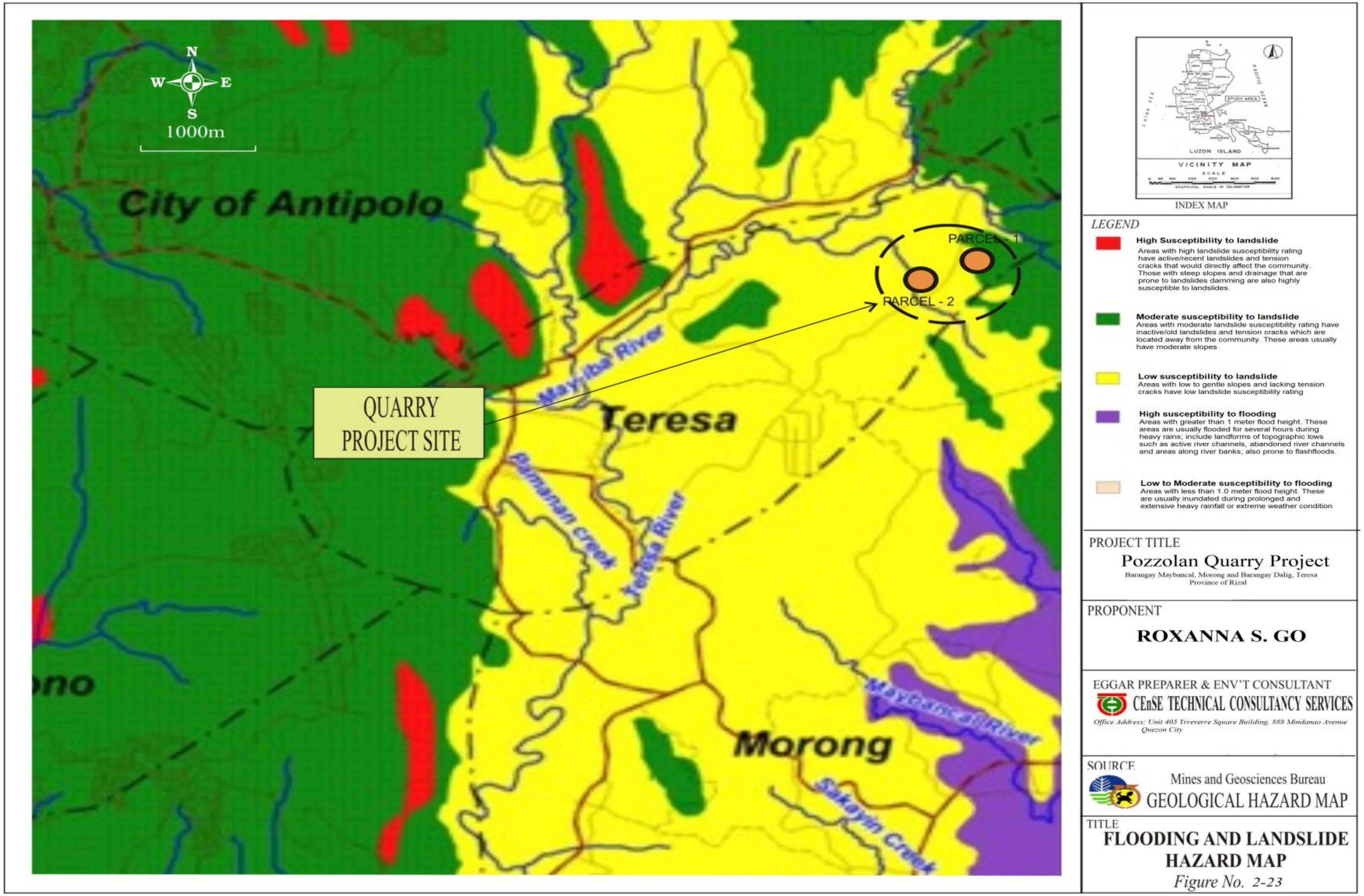
Source: PHIVOLCS

Figure 2-21 Liquefaction Hazard Map of the Municipalities of Morong and Teresa



Source: PHIVOLCS

Figure 2-22 Earthquake-Induced Landslide Hazard Map of the Municipalities of Morong and Teresa



Source: Mines and Geosciences Bureau (MGB)

Figure 2-23 Flood Hazard Map of the Municipalities of Morong and Teresa

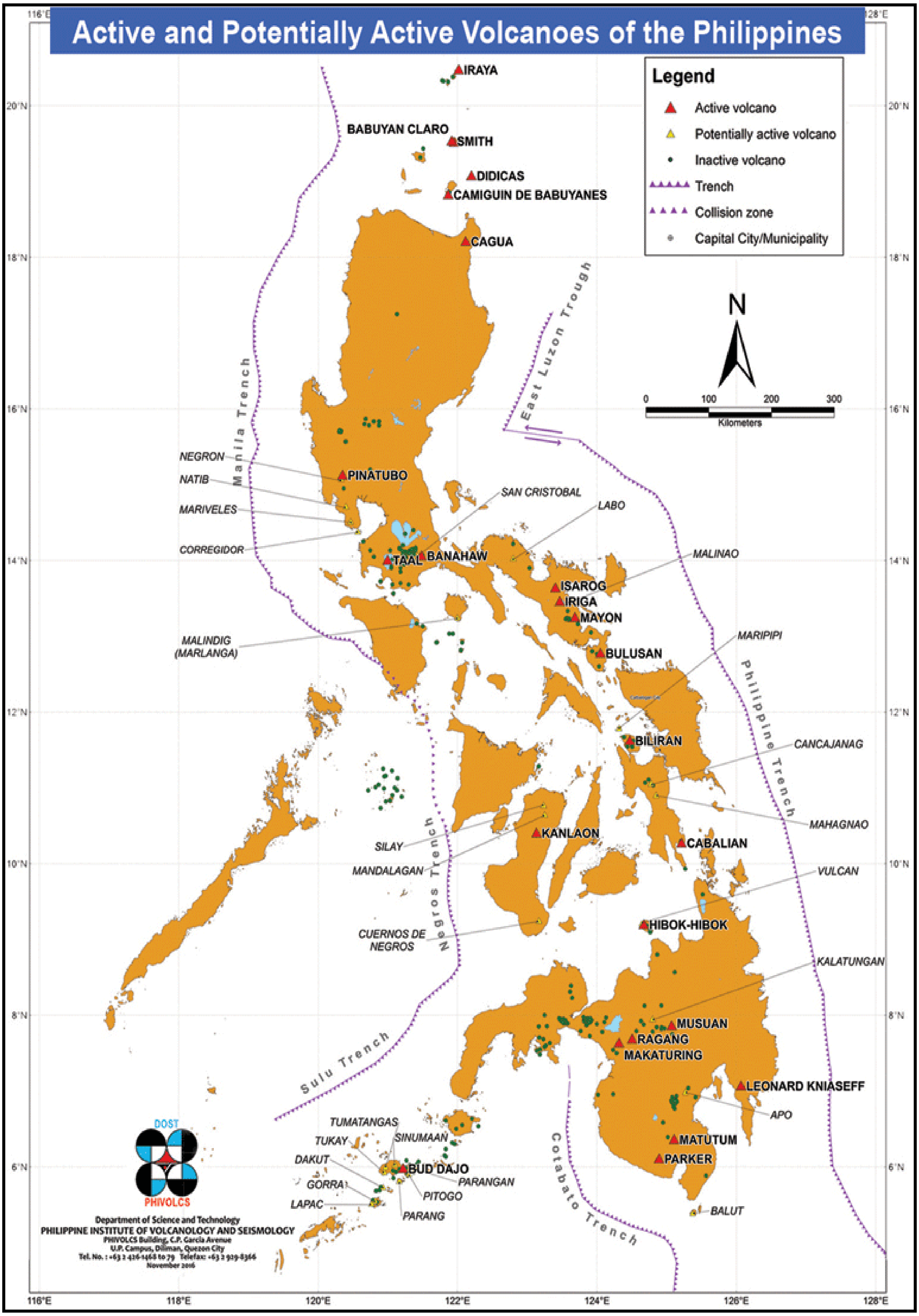


Figure 2-24 Volcanic Hazard Map

IMPACT ASSESSMENT AND MITIGATION

During Construction and Operation Phase

- Blasting for the construction of the pit and extraction of pozzolan will generate strong vibrations and shockwaves that could trigger the failure of unstable pit walls.
- Pit excavations and rock/soil piling increases slope gradients which also heightens susceptibility to landslides.
- Topographic disturbance caused by the construction of the pit; siltation ponds may cause the creation of new waterways which could experience flooding.
- Discharges from the siltation pond spillway could trigger flooding in downstream areas.
- Excavations for the pit quarry may uncover structural weaknesses within buried rock units and may promote the formation of extension fractures that could further weaken the rock.

To mitigate the potential effects, the following recommendations done are to be considered:

- A Blasting Management Plan will be implemented to make sure that safety and environmental standards are during blasting activities.
- Careful design and development of the quarry components will be enforced. The dimensions of berms, piles and lifts will be specified for safety.
- Progressive development of the quarry pit and siltation pond will be observed.
- The siltation ponds will be regularly monitored for structural integrity.
- Surface diversion drains will be installed to channel runoff water away from quarry components and into natural waterways located downstream.
- The siltation pond will be designed to stand against flood events. The siltation pond design will follow standard requirements.
- An Emergency Response Plan will be developed to handle unlikely occurrence of impoundment failure and downstream flooding.

2.1.3 Pedology

This section described the existing soil characteristics at the site and its immediate surrounding, assessed the potential impacts on soil, and proposed mitigations.

Methodology

The existing soil characteristics were described by using data in the Soils of the Philippines by Carating, R.B., et al (2014) of the Bureau of Soils and Water Management (BSWM), the Lada Soil Series 2013, and the CLUP of the Municipalities of Morong and Teresa.

The impacts assessed were a) soil erosion /loss of topsoil/ overburden, and b) change in soil quality and/or fertility. The relevant baseline information from the document reviews was included in the impact assessment.

2.1.3.1 Soil erosion / loss of topsoil/ overburden

Existing Conditions

Difficulties have been encountered in the classification of soils in the project because of the existing parent materials that were found overlapping each other in a number of places. A large part of the region is underlain by tuffaceous materials (Guadalupe Formation) and limestone. However, there are highly indurated siliceous deposits, volcanic tuff, and basalts occurring in some places (Kinabuan Formation).

Figure 2-25 shows the Soil Map of the MPSA area. Based on the soil survey and assessment conducted, both parcels belong to the Antipolo clay series. However small fraction of Parcel 2 belongs to the Binangonan Clay, thus, included in this study.

Binangonan Series

The Binangonan soil occupies an area of limestone. The surface soil is very dark brown to nearly black. The fine surface soil on drying assume a distinct grayish brown to nearly black. The subsoil is light gray to whitish gray sticky clay. The lower subsoil is a highly weathered soft limestone material.

Binangonan Clay

The surface soil of the Binangonan clay, ranging in depth from 20 to 25 centimeters, is dark brown to nearly black clay, coarse granular to cloddy when dry ad sticky when wet. The upper subsoil is clay, lighter in color than the surface soil. The lower subsoil ranging in depth from 40 to 55 centimeters is a calcareous horizon, light brown to nearly white. This is a highly weathered and disintegrated limestone. The substratum is a bed of stratified soft calcareous rock.

Binangonan Clay-lowland phase

The lowland phase of the Binangonan clay occupies the lacustrine valley of Teresa and the adjacent small valleys along the headwaters of Morong River.

Table 2-6. Soil Profile of Binangonan Clay

Depth of Soil (in cm)	Characteristics
0-20	Very dark-brown to nearly black clay, coarse granular and cloddy when dry and sticky when wet. Stiff when seemingly dry.
20-40	Clay lighter in color than above, granular when dry, sticky when wet.
40-55	Beginning of the lime accumulation. Light brown to nearly white in color, highly weathered limestone on the lower horizon.
55-100	Highly decomposed and weathered soft rock limestone.

Antipolo Series

The Antipolo series comprises red or reddish-brown soils developed from igneous and other volcanic rocks. In some parts, the upper subsoil is composed of highly weathered tuffaceous material. The lower part of the subsoil is lined with igneous or volcanic rocks, especially basalt of various degrees of weathering and disintegration. There are two types of soil in this series, namely, clay and clay loam.

Antipolo clay loam

This type occurs in isolated areas. The surface soil is dark reddish-brown clay loam, finely granular and friable when dry, but slightly sticky when wet. The subsoil and substratum are like the clay type of this series. On sloping areas basaltic boulders are abundant.

Antipolo clay

This is the largest single type in the province. The surface soil ranging in depth from 25 to 30 centimeters is light reddish brown, very friable, and finely granular clay. Spherical Tuffaceous concretions are present. The upper subsoil ranging in depth from 50-60 centimeters is dark reddish-brown, granular, and friable clay loam with fine spherical iron concretions. The lower subsoil to a depth of from 45 to 90 centimeters is a zone of highly weathered tuffaceous material. Few concretions are present. The substratum from 120 cm to an indefinite depth is coarse granular, dark reddish-brown clay loam with numerous iron concretions.

Table 2-7. Soil Profile of Antipolo Clay

Depth of Soil (in cm)	Characteristics
0 to 27	Light reddish brown, friable, and finely granular clay. Presence of spherical tuffaceous concretions. Slightly compact.
27 to 65	Dark reddish brown, granular to friable clay. Concretions are present. Slightly compact.
65 to 85	Bright reddish brown granular and friable clay loam. The lower part of this horizon is the beginning of the adobe structure. Slightly compact.
85 to 120	Zone of highly weathered tuffaceous material hardly noticeable unless the soil material is washed exposing the skeletal tuffaceous remains. The soil is finely granular, slightly friable clay loam. Concretions are present.
120 to 150	Course granular, dark reddish-brown clay loam and very friable. Soft concretions are present.

Table 2-8. **Mechanical analyses of the surface soil of selected soil types of Rizal Province**.

Type Name	Sand (2-0.05) mm	Silt (0.05-0.005) mm	Clay (0.005-0) mm
Binangonan Clay	36.6	8.0	55.4
Binangonan Clay lowland phase	31.7	20.4	47.9
Antipolo Clay	29.4	12.0	58.6
Antipolo Clay loam	27.0	18.2	54.8

Source: BSWM Note: The modified Bouyoucos method of analysis was followed. Data represent analysis of the surface soils only. Analyzed by the Soil Survey Section.

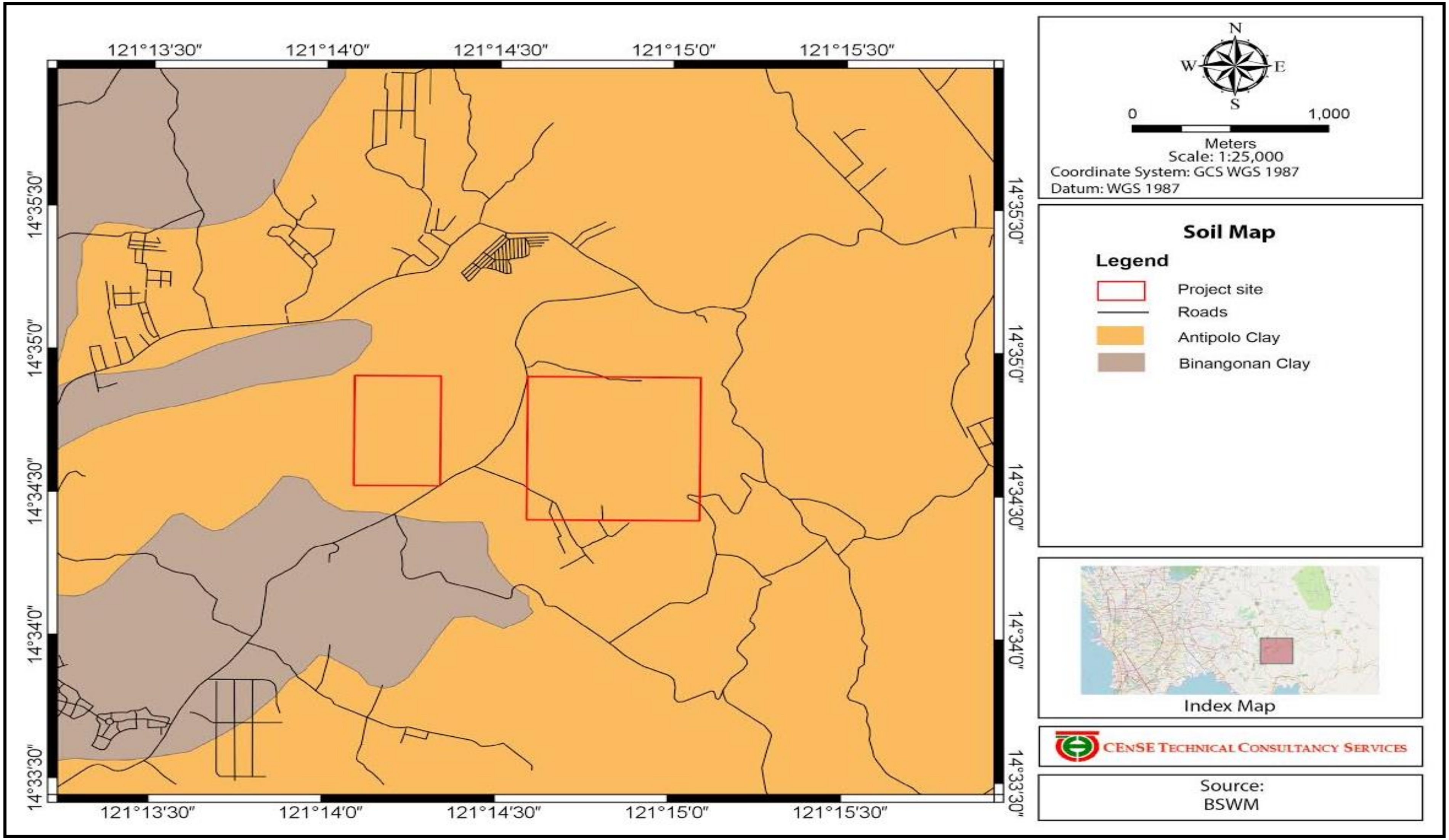


Figure 2-25 Soil Map

IMPACT ASSESSMENT AND MITIGATION

During Construction and Operation Phase

The site in general is slightly prone to erosion (***Figure 2-26***). However, activities during the development and operation phase of the project involves land disturbances which include removal of soil's vegetative cover (clearing and grubbing), stripping of the topsoil and excavations for pozzolan materials including laying out of quarry components. These activities will cause an increase in soil's erodibility by exposing to erosive agents such as wind and water.

Topsoil Stockpile Design Parameters

Topsoil materials will be temporarily transported to a designated stockpile area to be used for future rehabilitation. Typical thickness of topsoil ranges between 0.5m to 1.0m while overburden materials could reach up to 5.0 meters. To minimize suspended solids in run-off during heavy rains, slopes will be protected with rock facing. Large boulders will also be placed along the toe line increase stability.

IMPACT ASSESSMENT AND MITIGATION

During Construction and Operation Phase

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.

Stockpile soil quality will be improved through conservation management programs and soil quality improvement processes during stockpiling to reduce, if not prevent, soil degradation during the storage period. Lastly, soil quality of initially rehabilitated area will be monitored to assess the effectiveness of the rehabilitation.

2.1.3.2 Change in soil quality/ fertility

Existing Conditions

Soil Quality/ Fertility

Laboratory Analysis

Sampling was conducted on September 6, 2020 one (1) representative sample for each parcel. Sampling map and results is presented in ***Figure 2-25a*** and Table 2-8a, respectively. Soil test pits have depths of up to 2 meters. Test pits with varying soil layers was noted and samples per layer were collected. Approximately 4 kilograms of sample were collected per sampling site and kept in thick plastic bags tied with a straw and labelled accordingly.

Table 2-8a Results of Soil Samples

Parameter	Test Method	Soil Sample	
		RC-01A	RC-02A
pH at 10% solution	Electrometric	6.2	
Calcium (Ca)	Direct Nitrous Oxide-Acetylene Flame	1.89	1.422
Magnesium (Mg)	Direct Air-Acetylene Flame	1.45	1.380
Sodium (Na)	Direct Air-Acetylene Flame	0.88	0.82
Potassium (K)	Direct Air-Acetylene Flame	0.85	
Moisture Content	ASTM D 3173	10.15	11.52
Zinc (Zn)	Direct Air-Acetylene Flame	100.20	95.58
Lead (Pb)	Direct Air-Acetylene Flame	<0.10	<0.10
Total Nitrogen (N)	Kjeldahl	0.08	0.12
Total Phosphorus (P)	Titrimetric	0.094	0.081

Source: Ostrea Mineral Laboratories, Inc., October 2019

Discussion of Results

Figures 2.25b, 2.25c, 2.25d and **2.25e** show the soil pH, organic matter (OM) and essential nutrients-- Nitrogen, Phosphorous, Potassium (NPK) of the mining area adopted from the National Soil Sampling and Testing for Fertility and Crop Suitability Assessment Project of BSWM in partnership with the Department Agriculture- Regional Field Office and LGUs.

Soil pH of Parcel 1 predominantly falls within moderately acidic to slightly acidic while Parcel 2 falls within nearly neutral to extremely alkaline **(Fig. 2.25b)**. Soil pH affects the availability of most primary nutrients. At low pH and high pH, phosphorous is less available than when the pH is around 6.5 (near neutral). Soil pH is also important in nitrogen transformations including mineralization of organic matters, nitrification and nitrogen-fixation.

The organic matter (OM) concentration of the MPSA area falls within the deficient or low condition **(Fig. 2.25c)**. The major roles of organic matter in soil are adding nutrients and improving the soils structure and water-holding capacity. Soils with low organic matter have poor structure, hold little water, and erode or leach nutrients easily. While soils with high organic matter levels have good structure, good water-holding capacity, and reduced erosion and nutrient leaching.

Similarly, both nitrogen **(Fig. 2.25c)** and phosphorous **(Fig. 2.25d)** concentrations fall within the low or deficient category. Nitrogen as a primary nutrient is found in chlorophyll, nucleic and amino acids and a component of protein and enzymes in plants. Meanwhile, phosphorous is an essential component of DNA, RNA and phospholipids which play critical roles in cell membranes and plays a major role in the energy sytem of plants.

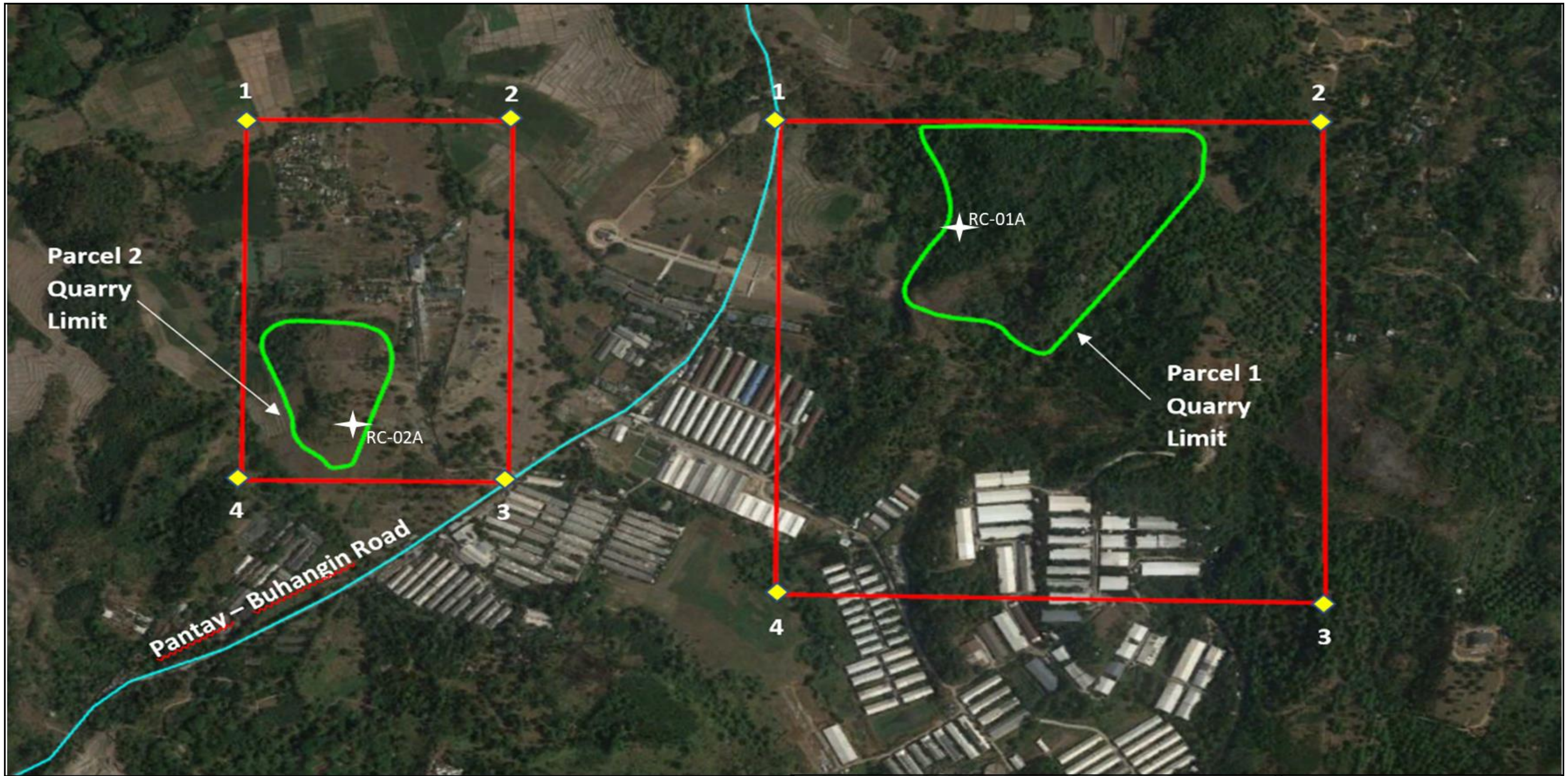
However, potassium **(Fig. 2.25e)** contents of the project area generally fall under the high or adequate category. Potassium plays a major role in plant metabolism, and is involved in photosynthesis, drought tolerance and protein synthesis, **Annex H.1a** shows results of analysis from Ostrea Mineral Laboratories, Inc.

Impact assessment and options for mitigation and/or enhancement

During Construction and Operation Phase

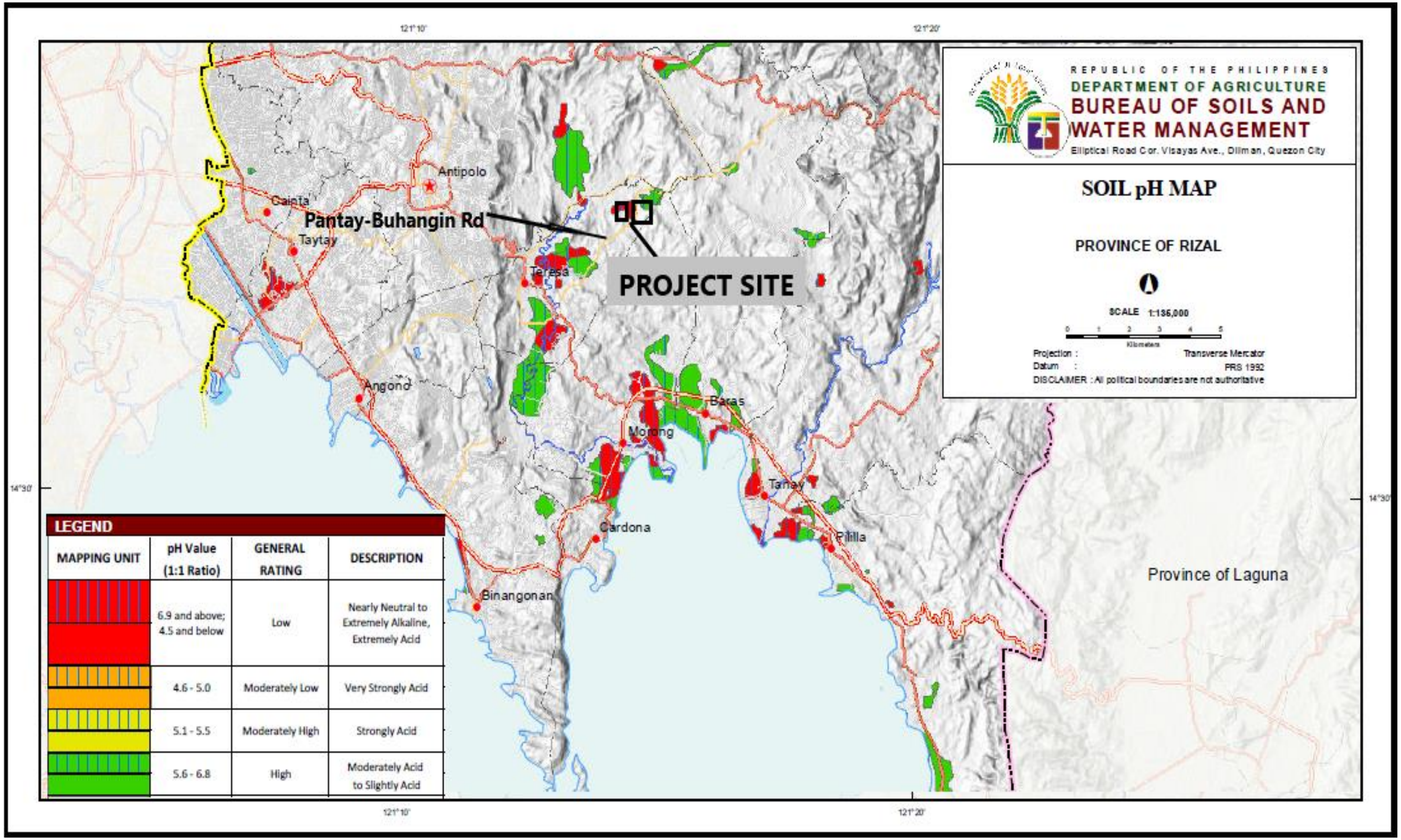
Soil fertility and quality will be impacted due to passage of vehicles and heavy equipment, above all, development and operation of the area over the course of the project.

Waste products such as oil and lubricants shall be properly handled, stored and disposed in accordance with the existing DENR guidelines. Hazardous materials and wastes shall be contained in areas with lining or in storage tanks. Safety procedures shall be implemented to avoid spillage by installation of auto shutoff valves in the refueling and lubricating stations. In case of accidental spills, contaminated soil shall immediately be removed to avoid further dispersion of contaminants.



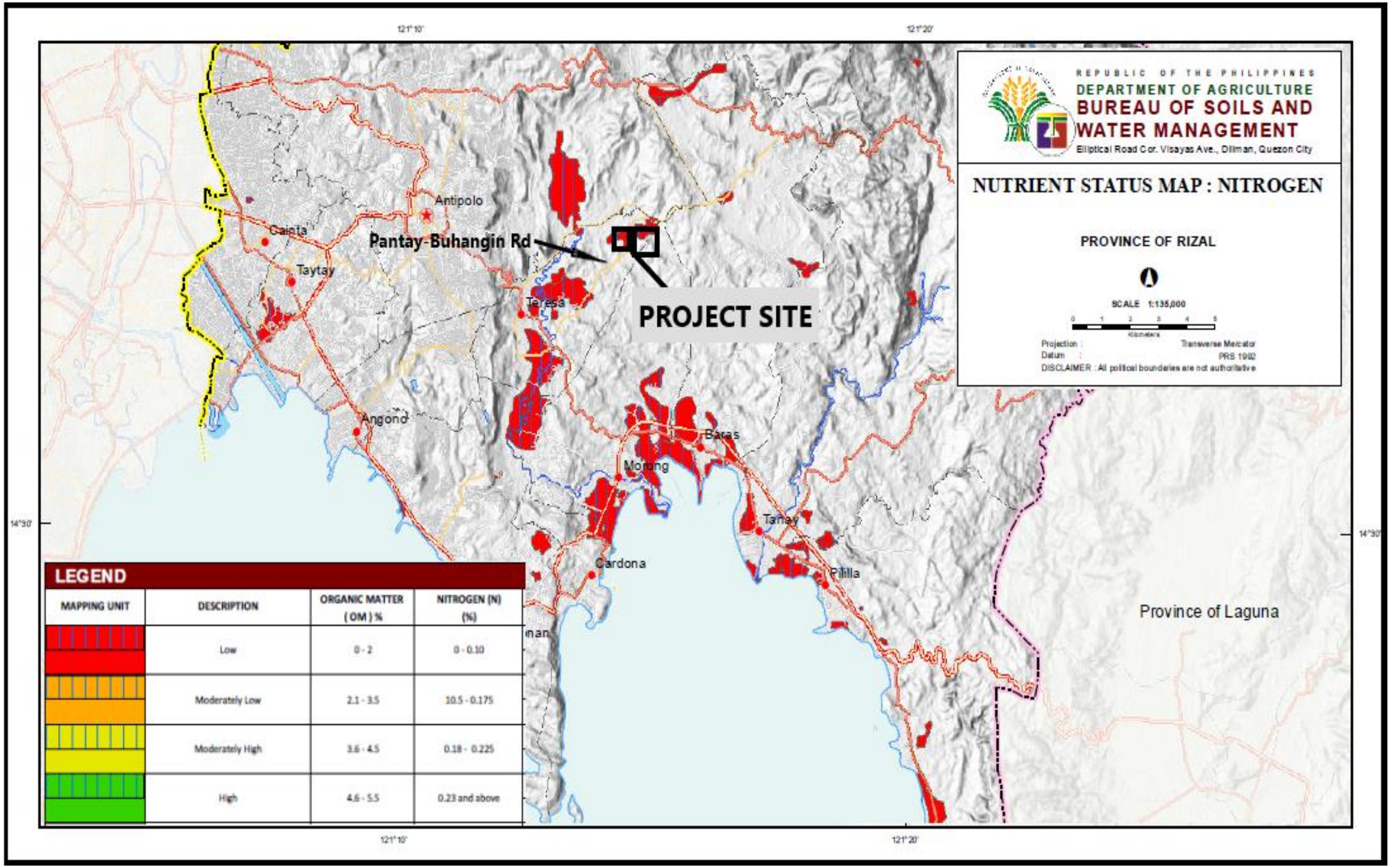
Proponent:	Consultant:	Project Title and Location:	Sheet Content:
Roxanna S. Go MPSA Holder 167 Sumulong Highway, Antipolo City	CEnSE Technical Consultancy Services Unit 405, 888 Yrreverre Square Building, Mindanao Avenue, Quezon City	Pozzolan Quarry (MPSA 347-2010-IVA) Barangay Maybancal, Morong and Barangay Dalig, Teresa Municipality of Rizal	Soil Sampling Map *Figure 1-25a*

Figure 2-25a Soil Sampling Map



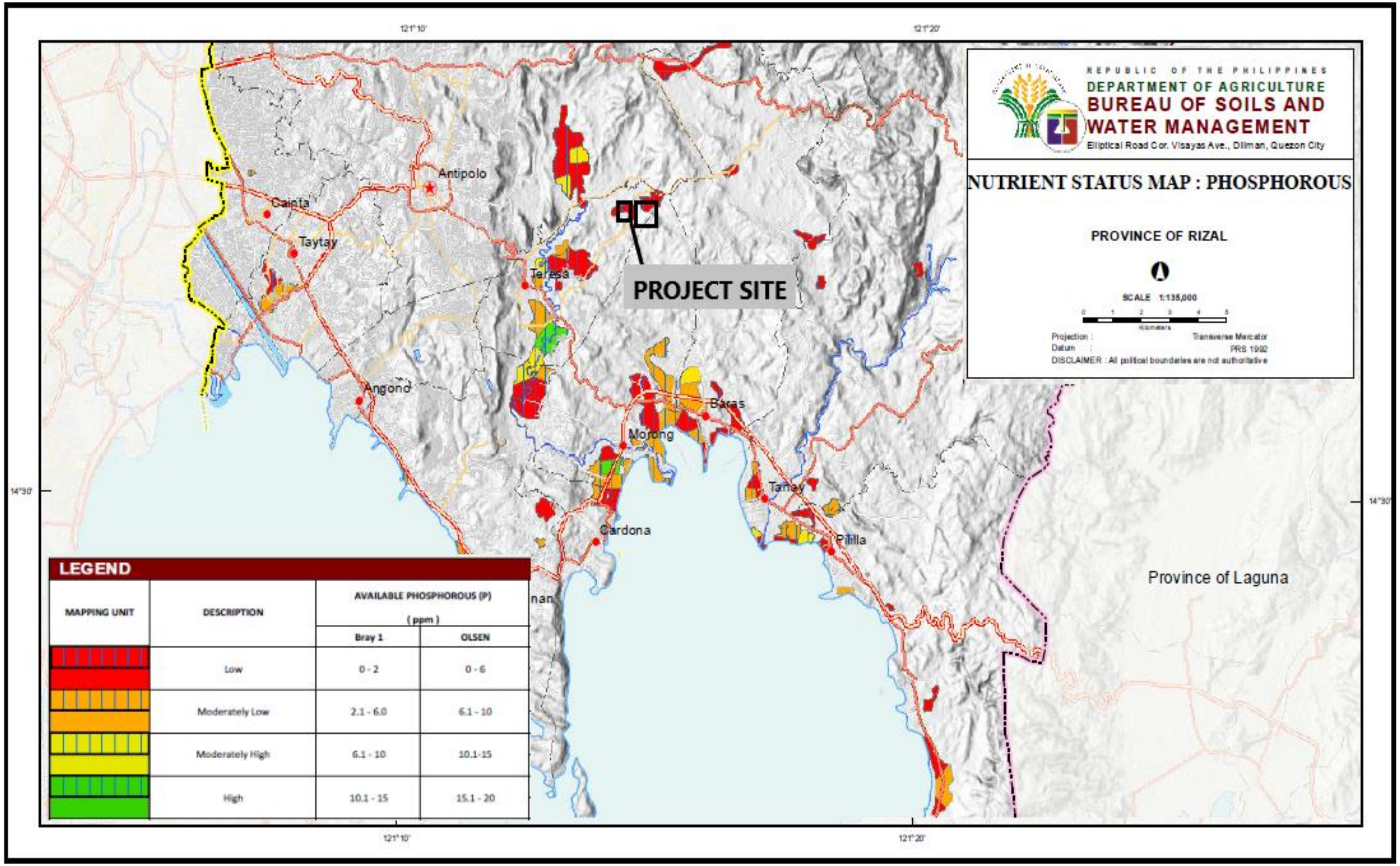
Source: BSWM-Geomatics and Soil Information Technology Division, 2017

Figure 2-25b Soil pH Map of MPSA Area



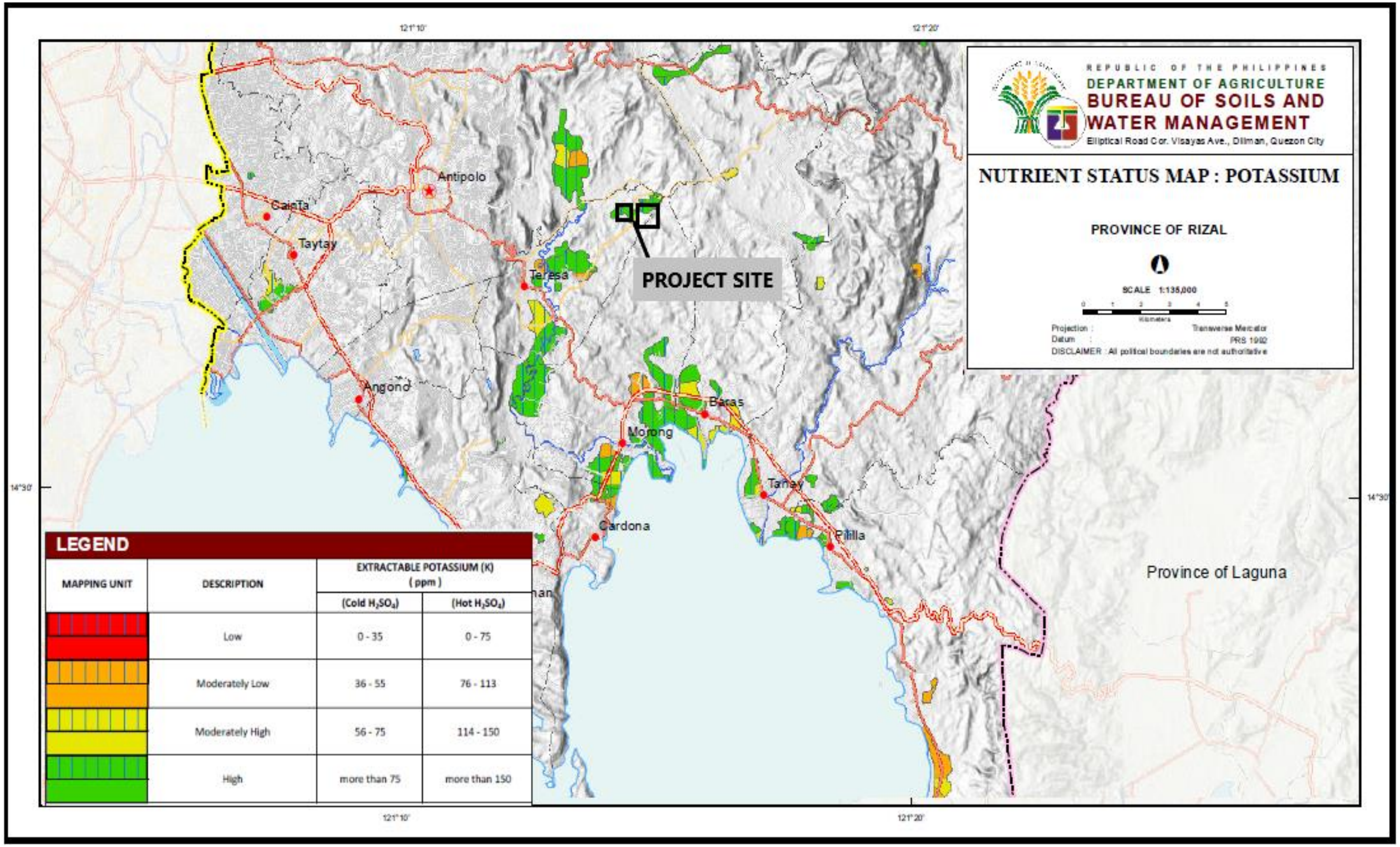
Source: BSWM-Geomatics and Soil Information Technology Division, 2017

Figure 2-25c Organic Matter and Nitrogen Status Map of MPSA Area



Source: BSWM-Geomatics and Soil Information Technology Division, 2017

Figure 2-25d Phosphorous Status Map of MPSA Area



Source: BSWM-Geomatics and Soil Information Technology Division, 2017

Figure 2-25e Potassium Status Map of MPSA Area

Source: Morong CLUP

Figure 2-26 Soil Erosion Map Covering the MPSA Site

2.1.4 Terrestrial Ecology

Objectives and Scope of the Study

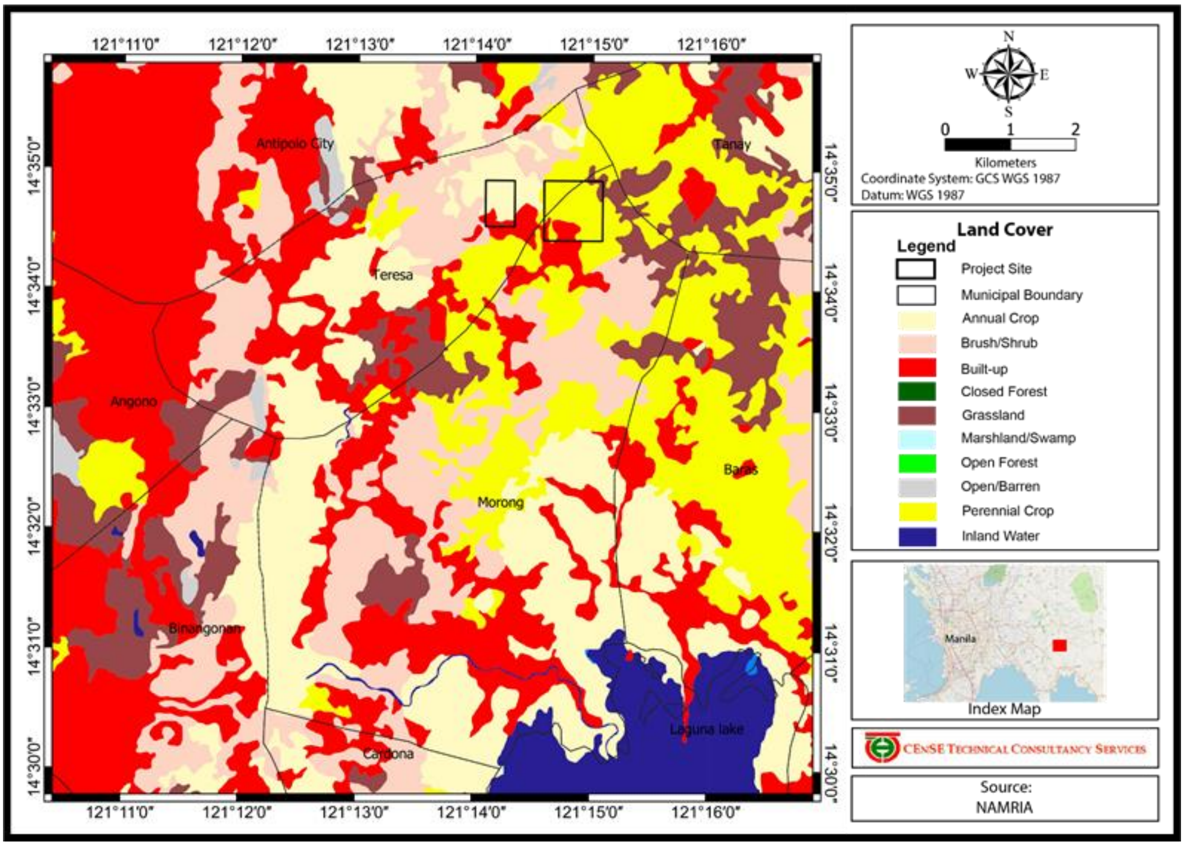
This assessment focuses on the study of the terrestrial ecosystems that encompasses both faunal and floral assemblages. Sampling stations established are within direct impact areas of the Pozzolan Quarry in Barangay of Dalig, Municipalities of Teresa and Barangay Maybancal, Municipality of Morong, Province of Rizal. The total quarry limit area that will be disturbed for Parcel 1 is about 36.70 hectares out from the total area 82.80 hectares and for Parcel 2 is 9.9026 hectares out from the 31.7206 hectares, while the remaining 67.90 hectares is identified as Excluded Area and buffer zones.

Figure 2-26a presents the land cover map of the Municipalities of Morong and Teresa in relation to the MPSA site which shows that Parcel 1 land cover mostly perennial crop, grassland and built-up area while Parcel 2 land cover are built-up and annual crop based on Namria 2010 Land Cover Map.

Methods

Terrestrial Flora

To quantify the vegetation composition in the area, a total of six quadrants and five transects were established in the identified sampling sites. Six quadrants with a dimension of 20m x 20m while 5 transect lines with a hundred-meter length each were established. Respectively, a total area of 2400m2 and length of 500m were assessed from both of the identified sampling sites. Grasses and shrubs present were also identified. Sampling collection was minimized; hence identification of plants was done on the field. Field photographs were taken using a digital camera for further identification and rechecking of the identified species. Morphological characteristics and differences were noted to identify the samples down to its possible taxonomic key. Identification and Conservation status of each species was based on the following relevant references: A Flora of Manila, and Philippine Native Trees 101, including the online database of Philippine plants, Co's Digital Flora of the Philippines. Furthermore, identification was verified through Phyto Images.



Source: NAMRIA 2010 Land Cover

Figure 2-26a Land Cover Map of Teresa and Morong, Rizal

Photo 2e. *Establishing sampling plots for flora sampling*

Photo 2f. *Flora sampling*

Terrestrial Fauna

Terrestrial fauna is defined as animals that are living on land and are using the land for the most part of their lives. Terrestrial fauna can be further divided into vertebrates (birds, mammals including bats, reptiles and amphibians) and invertebrates (arachnids, crustaceans, insects, mollusk and worms). Terrestrial fauna also helps in maintaining the general health of ecosystems since most invertebrate's act like pollinators that allow the dispersion of plant seeds, fruits and fungi spores.

A. Avifauna

The avifaunal survey was conducted through Point-count transect method and mist netting method.

Point-Count Transect Method

The point count method is arguably the simplest method of counting birds. Transect points are established for observation and documentations. From 0500H until 1000H, all birds seen observed by sight using a pair of binoculars and long-range still camera in the point-count stations are recorded. Identification by listening to bird calls/acoustic calls was also done.

Mist-Netting Method

Mist nets with a dimension of 10m x 2.5 m with fine mesh were laid along possible travel lanes for birds. They are set up preferably in area with tall trees or other vegetation to make cover. Suitable sites for setting up the nets were selected adjacent to the transect line. The nets were set hanging from the tree branches and anchored to the ground below. The captured individuals were retrieved at specific times to avoid excessive stress and prevent death to the entangled birds. Birds were identified according to their local names, acoustic calls and visual representations with the aid of a field guide (Tañedo, 2015 & Kennedy et al, 2000). Birds were released right after photo documentation.

***Photo 2g**. Setting up of Mist Net*

Indigenous Knowledge System (IKS) Method

There are species of birds that are expected to be present in the area but are not actually observed during the sampling period. To check for these bird species, local residents, especially farmers, hunters and enthusiasts, were also asked if they have recently observed these bird species.

Incidental Surveys

There are species of birds which may be spotted any time in the project area but are not found or observed within or around any of the established sampling stations. These birds are still identified.

B. Volant Mammals

Mist-Netting Method

Volant mammals (bats) were captured alive during sampling using mist nets. The mist nets have dimensions of 4m x 12m with 36mm mesh size. The nets were placed near fruit-bearing trees, in ridge tops, or probable flyways of bats at 1700H. The nets were regularly checked every 3 hours until 2300H, and then left open and checked before 0600H.

Captured bats were removed individually and were placed in temporary holding devices such as cloth bags for identification and documentation. Bats were identified using the Key to Philippine Bats (Ingle and Heaneys, 1992). After documentation, bats were revitalized with sugar solution and released back into the wild.

C. Non-volant Mammal

Non-volant mammals such as rodents were sampled using live traps. Traps were set up at around 1800H and were checked every four hours until morning. Peanut butter and dried fish were used as bait to attract small non-volant mammals roaming at night and during the day. Traps were positioned along possible runways, near burrow entrances, under root tangles, on top of fallen logs and another probable faunal corridor. Mammals that are trapped in the cage are subjected to basic morphometric measurements and are released thereafter. Identification is done using the book “A Synopsis of Mammalian Fauna of the Philippine Islands” by Heaney et al (1998).

***Photo 2h**. Setting Up of Cage Traps*

Herpetofauna

Frogs and amphibians were sampled by cruising methods or opportunistic sampling. Sampling was done at night. Any individual captured are subjected to identification using The Amphibians and Reptiles of Mindanao Island, Southern Philippines, II: The Herpetofauna of Northeast Mindanao and Adjacent Islands (Sanguila et. Al, 2016), Amphibians and Reptiles of Luzon Island, V: The Herpetofauna of Angat Dam Watershed, Bulacan Province, Luzon Island, Philippines (Mcleod et. Al 2012).

General Description of the Area

Fragmented forest patches were observed in the area which were composed of agriculturally cultivated species mixed with degraded vegetation. There are disturbances within the forests like unpaved trails to meet the needs of the nearby residents. Along the edge of the forests lie structures for commercial and industrial purposes and houses of the residents in the area.

Parcel 1 was mostly covered with cultivated species and agricultural plantation, with a mango plantation observed eastward of the sampling Site. There is less vegetation and forest cover in Parcel 2 as the area is adjacent to a dried and open rice field. Both of the identified sampling sites were subjected to limitations given the steepness of the terrain in the area. These limitations were considered by employing random sampling method. MPSA area for Parcel 1 is 82.80 hectares but only 32.70 hectares will be considered for quarry area, the remaining area of 50.10 hectares shall be allotted for permanent buffer zones and is considered excluded from quarry area. Parcel 2 has a total area of 31.7206 hectares, only 9.90 hectares shall be considered as quarry area, the remaining area of 21.8206 hectares shall be allotted for permanent buffer zones and is considered excluded from quarry area.

Parcel 1

Parcel 1 had thicker vegetation cover most of the area has not been cultivated to farmlands and fruit plantations. This area is near a piggery facility.

***Photo 2i**. Aerial view of parcel 1 showing the adjacent piggery facility*

***Photo 2j.** Aerial Vegetation cover of parcel 1.*

***Photo 2k**. Vegetation in a portion of parcel 1*

Parcel 2

***Photo 2l**. Aerial view of parcel 2 showing the rice fields at the center between the plant covered area and the stream*

***Photo 2m**. Aerial of the vegetation cover in parcel 2 showing the rice fields*

***Photo 2n**. Portion of parcel 2 were ipil-ipil are abundant*

2.1.4.1 Sampling Stations

A total of 11 stations were established within the Pozzolan Quarry site, comprising a combined 6 quadrants and 5 transect lines for both Parcels 1 and 2. The tables below show the geographical coordinates of each stations with their corresponding elevations.

Parcel 1

Table 2-9. Coordinates of the Quadrants in Parcel 1

Quadrant No.	Point 1	Point 2	Point 3	Point 4
1	14.580876 N 121.245766 E	14.580998 N 121.2459 E	14.581111 N 121.245705 E	14.580962 N 121.245554 E
2	14.580921 N 121.246796 E	14.580878 N 121.246895 E	14.580735 N 121.24687 E	14.580770 N 121.246747 E
3	14.579268 N 121.24774 E	14.579343 N 121.24781 E	14.579323 N 121.24754 E	14.579500 N 121.247642 E
4	14.579424 N 121.24573 E	14.579428 N 121.24589 E	14.579277 N 121.24598 E	14.579237 N 121.245724 E

Table 2-10. Coordinates of the Transects in Parcel 1

Transect No.	Point 1	Point 2
1	14.578833 N 121.24527 E	14.579275 N 121.246111 E
2	14.57876 N 121.247986 E	14.578388 N 121.24778 E
3	14.580483 N 121.24601 E	14.580426 N 121.245094 E

Parcel 2

Table 2-11. Coordinates of the Quadrants in Parcel 2

Quadrant No.	Point 1	Point 2	Point 3	Point 4
1	14.577255 121.235302	14.577345 121.235491	14.577575 121.235387	14.577483 121.235172
2	14.576722 121.235706	14.576499 121.235612	14.576405 121.235820	14.576618 121.235914

Table 2-12. Coordinates of the Transects in Parcel 2

Transect No.	Point 1	Point 2
1	14.575747 N 121.235221 E	14.576445 N 121.234806 E
2	14.577998 N 121.234657 E	14.578131 N 121.235365 E

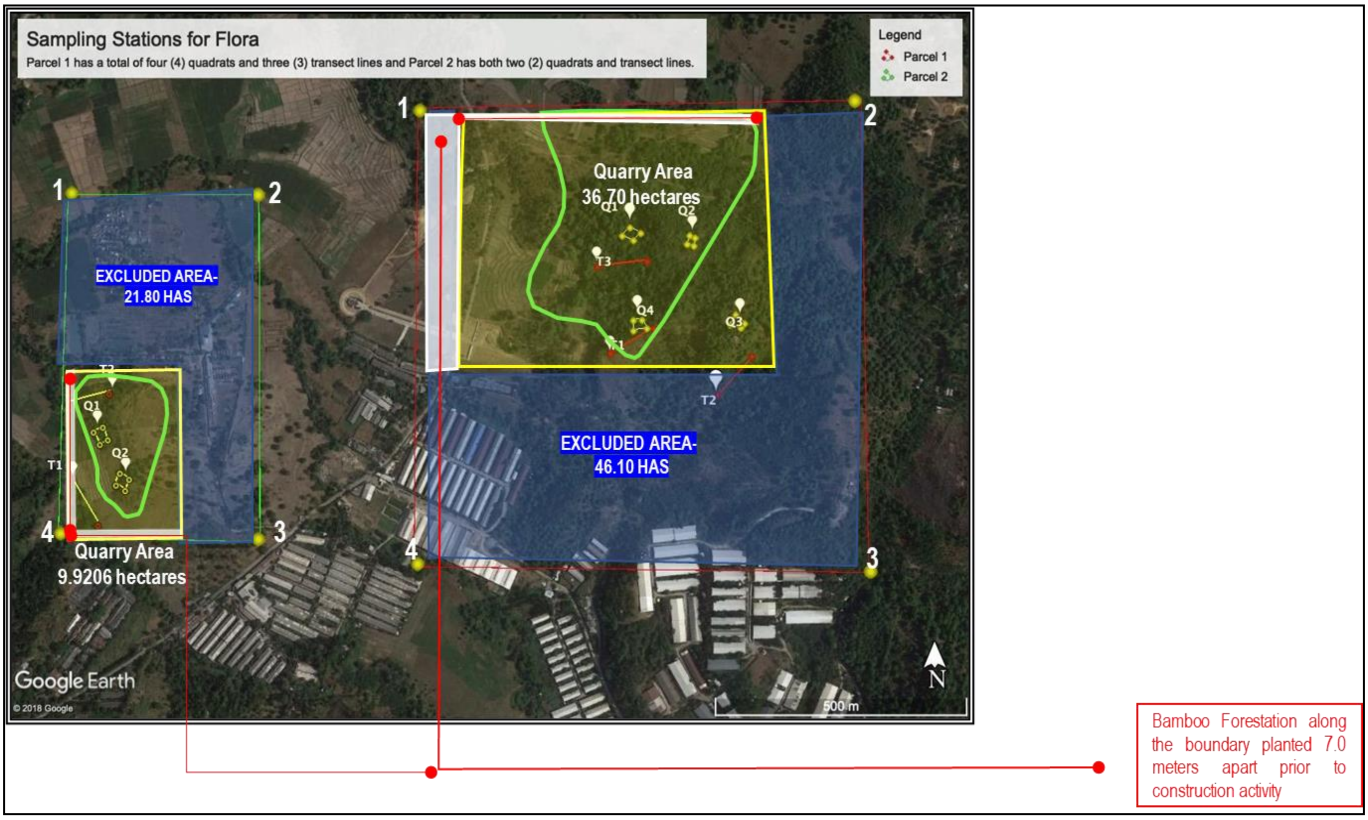


Figure 2-27. Visual Representation of the sampling stations of Flora in Parcel 1 and Parcel 2 showing Quarry Area and proposed Bamboo Forestation Area

There are four (4) quadrants and three (3) transects established in Parcel 1 (see Photo 2o below). A mango plantation was observed eastward of the sampling sites.

Photo 2o*. Quadrants and Transects in Parcel 1*

As seen in Photo 2p there are residential dwellings and other structures built along the forest trail and the forest edge. There are also some minimal disturbances observed in the forest which may serve to meet the needs of the nearby residents.

***Photo 2p**. Aerial shot of Parcel 1; Agroforest mixed with degraded vegetation*

Due to the existing reduced forest cover, only two (2) quadrants and two (2) transects were established in Parcel 2 (See Photo 2q and Photo 2r below).

***Photo 2q**. Quadrants and Transects in Parcel 2*

***Photo 2r**. Aerial view of Parcel 2 (Quadrants 1 and Quadrants 2)*

2.1.4.2 Terrestrial Flora

This chapter contains the terrestrial ecology assessment undertaken for the project. Terrestrial ecology assessment consists of flora and fauna existing in the project area or near the project area. The abundance of species provides baseline condition of the status of the environment which can aid the project managers in monitoring the project's impact to the environment.

Species Richness

A total of 51 species, belonging to 41 genus and 24 families, were identified in both Parcel 1 and Parcel 2. This includes unique species observed just outside the transect lines and quadrants. The following invasive species were also observed in the stations: Albizia saman, Gliricidia sepium, Leucaena sp., Gmelina arborea, Switenia macrophylla, and Lantana camara (Baguinon, Quimado, & Francisco, 2014; CABI, 2019). Invasive species are considered harmful to the natural ecosystem because they tend to proliferate fast, displacing or preventing the growth of natural species. They may also create monoculture in the area and cause changes in soil attributes ((U.S. Fish & Wildlife Service, 2012; Tulod, Casas, Marin, & Ejoc, 2017).

Parcel 1

There were 34 species identified in Parcel 1, as presented in **Table 2-13**.

Table 2-13. Flora Species observed in Parcel 1

Common Name	Common Name	Scientific Name
Manggang Kalabaw	Anacardiaceae	*Mangifera indica var kalabaw*
Indian Mango	Anacardiaceae	*Mangifera indica*
Bayag-usa	Apocynaceae	*Voacanga globosa*
Lanite	Apocynaceae	*Wrightia pubescens*
Pugahan	Araceae	*Caryota sp.*
Papaya	Caricaceae	*Carica papaya*
Bulakan	Convolvulaceae	*Decalobanthus peltatus*
Patola	Cucurbitaceae	Unidentified sp. 1
Bayog	Dombeyaceae	*Pterospermum sp.*
Kamoteng kahoy	Euphorbiaceae	*Manihot esculenta*
Alim	Euphorbiaceae	*Melanolepis multiglandulosa*
Acacia	Fabeceae	*Albizia saman*
Kakawete	Fabeceae	*Gliricidia sepium*
Sampaloc	Fabeceae	*Tamarindus indica*
Gmelina	Lamiaceae	*Gmelina arborea*
Alagau	Lamiaceae	*Premna odorata*
Lagundi	Lamiaceae	*Vitex negundo*
Santol	Meliaceae	*Sandoricum koetjape*
Mahogany	Meliaceae	*Swietenia macrophylla*
Ipil-ipil	Mimosaceae	*Leucaena sp.*
Marang	Moraceae	*Artocarpus odoratissimus*
Tibig	Moraceae	*Ficus nota*
Niog-niogan	Moraceae	*Ficus pseudopalma*
Hawili	Moraceae	*Ficus septica*
-	Moraceae	*Ficus sp.*
Isis	Moraceae	*Ficus ulmifolia*
Saba	Musaceae	*Musa acuminata × balbisiana*
Duhat	Myrtaceae	*Syzygium cumini*
Bignay	Phyllantaceae	*Antidesma bunius*
Kawayang Tinik	Poaceae	*Bambusa spinosa*
-	Poaceae	*Rottboellia sp.**
-	Poaceae	*Urochloa sp.**
Dalandan	Rutaceae	*Citrus × aurantium*
Lantana	Verbenaceae	*Lantana camara*

Parcel 2

There were 20 species identified in Parcel 2, presented in **Table 2-14**.

Table 2-14. Flora Species identified in Parcel 2

Common Name	Family Name	Scientific name
Manggang Kalabaw	Anacardiaceae	*Mangifera indica var kalabaw*
Lanite	Apocynaceae	*Wrightia pubescens*
Minunga	Euphorbiaceae	*Macaranga tanarius*
Kamoteng kahoy	Euphorbiaceae	*Manihot esculenta*
Acacia	Fabeceae	*Albizia saman*
Kakawete	Fabeceae	*Gliricidia sepium*
Gmelina	Lamiaceae	*Gmelina arborea*
Alagau	Lamiaceae	*Premna odorata*
Ipil-ipil	Mimosaceae	*Leucaena sp.*
Marang	Moraceae	*Artocarpus odoratissimus*
Tibig	Moraceae	*Ficus nota*
Niog-niogan	Moraceae	*Ficus pseudopalma*
Isis	Moraceae	*Ficus ulmifolia*
Saba	Musaceae	*Musa acuminata × balbisiana*
Bayabas	Myrtaceae	*Psidium guajava*
Duhat	Myrtaceae	*Syzygium cumini*
Kawayang Tinik	Poaceae	*Bambusa spinosa*
Usiw	Poaceae	*Dinochloa sp.*
Tagbak	Zingiberaceae	*Alpinia elegans*
Nangka	Moraceae	*Artocarpus heterophyllus*

Presence

From the sampled quadrants and transects, 34 species were identified in Parcel 1 while in Parcel 2, 20 were identified. Elevation and sampling size have contributed to the difference between the sampling sites. Overall, the combined number of identified species from both of the sampling sites is 39, ***Figure 2-28***.

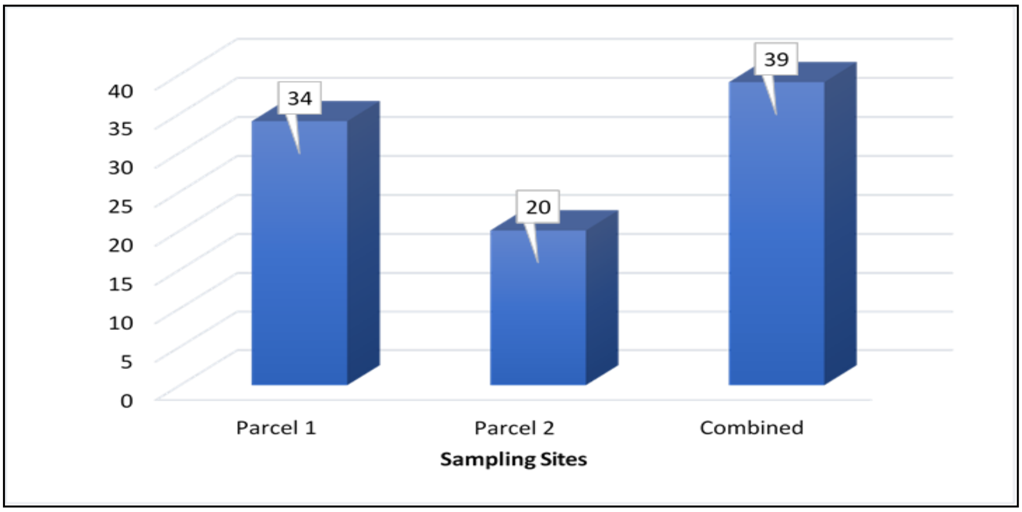


Figure 2-28. Number of Flora Species identified within the quadrants and transects

Parcel 1

There were 34 species of flora that were identified in all sampling stations in Parcel 1. **Table 2-15** below shows the presence of the identified flora species in each sampling station in parcel 1.

Table 2-15. Presence of Identified Species in each station of Parcel 1

Common Name	Scientific Name	Parcel 1						
		Quadrant				Transect		
		Q1	Q2	Q3	Q4	T1	T2	T3
Manggang Kalabaw	*Mangifera indica* var *kalabaw*	*		*			*	
Indian Mango	*Mangifera indica*			*				
Bayag-usa	*Voacanga globosa*						*	
Lanite	*Wrightia pubescens*		*	*	*	*	*	*
Badyang	*Alocasia* sp.	*	*				*	*
Pugahan	*Caryota* sp.					*		*
Papaya	*Carica papaya*						*	
Bulakan	*Decalobanthus peltatus*		*	*		*		
Patola	Unidentified sp. 1							*
Bayog	*Pterospermum* sp.					*		
Alim	*Melanolepis multiglandulosa*	*	*					*
Kamoteng kahoy	*Manihot esculenta*	*						
Acacia	*Albizia saman*							*
Kakawete	*Gliricidia sepium*		*	*		*		
Sampaloc	*Tamarindus indica*					*		
Gmelina	*Gmelina arborea*					*		
Alagau	*Premna odorata*	*						
Lagundi	*Vitex negundo*					*		
Santol	*Sandoricum koetjape*						*	
Mahogany	*Swietenia macrophylla*				*			
Ipil-ipil	*Leucaena sp.*		*		*	*		*
Marang	*Artocarpus odoratissimus*	*		*			*	
Isis	*Ficus ulmifolia*	*	*		*	*	*	
Tibig	*Ficus nota*	*	*		*	*	*	
Niog- niogan	*Ficus pseudopalma*	*						
Hawili	*Ficus septica*	*	*	*				
-	*Ficus sp.*	*			*			
Saba	*Musa acuminata × balbisiana*					*	*	*
Duhat	*Syzygium cumini*						*	
Bignay	*Antidesma bunius*					*		
Kawayang Tinik	*Bambusa spinosa*				*			
Kawayan sp. 2	*Bambusa* sp.							*
Dalandan	*Citrus × aurantium*						*	
Lantana	*Lantana camara*		*					

Parcel 2

There were 20 flora species identified in Parcel 2. **Table 2-16** below shows the presence of these species in each station in Parcel 2.

Table 2-16. Presence of Identified Species in each station of Parcel 2

Common Name	Scientific Name	Parcel 2			
		Quadrant		Transect	
		Q1	Q2	T1	T2
Manggang Kalabaw	*Mangifera indica* var *kalabaw*	*	*		*
Lanite	*Wrightia pubescens*	*			
Minunga	*Macaranga tanarius*	*	*		
Kamoteng kahoy	*Manihot esculenta*	*	*		
Acacia	*Albizia saman*		*	*	
Kakawete	*Gliricidia sepium*	*	*	*	
Gmelina	*Gmelina arborea*	*	*		
Alagau	*Premna odorata*	*			
Ipil-ipil	*Leucaena sp.*	*	*	*	
Marang	*Artocarpus odoratissimus*				*
Isis	*Ficus ulmifolia*	*	*	*	*
Tibig	*Ficus nota*		*		
Niog- niogan	*Ficus pseudopalma*		*		*
Nangka	*Artocarpus heterophyllus*		*		*
Saba	*Musa acuminata × balbisiana*	*		*	*
Bayabas	*Psidium guajava*	*			*
Duhat	*Syzygium cumini*		*		
Kawayang Tinik	*Bambusa spinosa*	*		*	
Usiw	*Dinochloa* sp.		*		
Tabak		*			*

Conservation Status

IUCN Red List

The International Union for Conservation of Nature (IUCN) lists and identifies the threatened species as a group of 3 categories: Vulnerable, Endangered and critically endangered species. The aim of the system is to provide a framework for the broadest classification of species in relation to their corresponding extinction risk.

DAO 2017-11

In the Philippines the Department of Environment and Natural Resources (DENR) issued a list of threatened species of plants in the country. The species of plants listed are monitored by the DENR. The categories fall under critically endangered, endangered, vulnerable and other threatened species. The list is based on scientific and internationally accepted criteria. (DAO 2017- 11).

Table 2-17 below shows the conservation status of the different flora species identified and recorded in all sampling stations. Among all the identified species, *Swietenia macrophylla* (mahogany) and *Ficus ulmifolia (Isis)* were listed in the IUCN list as Vulnerable with *Artocarpus odoratissimus (marang) considered near threatened.* Twenty of the identified species were listed as “Least Concern” or “LC”, four (4) were “Data Deficient” (DD) and the rest are not listed in the IUCN Red List. Among the species identified, *Alpinia elegans* and *Alocasia zebrina* are found in the DAO 2017-11 List as “Vulnerable.”

Table 2-17. Conservation status of floral species observed

Common Name	Family Name	Scientific name	IUCN List*	DAO 2017-11
Manggang Kalabaw	Anacardiaceae	*Mangifera indica* var *kalabaw*	DD	Not Listed
Indian Mango	Anacardiaceae	*Mangifera indica*	DD	Not Listed
Bayag-usa	Apocynaceae	*Voacanga globosa*	Not Listed	Not Listed
Lanite	Apocynaceae	*Wrightia pubescens*	LC	Not Listed
Badiang	Araceae	*Alocasia zebrina*	Not Listed	Vulnerable
Rattan	Araceae	*Calamus* sp.*	LC	Not Listed

Lucmoy	Araceae	Unidentified sp. 3*	Not Listed	Not Listed
Pugahan	Araceae	*Caryota* sp.	LC	Not Listed
Hagonoy	Asteraceae	*Chromolaena odorata**	Not Listed	Not Listed
Papaya	Caricaceae	*Carica papaya*	DD	Not Listed
Bulakan	Convolvulaceae	*Decalobanthus peltatus*	Not Listed	Not Listed
Patola	Cucurbitaceae	Unidentified sp. 1	Not Listed	Not Listed
Bayog	Dombeyaceae	*Pterospermum* sp.	Not listed	Not Listed
Minunga	Euphorbiaceae	*Macaranga tanarius*	LC	Not Listed
Kamoteng kahoy	Euphorbiaceae	*Manihot esculenta*	DD	Not Listed
Alim	Euphorbiaceae	*Melanolepis ultiglandulosa*	LC	Not Listed
Acacia	Fabeceae	*Albizia saman*	Not Listed	Not Listed
Kakawete	Fabeceae	*Gliricidia sepium*	Not listed	Not Listed
Sampaloc	Fabeceae	*Tamarindus indica*	LC	Not Listed
Gmelina	Lamiaceae	*Gmelina arborea*	LC	Not Listed
Alagau	Lamiaceae	*Premna odorata*	Not Listed	Not Listed
Lagundi	Lamiaceae	*Vitex negundo*	LC	Not Listed
Banaba	Lythraceae	*Lagerstroemia speciosa**	Not Listed	Not Listed
Santol	Meliaceae	*Sandoricum koetjape*	LC	Not Listed
Mahogany	Meliaceae	*Swietenia macrophylla*	Vulnerable	Not Listed
Ipil-ipil	Mimosaceae	*Leucaena sp.*	Not listed	Not Listed
Marang	Moraceae	*Artocarpus odoratissimus*	Near Threatened	Not Listed
Langka	Moraceae	*Artocarpus heterophyllus*	Not listed	Not Listed
Tibig	Moraceae	*Ficus nota*	Not Listed	Not Listed
Niog-niogan	Moraceae	*Ficus pseudopalma*	Not listed	Not Listed
Hawili	Moraceae	*Ficus septica*	LC	Not Listed
-	Moraceae	*Ficus* sp.	LC	Not Listed
Isis	Moraceae	*Ficus ulmifolia*	Vulnerable	Not Listed
Saba	Musaceae	*Musa acuminata × balbisian a*	LC	Not Listed
Bayabas	Myrtaceae	*Psidium guajava*	LC	Not Listed
Duhat	Myrtaceae	*Syzygium cumini*	LC	Not Listed
Bignay	Phyllantaceae	*Antidesma bunius*	LC	Not Listed
Kawayang Tinik	Poaceae	*Bambusa spinosa*	Not Listed	Not Listed
Kawayan	Poaceae	*Bambusa* sp.	Not Listed	Not Listed
Amor-seco	Poaceae	*Chrysopogon aciculatus**	Not Listed	Not Listed
Tanglad	Poaceae	*Cymbopogon citratus**	Not Listed	Not Listed
Usiw	Poaceae	*Dinochloa* sp.	Not Listed	Not Listed
Cogon	Poaceae	*Imperata cylindrica**	Not Listed	Not Listed
Carabao Grass	Poaceae	*Paspalum* sp.*	LC	Not Listed
-	Poaceae	*Rottboellia* sp.*	LC	Not Listed

Talahib	Poaceae	*Saccharum spontaneum**	LC	Not Listed
-	Poaceae	*Urochloa* sp.*	LC	Not Listed
Barako	Rubiaceae	*Coffea liberica**	LC	Not Listed
Dalandan	Rutaceae	*Citrus × aurantium*	Not Listed	Not Listed
Lantana	Verbenaceae	*Lantana camara*	Not Listed	Not Listed
Tagbak	Zingiberaceae	*Alpinia elegans*	Not listed	Vulnerable

Relative Abundance

Parcel 1

The area is an agroforest type of habitat given the numerous counts of cultivated species. The following cultivated genera are agriculturally valued: Mangifera, Carica, Tamarindus, Sandoricum, Artocarpus, Musa, Bambusa, and Citrus. Among the mentioned genera, two species were identified as hybrids: Saba (*Musa acuminata × balbisiana*) and Dalandan (*Citrus × aurantium*). The two species Isis (*Ficus ulmifolia*) and Niog-niogan (*Ficus pseudopalma*), which are both endemic in the Philippines, were also found in the area. Both Isis and Niog-niogan are edible and have medicinal uses, with the leaves of Isis also used for cleaning kitchenwares.

a. Parcel 1 Quadrant 1

A total of 11 species with 30 individuals were identified in P1Q1. The most abundant species is Melanolepis multiglandulosa with 26.67% abundance, followed by Alocasia sp. With 20% and Mangifera indica var kalabaw with 10%, followed by *Artocarpus odoratissimus*, *Ficus ulmifolia* and *Ficus nota* with 6.67% abundance each, and *Manihot esculenta*, *Ficus pseudopalma*, *Ficus septica*, *Ficus* sp. With 3.33% each, ***Figure 2-29***.

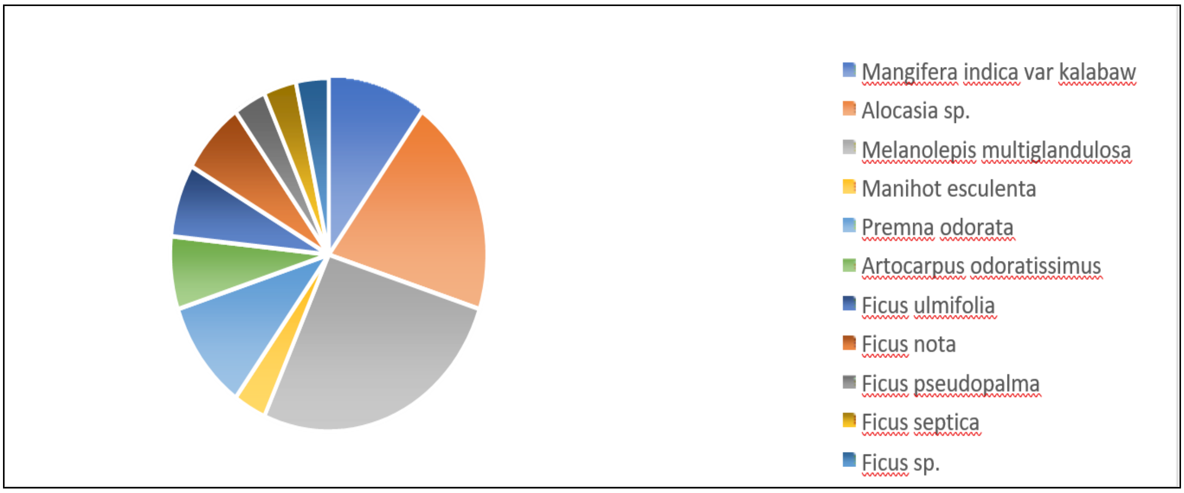


Figure 2-29. Relative Abundance of flora species identified in Parcel 1 Quadrant 1

***Photo 2s**. Quadrant 1 of Parcel 1*

b. Parcel 1 Quadrant 2

There were 10 species with 26 individuals found in P1Q2. Among these species, Alocasia sp. has the highest abundance with 30.77%, it is then followed by *Melanolepis multiglandulosa and Ficus ulmifolia, each with 11.54% abundance, then Decalobanthus peltatus, Gliricidia sepium, Leucaena sp., Ficus nota, Lantana camara comprising of 7.69% each. The least abundant species are Wrightia pubescens and Ficus septica, representing 3.85% each, **Figure 2-30**.*

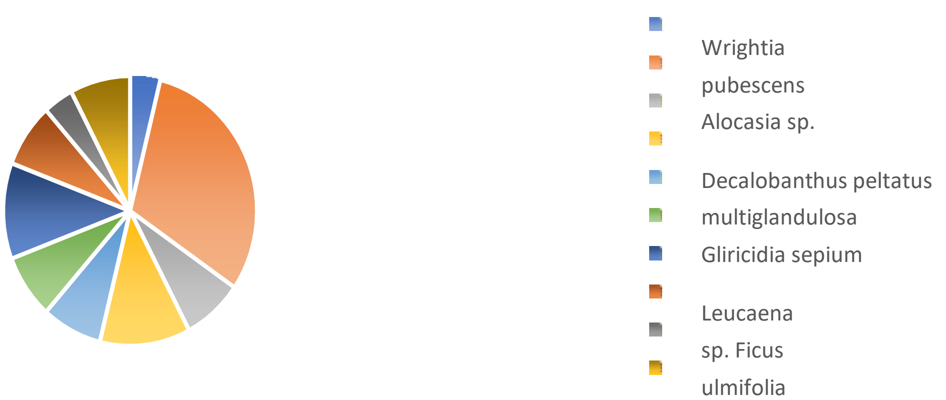


Figure 2-30. Relative Abundance of flora species identified in Parcel 1 Quadrant 2

***Photo 2t**. Quadrant 2 of Parcel 1*

c. Parcel 1 Quadrant 3

There were seven (7) species with a total of 14 individuals identified in P1Q3. Among the identified species, *Wrightia pubescens, Gliricidia sepium, Ficus septica* are the most abundant with 21.43%, followed by *Mangifera indica* with 14.29 % abundance, and the following species each have 7.14% abundance: Mangifera indica var kalabaw, Decalobanthus peltatus, Artocarpus odoratissimus, ***Figure 2-31***.

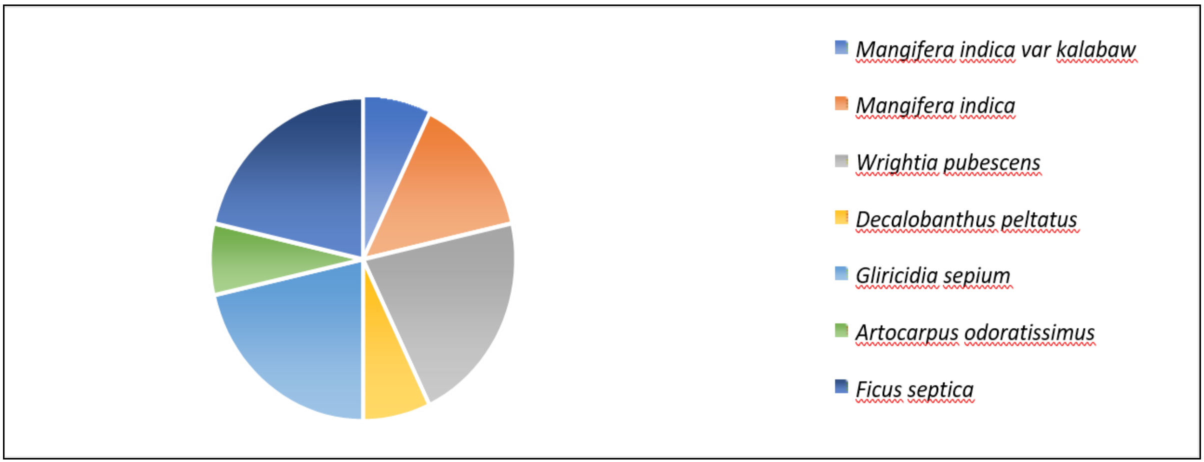


Figure 2-31. Relative Abundance of flora species identified in Parcel 1 Quadrant 3

***Photo 2u**. Quadrant 3 of Parcel 1*

d. Parcel 1 Quadrant 4

A total of 18 individuals were observed in P1Q4 belonging to seven (7) species. The species with the highest abundance is *Wrightia pubescens* with 33.33%, followed by *Ficus ulmifolia* and *Ficus sp*., each with 16.67% abundance, *Leucaena sp.* and *Ficus nota* with 11.11% abundance each. The least abundant species were *Swietenia macrophylla* and *Bambusa spinosa* with 5.56% each, ***Figure 2-32***.

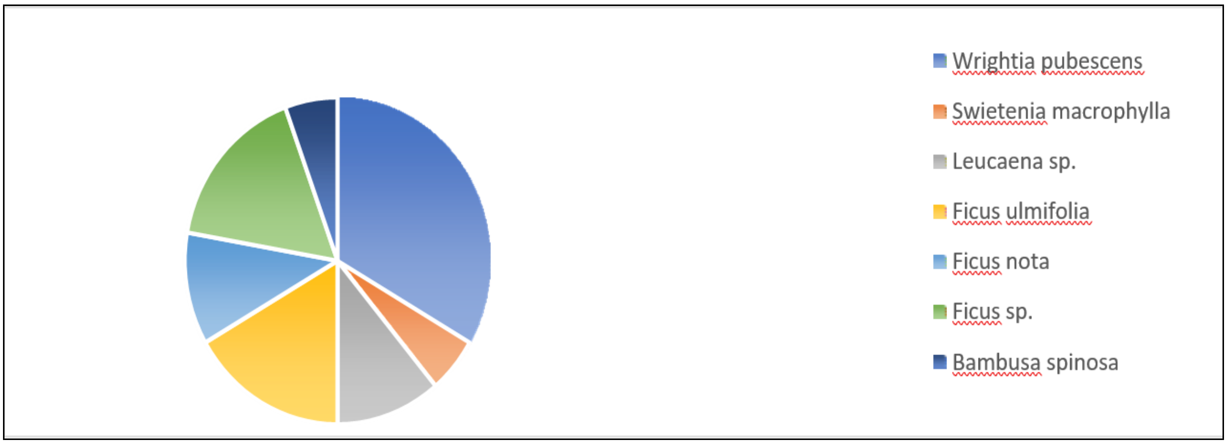


Figure 2-32. Relative Abundance of flora species identified in Parcel 1 Quadrant 4

***Photo 2v**. Quadrant 4 of Parcel 1*

e. Parcel 1 Transect 1

A total of 53 individuals belonging to 11 species were identified in P1T1. *Wrightia pubescens* has the highest abundance in the station with 26.42%, followed by *Gliricidia sepium* with 16.98%, *Leucaena sp.* and *Musa acuminata × balbisiana*, each with 15.09%, Pterospermum sp. and Gmelina arborea, each with 7.55% abundance, and *Tamarindus indica with 3.77% abundance.* The species with the least abundance identified in the station are *Caryota sp., Decalobanthus peltatus, Vitex negundo, Antidesma bunius*, each with 1.89% abundance, ***Figure 2-33***.

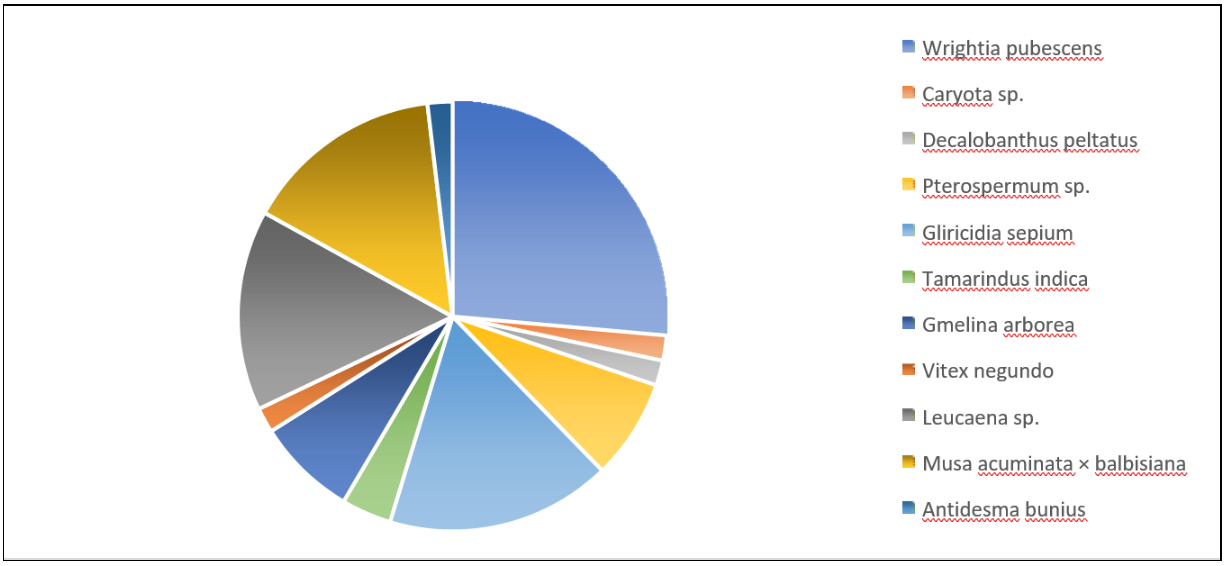


Figure 2-33. Relative Abundance of flora species identified in Parcel 1 Transect 1

***Photo 2w**. Transect 1 of Parcel 1*

f. Parcel 1 Transect 2

There were 12 species identified in the area, with a total of 27 individuals. The most abundant species was *Wrightia pubescens* with seven individuals or 25.93%, followed by *Mangifera indica var kalabaw, Alocasia sp. , Ficus ulmifolia , Musa acuminata × balbisian,* each with three (3) individuals or 11.11% abundance, then *Ficus nota* with 7.41% abundance (2 individuals), and finally, one (1) individual was found for the following species or 3.7%: *Voacanga globosa, Carica papaya, Sandoricum koetjape, Artocarpus odoratissimus, Syzygium cumini,Citrus × aurantium,* ***Figure 2-34****.*

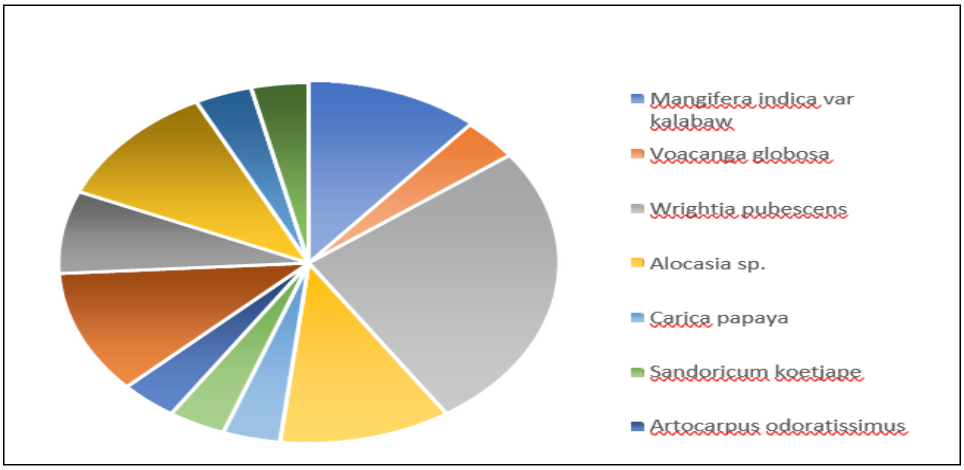


Figure 2-34. Relative Abundance of flora species identified in Parcel 1 Transect 2

***Photo 2x**. Transect 2 of Parcel 1*

g. Parcel 1 Transect 3

There were 47 individuals identified in P1T3, belonging to 12 different species. The species with the highest abundance was *Musa acuminata × balbisiana with 27.66%, followed by Wrightia pubescens with 17.02%, followed by Ficus nota* with an abundance of 10.64%, *Melanolepis multiglandulosa and Ficus ulmifolia* with 8.51% abundance each, then *Alocasia sp.* and *Ficus sp. with 6.38% each, Leucaena sp.* and *Bambusa sp*. with 4.26% abundance each. The species in the area with the lowest abundance of 2.13% each are *Caryota sp., Unidentified sp. 1 Iand Albizia saman,* ***Figure 2-35.***

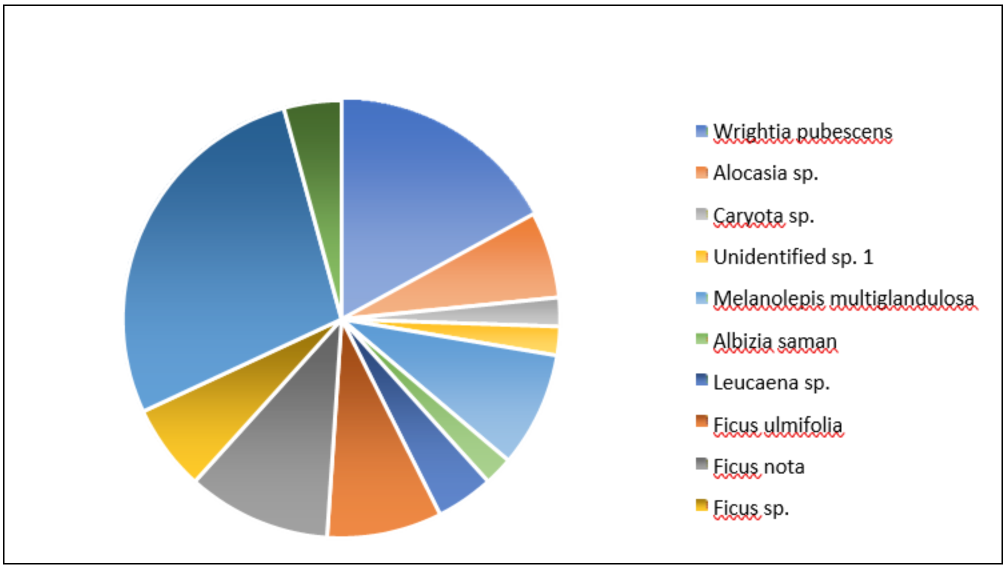


Figure 2-35. Relative Abundance of flora species identified in Parcel 1 Transect 3

***Photo 2y**. Transect 3 of Parcel 1*

Parcel 2

a. Parcel 2 Quadrant 1

There were 13 species consisting of 44 individuals which were identified in the sampling stations. Among the species identified, *Leucaena* sp. has the highest number of individuals identified with nine (9) or 20.45%, it is followed by *Musa acuminata × balbisiana* with seven (7) individuals or 15.91%, *Gliricidia sepium* with six (6) individuals or 13.64%, *Ficus ulmifolia* with five (5) individuals or 11.36%, *Wrightia pubescens* with four (4) individuals or 9.09%, and *Gmelina arborea* with three (3) individuals or 6.82%, *Manihot esculenta, Psidium guajava, Unidentified sp. 2,* each with Two (2) individuals or 4.55%. Finally, the following species has an abundance of 2.27%, with one individual identified for each species: *Mangifera indica var kalabaw, Macaranga tanarius, Premna odorata, Bambusa spinosa*is, ***Figure 2-36***.

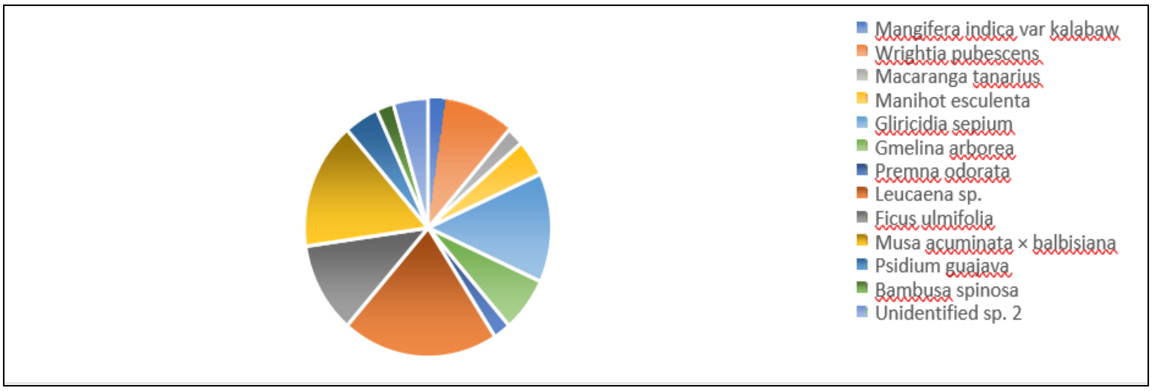


Figure 2-36. Relative Abundance of flora species identified in Parcel 2 Quadrant 1

***Photo 2z**. Quadrant 1 of Parcel 2*

b. Parcel 2 Quadrant 2

There were 12 species found in P2Q2, with a total of 25 individuals. The species with the highest abundance is *Ficus ulmifolia* with 10 individuals or 40.00%, it is followed by *Ficus nota with three (*3) individuals found or 12.00%, *Gliricidia sepium* and *Artocarpus heterophyllus* with two (2) individuals each or 8% abundance, and finally, there was one (1) individual found or 4% abundance for each of the following species: *Mangifera indica var kalabaw, Macaranga tanarius, Manihot esculenta , Albizia saman, Leucaena sp., Ficus pseudopalma, Syzygium cumini,* and *Dinochloa sp.*, ***Figure 2-37.***

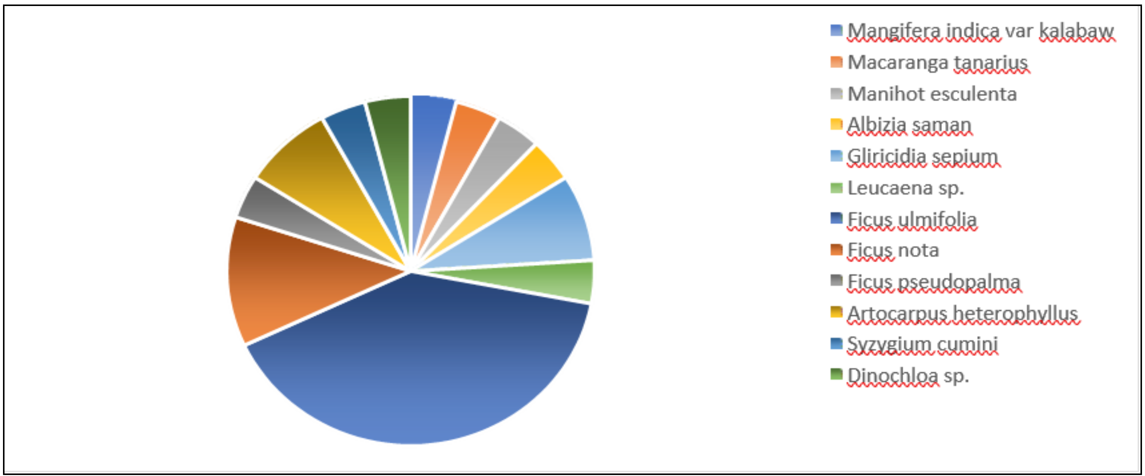


Figure 2-37. Relative Abundance of flora species identified in Parcel 2 Quadrant 2

***Photo 2aa**. Quadrant 2 of Parcel 2*

c. Parcel 2 Transect 1

A total of 58 individuals belonging to seven (7) species were found in the station. The most abundant species found in the station is *Musa acuminata × balbisiana with 79.31%* or 46individuals, it is followed by *Manihot esculenta, Albizia saman,* and *Ficus ulmifolia,* each with 5.17 percent or three (3) individuals each, and finally, *Gmelina arborea, Leucaena sp., Bambusa spinosa* comprise the remaining species found in the station with an abundance of 1.72% each or one (1) individual found for each species, ***Figure 2-38***.

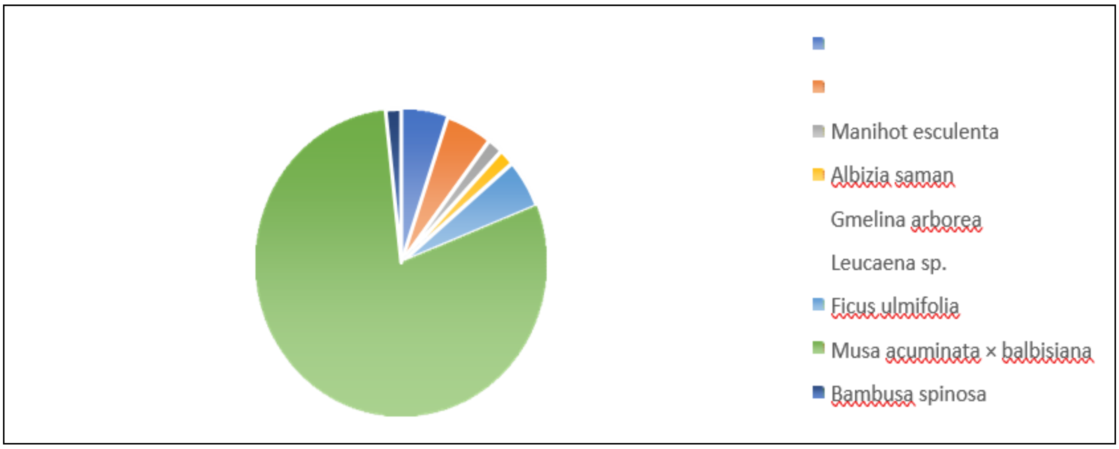


Figure 2-38. Relative Abundance of flora species identified in Parcel 2 Transect 1

***Photo 2bb**. Transect 1 of Parcel 2*

d. Parcel 2 Transect 2

There were 60 individuals identified in the station belonging to nine (9) species. The most abundant species is *Musa acuminata × balbisiana* with 39 individuals or 65.00%, followed by *Mangifera indica var kalabaw* with five (5) individuals or 8.33%, *Ficus pseudopalma* with four (4) individuals or 6.67%, *Manihot esculenta, Ficus ulmifolia* , and *Artocarpus heterophyllus with 5%* each or three (3) individuals found for each species, and lastly *Artocarpus odoratissimus, Psidium guajava,* and *Unidentified sp. 2* with 1.67% abundance or one (1) individual found for each species, ***Figure 2-39***.

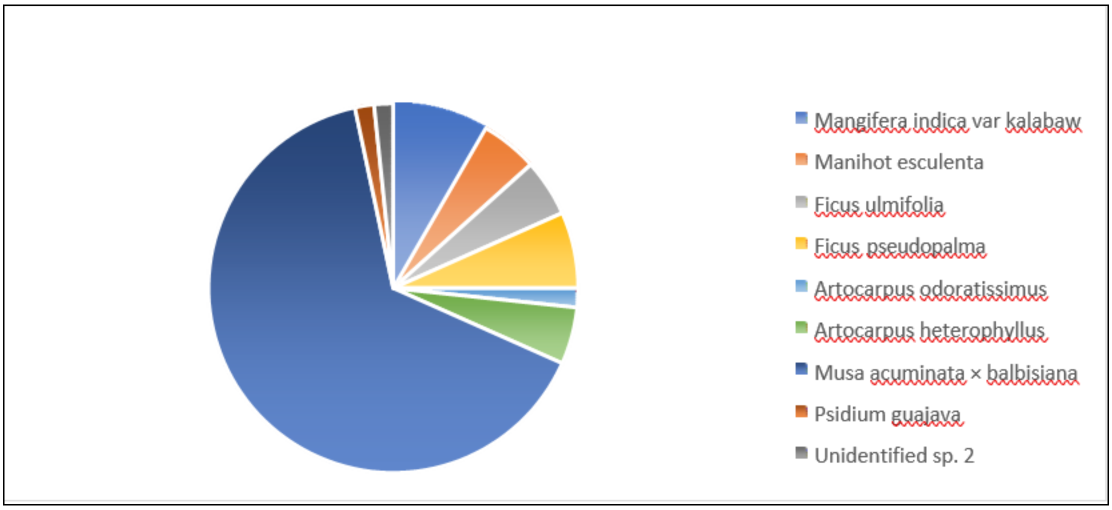


Figure 2-39. Relative Abundance of flora species identified in Parcel 2 Transect 2

***Photo 2cc**. Transect 2 of Parcel 2*

***Photo 2dd**. Aerial view of Transect 2 of Parcel 2*

Species Listing

There was a total of 51 flora species observed both parcel 1 and parcel 2. The following are representative species observed in the area:

***Photo 2ee**. Badlang (Alocasia zebrina)*

***Photo 2ff.** Saba (Musa acuminata x balbisiana)*

Photo 2gg. *Lanite (Wrightia pubescens)*

Photo 2hh. *Manggang Kalabaw (Mangifera indica var kalabaw)*

***Photo 2ii**. Santol (Sandoricum koetjape)*

***Photo 2jj**. Niog-niogan (Ficus pseudopalma)*

Photo 2kk. *Cogon (Imperata cylindrica)*

Photo 2ll. *Lantana (Lantana camara)*

Photo 2mm*. Alim (Melanolepsis multiglandulosa)*

Photo 2nn*. Ipil-ipil (Leucaena sp.)*

***Photo 2oo**. Kakawete (Gliricidia sepium)*

***Photo 2pp**. Kawayang Tinik (Bambusa spinosa)*

Vegetation Removal and Loss of Habitat

It is expected that all vegetation found in Parcel 1 and Parcel 2 will be removed due to the nature of the proposed project. Based on Table 2-17. Conservation status of floral species observed, among all the identified species, *Swietenia macrophylla* (mahogany) and *Ficus ulmifolia (Isis)* were listed in the IUCN list as Vulnerable with *Artocarpus odoratissimus (marang) considered near threatened.* Twenty of the identified species were listed as "Least Concern" or "LC", four (4) were "Data Deficient" (DD) and the rest are not listed in the IUCN Red List. Among the species identified, *Alpinia elegans* and *Alocasia zebrina* are found in the DAO 2017-11 List as "Vulnerable.

Threat to Existence And/Or Loss of Important Local Species

One threatened species was recorded in the sampling sites that falls under the "vulnerable" category of 2017 IUCN Red List of Threatened Species: Mahogany (Swietenia macrophylla), and is well distributed in the country, Marang *(Artocarpus odoratissimus)* considered near threatened and Isis (*Ficus ulmifolia)* were listed in the IUCN list as Vulnerable. There are no special or important local species identified inside the property area.

Threat to Abundance, Frequency and Distribution of Important Species

Species with highest importance value are Saba (*Musa acuminata × balbisiana*), Mahogany (*Swietenia macrophylla*), Mahogany (Swietenia macrophylla), Marang *(Artocarpus odoratissimus)* considered near threatened and Isis (*Ficus ulmifolia)* and Gmelina *(Gmelina arborea).*

IMPACT ASSESSMENT AND MITIGATION

The total minable covered area shall be stripped and removed due to major excavation. Parcel 1 from current 120 masl to 92 masl final elevation while Parcel 2 from 90 masl tp 76 final elevation. The area to be cleared is limited to the identified quarry area which is about 32.70 hectares for Parcel 1 and 9.90 hectares for Parcel 2.

During Construction and Operation Phase

<u>Loss of Existing Vegetation</u>

Mitigating Measures

- Observed excluded area and buffer zone at least 30-meters from the Road, Agri-industrial and residential area;
- In coordination with PENRO, the proponent should plant a total of 17,040 seedling in any part of the protected area in participation for the National Greening Program (NGP). The basis for computation is total quarry area of 42.60 hectares divided by 25 square meters.
- Bamboo Forestation along the buffer zones planted 7.0 meters apart
- Implement Progressive Rehabilitation thru final grading based on the proposed final land use.

<u>Solid Waste Generation of the Workers</u>

Excess construction debris will be generated during the construction and Operation phase.

Solid waste to be generated by the laborers is very minimal. It is mainly compost of left-over food and food wrappers such as paper, cartons and plastics.

Mitigating Measures

To minimize the impact of the solid waste, a temporary area within the site will be designated for storage and segregation of solid wastes prior to final disposal or putting a color-coded garbage bins for identification of biodegradable and non-biodegradable. A solid waste management system that encourages recycling will be established and enforced during the construction and operation phase.

Contribution in terms of Greenhouse Gas Emission

The projected greenhouse gas emissions (GHG) emanating from the project operation were determined by estimating the total fuel consumption and used of the GHG calculation tool of the World Resources Institute (WRI) named GHG protocol tool for mobile combustion, Version 2.6. Fuel consumption per equipment or source was estimated based on Klanfar, et al. (2016), "Fuel Consumption and Engine Load Factors of Equipment in Quarrying of Crushed Stone".

Based on the number of equipment and its corresponding rated power, fuel consumption and GHG emissions were estimated using the calculation spreadsheets shown in Annex H.5, the results of which are summarized as follows:

- Total estimated fuel consumption from vehicles/mobile sources = 626.38 cubic meter per year
- Total estimated GHG emissions = 1676.398 metric tons per year

The total GHG emissions per year is relatively low as compared to other large mining projects. It is recommended, however, that GHG accounting program be implemented to determine the actual GHG emissions and to determine the appropriate measures to reduce said emissions.

Mitigating Measures

Measures to control GHG emissions include minimization of idling time by shutting equipment off when not in use or reducing the time of idling, i.e., not more than 3 minutes. Fuel efficient vehicles and heavy equipment should also be used and well maintained. The number of vehicle trips should also be reduced, if necessary, based on operational requirements.

GHG emissions should also be offset by implementing an extensive rehabilitation and reforestation program for the project thru and in coordination with the Local Government Units (LGU) planting of local species outside if the project or in an identified streets and open areas that serves as the no-development zone in the municipalities.

Bamboo Forestation along the buffer zones planted 7.0 meters apart and Implement Progressive Rehabilitation thru final grading based on the proposed final land use.

Generation of Hazardous Wastes

Hazardous waste generated by the project operation is coming from the used oil during maintenance (change oil) of equipment.

Mitigating Measures

Hazardous material is stored separately from other material and hauled by an accredited treater for treatment. This may be accomplished by:

- Separate storage area and has an adequate safety distances from other materials;
- Hazardous materials are stored to prevent exposure to direct sunlight or located heat
- Hazardous storage area is properly and prominently marked or identified; and
- Hazardous area shall be secured at all times with access only to authorized personnel.

Storage Management

- Workers eating facilities, rest areas, lockers, and comfort rooms are far from hazardous materials storage and work areas.
- Those managing the workplace are responsible for ensuring that the inventory is complete, accurately maintained and updated as changes occur. The inventory list shall be available to all employees and safety officers.

2.1.4.3 Terrestrial Fauna

Parcel 1 has a total area of 82.80 hectares with quarry area of 32.70 hectares and Parcel 2 has a total area of 31.7206 hectares with quarry area of 9.9 hectares. The study area had undergone varying degree of disturbances; however, the covered areas still provide a suitable habitat for various avifauna and mammal species.

AVIFAUNA

There are about 600 bird species or 6% of the world's avifauna which are found in the Philippines. Since the country has a wide range of habitats such as tropical forests, mangrove areas, peat swamp forests and montane forests it supports a huge diversity of birds that results to high endemism.

There were 45 species of birds identified in all the sampling stations. After field collection it was observed that all avian species present in the area are assessed as "least concern" in reference to the IUCN Red List which means that the observed species are very common species and their population is stable and DAP 2004-15. There were eight (8) species identified to be endemic in the Philippines: *Phapetreron leucotis, Centropus viridis, Collocalia troglodytes, Hypsipetes philippinus, Pycnonotus urostictus, Parus elegans, Stachyris nigrocapitata, Zosterops meyeni.* Two of the endemic species are found to be Luzon-endemic namely: *Stachyris nigrocapitata, Zosterops meyeni*. All the other species found were resident avian species.

The most abundant species was the Philippine bulbul (*Hypsipetes philippinus*) with 165 individuals. This species was very adaptable to human habitation and could they could exist in those types of disturbed habitat. There were also a few nectar and fruit eating bird species observed in the area.

Aside from catching birds through mist nets, bird watching and listening to acoustic calls, and interviewing locals was done to identify the birds in the stations established.

Sampling Stations

There were 13 established sampling stations for avifauna see **Tables 2-18 and Table 2-19, Figure 2-40 for Sampling Map** below.

Table 2-18. Geographical location of AviFauna sampling stations in Parcel 1

Station	Latitude	Longitude	Elevation (masl)
1	14°34.783' N	121°14.668' E	95
2	14°34.739' N	121°14.688' E	111
3	14°34.695' N	121°14.695' E	108
4	14°34.679' N	121°14.712' E	123
5	14°34.683' N	121°14.769' E	110
6	14°34.688' N	121°14.798' E	103
7	14°34.678' N	121°14.823' E	110
8	14°34.682' N	121°14.836' E	113

Table 2-19. Geographical locations of AviFauna sampling stations in Parcel 2

Station	Latitude	Longitude	Elevation (masl)
1	14°34.629' N	121°14.125' E	82
2	14°34.680' N	121°14.087' E	78
3	14°34.703' N	121°14.086' E	81
4	14°34.735' N	121°14.112' E	82
5	14°34.737' N	121°14.162' E	82

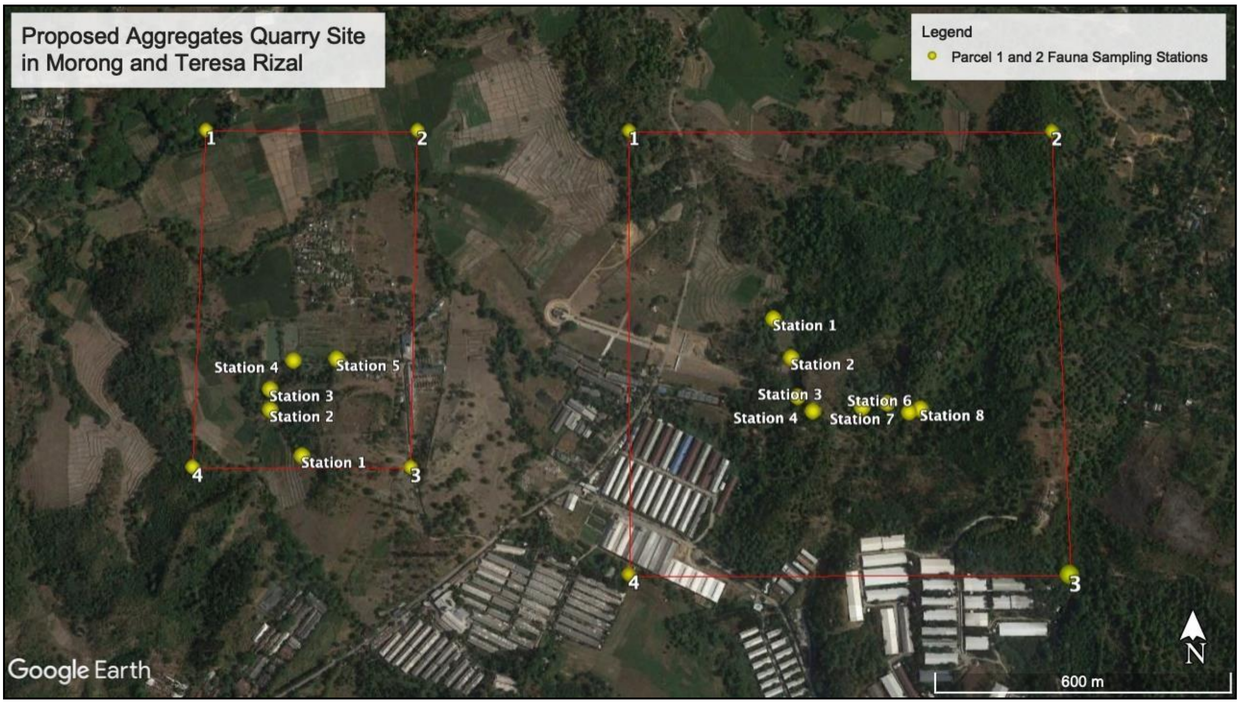


Figure 2-40. Visual Representation of the sampling stations for AviFauna Assessment in Parcels 1 and 2

Species Richness

There were 45 birds observed in both parcels 1 and 2. The following are representative species observed in the area.

***Photo 2qq**. Common Moorhen (Galllinula chloropus)*

***Photo 2rr**. Zebra Dove (Geophelia striata)*

***Photo 2ss**. Spotted Dove (Streptopelia chinensis)*

Photo 2tt*. Common Emerald-Dove (Chalcophaps indica)*

Photo 2uu*. Philippine Coucal (Centropus viridis)*

Photo 2vv*. Glossy Swiftlet (Collocalia esculenta)*

***Photo 2ww**. White-collared Kingfisher (Todirampus chloris)*

***Photo 2xx**. White-throated Kingfisher (Halcyon smyrnensis)*

***Photo 2yy**. Blue-Tailed Bee-eater (Merops philippinus)*

Photo 2zz. *Hooded Pitta (Pitta sordid)*

Photo 2aaa. *Philippine Bulbul (Hypsipetes philippinus)*

Photo 2bbb. *Oriental Magpie Robin (Copsychus saularis)*

Photo 2ccc. *Black-Nape Oriole (Oriolus chinensis)*

Photo 2ddd. *Large-billed Crow (Corvus macrorhynchos)*

Photo 2eee. *Tawny Grassbird (Megalurus timoriensis)*

Photo 2fff*. Striated Grassbird (Megalurus palustris)*

Photo 2ggg*. Pied Fantail (Rhipidura javanica)*

Photo 2hhh*. Mangrove Blue Flycatcher (Cyornis rufigastra)*

Photo 2iii*. Immature Mountain Verditer-Flycatcher (Eumyias panamis)*

Photo 2jjj*. White-breasted Wood Swallow (Artamus leucorynchus)*

Photo 2kkk*. Long-tailed Shrike (Lanius schach)*

***Photo 2lll**. Eurasian Tree Sparrow (Passer montanus)*

***Photo 2mmm**. Black-headed Munia (Lonchura atricapilla)*

***Photo 2nnn**. Scaly-breasted Munia (Lonchura punctulata)*

Parcel 1

A total of 43 species of birds were observed in Parcel 1, **Table 2-20**, which belongs to 25 families. The families Apopidae, Columbidae and Muscicapidae have the highest species richness among all families found in the area. Family Apopidae is composed of swift birds; Columbidae is primarily composed of doves and pigeons; and Muscicapidae is composed of old-world flycatchers. Swift birds and old-world flycatchers observed in the area are flying insects and airborne spider eater. Species which belong to the family Columbidae observed in the area were mostly known to be arboreal and feeds on fruits. Presence of species within this family can be primarily attributed to the abundance of fruit bearing trees. In addition, the presence of fruit bearing trees in the area is also well supported by the abundance of the families Pycnonotidae, and Sylviidae.

Table 2-20. Species Richness of Parcel 1

Family	*Scientific Name*	Common Name
Accipitridae	*Haliastur indus*	Brahminy Kite
Alcedinidae	*Todirampus chloris*	White-collared Kingfisher
	Halcyon smyenensis	White-Throated Kingfisher
Apodidae	*Collocalia esculenta*	Glossy Swiftlet
	Collocalia vanikorensis	Island Swiftlet
	Collocalia troglodytes	Pygmy Swiftlet
	Hirundapus celebebsis	Purple Needletail
Ardeidae	*Bubulcus ibis*	Cattle Egret
	Egretta garzetta	Little Egret
Artamidae	*Artamus leucorynchus*	White-breasted Wood-Swallow
Caprimulgidae	*Eurostopodus macrotis*	Great Eared Nightjar
Columbidae	*Phapetreron leucotis*	White-eared Brown-Dove
	Geophelia striata	Zebra Dove
	Streptopelia chinensis	Spotted Dove
	Chalcopaps indica	Common Emerald Dove
Corvidae	*Corvus macrorhynchos*	Large-billed Crow
Cuculidae	*Cacomantis variolosus*	Brush Cuckoo
	Centropus viridis	Philippine Coucal
Dicaeidae	*Decaeum trigonostigma*	Orange-bellied Flowerpecker
Estrildidae	*Lonchura punctulata*	Scaly-breasted Munia
Hirundunidae	*Hirundo tahitica*	Pacific Swallow
Laniidae	*Lanius schach*	Long-Tailed Shrike
Meropidae	*Merops philippinus*	Blue-Tailed Bee-eater
Muscicapidae	*Rhipidura javanica*	Pied Fantail
	Hypothymis azurea	Black-nape Monarch

Family	*Scientific Name*	Common Name
	Cyornis rufigastra	Mangrove Blue Flycatcher
	Eumyias panayensis	Mountain Verditer-Flycatcher
Nectariniidae	*Nectarinia jugularis*	Olive-backed Sunbird
Oriolidae	*Oriolus chinensis*	Black-Nape Oriole
Pittidae	*Pitta sordida*	Hooded Pitta
Ploceidae	*Passer montanus*	Eurasian Tree Sparrow
Pycnonotidae	*Pycnonotus goiavier*	Yellow-vented Bulbul
	Hypsipetes philippinus	Philippine Bulbul
	Pycnonotus urostictus	Yellow-wattled Bulbul
Rallidae	*Galliralus torquatus*	Barred Rail
	Galllinula chloropus	Common Moorhen
	Amaurornis phoenicurus	White-Breasted Waterhen
Sylviidae	*Megalurus timoriensis*	Tawny Grassbird
	Megalurus palustris	Striated Grassbird
	Cisticola exilis	Bright-Capped Cisticola
Timaliidae	*Stachyris nigrocapitata*	Black-crowned Babbler
Turdidae	*Copsychus saularis*	Oriental Magpie-Robin
Zosteropidae	*Zosterops meyeni*	Lowland White-eye

Parcel 2

A total of 42 species of birds were observed in Parcel 2 which belongs to 25 families, **Table 2-21**. The families with the highest species richness are Apopidae and Columbidae, followed by Pycnonotidae, Rallidae and Sylviidae.

Table 2-21. Species Richness of Parcel 2

Family	*Scientific Name*	Common Name
Accipitridae	*Haliastur indus*	Brahminy Kite
Alcedinidae	*Todirampus chloris*	White-collared Kingfisher
	Halcyon smyenensis	White-Throated Kingfisher
Apodidae	*Collocalia esculenta*	Glossy Swiftlet
	Collocalia vanikorensis	Island Swiftlet
	Collocalia troglodytes	Pygmy Swiftlet
	Hirundapus celebebsis	Purple Needletail
Ardeidae	*Bubulcus ibis*	Cattle Egret
	Egretta garzetta	Little Egret
Artamidae	*Artamus leucorynchus*	White-breasted Wood-Swallow
Caprimulgidae	*Eurostopodus macrotis*	Great Eared Nightjar
Columbidae	*Phapetreron leucotis*	White-eared Brown-Dove
	Geophelia striata	Zebra Dove

	Streptopelia chinensis	Spotted Dove
	Chalcopaps indica	Common Emerald Dove
Corvidae	*Corvus macrorhynchos*	Large-billed Crow
Cuculidae	*Cacomantis variolosus*	Brush Cuckoo
	Centropus viridis	Philippine Coucal
Dicaeidae	*Decaeum trigonostigma*	Orange-bellied Flowerpecker
Estrildidae	*Lonchura punctulata*	Scaly-breasted Munia
	Lonchura atricapella	Black-headed Munia
Laniidae	*Lanius schach*	Long-Tailed Shrike
Meropidae	*Merops philippinus*	Blue-Tailed Bee-eater
Musicapidae	*Rhipidura javanica*	Pied Fantail
	Eumyias panayensis	Mountain Verditer-Flycatcher
Nectariniidae	*Nectarinia jugularis*	Olive-backed Sunbird
Oriolidae	*Oriolus chinensis*	Black-Nape Oriole
Paridae	*Parus elegans*	Elegant Tit
Pittidae	*Pitta sordida*	Hooded Pitta
Ploceidae	*Passer montanus*	Eurasian Tree Sparrow
Pycnonotidae	*Pycnonotus goiavier*	Yellow-vented Bulbul
	Hypsipetes philippinus	Philippine Bulbul
	Pycnonotus urostictus	Yellow-wattled Bulbul
Timaliidae	*Stachyris nigrocapitata*	Black-crowned Babbler
Turdidae	*Copsychus saularis*	Oriental Magpie-Robin
Rallidae	*Galliralus torquatus*	Barred Rail
	Galllinula chloropus	Common Moorhen
	Amaurornis phoenicurus	White-Breasted Waterhen
Sylviidae	*Megalurus timoriensis*	Tawny Grassbird
	Megalurus palustris	Striated Grassbird
	Cisticola exilis	Bright-Capped Cisticola
Zosteropidae	*Zosterops meyeni*	Lowland White-eye

Presence

Forty-five (45) different species of birds were identified in both parcels 1 and 2, **Table 2-22** below shows the species of birds found in each parcel.

Table 2-22. Presence of Bird Species in Parcel 1 and Parcel 2

Scientific Name	Common Name	Parcel 1	Parcel 2
Bubulcus ibis	Cattle Egret	IKS, OBS, ABS	IKS, OBS, ABS
Egretta garzetta	Little Egret	IKS, OBS, ABS	IKS, OBS, ABS
Haliastur indus	Brahminy Kite	IKS, OBS, ABS	IKS, OBS, ABS
Galliralus torquatus	Barred Rail	Present, OBS	Present, OBS
Galllinula chloropus	Common Moorhen	IKS, OBS, ABS	IKS, OBS, ABS
Amaurornis phoenicurus	White-Breasted Waterhen	Present, OBS	Present, OBS
Phapetreron leucotis	White-eared Brown-Dove	Present, OBS	Present, OBS
Geophelia striata	Zebra Dove	Present, OBS	Present, OBS
Streptopelia chinensis	Spotted Dove	Present, OBS	Present, OBS
Chalcopaps indica	Common Emerald Dove	Present, OBS	Present, OBS
Cacomantis variolosus	Brush Cuckoo	Present, OBS	Present, OBS
Centropus viridis	Philippine Coucal	Present, OBS	Present, OBS
Eurostopodus macrotis	Great Eared Nightjar	Present, OBS	Present, OBS
Collocalia esculenta	Glossy Swiftlet	Present, OBS	Present, OBS
Collocalia vanikorensis	Island Swiftlet	Present, OBS	Present, OBS
Collocalia troglodytes	Pygmy Swiftlet	Present, OBS	Present, OBS
Hirundapus celebebsis	Purple Needletail	Present, OBS	Present, OBS
Todirampus chloris	White-collared Kingfisher	Present, OBS	Present, OBS
Halcyon smyenensis	White-Throated Kingfisher	Present, OBS	Present, OBS
Merops philippinus	Blue-Tailed Bee-eater	Present, OBS	Present, OBS
Pitta sordida	Hooded Pitta	Present, OBS	Present, OBS
Hirundo tahitica	Pacific Swallow	Present, OBS	Present, OBS
Pycnonotus goiavier	Yellow-vented Bulbul	Present, OBS	Present, OBS
Hypsipetes philippinus	Philippine Bulbul	Present, OBS	Present, OBS
Pycnonotus urostictus	Yellow-wattled Bulbul	Present, OBS	Present, OBS
Oriolus chinensis	Black-Nape Oriole	Present, OBS	Present, OBS
Corvus macrorhynchos	Large-billed Crow	IKS, OBS, ABS	IKS, OBS, ABS
Parus elegans	Elegant Tit	ABS	Present, OBS
Stachyris nigrocapitata	Black-crowned Babbler	Present, OBS	Present, OBS
Copsychus saularis	Oriental Magpie-Robin	Present, OBS	Present, OBS
Megalurus timoriensis	Tawny Grassbird	Present, OBS	Present, OBS
Megalurus palustris	Striated Grassbird	Present, OBS	Present, OBS
Cisticola exilis	Bright-Capped Cisticola	Present, OBS	Present, OBS
Rhipidura javanica	Pied Fantail	Present, OBS	Present, OBS
Hypothymis azurea	Black-nape Monarch	Present, OBS	ABS
Cyornis rufigastra	Mangrove Blue Flycatcher	Present, OBS	ABS
Eumyias panayensis	Mountain Verditer-Flycatcher	Present, OBS	Present, OBS
Artamus leucorynchus	White-breasted Wood- Swallow	Present, OBS	Present, OBS
Lanius schach	Long-Tailed Shrike	Present, OBS	Present, OBS
Nectarinia jugularis	Olive-backed Sunbird	Present, OBS	Present, OBS
Decaeum trigonostigma	Orange-bellied Flowerpecker	Present, OBS	Present, OBS
Zosterops meyeni	Lowland White-eye	Present, OBS	Present, OBS
Passer montanus	Eurasian Tree Sparrow	Present, OBS	Present, OBS

Scientific Name	Common Name	Parcel 1	Parcel 2
Lonchura punctulata	Scaly-breasted Munia	Present, OBS	Present, OBS
Lonchura atricapella	Black-headed Munia	ABS	Present, OBS

**IKS – Indigenous Knowledge System*
**OBS – Observed either through IKS or during sampling*
**ABS – Absent during actual sampling*

Abundance

A total of 1,097 individual birds were observed during the sampling period. 537 of these species were observed in Parcel 1 while 560 were observed in Parcel 2.

Parcel 1

The three (3) most abundant species are the *Pycnonotus goiavier* or the Yellow-vented Bulbul with 54 individuals, the *Hypsipetes philippinus* or the Philippine Bulbul with 47 individuals, and *Todirampus chloris* or the White-collared Kingfisher with 30 individuals. ***Figure 2-41*** below shows the abundance of birds in the parcel.

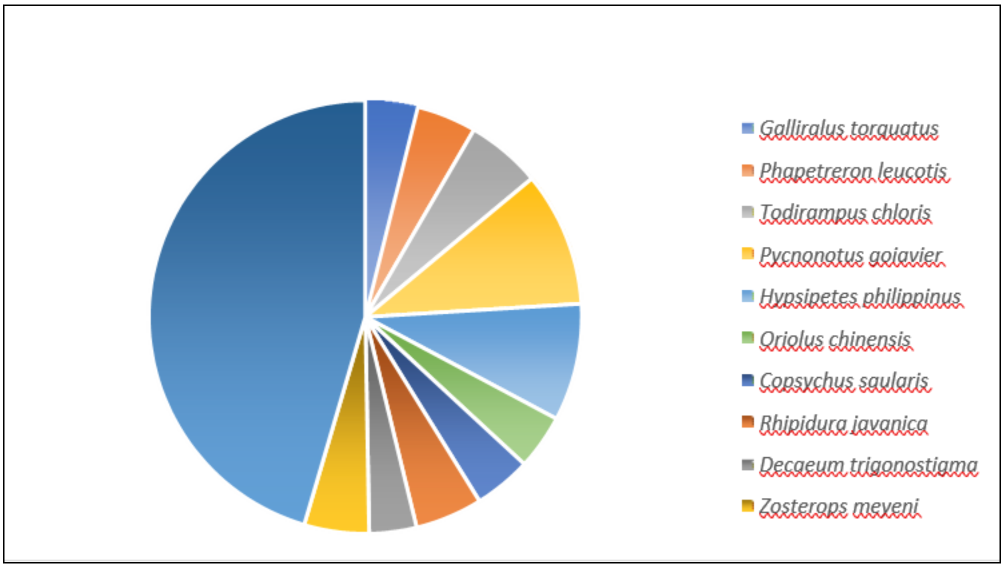


Figure 2-41. Relative Abundance of birds in Parcel 1

Parcel 2

The three (3) most abundant species are the *Hypsipetes philippinus* or the Philippine bulbul with 118 individuals, the *Todirampus chloris* or the White-collared Kingfisher with 38 individuals and the *Oriolus chinensis* or the Black Nape Oriole with 31 individuals. ***Figure 2-42*** below shows the abundance of birds in the parcel.

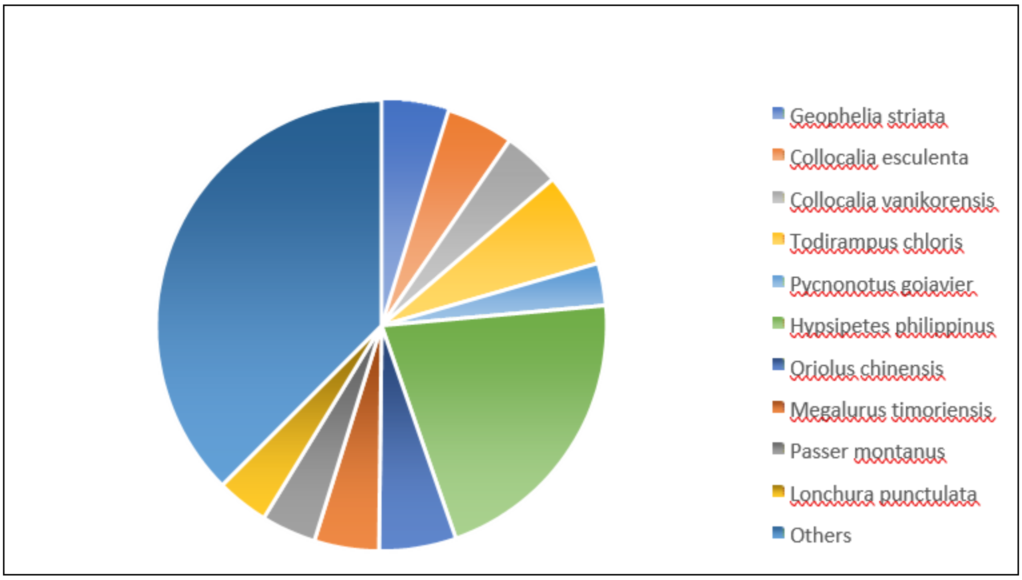


Figure 2-42. Relative Abundance of birds in Parcel 2

Distribution

Table 2-23, forty-five (45) species that were identified in all sampling sites, thirty-seven (37) species are considered residents, while the other eight (8) species are endemic in the Philippines. Of the eight (8) endemic species, two – *Stachyris nigrocapitata* and *Zosterops meyeni* – are found only in Luzon.

Table 2-23. Distribution of Avifauna Species observed in both Parcels 1 and 2

Family Name	Scientific Name	Common Name	Distribution
Ardeidae	*Bubulcus ibis*	Cattle Egret	Resident
	Egretta garzetta	Little Egret	Resident
Accipitridae	*Haliastur indus*	Brahminy Kite	Resident
Rallidae	*Galliralus torquatus*	Barred Rail	Resident
	Galllinula chloropus	Common Moorhen	Resident
	Amaurornis phoenicurus	White-Breasted Waterhen	Resident
Columbidae	*Phapetreron leucotis*	White-eared Brown-Dove	Endemic
	Geophelia striata	Zebra Dove	Resident
	Streptopelia chinensis	Spotted Dove	Resident
	Chalcopaps indica	Common Emerald Dove	Resident
Cuculidae	*Cacomantis variolosus*	Brush Cuckoo	Resident
	Centropus viridis	Philippine Coucal	Endemic
Caprimulgidae	*Eurostopodus macrotis*	Great Eared Nightjar	Resident
Apodidae	*Collocalia esculenta*	Glossy Swiftlet	Resident
	Collocalia vanikorensis	Island Swiftlet	Resident
	Collocalia troglodytes	Pygmy Swiftlet	Endemic
	Hirundapus celebebsis	Purple Needletail	Resident
Alcedinidae	*Todirampus chloris*	White-collared Kingfisher	Resident
	Halcyon smyenensis	White-Throated Kingfisher	Resident
Meropidae	*Merops philippinus*	Blue-Tailed Bee-eater	Resident
Pittidae	*Pitta sordida*	Hooded Pitta	Resident
Hirundunidae	*Hirundo tahitica*	Pacific Swallow	Resident

Pycnonotidae	*Pycnonotus goiavier*	Yellow-vented Bulbul	Resident
	Hypsipetes philippinus	Philippine Bulbul	Endemic
	Pycnonotus urostictus	Yellow-wattled Bulbul	Endemic
Oriolidae	*Oriolus chinensis*	Black-Nape Oriole	Resident
Corvidae	*Corvus macrorhynchos*	Large-billed Crow	Resident
Paridae	*Parus elegans*	Elegant Tit	Endemic
Timaliidae	*Stachyris nigrocapitata*	Black-crowned Babbler	Luzon Endemic
Turdidae	*Copsychus saularis*	Oriental Magpie-Robin	Resident
Sylviidae	*Megalurus timoriensis*	Tawny Grassbird	Resident
	Megalurus palustris	Striated Grassbird	Resident
	Cisticola exilis	Bright-Capped Cisticola	Resident
Musicapidae	*Rhipidura javanica*	Pied Fantail	Resident
	Hypothymis azurea	Black-nape Monarch	Resident
	Cyornis rufigastra	Mangrove Blue Flycatcher	Resident
	Eumyias panayensis	Mountain Verditer-Flycatcher	Resident
Artamidae	*Artamus leucorynchus*	White-breasted Wood-Swallow	Resident
Laniidae	*Lanius schach*	Long-Tailed Shrike	Resident
Nectariniidae	*Nectarinia jugularis*	Olive-backed Sunbird	Resident
Dicaeidae	*Decaeum trigonostigma*	Orange-bellied Flowerpecker	Resident
Zosteropidae	*Zosterops meyeni*	Lowland White-eye	Luzon Endemic
Ploceidae	*Passer montanus*	Eurasian Tree Sparrow	Resident
Estrildidae	*Lonchura punctulata*	Scaly-breasted Munia	Resident
	Lonchura atricapella	Black-headed Munia	Resident

Conservation Status

The list of categories and criteria of IUCN are intended to be an easily and widely understood system for classifying species at high risk of global extinction, **Table 2-24 and DAO 2004-15** List of Threatened Fauna. The general aim of the system is to provide an explicit, objective framework for the classification of the broadest range of species.

Table 2-24. Definition of Conservation Status and/or Categories

Conservation Status / Categories	International Union for the Conservation of Nature (IUCN)
EXTINCT (EX)	A taxon is Extinct when there is no reasonable doubt that the last individual has died. A taxon is presumed Extinct when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.

EXTINCT IN THE WILD (EW)	A taxon is Extinct when there is no reasonable doubt that the last individual has died. A taxon is presumed Extinct when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.
CRITICALLY ENDANGERED (CR)	A taxon is Critically Endangered when the best available evidence indicates that it meets any of the criteria A to E for Critically Endangered (see Section V), and it is therefore considered to be facing an extremely high risk of extinction in the wild.
ENDANGERED (EN)	A taxon is Endangered when the best available evidence indicates that it meets any of the criteria A to E for Endangered (see Section V), and it is therefore considered to be facing a very high risk of extinction in the wild
VULNERABLE (VU)	A taxon is Vulnerable when the best available evidence indicates that it meets any of the criteria A to E for Vulnerable (see Section V), and it is therefore considered to be facing a high risk of extinction in the wild.
NEAR THREATENED (NT)	A taxon is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future.
LEAST CONCERN (LC)	A taxon is Least Concern when it has been evaluated against the criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened. Widespread and abundant taxa are included in this category
DATA DEFICIENT (DD)	A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution are lacking. Data Deficient is therefore not a category of threat. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate. It is important to make positive use of whatever data are available. In many cases great care should be exercised in choosing between DD and a threatened status. If the range of a taxon is suspected to be relatively circumscribed, and a considerable period of time has elapsed since the last record of the taxon, threatened status may well be justified.
NOT EVALUATED (NE)	A taxon is Not Evaluated when it has not yet been evaluated against the criteria.

Table 2-25 below shows the conservation status of the different bird species identified and recorded within the area. The forty-five (45) bird species are listed under "Least Concern" category. Bird species that were observed were common and populations are widespread.

Table 2-25. Conservation Status Avifauna Species observed in Parcels 1 and 2

Family Name	Scientific Name	Common Name	IUCN Conservation Status	DAO 2004-15
Ardeidae	*Bubulcus ibis*	Cattle Egret	Least Concern	Least Concern
	Egretta garzetta	Little Egret	Least Concern	Least Concern
Accipitridae	*Haliastur indus*	Brahminy Kite	Least Concern	Least Concern
Rallidae	*Galliralus torquatus*	Barred Rail	Least Concern	Least Concern
	Galllinula chloropus	Common Moorhen	Least Concern	Least Concern
	Amaurornis phoenicurus	White-Breasted Waterhen	Least Concern	Least Concern
Columbidae	*Phapetreron leucotis*	White-eared Brown-Dove	Least Concern	Least Concern
	Geophelia striata	Zebra Dove	Least Concern	Least Concern
	Streptopelia chinensis	Spotted Dove	Least Concern	Least Concern
	Chalcopaps indica	Common Emerald Dove	Least Concern	Least Concern
Cuculidae	*Cacomantis variolosus*	Brush Cuckoo	Least Concern	Least Concern
	Centropus viridis	Philippine Coucal	Least Concern	Least Concern
Caprimulgidae	*Eurostopodus macrotis*	Great Eared Nightjar	Least Concern	
Apodidae	*Collocalia esculenta*	Glossy Swiftlet	Least Concern	Least Concern
	Collocalia vanikorensis	Island Swiftlet	Least Concern	Least Concern
	Collocalia roglodytes	Pygmy Swiftlet	Least Concern	Least Concern
	Hirundapus celebebsis	Purple Needletail	Least Concern	Least Concern
Alcedinidae	*Todirampus chloris*	White-collared Kingfisher	Least Concern	Least Concern
	Halcyon smyenensis	White-Throated Kingfisher	Least Concern	Least Concern
Meropidae	*Merops philippinus*	Blue-Tailed Bee-eater	Least Concern	Not Listed
Pittidae	*Pitta sordida*	Hooded Pitta	Least Concern	Least Concern
Hirundunidae	*Hirundo tahitica*	Pacific Swallow	Least Concern	
Pycnonotidae	*Pycnonotus goiavier*	Yellow-vented Bulbul	Least Concern	Least Concern
	Hypsipetes philippinus	Philippine Bulbul	Least Concern	Least Concern
	Pycnonotus urostictus	Yellow-wattled Bulbul	Least Concern	Least Concern
Oriolidae	*Oriolus chinensis*	Black-Nape Oriole	Least Concern	Least Concern
Corvidae	*Corvus macrorhynchos*	Large-billed Crow	Least Concern	Not Listed
Paridae	*Parus elegans*	Elegant Tit	Least Concern	
Timaliidae	*Stachyris nigrocapitata*	Black-crowned Babbler	Least Concern	Least Concern
Turdidae	*Copsychus saularis*	Oriental Magpie-Robin	Least Concern	Least Concern
Sylviidae	*Megalurus timoriensis*	Tawny Grassbird	Least Concern	Not listed
	Megalurus palustris	Striated Grassbird	Least Concern	Not Listed
	Cisticola exilis	Bright-Capped Cisticola	Least Concern	Not listed
Musicapidae	*Rhipidura javanica*	Pied Fantail	Least Concern	Least Concern
	Hypothymis azurea	Black-nape Monarch	Least Concern	Least Concern
	Cyornis rufigastra	Mangrove Blue	Least Concern	Least Concern

		Flycatcher		
	Eumyias panayensis	Mountain Verditer-Flycatcher	Least Concern	Least Concern
Artamidae	*Artamus leucorynchus*	White-breasted Wood-Swallow	Least Concern	
Laniidae	*Lanius schach*	Long-Tailed Shrike	Least Concern	Least Concern
Nectariniidae	*Nectarinia jugularis*	Olive-backed Sunbird	Least Concern	Least Concern
Dicaeidae	*Decaeum trigonostima*	Orange-bellied Flowerpecker	Least Concern	Least Concern
Zosteropidae	*Zosterops meyeni*	Lowland White-eye	Least Concern	Not listed
Ploceidae	*Passer montanus*	Eurasian Tree Sparrow	Least Concern	Not Listed
Estrildidae	*Lonchura punctulata*	Scaly-breasted Munia	Least Concern	Least Concern
	Lonchura atricapella	Black-headed Munia	Least Concern	Least Concern

VOLANT MAMMALS

Bats are widely spread and diverse in the Philippines. They are under the mammalian order Chiroptera, which is one of the most diverse and poorly known mammalian orders. It is believed that there are at least sixty-eight known species of bats in the country.

Sampling Stations

There were 11 established sampling stations for volant mammals see **Tables 2-26** and **Table 2-27, *Figure 2-43*** below:

Table 2-26. Geographical location of sampling station in Parcel 1.

Station	Latitude	Longitude	Elevation (masl)
1	14°34.783' N	121°14.668' E	95
2	14°34.739' N	121°14.688' E	111
3	14°34.695' N	121°14.695' E	108
4	14°34.679' N	121°14.712' E	123
5	14°34.683' N	121°14.769' E	110
6	14°34.688' N	121°14.798' E	103
7	14°34.678' N	121°14.823' E	110
8	14°34.682' N	121°14.836' E	113
9	14°34'51.22'' N	121°14.3891"E	93

Table 2-27. Geographical location of sampling station in Parcel 2

Station	Latitude	Longitude	Elevation (masl)
10	14°34.629' N	121°14.125' E	82
11	14°34.703' N	121°14.086' E	81

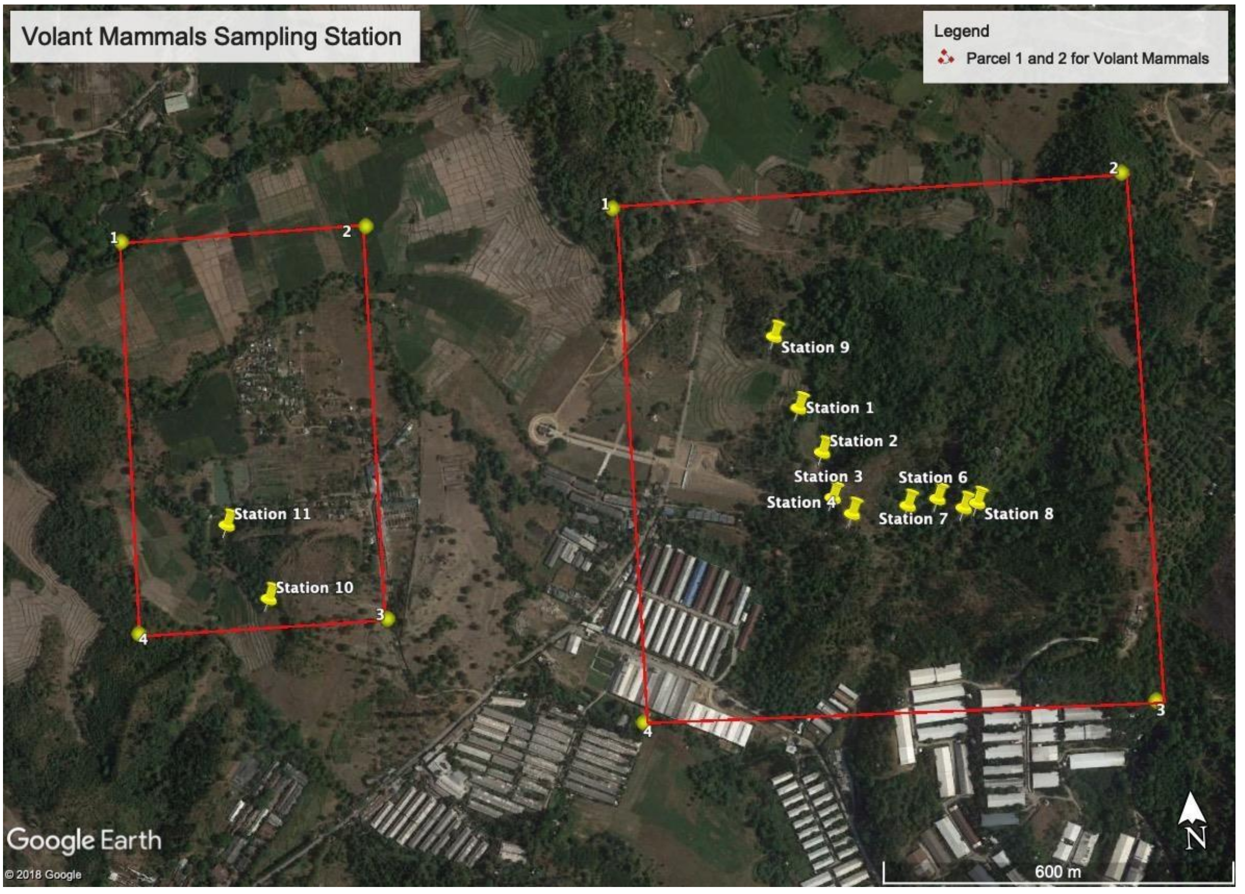


Figure 2-43. Visual representation of the sampling stations for Volant Mammals assessment in Parcels 1 and 2.

Species Listing

In this assessment three (3) species of bats with a total of 133 individuals were captured on the site. Bats were identified using Key to Philippine Bats (Ingle and Heaneys, 1992). All species identified belong to family Pteropodidae or fruit bats, the third most species-rich family within Luzon.

The following are the bat species found in the sampling sites:

Cynopterus brachyotis, also known as the lesser dog-faced fruit bat, is a species of bats that are widespread throughout the Southeast Asia. They are distinguished by the presence of 2 pairs of lower incisors in their mouths, and by the white edges of their ears and wig bones as compared to other bat species. The lesser short-nosed fruit bat is very abundant within agricultural areas, common in secondary forest and uncommon or may be even absent within primary forest. These bats persist well in residential areas.

Eonycteris spelaea, also known as the Philippine dawn bat, are abundant in lowland forest and entirely or absent in montane forest and mossy forest. This bat has an elongated muzzle, adapted to drinking nectar. Its lower parts are pale, with a yellowish-brown neck. Their abundance generally decreases with increasing elevation.

Ptenochirus jagori, also known as the greater musky fruit bat, is a species of bats that is endemic in the Philippines. It has a short muzzle with tube-shaped nostrils and large eyes, and its appearance is similar to that of a dog's. It has small, pointy ears at the tips. The greater musky fruit bats are one of the most abundant and habitat-tolerant bat species in the Philippines. Although endemic in the country, they are common and widespread. They are abundant in primary, secondary lowland forest, and usually present in rural parks and residential areas.

Below are the representative bats for each species identified:

Photo 2ooo. *Cynopterus brachyotis*

Photo 2ppp. *Ptenochirus jagori*

Photo 2qqq. *Eonycteris spelaea*

Presence

Parcel 1

Three (3) different species of bats were identified within the sampling areas. All bats identified and recorded belong to Family Pteropodidae, which are also called fruit bats.

The lesser dog-faced bats or *Cynopterus brachyotis* were recorded in all sampling stations. The Philippine Dawn Bat were recorded in stations 2, 7 and 8 while the greater musky bats were recorded in stations 1, 5, 6, 7, and 8. Below is **Table 2-28** showing the presence of bats species within each station.

Table 2-28. Bat Species present in each station of in Parcel 1

Common Name	Station							
	1	2	3	4	5	6	7	9
Greater musky fruit bat	x				x	x	x	
Lesser dog-faced fruit bat	x	x	x	x	x	x	x	x
Philippine Dawn Bat		x					x	

Parcel 2

There were only two (2) bat species that were observed in the area. The bats identified and recorded belong to Family Pteropodidae, which are also called fruit bats.

Both the greater musky fruit bat and the lesser dog-faced fruit bat were observed in stations 10 and 11. Below is **Table-29** showing the presence of bats species within each station

Table 2-29. Bat species found in each station in Parcel 2

Common Name	Station	
	10	11
Greater musky fruit bat	x	x
Lesser dog-faced fruit bat	x	x
Philippine Dawn Bat		

Abundance

Parcel 1

One hundred thirty-eight (138) individual bats under the family Pteropodidae were collected and identified in both Parcels 1 and 2 during the sampling activity. The most abundant species identified was the lesser dog-faced fruit bat with 79% followed by the greater musky fruit bat with 18.12% and The Philippine Dawn Bat with 2.88%.

Station 1

Percent abundance of bats within Station 1 is presented below, ***Figure 2-44***. There were 24 individual bats identified. The lesser dog-faced fruit bats were the most abundant species with 22 individuals or 91.67% followed by the greater musky fruit bat with 2 individuals or 8.33%.

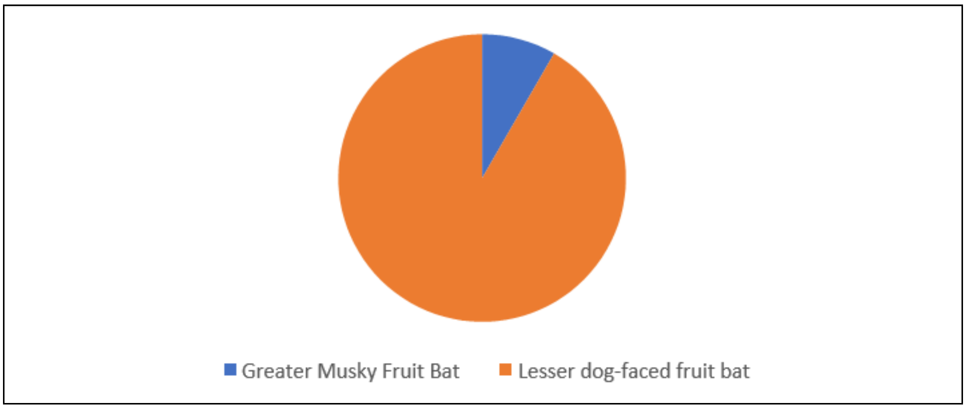


Figure 2-44. Percent Abundance of bats in Station 1.

Station 2

A total of 13 individual bats were identified in Station 2, ***Figure 2-45***. The identified bats were the lesser dog- faced fruit bats (84.62%) and the Philippine Dawn Bat (15.38%).

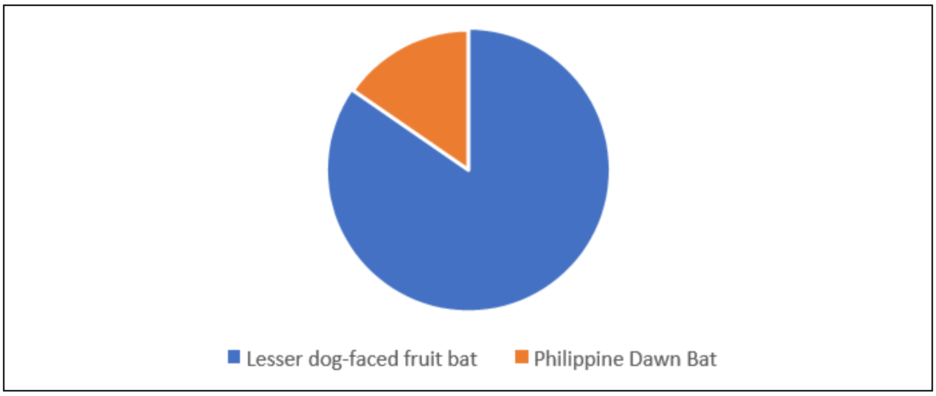


Figure 2-45. Percent Abundance of bats in Station 2.

Stations 3 and 4

There are 11 individuals recorded in stations 3, ***Figure 2-46*** and 14 individuals in station 4, ***Figure 2-47***, all of them belonging to a single species, the Lesser dog-faced fruit bat. The two sampling stations are located beside a cliff and there are few vegetations in the area, which may be the reason there are no other species found.

Figure 2-46. Percent Abundance of bats in Station 3.

Figure 2-47. Percent Abundance of bats in Station 4.

Station 5

There were 10 individual bats recorded in station 5, ***Figure 2-48***. The Lesser dog-faced fruit bat dominates with 80% abundance or 8 individuals, followed by greater musky fruit bats with 2 individuals (20%).

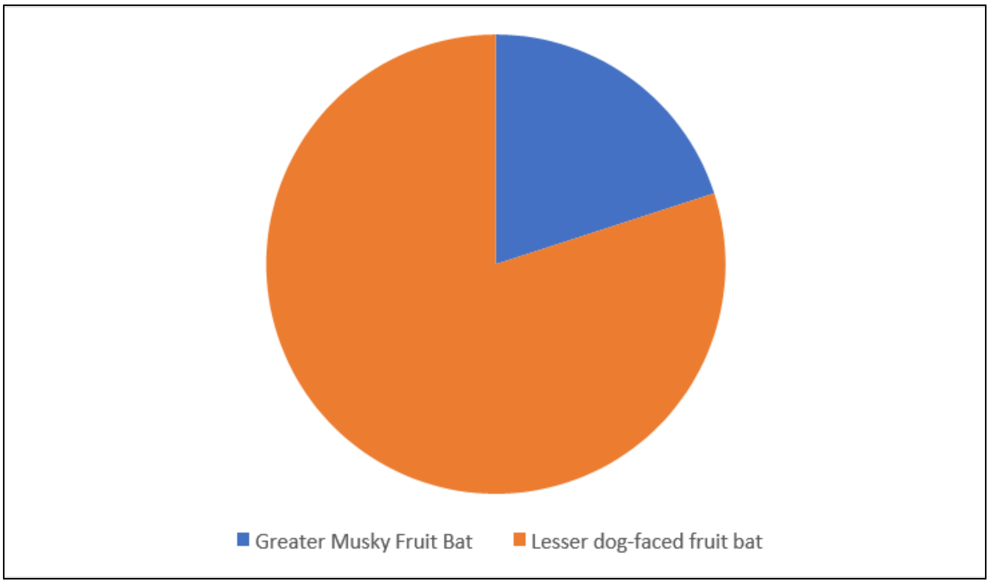


Figure 2-48. Percent Abundance of bats in Station 5.

Station 6

*Two sp*ecies of bats were recorded in station 6 comprising of 9 individual bats, ***Figure 2-49***. The Lesser dog- faced fruit bat dominated the station with 6 individuals or 66.67%, followed by the greater musky fruit bat with 3 individuals or 33.33%.

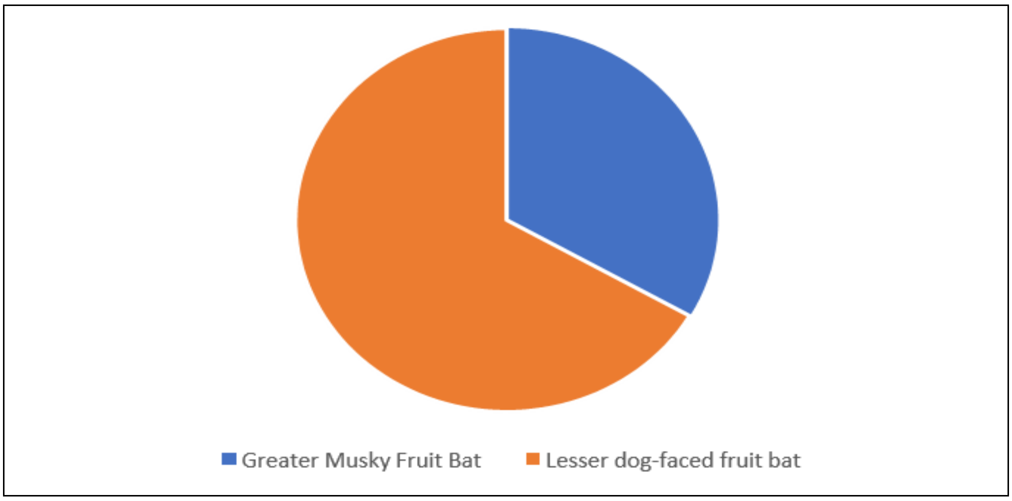


Figure 2-49. Percent Abundance of bats in Station 6.

Station 7

All three species of identified bats were found in station 7, with a total of 12 individuals, ***Figure 2-50***. The area is dominated by the Lesser dog-faced fruit bat with 10 individuals or 83.33% abundance, followed by the greater musky fruit bats and the Philippine dawn bat with one individual captured for each species, or 8.33% abundance each.

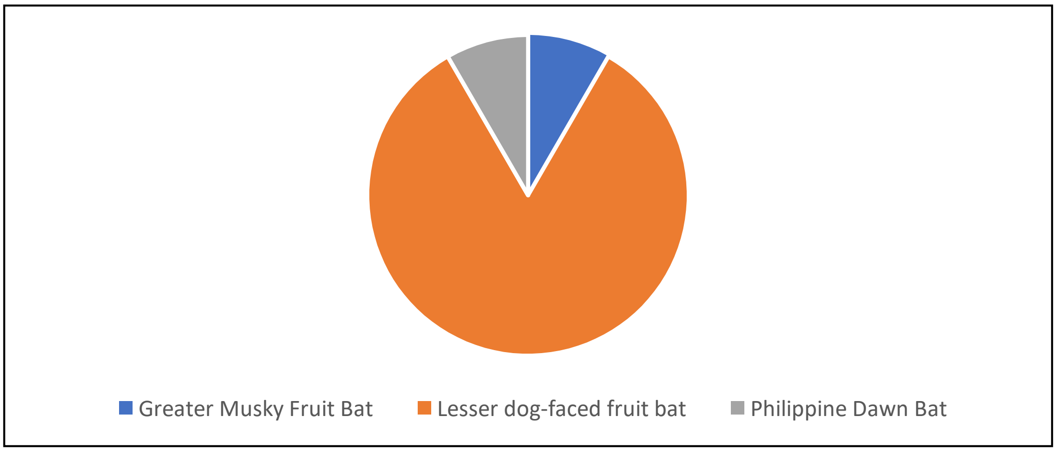


Figure 2-50. Percent Abundance of bats in Station 7.

Station 8

A total of 12 individual bats were recorded in station 8, ***Figure 2-51*** below shows that 10 (83.33%) of the recorded bats were greater musky fruit bat, followed by both the Lesser dog-faced fruit bat and the Philippine dawn bat with 8.33% each or 1 individual captured for each of these two species.

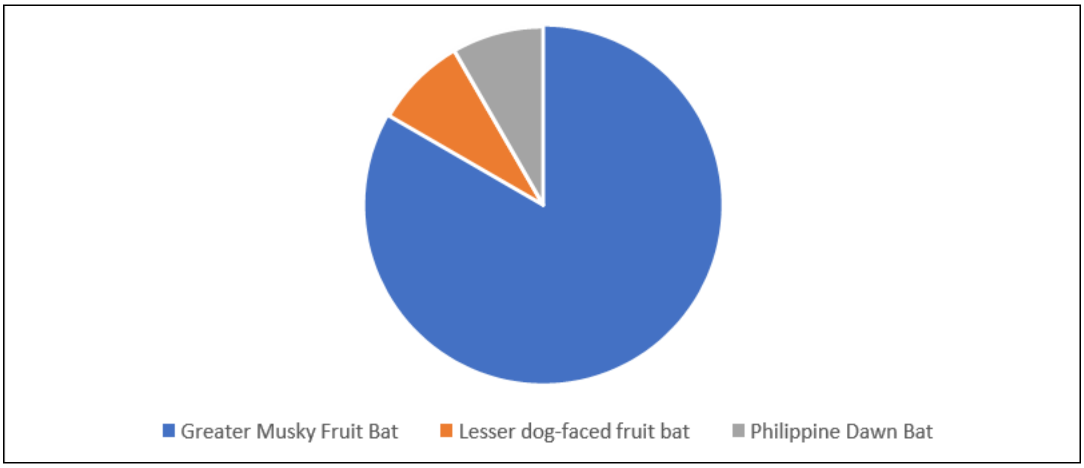


Figure 2-51. Percent Abundance of bats in Station 8.

Station 9

All of the 11 identified individual bats in station 9 belong to a single species. Below is a ***Figure 2-52*** showing 100% of the captured bats in the station are the lesser dog-faced fruit bat.

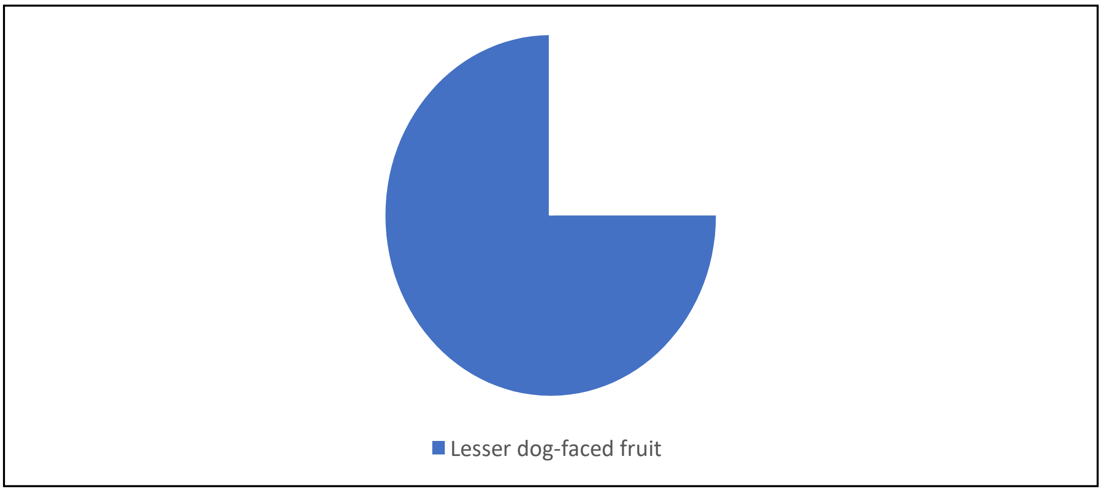


Figure 2-52. Percent Abundance of bats in Station 9.

Parcel 2

Station 10

There were 10 individual bats recorded in station 10 belonging to two species, ***Figure 2-53***. The most abundant species in the sampling station is the lesser dog-faced fruit bat with 9 individuals or 90%, followed by the greater musky fruit bat accounting for 10%.

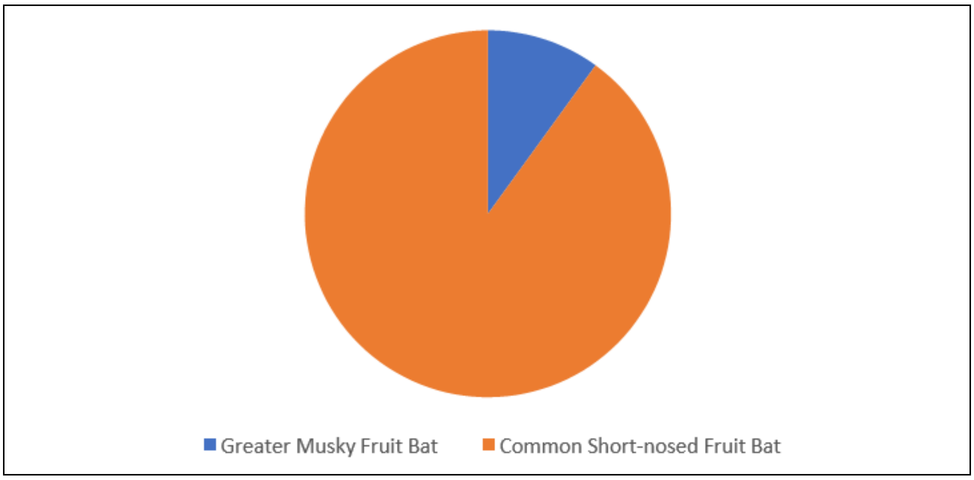


Figure 2-53. Percent Abundance of bats in Station 10

Station 11

There were two species recorded in the sampling station comprising of 12 individual bats, ***Figure 2-54***. There were 6 greater musky fruit bat or 50%, and 6 common short-nosed fruit bat or 50% of the captured individuals.

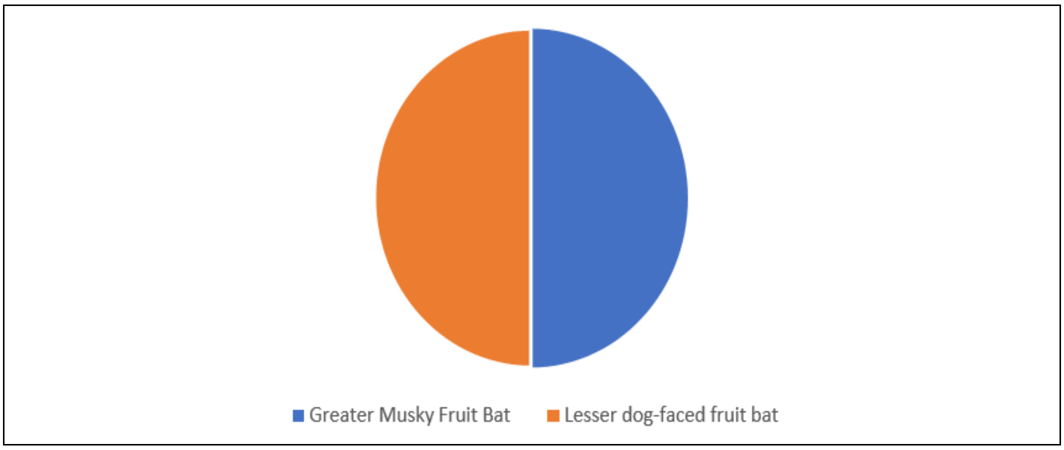


Figure 2-54. Percent Abundance of bats in Station 11.

Conservation Status

Table 2-30 presents all identified and recorded volant mammals are under “least concern” category on the IUCN Red list and DAO 2004-15 National List of Threatened Fauna. This means that their distribution and population is high and is unlikely to decline. Among the three species identified, the greater musky fruit bat was determined to be endemic in the Philippines.

Table 2-30. Conservation status of recorded volant mammals observed

Common Name	Family Name	Scientific Name	IUCN Conservation Status	DAO 2004-15
Philippine Dawn Bat	Pteropodidae	*Eonycteris spelaea*	Least Concern	Least Concern
Greater musky fruit bat	Pteropodidae	*Ptenochirus jagori*	Least Concern	Least Concern
Lesser dog-faced fruit bat	Pteropodidae	*Cynopterus brachyotis*	Least Concern	Least Concern

NON-VOLANT MAMMALS

Non-volant mammals are land-based mammals that are not able to take flight such as rodents. At the time of sampling no non-volant mammals were caught in the cage traps but follow up key informant interviews were done. As mentioned by key informants roaming in the area there are presence of rodents, however, the species of these rodents were not identified.

HERPETOFAUNA

Herpetofauna are reptiles and amphibians of a particular region. During the sampling, only one species of amphibians and reptiles was present. However, an informant was interviewed and as mentioned by key informants roaming in the area there are presence of frogs and other reptiles in the area, however, the species of these animals were not identified.

Amphibians

The Cane Toad (*Rhinella marina*) is the only species of amphibians found and recorded.

***Photo 2rrr**. Cane Toad (Rhinella marina)*

It was both present at the two stations. The highest number of cane toad present was found at station 2 with a total of 15 individuals, while the least number of cane toad is station with only 5 individuals present, ***Figure 2-55***.

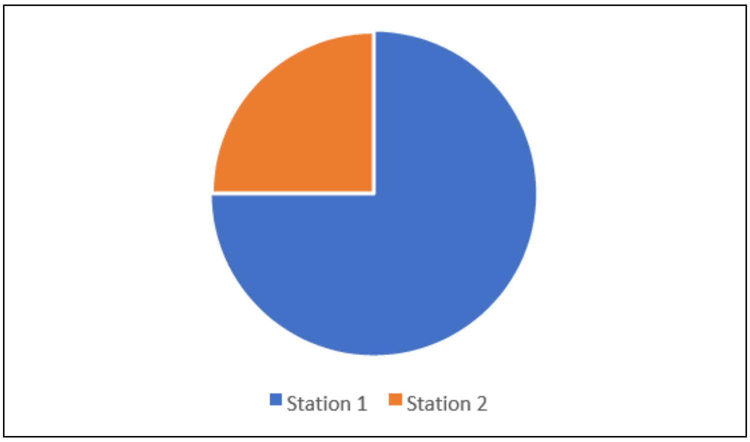


Figure 2-55. Abundance of Cane Toad per Station

The conservation status of this species is considered under the category of least concern, **Table 2-31**. This is due to its wide distribution, tolerance of a broad range habitats, and presumed large population.

Table 2-31. Conservation status Amphibians observed

Common Name	Family name	Scientific name	Conservation status (IUCN)	DA0 2004-15
Cane Toad	Bufonidae	*Rhinella marina*	Least Concern	Least Concern

Reptiles

The Golden skink (*Eumeces schneiderii*) was the only reptile spotted and recorded at the sampling area.

Photo 2sss. Golden skink (Eumeces schneiderii)

It was also both present at the two stations. The highest number of cane toad present was found at station 2 with a total of 5 individuals, while the least number of cane toad is station with only 3 individuals present, ***Figure 2-56***.

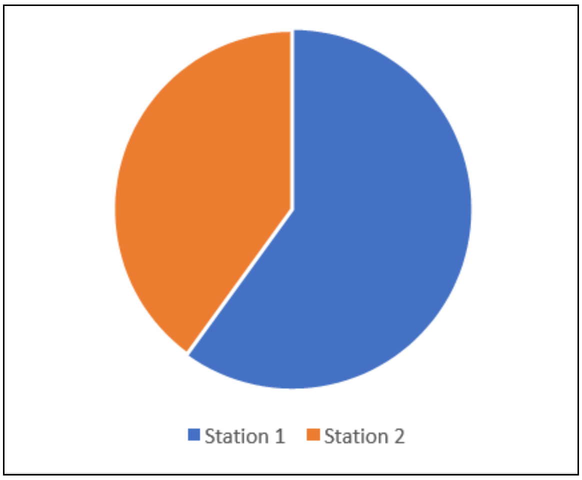


Figure 2-56. Abundance of Golden skink per station.

The conservation status of this reptile is as the same with the amphibian Cane Toad, **Table 2-32**. It is also considered as least concern by the IUCN due to its wide distribution and presumed large population. This is because the population of this species is unlikely to decline fast enough to be qualified for listing in a more threatened category.

Table 2-32. Conservation status of Reptiles observed

Common Name	Family name	Scientific name	Conservation status (IUCN)	DAO 2004-15
Golden skink	Scincidae	*Eumeces schneiderii*	Least Concern	Least Concern

2.1.4.4 Hindrance to Wildlife Access

Considering the nature of the proposed project, it is expected that the identified volant, and herpetofauna though least concern in terms of conservation status would temporarily leave the area no wildlife shall stay in the area considering that this will no longer be suitable as habitat or breeding place.

IMPACT ASSESSMENT AND MITIGATION

During Construction and Operation

Quarry operation will temporarily disturb the presence of faunal species in the area and will prevent migrants or local species to promote habitat in the area, moreso during blasting activites. Based on the observed terrestrial fauna, no identified extint, critically endangered, endangered or near threatened in the area. Samples collected belong to least concern.

Possible displacement of existing habitat and destruction or alteration of shelter and loss of food for birds, animals, and creatures that depend on trees and plants for food. The fauna species shall be moved to the excluded and buffer zone area.

2.2 THE WATER

This section presents the key baseline conditions of the project's site in terms of drainage morphology and inducement to hydrologic hazards, depletion of water source and existing quality of the waterways.

The potential impacts of the project's activities during pre-construction, construction, operations, and abandonment stage on these environmental aspects and their corresponding options for prevention, mitigation or enhancement are also assessed and discussed in this section.

Methodology

This geohazard assessment was prepared following the activities enumerated below:

- Literature research/desk study
- Ocular investigation
- Assessment and report preparation

Sources of Information

The data and information in this report, as mentioned above, came from primary and secondary sources. Primary data and information were obtained during the fieldwork, while the secondary facts and figures were acquired from various agencies and institutions, including the project proponent.

Primary information was acquired through ocular site investigation. Interviews were also made to gain information on past natural hazards. Secondary information and data were obtained from published and unpublished reports and maps prepared by the *Mines and Geo-Sciences Bureau (MGB), the National Water Resources Board (NWRB) and National Mapping and Information Administration (NAMRIA)* of the Department of Environment and Natural Resources (DENR); *the Philippine Institute of Volcanology and Seismology (PHIVOLCS) and Philippine Atmospheric, Geophysical and*

Astronomical Services Administration (PAGASA) of the Department of Science and Technology (DOST) and various data and information readily available from different websites.

2.2.1 Hydrology/Hydrogeology

2.2.1.1 Change In Drainage Morphology/ Inducement Of Flooding/Reduction In Stream Volumetric Flow

Based on the Namria contour map, the major river systems covered by the governing watershed in Teresa, Morong and the upper reaches of Antipolo (Boso-Boso area) are composed of May-iba River (northern terminus), Teresa River and Morong River. Both proposed mine sites are traversed by a system of creeks that generally runs northwest then turns westward to join May-iba River which eventually join Teresa and Morong River which eventually spills into Laguna de Bay, ***Figure No. 2-57, Topographic and Drainage Map.*** Generally, the rivers, creeks and small tributaries display trellis to dendritic drainage patterns which are characteristics of a mature drainage basin. ***Figure No. 2-57a*** shows the existing operational quarry activities, limiting to 5-km radius from the proposed site. ***According to the record of the Mine Management Division of the Mines and Geosciences Bureau Region IV-A (MGB, R-IVA)*** reveals that Mining Claim is surrounded by equally large mining claimants on which the applied areas are either subject for exploration permit, Mineral processing Sharing Agreement (MPSA) application or who have already issued a MPSA certificate such as Rapid City Realty and Development Corporation, Island Quarry and Aggregates Corp., and Republic Cement and Building Materials Inc. All claims mentioned will finally drains at May-iba River and drains to Teresa and Morong Rivers.

Distribution and Occurrence

May-iba River and its tributaries appears to the dominating drainage system in the area. It meandering features from the mine site stretches to the north with headwater reaching the upper portion and foot slopes of Sierra Madre Range in the vicinity of Upper Boso-Boso in Antipolo. It flows downstream and joins Teresa and Morong River which empty its loads in Laguna Lake.

Relationship to Topography

At the project site, excess rain generally showers the surrounding mountain and hill slopes of the project area. This surface flows had resulted in a northwest and southwest directional surface flow or runoff. As such, the topography at the proposed quarry areas appear to be much higher as compare to its surrounding vicinities.

Source and Permanence of Water

Generally, precipitations and surface flows are the only source of runoff in the area. Water from most of river system that proliferates within its surrounding or at the main quarry site are considered to be of intermittent stream behavior due to the absence of surface flow during dry periods and appearance of stream flows during rainy weather or season.

Evidence of Pervious Occurrence of Water at the Site

Being part of the older volcanic rock overlain by an apparently thin layer of alluvial soil deposits forming a small topographic valleys and basin, characterized by the presence of surrounded hill slopes and uplifted mount, only indicates that surface water had existed at the site in recent geologic times.

Effects of Water on the Material

Surface runoff through precipitation may tend to erode if not weaken the soil. The vulnerability of liquefaction and settlement occurrences may not be realized due to the presence of thinly bedded and soft soil accumulation or deposition. Thus, a well-densified or compacted ground foundation and constructed drainage structures and retaining walls are prerequisite to minimized localized accumulation of rainwater and maintain the shearing strength of the filled material.

Ground Water Table

Groundwater level appears to be deep. Findings of NWRB in recent study suggests that groundwater levels in the northern portion of Metro Manila along the area of Bulacan, Quezon City and Rizal province may have an average depth of water table (static water level) of more than 20m below ground surface which may decline considerably should pumping operation intensified ***Figure No. 2-58, Groundwater availability map.*** Apparently, groundwater mainly confined within fractured zones in hard volcanic rock and layer of loose granular pyroclastic sedimentary rock units.

Hydrologic Hazard

Flood due to overflowing

As a general rule, flood is defined as an overflowing of certain stream channel with the rate of accumulation of surface run-off is much greater than the combined rate of discharge and infiltration in that same channel causing the water to rise tremendously above its normal level. It occurs whenever a stream or river overflows its bank or an abnormal progressive raise in the water level resulting in an overflowing by the water that subsequently inundates an area that not normally submerged. Moreover, water arise due to some adverse factors as extensive watershed area, heavy and protracted precipitation, damming or clogging of the waterway, very low infiltration capacity of the soil of the slopes and banks or when the stream channel is silted up causing the swallowing of the steam channel. Based on the published hazard map by MGB, ***Figure 2-59, Flooding and Landslide Map,*** shows that the ***proposed quarry sites are not prone to flooding*** due to the fact that the site is located on a relatively elevated ground surface. However, proper and efficient drainage design would be suggested to prevent any unwarranted localized flooding. **Table 2-33** and **Table 2-34** presents the computation of run-off for 30 year and 100-year run-off for each parcel which shall serve as a guide to the proponent in the design and volume capacity of the siltation ponds. **Estimation of Design Surface Run-off Rate for Storm Water Control Utilizing Rational Method Calculation:**

Equation Formula: q=CxIxA
Where: q = peak surface run-off, m^3/sec
C = Run-off Coefficient
I = rainfall intensity for 30 or 100year return period @ 30 and 60mins duration
A = Watershed area or catchment basin, m

Sedimentation and Siltation

Future earth moving activities as well as the removal of vegetation cover within the project area will create large amounts of loose materials that will end up in several sections of the drainage systems and eventually may alter natural drainage system and increase in sediment load into creek and stream systems. As a result, siltation and sedimentation of streams will be experienced and that if not will greatly affect the communities along the downstream portion of streams. Silt traps, sediment collecting ponds as well as interceptor structures should be installed along the river/creeks channels to collect these loose eroded fragments.

Table 2-33 Watershed Computation Area for Parcel 2

A. PARCEL -2/R1 Watershed

Rainfall duration, mins for 30year return period	Watershed Area (A), Hectares	%, Open Area	Effective Area, has	Total Area, m²	Mean runoff coefficient, (C)	Rainfall Intensity,mm/hr(I)	Rainfall Intensity,m/sec (I)	Computed surface run-off q, m3/sec
A	*B	C	D	E	**F	***G	H	I
120	95.80	40	38.32	383,200.00	0.44	135.30	0.0376	6,336.85
30	95.80	40	38.32	383,200.00	0.44	68.20	0.0189	3,194.18
Rainfall duration, mins for 100year return period	**Watershed Area (A), Hectares**	**%, Open Area**	**Effective Area, has**	**Total Area, m²**	**Mean runoff coefficient, (C)**	**Rainfall Intensity,mm/hr(I)**	**Rainfall Intensity,m/sec (I)**	**Computed surface run-off q, m3/sec**
A	*B	C	D	E	**F	***G	H	I
120	95.80	40	38.32	383,200.00	0.44	159.10	0.0442	7,451.54
30	95.80	40	38.32	383,200.00	0.44	80.40	0.0223	3,765.58

Table 2-34 Watershed Computation Area for Parcel 1

B. PARCEL -1/R2 Watershed

Rainfall duration, mins for 30year return period	Watershed Area (A), Hectares	%, Open Area	Effective Area, has	Total Area, m²	Mean runoff coefficient, (C)	Rainfall Intensity,mm/hr(I)	Rainfall Intensity,m/sec (I)	Computed surface run-off q, m3/sec
A	*B	C	D	E	**F	***G	H	I
120	54.75	95	52.0125	520,125.00	0.44	135.30	0.0376	8,601.13
30	54.75	95	52.0125	520,125.00	0.44	68.20	0.0189	4,335.53
Rainfall duration, mins for 100year return period	**Watershed Area (A), Hectares**	**%, Open Area**	**Effective Area, has**	**Total Area, m²**	**Mean runoff coefficient, (C)**	**Rainfall Intensity,mm/hr(I)**	**Rainfall Intensity,m/sec (I)**	**Computed surface run-off q, m3/sec**
A	*B	C	D	E	**F	***G	H	I
120	54.75	95	52.0125	520,125.00	0.44	159.10	0.0442	10,114.12
30	54.75	95	52.0125	520,125.00	0.44	80.40	0.0223	5,111.10

* refer attached figure

**Guidelines for surface runoff coefficients by the Ministry of Education, Culture, Sports, Science and Technology, Japan.

***DPWH-JICA Report - Stormy Rainfall Analysis for Pasig & Marikina River Basin, 2013

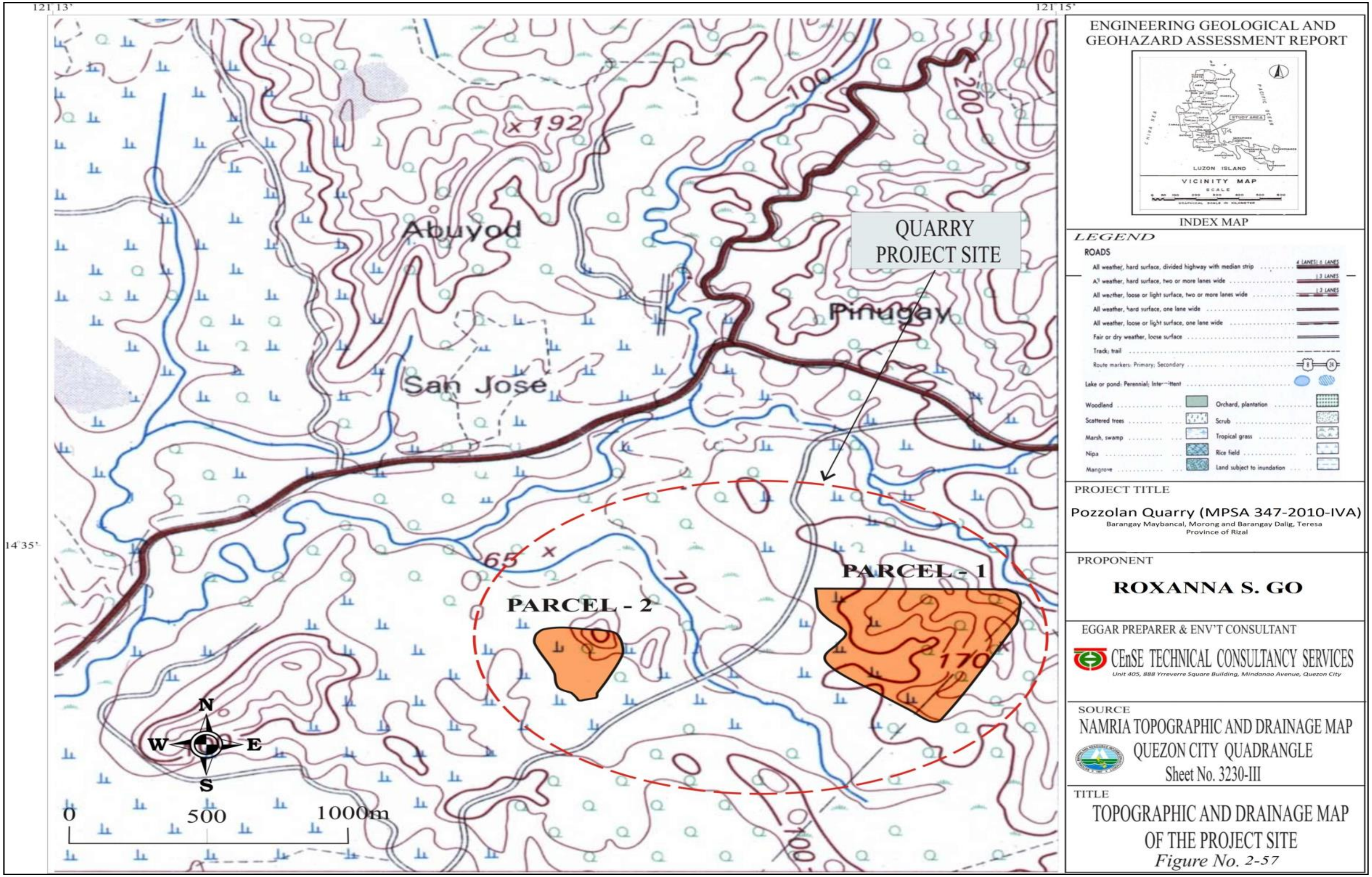
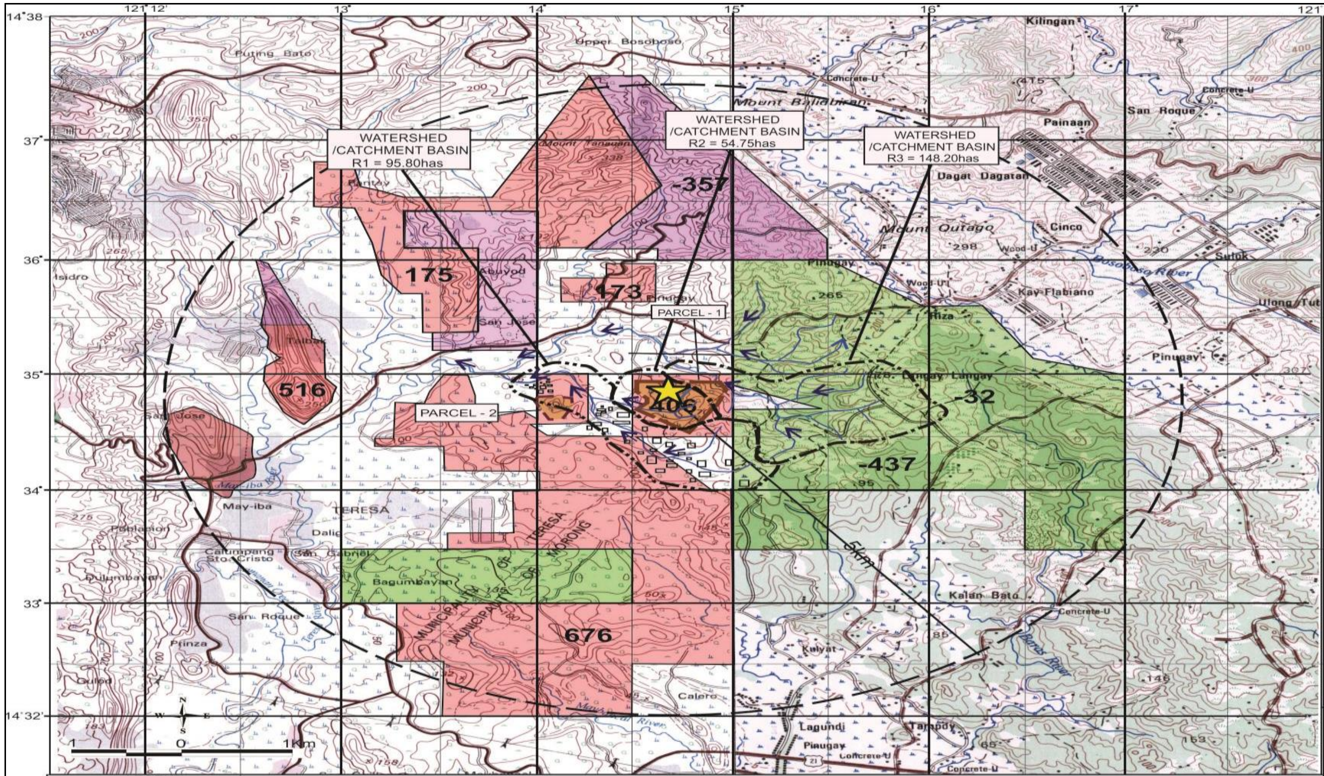


Figure 2-57 Topographic and Drainage Map



ENGINEERING GEOLOGICAL AND GEOHAZARD ASSESSMENT REPORT (EGGAR)

INDEX MAP

LEGEND

- LOCATION OF PROJECT SITE/STUDY AREA
- APPLICATION AND APPROVED MPSA/EX-PLORATION PERMIT MINING/QUARRY CLAIM AREA
- Direction of flow
- Road network
- Watershed/ Catchment Basin
- Stream/River Channel
- Built-up Area

PROPONENT
ROXANNA S. GO
Pozzolan Quarry
Barangay Maybancal, Morong and Barangay Dalig, Teresa Province of Rizal

EGGAR PREPARER & ENV'T CONSULTANT
CEnSE TECHNICAL CONSULTANCY SERVICES
Unit 405 Yrreverre Square Building, 888 Mindanao Avenue Quezon City

SOURCE
REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES
MINES AND GEOSCIENCES BUREAU
1515 DENR by the Bay Bldg., Roxas Blvd. Ermita, Manila
Regional Office No. IV-A (CALABARZON)

MINING TENEMENTS CONTROL MAP
CAVITE, LAGUNA, BATANGAS, RIZAL, QUEZON
AS OF JANUARY 2020

Mine Management Division
MGB R-IV, Calabarzon

TITLE **TENEMENT MAP**
Figure No. 2-57a

APPLICATION FOR EXPLORATION PERMIT

SEQ	TENEMENT NO.	HOLDER	AREA, Hectares
-95	EPA-IVA-61	GOODSEED MINING CORP	996
-437	EPA-IVA-136	RAPID CITY REALTY & DEVLOPMENT CORP	648
-450	EPA-IVA-149	REPUBLIC CEMENT & BLDG. MATERIAL, INC.	82.79

APPLICATION FOR MINERAL PROCEESING & SHARING AGREEMENT

SEQ	TENEMENT NO.	HOLDER	AREA, Hectares
657	AMA-IVA-230	RAPID CITY REALTY AND DEVLOPMENT CORP	279.78
24	PMSA-IVA-024	ISLAND QUARRY AND AGGREGATE CORP.	462.71
336	AMA-IVA-053	ISLAND QUARRY AND AGGREGATE CORP.	63.72
509	AMA-IVA-164	ISLAND QUARRY AND AGGREGATE CORP.	248.22

MINERAL PRODUCTION SHARING AGREEMENT

SEQ	TENEMENT NO.	HOLDER	AREA, Hectares
176	MPSA-075-97-IV	RAPID CITY REALTY AND DEVLOPMENT CORP	6.95
213	MPSA-112-98-IV	QUARRY ROCK GROUP, INC.	586.71
175	MPSA-116-98-IV	ISLAND QUARRY AND AGGREGATE CORP.	70.98
23	MPSA-126-98-IV	RAPID CITY REALTY AND DEVLOPMENT CORP	399.25
109	MPSA-137-99-IV	QUMSON LIMESTONE, INC.	358.76
71	MPSA-138-99-IV	REPUBLIC CEMENT AND BUILDING, INC.	154.69
508	MPSA-206-2004-IV	LANDTECH MINING RESOURCES, INC.	304.39
676	MPSA-345-2010-IV	RAPID CITY REALTY AND DEVLOPMENT CORP	1,015.17
406	MPSA-347-2010-IV	ROXANNA S. GO	114.52
568	MPSA-142-89-IV	RAPID CITY REALTY AND DEVLOPMENT CORP	124.26

Figure 2-57a Tenement – Existing Quarry Map within 5-km

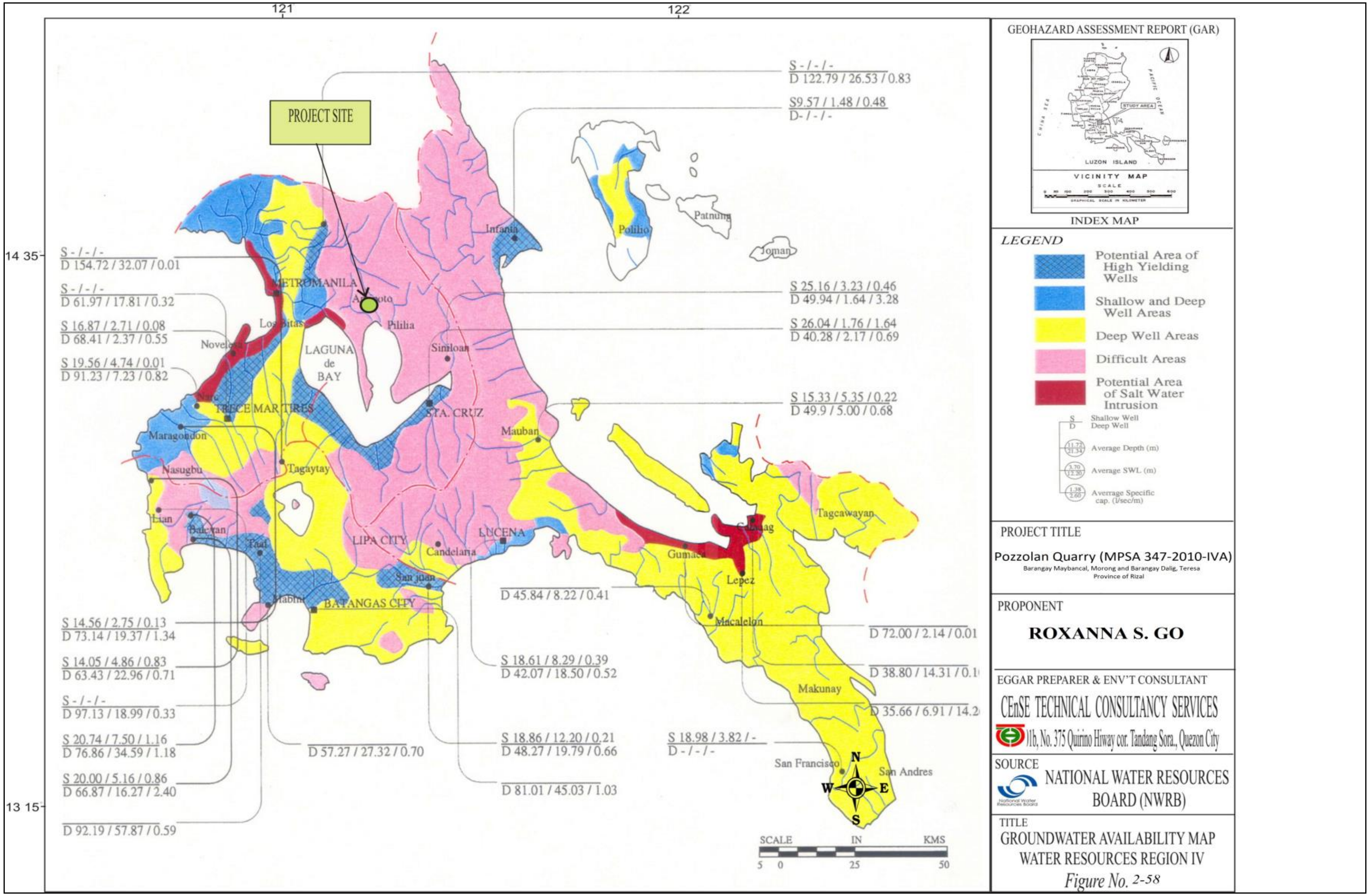


Figure 2-58 Groundwater Availability Map

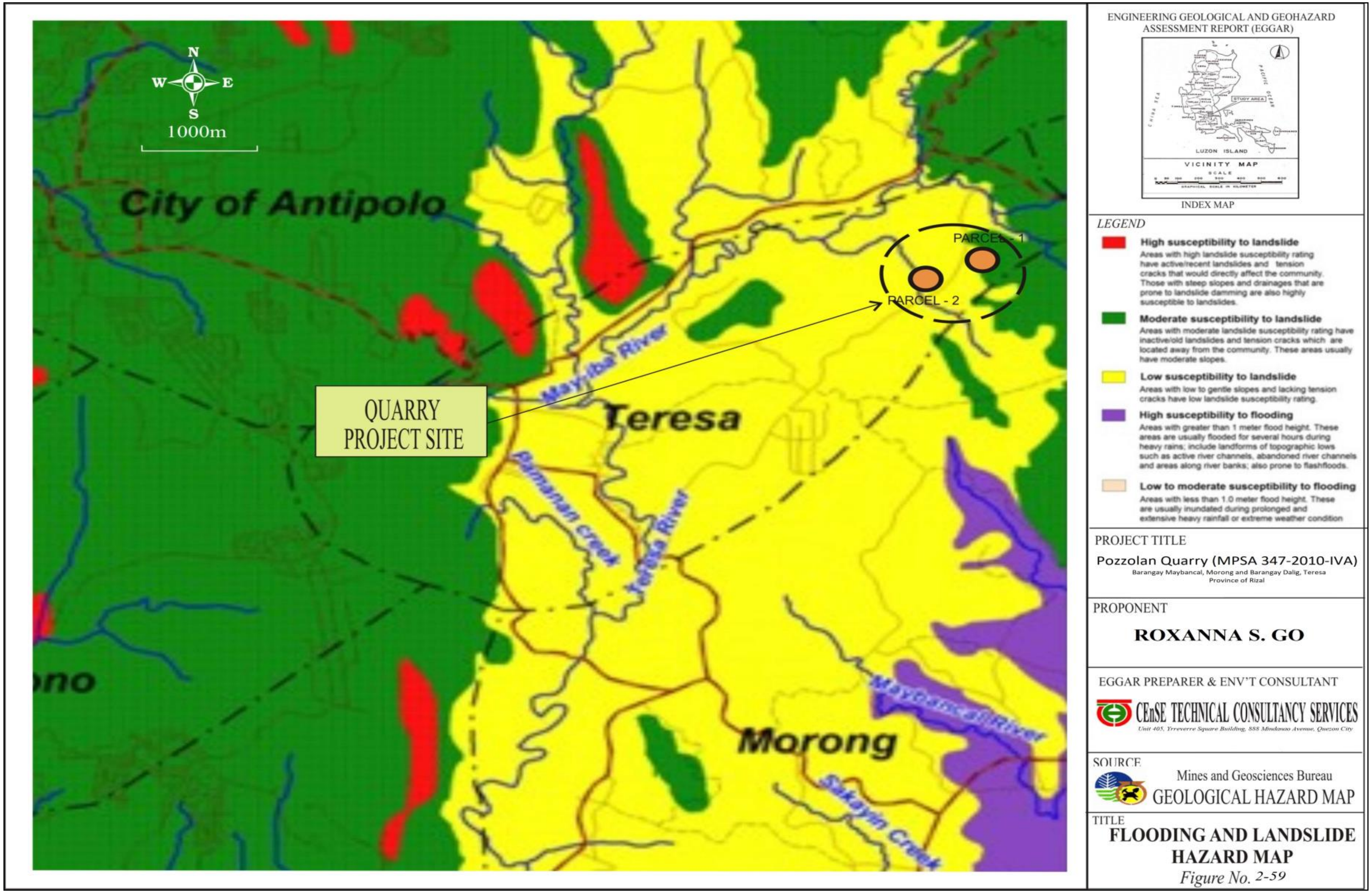


Figure 2-59 Landslide and Flooding Susceptability Hazard Map

IMPACT ASSESSMENT AND MITIGATING MEASURES

The proposed quarry operations will alter the existing topography by the quarry operation which will result in creation of quarry pits. As earlier discussed, the tenement area lies within a generally moderately to gently sloping terrain with highest contour level of 180masl at its peak and gradually reduced in all directions having an average of 70-85masl. Consequently, the main quarry area is devoid of any major seasonal or perennial water body except for small tributaries a few hundred meters to the north of Parcel 1 & 2, ***Figure 2-61 shows the Watershed Map***.

Quarry activity inevitably leads into sediment and suspended load due to erosional activity by rainwater resulting into surface run-off of overburden dump and loosened soil by blasting activity. Surface run-off carrying fine silt particles may flows through the cracks and fissure in the rocks and along the slope of the area and joins the seasonal streams flowing outside the quarry area. To avoid heavy siltation into the surrounding river system and areas, the following measures will be taken up to reduce this load.

During Construction and Operation Phase

- Use of properly sized, graded, and lined storm water management system – A diversion drainage channel keeps surface run-off away from disturbed areas; a dirty water channel directs the run-off through catchment ponds, and settling ponds.

- Developed siltation pits at the toe of the dumps to channelize the runoff water from dumps into the settling tank for treatment. Retaining walls having water holes along the toe of the dumps to avoid the soil wash out.

- During the rainy season, there may be accumulation of surface water, which is proposed to be pumped out to keep the working area dry and it will be utilized for dust suppression. The surface run-off from dumps and mining area will be collected in this settling tank and will be used for dust suppression and plantation in the mine and crusher.

- Excess water, if any, will be diverted to the mine sump for storage.

- Stabilization of dump slopes by plantation to avoid soil erosion.

2.2.1.2 Change In-Stream, Lake Water Depth

There are no major creek, lakes or stream located in the quarry area and surface water considered are intermittent creek, ***Photo 2ttt photo 2eeee, Figure 2-60 shows where the photos were taken***.

The nearest identified river in the area is May-iba River which is about 2.30 kilometers southwest of Parcel 2.

IMPACT ASSESSMENT AND MITIGATING MEASURES

During Construction and Operation Phase

No significant impact on the drainage outfall in the area since small tributaries are considered intermittent. In addition, the same volume of rainwater still occurs even in the absence of the quarry. However, silt due loose soil during rainy days may contribute due to earthmoving and quarrying.

Mitigating Measures

Construction of Siltation Pond both for Parcel 1 that can accommodate a volume of 12,936.36 cubic meters and Parcel 2 that can accommodate a volume of 11,217.12 cubic meters.

Photo 2ttt. *Parcel 1 Looking Westside along Pantay-Buhangin Road (No Rain Scenario)*

Photo 2uuu. *Parcel 1 Looking Westside along Pantay-Buhangin Road (After the Rain Scenario)*

Photo 2vvv. *Under the Bridge (Intermittent) North of Parcel 1 (No Rain Scenario) near Quest Adventure*

Photo 2www. *Under the Bridge (Intermittent) North of Parcel 1 (After Rain Scenario) near Quest Adventure-small rice field is fed through the rain*

Photo 2xxx. *Under the Bridge (Intermittent) North of Parcel 1 (No Rain Scenario) near Quest Adventure taken January 9, 2020*

Photo 2yyy. *Box Culvert serves as drainage outfall along Pantay-Buhangin Road, rainwater is captured at the lowest elevation (After the rain scenario)*

Photo 2zzz. *Box Culvert along Pantay-Buhangin Road, rainwater is captured at the lowest elevation (No Rain Scenario)*

Photo 2aaaa. *Existing RCP Pipe as drainage connected from the Culvert along Pantay-Buhangin Road, run-off is served as the irrigation (After the rain scenario)*

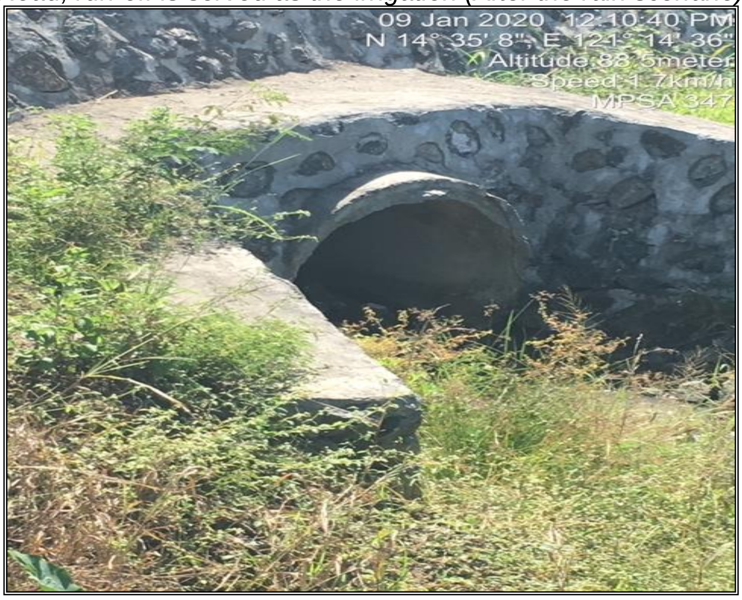


Photo 2bbbb. *Existing RCP Pipe as drainage connected from the Culvert along Pantay-Buhangin Road, run-off is served as the irrigation (No rain scenario)*

Photo 2cccc. *From the RCP Pipe – water is diverted to the rice field which serves as the irrigation (No rain scenario)*

Photo 2dddd. *Another intermittent creek (With Rain Scenario)*

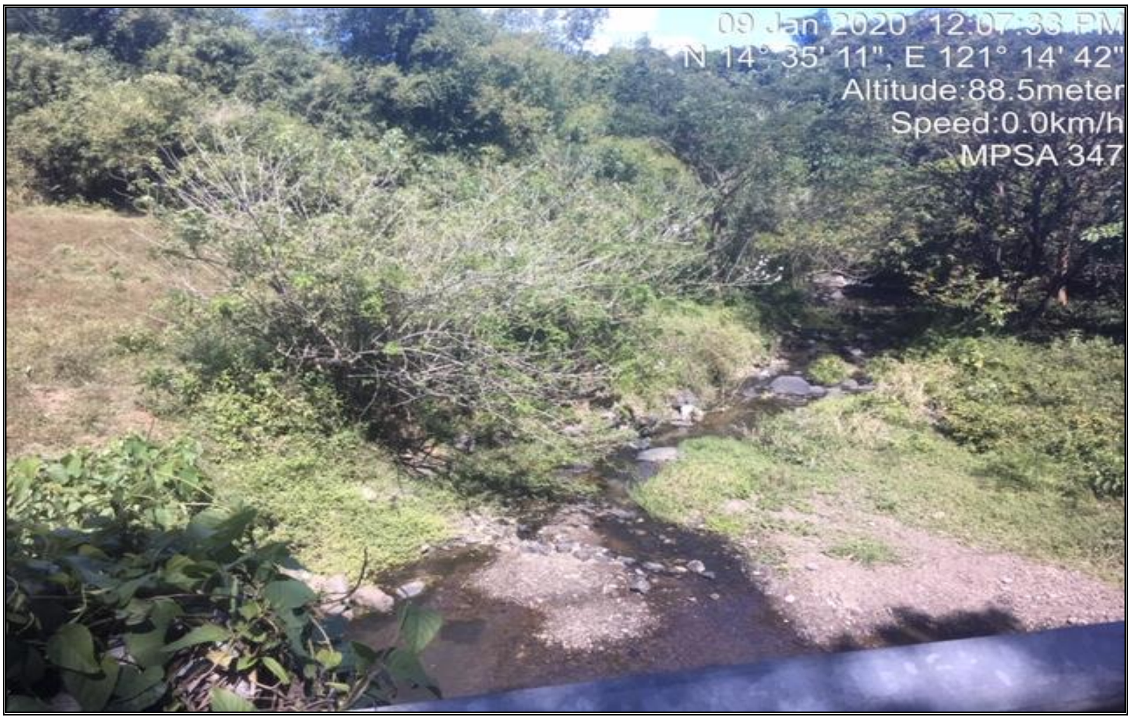
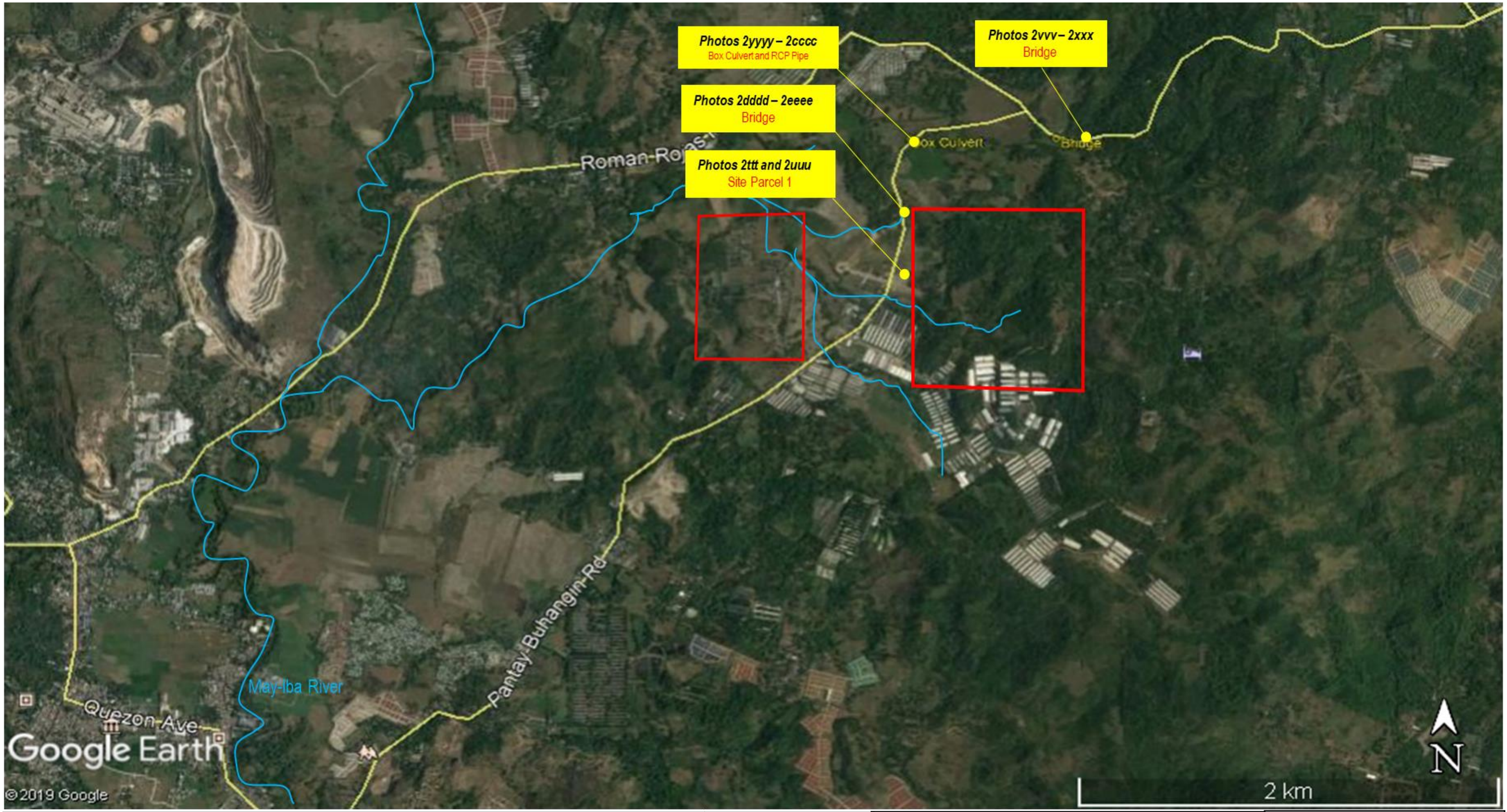


Photo 2eeee. *Another intermittent creek (No Rain Scenario)*



Proponent:	Consultant:	Project Title and Location:	Sheet Content:
Roxanna S. Go MPSA Holder 167 Sumulong Highway, Antipolo City	CEnSE Technical Consultancy Services Unit 405, Yrreverre Square Building, 888 Mindanao Avenue, Quezon City	Pozzolan Quarry (MPSA 347-2010-IVA) Barangay Maybancal, Morong and Barangay Dalig, Teresa Municipality of Rizal	Drainage Google Map *Figure 2-60*

Figure 2-60 Google Drainage Photo

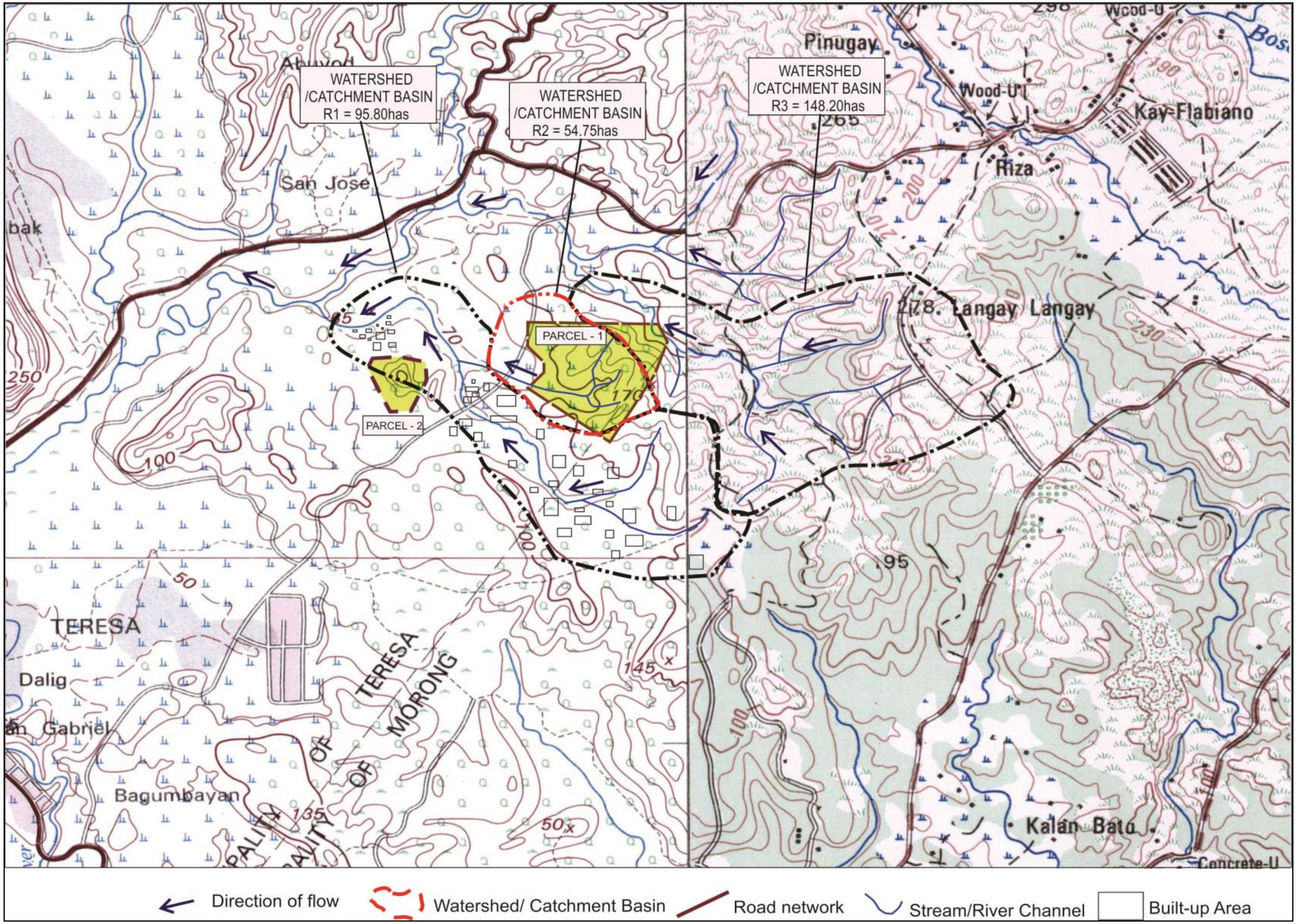


Figure 2-60a Watershed (Surface Run-off) Map

2.2.1.3 Depletion of Water Resources/ Competition in Water Use

There are three (3) major waterways in the municipality. These include the the May-iba River, Pamanaan Creek, and the Teresa River (***Figure 2-60b***). The headwaters of May-iba River is in Antipolo City beyond the Teresa-Pinugay Road. May-iba River has an extension called Pamanaan Creek in Barangays Poblacion and Calumpang-Sto.Cristo. Teresa River traverse extends from Barangay Dalig towards Barangays San Gabriel, San Roque and Prinza.

There are six (6) ground water resources being used by the municipality for its water supply. These are the pump station in Dalig, Bagumbayan (2), San Roque, San Gabriel, and Dulumbayan. Water supply is also being sourced from Manila Water and Morong Water District. The proposed quarry is not considered a water intensive activity, only domestic water requirement shall be catered by the water concessionaire. Rainwater collection is encouraged for the purposed of watering the surface area to prevent dust pollution.

IMPACT ASSESSMENT AND MITIGATING MEASURES

During Construction and Operation Phase

<u>Increased in Domestic Water Demand</u>

No major impact on the increase of water since the domestic water requirement during construction and operation is about 1.0 cubic meters per day which shall be served by Manila Water.

Mitigating Measures

The proponent practice water conservation system.

2.2.2 <u>Oceanography</u>

The proposed quarry project is away from the nearest ocean or sea. The nearest seawater is Manila Bay which is about 53.60 kilometers west from the quarry site.

2.2.2.1 Change/Disruption In Water Circulation Pattern, Littoral Current, And Coastal Erosion and Deposition

There will be no change or disruption in the water circulation pattern since the quarry area is located inland.

2.2.2.2 Change in Bathymetry

No disturbance on the surface or sub-surface navigation in relation to the quarry project.

IMPACT ASSESSMENT AND MITIGATING MEASURES

During Construction and Operation Phase

No Impact Identified.

2.2.3 <u>Water Quality</u>

2.2.3.1 Degradation of Groundwater Quality

The proposed quarry project is a dry process and merely earthmoving and extraction of pozzolanic materials shall be done groundwater levels in the northern portion of Metro Manila along the area of Bulacan, Quezon City and Rizal province may have an average depth of water table (static water level) of more than 20m below ground surface, thus degradation of groundwater quality is not seen to happen. Two (2) groundwater samples were collected last August 9, 2019 at the community residents in Parcel 2, **Table 2-35**. The location of the sampling station is excluded from the quarry area.

Ground Water Sampling Results

Table 2-35 Groundwater Sampling Results, August 9, 2019

PARAMETERS	Deepwell 1 Cloudy with Rainy morning 23° - 29° C	Deepwell 2 Cloudy with Rainy morning 23° - 29° C		TEST METHOD AND WHERE ANALYZED	
	TEST RESULTS	TEST RESULTS	DAO 2016-08 *Class A* WQG		
	N= 14° 34' 48.74" E= 121° 14' 9.16"	N= 14° 34' 52.45" E= 121° 14' 9.33"	Results		
Biochemical Oxygen Demand (BOD_5), Mg/L	**18**	**14**	3	Gravimetric Method	ELARSI, INC Authorized Laboratory
Dissolved Oxygen as DO, mg/L	**6.8**	**6.9**	5	Gravimetric Method	ELARSI, INC Authorized Laboratory
Total Suspended Solids (TSS), mg/L	**10**	**22**	50	Gravimetric Method	ELARSI, INC Authorized Laboratory
Fecal Coliform, mg/L	**1.1**	**< 1.1**	<1.1	Gravimetric Method	ELARSI, INC Authorized Laboratory

Discussion of the Results

Groundwater sampling was conducted on August 9, 2019 at the community inside Parcel 2 of the MPSA 347-2010-IVA, locations were identified based on the existing available jetmatic well used by the community for washing, cleaning, laundry and others, no identified available jetmatic in Parcel 1. Based on the results, compared with DAO 2016-08 *Class 'A'*, parameters such as BOD, DO failed the DENR Standards both for Ground water 1 and 2, Total Suspended Solids however are within the limits. Ground water 1 is considered not potable for drinking, ***Photo 2ffff to Photo 2iiii, Figure 2-61 shows the Groundwater Sampling Map.***

***Photo 2ffff**. Groundwater Station 1 Actual Sampling Site within Parcel 2 Community but to be excluded from Quarry Limit*

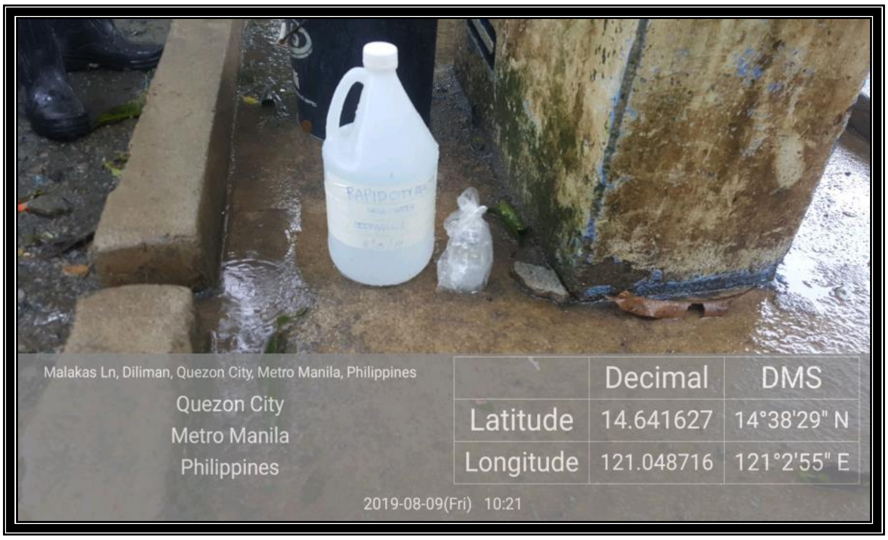


***Photo 2gggg**. Groundwater Station 1 Sampling Bottle*

***Photo 2hhhh**. Groundwater Station 2 Actual Sampling Site within Parcel 2 Community but to be excluded from Quarry Limit*

***Photo 2iiii**. Groundwater Station 2 Sampling Bottle*

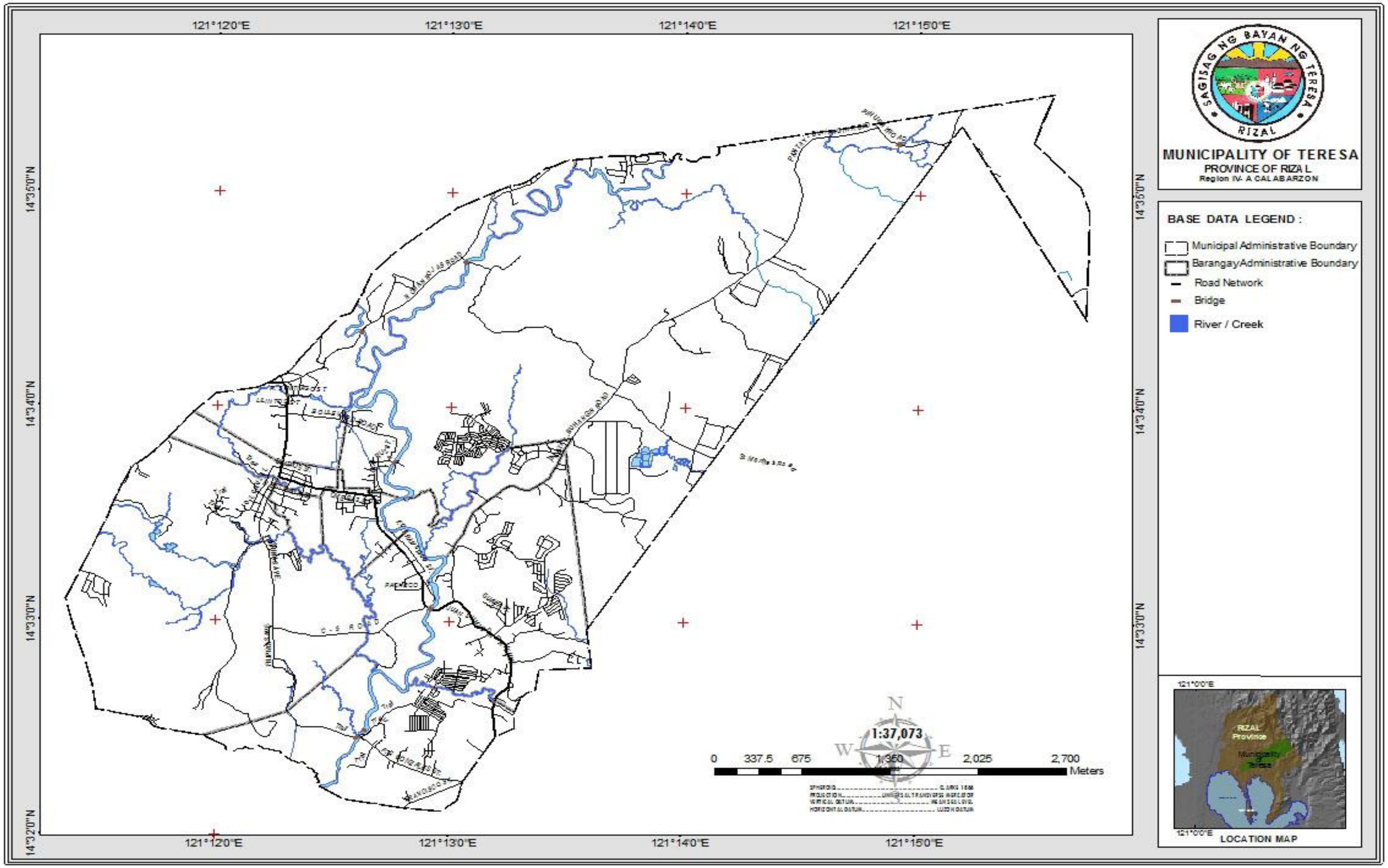
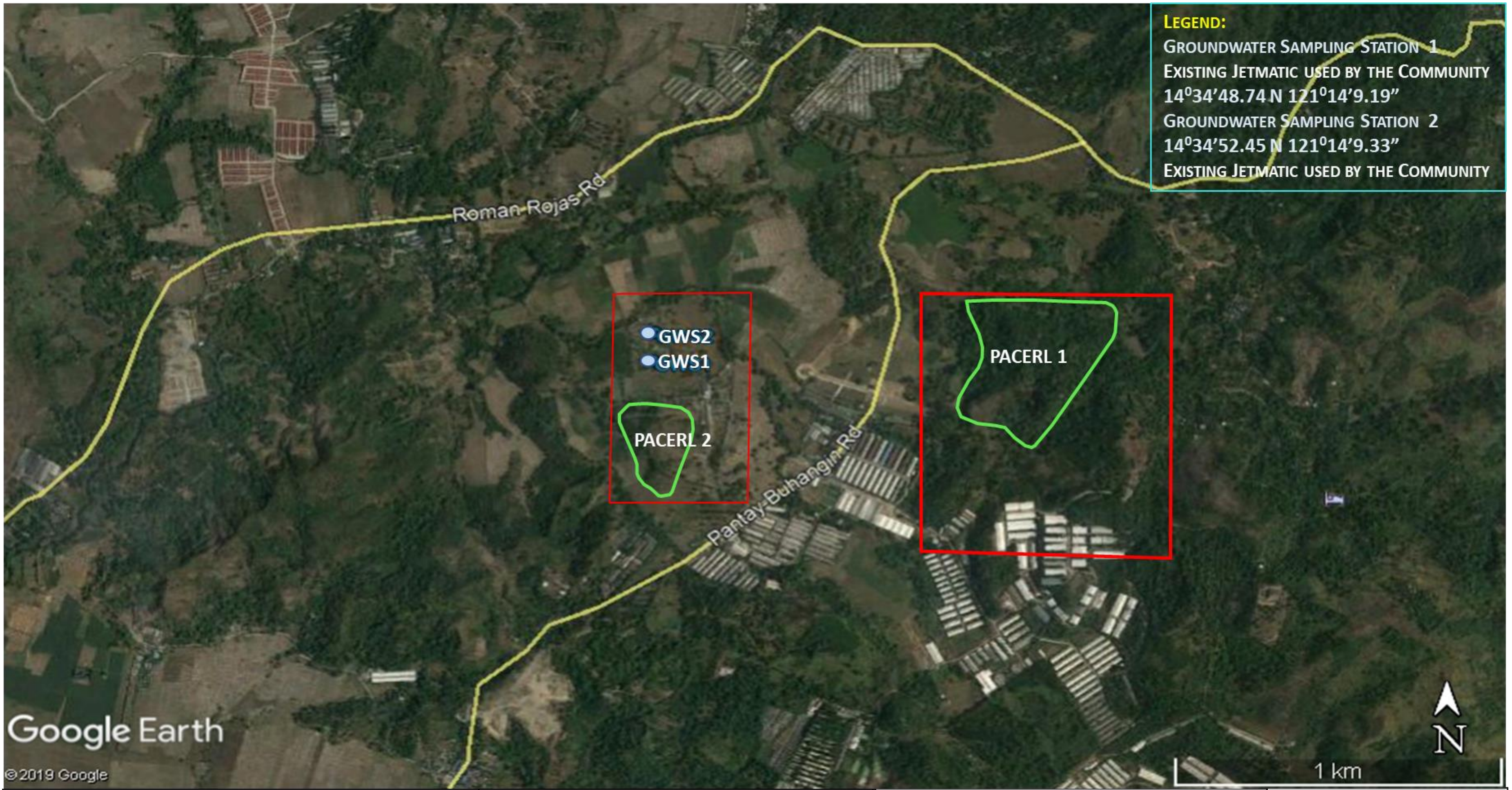


Figure 2-60b Surface Water Resources Map



Proponent:	Consultant:	Project Title and Location:	Sheet Content:
Roxanna S. Go MPSA Holder 167 Sumulong Highway, Antipolo City	CEnSE Technical Consultancy Services Unit 405, Yrreverre Square Building, 888 Mindanao Avenue, Quezon City	Pozzolan Quarry (MPSA 347-2010-IVA) Barangay Maybancal, Morong and Barangay Dalig, Teresa Municipality of Rizal	Groundwater Sampling Map *Figure 2-61*

Figure 2-61 Ground water Sampling Map

2.2.3.2 Degradation of Surface Water Quality

There is no surface water or creek within the 50-meter radius of the project site. Generally, precipitations and surface flows are the only source of runoff in the area. Water from most of river system that proliferates within its surrounding or at the main mine site are considered to be of intermittent stream behavior due to the absence of surface flow during dry periods and appearance of stream flows during rainy weather or season.

Surface Quality Sampling Results

Methodology

Surface Sampling Conducted August 9, 2019

Surface water sampling was conducted after the morning rain of August 9, 2019 considering that the identified was classified as run-off channel, (Photo 2jjj to 2lll). No water is seen during summer or no rain scenario. Station 1 and Station 2 is considered upstream of the run-off channel which leads to the main river which is the May-iba River about 3.5 km aerial from the proposed quarry.

Field measurement of pH was undertaken. Using a portable digital pH meter, on-site measurement was taken. The pH meter was properly calibrated prior to use. Physical appearance of the water is also observed.

Table 2-36 shows that results of the surface water collected**, Figure 2-62** shows the location of the sampling stations. Parameters were based on Table 8 of DAO 2016-08 Quality Parameters per Sector under PSIC Code B 05 (Mining and Quarrying) except for TSS because the sampling site is not considered a water body but a run-off channel.

Surface Water Sampling Results

Table 2-36 Surface Water Sampling Results, August 9, 2019

PARAMETERS	Station 1 Upstream Cloudy with Rainy morning 23° - 29° C	Station 2 Upstream Cloudy with Rainy morning 23° - 29° C	Station 3 Downstream Cloudy with Rainy morning 23° - 29°	TEST METHOD	DAO 2016-08 Class C WQG
	N= 14° 35' 19.83" E= 121° 14' 45.67"	N= 14° 35' 8.67" E= 121° 14' 59.69"	N= 14° 35' 11.02" E= 121° 14' 42.05"		
COD, Mg/L	27	18	21	Gravimetric Method	NS
Cadmium as Cu, mg/L	< 0.003	< 0.003	< 0.003	Gravimetric Method	0.005
Chromium as Cr, mg/L	< 0.01	< 0.01	21	Gravimetric Method	0.01
Cobalt as Co, Mg/L	< 0.01	< 0.01	< 0.01	Gravimetric Method	
Copper as Cu, Mg/L	< 0.004	< 0.004	< 0.004	Gravimetric Method	0.02
Lead as Pb, Mg/L	< 0.03	< 0.03	< 0.03	Gravimetric Method	0.05
Magnesium as Mg, mg/L	10.52	8.32	10.33	Gravimetric Method	
Mercury as Hg, mg/L	< 0.0003	< 0.0003	< 0.0003	Gravimetric Method	0.002
Nickel as Ni, ng/L	< 0.03	< 0.03	< 0.03	Gravimetric Method	
Zinc as Zn, mg/L	< 0.1	< 0.1	< 0.1	Gravimetric Method	
PH, mg/L	7.22	7.22	7.24	Gravimetric Method	6.5-9.0
Color, mg/L	60	70	60	Gravimetric Method	
Temperature, mg/L	20	20	20	Gravimetric Method	25-31

Source: ELARSI, Inc., Annex H.3

Discussion of the Results

Surface Water sample was collected last August 9, 2019. The results of analyses were compared based on the DAO 2016-08, DENR Standards for Class "C" Waters, which showed that all parameters were within the DENR standards, ***attached in Annex H.3 is the Surface Water Sampling Laboratory results. Surface Sampling Map is presented in Figure 2-62.***

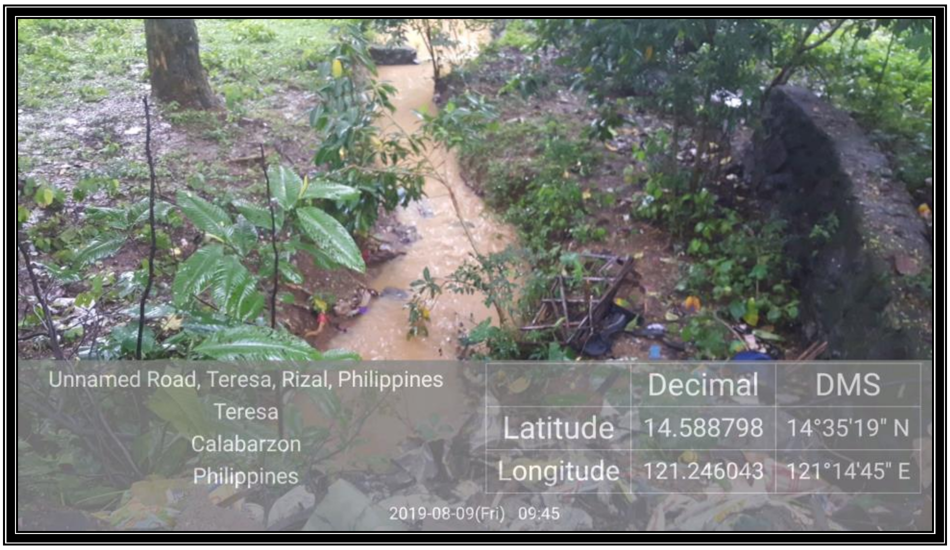


***Photo 2jjjj**. Upstream 1 along Roman Rojas Road -Drainage Line*

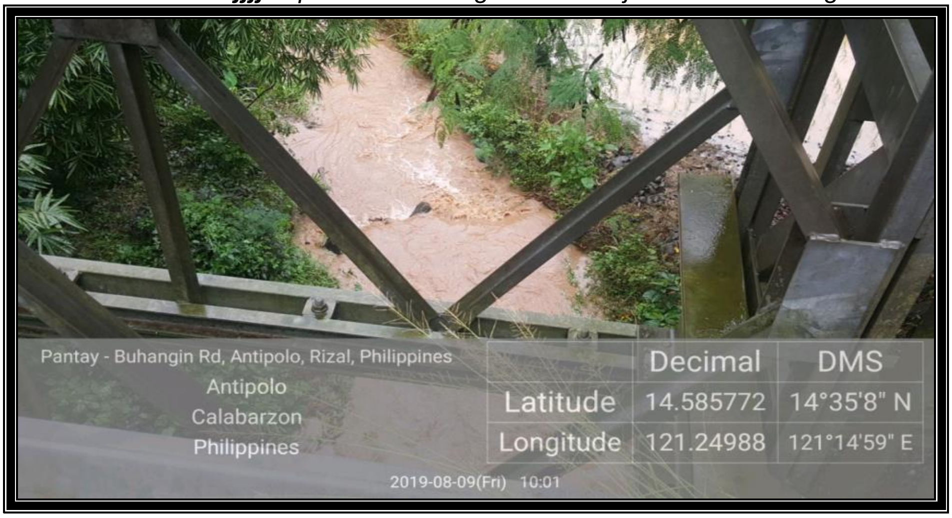
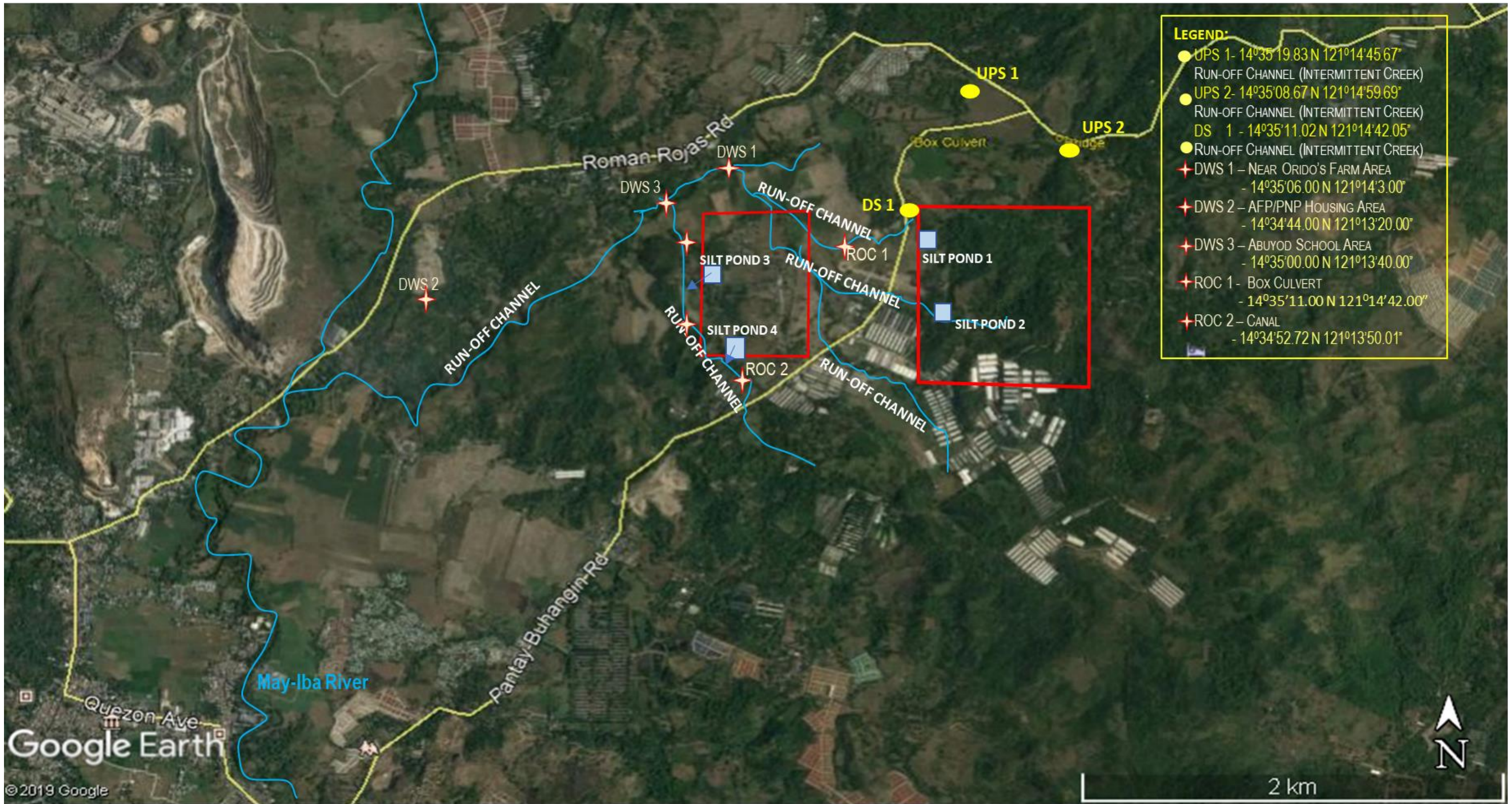


***Photo 2kkkk**. Upstream 2 along Roman Rojas Road – Bridge near Quest Adventure*

***Photo 2llll**. Downstream along Pantay-Buhangin Road – Intermittent Creek*



Proponent:	Consultant:	Project Title and Location:	Sheet Content:
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Figure 2-62 Surface water Sampling Map

IMPACT ASSESSMENT AND MITIGATING MEASURES

During Construction and Operation Phase

<u>Possible Increase in Sedimentation of Run-off Channel</u>

The situation of the run-off channel/intermittent creek during heavy downpour (Photo 2jjj to 2lll) showed that without the operation of the quarry, water was seen to have presence of silts. During operation of the quarry, possible increase in siltation due to surface run-off brought about by heavy downpour.

Mitigating Measures

In a mining or quarry operation, enough settling ponds shall be constructed to ensure that silts are gathered and collected at the pond therefore only overflow clear water goes directly to the final outfall. Silts are collected and desilting will be done regularly or every six (6) months and become another source of filling material after the drying.

The quarry project shall construct siltation pond, three (3) for Parcel 2 where and two (2) for Parcel 1.

2.2.3.3 Degradation of Coastal/Marine Water Quality

The project site is located about 56 kilometers away from Manila Bay where the nearest identified marine water from the site.

2.2.4 <u>Freshwater Ecology</u>

Although, there is no identified freshwater near the quarry site, creek was considered intermittent, assessment was done after the downpour so as water could be gathered from the creek.

Assessing freshwater ecology is important in determining the current condition of an aquatic habitat. Freshwater ecology in the area is discussed by assessing the two (2) streams near parcel 1 and parcel 2. Macrobenthic and epilithic algae in the streams are assessed.

Macrobenthic invertebrates

Kicknet method

A 5-m transect line was laid for the macroinvertebrates sampling along a portion of the streams. A 1 m^2 kick net supported by 2 poles was used to collect samples. The net was placed downstream while about 1 m upstream of the net was disturbed while slowly walking upstream, exposing the bedrocks and leaf pacts, the process is done continuously until the 5m transect was reached. Collected specimens were transferred to a 150ml polyethylene bottle with 5% ethanol for preservation and were identified up to its family level.

Photo 2mmmm*. Macrobenthic sampling using the kick net method*

Epilithic Algae

Three submerged stones with possible algal growth were collected in each sampling station. A 7mm diameter PVC pipe was placed on the surface of the stone for area measurement and the inside part was brushed and was rinsed with water using a squirt bottle to a basin. Samples were then placed in an amber bottle with 5% ethanol. Subsamples were obtained from each bottle and microalgae were identified and counted under a compound microscope. Identification was up to family level only.

Photo 2nnnn*. Brushing of rocks for sampling epilithic algae.*

Sampling stations

The nearest body of water from the parcels were assessed. Two (2) sampling stations for each parcel was established, **Table 2-37**. In parcel 1 the nearest stream/creek was within the parcel while in parcel 2 was located outside the parcel, ***Figure 2-63 shows the Freshwater Sampling Map.***

Table 2-37. Freshwater stations established for parcel 1 and parcel 2.

Stations	Latitude	Longitude
Parcel 1 S1	14°34'33.25"N	121°14'6.50"E
Parcel 1 S2	14°34'37.06"N	121°14'4.22"E

2.2.4.1 Threat to Existence And/Or Loss Species of Important Local and Habitat

Macrobenthic invertebrates

Macrobenthic invertebrates composed of insects and mollusks in their larval stages of development, which are found in freshwater bodies. They play an important role as primary consumers, nutrient cycle and energy flow between epilithic algae and other consumers.

Macroinvertebrates identified

There were one hundred fifty (150) macroinvertebrates identified belonging to Phyla Arthropoda that were grouped into 11 families, with one (1) unidentified. Macroinvertebrates identified within the 2 streams includes beetles, midges and mostly flies. The identified 10 families of macroinvertebrates are the following: Elmidae, Baetidae, Caenidae, Ceratopogonidae, Chironomidae, Simuliidae, Tabanidae, Calopteridae, Gerridae and Hydropsychidae. An unidentified pupa was also found in the samples.

Most of the macroinvertebrates identified are from Order Diptera with 4 families. Order Diptera, or the "true flies" can be found in all freshwater environments and can be very tolerant to poor water quality and anoxic conditions. The sampling stations are near piggeries and poultry farms thus adult flies are present in the area. Below are representatives of the macroinvertebrates identified:

***Photo 2oooo**. Family Elmidae*

Photo 2pppp. *Family Caenidae*

Photo 2qqqq. *Family Chironomidae*

Photo 2rrrr. *Family Hydropsychidae*

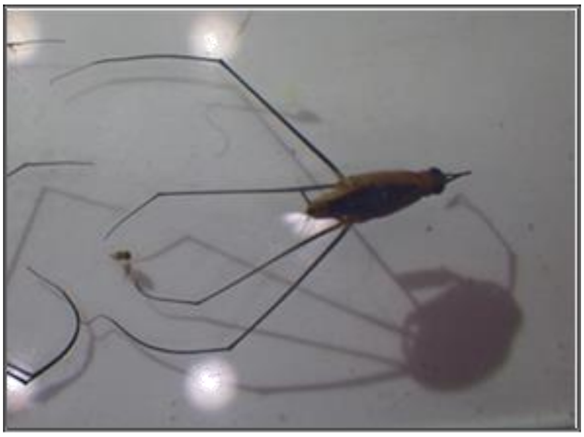


Photo 2ssss. *Family Gerridae*

***Photo 2tttt**. Unidentified pupa*

Parcel 1

There were eight (8) identified families of macroinvertebrates that were found in the streams of Parcel 1, **Table 2-38**. Another unidentified pupa, which may belong to another family was also found.

Table 2-38 Macroinvertebrates Found in the Streams of Parcel 1

Phylum	Order	Family	Common Names	Parcel 1
Athropoda	Coleoptera	Elmidae	riffle beetles	*
	ephemeroptera	Baetidae	maylies	*
		Caenidae	mayflies	*
	Diptera	Ceratopogonidae	no-see-ums/biting midges	*
		Chironomidae	lake flies	*
		Simuliidae	black flies	*
	Odonata	Calopteridae	damselflies	*
	Trichoptera	Hydropsychidae	net-spitting caddiis flies	*
			unknown pupa	*

Parcel 2

There were five (5) identified families of macroinvertebrates found in the stream near Parcel 2, **Table 2-39**. An unidentified pupa was also found among the samples which may belong to another family.

Table 2-39 Macroinvertebrates Found in the Streams of Parcel 2

Phylum	Order	Family	Common Names	Parcel 2
Athropoda	ephemeroptera	Baetidae	maylies	*
		Caenidae	mayflies	*
	Diptera	Chironomidae	lake flies	*
		Simuliidae	black flies	*
		Tabanidae	horseflies	*
			unknown pupa	*

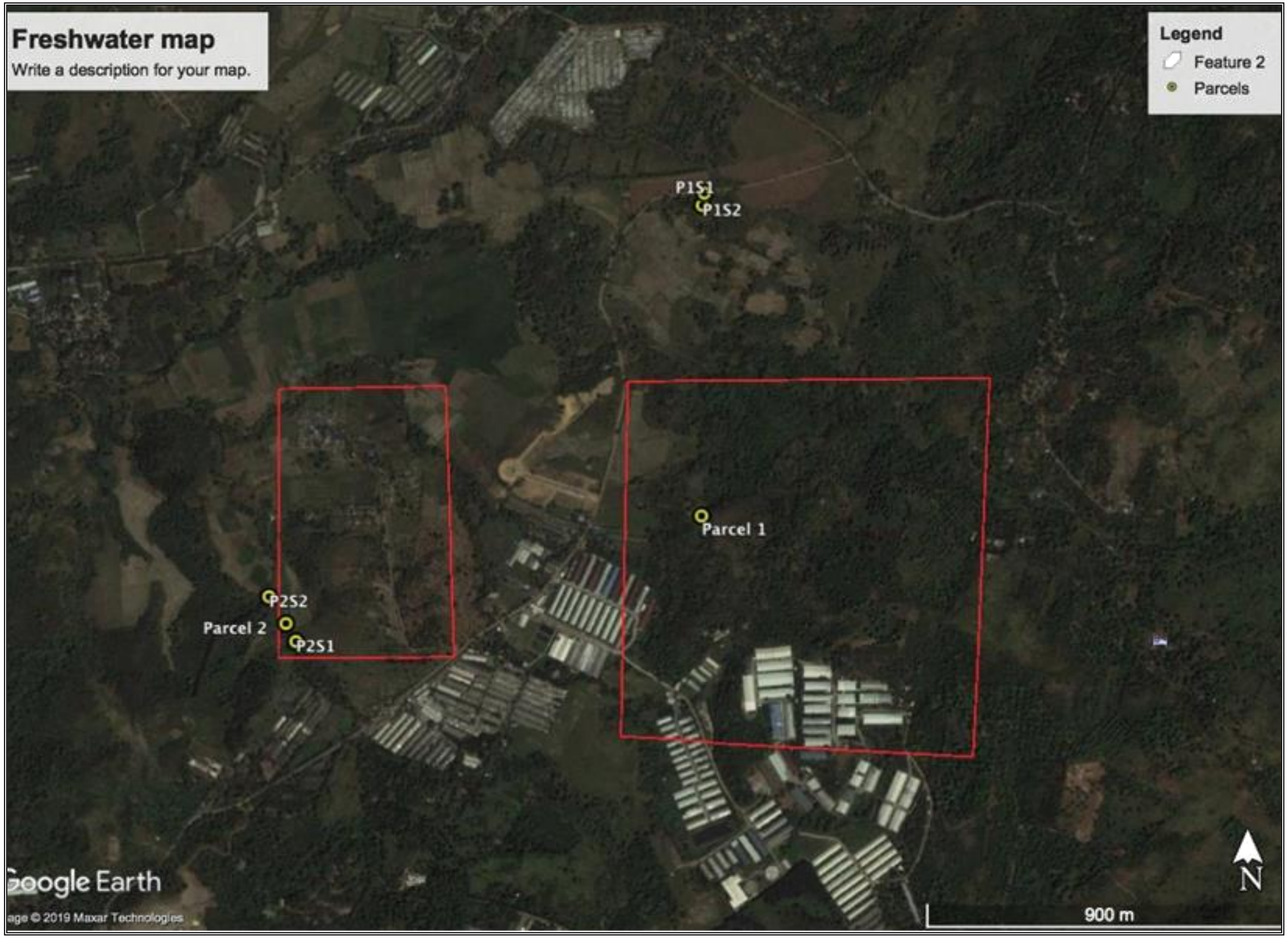


Figure 2-63 Freshwater Sampling Map

2.2.4.2 Threat to Abundance, Frequency and Distribution of Species

There will be no threat to abundance, frequency and distribution of species in the area brought about by the proposed project. As such, the existing creek is considered with substantial pollution (Fairly poor) based on Family Biotic Index (FBI).

Parcel 1

A total of 130 macroinvertebrates were counted in parcel 1. Among the two parcels established this had the most number of macrobenthic invertebrates identified. ***Figure 2-64 shows the relative abundance of macroinvertebrates found in Parcel 1***, Macroinvertebrates under Family Caenidae had the highest abundance of 22% (29 individuals) followed by Calopterygidae with 19% (25 individuals), Gerridae with 13% (17 individuals) and Hydropsychidae with 11% (14 individuals). Five (5) families have abundance values lesser than 10% for the whole parcel. The least abundant family belongs to Elmidae with 4% (5 individuals), the family of riffle beetles that have a low tolerance value of 4 when compared to Family Caenidae with a tolerance value of 7.

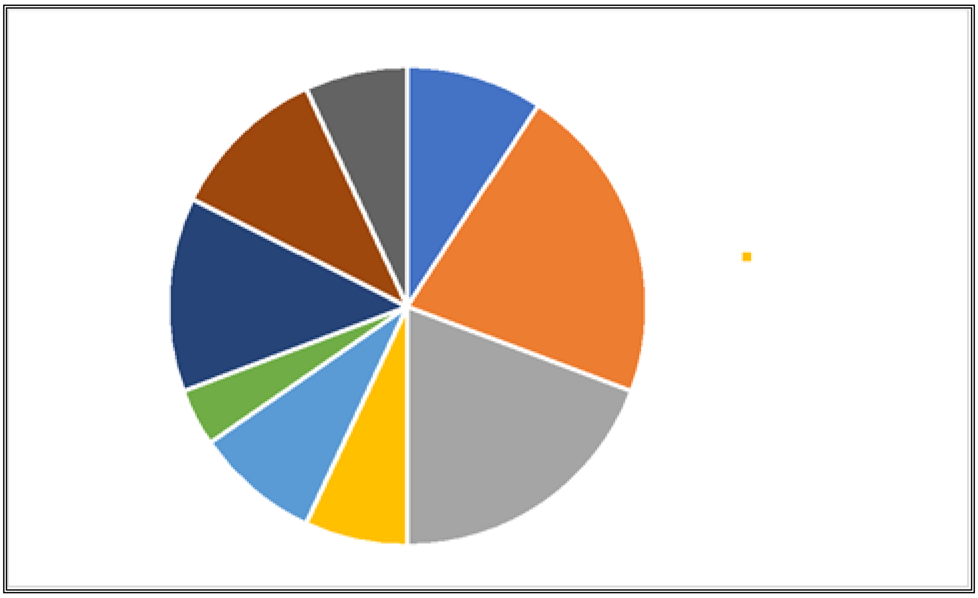


Figure 2-64. Relative abundance of macroinvertebrates in Stations located in parcel 1.

Parcel 2

A total of twenty (20) macroinvertebrates were identified in established station in Parcel 2. ***Figure 2-65 shows the relative abundance of macroinvertebrates found in Parcel 2.*** The most abundant macroinvertebrates in this station belong to the family Simuliidae, the blackflies with 60% (12 individuals) followed by Chironomidae 20% (4 individuals), and Tabanidae with 10% (2 individuals). Families Baetidae and Caenidae both have the least relative abundance of 5% with 1 individual present. Macrobenthic invertebrates under family Simuliidae are known to be very tolerant to organic wastes in the aquatic ecosystem with a tolerance value of 6. Two families had the least abundance and are below 10%, families Baetidae and Caenidae which are commonly called mayflies under order Ephemeroptera

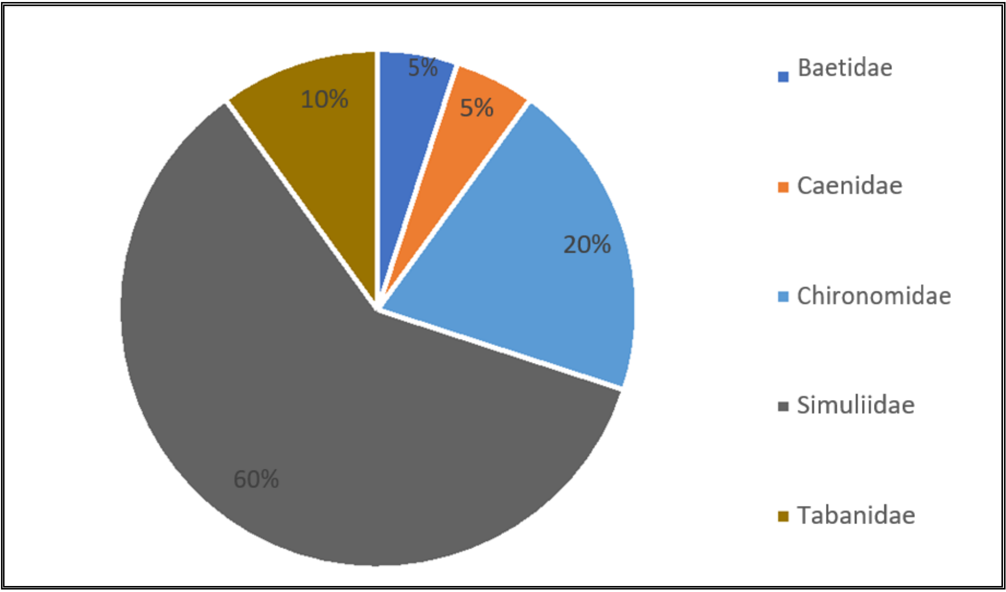


Figure 2-65. Relative abundance of macroinvertebrates in Stations located in parcel 2.

Family Biotic Index

Macroinvertebrates can be used as biotic indicators for water quality since they have a degree of tolerance and sensitivity. External factors such as pollution and siltation changes water quality in an aquatic habitat where macrobenthic invertebrates are present since there is a wide tolerance per family, they are good indicators. Biotic indexes such as HBI is important in assessing water quality in a given water body. Hillsenhoff's Biotic Index (HBI) uses categorized tolerance values of each macroinvertebrate family over the total abundance of macroinvertebrates in a given sample. **Table 2-40** below shows the water quality degree based on Hilsenhoff Field Biotic Index (FBI) and FBI of microbenthic invertebrates found in each of the two stations.

Table 2-40 Water quality degree based on Family Biotic Index (from Hilsenhoff, 1977)

FBI	Water Quality	Degree of organic pollution
0.00 - 3.75	Excellent	Organic Pollution unlikely
3.76 - 4.25	Very Good	Possible slight organic pollution
4.26 - 5.00	Good	Some organic pollution probable
5.01 - 5.75	Fair	Fairly substantial pollution likely
5.76 - 6.50	Fairly Poor	Substantial pollution likely
6.51 - 7.25	Poor	Very substantial pollution likely
7.26 - 10.00	Very Poor	Severe organic pollution likely

Water quality for all stations established in the streams in each parcel is shown below. Both streams sampled have an FBI of 5.78 and 6.35 which is considered as "Fairly Poor" with substantial pollution, **Table 2-41**. This is mainly brought by the untreated domestic sewerage draining to the streams by the adjacent residential houses and farms especially in parcel 1 which is near a piggery where the water is stagnant. Furthermore, the water in the area has a foul odor and some solid waste such as sachets and plastics, detergents and many more were thrown in the streams in Parcel 1. In parcel 2 though it is also classified as fairly poor the water in the stream is flowing but it is near farms and houses also.

Table 2-41 Water quality degree based on Family Biotic Index (from Hilsenhoff, 1977)

Location	FBI	Water Quality	Degree of Organic Pollution
Parcel 1	Excellent	Fairly Poor	Substantial Pollution likely
Parcel 2	Very Good	Fairly Poor	Substantial Pollution likely

Epilithic Microalgae

Epilithic microalgae are photosynthetic organisms that thrives and usually form benthic algal communities on stones, rocks and debris found in the bottom of rivers or streams. They serve as the primary producers in freshwater communities that are needed by macrobenthic invertebrates, slight changes in the abundance of these algae affect the population of macrobenthic also.

Species Richness of Epilithic Algae Identified

There were seven (7) species of epilithic algae that were identified both parcels. Five (5) of these species belonged to Phylum Bacillariaphyta, commonly called Diatoms. The other two species belong to the Phyla Chlorophyta (Green Algae) and Cyanophyta (Blue Green Algae).

The following images are some of the epilithic algae identified in the area:

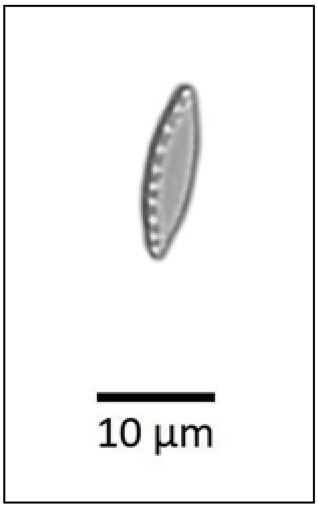


***Photo 2uuuu**. Niztschia sp.*

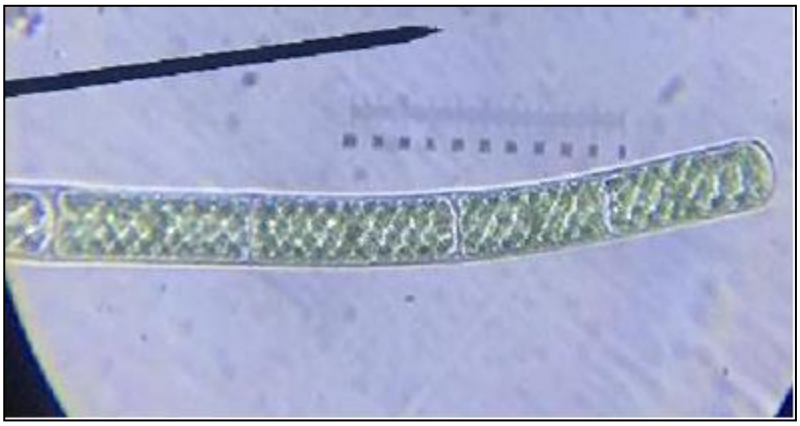


***Photo 2vvvv**. Epilithic algae, Spirogyra sp*

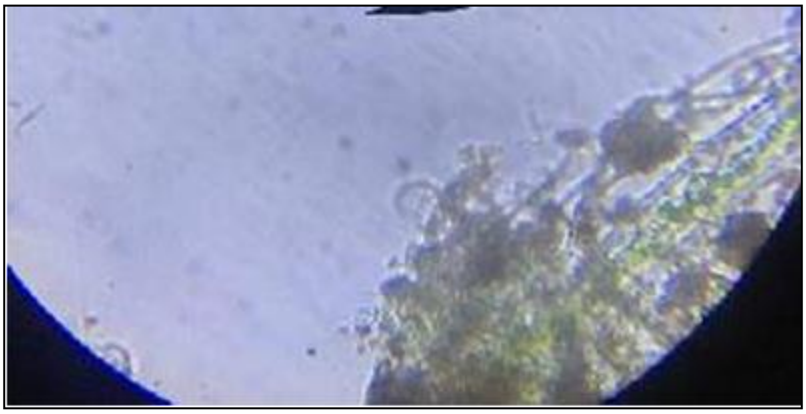


***Photo 2wwww**. Epilithic algae, Spirogyra sp.*

Presence

Among the 2 parcels all 7 species were present in parcel 1 while only 6 were present in parcel 2, Table 2-42.

Table 2-42. Epilithic algae found in the established stations within the 2 parcels.

	Phyla	Species	Parcel 1	Parcel 2
Blue Green Algae	Cyanophyta	*Oscillatoria sp.*	*	*
Green algae	Chlorophyta	*Spirogyra sp.*	*	*
Diatoms	Bacillariaphyta	*Fragellaria sp.*	*	*
Diatoms	Bacillariaphyta	*Gomphonema sp.*	*	*
Diatoms	Bacillariaphyta	*Melosira sp.*	*	
Diatoms	Bacillariaphyta	*Navicula sp.*	*	*
Diatoms	Bacillariaphyta	*Nitzchia sp.*	*	*

Abundance

Parcel 1

A total of five hundred seventy-seven individuals were counted in the 2 stations established for parcel 1.

All the 7 species were also identified in this parcel with Oscillatoria sp. as the most abundant species with 33% in station 1 and 20% in station 2. Navicula sp. follows with 22% in station 1 and 28% in station 2. The least abundant algae for station 1 was Gomphonema sp. with 5% and for station 2 Spirogyra sp as shown in ***Figure 2-66***.

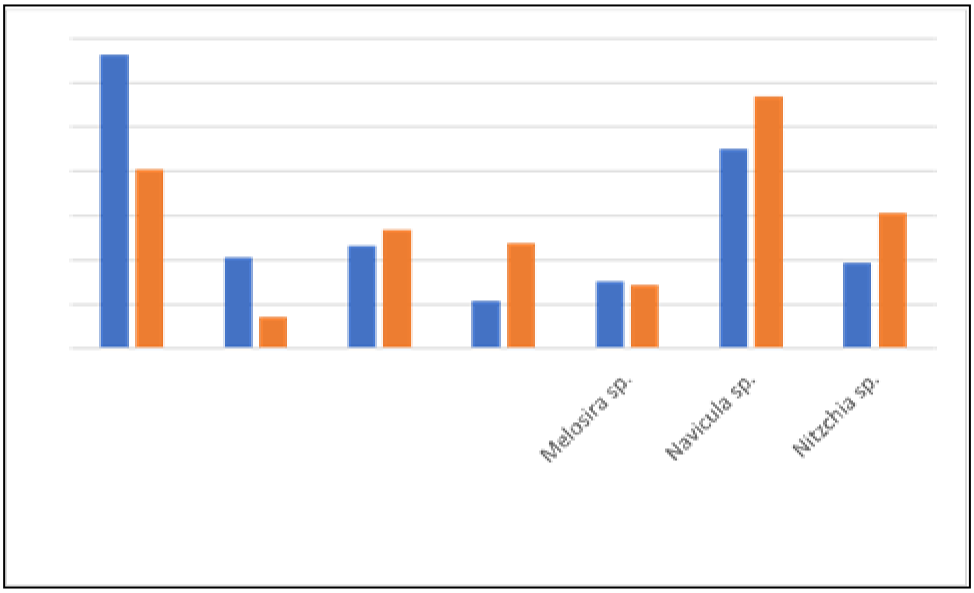


Figure 2-66. Relative abundance of epilithic algae found in the 2 stations in parcel 1

Parcel 2

A total of 229 epilithic algae were counted for the2 stations in parcel 2. Among the stations, station 1 (p1s1) had more individuals than station 2(p1s2). Six species were identified in parcel 1 but between the stations only the species Oscillatoria sp., Spirogyra sp. and Gomphonema sp. were present in all stations. Navicula sp. is only found in station 1 and Nitzchia sp. in station 2, ***Figure 2-67***.

The most abundant species found for the whole parcel is Oscillatoria sp. with 47% in station 2 and 32% in station 1. This is followed by Spirogyra sp. in station 2 with 25% and Fragillaria sp. in station 1 with 25%. The least abundant species for this parcel is found in station 1 under Gomphonema sp. with 3%.

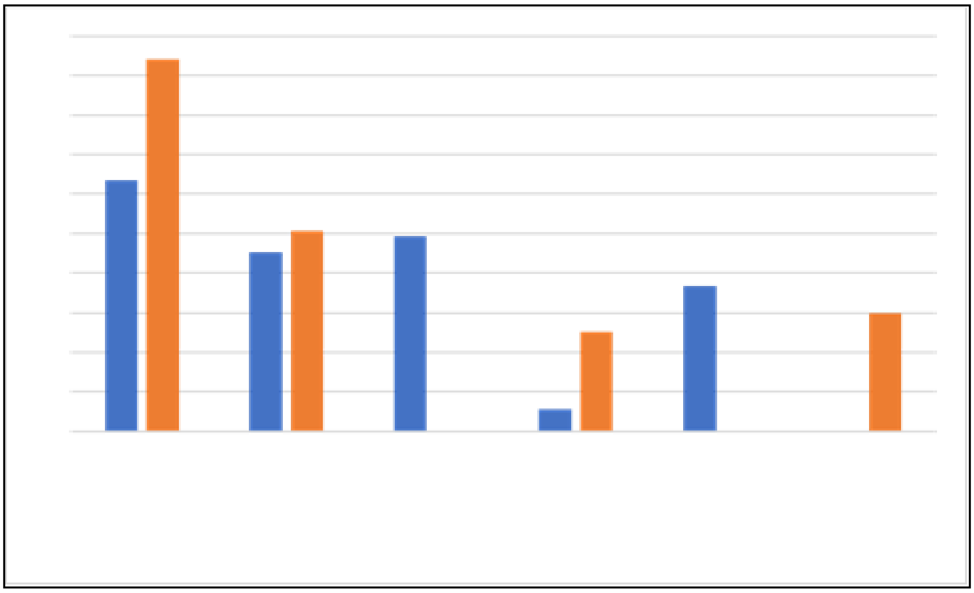


Figure 2-67. Relative abundance of epilithic algae found in the 2 stations in parcel 2

IMPACT ASSESSMENT AND MITIGATING MEASURES

During Construction and Operation Phase

No identified impact since project is away from any freshwater/creek considering that water is considered intermittent and classified as with substantial pollution. The proposed quarry project shall implement zero discharge.

2.2.5 Marine Ecology

The proposed quarry project is away from the any marine ecosystem. The nearest seawater is Manila Bay which is about 53.60 kilometers west from the quarry site. No marine water sampling was done for this particular module.

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

The proposed quarry project will not pose any threat to existence and/or loss species of important local and habitat.

2.2.5.2 Threat to Abundance, Frequency and Distribution of Species

There will be no threat to abundance, frequency and distribution of species in the area brought about by the construction and operation of the quarry project.

IMPACT ASSESSMENT AND MITIGATING MEASURES

During Construction and Operation Phase

No identified impact for this particular section.

2.3 THE AIR

2.3.1 Meteorology/Climatology

2.3.1.1 Change in The Local Micro-Climate e.g. Local Temperature

Scope

This sub-section presents the two (2) key impacts as specified in the Technical Scoping Checklist for the project.

a) Change in Local Climate

The required baseline parameters to be presented in the report are the monthly average rainfall and air temperature, climatological extremes, wind rose/frequencies and frequency of tropical cyclones. Impact assessment focused on the identification and assessment of the project impact in terms of change in local microclimate and on the effects of climate change using PAGASA's medium to long-term projections

b) Contribution in Terms of Greenhouse Gas (GHG) Emissions

Estimates of greenhouse gas (GHG) emissions and the mitigation and/or sequestration for both construction and operation

Methodology

a) Change in Local Climate

Table 2-43 presents the meteorological data used in this study, which were based from Science-Garden PAGASA Station located in Diliman, Quezon City, the nearest synoptic station from the project site. This station is located about 22.6 km west-northwest (or 290° azimuth) of the proposed project site.

Baseline monthly average parameters of rainfall, air temperature and winds were based from the said station, including the extreme recorded rainfall, air temperature and wind speeds.

Projected changes of rainfall amd air temperatures were based from the latest publication of PAGASA in 2018. PAGASA (2018) published the updated climate projections for all provinces in the Philippines.

Table 2-43: Meteorological Data and Sources of Information

Data	Covered Period	Source/Remarks
Climate Map of the Philippines	1951 to 2010	PAGASA
Climatological Normals for Science Garden PAGASA Station in Diliman, Quezon City (**Table 2-43**)	1981 to 2010	PAGASA
Climatological Extremes for Science Garden PAGASA Station in Diliman, Quezon City (**Table 2-44**)	1961 to 2018	PAGASA
Observed climate trends and projected climate change in the province of Rizal	Baseline period (1971 to 2010); projected period (2036 to 2065)	PAGASA
Typhoon Frequency Map	March 2017	PAGASA

b) Contribution in Terms of GHG

The projected greenhouse gas emissions (GHG) emanating from the project operation were determined by estimating the total fuel consumption and used of the GHG calculation tool of the World Resources Institute (WRI) named GHG protocol tool for mobile combustion, Version 2.6. Fuel consumption per equipment or source was estimated based on Klanfar, et al. (2016), "Fuel Consumption and Engine Load Factors of Equipment in Quarrying of Crushed Stone".

Climate and Baseline Rainfall

The climate of the project site belongs to Type III climate (***Figure 2-68***). This type of climate has no very pronounced maximum rain period. Dry season in Type III climate last only for one to three months, either from December to February or from March to May.

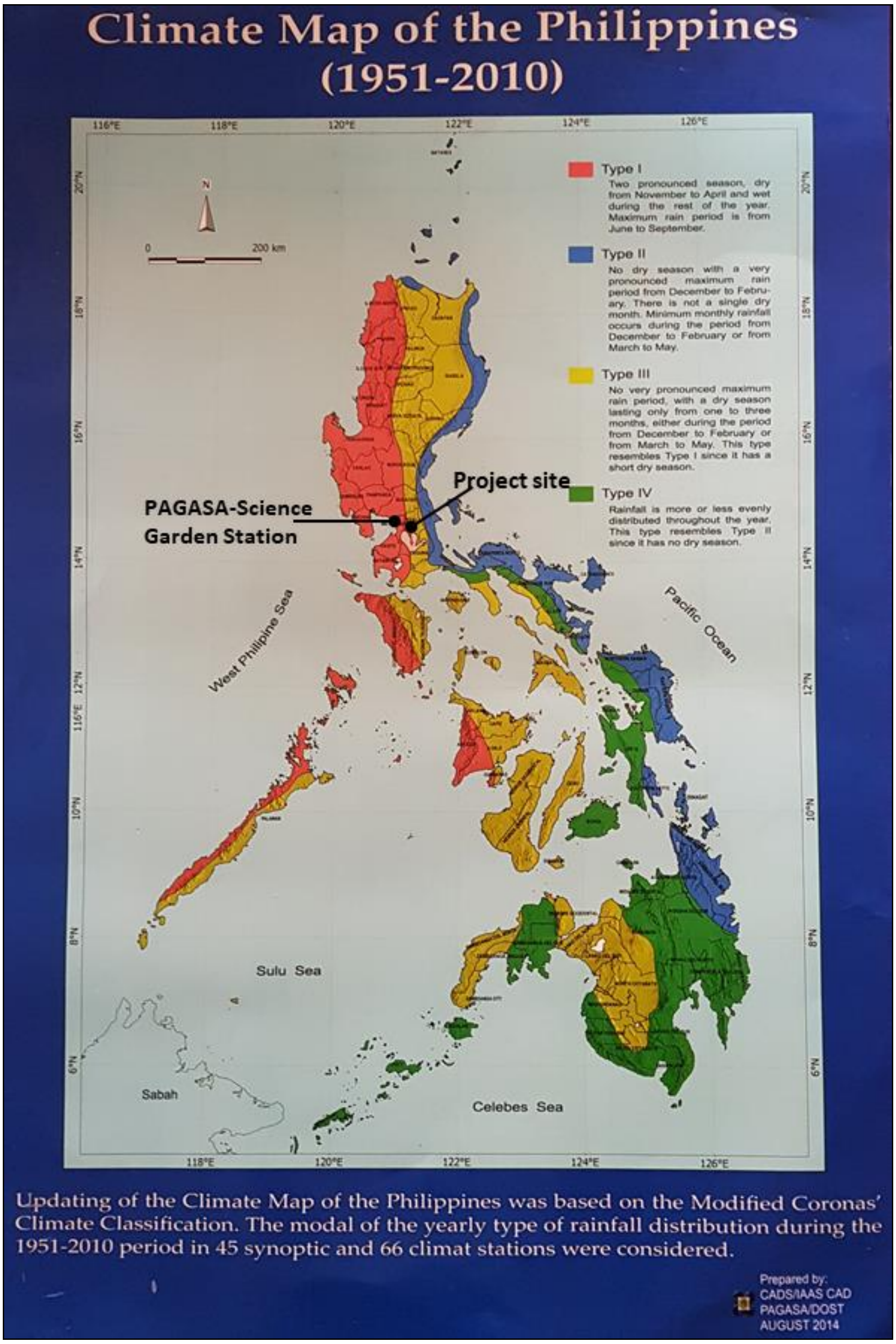


Figure 2-68 Climate map of Philippines are the locations of the project site and the Science Garden PAGASA Station

Table 2-44. Climatological Normals (1981 to 2010) for Science Garden PAGASA Station (Source: PAGASA)

Month	Rainfall (mm)	No of rainy days	Temperature (ºC)						VP (mbs)	Rel. Hum. (%)	MSLP (mbs)	Wind (m/s)		Clouds (Okta)	No. of days With	
			Max	Min	Mean	Dry Bulb	Wet Bulb	Dew Pt.				Dir.	Speed		TSTM	LTNG
Jan	18.5	4	30.6	20.8	25.7	25.3	22.2	20.9	24.6	76	1012.3	N	1	5	1	0
Feb	14.6	3	31.7	20.9	26.3	26	22.3	20.8	24.4	73	1012	NE	1	5	0	0
Mar	24.8	4	33.4	22.1	27.8	27.6	23.2	21.5	25.4	69	1011.3	SE	1	4	2	1
Apr	40.4	5	35	23.7	29.4	29.2	24.4	22.7	27.2	67	1009.7	SE	1	4	4	2
May	186.7	10	34.7	24.7	29.7	29.3	25.3	23.9	29.5	72	1008.5	S	1	5	12	8
Jun	316.5	18	33.1	24.6	28.8	28.4	25.5	24.5	30.6	79	1008.1	SW	1	6	17	9
Jul	493.3	22	31.9	24.1	28	27.5	25.2	24.4	30.5	83	1007.7	SW	2	6	19	9
Aug	504.2	23	31.3	24.2	27.8	27.3	25.2	24.5	30.6	84	1007.4	SW	2	7	17	6
Sept	451.2	22	31.6	24	27.8	27.2	25.1	24.4	30.4	84	1010.6	SW	1	6	18	9
Oct	296.6	18	31.6	23.5	27.6	27	24.7	23.9	29.5	83	1008.8	N	1	6	11	6
Nov	148.8	14	31.4	22.7	27.1	26.5	24.1	23.2	28.4	82	1010.1	N	1	5	5	1
Dec	78.7	8	30.5	21.6	26	25.5	22.8	21.7	25.9	79	1011.5	N	1	5	1	0
Annual	**2574.4**	**153**	**32.2**	**23.1**	**27.7**	**27.2**	**24.2**	**23**	**28.1**	**78**	**1009.8**	**N**	**1**	**5**	**107**	**51**

Latitude: 14°38'41.35" N
Longitude: 121°02'40.45" E
Elevation: 43 m

Notes:
VP – Vapor Pressure
mbs – millibar
MSLP – mean sea level pressure
Dir – direction
TSTM – thunderstorm
LTNG – lightning

Table 2-45. Climatological Extremes for Science Garden PAGASA Station, as of 2018 (Source: PAGASA)

Month	Temperature (°C)				Greatest Daily Rainfall (mm)		Highest Wind (m/s)			Sea Level Pressure			
	High	Date	Low	Date	Amount	Date	Speed	Dir	Date	High	Date	Low	Date
Jan	34.7	01-17-1998	15.5	01-27-1987	55.8	01-16-1988	24	ESE	01-17-1972	1021.4	01-21-2005	998.8	01-22-1989
Feb	35.6	02-24-1967	15.1	02-04-1987	61.7	02-22-2013	22	SSE	02-02-1992	1021.7	02-14-2017	1002.3	02-09-1985
Mar	36.8	03-26-1983	14.9	03-01-1963	65.0	03-31-2012	13	S	03-16-1992	1021.0	03-05-2005	997.8	03-28-1988
Apr	38.0	04-25-1998	17.2	04-05-1963	64.8	04-21-2015	26	SSE	04-07-1992	1016.9 1016.9	04-05-1998 04-03-2017	1001.4	04-16-2007
May	38.5	05-14-1987	17.8	05-03-1962	166.0	05-20-1966	21	N	05-10-1992	1015.1	05-28-1986	992.4	05-17-1989
Jun	38.0	06-02-1993	18.1	06-27-1961	334.5	06-07-1967	37	SW	06-25-1972	1014.9	06-07-1997	978.7	06-26-1993
Jul	36.2	07-20-1998	17.7	07-23-1961	246.4	07-07-2002	36	NNW	07-09-1977	1015.0	07-01-1979	989.2	07-15-1978
Aug	36.1	08-17-2017	17.8	08-23-1964	391.4	08-07-2012	32	N	08-22-2000	1015.3	08-23-2002	994.2	08-24-1978
Sep	35.6	09-10-2017	20.0	09-08-1964	455.0	09-26-2009	35	NE	09-28-2006	1016.0	09-28-1997	987.4	09-30-1995
Oct	35.4	10-09-2003	18.6	10-31-1967	209.3	10-18-1975	30	SE	10-11-1989	1016.0	10-25-1986	978.7	10-23-1988
Nov	35.0	11-01-2001	15.6	11-12-1962	169.9	11-20-1966	50	NNW	11-03-1995	1019.1	11-18-1979	980.6	11-03-1995
Dec	34.9	12-06-2018	15.1	12-13-1988	135.5	12-15-2015	22	SE	12-22-1997	1020.0	12-27-2001	998.1	12-02-2004
Annual	**38.5**	**05-14-1987**	**14.9**	**03-01-1963**	**455.0**	**09-26-2009**	**50**	**NNW**	**11-03-1995**	**1021.4**	**01-21-2005**	**978.7**	**06-26-1993 10-23-1988**
Period of Record	**1961 - 2018**				**1961 - 2018**		**1961 - 2018**			**1961 - 2018**			

Latitude: 14°38’41.35” N
Longitude: 121°02’40.45” E
Elevation: 43 m

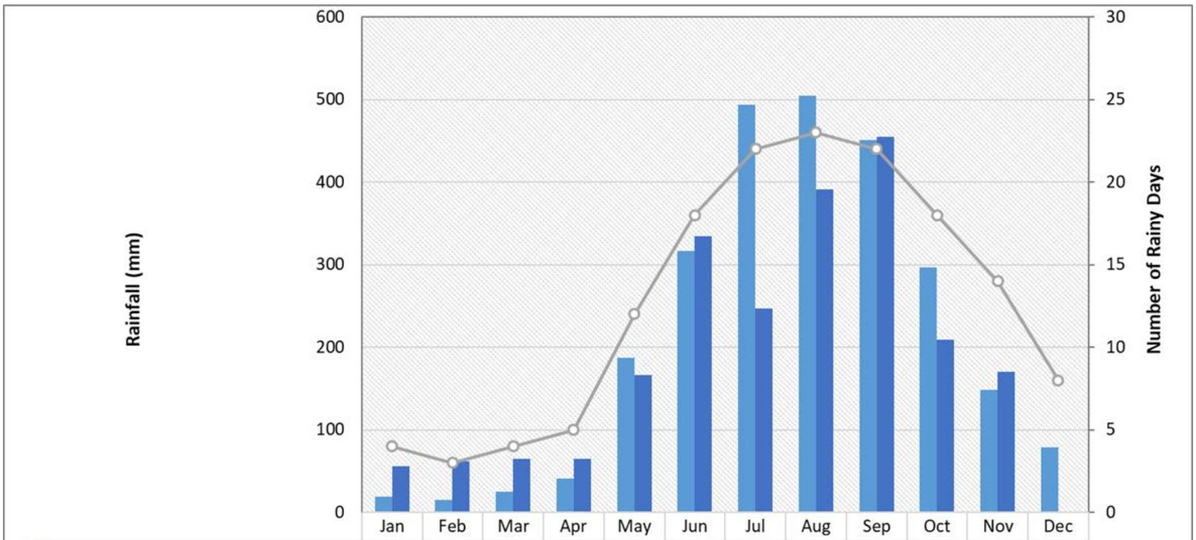
Normal and Extreme Rainfall

Figure 2-69 shows the plots of the following parameters related to normal and highest recorded rainfall.

- Normal monthly rainfall -monthly average rainfall amount for at least three (3) consecutive 10-year period, which in this case are from 1981 to 2010.
- Rainy day - a period of 24 hours beginning at 8:00 A.M. to 8:00 A.M. of the next day in which at least 0.1 mm of rain is recorded
- Highest recorded daily rainfall – pertains to the highest recorded daily rainfall, which in this case are the highest recorded rainfall in each month of the year.

August is the rainiest month with 504.2 mm of rainfall and average of 23 rainy days. The driest month is February with 14.6 mm of rainfall and only three (3) rainy days. The trend or pattern of rainfall shows recurrence of high rainfall during the southwest monsoon season with peak rainfall in August and the opposite during the northeast monsoon season.

Figure 2-69 also shows the highest recorded rainfall of 455 mm on September 26, 2009, also within the southwest monsoon season. This occurred during passage of Tropical Storm Ondoy, which made landfall between the boundary of Aurora and Quezon provinces on September 26, 2009.
On August 7, 2012, the second highest recorded rainfall was recorded at 391.4 mm. Heavy rainfall in August 2012 was experienced in Metro Manila and nearby provinces due to an enhanced monsoon.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly Average Rainfall (mm)	18.5	14.6	24.8	40.4	186.7	316.5	493.3	504.2	451.2	296.6	148.8	78.7
Highest Recorded Daily Rainfall (mm)	55.8	61.7	65.0	64.8	166.0	334.5	246.4	391.4	455.0	209.3	169.9	
No. of rainy days	4	3	4	5	12	18	22	23	22	18	14	8

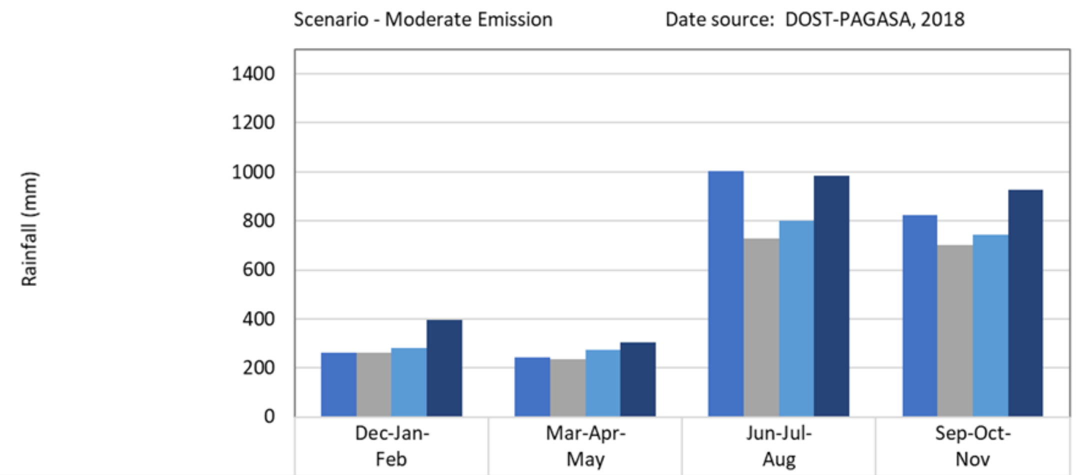
Figure 2-69. Monthly average rainfall and number of rainy days (1981 to 2010) for Science Garden PAGASA Station

Projected Changes of Rainfall

DOST-PAGASA (2018) noted increasing trends in annual and seasonal rainfall in many parts of the Philippines and such trends were associated with extreme rainfall events. There is also decrease or increase in the seasonal-mean rainfall exceeding 40% of its historical values.

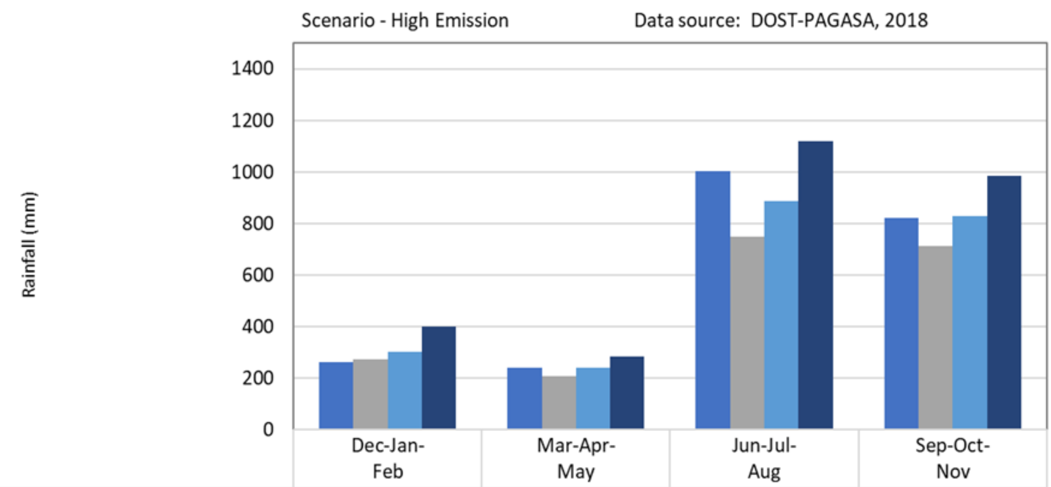
In the province of Rizal, rainfall is projected to increase in Dec-Jan-Feb and March-April-May at median and upper bounds at moderate emission scenario (***Figure 2-70***). For the periods, June-July-Aug and Sep-Oct-Nov, there were projected decrease of rainfall at the moderate emission scenario.

At high emission scenario, the projected rainfall appears at the same trend as the moderate emission scenario, and at relatively higher levels, except on Mar-Apr-May wherein the projected rainfall amounts were lower than the moderate emission scenario (***Figure 2-71***).



	Dec-Jan-Feb	Mar-Apr-May	Jun-Jul-Aug	Sep-Oct-Nov
Observed (1971 to 2010)	262.4	241.5	1001.3	821.8
Projected (2036 to 2065) - lower bound	262.4	234.8	728.0	699.5
Projected (2036 to 2065) - median	282.8	272.7	800.7	743.7
Projected (2036 to 2065) - Upper bound	397.4	303.4	983.9	926.5

Figure 2-70. Projected change of rainfall at moderate emission scenario



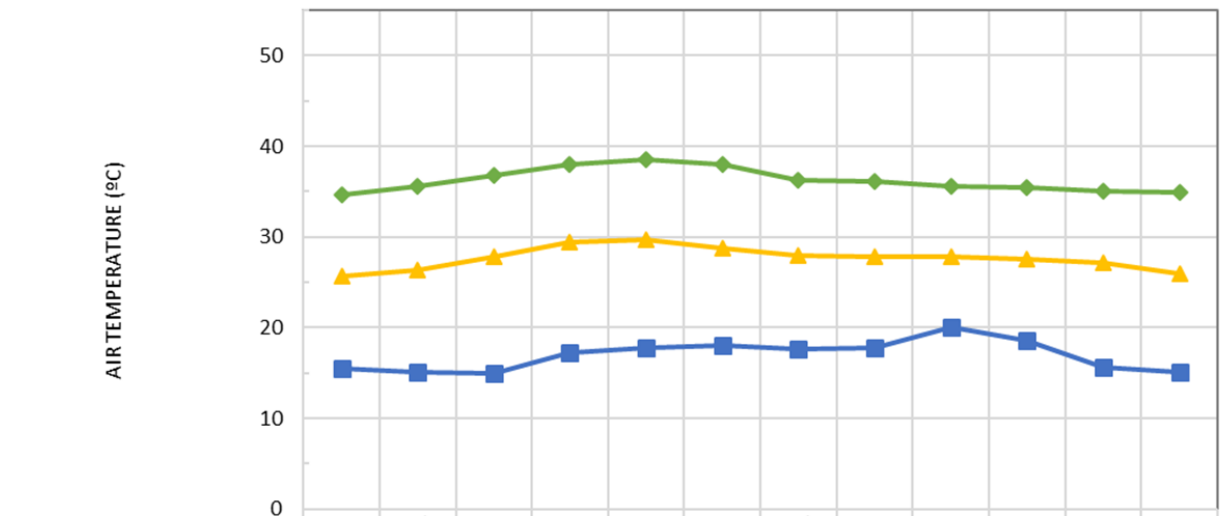
	Dec-Jan-Feb	Mar-Apr-May	Jun-Jul-Aug	Sep-Oct-Nov
Observed (1971 to 2010)	262.4	241.5	1001.3	821.8
Projected (2036 to 2065) - lower bound	271.8	207.2	747.4	713.6
Projected (2036 to 2065) - median	301.7	238.8	885.5	829.6
Projected (2036 to 2065) - Upper bound	399.4	282.7	1,118.9	983.1

Figure 2-71. Projected change of rainfall at high emission scenario

Air Temperature

Figure 2-72 shows the plot of the monthly average air temperature and the highest and lowest recorded air temperatures. The hottest month is May with an average of 29.7 °C followed by April with 29.4 °C. The highest recorded air temperature was 38.5 °C, which was also recorded in May, specifically on May 14, 1987.

On the average, the coldest month is January with an average air temperature of 25.7 °C. The lowest recorded temperature, however, occurred on March 1, 1963 at 14.9 °C.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Highest Recorded	34.7	35.6	36.8	38.0	38.5	38.0	36.2	36.1	35.6	35.4	35.0	34.9
Lowest Recorded	15.5	15.1	14.9	17.2	17.8	18.1	17.7	17.8	20.0	18.6	15.6	15.1
Mean Monthly Dry Bulb	25.7	26.3	27.8	29.4	29.7	28.8	28.0	27.8	27.8	27.6	27.1	26.0

Figure 2-72. Monthly average air temperature and highest and lowest recorded monthly air temperatures

<u>Projected Change in Air Temperature</u>

The projected air temperatures in the province of Rizal show increasing trends in all periods at moderate and high emission scenarios (***Figure 2-73 and Figure 2-74***). The following are the ranges of temperature increases (upper bounds) from the baseline years at moderate to high emission scenarios.

- Dec-Jan-Feb – 1.6 to 1.9 °C
- Mar-Apr-May – 1.7 to 2.2 °C
- Jun-Jul-Aug – 1.8 to 2.3 °C
- Sep-Oct-Nov- 0.6 to 1.0 °C

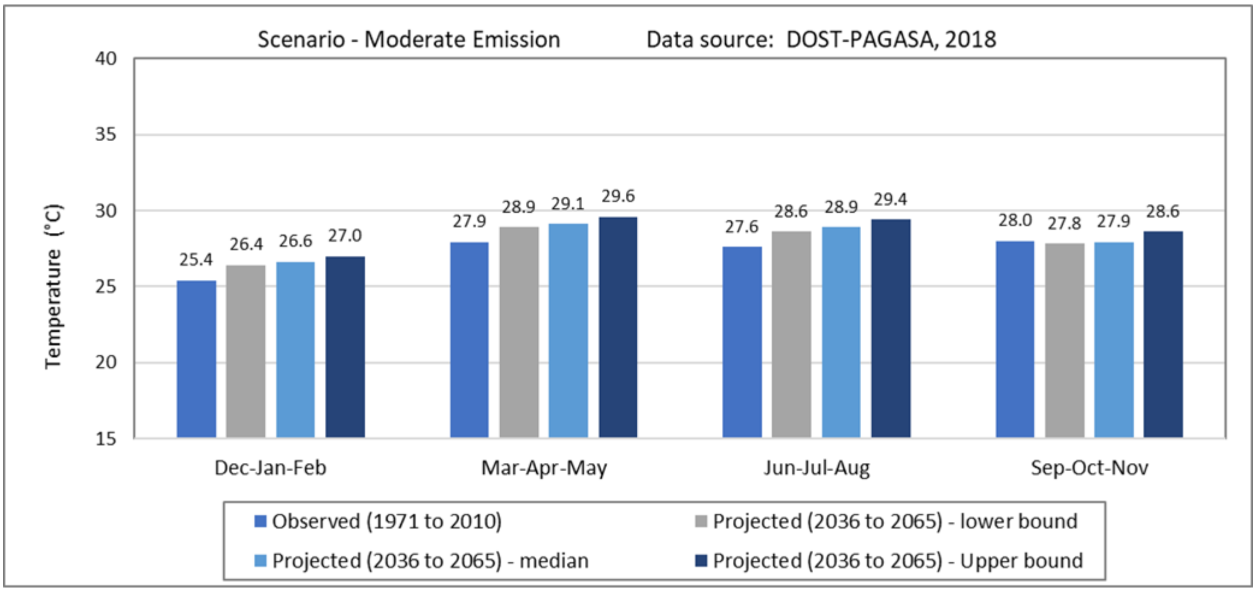


Figure 2-73. Projected change of air temperature at moderate emission scenario

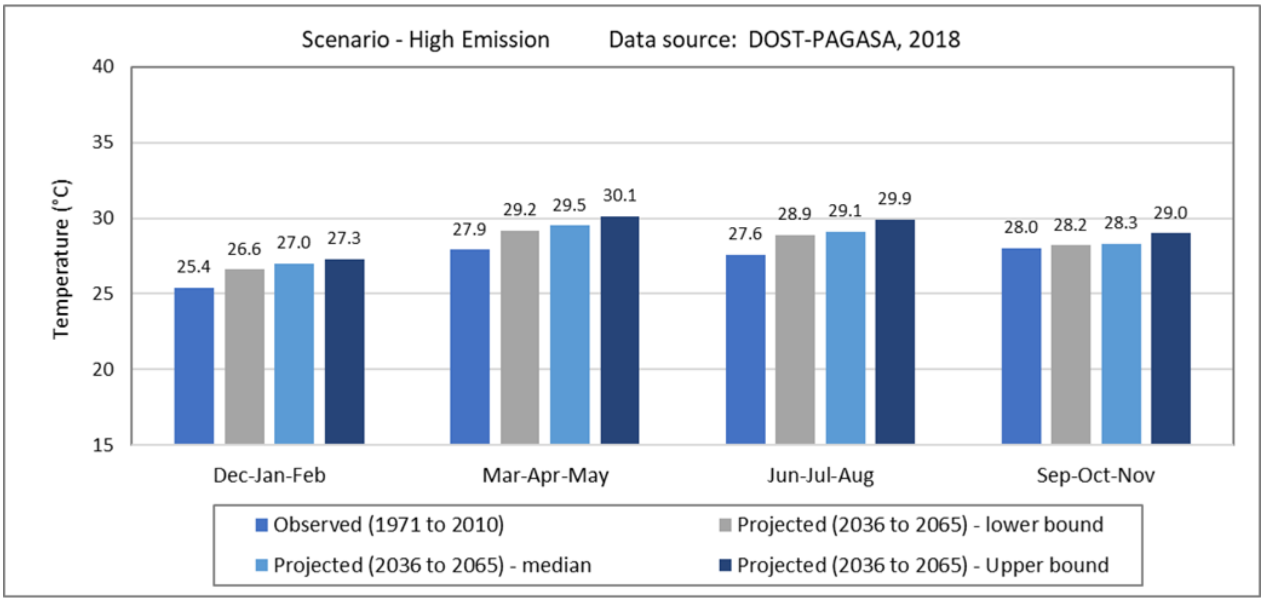


Figure 2-74. Projected change of air temperature at high emission scenario

Wind Speed and Wind Direction

Based on the climatological normals from Science Garden PAGASA Station, the average wind directions from October to February are from the north and northeast directions. In May to September, winds are from the southwest.

The monthly average wind speed ranges from 1 to 2 m/s with annual average of 1 m/s (**Table 2-46**).

Table 2-46. Monthly average wind speed and wind direction

Month	Wind Direction (16 pt)	Wind Speed (m/s)
January	N	1
February	NE	1
March	SE	1
April	SE	1
May	S	1
June	SW	1
July	SW	2
August	SW	2
September	SW	1
October	N	1
November	N	1
December	N	1
Annual	**N**	**1**

(Source: Climatological Normals of Science Garden PAGASA Station)

Figure 2-75 and ***Figure 2-76*** show the monthly average tropical cyclone (TC) tracks within the Philippine Area of Responsibility (PAR). The following are the description of the lines and the color scales as shown in the said figures.

- black solid lines - mean monthly tropical cyclone tracks;
- black thin lines – actual tracks of tropical cyclones; and
- colored scale - frequency of tropical cyclones with red boxes or grids denoting areas frequently visited by tropical cyclones

The monthly average tracks of the tropical cyclones show that these synoptic disturbances are more frequent in Rizal and nearby provinces in July, and in September to December. The average cyclone tracks in April to June appear closer in Rizal and nearby provinces. The frequencies of tropical cyclones, however, are higher in most areas in the Philippines during the southwest monsoon period as compared to other periods, i.e., northeast monsoon.

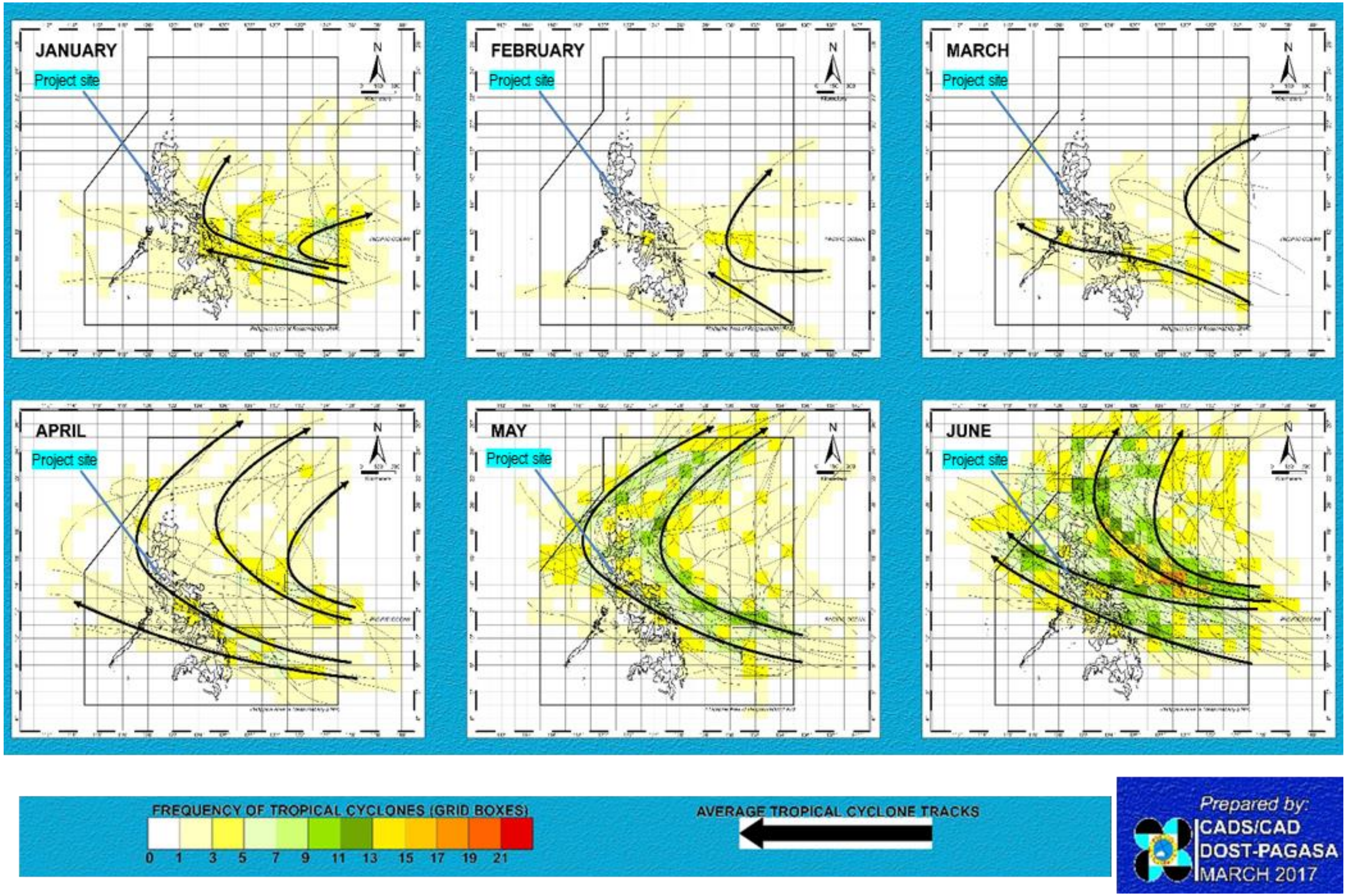


Figure 2-75. Frequency of tropical cyclones from January to June (Source: PAGASA)

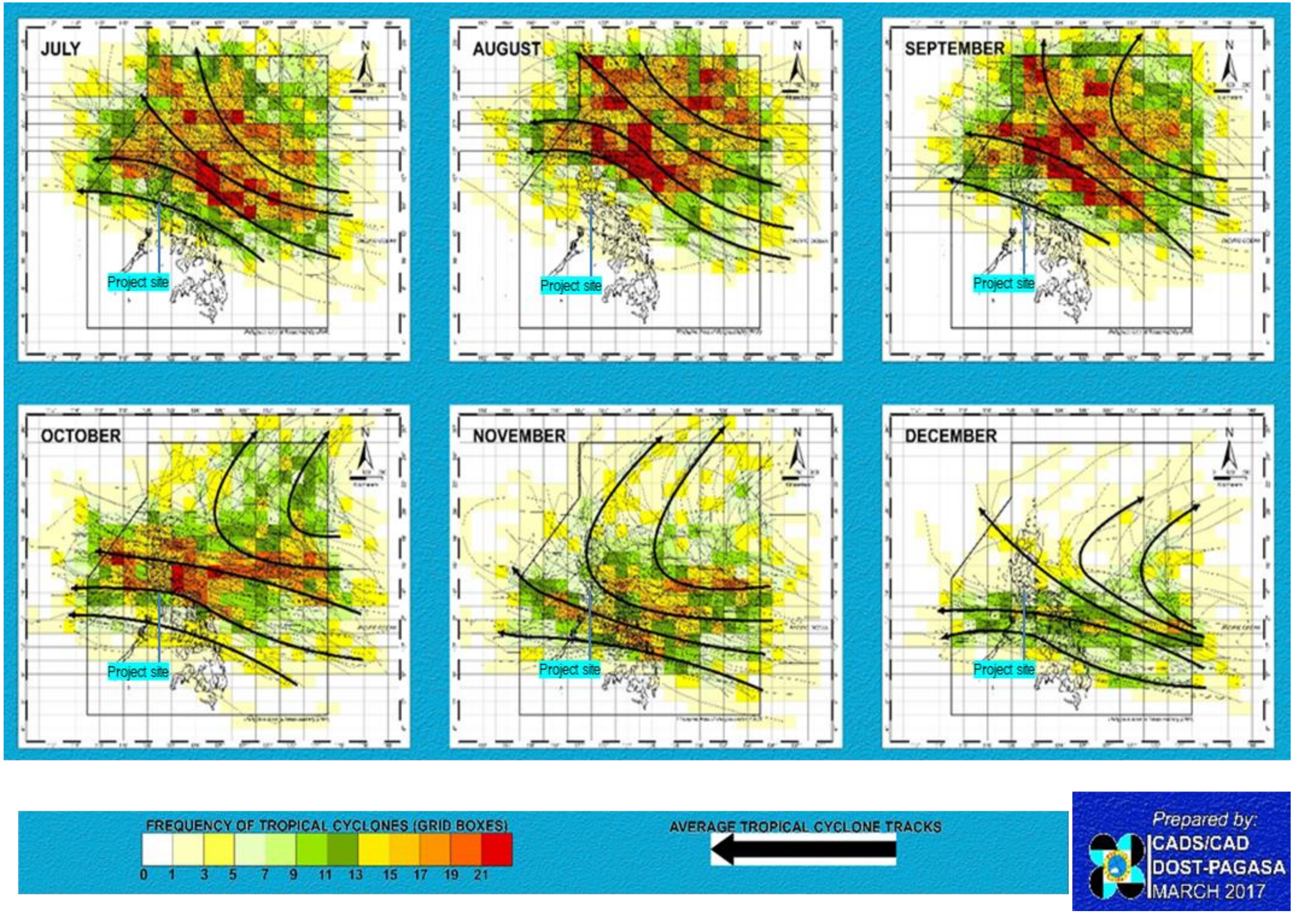


Figure 2-76. Frequency of tropical cyclones from July to December (Source: PAGASA)

2.3.1.2 Contribution in Terms Of Greenhouse Gas Emissions (Or GHG Mitigation Potential)

The projected greenhouse gas emissions (GHG) emanating from the project operation were determined by estimating the total fuel consumption and used of the GHG calculation tool of the World Resources Institute (WRI) named GHG protocol tool for mobile combustion, Version 2.6. Fuel consumption per equipment or source was estimated based on Klanfar, et al. (2016), “Fuel Consumption and Engine Load Factors of Equipment in Quarrying of Crushed Stone”.

Based on the number of equipment and its corresponding rated power, fuel consumption and GHG emissions were estimated using the calculation spreadsheets shown in ***Annex H.5***, the results of which are summarized as follows:

- Total estimated fuel consumption from vehicles/mobile sources = 626.38 cubic meter per year
- Total estimated GHG emissions = 1676.398 metric tons per year

The total GHG emissions per year is relatively low as compared to other large mining projects. It is recommended, however, that GHG accounting program be implemented to determine the actual GHG emissions and to determine the appropriate measures to reduce said emissions.

Measures to control GHG emissions include minimization of idling time by shutting equipment off when not in use or reducing the time of idling, i.e., not more than 3 minutes. Fuel efficient vehicles and heavy equipment should also be used and well maintained. The number of vehicle trips should also be reduced, if necessary, based on operational requirements.

GHG emissions should also be offset by implementing an extensive rehabilitation and reforestation program for the project.

2.3.2 Air Quality and Noise Quality

Scope

The scope on air quality focused on the following requirements as stipulated in the Technical Scoping and Screening Form for the project.

- Characterization of ambient air quality using DENR standard methods and procedures for sampling and analysis, and relate selection of sampling locations using data collected in meteorology component; and
- The required assessment methodologies are a) identification and assessment of the impact of the project to the identified parameters including volatile organic compounds and odor through air dispersion modelling (as may be applicable), and b) comparison of the changes in air quality over time using statistical tools, e.g., across sampling sites over time

  As this project mainly involved emissions of fugitive particulates, which are highly mobile and variable, air dispersion modelling focused on assessment of air emission emanating from access roads or haul roads.

Methodology

Background Air Monitoring

Background ambient air monitoring was conducted on August 9, 2019 in the vicinities of the project site (***Figure 2-77***). Ambient air concentrations of PM_{10}, SO_2, and NO_2 were sampled at four (4) stations, the locations and coordinates of which are shown in **Table 2-47**.

As indicated in the third-party monitoring report, the methods of sampling and analyses were based on the reference methods of the United States Environmental Protection Agency (U.S.EPA) for PM_{10} and SO_2 and the DENR-EMB for the NO_2 (**Table 2-48**).

Plate 1 to **Plate 4** show the geotagged photos of the air sampling equipment.

Table 2-47 Coordinates of Air Sampling stations and the pollutants sampled

Station ID	Location	Latitude (deg)	Longitude (deg)	Pollutants Sampled	Averaging Period
1	Near Pantay Elementary School/ Along Pantay Buhangin Road	14º 34' 2.41"	121º 13' 49.24"	PM_{10}, SO_2, NO_2	One (1) hour
2	Near Quest Adventure Camp Team Building	14º 35' 10.27"	121º 14' 35.55"	PM_{10}, SO_2, NO_2	One (1) hour
3	Infront of Coral Agri-Ventures Corp./ Along Pantay Buhangin Rd	14º 34' 27.08"	121º 14' 13.91"	PM_{10}, SO_2, NO_2	One (1) hour
4	Infront of RLC farm, Brgy. Dalig Teresa, Rizal	14º 34' 43.59"	121º 14' 14.01"	PM_{10}, SO_2, NO_2	One (1) hour

* PM_{10}= Particulate Matter at 10µm or less; NO_2 = nitrogen dioxide; SO_2 = sulfur dioxide

Table 2-48 Methods of Air Sampling and Analysis

Pollutant	Method of Analysis	Sampling Equipment	Reference Method
Particulate Matter 10 (PM_{10})	Gravimetric Method	Graseby High Volume Sampler	USEPA, 40 CFR 50, Appendix B
Sulfur Dioxide (SO_2)	Pararosaniline Method	Graseby Gas Bubbler Sampler (USEPA Compliant)	USEPA, 40 CFR 50, Appendix A
Nitrogen Dioxide (NO_2)	Colorimetric, Griess Saltzman	Graseby Gas Bubbler Sampler (USEPA Compliant)	Air Pollution Monitoring Manual, EMB-1994

Presented below are the brief discussions of the methods of air sampling and analysis:

Particulate Matter Equal or Less Than 10 Micrometer

Sampling of PM10 was carried out by using a high volume PM10 sampler. Ambient air was drawn at a controlled flow rate into a specially-shaped cyclone inlet where the larger particulates were initially separated from PM10 size range. Each size fraction in the PM10 size range was then collected on a pre-weighed glass microfiber filter over the specified sampling period.

The filter paper with retained particles was recovered after sampling and desiccated for 24 hours in the laboratory followed by weighing using a calibrated mass balance. The net weight (mass gain) from the initial and final masses of the filter paper corresponds to the amount of PM10 collected. The concentration of PM10 in ambient air was determined from the ratio of total mass of PM10 collected and the total normal volume of air sampled.

Sulfur Dioxide (SO2)

Sulfur dioxide in the ambient air was sampled using a handy gas sampler by aspirating air at a controlled flowrate into a solution of 0.04 M sodium tetrachloromercurate (TCM) through a glass midget impinger over the specified sampling period. The solution was then treated in the laboratory with formaldehyde and with a specially purified acid-bleached pararosaniline to form an intensely colored pararosaniline methyl sulfonic acid. The color intensity was measured spectrophotometrically at 548 nm and was directly related to the amount of SO2 collected. SO2 concentration was then determined by the difference between the absorbance of the sample and blank, multiplied by the calibration factor, and divided by the total normal volume of air sampled.

Nitrogen Dioxide (NO2)

Nitrogen dioxide in the ambient air was determined using Griess-Saltzman Reaction Method. Air was drawn using a handy gas sampler at a controlled flowrate into an azo dye forming reagent through a glass midget impinger over a specified sampling period. The absorption reaction produces a stable red-violet color. The color intensity was read by a spectrophotometer in a laboratory at 550 nm and is directly related to the amount of NO2 collected. NO2 concentration was determined by the difference between the absorbance of the sample and blank, multiplied by the calibration factor, and divided by the total normal volume of air sampled.

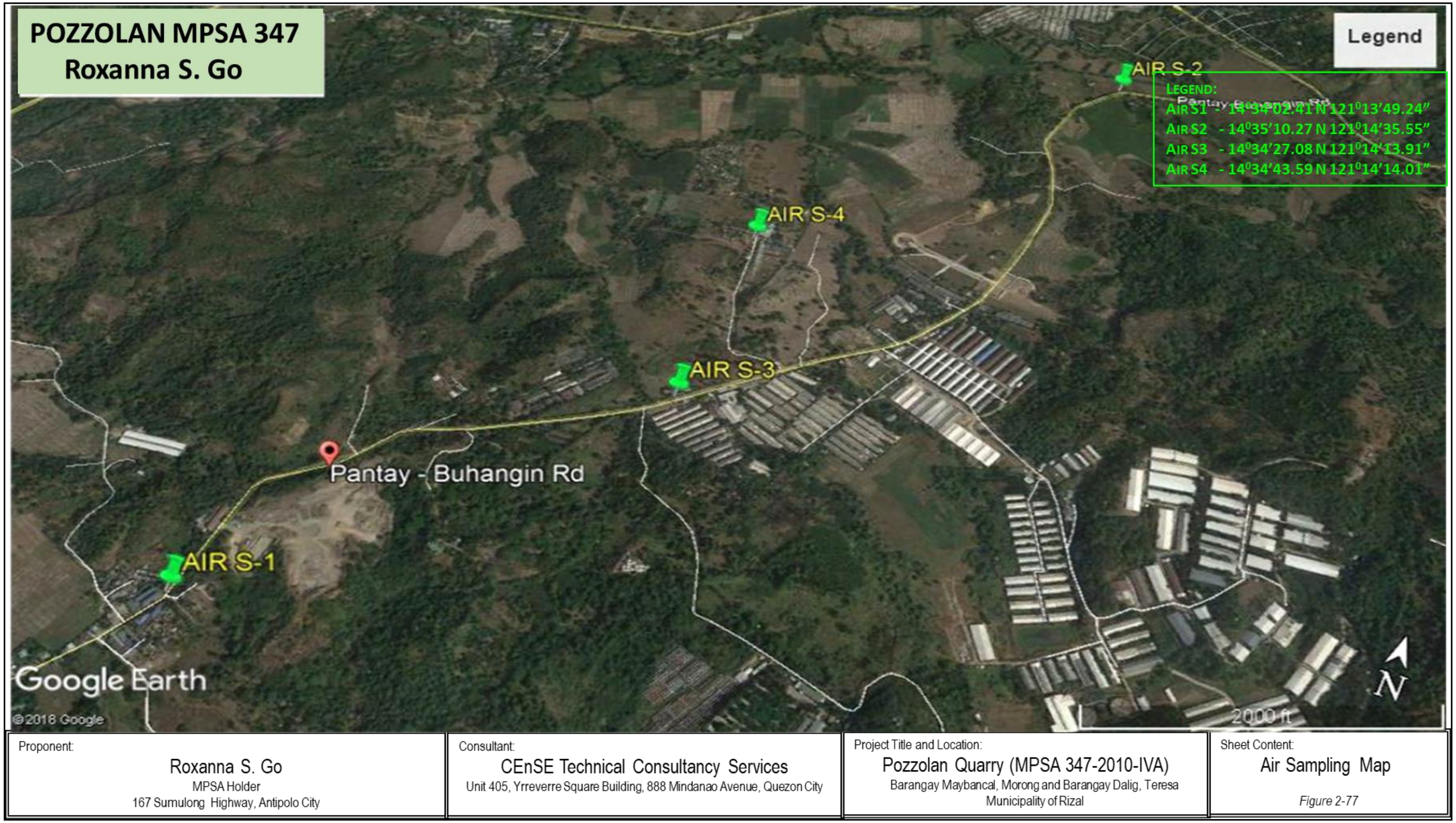


Figure 2-77 Sampling Station Map

***Photo 2xxxx**. Air Sampling Station 1*

***Photo 2yyyy**. Air Sampling Station 2*

***Photo 2zzzz**. Air Sampling Station 3*

***Photo 2aaaaa**. Air Sampling Station 4*

Emission Estimates

Impact assessment involved estimation of the emissions of particulates (TSP, PM10, and PM2.5) and gaseous air pollutants emanating from the operation of the heavy equipment and other emission sources. Emissions factors of the U.S.EPA and the National Pollution Inventory (NPI) of the Australian Government were generally used in estimating emission rates. **Table 2-49** shows the number of heavy equipment, vehicles, crusher and vibration screen to be used during project operation.

Table 2-49. Number of heavy equipment, vehicles, crusher and vibrating screen

Equipment	Number
PC 350 Excavator or Equivalent	3
D155 Excavator or equivalent	1
Hyundai 470 Loader or equivalent	1
15 cu.m. 10- wheeler dumptruck	4
Stationary Vibrating Screen	1
Mobile Crusher	1
5 cu.m. water truck	1
Total	**12**

The following presents the emission factors as derived from the U.S.EPA and NPI.

Bulldozing

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

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

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

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

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

Materials Handling

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

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

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

Grading at Mine

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

$$E_{TSP\,grading-scraping} = 0.0034\ x\ S^{2.5} \qquad \text{Equation 5}$$

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

$$E_{PM10\,grading-scraping} = 0.6\ x\ 0.0056\ x\ S^{2.0} \qquad \text{Equation 6}$$

Travelling of Haul Trucks Along Unpaved Roads

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

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

where k, a, and, b, are constants shown in **Table 2-50**.

Table 2-50. Constants used on emission factors for unpaved roads

Constant	Industrial Roads		
	PM_{30}*	**PM_{10}**	**$PM_{2.5}$**
K (lb/VMT)	4.9	1.5	0.15
a	0.7	0.9	0.9
b	0.45	0.45	0.45

**Assumed equivalent to total suspended particulate matter (TSP)*
Source: Table 13.2.2-2 of AP-42

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

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

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

where

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

Motor Vehicle Combustion

Tailpipe emissions emanating from operation of heavy equipment were estimated using emission factors prescribed in NPI Emission Estimation Technique I for Combustion Engine V3.0 (June 2008). Computation of emission rates included estimation of fuel consumption as provided in the report of Klanfar, et. al. (2016) entitled, "Fuel Consumption and Engine Load Factors of Equipment in Quarrying of Crushed Stone". This reference provides good estimates of fuel consumption rate based on calculated load factor.

Table 2-51 shows list of heavy equipment used for quarry operation, the corresponding engine rated power, the average load factor as provided by Klanfar, et.al (2016), and the fuel consumption rate and emission factors.

Table 2-51 Emission Factors for Heavy Equipment Operations

Source	Rated Power (kW)*	Average Load Factor	Fuel Consumption based on Average Load factor (l/hr)	Emission Factor (kg/hr)		
				Total Particulates	PM_{10}	$PM_{2.5}$
PC 350 excavator or equivalent	194	0.56	28.12	0.318	0.245	0.225
D155 excavator or equivalent	162	0.48	20.13	0.080	0.062	0.056
Hyundai 470 loader or equivalent	162	0.27	11.32	0.052	0.040	0.036
15 cu.m 10-wheeler trucks	251	0.23	14.92	0.140	0.107	0.101
5 cu.m water truck	112	0.23	6.66	0.020	0.015	0.015
Mobile crusher	224	0.46	26.67	0.318	0.073	0.068
*Assumed rated power based on available references						

Blasting

The emission factor in AGH EH (2006) provided the revised emission factor of TSP during blasting operation, as follows:

$$E_{TSP\ (blasting)} = 0.000222\ x\ A^{1.5} \qquad \text{Equation 9}$$

where, A, is the area blasted (m^2). Equation (8) was recommended as replacement to the emission factor presented in Chapter 11 of AP-42. PM_{10} emission was estimated at 52% of the TSP emission, as provided in AP-42.

Crusher Area

The emission factors related to crushing operations were based from based from Table 11.19.2-1 in Section 11.19.2 (Crushed Stone Processing and Pulverized Mineral Processing) of the U.S.EPA AP-42 (**Table 2-52**). There are emission factors with "no data" or (ND) as presented in Table 11.19.2-1 in Section 11.192 of the U.S. EPA AP-42, although there are specific notes or instructions to use, for example, the emission factors for PM_{10} intended for tertiary crushers as upper limits for primary and secondary crushing.

Table 2-52 Emission factors for crushing related activities (in kg/Mg)

Source	Total PM	Total PM10	Total PM2.5
Truck loading of material	0.000113	0.0000500	0.0000093
Truck unloading of material at crusher	0.000018	0.0000080	0.0000015
Primary crushing	0.002700	0.0012000	0.0000500
Secondary crushing	0.002700	0.0012000	0.0000500
Screening (2 points)	0.012500	0.0043000	0.0007960
Conveyor transfer points (primary to secondary crushing)	0.001500	0.0005500	0.0001019
Conveyor transfer points (secondary to screening)	0.001500	0.0005500	0.0001019
Conveyor transfer points (screening to wash screen)	0.001500	0.0005500	0.0001019
Truck loading of material to trucks	0.000113	0.0001125	0.0001125

Materials Handling and Storage Piles

Fugitive particulate emissions are also generated during movement of truck and transfer of materials at or within the area where the stockpiles are located, including wind erosion at the stockpiles, as these are left uncovered because of the need to transfer materials within crusher site.

Table 2-53 shows the emission factors for particulate emissions emanating from aggregate handling and storage piles, as provided in Equations 13.2.4.3 in Section 13.2.4 (Aggregate Handling and Storage Piles).

Table 2-53 Emission Factors for Aggregate Handling and Storage Piles

Pollutant	Emission factor (kg/Mg)
TSP	0.000491
PM_{10}	0.000232
$PM_{2.5}$	0.000035

2.3.2.1 Degradation of Air Quality

Dispersion Modelling of Particulate Emissions

The following presents the brief description of AERMOD View and the model input data used in the simulations.

a) Dispersion Model

This study utilized a licensed AERMOD View Air Dispersion Model (Version 9.8.1) with Serial No. AER0006927, to initially assess the extent of air emissions emanating from the project. AERMOD View is a Graphical User Interface (GUI) developed for the U.S. EPA's AERMOD. AERMOD model was developed by the American Meteorological Society (AMS/United States Environmental Protection Agency (EPA) Regulatory Model Improvement Committee (or AERMIC). In accordance with DENR MC 2008-003 (Guideline on Air Dispersion Model), AERMOD is currently recommended by DENR-EMB for regulatory air modeling application in Tier 4 impact assessment.

Plate 1 shows the screenshot of AERMOD View Version 9.8.1 with the licensed serial number of the preparer.

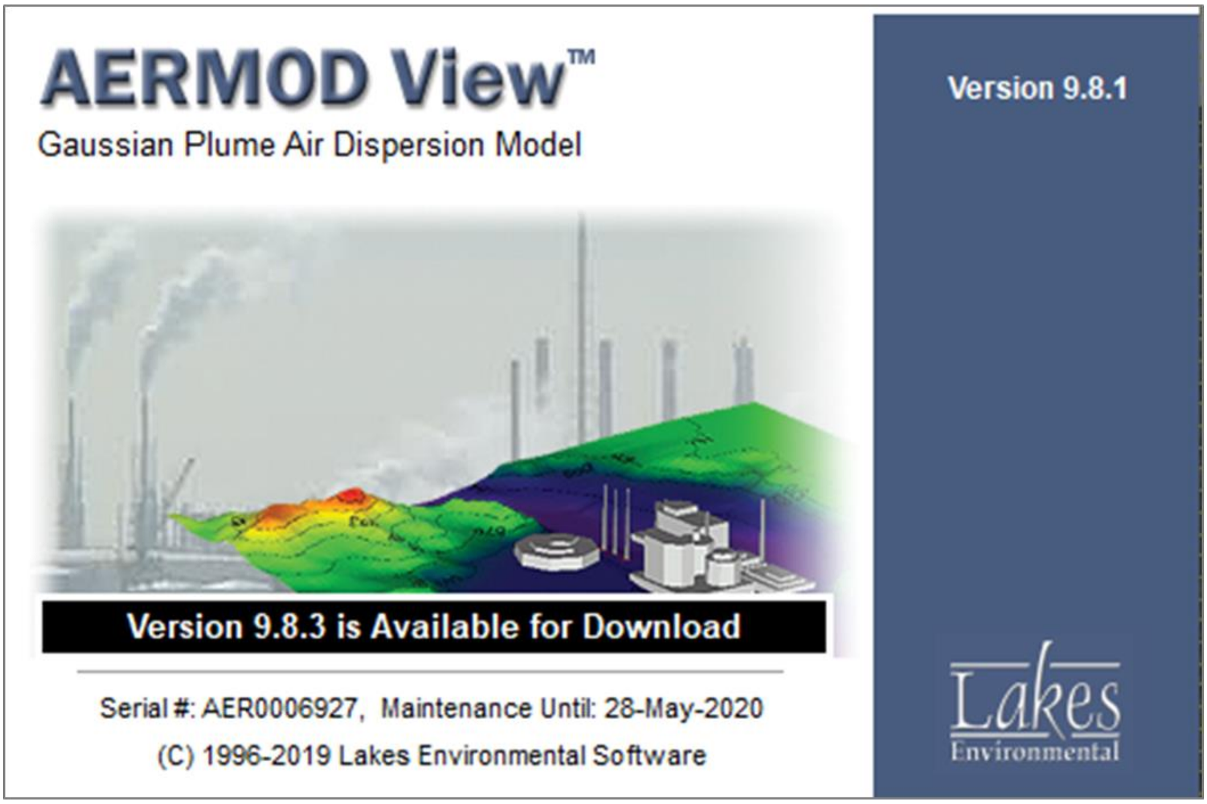


Plate 1. Serial number of the licensed AERMOD View Air Dispersion Model

b). Source Input Parameters

Although air emissions will be generated from various types of sources within in the quarry site, i.e., materials handling, crusher, unpaved roads, grading, and dozing, simulations focused only on the dispersion of particulate emissions emanating from the haul road (or unpaved road) from the quarry to the crusher area. This is because fugitive particulate emissions emanating haul roads were estimated to have the highest emission rates among the other area sources and that modelling of other

Plate 2 and ***Plate 3*** show the screenshots of the source inputs of line area sources for unmitigated TSP and PM_{10} emissions, respectively. The estimated mitigated emission rates of TSP and PM_{10} are as follows:

- TSP - 0.281 g/s; and
- PM_{10} – 0.08 g/s

Annex H.5 presents the emission factors, assumptions and the computed emission rates for the unpaved roads. Annex H-5 presenrs the screenshots of the emissions calculation spreadsheets. The spreadsheets indicate the values of moisture, wind speed, and mean vehicle speed. It also indicate the formula and output values. Moisture content and wind speed were based on typical values in AP-42 (U.S.EPA emission factors). Grading or grader vehicle speed was based on typical speed of this type of heavy equipment.

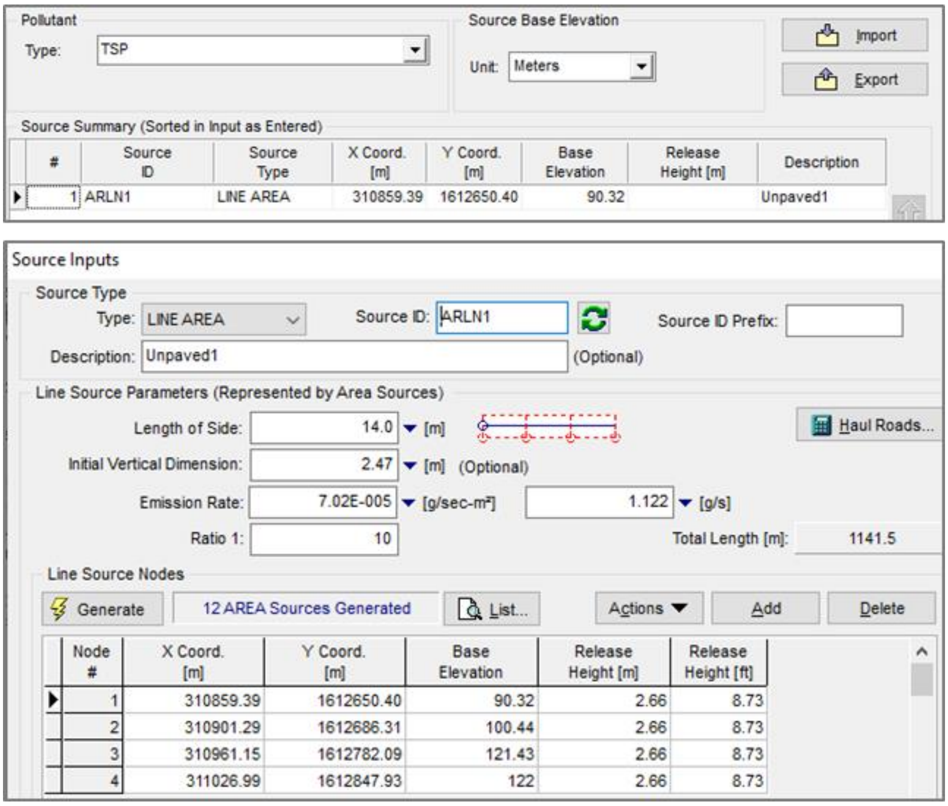


Plate 2. Screenshots of line area source inputs for unmitigated TSP emissions (Note: Due to file size, only portion of the line source nodes are shown)

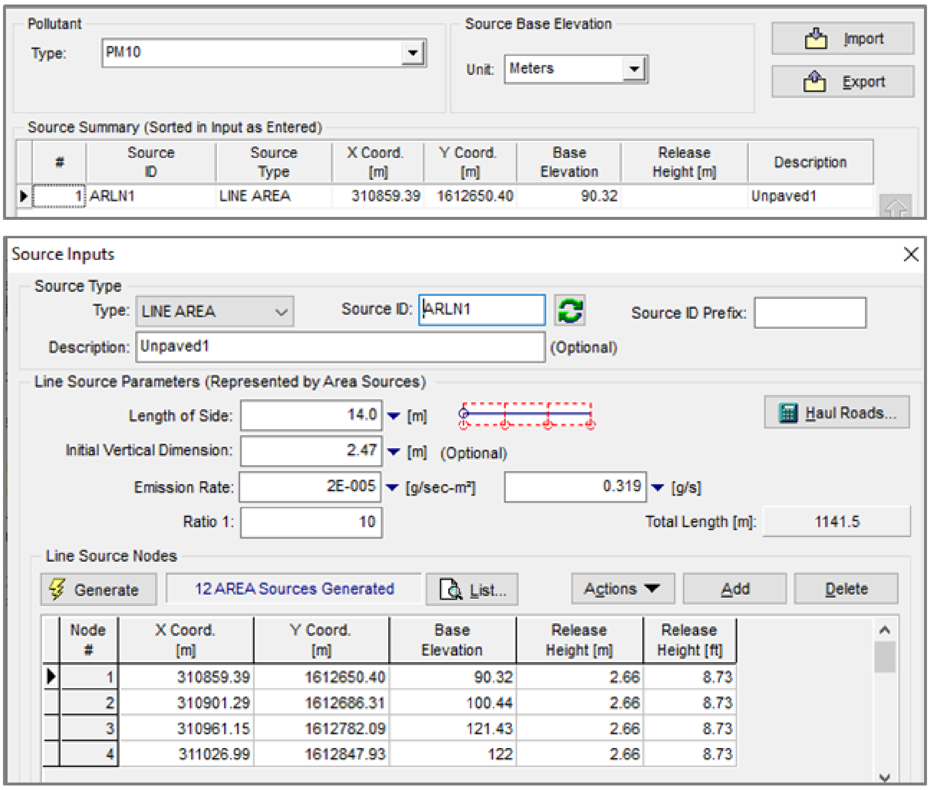


Plate 3. Screenshots of line area source inputs for unmitigated PM_{10} emissions (Note: Due to file size, only portion of the line source nodes are shown)

c) Modelling Domain, Risk Receptors and Topography

Modelling domain covers three (3) km from about the center of Parcel 1 and Parcel 2 (***Figure 2-78***). Modelling domain defines the boundaries or extent of the area where the predicted concentrations from dispersed emissions of the project are determined.

Multi-tier receptors were generated within the modelling domain. The following are the receptor spacings and distances from the center of the domain.

- 50 m grid spacing at 1000 m from center of the modelling domain, and
- 100 m grid spacing from 1000 to 3000 m from the center of the modelling domain

Plate 4 shows the technical description of the multi-tier receptors. Closer view of the risk receptors spaced at 50-m on center are shown in ***Figure 2-79***. Note that all possible receptors (residences and commercial areas) are covered or included as the receptors are finely spaced (50 m).

Elevations of the risk receptors were derived from Shuttle Radar Topography Mission (SRTM) data . These were processed using AERMAP View – a terrain pre-processor of AERMOD View.

The terrain is relatively flat to rolling with relatively higher elevations (100 to 140 m above mean sea level or amsl) within Parcel 1. Terrain contours within Parcel 2 range from about 80 to 90 masl (***Figure 2-80***).

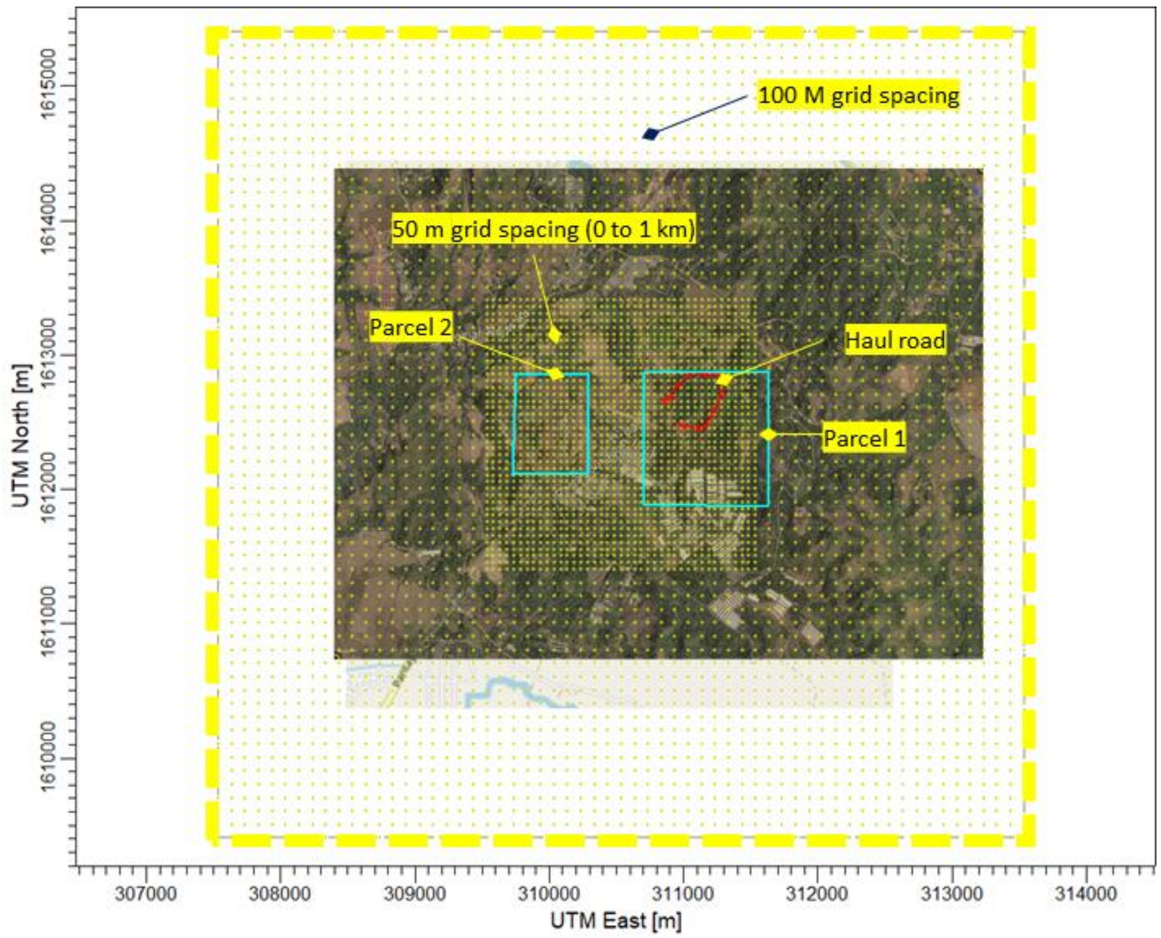


Figure 2-78. Modelling domain, risk receptors and the assumed located of the haul road within Parcel

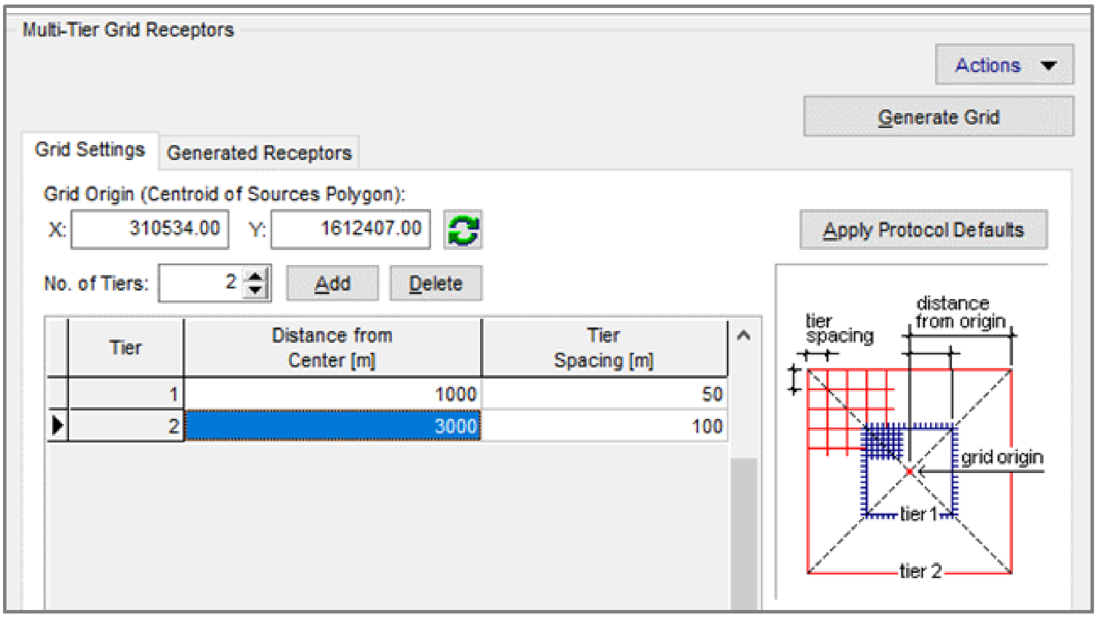


Plate 4. Tier spacings and distances from the center of the risk receptors

d) Meteorological Input Data

Surface and profile meteorological input data used in the dispersion modelling were generated using the MAKEMET Utility of AERMET View. This utility requires meteorological input data, as follows:

- Minimum and maximum air temperatures, albedo, Bowen Ratio, surface roughness, and
- Wind direction parameters, such as the starting wind direction and the wind direction increment.

Note that the generated meteorological data (surface and profile) for the project were considered as “screening data” as all wind directions were assumed rotated within 360-degree direction and that b) minimum and maximum air temperatures were included in computing the boundary layer parameters, such as surface friction velocity and Monin-Obukhov length.

Plate 5 shows the screenshot of the generated surface input data file. The meteorological input data could be considered as “worst-case” screening meteorological data, as extreme values were included in generating the surface and profile (or upper) air data. Furthermore, wind flows were assumed to come from other directions starting from the north, and rotate clockwise at 30-degree increment.

Regardless of whether higher tier data are used, predicted concentrations for area, volume, and line sources will still be very high as modelled/demonstrated in other projects. This is because emission factors were derived from other countries and not of the Philippine setting and the assumed control efficiency is only 75% as indicated in the emission factors. Further, as indicated in the Figures 2-85 and 2-85a, the locations of highest predicted concentrations were within the workplace standards (permission limits) of the OSHS, in which the DOLE apply.

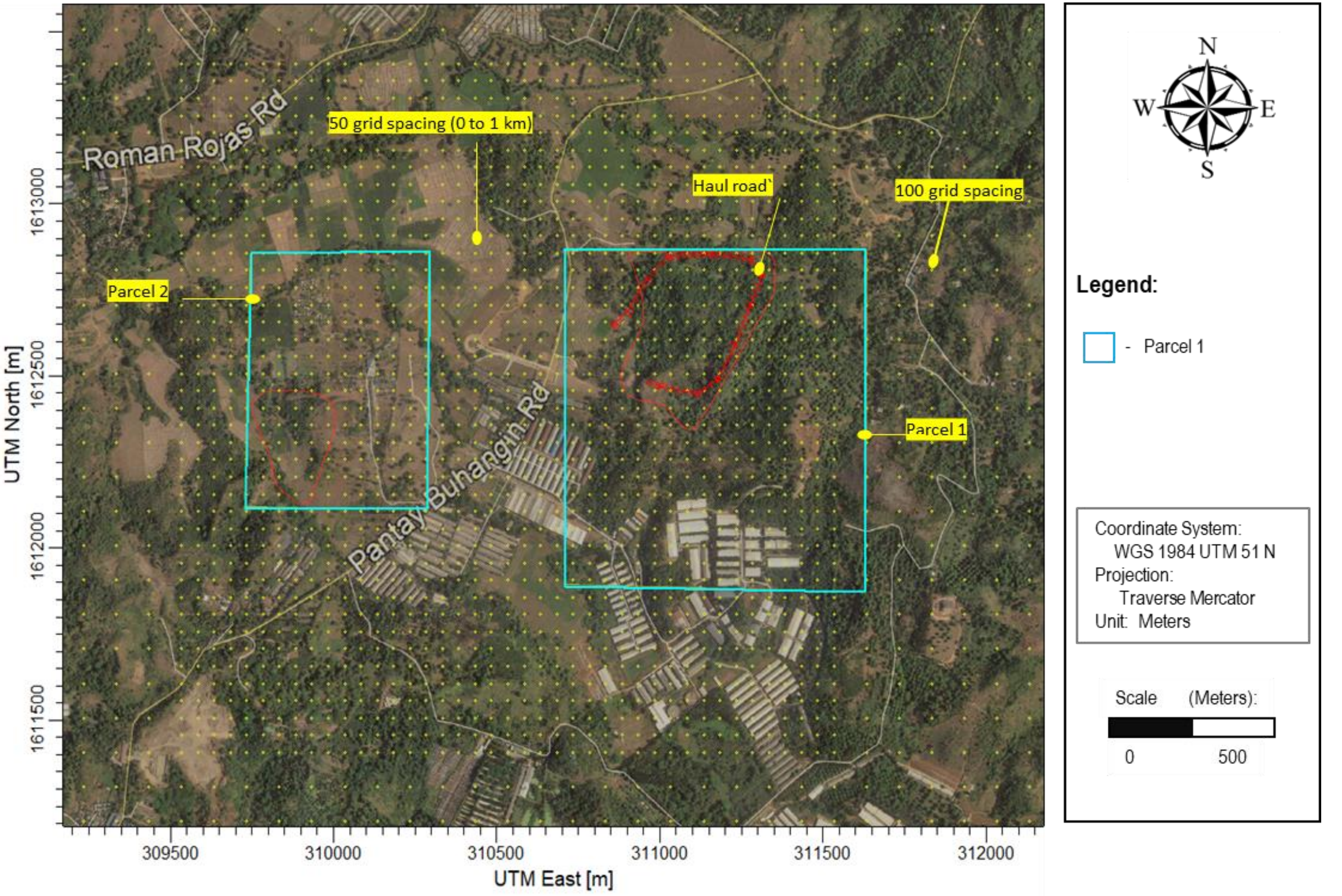


Figure 2-79. Closer view of the 50-m grid receptors

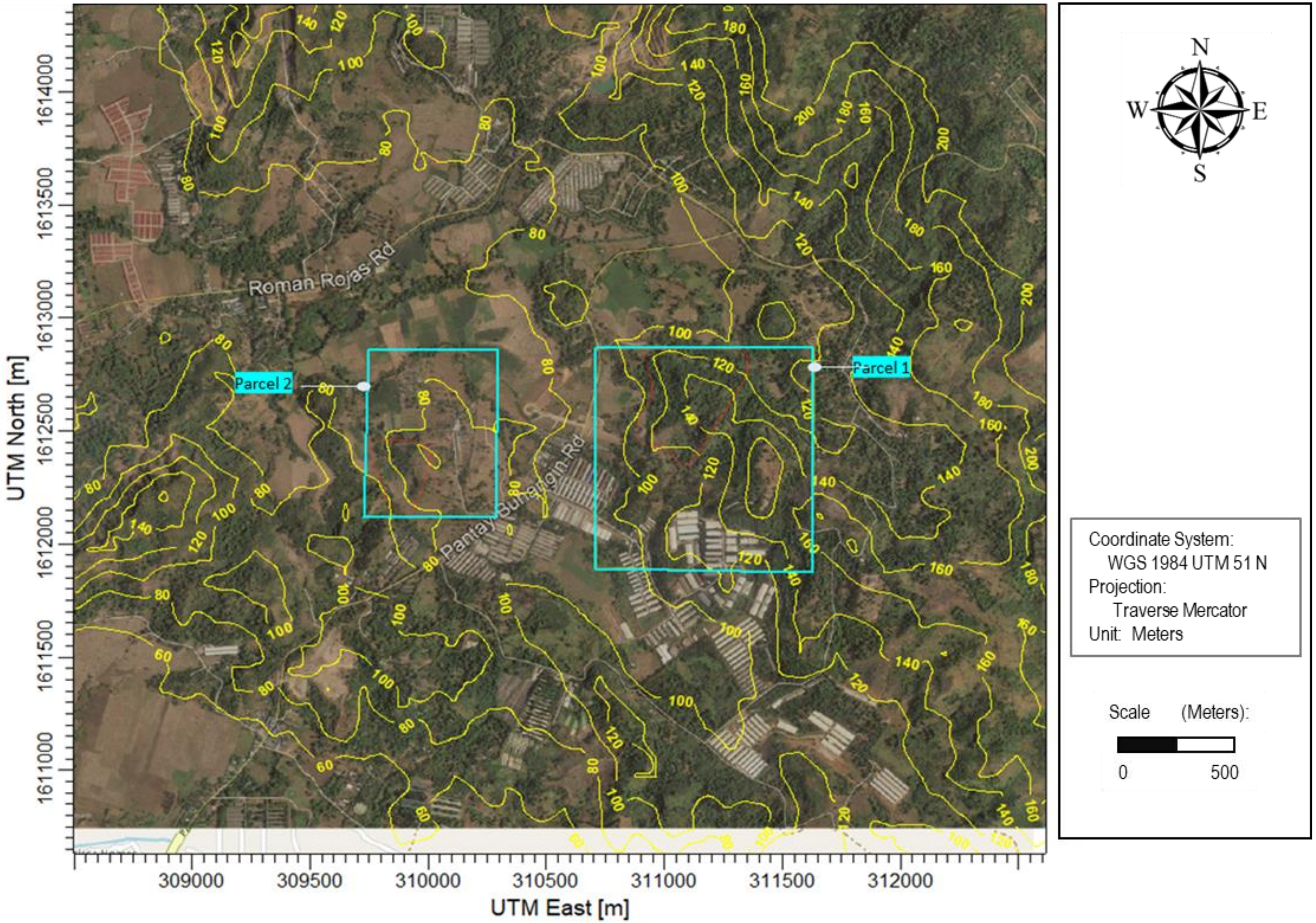
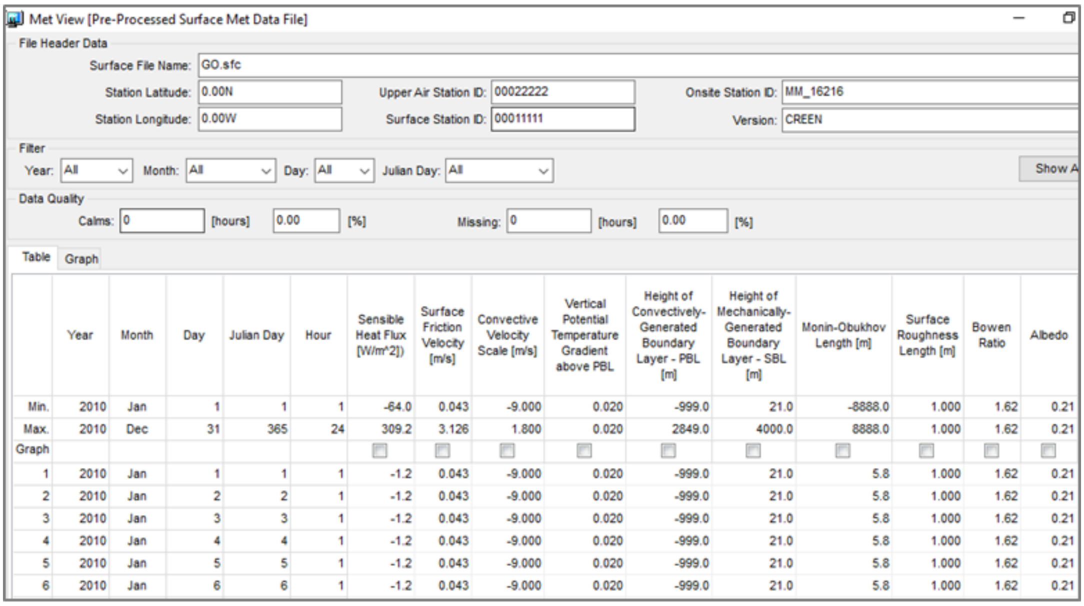


Figure 2-80. Terrain contours within and in the vicinities of the quarry blocks/parcels



Met View [Pre-Processed Surface Met Data File]

File Header Data

Surface File Name: GO.sfc

Station Latitude: 0.00N | Upper Air Station ID: 00022222 | Onsite Station ID: MM_16216

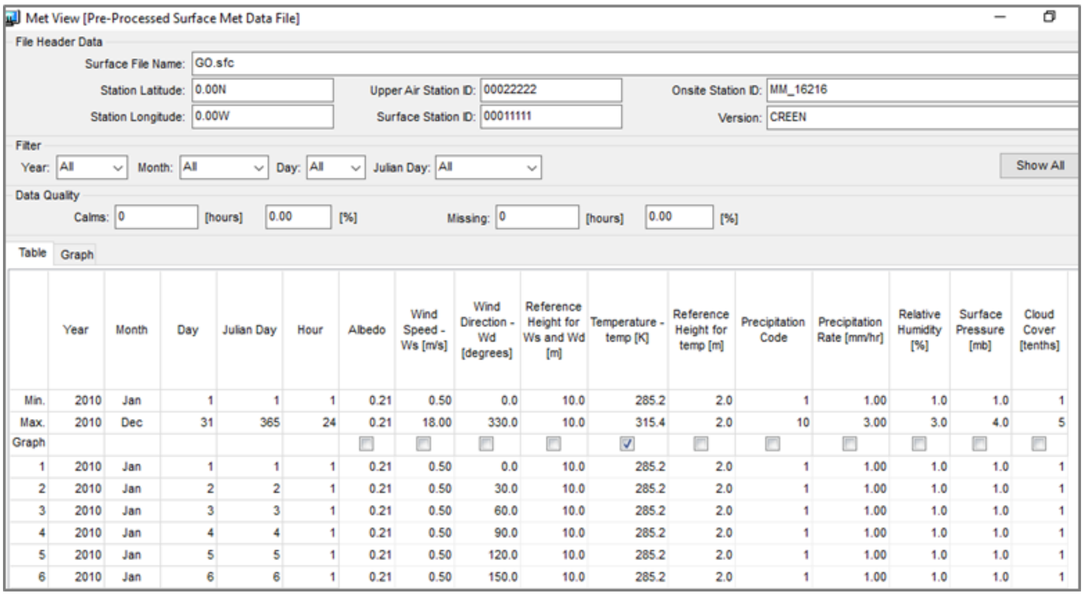
Station Longitude: 0.00W | Surface Station ID: 00011111 | Version: CREEN

Filter: Year: All | Month: All | Day: All | Julian Day: All | Show A

Data Quality: Calms: 0 [hours] 0.00 [%] | Missing: 0 [hours] 0.00 [%]

Table | Graph

	Year	Month	Day	Julian Day	Hour	Sensible Heat Flux [W/m^2])	Surface Friction Velocity [m/s]	Convective Velocity Scale [m/s]	Vertical Potential Temperature Gradient above PBL	Height of Convectively-Generated Boundary Layer - PBL [m]	Height of Mechanically-Generated Boundary Layer - SBL [m]	Monin-Obukhov Length [m]	Surface Roughness Length [m]	Bowen Ratio	Albedo
Min.	2010	Jan	1	1	1	-64.0	0.043	-9.000	0.020	-999.0	21.0	-8888.0	1.000	1.62	0.21
Max.	2010	Dec	31	365	24	309.2	3.126	1.800	0.020	2849.0	4000.0	8888.0	1.000	1.62	0.21
Graph															
1	2010	Jan	1	1	1	-1.2	0.043	-9.000	0.020	-999.0	21.0	5.8	1.000	1.62	0.21
2	2010	Jan	2	2	1	-1.2	0.043	-9.000	0.020	-999.0	21.0	5.8	1.000	1.62	0.21
3	2010	Jan	3	3	1	-1.2	0.043	-9.000	0.020	-999.0	21.0	5.8	1.000	1.62	0.21
4	2010	Jan	4	4	1	-1.2	0.043	-9.000	0.020	-999.0	21.0	5.8	1.000	1.62	0.21
5	2010	Jan	5	5	1	-1.2	0.043	-9.000	0.020	-999.0	21.0	5.8	1.000	1.62	0.21
6	2010	Jan	6	6	1	-1.2	0.043	-9.000	0.020	-999.0	21.0	5.8	1.000	1.62	0.21



Met View [Pre-Processed Surface Met Data File]

File Header Data

Surface File Name: GO.sfc

Station Latitude: 0.00N | Upper Air Station ID: 00022222 | Onsite Station ID: MM_16216

Station Longitude: 0.00W | Surface Station ID: 00011111 | Version: CREEN

Filter: Year: All | Month: All | Day: All | Julian Day: All | Show All

Data Quality: Calms: 0 [hours] 0.00 [%] | Missing: 0 [hours] 0.00 [%]

Table | Graph

	Year	Month	Day	Julian Day	Hour	Albedo	Wind Speed - Ws [m/s]	Wind Direction - Wd [degrees]	Reference Height for Ws and Wd [m]	Temperature - temp [K]	Reference Height for temp [m]	Precipitation Code	Precipitation Rate [mm/hr]	Relative Humidity [%]	Surface Pressure [mb]	Cloud Cover [tenths]
Min.	2010	Jan	1	1	1	0.21	0.50	0.0	10.0	285.2	2.0	1	1.00	1.0	1.0	1
Max.	2010	Dec	31	365	24	0.21	18.00	330.0	10.0	315.4	2.0	10	3.00	3.0	4.0	5
Graph																
1	2010	Jan	1	1	1	0.21	0.50	0.0	10.0	285.2	2.0	1	1.00	1.0	1.0	1
2	2010	Jan	2	2	1	0.21	0.50	30.0	10.0	285.2	2.0	1	1.00	1.0	1.0	1
3	2010	Jan	3	3	1	0.21	0.50	60.0	10.0	285.2	2.0	1	1.00	1.0	1.0	1
4	2010	Jan	4	4	1	0.21	0.50	90.0	10.0	285.2	2.0	1	1.00	1.0	1.0	1
5	2010	Jan	5	5	1	0.21	0.50	120.0	10.0	285.2	2.0	1	1.00	1.0	1.0	1
6	2010	Jan	6	6	1	0.21	0.50	150.0	10.0	285.2	2.0	1	1.00	1.0	1.0	1

Plate 5. Screenshots of the Surface Meteorological Data File

Background Air Quality

Table 2-54 shows the results of the ambient air monitoring (PM_{10}, SO_2, and NO_2) at four (4) locations in the vicinities of the project site on August 9, 2019. The results of ambient air monitoring, which are one-hour average concentrations of PM_{10}, SO_2, and NO_2, are compared with the corresponding National Ambient Air Quality Standards (NAAQS) for source specific air pollutants. DAO 2000-81 defines ambient air quality standard (or the NAAQS) as the "concentration of an air pollutant which, in order to protect public health and/or public welfare, shall not be exceeded in the breathing zone, at any time".

Table 2-54. Measured one-hour average concentrations of PM_{10}, SO_2 and NO_2 on August 9, 2019

Station ID	Location	Date/Time Start of Sampling	PM_{10} (µg/Nm^3)	SO_2 (µg/Nm^3)	NO_2 (µg/Nm^3)
1	Near Pantay Elementary School/ Along Pantay Buhangin Road	August 9, 2019/ 0730H-0830H	72	< 0.504	0.541
2	Near Quest Adventure Camp Team Building	August 9, 2019/ 0850H-0950H	62	< 0.504	0.456
3	Infront of Coral Agri-Ventures Corp./ Along Pantay Buhangin Rd	August 9, 2019/ 1008H-1108H	28	< 0.504	0.768
4	Infront of RLC farm, Brgy. Dalig Teresa, Rizal	August 9, 2019/ 1125H-1225H	18	< 0.504	2.21
National Ambient Air Quality Standards (NAAQS) for Source Specific Air Pollutants			**200**	**340**	**260**

Background levels of PM_{10} range from 18 to 72 µg/Nm^{3}and were much less as compared to the NAAQS for PM10 of 200 µg/Nm^3. There were observed light to moderate rainfall at the time of monitoring, which likely controlled or suppressed emissions of fugitive particulates from other sources (i.e., open areas) (**Table 2-55**).

SO_2 levels were all not detected (less than 0.504 µg/Nm^3) at the four (4) sampling stations. NO_2 levels were also very low with highest of 2.2 µg/Nm^3 at Station 4. A t Stations 1, 2, and 3, the measured NO_2 levels range only from 0.456 to 0.768 µg/Nm^3.

In the vicinities of the project sites (Parcel 1 and Parcel 2) are poultry farms, residential areas, and other agricultural establishments (i.e., piggery and other livestocks). The proposed Quarry, which is located about 500 m (0.5 km) south-southwest from Corner 4 of MPSA 347-2010-V Parcel 2, is the nearest significant sources of fugitive air emissions. The other existing neary quarry is the Solid Cement quarry located about 1.8 km west of the western boundary of the MPSA 347-2010-V Parcel 2.

Table 2-55. Observed meteorological conditions during sampling

Station ID	Location	Date/Time Start of Sampling	Wind Direction	Air Temperature (°C)	Barometric Pressure (in Hg)	Weather Condition	Other Observation
1	Near Pantay Elementary School/ Along Pantay Buhangin Road	August 9, 2019/ 0730H-0830H	Southwest	27	29.35	Rainy	Roadside/ paved road
2	Near Quest Adventure Camp Team Building	August 9, 2019/ 0850H-0950H	Southwest	28	29.32	Rainy	Roadside/ paved road
3	Infront of Coral Agri-Ventures Corp./ Along Pantay Buhangin Rd	August 9, 2019/ 1008H-1108H	Northeast	28	29.31	Rainy	Roadside/ paved road

Station ID	Location	Date/Time Start of Sampling	Wind Direction	Air Temperature (°C)	Barometric Pressure (in Hg)	Weather Condition	Other Observation
4	Infront of RLC farm, Brgy. Dalig Teresa, Rizal	August 9, 2019/ 1125H-1225H	Northeast	28	29.31	Rainy	Roadside; unpaved road; muddy

Identification and Assessment of Impacts

a) Estimated Air Emissions

Fugitive particulates will be emitted during the operation of the project due to the following activities.
a) Bulldozing;
b) Materials handling (mine site and crusher area);
c) Grading;
d) Travel of haul trucks along unpaved roads;
e) Motor vehicle emissions (tailpipe);
f) Crushing; and
g) Handling and storage piles.

Emission rates of fugitive particulates emanating from the above-mentioned activities were derived based on emission factors, as discussed in the methodology section (**Emission Estimates**). The results of emission estimates for uncontrolled and controlled activities are presented in ***Figure 2-81*** to ***Figure 2-82*** and ***Figure 2-83*** and ***2-84*, respectively.**

Emission estimates of the above sources and activities were estimated using available emission factors from the U.S.EPA AP-42 and the National Pollution Inventory (NPI) of the Australian Government. The details of the emission factors are presented in Section 1.2.4 (Emission Estimates). **Annex H.5** presents the screenshots of the calculation spreadsheets indicating the emission factors, assumptions, and the computed emission rates.

Uncontrolled emissions refer to emissions emanating from activities without control measures to reduce particulate emissions. This control measures include, among others, application of water, installation of pollution control devices, i.e., use of enclosures and proper venting, and buffer strips of trees to reduce transport of particulate outside property boundaries.

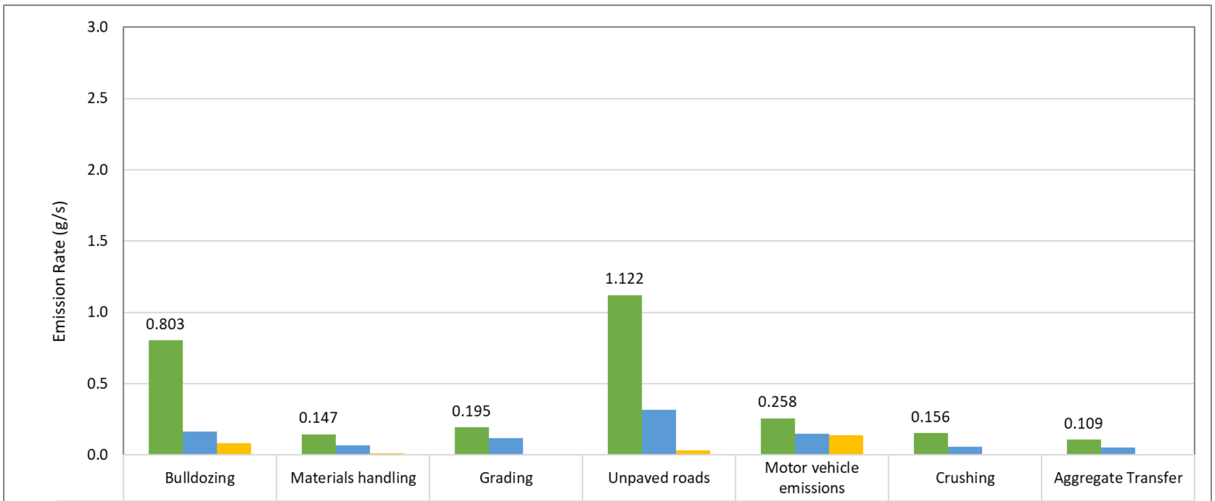
The total uncontrolled particulate emissions (TSP) is about 2.79 g/s while for PM_{10} and $PM_{2.5}$ are 0.83 and 0.29 g/s, respectively (***Figure 2-81***). PM_{10} and $PM_{2.5}$ emissions are about 33.3 and 10.4%, respectively.

Particulate emissions emanating from transport of materials from the quarry to the crusher represent about 40.2% of the total emissions (***Figure 2-82***). The second highest is bulldozing (29%) and motor vehicle emissions (9%). Hence, emission control emission should focus on reducing emissions along unpaved roads, which are the expected main source of air emission during operation.

Assuming that control measures to reduce particulate emissions are provided, total particulate emissions is reduced by about 75% and PM_{10} by 68% (***Figure 2-83*** and ***Figure 2-84***). The control efficiencies based on NPI and the U.S.EPA are as follows:

- Bulldozing, materials handling – 90%,
- Grading – 80%,
- Unpaved road – 75%,
- Motor vehicle and blasting– not specified, and
- Crusher – varies from 78% (primary crushing) to 95% (conveyor transfer points)

Control efficiency for unpaved road is relatively low (75%) due to difficulty of controlling emissions during dry and windy conditions. Unpaved roads when applied with water to control dust may dry quickly, specifically during dry weather condition (“summer” months).



	Bulldozing	Materials handling	Grading	Unpaved roads	Motor vehicle emissions	Crushing	Aggregate Transfer
TSP	0.803114	0.146897	0.195122	1.122232	0.257928	0.155692	0.109177
PM10	0.163121	0.069478	0.117073	0.319122	0.150763	0.058586	0.051638
PM2.5	0.084327	0.010521	0.006049	0.031912	0.139302	0.009109	0.007819

Figure 2-81. Plot of uncontrolled emission rates of particulates (g/s)

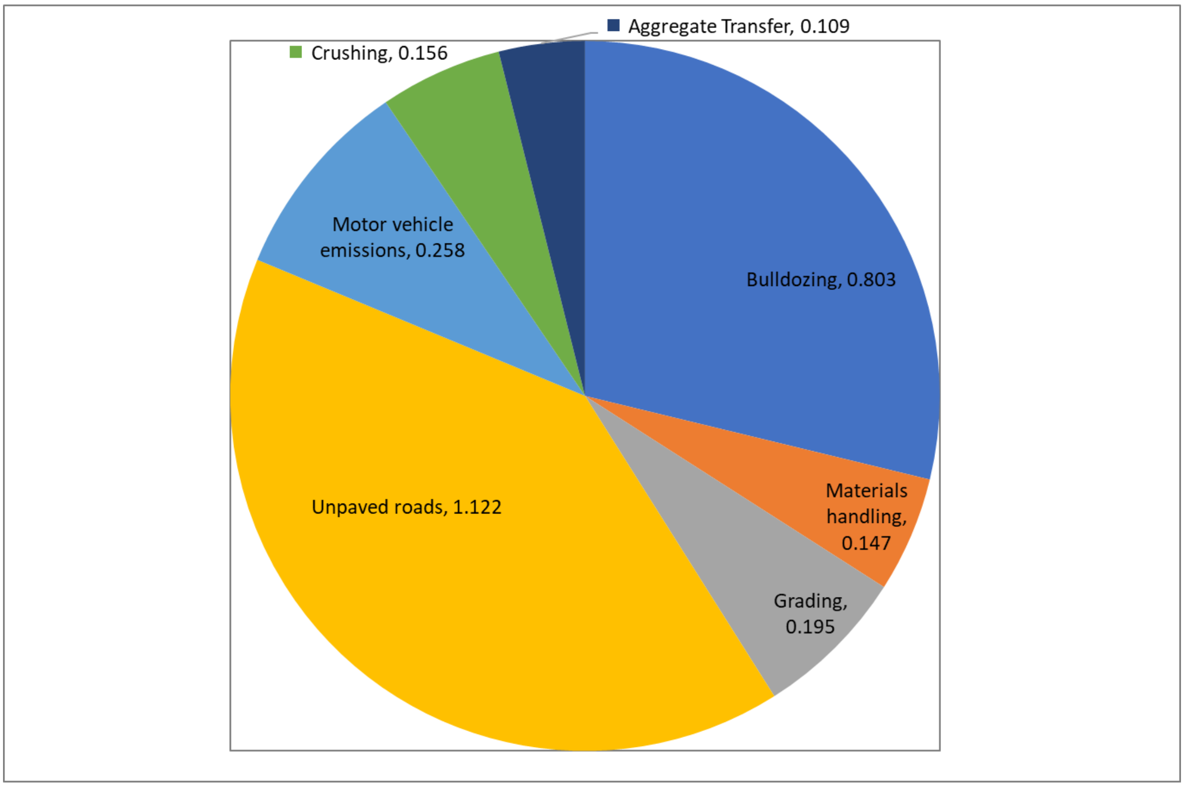
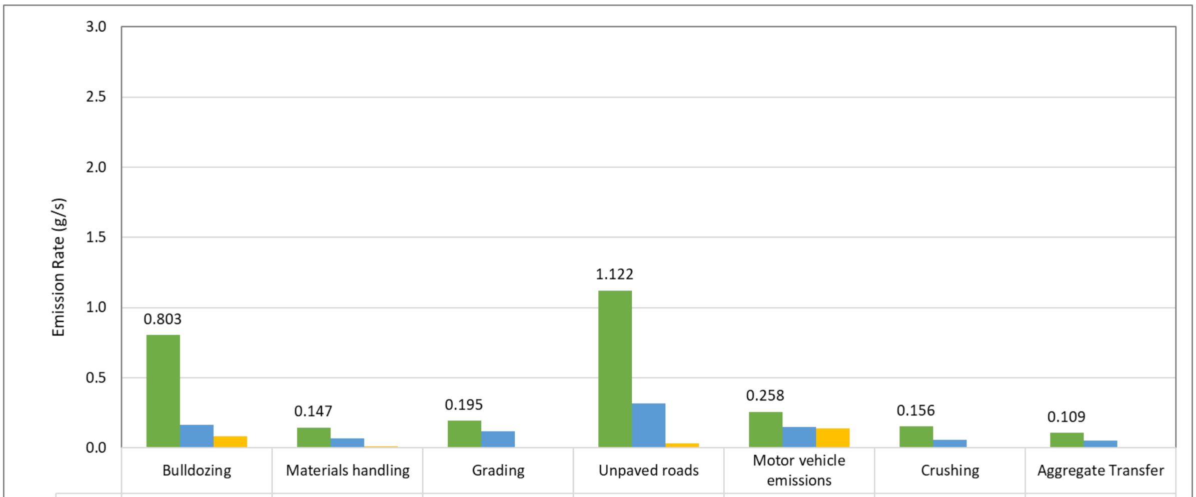


Figure 2-82. Plot of uncontrolled emission rates of particulates (g/s)



	Bulldozing	Materials handling	Grading	Unpaved roads	Motor vehicle emissions	Crushing	Aggregate Transfer
TSP	0.803114	0.146897	0.195122	1.122232	0.257928	0.155692	0.109177
PM10	0.163121	0.069478	0.117073	0.319122	0.150763	0.058586	0.051638
PM2.5	0.084327	0.010521	0.006049	0.031912	0.139302	0.009109	0.007819

Figure 2-83. Plot of controlled emission rates of particulates (g/s)

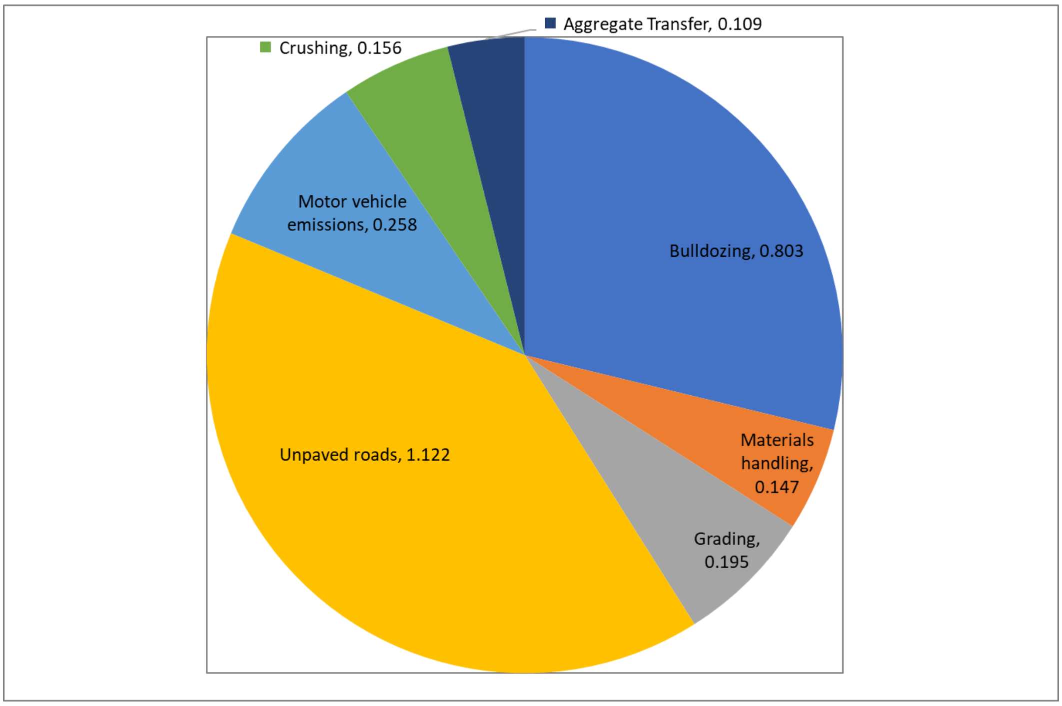


Figure 2-84. Plot of controlled emission rates of particulates (g/s)

b) Dispersed Particulate Emissions (TSP and PM_{10})

Figure 2-85 to ***Figure 2-88*** show the predicted dispersed concentrations of TSP and PM_{10} emanating from the assumed haul road location in Parcel 1. The predicted concentrations represent one-hour average concentrations (TSP and PM_{10}), both for unmitigated (without dust control measures) and mitigated scenarios. Note that meteorological data used in the simulations were generated using MAKEMET Utility of AERMET – a meteorological preprocessor of AERMOD, in which wind directions were assumed to rotate 360-degree direction at increment of 30 degrees.

Figure 2-85 shows that without mitigation measures to control dust emissions, the highest dispersed TSP concentration was about 2,191 µg/m^3, which is located along the unpaved road inside Parcel 1. There were exceedances or dispersed TSP concentrations greater than ambient air quality standard for TSP set at 300 µg/m^3 within and outside Parcel 1. Due to proximity of the unpaved road or quarry site to the northern boundary of the mining block (Parcel 1), high dispersed concentrations of TSP are expected north of the quarry site including other areas in the vicinities of the quarry site.

With mitigation measures to control dust emissions along unpaved roads or haul roads, there were significant reductions of the dispersed TSP concentration to about 547.6 µg/m^3, though the location of highest predicted concentration is along the unpaved or haul road (within the quarry site) and adjacent areas (***Figure 2-86***).

As emission rates of PM_{10} are relatively lower than TSP, predicted dispersed PM_{10} concentrations were relatively lower in extent than those of TSP (***Figure 2-87***). Without the mitigation measures, PM_{10} concentrations greater than the ambient air quality standard for PM_{10} set at 200 µg/m^3 were still noted in the vicinities of the haul roads. There was significant reduction of PM_{10} concentrations, however, with the assumed mitigation or control measures, as shown in ***Figure 2-88***.

The results of dispersion modelling imply the need to provide mitigation measures to control dust emissions to within the ambient air quality standard as stipulated in the Philippine Clean Air Act (PCAA) and its implementing rules (DAO 2000-81). Measures to control dust emissions are presented below.

For the mitigated scenario of TSP, the highest predicted one-hour average concentration was 547.9 µg/m3 and located along the haul road, as shown in the ***Fgure 2-85a***. The location of the highest predicted concentration (unmitigated) is along the haul road and within/adjacent haul roads, in which the permission workplace standards of the Department of Labor and Employment (DOLE) may apply. There were also no residences/households in areas with TSP concentrations exceeding standards (if compared with the NAAQS), though as noted earlier, these areas fall within the quarry site in which workplace standards of the DOLE apply. The occupational safety and health standards for dust (8-hour permissible limits are) 5 milligram per m3, mg/m3, for respirable dust and 10 milligram per cubic meter for total dust). There are area delineations on the application of the ambient air quality standards and the workplace air quality standards.

Yes, we noted on the title of the figures which indicated “g/s”. The figures should be in concentration (µg/m3) as indicated in the right part of the figures (beside the concentrations scale). The titles of the figures were revised (g/s deleted) as noted.

Parcel 1 was modelled because modelling was done to demonstrate that without mitigation measures, high concentrations of particulate air pollutants will be generated during project operation. The prevailing wind flows are northeast and southwest winds and as the distance (edges of closest parcels) between the two parcels are about 1 km and the locations of the two (2) parcels are oriented about/approx. the east and west direction, it can be deduced that there would be no significant contribution of the two (2) parcels at any given receptor location. Further, if Parcel 2 will be included in the modelling, the trend on results would be the same, that is, high concentrations of TSP are expected along unpaved roads with and without mitigation measures.

Please also consider predicted concentrations at mitigated scenarios were still high because the control efficiency (maximum) for unpaved roads is 75%, as indicated in the emission factors of the U.S.EPA. We can’t use higher efficiency control values because of unavailability of such data. We only rely on emission factors developed abroad.

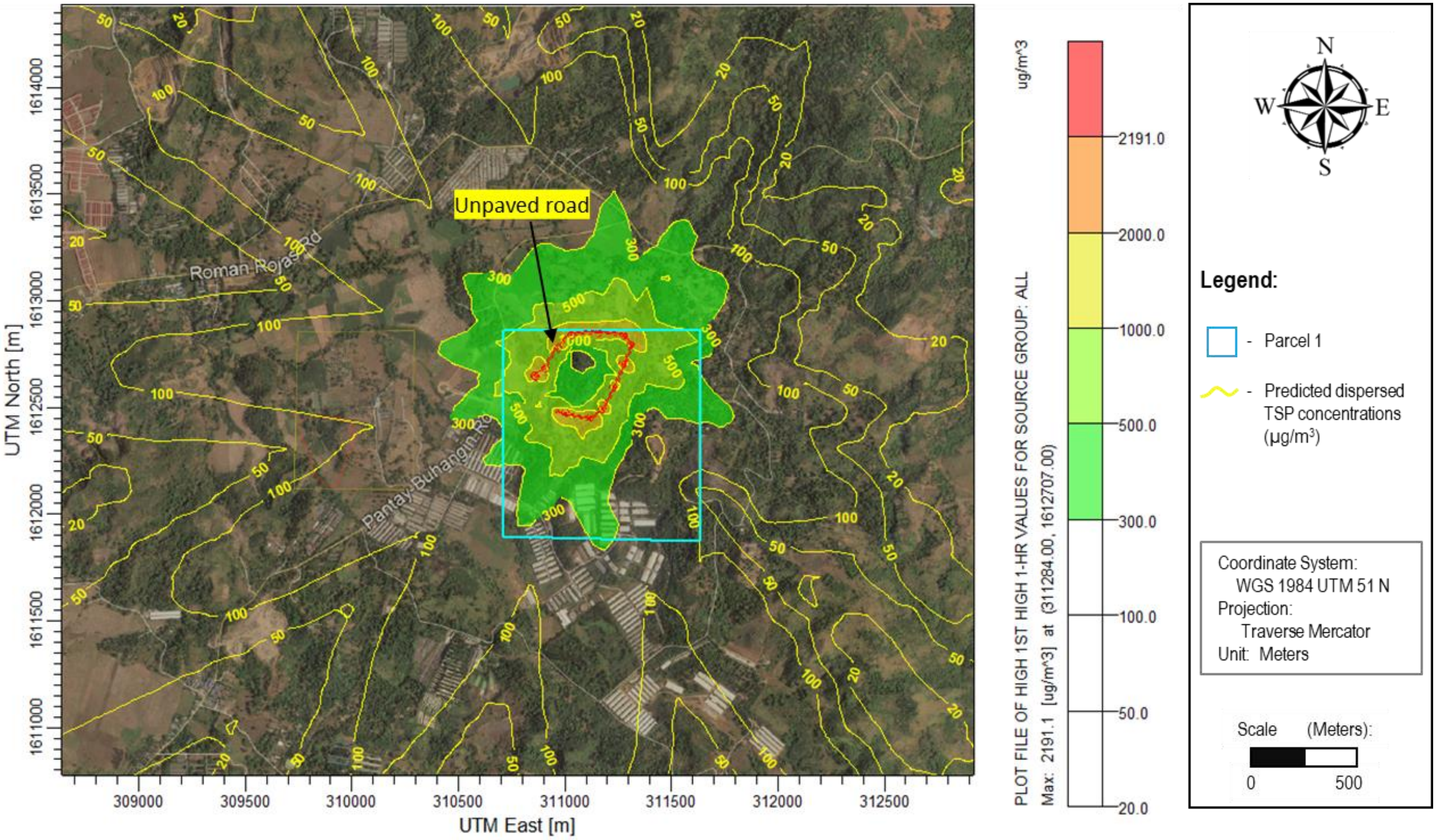


Figure 2-85. Predicted dispersed 1-hour average concentrations of TSP (uncontrolled) g/s)

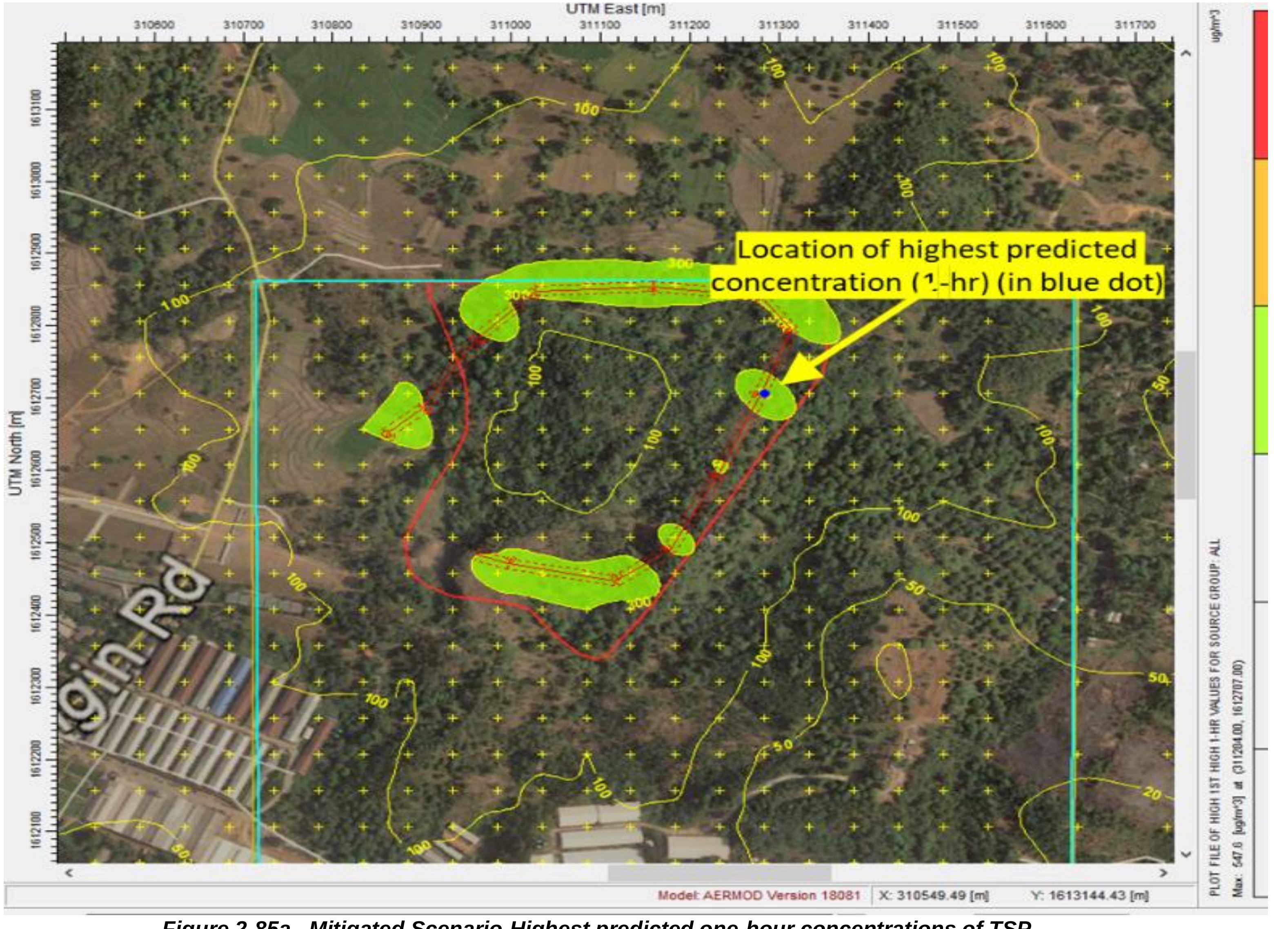


Figure 2-85a. Mitigated Scenario-Highest predicted one-hour concentrations of TSP

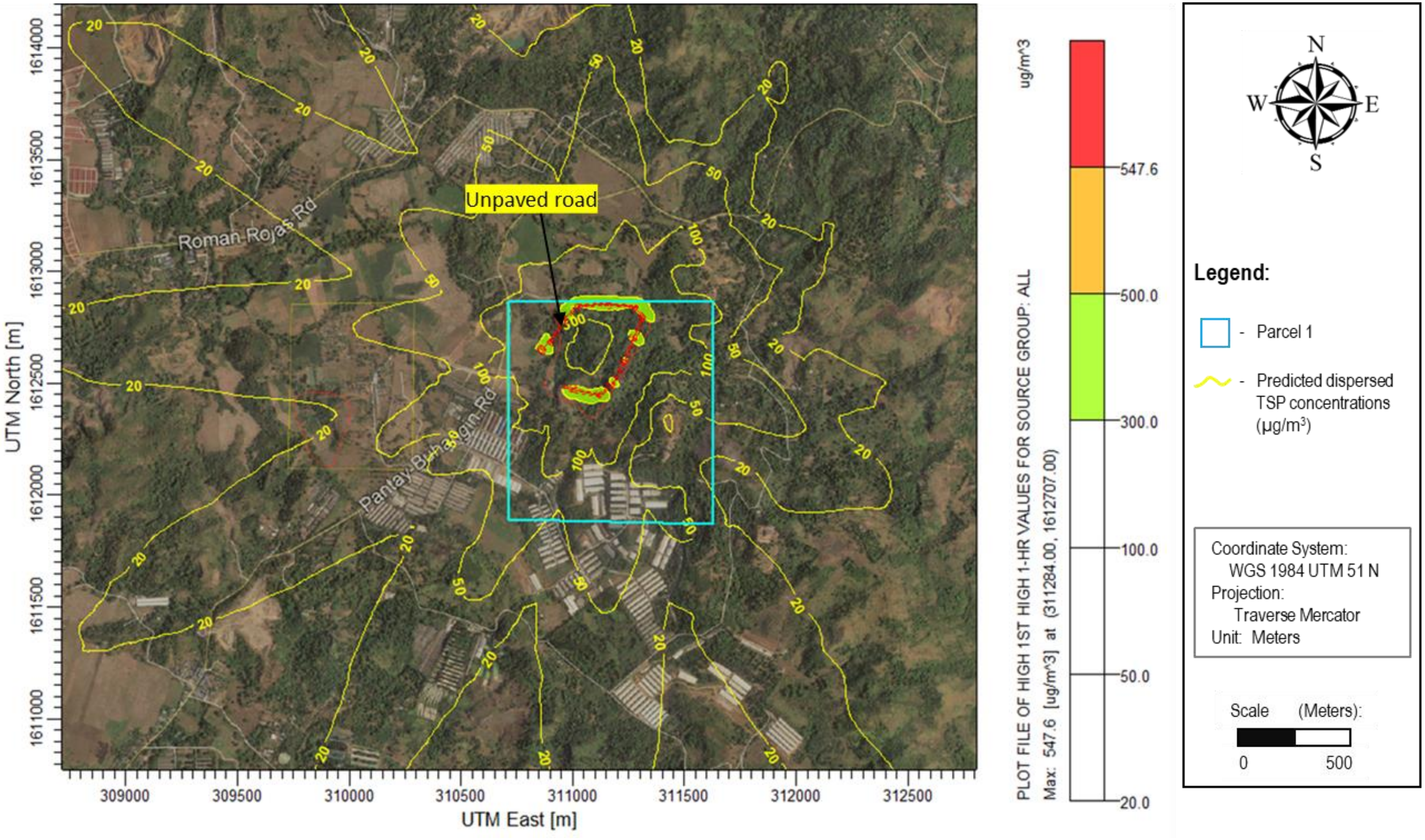


Figure 2-86. Predicted dispersed 1-hour average concentrations of TSP (controlled) g/s)

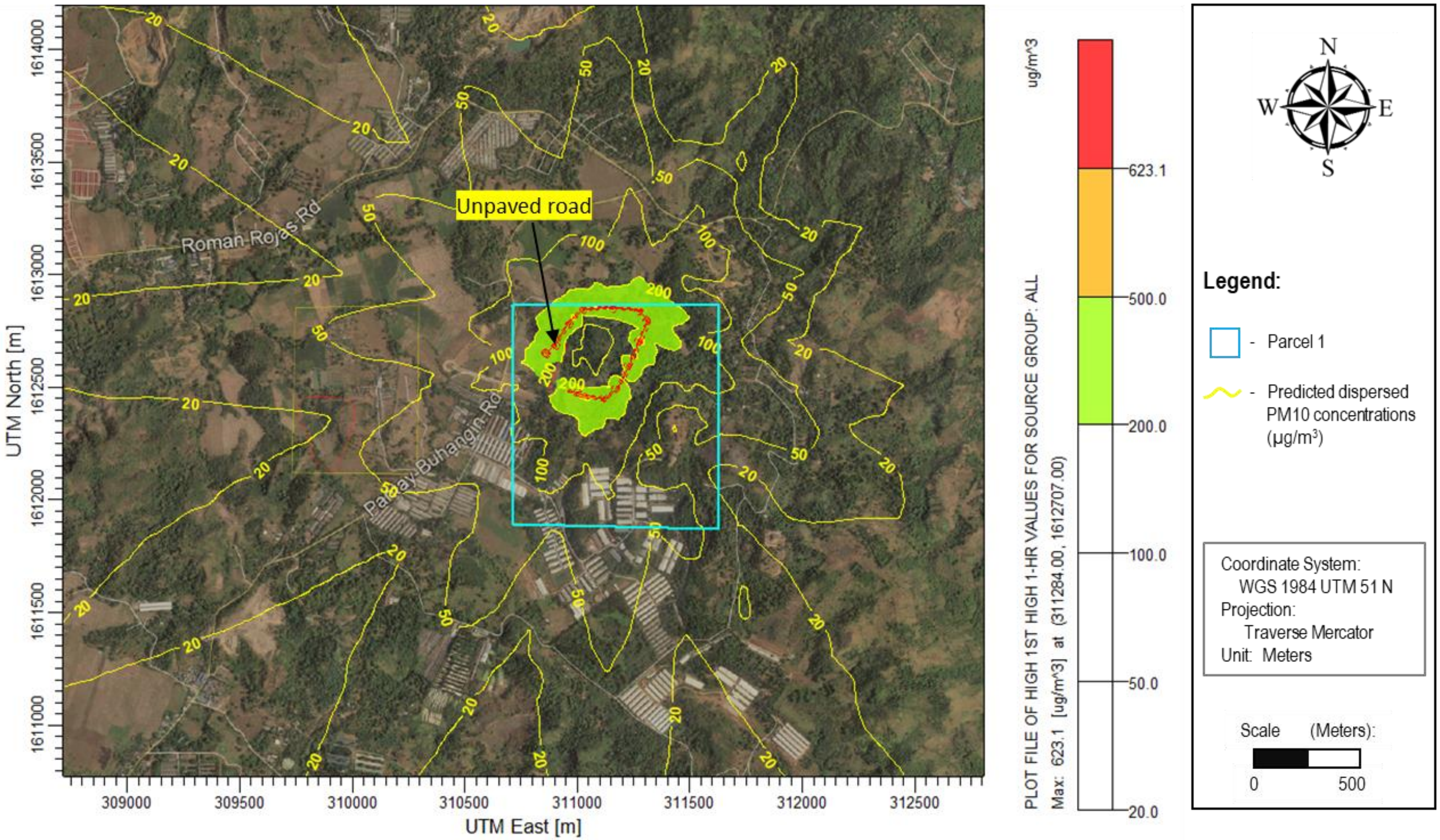


Figure 2-87. Predicted dispersed 1-hour average concentrations of PM_{10} (uncontrolled) g/s)

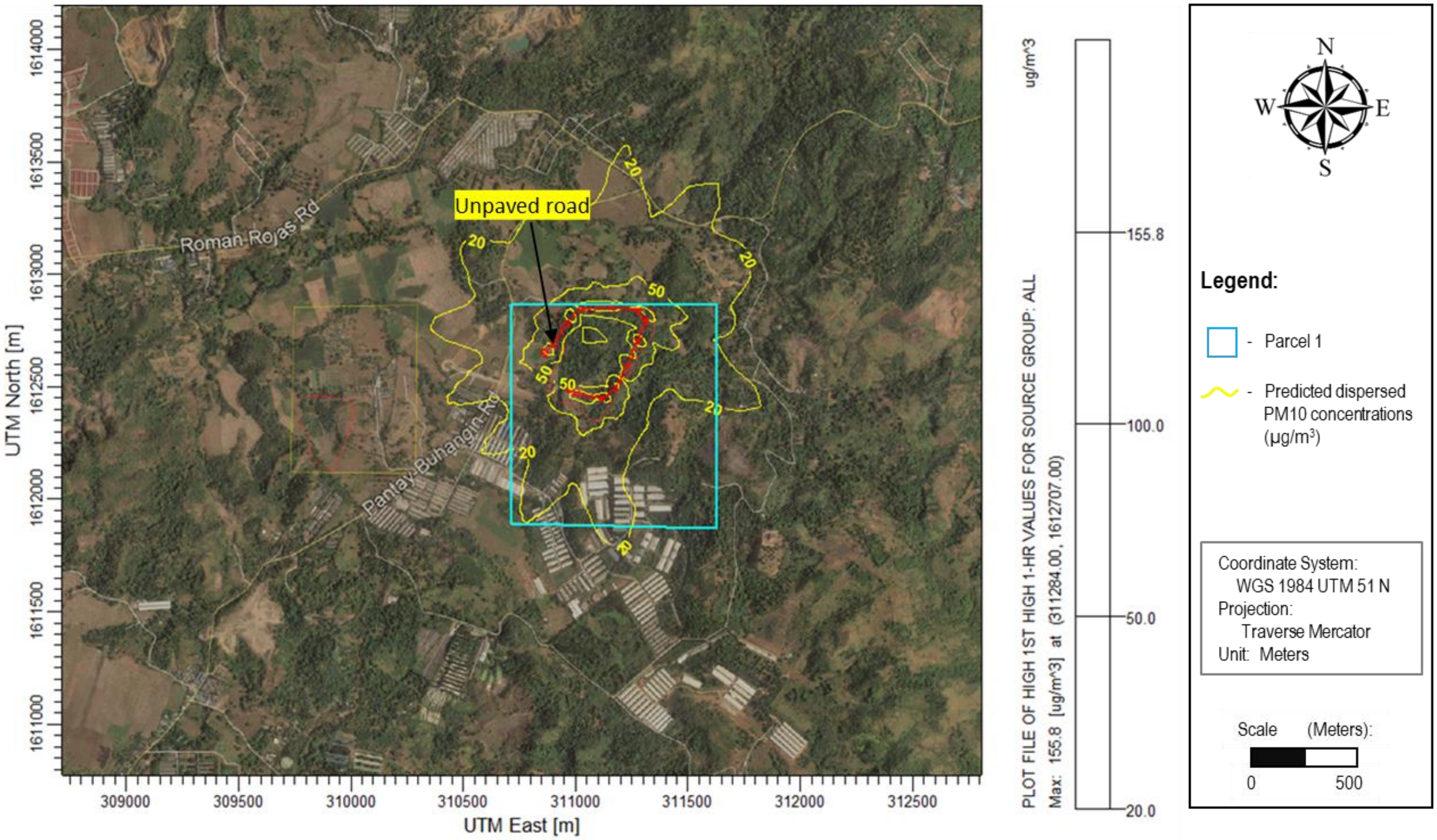


Figure 2-88. Predicted dispersed 1-hour average concentrations of PM_{10} (controlled) g/s)

Mitigation Measures and Monitoring Program

Mitigation measures to reduce or control fugitive are stipulated in the implementing rules and regulations of the Philippine Clean Air Act (PCAA) of 1999 (or DAO 2000-81. These mitigation measures included, among others, the following (Source: Section 13(a), Rule XXV of DAO 2000-81):

1) Use, where possible, of water for control of dust from construction and quarrying or clearing of lands;
2) Application of water on roads, materials of stockpiles and other surface which create airborne dust problem; and
3) Installation and use of hood fans and fabric filters or any other suitable control devices to enclose and vent the handling of dusty materials. Adequate containment methods shall be employed during sandblasting or other similar operations.

In addition to the above-mentioned mitigation measures, the following are the recommended mitigation measures.

- Haul roads and trucks – regular watering of road surfaces during dry condition, provision of covers for trucks hauling spoils and other materials (if materials will be transferred off-site), installation of wheel washing facility, strict implementation of speed limits, and regular maintenance of trucks to reduce or maintain tailpipe emissions.
- Grading and bulldozing - wet suppression or water spraying of exposed areas. Road grading to be done separately at other areas to minimize total cumulative dust
- Crusher area - installation of temporary wind barriers, if needed. This depends on site conditions and the severity of the fugitive emissions; water spraying at main crusher
- Materials handling - provision of dust suppression system (water spraying) prior to and during unloading (materials handling)
- Blasting - watering or wetting of the area to be blasted before blasting. Immediately after blasting, allow dust to settle down prior to commencing other quarry operations in vicinities of the blasted area. Conduct blasting during relatively low wind speeds to avoid dispersion of dust at nearby households/residences.

2.3.2.2 Ambient Noise Quality

Methodology

Ambient Noise Standard

The ambient noise standards, as provided in NPCC 1978 and 1980, established the noise levels that should be attained at residential, commercial, light and heavy industrial areas, **Table 2-56**. It is subdivided into four (4) periods within the 24-hour period as follows:

- Daytime (9:00 A.M. to 6:00 P.M.),
- Evening (6:00 P.M. to 10:00 P.M.),
- Nighttime (10:00 P.M. to 5:00 A.M.), and
- Morning (5:00 A.M. to 9:00 A.M.)

Correction factors of +5 dBA and +10 dBA are applied to the noise standards if the areas are directly facing roads, though there are discrepancies as regard to the number of lanes that the correction factors apply, i.e., correction factors for four-lane or wider roads are +5 and +10 dBA. The noise standards stipulated in NPCC MC No 2, Series of 1980 have not been revised since its issuance in 1980, and are still applicable to date.

Table 2-56. Environmental quality standards for noise in general areas

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

Source: NPCC Memorandum Circular No. 002, Series of 1980
Class AA- a section of contiguous area which requires quietness, such as areas within 100 meters from school site, nursery schools, hospitals and special house for the aged
Class A - a section of contiguous area which is primarily used for residential area
Class B - a section of contiguous area which is primarily a commercial area
Class C - a section of contiguous area reserved as light industrial area
Class D-a section which is primarily reserved as heavy industrial area

There is a nuisance provision in Article 694 of Republic Act No. 386 (Civil Code of the Philippines) which is defined as "any act, omission, establishment, business, condition of property, or anything else which annoys or offends the senses or injures or endangers the health and safety of others, or other effects as provided in Article 694. This includes annoyance or nuisance by high noise emitting sources.

As defined further in Article 695 of A 386, "nuisance is either public or private. A public nuisance affects a community or neighborhood or any considerable number of persons, although the extent of the annoyance, danger or damage upon individuals may be unequal. A private nuisance is one that is not included in the foregoing definition.

Background Noise Monitoring

Background sound levels were measured in the vicinities of the project site on August 9, 2019. A sound level meter (SLM) was used to measure sound levels at the monitoring stations (**Plate 6**). The SLM was set at "A" mode and "slow response", in accordance with the NPCC (1978) requirements.

Background Noise Levels

Table 2-57 presents the statistics of the measured sound levels on August 9, 2019 at the four (4) stations. The measured noise levels at Stations 1 to 4 are shown in **Table 2-58 to Table 2-61**, respectively.

As indicated in the ambient air and monitoring report by third-party monitoring team, the medians of noise levels range from 58.1 to 69.2 dBA and mean values of 59.8 to 69.7 dBA. Station 3 (Fronting Coral Agri-Venturs Corporation/Along Pantay Buhagin Road registered the highest noise levels among the four (5) stations. Station 2 (Near Quest Adventure Camp Team Building) registered the lowest median.

Passing trucks and motorcycles, people conversing while passing at the monitoring stations and noise generated from movement of trees/branches due to winds, were the sources of noise at the time of monitoring.

Median of noise levels were all within the NPCC (1980) noise standards set for Class C (Light Industrial Area). Monitoring results were compared with the standards for light industrial area (daytime) as the stations were located near/adjacent commercial areas (Class C - Light Industrial Area).

NOISE METER

Plate 6. Sound level meter used in monitoring

Table 2-57. Statistics of measured sound levels on August 9, 2019
(Source: Ambient Air and Noise Monitoring Report, 2019)

Station ID	Location	Date/Start of Sampling	Min (dBA)	Max (dBA)	Median (dBA)	Mean (dBA)	DENR Class C Standard
1	Near Pantay Elementary School/ Along Pantay Buhangin Road	August 9, 2019/ 7:30 A.M.	56.1	79.3	61.6	64.6	70
2	Near Quest Adventure Camp Team Building	August 9, 2019/ 8:50 A.M..	54.2	76.7	58.1	61.3	70
3	Infront of Coral Agri-Ventures Corp./ Along Pantay Buhangin Road	August 9, 2019/ 10:00 A.M.	66.5	76.7	69.2	69.7	70
4	Infront of RLC farm, Brgy. Dalig Teresa, Rizal	August 9, 2019/ 11:20 A.M.	55.8	64.7	58.8	59.8	70

Table 2-58. Measured Noise levels at Station 1
(Source: Ambient Air and Noise Monitoring Report, 2019)

Address:	**Barangay Dalig, Teresa Rizal**			
Date of Sampling:	**9-Aug-19**			
Time of Sampling:	**7:30 AM**			
Station No:	**1**			
0730H	**0735H**	**0740H**	**0745H**	**0750H**
Trial 1	**Trial 2**	**Trial 3**	**Trial 4**	**Trial 5**
62.80	69.90	79.30	63.50	61.10
60.10	67.50	72.10	71.30	62.30
62.40	60.10	67.10	75.70	62.10
59.60	63.10	64.30	67.10	78.10
60.30	59.80	61.20	61.30	79.00
59.90	60.90	60.40	63.30	76.50
59.40	61.10	59.30	62.90	72.50
62.20	66.30	58.70	60.10	67.30
62.70	68.60	56.10	59.60	60.20
61.70	72.50	59.10	60.70	60.50
Median =	**61.65**		**Average =**	**64.60**
Minimum =	**56.10**		**Maximum =**	**79.30**
*Source of Noise: *Trucks and Motor vehicles passing along station 1 - Pantay Buhangin road * People talking while walking along station 1 * Waving of trees and wind blowing*				

Table 2-59. Measured Noise levels at Station 2
(Source: Ambient Air and Noise Monitoring Report, 2019)

Address:	**Barangay Dalig, Teresa Rizal**			
Date of Sampling:	**9-Aug-19**			
Time of Sampling:	**8:50 AM**			
Station No:	**2**			
0850H	**0855H**	**0900H**	**0905H**	**0910H**
Trial 1	**Trial 2**	**Trial 3**	**Trial 4**	**Trial 5**
60.10	56.40	60.70	55.30	62.10
60.80	55.90	55.30	65.70	60.70
57.60	58.70	58.10	71.10	60.50
56.90	60.50	57.60	76.70	62.30
54.70	68.70	55.50	75.50	61.10
58.10	71.30	57.90	70.10	60.90
57.30	75.40	59.10	69.70	58.50
59.70	69.90	60.40	65.40	59.30
55.90	64.70	60.70	60.20	57.50
54.20	60.10	58.60	61.30	56.00
Median =	**58.05**		**Average =**	**61.30**
Minimum =	**54.20**		**Maximum =**	**76.70**
Source of Noise: **Trucks and Motor vehicles passing along station 2 - Pantay Buhangin road* ** People conversing while walking along station 2* ** Waving of trees and wind blowing*				

Table 2-60. Measured Noise levels at Station 3
(Source: Ambient Air and Noise Monitoring Report, 2019)

Address:	**Barangay Dalig, Teresa Rizal**			
Date of Sampling:	**9-Aug-19**			
Time of Sampling:	**10:00 AM**			
Station No:	**3**			
1000H	**1005H**	**1010H**	**1015H**	**1020H**
Trial 1	**Trial 2**	**Trial 3**	**Trial 4**	**Trial 5**
68.30	68.80	70.90	68.30	74.30
66.50	69.30	70.70	66.50	75.10
71.50	70.10	73.20	67.30	71.20
69.30	72.50	76.70	66.60	68.60
72.00	77.10	68.10	68.40	69.20
75.10	82.10	67.40	69.70	67.50
76.40	72.00	68.30	68.30	69.30
73.10	69.70	66.70	68.00	68.60
70.30	70.60	69.30	67.90	69.00
69.10	69.10	67.20	70.10	70.10
Median =	**69.20**		**Average =**	**69.70**
Minimum =	**66.50**		**Maximum =**	**76.70**

Source of Noise:
**Trucks and motor vehicles passing along station 3 - Pantay Buhangin road*
** People conversing while walking*
** Waving of trees and wind blowing*

Table 2-61. Measured noise levels at Station 4
(Source: Ambient Air and Noise Monitoring Report, 2019)

Address:	**Barangay Dalig, Teresa Rizal**			
Date of Sampling:	**9-Aug-19**			
Time of Sampling:	**11:20 AM**			
Station No:	**4**			
1120H	**1125H**	**1130H**	**1135H**	**1140H**
Trial 1	**Trial 2**	**Trial 3**	**Trial 4**	**Trial 5**
59.50	55.80	62.20	63.00	61.10
61.00	56.00	58.70	64.00	61.20
64.70	58.80	57.30	60.10	61.80
60.10	57.50	59.10	62.30	58.50
58.70	56.50	59.00	62.90	57.90
59.50	58.90	58.60	61.80	58.00
57.90	59.80	60.70	60.90	59.80
60.70	58.00	57.70	60.00	57.10
61.40	60.40	60.10	62.10	58.40
59.50	58.10	60.80	61.90	58.20
Median =	**58.85**		**Average =**	**59.80**
Minimum =	**55.80**		**Maximum =**	**64.70**
Source of Noise: **Trucks and Motor vehicles passing along station 4* ** People talking while walking along station 4* ** Waving of trees and wind blowing*				

IMPACT ASSESSMENT AND MITIGATING MEASURES

During Construction and Operation Phase

Mitigation measures to control noise emissions at the project site should be implemented to avoid complaints from nearby noise sensitive receptors, i.e., households, and to comply with the ambient noise standards. Article 694 of Republic Act No. 386 (Civil Code of the Philippines) prohibits nuisance that annoys or offends the senses or injures or endangers the health and safety of others, among others. This includes generation of high noise levels due to operation of the heavy equipment, crusher, and other equipment at the project area.

Mitigation measures to reduce noise levels to within acceptable levels should include, among others, the installation of effective mufflers at all heavy equipment and other equipment using internal combustion engine. High noise levels are emitted at exhaust of the internal combustion engines, which could be effectively reduce using mufflers.

If the crusher and related facilities will generate excessive noise during initial noise monitoring, it is recommended to provide noise barriers within the crusher area or other measures, e.g., noise enclosures, to control noise at the crusher area.

Other measures to control noise emissions include the reduction on the equipment usage at nighttime, particularly at areas near residence and to impose speed limits, at the project site and at access roads.

It is also recommended to conduct extensive noise monitoring during initial project operation to check compliance with the NPCC noise standards, and to implement noise mitigation measures should noise readings exceeded said noise standards.

2.4 THE PEOPLE

This section presents the key baseline conditions of the project's site in terms of barangay profile such as demography, current status of the land, health profile and infrastructure and perception. Barangay profile taken from the Barangay Office was used, however, the barangay has no five (5) year plan yet which can help and assist the proponent in the formulation of the Social Development Program. Results of the perception survey was also used to determine the actual profile of the community. In addition, data from Philippines Statistics Authority (PSA) and data from the covering municipalities were used as an updated reference.

The potential impacts of the project's activities during pre-construction, construction, operations, and abandonment stage on these environmental aspects and their corresponding options for prevention, mitigation or enhancement are also assessed and discussed in this section.

Demography

The Province of Rizal

Population of the Province

Rizal Province has a total population of 2,884,227 as of 2015 PSA covering thirteen (13) municipalities and one (1) City, **Table 2-62**. The highest recorded population is in Antipolo City with total of 776,386 followed by Rodriguez with 369,222 with 322,128, and Cainta while the lowest town population is Jala-jala has abaout 32,254. Municipality of Morong and Teresa ranks 11th and 12th, respectively.

Table 2-62 Population of the Province of Rizal

Name	Status	**Population** Census 1990-05-01	**Population** Census 2000-05-01	**Population** Census 2010-05-01	**Population** Census 2015-08-01
Rizal	**Province**	**977,448**	**1,707,218**	**2,484,840**	**2,884,227**
Angono	Municipality	46,014	74,668	102,407	113,283
Antipolo	City	207,842	470,866	677,741	776,386
Baras	Municipality	16,880	24,514	32,609	69,300
Binangonan	Municipality	127,561	187,691	249,872	282,474
Cainta	Municipality	126,839	261,500	311,845	322,128
Cardona	Municipality	32,962	39,003	47,414	49,034
Jala-Jala	Municipality	16,318	23,280	30,074	32,254
Morong	Municipality	32,165	42,489	52,194	58,118
Pililla	Municipality	32,771	45,275	59,527	64,812
Rodriguez (Montalban)	Municipality	67,074	115,167	280,904	369,222
San Mateo	Municipality	82,310	135,603	205,255	252,527

Name	Status	**Population** Census 1990-05-01	**Population** Census 2000-05-01	**Population** Census 2010-05-01	**Population** Census 2015-08-01
Tanay	Municipality	58,410	78,223	98,879	117,830
Taytay	Municipality	112,403	198,183	288,956	319,104
Teresa	Municipality	20,645	29,745	47,163	57,755

Source: PSA, 2015

Population of the Municipalities

Municipality of Morong

Morong is a municipality in the landlocked province of Rizal. The municipality has a land area of 37.58 square kilometers or 14.51 square miles which constitutes 3.15% of Rizal's total area. Its population as determined by the 2015 Census was 58,118. This represented 2.02% of the total population of Rizal province, or 0.40% of the overall population of the CALABARZON region. Based on these figures, the population density is computed at 1,547 inhabitants per square kilometer or 4,005 inhabitants per square mile.

Municipality of Teresa

The municipality has a land area of 18.61 square kilometers or 7.19 square miles which constitutes 1.56% of Rizal's total area. Its population as determined by the 2015 Census was 57,755. This represented 2.00% of the total population of Rizal province, or 0.40% of the overall population of the CALABARZON region. Based on these figures, the population density is computed at 3,103 inhabitants per square kilometer or 8,033 inhabitants per square mile.

Barangays and Municipalities

Barangay Maybancal, Municipality of Morong, Province of Rizal

Maybank is situated at approximately 14.5570, 121.2445, in the island of Luzon. Elevation at these coordinates is estimated at 32.2 meters or 105.6 feet above mean sea level. Barangay Maybancal is more or less 1 kilometer away from the Town Proper. Barangay Maybancal is a rural community with a total land area of 478 Hectares.

Maybancal is a barangay in the Municipality of Morong, in the province of Rizal. Latest population of the barangay is not available due to the re-organization of the council. Turn-over of the former Secretary was not yet done. The latest recorded population at the barangay office was year 2013.

Its population as determined by the 2015 Census was 8,725, **Table 2-63**. This represented 15.01% of the total population of Morong. The population of Maybancal grew from 3,507 in 1990 to 8,725 in 2015, an increase of 5,218 people. The latest census figures in 2015 denote a positive growth rate of 3.75%, or an increase of 1,535 people, from the previous population of 7,190 in 2010.

Table 2-63 Population and Population Growth of Morong per Barangay

Barangay	Population percentage (2015)	Population (2015)	Population (2010)	Change (2010-2015)	Annual Population Growth Rate (2010-2015)
Bombongan	6.34%	3,684	3,118	18.15%	3.23%
Can-Cal-Lan	8.11%	4,714	4,471	5.44%	1.01%
Lagundi	16.63%	9,665	8,823	9.54%	1.75%
Maybancal	***15.01%***	***8,725***	***7,190***	***21.35%***	***3.75%***
San Guillermo	16.73%	9,722	8,119	19.74%	3.49%
San Jose	7.46%	4,333	3,321	30.47%	5.19%
San Juan	18.44%	10,715	10,626	0.84%	0.16%
San Pedro	11.29%	6,560	6,526	0.52%	0.10%
Morong Total		58,118	52,194	11.35%	2.07%

Barangay Dalig, Municipality of Teresa, Province of Rizal

Barangay Dalig, Municipality of Teresa, Province of Rizal. Dalig is situated at approximately 14.5639, 121.2086, in the island of Luzon. Elevation at these coordinates is estimated at 54.4 meters or 178.5 feet above mean sea level.

The latest population recorded in Barangay Dalig is 14,752 with 3,311 households as of October 2019. The population per PSA 2015 Census was 12,365. This represented 21.41% of the total population of Teresa, **Table 2-64**. According to the 2015 Census, the age group with the highest population in Dalig is 5 to 9, with 1,357 individuals. Conversely, the age group with the lowest population is 80 and over, with 45 individuals.

Table 2-64. Population and Population Growth of Teresa per Barangay

Barangay	Population percentage (2015)	Population (2015)	Population (2010)	Change (2010-2015)	Annual Population Growth Rate (2010-2015)
Bagumbayan	20.15%	11,638	9,099	27.90%	4.80%
Calumpang Santo Cristo	2.96%	1,710	1,522	12.35%	2.24%
Dalig	***21.41%***	***12,365***	***9,501***	***30.14%***	***5.14%***
Dulumbayan	14.46%	8,353	7,108	17.52%	3.12%
May-Iba	14.87%	8,590	6,973	23.19%	4.05%
Poblacion	4.36%	2,519	2,182	15.44%	2.77%
Prinza	9.08%	5,247	4,726	11.02%	2.01%
San Gabriel	6.84%	3,950	2,906	35.93%	6.02%
San Roque	5.86%	3,383	3,146	7.53%	1.39%

Barangay	Population percentage (2015)	Population (2015)	Population (2010)	Change (2010-2015)	Annual Population Growth Rate (2010-2015)
Teresa Total		57,755	47,163	22.46%	3.93%

Source: PSA, 2015

Population by Age Group and Age Dependency Ratio

Barangay Maybancal, Municipality of Morong, Province of Rizal

According to the 2015 Census, the age group with the highest population in Maybancal is 5 to 9, with 973 individuals. Conversely, the age group with the lowest population is 80 and over, with 53 individuals, **Table 2-65**.

Combining age groups together, those aged 14 and below, consisting of the young dependent population which include infants/babies, children and young adolescents/teenagers, make up an aggregate of 33.16% (2,893). Those aged 15 up to 64, roughly, the economically active population and actual or potential members of the work force, constitute a total of 62.60% (5,462). Finally, old dependent population consisting of the senior citizens, those aged 65 and over, total 4.24% (370) in all.

The computed Age Dependency Ratios mean that among the population of Maybancal, there are 53 youth dependents to every 100 of the working age population; there are 7 aged/senior citizens to every 100 of the working population; and overall, there are 60 dependents (young and old-age) to every 100 of the working population.

The median age of 24 indicates that half of the entire population of Maybancal are aged less than 24 and the other half are over the age of 24

Table 2-65 Population Per Age Group of Barangay Maybancal, Morong

Age group	Population (2015)	Age group percentage
Under 1	199	2.28%
1 to 4	833	9.55%
5 to 9	973	11.15%
10 to 14	888	10.18%
15 to 19	822	9.42%
20 to 24	832	9.54%
25 to 29	755	8.65%
30 to 34	667	7.64%
35 to 39	583	6.68%
40 to 44	414	4.74%
45 to 49	433	4.96%
50 to 54	410	4.70%
55 to 59	312	3.58%
60 to 64	234	2.68%

Age group	Population (2015)	Age group percentage
65 to 69	169	1.94%
70 to 74	89	1.02%
75 to 79	59	0.68%
80 and over	53	0.61%
Total	8,725	100.00%

- Youth Dependency Ratio: 52.97
- Old Age Dependency Ratio: 6.77
- Total Dependency Ratio: 59.74
- Median Age: 23.89

Source: PSA, 2015

Barangay Dalig, Municipality of Teresa, Province of Rizal

According to the 2015 Census, the age group with the highest population in Teresa is 15 to 19, with 6,099 individuals. Conversely, the age group with the lowest population is 80 and over, with 265 individuals, **Table 2-66**.

Combining age groups together, those aged 14 and below, consisting of the the young dependent population which include infants/babies, children and young adolescents/teenagers, make up an aggregate of 30.82% (17,800). Those aged 15 up to 64, roughly, the economically active population and actual or potential members of the work force, constitute a total of 65.73% (37,964). Finally, old dependent population consisting of the senior citizens, those aged 65 and over, total 3.45% (1,991) in all.

The computed Age Dependency Ratios mean that among the population of Teresa, there are 47 youth dependents to every 100 of the working age population; there are 5 aged/senior citizens to every 100 of the working population; and overall, there are 52 dependents (young and old-age) to every 100 of the working population.

The median age of 25 indicates that half of the entire population of Teresa are aged less than 25 and the other half are over the age of 25.

Table 2-66 Population Per Age Group of Barangay Dalig, Teresa

Age group	Population (2015)	Age group percentage
Under 1	1,164	2.02%
1 to 4	4,865	8.42%
5 to 9	5,945	10.29%
10 to 14	5,826	10.09%
15 to 19	6,099	10.56%
20 to 24	5,301	9.18%
25 to 29	4,594	7.95%
30 to 34	4,396	7.61%
35 to 39	4,369	7.56%

Age group	Population (2015)	Age group percentage
40 to 44	3,898	6.75%
45 to 49	3,400	5.89%
50 to 54	2,617	4.53%
55 to 59	1,970	3.41%
60 to 64	1,320	2.29%
65 to 69	859	1.49%
70 to 74	541	0.94%
75 to 79	326	0.56%
80 and over	265	0.46%
Total	57,755	100.00%

- Youth Dependency Ratio: 46.89
- Old Age Dependency Ratio: 5.24
- Total Dependency Ratio: 52.13
- Median Age: 24.70

Source: PSA, 2015

Number of Household, and Household Size

Rizal Province

Table 2-67 presents the household population, number of population and average household size per city and municipalities. Based on 2015 PSA, Municipality of Morong has a total household of 13,180 with household size as of 4.4 while Municipality Teresa has a total household of 13,457 with household size of 4.3

Table 2-67. Household Population, Number of Households and Average Household Size by Region, Province, City, and Municipality: Philippines, 2015

Rizal Province	Household Population	Number of Households	Household Size
RIZAL	**2,877,509**	**652,605**	**4.4**
Angono	113,114	25,325	4.5
City of Antipolo	774,734	170,523	4.5
Baras	69,150	16,706	4.1
Binangonan	282,213	69,786	4.0
Cainta	321,426	71,463	4.5
Cardona	48,926	12,114	4.0
Jala-jala	32,117	6,919	4.6
Rodriguez (Montalban)	368,716 82	82,348	4.5
Morong	***58,008***	***13,180***	***4.4***
Pililla	64,715	14,734	4.4
San Mateo	252,105	252,105	4.5
Tanay	116,503	25,836	4.5
Taytay	318,576	73,835	4.3
Teresa	***57,206***	***13,457***	***4.3***

Source: PSA, 2015

Barangay Maybancal, Municipality of Morong, Province of Rizal has a total number of households of 1,983 while Barangay Dalig, Municipality of Teresa, Province of Rizal has a total number of household of 2,876, as of PSA 2015. The latest household of Barangay Dalig was 3,311 as of October 2019.

Gender Profile of the Municipality

Rizal Province

The whole province of Rizal has almost 1:1 ratio of men and women as presented in **Table 2-68**.

Table 2-68 Gender Profile of the Province of Rizal

Gender (C 2015)	
Males	1,444,063
Females	1,440,164

Source: PSA, 2015

Barangay Maybancal, Moring has the ratio of men to women of 1:2 while and Barangay Dalig, Teresa has a ratio of almost 1:1, *PSA 2015*.

Settlement Map

See Barangay Settlement Map for Barangay Maybancal, Morong and Barangay Dalig, Teresa is presented in Figure 2-89 and Figure 2-90, respectively.

2.4.1 <u>Displacement of Settler/s</u>

Parcel 1 which covers about 82.80 hectares has identified Coral Farm to be inside the MPSA area, however, based on the mineral reserve, Coral farm is outside of the quarry limit. The quarry area shall be limited to at least 25 hectares only to give way for the establishments of buffer zones along road, residential and agro-industrial area. There are about 15-20 families of informal settlers located in Parcel 2 that covers an area of 31.7206 hectares but will be excluded from the operation and is outside of the quarry limit of at least 10 hectares. There are some surface rights owners that need to be settled first before any operation is done.

Displacement/Disturbance of Properties

There will be no displacement of informal settlers as those shall be excluded from the quarry limit operation. Private surface rights of the lands in a Parcel 1 and Parcel 2 shall be settled first in a form of direct acquisition, royalty or joint venture agreement which ever instruments agreeable to both parties.

Change/Conflict in Land Ownership

Most of the lands in Teresa and Morong had been classified Alienable and Disposable in 1927 and land titles had been awarded to the owners. Part of Teresa has been classified as part of Lungsod Silangan Townsite Reservation, hence, classified for residential, commercial and industrial uses and had ceased to be agricultural approved on April 18, 1977 under Presidential Proclamation No. 1637.

It is recommended that those surface rights that had not been acquired need to be acquired, settled or enter into agreement before any commencement of the development. In addition, to be able to start the project on phasing basis, the proponent can start to the areas where the full ownership of the surface rights had been cleared or settled.

Change/Conflict Right of Way

The area is not being utilized as right of way by any of the nearby community.

Impact on Public Access

The project is bounded by Pantay-Buhangin Road west side boundary of Parcel 1 and East side boundary of Parcel 2 with no exclusivity of the proponent on the use of the public road.

Literacy and Educational Profile

Teresa, Rizal Educational institutions consist of one (1) University and College, eight (8) High Schools, and Twelve (12) Elementary Schools. There are seven (7) Private integrated Schools in the municipality of Teresa, *source: Masterlist-of-Private-Sec.-Schools-S.Y.-2016-2017-Rizal-Province (1).*

Barangay Dalig where Parcel 1 and Parcel 2 is most located has one (1) Private school and two (2) Public schools.

Morong, Rizal has twelve (12) Public Elementary Schools and two (2) High schools. There are five (5) Private Integrated Elementary and High School and one (1) Private College School, *source: Masterlist-of-Private-Sec.-Schools-S.Y.-2016-2017-Rizal-Province (1).*

Barangay Maybancal where the portion of Parcel 1 project is to be located has three (3) Public has Elementary Schools namely Maybancal Elementary School, Maybancal SPED Center, Talaga Elementary School and three (3) Day care centers; Maybancal Day Care Center, Taghangin Day Care Center, Talaga Day Care Center.

2.4.2 In-Migration

During construction and operation phase, there will be twenty-seven (27) workers that will be hired for the quarry operations mostly identified as equipment operators and drivers. The project will not significantly affect the in-migration pattern in the area considering that the priority of employment will be coming from the host barangays.

Census of Population/Property that will be Displaced/Disturbed

No person will be displaced nor disturbed due to the quarry operation, however, the surface property owners prior to operation shall be settled in a form of direct acquisition.

Housing Ownership profile/Availability of Housing/Number of Informal Settlers

Settlers within Parcel 2 shall be excluded from the quarry operations therefore none shall be displaced.

Proliferation of Informal Settlers

The proliferation of the informal settlers is unlikely to occur due to the operation of the quarry project, as the location is situated in an MPSA area and at the same time secluded by its perimeter.

2.4.3 Cultural/Lifestyle Change (especially On Indigenous People, if any)

There are no indigenous people at the project site and the project is not foreseen to significantly affect the Culture and Lifestyle of the people. On the other hand, with the increased revenue of the host barangay due to the tax payment generated by the project, more projects may be implemented that will improve the lifestyle of the people and the implementation of the Social Development and Management Plan (SDMP) will in effect improve the basic services and means of the people. In addition, the proposed quarry shall still observe the existing culture and traditions in the area such as fiestas and other festivities. However, due to quarry operation, farmers near the area may opt to stop farming or cropping due to nuisance in the area.

2.4.4 Impacts On Physical Cultural Resources

Impact on physical and cultural resources in the area could be attributed to the quarry operation itself due levelling and excavation operation. No farmers or agricultural crops identified in the quarry limit, the existing agricultural farm is outside of the mineral reserve. The current area is classified as agro-industrial zone by the Municipalities.

2.4.5 Threat To Delivery Of Basic Services/Resources Competition

Basic services may include supply of electricity, potable water, education (availability of public schools) and health services. Availability of these services will not be affected with the project. Supply of electricity and water are available from the local service provider.

Water Supply System

Municipality of Morong

Municipality of Morong is served by MOWAD Morong Water District (MOWAD) for its domestic water use.

Municipality of Teresa

Municipality of Teresa's water supply is through the municipal Teresa Water District (TERWD) and Buhay Na Tubig Multi-Purpose Cooperative.

Considering the location of the quarry project mostly covered by Barangay Dalig, Teresa, water supply shall be thru the Teresan Water District (TERWD) for the domestic water requirement which is estimated only at 1.0 cubic meter per day.

Power Supply

Both municipalities are covered by Manila Electric Company (MERALCO). Existing power lines along Pantay-Buhangin road readily available for future use.

Communication Services Facilities

The whole province of Rizal has an existing communication facility such as PLDT, Smart, Globe, Sun Cellular.

Peace and Order

Maintenance of peace and order is still the responsibility of the police, however, the local government units specially the Barangay has organized some of its residents and appointed as Barangay Police (formerly called the Barangay Tanod) and Ladies Brigades to enforce peace and order in the community. The Program "Barangay at Pulisya Laban sa Krimen" is very much active in Teresa.

Morong PNP as being mandated by our Headquarter and thru the diligent support of the local and barangay officials, Peace and Order campaign is well implemented in this Municipality, with the energetic effort of the Morong PNP, the anti-criminality Action Plan was activated. As a result of our closed coordination with NGO's and other volunteer groups.

Recreational Facilities

Barangay Maybancal, Morong has Covered Court, Naz Fitness Gym, Tapal's, Badminton Center and Shooting Range being used by the public while Barangay Dalig, Teresa has Barangay Hall and Multi-purpose covered courts. Both towns have several private recreational facilities such as Alamaris Resort, Paseo Rizal, Danjo's Ville, 7 Mars, Resort, Hidden Trail Resort, Cavalier Statue, Mownlet Conference Center for Morong and Bravo's farm and Quest Adventure Park in Teresa, Rizal.

Barangay Fiestas

Municipality of Morong

Barangay Maybancal celebrates different festivities every year in which they celebrate their feast last Sunday of February. They also celebrate the procession of Sto. Cristo, Feast of Sto. Niño 3rd Sunday of January, Christmas, New Year, sta. Cruzan 2nd Sunday of May, sports league every March

Municipality of Teresa

The municipality celebrates the Town Fiesta (1st Sunday of March) and Turumba Festival (August 23).

Food Security

The Municipalities is covered by Agricultural, Livestock - Piggery and Poultry Farms based on the existing Land use plan. There are patches of rice field in Barangay Dalig, Teresa but its production and area shall be considered as prime agricultural areas. However, livestock is predominant in the area such as poultry and piggery which is the main sources of income of the municipality.

2.4.6 Threat To Public Health And Safety

The project will involve quarry operation. During operation, it will have a potential to dust pollution or increase in Total Suspended Particulates (TSP) and Particulate Matter (PM) due to the nature of operation itself. Noise will also be generated all throughout the construction and operation phase with the use earth moving equipment such as dump trucks, backhoe, loader etc.

Health Profile

For this sub-section, the report is made on the illness by the respondents including themselves in the last five years, the common sickness encountered by the barangay and the medical practitioner or institutions that they had sought for medical assistance.

Medical Health Personnel, Facilities, and Condition

Majority of the respondents in Barangay Maybancal, 55 or 36.18% sought medical consultation to the health center as provided by the barangay. The respondents mentioned more than one (1) medication consultation which resulted to greater number than the actual survey results. Similar to Barangay Dalig, Teresa, most of the respondents, 96 or 72.72% seek medical consultation at the Health Center. **Table 2-69** shows the distribution of the respondent's medical consultation. This means that both barangays were equipped medical health facilities and workers.

Table 2-69 Where To Seek Medication of the Respondents

	Municipality of Morong		Municipality of Teresa	
	Barangay Maybancal	% Total	Barangay Dalig	% Total
Health Center	55	*36.18*	96	***72.72***
Doctor	45	*29.61*	1	***0.76***
Clinic	3	*1.97*	1	***0.76***
Nurse	2	*1.32*	14	***10.61***
Hospital	30	*19.74*	1	***0.76***
Midwife	10	*6.58*	19	***14.39***
No Answer	7	*4.61*	96	***72.72***
Total	***152***	***100%***	***132***	***100.00%***

Ten Leading Causes of Morbidity and Mortality

Morbidity

Rizal Province

Based on the Department of Health (DOH), Regional Office, 2015 record, the top three (3) leading causes of morbidity **Table 2-70** is acute upper respiratory, followed by cute lower respiratory infection and symptoms involving circulatory and respiratory system.

Table 2-70 Top 10 Leading causes of Morbidity in the Province of Rizal

No.	Causes of Morbidity Number of Cases	No. of Cases
1	Acute upper respiratory infections	59,685
2	Other acute lower respiratory infection	32,348
3	Symptoms and signs involving the circulatory and respiratory system	8,365
4	General symptoms and signs	7,527
5	Influenza and pneumonia	6,832
6	Bacterial, viral and other infectious	6,782
7	Hypertensive diseases	6,499
8	Other disease of urinary system	5,828
9	Injuries to unspecified part of the trunk, limb or body region	4,779
10	Chronic lower respiratory infection	4,387

Source: 2015 DOH, Regional Office

Barangay Dalig, Municipality of Teresa

Table 2-70a presents, the leading cause of morbidity is Acute Upper Respiratory Tract Infection. Top two (2) to the highest common ailments are Influenza (2011), Fever (2017) and Coyza (2018).

Table 2-70a. Ten Leading Causes of Morbidity for The Last Three Years

2011		2017		2018	
Causes	**No. of Cases**	**Causes**	**No. of Causes**	**Causes**	**No. of Cases**
Acute Respiratory Infection	8695	URTI	2,153	Acute Upper Respiratory Tract Infection	1,266
Influenza	515	Fever	2,466	Fever	728
Acute Diarrhea	338	Hypertension	1,155	Coryza	1,266
Urinary Tract Infection	310	UTI	825	Cough	728
Pulmonary Tuberculosis	270	Acute Lower Respiratory Failure	711	UTI	264
Skin Disease	117	Diabetes Mellitus	615	Injury Unspecipied	251
Animal Bite	98	Vitamin Deficiencies	563	Hypertension	185
Hypertension	62	Infectious Gastro	520	Oral Cavity	101
Dengue	54	Headache	451	Vitamin Deficiencies	151
Cephalgia	52	Oral Cavity	280	Other Functional Intestinal Disorder	101

Source: Municipal Health Center

Barangay Maybancal, Municipality of Morong

Table 2-70b shows the ten leading causes of morbidity for year 2015. The leading cause of morbidity is animal bites due to the prevalence of stray animals in the municipality. Lung and Heart disease related causes are the majority of the causes of morbidity in the municipality. It is stressed that the RHU is implementing different ways to promote holistic wellness to the local residents by expanding its services in health promotion, laboratory screening, early diagnosis, physical exercises and as well as giving free medicine to lessen the incidence that causes morbidity in the municipality.

Table 70b: Ten Leading Causes of Morbidity, Year 2015

Rank	Cause	No. of Reported Cases	Rate
1	Animal Bite	304	5.33
2	Hypertension	220	3.86
3	Acute Respiratory Tract Infection	125	2.19
4	Urinary Tract Infection	42	0.74
5	Diabetes Miletus	36	0.63
6	Pneumonia	35	0.61
7	Dengue	27	0.47
8	Bronchopneumonia	22	0.39
9	Skin Diseases (All forms)	22	0.39
10	Bronchitis	20	0.35

Source: Morong Rural Health Unit

Mortality

Rizal Province

Based on the Department of Health (DOH), Regional Office, 2015 record, the top three (3) leading causes of mortality **Table 2-71** is ischaemic heart diseases, followed by influenza and hypertensive diseases.

Table 2-71. Top 10 Leading causes of Mortality in the Province of Rizal

No.	Causes of Morbidity Number of Cases	No. of Cases
1	Ischaemic heart diseases	966
2	Influenza and pneumonia	829
3	Hypertensive diseases	677
4	Other forms of heart disease	658
5	Acute upper respiratory infections	587
6	Malignant neoplasms	585
7	Tuberculosis	410
8	Diabetes mellitus	385
9	Cerebrovascular diseases	329
10	Chronic lower respiratory distress	326

Source: 2015 DOH, Regional Office

Barangay Dalig, Municipality of Teresa

Table 2-71a presents the ten leading causes of mortality for the last three (3) years, a lot of sudden deaths was recorded. Lat 2017, a lot of deaths was undermined and for autopsy. And, last 2016 most deat was due to cardiomascular diseases.

Table 2-71a. Ten Leading Causes of Mortality For The Last Three Years

2016		2017		2018	
Causes	**Number of Deaths**	**Causes**	**Number of Deaths**	**Causes**	**Number of Deaths**
Cardiovascular Disease	52	Undetermined for Authopsy	79	Other Sudden Death	70
Pneumonia	49	Heart Disease	43	Hypertension	54
Sudden Death	11	Pneumonia	36	Pneumonia	34
Diabetes Mellitus	4	Gun Shot Wound	13	Cardio Arrest	
Acute Renal Failure	6	DM Type 2	11	Hypertensive Heart Disease	17
End Stage Renal	5	Cancer	10	Acute M.I	15
Diseases (ESRD)		Stab Wounds	7	DM Type II	13
Cancer	4	Chronic Kidney Disease	4	Heart Failure	9
Pulmonary Tuberculosis	2	Multiple Organ Failure	3	Cerebral Infarction	6
Traumatic Injiries	2	Massive Gastro Intestinal Bleeding	2	Respiratory Failure	6
Hematoma	6	Tuberculosis	2		

Source: Municipal Health Center

Barangay Maybancal, Municipality of Morong

Table 2-71b shows the ten leading causes of mortality for year 2015. The leading cause of mortality is the Community Acquired Pneumonia which is highly communicable disease of the lungs and it is also noted that it lists at top 6 as the leading cause of morbidity. With these, there is a high incidence of acquiring the disease in the community.

Another major cause of mortality in the municipality is heart related diseases such as Acute Myocardial Infarction, Hypertension and Hypertensive Cardiovascular Disease, which indicates that cardiovascular health and proper nutrition of the local residents must be prioritized to minimize the incidence of these diseases.

Table 2-71b: Ten Leading Causes of Mortality, Year 2015

Rank	Cause	No. of Reported Cases	Rate
1	Community Acquired Pneumonia	41	7.19
2	Acute Myocardial Infarction	25	4.38
3	Cancer (All forms)	23	4.03
4	Diabetes Miletus	16	2.80
5	Pulmonary Tuberculosis	16	2.80
6	Cerebrovascular Accident	16	2.80
7	Electrolyte Imbalance	13	2.28
8	Hypertensive Cardiovascular Disease	13	2.28
9	Chronic Kidney Disease	12	2.10
10	Hypertension	5	0.88

Source: Morong Rural Health Unit

Common Illnesses of the Barangay for the Past Three Years

The number of illnesses reported more than the respondents but this does not mean that the same illnesses were encountered. This is because some illnesses such as fever, cough, colds and flu are mentioned more than once.

Barangay Maybancal, Municipality of Morong

Table 2-72, survey results show that cough is the common and usual sickness encountered by the respondents and their families which attained a total of 84 or 40.58% of the total illnesses recorded, followed by colds which has 75 or 36.23% and fever which resulted to 18 or 8.70%. Some 14 or 6.76% said flu. There are also respondents who had encountered high blood which accounts for 4 or 1.93%, 2 or 0.97% encountered stroke and 1 or 0.48% said about hypertension, LBM, toothache and diabetes. Some 6 or 2.90% did not answer the question.

Table 2-72. Common Illnesses/Sickness of the Respondents

Illnesses	Barangay Maybancal	Total %
Fever	18	*8.70*
Cough	84	*40.58*
Colds	75	*36.23*
Flu	14	*6.76*
Stroke	2	*0.97*
Hypertension	1	*0.48*
High Blood	4	*1.93*
LBM	1	*0.48*
Toothache	1	*0.48*
Diabetes	1	*0.48*
No Answer	6	*2.90*
Total	***207***	***100%***

Barangay Dalig, Municipality of Teresa

Table 2-73 survey results show that flu is the common and usual sickness encountered by the respondents and their families which attained a total of 38 or 11.25% of the total illnesses recorded, followed by colds and fever which has 26 or 19.70% and RPH which resulted to 5 or 3.12%. Some 3 or 1.88% said asthma. There are also respondents who had encountered pigsa which accounts for 2 or 1.25%, 1 or 0.625% encountered LBM and 49 or 30.63% did not answer the question

Table 2-73. Common Illnesses/Sickness of the Respondents

Illnesses	Barangay Dalig	Total %
Fever	18	***11.25***
Cough	26	***19.70***
Colds	18	***11.25***
Flu	38	***28.79***
RPH	5	***3.12***
LBM	1	***0.625***
Asthma	3	***1.88***
Pigsa	2	***1.25***
No Answer	49	***30.63***
Total	***160***	***100%***

Environmental Health and Sanitation Profile

Waste Management

Municipality of Morong

The Morong Integrated Solid Waste Management Facility is a component under the Waste Management and Sanitation program of the Local Government Unit of Morong in Rizal Province. The facility is implemented with assistance of the World Bank, Netherlands Government and LLDA through the LISCOP project. It is designed to recover reusable and recyclable materials from collected municipal solid wastes.

The Municipal Environment and Natural Resources Office is responsible for monitoring the Cleanliness Act known as the Ecological Solid Waste Management Act of 2000 or R.A. 9003 and ensuring the protection of the public health and environment. MENRO ensures the proper segregation, collection of solid waste through the formulation and adoption of the best environmental practice in ecological waste. Their Method of Solid Waste Disposal/Treatment is the Basic Environmental Systems & Tech. Inc. – Brgy. San Guillermo, Morong Rizal.

Municipality of Teresa

Teresa is famous for its best solid waste management practice, the Integrated Solid Waste Management Recovery Facility (ISWMRF) located in Sitio Pantay, Barangay Dalig. The MRF is a multi-awarded project of the municipal government that has been visited by domestic and foreign tourist, local officials, students, and other interested groups for education purposes and possible replication. At present, Teresa is composed of nine (9) barangays namely Bagumbayan, Calumpang-Sto. Cristo, Dalig, Dulumbayan, May-iba, Poblacion, Prinza, San Gabriel and San Roque.

2.4.7 <u>Generation Of Local Benefits From The Project</u>

<u>Socio-Economic Profile</u>

Economy and Industry

Morong is a farming community and many others are engaged in businesses like garment industry, poultry and piggery.

Teresa is considered as an agro-industrial town. In fact, rice is the primary crop of the municipality. The areas not devoted to rice are planted with secondary crops such as corn, root crops, vegetables, and fruit tree.

Some of the industrial companies located in the municipality are: Republic Cement Corp (Lafarge), Teresa Marble Corporation and ABC Philippines, Inc.

There are also many piggery and poultry farms located in Teresa. Some of these are Foremost Farms, Robina Farms, Acme Far and Coral Farm. Many households of Teresa are also engaged in backyard swine raising and farming as an additional source of income to meet their family needs.

Formerly, the predominant source of livelihood in Teresa is agriculture. But with the opening of the FR Cement factory (Dragon Cement), Teresa Marble, and ABC Chemical factory, member of the community had slowly shifted to industry. More, real estate boom in the 90s cause a surge in the population in Teresa with the opening of Carissa 1 and 2 Subdivisions.

Main Sources of Income

Municipality of Teresa

The major sources of income in Teresa are: Agricultural, Livestock - Piggery and Poultry Farms, Industrial, Mining and Quarrying.

Labor Force and Employment Status

The Public Employment Service Office or PESO is a non- fee charging multi- employment service facility or entity established or accredited pursuant to Republic Act 8759 otherwise known as the PESO Act of 1999.

To carry our fulfilment and equality of employment opportunities for all, and for this purpose, to strengthen and expand the existing employment facilitation service machinery of the government particularly at the local levels there shall be established in all capital towns of provinces, key cities, municipalities and other strategic areas a Public Employment Service Office. Hereinafter referred to as PESO which shall be community – based and maintained largely by the Local Government Units (LGUs), Non- Government (NGOs) Community Based Organization (CBOs), Universities and Colleges, Technical and Vocational Institution, as well as those institutionalized by virtue of legislative actions of local government coordination and technical supervision, and to the DOLE central office, to constitute the national employment service network.

The Public Employment Services Office (PESO) were already established for both Municipalities. Based on the record of Barangay Dalig, Teresa, Rizal 58% of the total population (14,752 as of December 2019), or 8,556 of were employed.

Sources of Livelihood

Barangay Maybancal

The main industries are Farming, Textile Manufacturing, and Food Industry. Based on the results of the perception survey, the sources of livelihood were tricycle drivers, barangay employee, vendor, laundry washer, sari-sari stores vendors, construction worker, pensioner, teacher, sewer, avon dealer, MOWAD Employee, salesman/saleslady, cashier, farmer, business owner, secretary and housemaid, rice dealer, company merchandiser, buy & sell, production staff, , cook, mushroom farm, laborer, call center agent, courier business, tailoring, storekeeper, security guard and OFW.

Barangay Dalig

Based on the results of the survey, the sources of livelihood in Barangay Dalig were construction workers, sewer, carpenter, housemaid, painter and vendor, security guard, sari-sari store, laundry washer, janitor, mechanic, balot vendor, maintenance, therapist, farmer, laborer, mason, finishing, MTCE, government employee, packing, soft drink dealer and welder.

Commercial Establishments and Activities

Morong, Rizal has several commercial establishments such as: Savemore – Sanford Marketing Corporation, Jollibee Foods Corporation, Mercury Drug Corporation, Mang-Inasal – Jimcar & Sons's Phils. Corporation, Lucky Seven Commercial Leasing Corporation, Pandayan Bookshop, Inc., The D.I.Y. (Do It Yourself) Shop Corporation, Motortrade Nationwide Corporation, Cebuana Lhuillier Pawnshop – Morong Branch, First Macro Bank, Cristina Mart, Thriftmart, Inc., My Generics Pharmacy Inc., Alamaris Coco Lumber and Construction Supply,

Teresa is primarily known for the nearby mountain resorts, Villa Sampaguita Resort and Real Cove Resort (Formerly Sunrise Resort, Sunset Resort, and Terra Villa Resort). In addition, various restaurants and other servicing commercial establishments is also present in the municipality such as Jollibee Foods, McDonald, Primemark Town Center, Goldilocks, groceries, convenience stores, supermarkets, gasoline stations, general merchandise, among others.

Increased Business Opportunities and Associated Economic Activities

The contribution of the project in terms of continuous supply of raw materials for the cement production in the province of Rizal, opening opportunities to local suppliers and project due to the mandatory implementation of Social Development and Management Program (SDMP).

Increased Revenue of LGUs

The contribution of the project in terms of revenue is associated with Revenue from Taxation such as real property tax, business tax, Non-Tax Revenue such as receipts from economic enterprise, fees and charges and Aids and Allotments from Internal Revenue Allotment (IRA).

2.4.8 Traffic Congestion

Road and Bridges

Existing Transportation/Traffic Situation

Various means of public transportation are available in Teresa and Morong. Inter municipality and City transportation is provided by a combination of buses, AUV's/Express and jeepneys. Within the poblacion, the tricycle is the most popular mode of public transport. The stretch of Sumulong Highway to Quezon Avenue Road has an existing all weather four-lane road. Traffic or low speed may experience at the Teresa Public Market where most of the center of commercial establishments are located. Traffic situation is being managed by the local traffic enforces of Municipality of Teresa.

Passing Pantay-Buhangin road access to the proposed quarry site is passable by all means of transportation with existing four-lane concrete road. Traffic is at its speed except for some traffic signs with imposition of speed limit due to the existing populated and dense area at the Pantay Elementary School with is about 1.2 km south of the proposed quarry site.

2.4.9 Public Participation

Information Education Campaign (IEC)

Pursuant to the provision of DAO 2017-15 under Public Participation (PP), the proponent's initiative to properly inform the community and stakeholders about the upcoming development in the area. **Table 2-74** presents the summary of the Information Education Campaign (IEC) performed by the proponent.

Table 2-74. Summary of Focused Group Discussion (FGD)

	ACTIVITY	DATE/S	STAKEHOLDERS	PARTICIPANT	PROOF
1	Initial visit/meeting with Barangay Dalig, Municipality of Teresa, Province of Rizal	February 19, 2019	Barangay Dalig, Teresa, Rizal	Hon. Jhanda Sto. Doming-Barangay Chairwoman and Council	Duly received IEC Materials and Photographs
2	Initial visit/meeting with Barangay Maybancal, Municipality of Morong, Province of Rizal	February 20, 2019	Barangay Maybancal, Morong, Rizal	Hon. Harold Ramos-Barangay Chairman and Council	Duly received IEC Materials and Photographs
3	General Assembly (Talakayang Barangay) in Barangay Maybancal, Morong, Rizal	March 11, 2019	Barangay Maybancal, Morong, Rizal	Hon. Harold Ramos-Barangay Chairman and Council and stakeholders with Fifty-Five (55) Attendees	Transcription of the General Assembly. Attendance Sheet, Photographs and issues and concerns
4	General Assembly (Talakayang Barangay) in Barangay Dalig, Teresa, Rizal	March 26, 2019	Barangay Dalig, Teresa, Rizal	Hon. Jhanda Sto. Domingo-Barangay Chairwoman and Council and stakeholders and One Hundred Twenty-Five (125) Attendees	Transcription of the General Assembly. Attendance Sheet, Photographs and issues and concerns
5	IEC Leaflets Distribution	March 11, 2019	Barangay Dalig, Teresa, Rizal	TODA and Commercial Establishment	Photographs
6	Perception Survey	February 19, 2019 to March 26, 2019	Barangay Maybancal, Morong and Barangay Dalig, Teresa, Rizal	100 Residents of the Barangay Maybancal and 90 Residents in Barangay Dalig	Perception Survey Filled Forms and Results and Photographs

Annex H.6a attached is the full documentation of the Information Education Campaign (IEC) in a form of General Assembly and Meeting.

Public Scoping

Public scoping was conducted as part of the Public Participation (PP) on July 9, 2019 at the Pantay Covered court in Barangay Dalig, Teresa, Rizal participated d by the Local Government Units (LGU)-Province, Municipalities and Barangays and other stakeholders. **Table 2-75** presents the summary of issues and concerns raised during the Public Scoping.

Table 2- 75. Summary of Issues and Concerns

EIA MODULE	Issues/Suggestions Raised by the Stakeholders	Sector or Representative Who Raised the Issue/Suggestion	Proponent's Response
1. Project Description	No issues raised	NA	NA
2. Land	1. Apply reclassification from agricultural to mining/quarry Municipality on the last stage of the compliance	MPDO – Teresa, Rizal	Properly noted to comply.
3. Water	Hydrology Study. 1. Are there flood control measures? Volume of water in Talaga Creek 2. Water quality – silica can affect the surface water which is currently used for irrigation	LGU- Morong, Rizal	The consultant shall undergo the study and consider the issues related to Talaga creek
	3. Flow of water from upstream if there is impact in our structures	Quest Adventure Park	There will be no impact on the structures of the Adventure Quest since the project shall provide adequate buffer zone in the area.
4. Air	1. Air pollution experience – can affect the community	LGU- Morong, Rizal	Will sprinkler water in the open and access area to prevent dust. However, will consider the suggestion of Mayor Palino for street sweeper because sprinkling of water will only aggravate the emission of dust.
5. People	1. Existing Road and Pollution What will happen to the road, impact of additional trucks; Can you regulate the time of hauling for safety of children and to prevent traffic	Teresa Four Square Gospel Church	Will consider management plan with regards to the regulation of trucks. With regards to road, will bring this to the management
6. Others	Coordinate with MWSS with regards to the location of the area due to the ongoing Water Resource Project in the area.	Mayor Palino of Teresa, Rizal	Noted. The consultant will research on the project.
	Watering is not applicable and effective in the area		Will consider the suggestion.
	Adopt the best practices in Batong Angono in terms of environmental measures and policy in road repair and maintenance		Will consider the suggestion
	Who will monitor the utilization of the SDMP?		MGB and MMT shall monitor the utilization of the SDMP.
	Adhere/Support the Busilak Project	Roberto Estrada – Office of the Governor	Will consider the suggestion

Annex H.6b attached is the Public Scoping Report (PSR)

<u>Perception Survey</u>

The perception survey was conducted to identify the present socio-economic profile of the pre-determined social impact areas and to know the level of awareness of the different people and their acceptance to the proposed quarry project.

The survey was conducted on February 17 to March 26, 2019 for Barangay Dalig, Teresa, February 20- March 11, 2019 from 6 am to 8 pm in Barangay Maybancal. The survey team was assisted by the Office of the Barangay thru the Barangay Health Workers (BHW) and Barangay Secretary on the conduct of one-on-one interview.

The main questionnaires consisted of six parts, namely (1) family background information, (2) information on housing, water, communication, energy sources and sanitary facilities, (3) health, (4) peace and order situation (5) general perception awareness of activities on the area, (6) questions about the project.

Social Impact Areas and Number of Respondents

The primary impact areas identified is approximately 114.5206 hectares property of the project area. There are about 15-20 settlers inside Parcel 2 and with existing agro-industrial farm in Parcel 1 but will be excluded from the quarry limit which brought down the quarry limit to about 35 hectares (25 hectares for Parcel 1 and 10 hectares for Parcel 2). The study team distributed questionnaires to communities of while doing the perception survey.

All in all, the study is a result of the unstructured one-on-one interviews. All-in-all, a total of Two Hundred Thirty-Two (232) respondents were interviewed, distributed to one hundred (100) respondents distributed to Barangay Maybancal, Morong and about One Hundred Thirty-Two (132) for Barangay Dalig, Teresa, where the project will be located, **Table 2-76**. The basis for the number of respondents was in addition to those who have not attended the General Assembly conducted last March 11, 2019.

For the perception survey, due to the on-going similar quarry application in the same area with the same scope as to the public participation, the number of respondents was divided and was not able to achieve at least 10% of the total household.

Table 2-76. Age Distribution of the Respondents
(Maybancal, Morong and Barangay Dalig, Teresa)

	Municipality of Morong		Municipality of Teresa	
	Barangay Maybancal	% Total	Barangay Dalig	% Total
Below 20 Years	6	***6.00***	4	***3.03***
21-30	22	***22.00***	15	***11.36***
31-40	27	***27.00***	47	***35.60***
41-50	14	***14.00***	43	***32.57***
51-60	15	***15.00***	15	***11.36***
61-70	14	***14.00***	4	***3.03***
71 & Above	2	***2.00***	4	***3.03***
Total	***100***	***100%***	***132***	***100%***

Responses Concerning The Project

In terms of level of awareness, majority in Barangay Maybancal, Morong which accounts for 88 or 88.00% were not aware of the proposed quarry project while in Barangay Dalig, Teresa were the project is most located were aware which accounts for 55 of 41.67%, **Table 2-77**. The level of awareness was addressed during the conduct of general assembly and public scoping.

Table 2-77. Awareness of the Project
(Maybancal, Morong and Barangay Dalig, Teresa)

	Municipality of Morong		Municipality of Teresa	
	Barangay Maybancal	% Total	Barangay Dalig	% Total
Yes	6	6.00	55	*41.67*
No	88	88.00	50	*37.88*
No Answer	6	6.00	27	*20.54*
Total	**100**	**100%**	**132**	**100%**

Personal View/Opinion Of The Quarry Project

Barangay Maybancal

Table 2-78 presents the personal opinion of the respondents to the proposed quarry both the positive and negative aspects. For the positive aspect, majority was expecting for an employment which accounts for 36 or 36% while for the negative aspect, flood is the major concerns of the respondents which accounts for 58 or 37.91%.

Table 2-78. Personal View/Opinion of the Respondents

Opinion	Barangay Maybancal	Total %
A. POSITIVE		
Employment	36	***36.00***
Improve Drainage System	2	***2.00***
Can build houses	1	***1.00***
No answer	58	***58.00***
Total	***100***	***100%***
B. NEGATIVE		
Harmful to Health	10	***6.55***
Air Pollution	18	***11.76***
Landslide	22	***14.38***
Flood	58	***37.91***
Can ruin Mother Earth	17	***11.11***
A lot	3	***1.96***
Soil Erosion	3	***1.96***
Will lessen trees in forest	1	***0.65***
Traffic	2	***1.31***
No Answer	19	***12.42***
Total	***153***	***100%***

Barangay Dalig

Table 2-79 presents the personal opinion of the respondents to the proposed quarry both the positive and negative aspects. For Barangay Dalig, Teresa, about 129 or 97.72% refused to give opinion while for the negative aspect, concerns of the respondents were the possibility for damage of the houses (cracked houses) to which accounts for 27 or 24.55%.

Table 2-79. Personal View/Opinion of the Respondents

Opinion	Barangay Dalig	Total %
A. POSITIVE		
Can help us	2	***1.52***
Medical Assistance	1	***0.76***
No answer	129	***97.72***
Total	***132***	***100%***
B. NEGATIVE		
Cracked Houses	27	***24.55***
Harmful to animals	6	***5.45***
Flood	3	***28.19***
deforestation	6	***5.45***
Can cause earthquake	7	***6.36***
Noise due to blasting	2	***1.82***
Filthy water	1	***0.91***
Earthmoving	19	***17.27***
Damage roads	1	***0.91***
landslide	5	***4.45***
Pollution	2	***1.82***
No Answer	31	***17.27***
Total	***110***	***100%***

Recommendation About the Project

Barangay Maybancal

- Tutol
- Huwag na pong ituloy
- Dapat huwag na itong matuloy sa aming bayan
- Baka po pwedeng huwag na ituloy
- Payag
- Dapat pakinabangan at pagkakitaan ng mga tao
- Huwag na po mag-quarry
- Sana hindi piling tao kundi lahat ng mga nakatira sa lugar o kahit sa karatig lugar ng proyektong quarry ang nakakaalam tulad namin nabigla dahil ngayon lang namin nalaman para aware ang iba.
- Hindi ba ito makakaapekto sa kalikasan o makadulot ng landslide at pagbaha dahil sa paghuhukay ng mga bato.
- Makakatulong po ba ang pag quarry sa aming mga taga Morong.
- Sana walang air pollution kung matuloy.
- Sana tulungan ang mamamayan ng aming barangay.
- Kung matuloy sana ay i-ayos para hindi makalbo ang aming kabundukan.
- Sana maganda.
- More knowledge about the project.

Barangay Dalig

- Give us livelihood programs
- Sana kung magkaroon kayong choice maaari bang itayo niyo sa mga kabahayan
- Wag masyadong magpasabog sa ilalim ng lupa adhil nakakatakot
- Magkaron ng sariling tubig at hanapbuhay.
- Sana po mabigyan kami ng semento para matapal sa naputukan na pader namin.
- Nakakasira ng puno at bahay
- Magkaron ng livelihood program
- Gusto po namin na kung kami ay hihiling ng anumang bagay ay mabigyan kami.
- Sana magkaroon ng resolba ang mga problema tungkol sa pag quarry.
- Dapat may livelihood program project
- Nais po naming bigyan kami ng sementong pang-ayos ng crack ng bahay namin
- Ang gusto namin bigyan kami ng kahit anong proyekto.

Annex H.6c presents the complete report of Perception Survey

IMPACT ASSESSMENT AND MITIGATING MEASURES

During Construction and Operation Phase

<u>Generation of Employment</u>

The project is not yet in its operational phase. There will be twenty-seven (27) identified for skilled such as operators and admin. The proponent shall give priority to local residents in coordination with the Public Employment Service Office (PESO) of the municipalities.

<u>Generation of Business Opportunities</u>

<u>The business community:</u> This includes the public transport operators, suppliers, sari-sari stores, among others.

Mitigating Measures

Positive impact to the community and supplier with its multiplier effect.

Introduction of Construction Hazards

Hazards associated with construction activities will be introduced in the area. These hazards could lead to injury and sometimes fatalities as a results of construction equipment and hauling transportation of raw materials.

Mitigating Measures

Health and safety program will be instituted within the construction site to minimize accidents caused by construction hazards.

Safety devices (hard hats and safety shoes and among others) shall be necessary as dictated by the nature of the construction work and the type of equipment to be used. The contractor shall be required to conduct operations in compliance with all safety regulations. All field personnel directly involved with the dangerous activity/operation must be thoroughly familiar with the safety rules and regulations governing the use of explosives. Any unsafe practices must be immediately reported and corrected to avoid accidents. A safety engineer should be appointed to oversee safety-related matter.

Solid Waste Generation

During the operation phase of the project, it is expected that at least a total 10 kilograms per day of domestic solid waste coming from the workers are derived. Collection and disposal of these waste will be handled by the Local Government Units (LGU), however, implementation of RA 9003 thru segregation or establishment of color-coded garbage bins within the area is strictly enforced.

Possible Increase in Traffic and Road Safety

During operation of the plant about 15-20 hauling trucks per day is expected, it is also expected that the same number of vehicles will be passing and entering the project excluding the visitors that are coming in. This will lead to traffic volume built-up not only in the roads within the site but also along the access road connecting the area along the main highway. Proper scheduling of trucks shall be established and at the same time provide for enough parking space for lining while waiting to be accommodated and imposition of speed limit shall be strictly followed all through-out the Pantay-Buhangin Road.

Promotes Livelihood Activity

With the operation of the project, Social Development and Management Plan (SDMP) shall be implemented with identitied livelihood to the unemployed community, these may be associated with food and other services.

Mitigating Measures

Impact is positive to the community and to the project including the required implementation of the Social Development Management Plan (SDMP).

Health and Safety of the People

Physical Hazard

Potential physical hazard is expected during operation related to operation and hauling process.

Mitigating Measures

Personal Protective Equipment (PPEs) are a must to reduce or eliminate the risks associated with the handling of materials.

The proponent shall have a readily available emergency and first aid kit device.

Contribution to Local and Regional Economy

Once fully operational, the proposed project will, on minimum, contribute to the local economy of Provincial, Municipal and Local through taxes and such cost of production as salaries and wages, local supplies and hauling services. The Province will get thirty five percent (35%) proceeds from taxes, among others accrue to the general fund of the National. The Municipality gets forty percent (40%) to the general fund of the municipality where the property is located and twenty five percent (25%) shall accrue to the Barangay.

Increase Revenue for the National Government

More sources of revenues in the form of taxes, income shares and other fees will increase the income of the government. The employment generated by the project will also increase the income tax base of the government. The National Government will benefit at least thirty-five (35%) share of the taxes, among others.

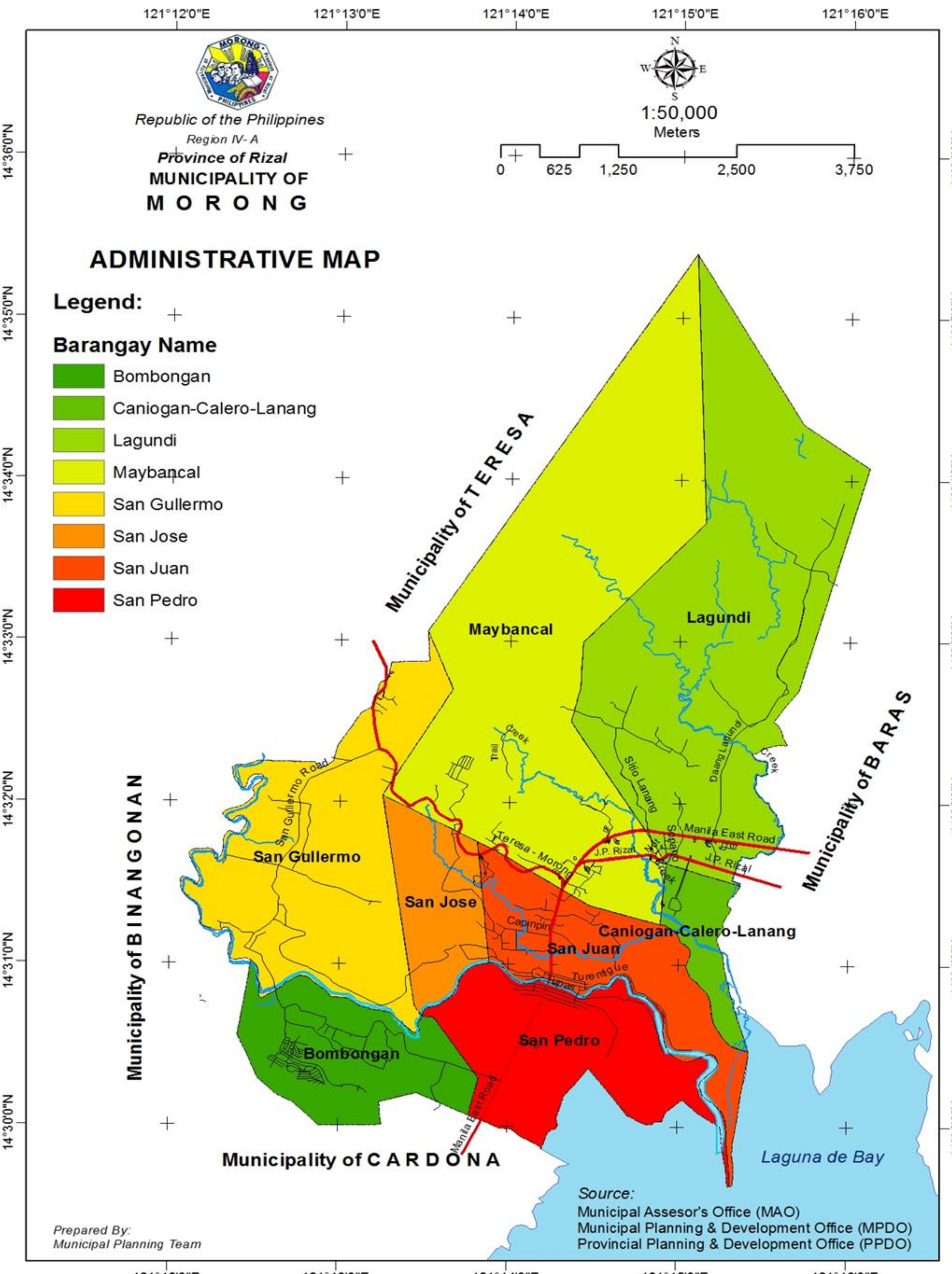
During Abandonment

Plans for Removal or Disposition of Temporary Structures and Facilities

All temporary facilities installed during the construction phase of the project shall be dismantled or removed from the project site once the construction is completed.

Relocation and/or Termination Plans for Project Facilities

All heavy equipment used during the construction phase of the project will be pulled-out after project completion. Hired workers except for the permanent personnel of the Project Contractor will be terminated or maybe relocated to other projects of the company.


Republic of the Philippines
Region IV- A
Province of Rizal
MUNICIPALITY OF
MORONG
ADMINISTRATIVE MAP
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Meters
0 625 1,250 2,500 3,750
Legend:
Barangay Name
Bombongan
Caniogan-Calero-Lanang
Lagundi
Maybancal
San Gullermo
San Jose
San Juan
San Pedro
Municipality of TERESA
Municipality of BARAS
Municipality of BINANGONAN
Municipality of CARDONA
Maybancal
Lagundi
San Gullermo
San Jose
San Juan
Caniogan-Calero-Lanang
San Pedro
Bombongan
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Manila East Road
J.P. Rizal
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Source:
Municipal Assesor's Office (MAO)
Municipal Planning & Development Office (MPDO)
Provincial Planning & Development Office (PPDO)
Prepared By:
Municipal Planning Team

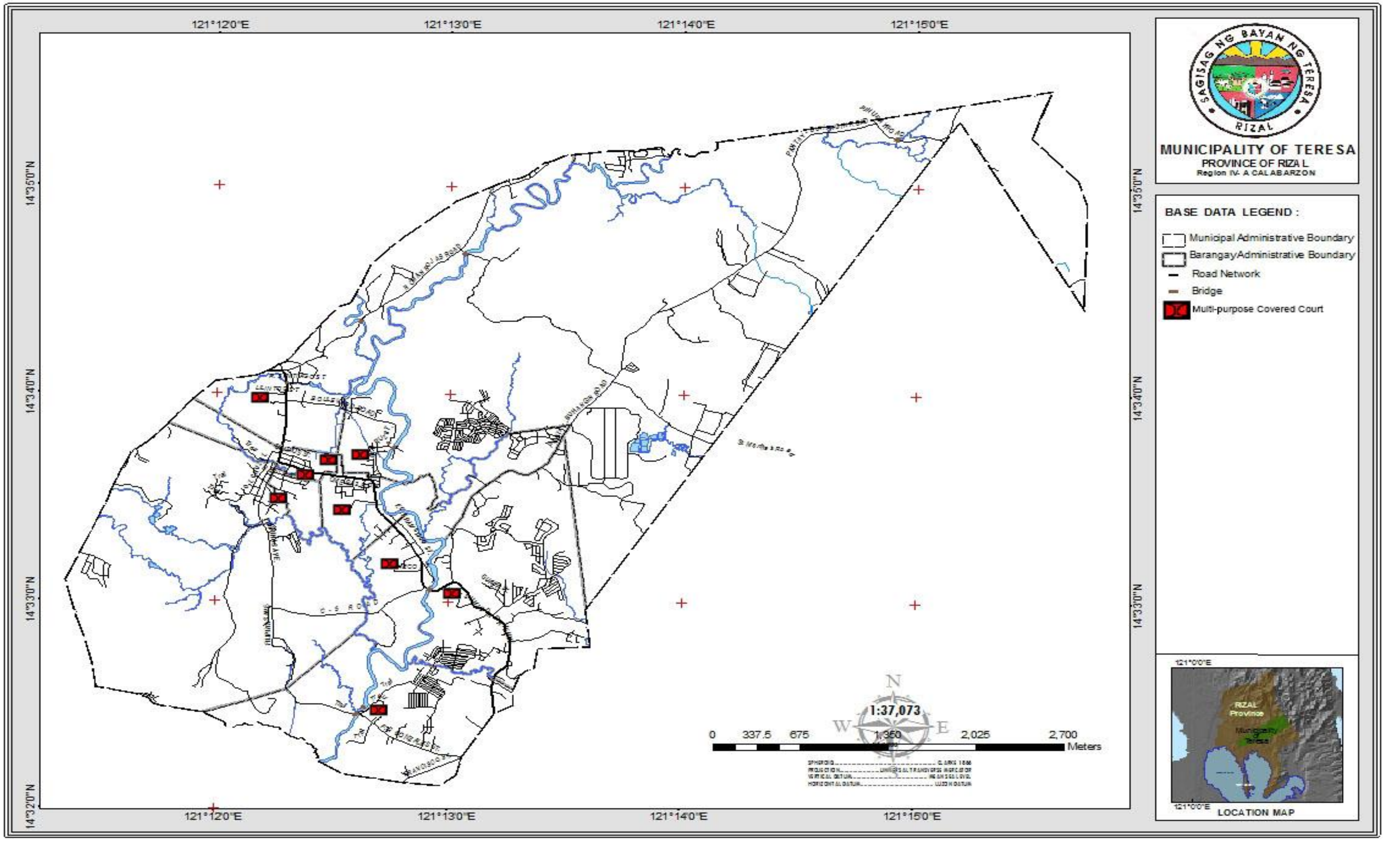


Figure 2-90 Barangay Settlement Map of Barangay Dalig, Teresa

3.0 ENVIRONMENTAL MANAGEMENT PLAN

EMP – which essentially involves the measures required to protect and enhance the environment – is in line with the Proponent's adherence to sound environmental policies and to provide guidelines by which compliances with environmental laws and regulations may be ascertained.

It essentially involves various significant impacts during operation phase, i.e. generation, solid waste.

The aspects of an effective and complete Environmental Management Plan are:

- The identification of potential environmental impacts of the Project and formulation of corresponding Mitigating Measures;
- The Environmental Monitoring Plan;
- The Institutional Plan

3.1 IMPACT MANAGEMENT PLAN

Table 3-1 Impact management Plan (IMP) is the summarized tabulated form of the impact and mitigation measures.

Table 3-1 IMPACT MANAGEMENT PLAN

Project Phases/ Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact	Options for Prevention or Mitigation or Enhancement	Efficiency of Measures	Responsible Entity	Cost	Guarantee/ Financial Arrangements
I. PRE-CONSTRUCTION PHASE							
Exploration	**The Land**	**Disturbance of Existing vegetation due to exploration activities**	• Conducted Final Exploration Study for the identification of extent of quarry area • Disturbance of exploration area was confined within a small area and rehabilitation (backfilling of voids, re-vegetation, etc.) shall proceed immediately. • Establishment of buffer zone	100% Compliant to Final Exploration Report	Roxanna S. Go Thru Consultant	Php 33,000,000.00	With Report Submitted Annex H.1 and Annex H.8
		Possible Hazard such as Erosion, Flooding and Siltation	• Conducted Engineering Geological and Geohazard Assessment Report (EGGAR) • Identification of the location of silt ponds • Provision of sump ponds, drill hole grouting, slope stabilization and appropriate disposal of drill cuttings	100% Hazard Identified and incorporate the findings to the EIS Report and in the mitigation and management measures	Roxanna S. Go Thru Consultant		With Report Submitted Annex H.9
Total Pre-Construction Cost					Php 33.00 M		
CONSTRUCTION PHASE							
Clearing and Earthmoving (Land Development)	**Air Quality**	Dust pollution due to land preparation	• Immediate compaction of open areas. ▪ Sprinkling of water using water tanker at least four times a day to quarry area, especially during dry season	100% compliant to RA 8749 in terms of air quality standards	Roxanna S. Go and MMT Member	Php 2.00 M	Strict monitoring of the MMT and MRFC and ECC Condition Commitment
	Land - Terrestrial Flora and fauna	Loss of existing land cover and animal habitat due to clearing and earthmoving	• Observed buffer zones. • Transplanting/Relocation of trees to be affected during clearing within the buffer zone area • Implement section or phasing or activity	100% compliant Bamboo Planting along Buffer Zones and 100% No Cutting of Trees without Permit	Roxanna S. Go and MMT Member		Strict monitoring of the MMT and MRFC and ECC Condition Commitment
Construction of Access Road, facilities and installation of Mobile Crusher	**Air Quality**	Dust pollution due to vehicle/equipment movements: -Along the road leading and the project area activities	▪ Sprinkling of water using water tanker at least four times a day along all possible roads leading quarry area, especially during dry season. ▪ Covering all loaded trucks properly/fully using tarpaulin throughout the hauling period. ▪ All trucks shall be road-worthy	100% compliant to RA 8749 in terms of air quality standards	Roxanna S. Go and MMT Member		Strict monitoring of the MMT and MRFC and ECC Condition Commitment

Project Phases/ Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact	Options for Prevention or Mitigation or Enhancement	Efficiency of Measures	Responsible Entity	Cost	Guarantee/ Financial Arrangements
	Land	Land pollution due to indiscriminate /improper dumping of solid wastes and toxic substances	▪ Ensure that its contractors shall practice onsite segregation and establish storage facility of the following: 1. Construction debris such as used drum, used tires, wood cuttings, iron bar cuttings, etc. 2. Hazardous wastes such as used oil, busted lamps, oily rags, etc. The above waste materials shall be hauled and disposed of by a DENR accredited hauler and treater • The proponent shall assign a Pollution Control Officer (PCO) to oversee the implementation of the environmental measures	100% compliance with the following: • RA 9003 • DAO 1992-29 and • DAO 2013-22 and its Revised Procedural Manual	Roxanna S. Go and MMT Member		Strict monitoring of the MMT and MRFC and ECC Condition Commitment
	Land/Water	Generation of untreated/ improper disposal of domestic wastewater	• Personnel stationed will be provided with on-site portable toilets and washrooms ▪ Collection and disposal will be done by a DENR accredited hazardous waste hauler and treater ▪ The proponent shall assign a Pollution Control Officer (PCO) to oversee the implementation of the environmental measures ▪ Provision for septic tank, Siphoning or desludging shall be done at least twice a year for proper treatment by an Accredited hauler and treater	Zero discharge of domestic wastes	Roxanna S. Go and MMT Member		Strict monitoring of the MMT and MRFC and ECC Condition Commitment
	Air (Quality)	Dust pollution due to construction of access road and land development	• Sprinkling of water along all at least four times a day, especially during dry season.	100% compliance with RA 8749 in terms of air quality standards	Roxanna S. Go and MMT Member		Strict monitoring of the MMT and MRFC and ECC Condition Commitment
	People	Health and Safety due to exposure to Construction Hazard	• Implement wearing of PPE's at all times when inside the project site • A positive health and safety culture and attitude should also be developed/established.	100% compliance to PPEs and Zero accident. Strict compliance to DAO 2000-98 Mine Safety and Health Standards	Roxanna S. Go and MMT Member		Strict monitoring of the MMT and MRFC and ECC Condition Commitment
Total Construction Cost				**Php 2.00 M**			
OPERATION PHASE							

Project Phases/ Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact	Options for Prevention or Mitigation or Enhancement	Efficiency of Measures	Responsible Entity	Cost	Guarantee/ Financial Arrangements
Quarry Activity	**Land - Terrestrial Flora and fauna**	Loss of existing land cover and animal habitat due to excavation and alteration of topography	• Observed buffer zone at least 20-meters from the Road, Agri-industrial and residential area; • In coordination with PENRO, the proponent should plant a total of 46,000 seedling in any part of the protected area in participation for the National Greening Program (NGP). The basis for computation is total MPSA area divided by 25 square meters. • Implement Progressive Rehabilitation thru planting of bamboos at least 7.0 meters apart along the buffer zone prior to the any quarry activity. • Removal of overburden must be in accordance with the responsible mining methods, dumping on creeks and streams must be avoided • Parcel 1 has a total of 36.70 has quarry area covered cultivated species, shrubs and two (2) endemic species, this will mitigate thru planting of local species. • Parcel 2 has a total of 9.9206 hectares. There are no special or important local species identified inside the property area, this will mitigate thru planting of local species. • There are no endangered or endemic animal species in the area, no specific niches will be affected. • Conduct periodic/yearly Biodiversity Assessment and Monitoring System (BAMS) pursuant to TB 2016-05 in the nearby project site	100% No cutting of Prime Trees without securing Tree Cutting Permit for proper replacement 100% Complaint to RA 10631- Animal Welfare Act of 1998.	Roxanna S. Go and MMT Member		Strict monitoring of the MMT and MRFC Secure Tree Cutting Permit from PENRO

Project Phases/ Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact	Options for Prevention or Mitigation or Enhancement	Efficiency of Measures	Responsible Entity	Cost	Guarantee/ Financial Arrangements
	Land/Water	Land/Water Pollution Siltation due to Erosion of Unstable of Slopes	• Progressive and systematic land stripping or excavation would minimize exposure of the soil or rock to the elements. • Benches with appropriate heights and slope angles will be maintained to prevent failure. When deemed necessary, the installation of slope stabilization fixtures such as shotcrete, geotextile, weep holes, gabions, etc. will be considered. Dewatering pumps and runoff canals and galleries will be installed to control water accumulation inside the quarry pit. • Progressive development of the quarry pit and siltation pond will be observed. • The siltation ponds will be regularly monitored for structural integrity. • Surface diversion drains will be installed to channel runoff water away from quarry components and into natural waterways located downstream. • The siltation pond will be designed to stand against flood events. The siltation pond design will follow standard requirements. • Soils and spoils must be collected and put in the proper locations where it is free from the risks of erosion and landslides	100% No Siltation and no sediments in low-lying area	Roxanna S. Go and MMT Member		Strict monitoring of the MMT and MRFC and ECC Condition Commitment
	Water	Possible Flooding Within Area and Possible Increase in Sediments of the creek during rainy days	• A water catchment in a form of siltation pond designed enough to accommodate the volume of rainwater which are about 12,936.66 cum for Parcel 1 and 11,217.12 cum for Parcel 2. • It is recommended that proper drainage shall be constructed during construction to divert the flow of run-off to the siltation pond • Use of properly sized, graded, and lined storm water management system – A diversion drainage channel keeps surface run-off away from disturbed areas; a dirty water channel directs the run-off through catchment ponds, and settling ponds • Silts are collected and desilting will be done regularly or every six (6) months and become another source of filling material after the drying.	100% No Flooding	Roxanna S. Go and MMT Member		Strict monitoring of the MMT and MRFC and ECC Condition Commitment

Project Phases/ Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact	Options for Prevention or Mitigation or Enhancement	Efficiency of Measures	Responsible Entity	Cost	Guarantee/ Financial Arrangements
	Air/Noise (Quality)	Dust pollution emanating from open areas	• Sprinkling of water in open or disturbed area, at least four times a day, especially during dry season. • Open areas should be covered with greeneries such as grass, shrubs, etc. • All heavy equipment and machinery should be equipped with exhaust mufflers • Maximize operation during daytime hours preferable between 7AM to 6PM	100% compliance with RA 8749 in terms of air quality standards 100% Compliant with Noise Standards	Roxanna S. Go and MMT Member		Strict monitoring of the MMT and MRFC and ECC Condition Commitment
	People	Generation of Employment	• Positive impact due to job and business opportunities should be given priority to local residents, 30% of the total employees should come from the host barangay thru the Public Employment Service Office (PESO)	100% SDMP Compliance	Roxanna S. Go and MMT Member		Strict monitoring of the MMT and MRFC and ECC Condition Commitment
		Introduction to Construction Hazard	• Health and safety program will be instituted • Orient with occupational health and safety procedures and guidelines • Safety devices (hard hats and safety shoes among others) shall be used • Health and safety program to be developed should result to a positive health and safety culture or attitude	100% No Quarry Operation Related Accident	Roxanna S. Go and MMT Member		Strict monitoring of the MMT and MRFC and ECC Condition Commitment
Blasting Activity	**Land - Fauna**	Possible displacement of existing habitat and destruction or alteration of shelter and loss of food for birds, animals, and creatures that depend on trees and plants for food	• There are no endangered or endemic animal species in the area, no specific niches will be affected. • Considered Temporary and may transfer shelter to the buffer zone and excluded area • Conduct periodic/yearly Biodiversity Assessment and Monitoring System (BAMS) pursuant to TB 2016-05 in the nearby project site	100% Protection to Fauna	Roxanna S. Go and MMT Member		Strict monitoring of the MMT and MRFC and ECC Condition Commitment

Project Phases/ Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact	Options for Prevention or Mitigation or Enhancement	Efficiency of Measures	Responsible Entity	Cost	Guarantee/ Financial Arrangements
	Land – Existing structures	Possible damage to nearby infrastructures/structures due to vibration during the blasting operation	• All blasting activities will be performed by a duly accredited blaster following Australian standard 2187.2-2006 on Ground vibration peak particle velocity f 10mm per sec and Airblast overpressure of not greater than 120cB (Linear) Peak at any time. However, with the advancement of blasting technology and the use of controlled blasting will help address this impact. • Observed distance of the blasting area to the nearest infrastructure	100% Damage Free	Roxanna S. Go and MMT Member		Strict monitoring of the MMT and MRFC and ECC Condition Commitment
	Air Quality	Possible Increase in Ambient Concentration of Air Pollutants of TSP, SOx and NOx due to operation of Heavy Equipment and Blasting	• Watering or sprinkling of dry surfaces to minimize fugitive dust at least three (3) times a day • Removal of mud or dirt carried out to the road. • Revegetation of the area should be undertaken as soon as possible to reduce dust impact • All equipment must be properly tuned with properly scheduled tune-up • Off-road construction ignition to reduce unnecessary idling • On-road and off-road hauling vehicles and equipment shall shut-off engines while queuing for loading and unloading. • No Blasting activity on Sundays and Holidays • Submission of Annual Certificate of Emission Test results of all Vehicles (Listed under Table 1-14) involved in the project to PCO as part or SMR/CMR • Planting of vegetation / trees in perimeter and strategic area	100% compliance with RA 8749 in terms of air quality standards	Roxanna S. Go and MMT Member		Strict monitoring of the MMT and MRFC and ECC Condition Commitment

Project Phases/ Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact	Options for Prevention or Mitigation or Enhancement	Efficiency of Measures	Responsible Entity	Cost	Guarantee/ Financial Arrangements
	Noise	Possible disturbance of animal habitat cause by Increase in Noise Pollution due Blasting	• All blasting activities will be performed by a duly accredited blaster following Australian standard 2187.2-2006 on Ground vibration peak particle velocity f 10mm per sec and Airblast overpressure of not greater than 120cB (Linear) Peak at any time. However, with the advancement of blasting technology and the use of controlled blasting will help address this impact. • Observe the buffer zone and planting with trees which act as a barrier for noise transmission, further in terms of wildlife, there are no endangered or endemic animal species in the area, no specific niches will be affected.	100% Compliant with Noise Standards	Roxanna S. Go and MMT Member		Strict monitoring of the MMT and MRFC and ECC Condition Commitment
Crushing Activity	**Air Quality**	Possible Increase in Ambient Concentration of Air Pollutants of TSP and PM10 due to operation Mobile Crusher	• Equipped with good exhaust system utilizing hoods and enclosure to capture and confine emission, • Ducting to convey the captured emission • Mobile crusher has built-in filter materials • All equipment must be properly tuned with properly scheduled tune-up • On-road and off-road hauling vehicles and equipment shall shut-off engines while queuing for loading and unloading • Enclosed Storage Areas	100% compliance with RA 8749 in terms of air quality standards	Roxanna S. Go and MMT Member		Strict monitoring of the MMT and MRFC and ECC Condition Commitment
	Noise	Possible Increase in Noise Pollution due crushing works	• Mobile crusher is positioned away from the nearest establishments • Limit crushing to daytime only	100% Compliant with Noise Standards	Roxanna S. Go and MMT Member		Strict monitoring of the MMT and MRFC and ECC Condition Commitment
Hauling Activity from Quarry to End User (Cement Industries) within Rizal Province	**Land and People**	Traffic and Road Safety	• Imposition of speed limits, adoption of sufficient easement along busy roads and landscaping the major roads with vegetative noise barriers could mitigate noise disturbance from vehicular traffic.	100% Zero Accident	Roxanna S. Go and MMT Member		Strict monitoring of the MMT and MRFC and ECC Condition Commitment
	Noise	Noise Pollution	• Imposition of speed limits, adoption of sufficient easement along busy roads and landscaping the major roads with vegetative noise barriers could mitigate noise disturbance from vehicular traffic.	100% Zero Accident	Roxanna S. Go and MMT Member		Strict monitoring of the MMT and MRFC and ECC Condition Commitment

Project Phases/ Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact	Options for Prevention or Mitigation or Enhancement	Efficiency of Measures	Responsible Entity	Cost	Guarantee/ Financial Arrangements
	Air	Possible Increase in Ambient Concentration of Air Pollutants of TSP, SOx and NOx due to Heavy Equipment	• Imposition of speed limits, adoption of sufficient easement along busy roads. • Street sweeping along Pantay-Buhangin Road during delivery/hauling time. • A schedule of tune-ups would be developed and performed for all equipment operating within the Project area, particularly for haul and delivery trucks • Require off-road compression ignition equipment operators to reduce unnecessary idling with a two (2) minute time limit. • On-road and off-road material hauling vehicles would shut off engines while queuing for loading and unloading for time periods longer that two (2) minutes	100% compliance with RA 8749 in terms of air quality standards	Roxanna S. Go and MMT Member	Php 120,200,000.00	Strict monitoring of the MMT and MRFC and ECC Condition Commitment
	People	Safety - Increase in Traffic Generation Due to Increase in Number of Trucks and Equipment and potential road damage due to passage of heavy equipment during hauling of materials	• Adequate signages with proper scheduled hours will be posted on strategic places for easy access and provide personnel to manage or direct the vehicle going in and out of the premises. • Imposition of speed limit along Pantay-buhangin Road • Formulate an organization to all quarry operators using Pantay-Buhangin Road as their access road for a road users fee which shall be used in the event of road damage.	100% Road Safety	Roxanna S. Go and MMT Member		Strict monitoring of the MMT and MRFC and ECC Condition Commitment
		Possible Loss of Livelihood since there is an existing agri-farm within the excluded area	• Implement Social Development and Management Plan (SDMP)	100% Commitment to SDMP	Roxanna S. Go and MMT Member		Strict monitoring of the MMT and MRFC and ECC Condition Commitment
Total Operation Cost				**Php 122.20 M**			
III. DURING ABANDONMENT PHASE							
Removal or Disposition of Temporary Structures and Facilities	**The Land**	Possibility of contamination due to oil spill used by the equipment	• All temporary facilities installed during the construction phase of the project shall be dismantled or removed from the project site once the operation is completed. • All heavy equipment used during the construction and operation phase of the project will be pulled-out after project completion. • No overfilling of oil tanks to prevent spill; • Immediate containment and removal of land due to	100% Compliant to RA 6969 and RA 9003	Roxanna S. Go and MMT Member	Php 50,000.00	Included in the ECC Condition and Monitoring Group thru MOA

Project Phases/ Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact	Options for Prevention or Mitigation or Enhancement	Efficiency of Measures	Responsible Entity	Cost	Guarantee/ Financial Arrangements
			oil spill shall be done.				
Implementation of Final Mine Rehabilitation and Decommissioning Plan (FMRDP)		Compatibility of Final Land Use	• Quarry areas must be subject to final inspections for the identification of potential hazards such as Landslides and debris flows, therefore, Environmental Site Assessment (ESA) shall be done in relation to potential hazard, land and water pollution. • Final Plan of the area is land development for farm lots • Secure separate permit from LGU for the development of farm lots.	100% Land Use Compatibility	Roxanna S. Go and MMT Member		Secure separate permits
Total Abandonment Cost				**Php 50,000.00**			

4.0 ENVIRONMENTAL RISK ASSESSMENT (ERA) AND EMERGENCY RESPONSE POLICY AND GUIDELINES

The proposed Quarry Project will not involve processes that are required for risk screening (i.e., as specified in Annex 2-7e of DAO 2003-30 Procedural Manual). It will also not store hazardous materials in excess of the amount can be accommodate by the area.

As defined by DAO 2003-30, ERA is the use of universally accepted and scientific methods to assess the risks associated with a project. It focuses on determining the and probability of occurrence of accidents and their magnitude (e.g. failure of containment or exposure to hazardous materials or situations).

The ERA within the context of Philippine EIS System, is concerned primarily with safety risks (characterized by low probability, high consequences, accidental nature and acute affects (human safety focus). In contrast geologic risks are covered by Engineering Geological and Geohazard Assessment Report (EGGAR) requirement under MGB while health risks (characterized by high probability, low consequences, ongoing or continuing exposure and chronic human health effects) area assessed in the environmental health impact assessment under the DOH mandate.

The ERA process is presented in ***Figure 4-1***. Based on the process and material inventory levels, the project is not covered by ERA, however an Emergency Plan is prepared based on Hazard Analysis.

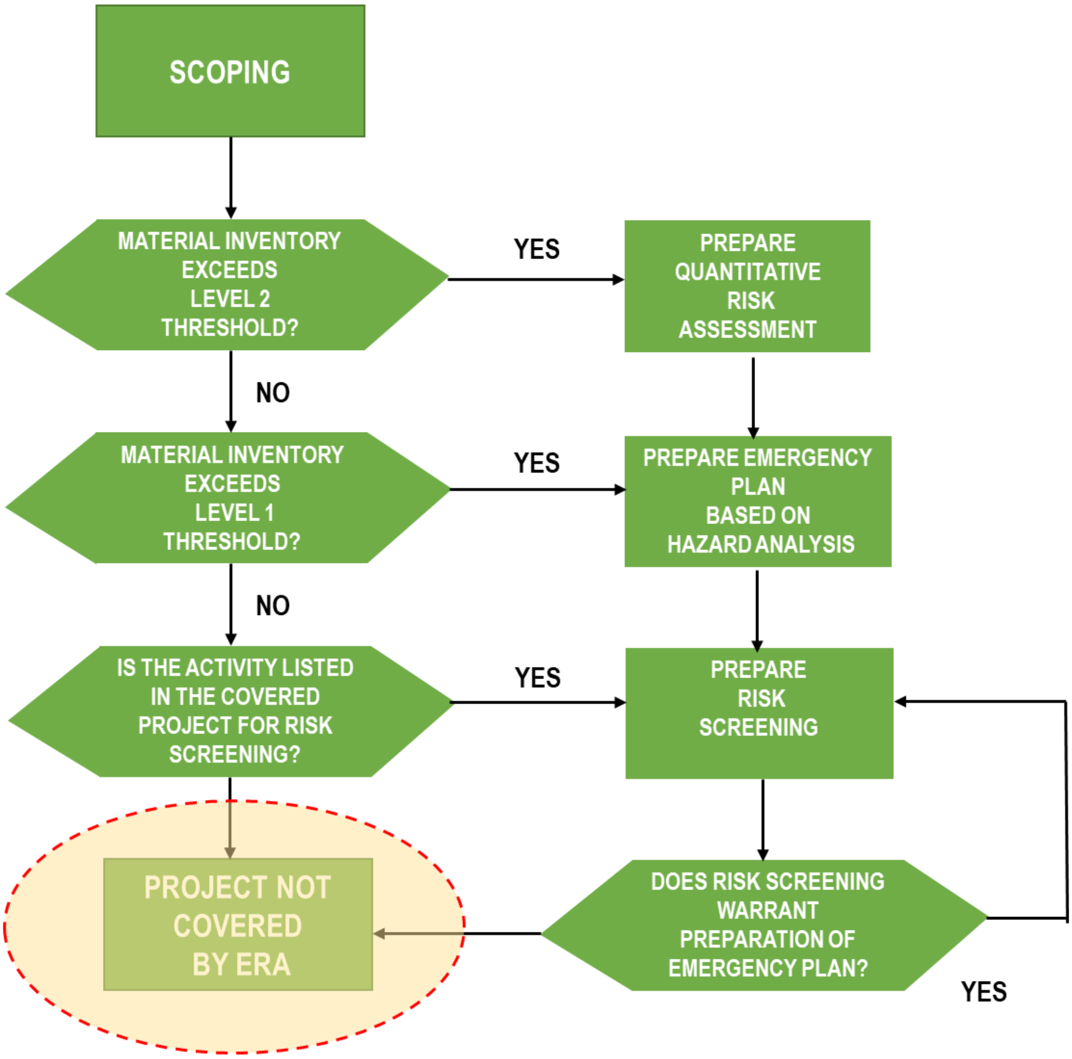


Figure 4-1 Environmental Risk Assessment (ERA) Process

TECHNICAL GUIDELINES FOR THE CONDUCT OF ENVIRONMENTAL RISK ASSESSMENT

A. Determination of Risk Levels

1. Levels of Coverage and Requirements

a. Risk Screening Level. The following activities are required to undertake a risk screening exercise:

1) Facilities for the production or processing of organic and inorganic chemicals using:
   a) Alkylation
   b) Amination by ammonolysis
   c) Carbonylation
   d) Condensation
   e) Dehydrogenation
   f) Esterification
   g) Halogenation and manufacture of halogens
   h) Hydrogenation
   i) Hydrolysis
   j) Oxidation
   k) Polymerization
   l) Sulphonation
   m) Desulphurization, manufacture and transformation of Sulphur-containing compounds
   n) Nitration and manufacture of nitrogen-containing compounds
   o) Manufacture of phosphorus-containing compounds
   p) Formulation of pesticides and of pharmaceutical products
   q) Distillation
   r) Extraction
   s) Solvation
2) Installation for distillation, refining or other processing of petroleum products.
3) Installation for the total or partial disposal of solid or liquid substances by incineration or chemical decomposition.
4) Installations for the production or processing of energy gases, for example, LPG, LNG, SNG.
5) Installations for the dry distillation of coal or lignite.
6) Installations for the production of metals or non-metals by a wet process or by means of electrical energy.
7) Installations for the loading/ unloading of hazardous materials as defined by RA 6969 (or DAO 29)

2. **Level 1 and Level 2 Threshold Inventory as presented in Table 4-1**. The Following threshold levels shall be used to determine whether a proposed project or undertaking shall be required to prepare a QRA and/ or an emergency/ contingency plan:

Table 4-1 Level 1 and Level 2 Threshold Inventory

Category	Level 1 (tons)	Level 2 (tons)	Risk
Explosives	10	50	None
Flammable substances	5,000	50,000	None
Highly flammable substances	50	200	None
Extremely Flammable Substances	10	50	None
Oxidizing substances	50	200	None
Toxic substances	50	200	None
Toxic Substances (Medium)	10	50	None
Toxic Substances (High)	5	20	None
Toxic Substances (Very High)	0.2	1	None
Toxic Substances (Extreme)	0.001	0.1	None
Unclassified (Type A)	100	500	None
Unclassified (Type B)	50	200	None

4.1 Possible Risk During Quarry Operation

Ground Shaking. The project site is approximately 16.70 km north-northwest from East valley Fault, 1.9 km west from unnamed Fault from Parcel 1 and 2.9 km west from unnamed Fault from Parcel 2 ***(Annex H.1 Earthquake Hazard Assessment).***

Settlement. Settlement may occur on fill areas that are not properly compacted.

Ash fall. The effect of ashfall in the event of an eruption of Mount Pinatubo or Taal Volcano is negligible.

Typhoon. The project site may experience a direct hit of 3 typhoons in every 2 years.

Siltation. Minimal risk since the waterway is considered intermittent is protected as part of the mitigating measures.

- Flooding. Minimal risk since the proponent shall install series of siltation ponds or catch basin to collect and control flow of surface run-off.

Description of conditions, events and circumstances which could be significant in bringing about identified safety risks

Fire. commonly equated with welding and torch cutting, there are many other activities — including brazing, burning, heating, and soldering — that pose a fire hazard.

- Fire protection will consist of the provision of fire hydrants

Explosion. Nitrogen oxides (NOx), primarily NO and NO2, are formed by diesel engines and as a by-product of blasting. In engines, NOx are formed as an inherent by-product of putting air, 79% of which is nitrogen and 20% of which is oxygen, under conditions of high temperature and pressure, the very conditions necessary to the functioning of a diesel engine.

- Workers are removed from an area where blasting will occur

Description and assessment of the possible accident scenarios posing risk to the environment

The possible accident scenarios posing risk to the environment are related to the operation of the heavy equipment:

Operation of the Equipment and Hauling Trucks:

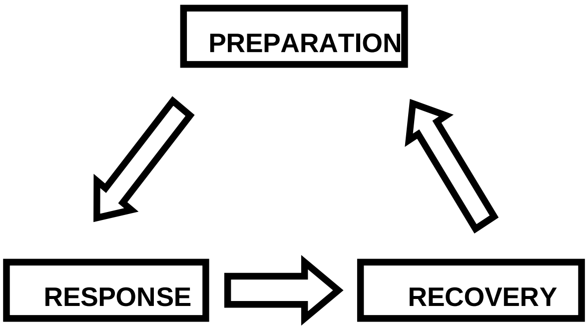
Hauling trucks for materials leading to the end user of the materials. Road signages will be posted at strategic places.

Description of the hazards, both immediate (acute effects) and delayed (chronic effects) for man and the environment posed by the release of toxic substance, as applicable

Release of Toxic Substances. Blast fumes are the gases that may be generated during blasting. In terms of health impacts, the critical gases generated are oxides of nitrogen (NOx) - nitrogen dioxide (NO2) and nitric oxide (NO) which can cause serious lung inflammation and has been known to develop several hours after exposure to very high levels of NO2.

The proponent will implement Emergency Response Plans (ERPs) to alleviate or decrease the likelihood of accidents from occurring in accordance to DENR Administrative Order No. 2000-98 on Mine Safety and Health Standards. It will also provide the proponent to the appropriate strategy on responding to critical situations, which will minimize loss of life and property, and finally, doing the necessary recovery efforts should an emergency does happen. This principle is summarized in ***Figure 4-2*** below or the Emergency Response Plan diagram, and further discussed in **Table 4-2 Emergency Response Plan**.

Figure 4-2 Emergency Response Plan Diagram



Preparedness is the development of actual action plans should an emergency happens, and elimination or avoidance of hazards from happening or occurring.

Response is the execution of the plans and procedures during an actual emergency event

Table 4-2. Emergency Response Plan

PREPARATION	RESPONSE	RECOVERY
A. Earthquakes		
• Make necessary preparations, which includes equipment and facility checks to prevent injuries in an event or an earthquake • All loose items must be secured to prevent falling • Heavy materials are placed near the ground • Flammable items are stored in designated safe areas • Personnel are familiarized to safe locations, emergency response equipment and evacuation routes	•All personnel and administrative •officers are advised not to panic to •prevent further injuries Personnel •are advised to protect themselves •by getting under sturdy structures Personnel are advised to stay away from sharp, flammable, or heavy items Personnel are advised to prepare immediate evacuation of the facility if necessary All gas and electric equipment are shut down	If there are no threats of aftershocks, check other personnel that may be trapped, injured, or needs further assistance. Avoid returning to the facility if it is deemed structurally unstable, or declared unsafe Check for possible fires and advice authorities for appropriate response. Secure important items and equipment from unauthorized access from outsiders, after the building is declared safe for re-entry Inspect the facility for any major structural defects, cracks, and unstable items, other potential hazards • If the earthquake damage is minimal, or facility is recoverable, make necessary corrective measures to prevent the further hazards from affecting personnel and property
B. Occupational Hazards		
• Formation of emergency response teams for each department • Provision of first-aid kits and emergency equipment on critical areas • Regular supervision of production personnel especially on the operation of machinery • Training of personnel on proper equipment handling and other safety practices • Posting of safety reminders on critical areas and equipment • Provision of safety features such as adequate lighting, guide rails, and safety signage • Adequate signages placed in strategic areas on the active quarry area, moving equipment and vehicles	Report immediately any accidents, especially those considered life-threatening Immediate application of first-aid Removal of the affected personnel on the accident site Bring the affected personnel to the nearest first aid station or hospital if necessary	• Perform corrective measures on • equipment and procedures Provision of additional safety procedures, equipment, and training
C. Risk Associated By Natural Calamity such as Typhoon and Earthquake		
• In case of typhoon, listen to the radio, media on the update of the storm • Announcement to all workers and employees on the weather update • Conduct disaster prepared drill • Removal and relocation of important documents in the office • Distribution of safety gears, gadget and other emergency kits • Adequate signages placed in strategic areas on the active quarry area, slope stability and erodibility and water channels and siltation ponds hazards and	• All personnel and administrative officers are advised not to panic to prevent further injuries Personnel are advised to protect themselves by getting under sturdy structures • Personnel are advised to stay away from sharp, flammable, or heavy items Personnel are advised to prepare immediate evacuation of the facility if necessary • Immediate coordination with LGU on the extent of damage	• Avoid returning to the facility if it is deemed structurally unstable, or declared unsafe • Secure important items and equipment from unauthorized access from outsiders, after the building is declared safe for re-entry

• Possible risks in the concerned areas should be displayed at strategic locations including locations of pick up points and evacuation routes both included in the maps and displayed as signages at strategic locations • Coordinated effort with concerned LGUs is necessary to incorporate the disaster management plan. • Strengthen the IEC drive to the quarry personnel, LGU and community		
D. Risk on natural hazards to the Infrastructures and facilities		
• Identify natural hazard prone areas related to the Geological Hazard that can cause damage to properties • Proper Information campaign drive to the Local Communities and LGUS';s • Strengthen the Disaster Preparedness program thru yearly drills and seminar	• Immediate evacuation of the facility if necessary • Call the Local Office/Engineering Office for possible assessment of the infrastructure and facilities • Secure clearance from LGU for structural stability of the facilities • Immediate repair or retrofitting when necessary and applicable	• Avoid returning to the facility if it is deemed structurally unstable, or declared unsafe • Secure important items and equipment from unauthorized access from outsiders, after the building is declared safe for re-entry
E. Risk on fire, explosion, release of toxic substances		
• Fire emergency evacuation plan (FEEP) which includes the action to be taken by all staff in the event of fire and the arrangements for calling the fire brigade as follows: + a clear passageway to all escape routes. + clearly marked escape routes that are as short and direct as possible. + enough exits and routes for all people to escape. + emergency doors that open easily. + emergency lighting where needed. + training for all employees to know and use the escape routes + readily available fire extinguisher.	• Immediate evacuation of the facility if necessary • Immediate assembly of fire volunteers • Call the Local Office /Fire Department for immediate assistance • Secure clearance from LGU for structural stability of the facilities • Immediate repair or retrofitting when necessary and applicable	• Avoid returning to the facility if it is deemed structurally unstable, or declared unsafe • Secure important items and equipment from unauthorized access from outsiders, after the building is declared safe for re-entry
• Strengthen IEC of during scheduled blasting for possible explosion thru training and orientation • Preparation evacuation plan	• Evacuate, go to an area upwind from the explosion site to avoid possible toxic fumes. Once outside, move at least 150 feet away from the effected area. Keep roadways and walkways clear for emergency vehicles • Immediately take cover under tables, desks or other such objects that will give protection against flying glass and debris. • Call LGU for assistance	• Wait for instruction from emergency personnel. Do not re-enter into the facility until instructed to do so by the Public Safety Department or other properly identified emergency personnel.
• Develop an On-Site Emergency Response Team. • Conduct Training • Chemical must be placed away	• Avoid exposure to the plume. If you see a plume, do not enter it (this includes driving through it) and move out of the plume's path if	• Avoid returning to the facility if it is deemed structurally unstable, or declared unsafe • Secure important items and

from the blasting area or away from direct sunlight	possible. • If at home, head indoors, close all doors and windows. If you are in a car, wind up windows and close vents until the plume passes. • If you find yourself in a plume, try to move out of it as quickly as possible. • If you have been exposed, use water to thoroughly wash eyes, and to clear your nose and throat. • If you experience respiratory symptoms you should seek immediate medical attention and inform the doctor of possible NO2 exposure. Be alert for possible delayed breathing problems. If you are an asthmatic, use your reliever medicine. • Sprinkling of water may ease the fumes	equipment from unauthorized access from outsiders, after the building is declared safe for re-entry • •

5.0 SOCIAL DEVELOPMENT PLAN/FRAMEWORK (SDP) AND IEC FRAMEWORK

This section provides the proposed Social Development Program (SDP), presented in **Table 5-1** identified during the General Assembly, Perception Survey and Public Scoping conducted for the project while **Table 5-2** shows the Information Education Campaign (IEC) conducted by the proponent. DAO 2010-21 allocation for SDMP and IEC is 1.5% of the Operating Cost.

The funds for the implementation of the SDMP will be provided by the proponent with an allotment of a minimum of 1.5% of the total operating cost annually, of which 75% shall be appropriated to implement the SDMP, 15% for the IEC, as well as the corresponding manpower training and development and 10% for the development of mining technology and geosciences.

5.1 SOCIAL DEVELOPMENT AND MANAGEMENT PLAN (SDMP)

Table 5-1 Social Development and Management Plan (SDP)

Concern	Responsibility Community Member/Beneficiary	Government Agency and Services	Proponent	Indicative Time	Source of Fund
GENDER RESPONSIVE					
1. **Recruitment Activities**- Construction Workers and Laborers	Seventeen (17) people skilled and unskilled - The proponent ensure a minimum of 60% in terms of job hiring coming from the barangay	Proponent in coordination with Barangay Office	Contractor/ Proponent	•Pre-Construction •Construction •Operation	Proponent
2. **Livelihood Program**-Food Processing for Women	Qualified Women from the Community Residents	•Barangay Office •TESDA	Community Relations Officer	•Construction •Operation	Proponent
3. **Livelihood Program-** Landscaping and Planting Materials (for elderly men and women)	Qualified elderly (men and women) Community Residents	•Barangay Office •TESDA	Community Relations Officer	•Construction •Operation	Proponent
4. Safety **Acquisition of Multi-purpose Vehicle-** Health and Safety of the Community	Community Residents of Barangay Maybancal, Morong and Barangay Dalig, Teresa, Rizal	•Municipal Office •Barangay Office- Barangay Health Worker (BHW)	Community Relations Officer	•Construction •Operation	LGU/ Proponent
5. Education and Safety Trainings for Emergency Response Team such as CPR, First-Aid, etc.	Community Residents of Barangay Maybancal, Morong and Barangay Dalig, Teresa, Rizal	•Municipal Office •Barangay Office- •Barangay Health Worker (BHW)	Community Relations Officer	•Construction •Operation	LGU/ Proponent
6. Health and Nutrition Medical Mission and Feeding Program	Community Residents of Barangay Maybancal, Morong and Barangay Dalig, Teresa, Rizal	•Barangay Office- Barangay Health Worker (BHW)	Community Relations Officer	•Construction •Operation	LGU/ Proponent
7. Education	Community Residents of Barangay	•Pantay Elementary	Community	•Construction	LGU/

Province Assistance for School supplies	Maybancal, Morong and Barangay Dalig, Teresa, Rizal	School •Barangay Office	Relations Officer	•Operation	Proponent
8. Environment and Sanitation Operation Walis-Street Sweeping for Dust Control along Pantay-Buhangin Road	Community Residents of Barangay Maybancal, Morong and Barangay Dalig, Teresa, Rizal	•Barangay Office	Community Relations Officer	•Construction •Operation	LGU/ Proponent
9. Environment Tree Planting Program-	Community Residents of Barangay Maybancal, Morong and Barangay Dalig, Teresa, Rizal	•Municipal Environment Officer (MENRO) •Barangay Office	Community Relations Officer	•Construction •Operation	LGU/ Proponent
10. Spiritual - Spiritual Guidance for the community through assistance during Sunday Mass and support to other religious groups in the area through financial yearly contributions or as the need arises	Community Residents of Barangay Maybancal, Morong and Barangay Dalig, Teresa, Rizal	•Parish Priest •Pastor •Other Religious Organization in the area	Roxanna Go	•Construction •Operation	Proponent
11. Donations to the Barangays Proponent will support the activities of the barangay such as fiestas and sports activities	Community Residents of Barangay Maybancal, Morong and Barangay Dalig, Teresa, Rizal	•Barangay Office	Community Relations Officer	•Construction •Operation	Proponent
12. Disaster Preparedness – Conduct seminar on disaster preparedness and emergency response such as flooding, tsunami, earthquake, etc.	Community Residents of Barangay Maybancal, Morong and Barangay Dalig, Teresa, Rizal	•Municipal Office •Barangay Office	PCO/Community Relations Officer	•Construction •Operation	Proponent

5.2 INFORMATION AND EDUCATION CAMPAIGN (IEC)

Table 5-2 Information Education Campaign (IEC)

Target Sector	Major Topics of Concern In Relation to the Project	IEC Scheme/Strategy/ Methods	Information Medium	Indicative Timeframe	Indicative Cost
PRE-CONSTRUCTION ACTIVITIES					
1. Barangay Office	a. Submission of project Description in connection with the Information Education Campaign (IEC)	Proponent Driven-coordination with the concerned barangay. Public scoping was part of the initial introduction	Letter Request	Pursuant to DAO 2017-15 under Public Participation	P 50,000.00
2. LGUs, and Stakeholders	a. Submission of project Description in connection with the Public Scoping	Coordination with the concerned LGUs, and Stakeholders. Public scoping was conducted	Letter Request	Pursuant to DAO 2017-15 under Public Scoping was conducted July 9, 2019 at Sitio Pantay Covered Court, Dalig, Teresa, Rizal with 133 attendees.	P 100,000.00
DURING CONSTRUCTION					
1. Barangay Office	a. Posting of Job Requirements	Coordination with the Barangay	Public Address in the Barangay	At least one (1) month before the start of construction	P0.5M/month expected salary of the workers
DURING OPERATION					
1. Multi-Sector Group-Barangay, NGO, Government Office-LGU and DENR	a. Creation/Formulation of the Multi-Partite monitoring Team (MMT) to discuss about the Environmental Management Plan (EMP), monitoring of actual impacts	a. Invitation Letters b. Coordination Group meeting	a. Memorandum of Agreement (MOA)	Sixty (60) days after issuance of ECC	P50,000/ Per quarter/ meeting
2. Public Information through Billboard	a. Schedule of operational activity such as blasting, community service, truck deliveries, dust control, flood control among others	a. Billboard	Posters	Upon Operation	P10,000
3. . Multi-Sector Group-Barangay, NGO, Government Office-LGU and DENR	a. Disaster preparedness and emergency response such as flooding, tsunami, earthquake, and other identified hazards and risk in the area and the results of the Engineering Geological and Geohazard Assessment Report (EGGAR) on the possible hazards in the proposed quarry.	a. Invitation Letters b. Group meeting	a. Letter of Invitation	Every six (6) months	P20,000/ meeting

5.1.1 Discussion of Social Development Plan (SDP)

Social Development Plan (SDP) aims to address the socio-economic issues and concerns relevant to the proposed project. Based on the results of the General Assembly, Perception Survey and Public Scoping and coordination with the Barangay Offices of Barangay Maybancal, Morong and Barangay Dalig, Teresa, Province of Rizal in terms of the Social Development Plan of the barangay, job opportunities, benefits and hazards are most likely important issues in the barangay.

The Social Development Plan (SDP) is in line with the activities and programs of the barangay for the year 2018-2022 as identified in ***Table 6-2*** above. There are two (2) types of programs that the proponent proposes, the Recruitment, Trainings and Seminars including Livelihood programs. The proponent will support the identified programs of the barangay.

The beneficiaries of the SDP are mostly the communities of Barangay Maybancal, Morong and Barangay Dalig, Teresa. The SDP will be implemented during the construction and operation phase of the project in partnership with local government units.

Barangay Program: Coordination with the Barangay Office, their office has already lined up a list of programs to be implemented for the year 2018-2022, namely: Education, Health and Nutrition, Peace and Order, Environment and Improvement of the Barangay Hall.

Recruitment Activities: during pre-construction phase, the proponent shall seek assistance to the barangay office in terms of technical qualified skilled and unskilled workers. Hiring more workers will be done on the operation phase of the project. The number identified above are just estimated which could vary and increase from time to time. Hiring during operation phase of the project are utility workers, Operators, and Administrative Staff.

Training and Seminars: the proponent in coordination with the LGU shall conduct a seminar and training in terms of livelihood which the proponent may assist to be implemented for the project during operation phase. Security, safety and disaster preparedness measures training as part of the peace and order program shall be implemented.

5.2.1 INFORMATION EDUCATION FRAMEWORK

Presented in ***Table 5-2*** is the Information Education Framework Plan of the proponent during pre-construction, construction and operation phase of the project. The primary goal of the project is to strengthen the information campaign drive to the stakeholders specially the community thru regular meetings and assembly to discuss the status of the project, its environmental measures and the social development plan.

5.2.1.1 Goals

The implementation of the Information Education Plan aims for the following:

a. To institutionalize environmental management and sustainable development concerns in the development structures, policies and programs of the corporation;
b. To promote that the project is one that recognizes the synergy and reconciliation of environmental management and economic development;
c. To mobilize active advocacy from identified stakeholders.

5.2.1.2 Specific Objectives

a. To make information accessible to all sectors of the community;
b. To increase the level of awareness and understanding about the project;
c. To encourage upgrading of skills of various groups for future development;
d. To mobilize multi-sectoral participation in and support for sustainable development initiatives of the proponent.

6.0 ENVIRONMENTAL COMPLIANCE MONITORING

This section provides the proponent's guidance in the conduct of monitoring activities in terms of frequency, parameters and locations of the sampling sites for air, water and people as they conduct continuous Information Education Communication (IEC). **Table 6-1** shows the Summary of Matrix of Environmental Monitoring Plan during construction and operation phase. The ambient air and surface water monitoring location is presented in **Figure 6-1** and **Figure 6-2,** respectively.

6.1 SELF-MONITORING PLAN

Submission of the Semi-annual report shall be submitted to the DENR Region IVA and Central Office thru on-line in compliance to MC 2016-001 office showing the actual implementation during construction phase of the Environmental Management Plan, Social Development Plan (SDP) and Information Education Campaign (IEC). Likewise, the proponent shall monitor compliance to the following:

- Compliance to Republic Act 9003, Ecological Solid Waste Management Act.
- Compliance to Republic Act 9275, Clean Water Act of 2000.
- Compliance to Republic Act 6969, Hazardous Wastes
- Compliance to Republic Act 8749, Clean Air Act
- Compliance to PD 1586 and the conditions stipulated in the ECC

6.2 MULTI-SECTORAL MONITORING FRAMEWORK (MSMF)

The proponent shall establish and create a Multi-Sectoral Monitoring Team (MSMF) in compliance with DAO 2003-30 and DAO 2017-15 one (1) month before the actual operation of the project but preparation or creation shall be done at least sixty (60) days after the issuance of the certificate. Pursuant to DAO 2018-18, CENRO shall be a member of the MMT as representative of the Regional Executive Director (RED). The establishment of the MMT shall be based on provisions under DAO 2018-18. The members of the MMT are from the Local Government Units (Barangay and Municipal), Proponent, Mines and Geosciences Bureau (MGB), Non-Government Organization (NGO) and Department of Environment and Natural Resources (DENR) Region IV and other identified stakeholders. The objective of MMSF is to monitor the implementation of the IMP and the EMP of the project and reports the same to the concerned government agency.

6.3 ENVIRONMENTAL GUARANTEE AND MONITORING FUND and COMMITMENTS

Under Philippine Mining Act of 1995 and its Implementing Rules and Regulations, establishment of the Contingent Liability and Rehabilitation Fund (CLRF) is the financial instrument of the Multi-Partite Monitoring Team (MMT), Progressive Rehabilitation and compensation damages. The CLRF is divided in three (3) forms such as the Mine Rehabilitation Fund (MRF), Mine Wastes and Tailings Fund (MWTF), and Final Mine Rehabilitation and Decommissioning Plan (FMRDP). The CLRF shall be in the form of the Mine Rehabilitation Fund and the Mine Waste and Tailings Fees as stipulated in the Act and shall be administered by the CLRF Steering Committee as prescribed under DAO 2004-54.

The Mine Rehabilitation Fund (MRF) is established to ensure and guaranteed environmental deposit to ensure the compliance and implementation of the Environmental Protection and Enhancement Program (EPEP). The MRF is composed of the following:

- *Monitoring Trust Fund (MTF)* - This fund covers the expenses incurred by the Multi-partite Monitoring Team (MMT) and Mine Rehabilitation Fund Committee (MRFC) for the monitoring activities and shall be in cash and in an amount to be determined by the MRF Committee during the preparation of Annual Working Financial Plan (AWFP). The minimum amount of the Environmental Monitoring Fund (EMF) is One Hundred Fifty Thousand (Php 150,000.00) Pesos maintained per annum that will be established in support of the compliance monitoring activities and to fund the annual work and financial plan (AWFP) of the MMT. The EMF shall cover maintenance and other operating budget for the transportation and travel expenses, cost of laboratory analysis, cost of supplies and materials, cost of communication services, cost of consultancy work and other reasonable expenses incurred by the monitoring team;

- *Rehabilitation Cash Fund (RCF)*- This fund covers the actual expenses/budget for the implementation of the EPEP activities amounting to 10% of the total EPEP in which case, the amount of Rehabilitation Cash Fund has yet to be prepared by the proponent.

- *Environmental Trust Fund (ETF)* – This is allocated to serve as compensation for damages, the ETF shall be set at a minimum of Php 50,000.00.

Mine Wastes and Tailings Fund (MWTF) is collected semi-annually from each operating mining company as fees based on the amount of mine waste and tailings generated for the said period. The fund is reserved for payment of compensation for damages caused by mine wastes and tailings.

Final Mine Rehabilitation and Decommissioning Plan (FMRDF) is established by each operating mining company to ensure the implementation of the approved Final Mine Rehabilitation and Decommissioning Plan. The FMRDF is accrued before the end of the operating life of the mine and is deposited in a Government depository bank for the sole purpose of FMRDP implementation.

Draft Memorandum of Agreement (MOA) is presented in **Annex I.1**. Rationalization of the Multi-Partite Monitoring Team (MMT) pursuant to DAO 2017-15 Section 16/16.1.

Table 6-1 Summary of Matrix of Environmental Monitoring Plan

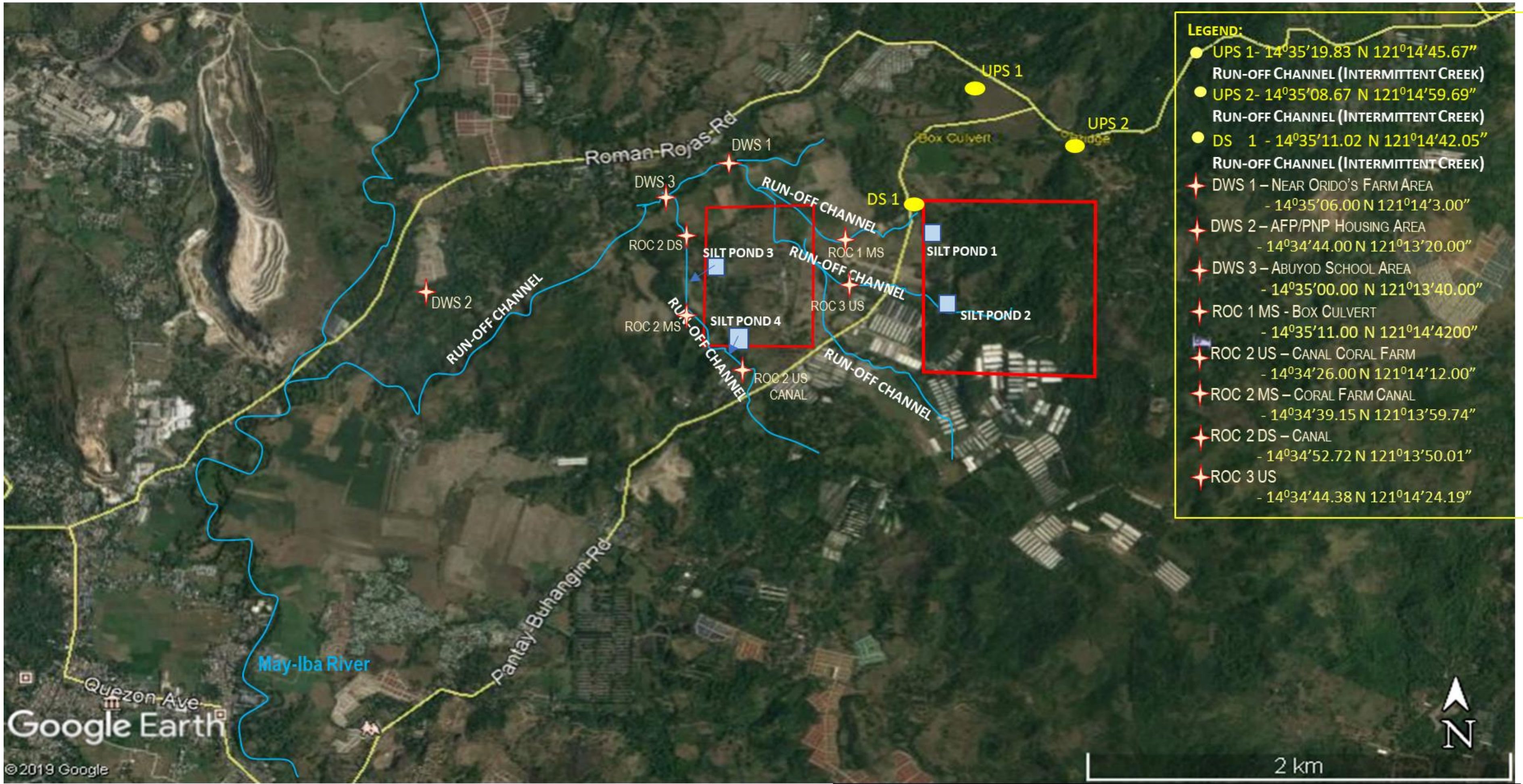
ENVIRONMENTAL ASPECT PER PROJECT PHASE	POTENTIAL IMPACT PER ENVIRONMENTAL SECTOR	PARAMETER TO BE MONITORED	SAMPLING & MEASUREMENT PLAN			Lead Person	Annual Estimated Cost	EQPL MANAGEMENT SCHEME					
								EQPL RANGE			MANAGEMENT MEASURES		
			Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
I. PRE-CONSTRUCTION PHASE	NA												
II. CONSTRUCTION PHASE													
Clearing and Earthmoving (Land Development) and Construction of Access Road, facilities and installation of Mobile Crusher	**The Land** *Loss of Vegetation*	Number of trees/ plants	Observation	Monthly	Buffer Zone and Progressive Rehabilitation	PCO	Part of the landscape cost	80% planted bamboo along the buffer zones	90% planted bamboo along the buffer zones	100% planted bamboo along the buffer zones	80% available bamboo seedlings	90% available bamboo seedlings	100 % complete bamboo plantation
	Improper dumping of solid waste and toxic substances	Quality and quantity of solid and hazardous wastes	Observation	Daily	The Site, MRF and storage area	PCO	Part of the operating cost	No garbage collection has been observed on the assigned day	No garbage collection has been observed for the week	Presence of flies and other insects and emission of foul odor	Coordinate with LGU for collection Strictly Implement RA 9003 and RA 6969	Strictly Implement RA 9003 and coordinate with LGU for hauling and disposal	Strictly Implement RA 9003 and coordinate with LGU for hauling and disposal. Fumigation shall be done
	The Water *Generation of untreated/ improper disposal of domestic wastewater*	BOD nitrate, phosphate, ammonia, fecal coliform, Oil and Grease and Surfactants	Sampling	Yearly	Outfall- Septic Tank Over flow (Effluent)	PCO	P20,000	BOD-42.50 O & G-4.25 Nitrates-11.9 Phosp-0.85 Ammo-0.425 FCol-340 Surfactant-4.25	45.00 4.5 12.6 0.90 0.45 360 4.50	50.00 5.0 14 1.0 0.50 400 5.0	Siphong/ desludging of the septic tank at least twice a year	Immediate siphoning or de-sludging prior to scheduled date.	Implement RA 9275 Provide additional chamber Secure Zero Discharge Permit
	The Air *Dust pollution due to land and facilities preparation*	TSP, PM10, SO2, NO2	Sampling	Semi-annual	Refer to Table 2-77 of the EIS Main Report	PCO	None	Refer to Table 2-54 of the EIS Main Report	Refer to Table 2-54 of the EIS Main Report	Refer to Table 2-54 of the EIS Main Report	Dusty Area water sprinkling in the access areas	Immediate watering of open areas and no activity during heavy winds	Minimal Dust present, regular sweeping and watering of access road

	The People SDP implementation	SDP Plan	Actual	Annual	Refer to Chapter 5.0 of the EIS Main Report	ComRel	1.5% of the Operating Cost	Refer to Chapter 5.0 of the EIS Main Report Yearly Accomplishment based on the approved SDMP	Refer to Chapter 5.0 of the EIS Main Report Yearly Accomplishment based on the approved SDMP	Refer to Chapter 5.0 of the EIS Main Report Yearly Accomplishment based on the approved SDMP	Regular Monitoring	*Regular Monitoring*	Regular Monitoring
III. OPERATION PHASE													
Quarry Operation including Blasting, Operation of Crushing Plant and Hauling outside of Quarry site	**The Land - Terrestrial Flora and fauna** *Loss of vegetation and existing land cover due to excavation and alteration of topography*	Number of trees/ plants	Observation	Monthly	Buffer Zone and observed boundaries of excluded area. Implement Progressive Rehabilitation	PCO	Part of the landscape cost	80% planted bamboo along the buffer zones	90% planted bamboo along the buffer zones	100% planted bamboo along the buffer zones	80% available bamboo seedlings	90% available bamboo seedlings	100 % complete bamboo plantation
	The Land *Traffic generation due to incoming and outgoing trucks and vehicles*	Traffic Flow in the vicinity	Observation	Daily	Project	Guard	Part of the salary of the assigned guard	Slow moving flow of traffic	Lined up vehicles and hearing blowing of horns	Traffic Congestion	Assign Traffic Personnel	Designate Temporary parking area	Presence of traffic personnel at the site
	The Water *Generation of Domestic Wastes employees*	BOD nitrate, phosphate, ammonia, fecal coliform, Oil and Grease and Surfactants	Sampling	Yearly	Outfall- Septic Tank Over flow (Effluent)	PCO	P20,000	BOD-42.50 O & G-4.25 Nitrates-11.9 Phosp-0.85 Ammo-0.425 FCol-340 Surfactant-4.25	45.00 4.5 12.6 0.90 0.45 360 4.50	50.00 5.0 14 1.0 0.50 400 5.0	Siphong/ desludging of the septic tank at least twice a year	Immediate siphoning or de-sludging prior to scheduled date.	Implement RA 9275 Provide additional chamber Secure Zero Discharge Permit
	The Water *Siltation of Run-off Channel that will cause water pollution to May-iba creek due to operation*	**For DWS** Ph, BOD, COD, DO, TSS, Oil and Grease, Hg, Pb, Cd, As and Cr	Sampling	Quarterly	Refer to Figure 6-2 Surface Water Sampling Monitoring Map	PCO	P50,000	BOD-5.95 O & G-4.25 Ph-5.525-7.65 COD-85 DO-4.25 TSS-69.7 Hg-0.0017 Pb-0.0425 Cd-0.00425 As-0.017	6.30 4.5 5.85-8.1 90 4.5 72 0.0018 0.045 0.0045 0.018	BOD-7.00 O & G-5.00 Ph-6.5-9.0 COD-100 DO – 5.0 TSS - 80 Hg-0.002 Pb-0.05 Cd-0.005 As-0.02	Siltation ponds properly in-placed and maintained with regular desilting	Provide additional silt ponds .	Implement RA 9275 Provide silt additional ponds. Implement Zero discharge

		For ROC Ph, BOD, COD, DO, TSS, Oil and Grease, Hg, Pb, Cd, As and Cr						Cr-0.0085 BOD-42.50 O & G-4.25 Ph-5.1-7.65 COD-85.00 DO- TSS-85 Hg-0.0034 Pb-0.0085 Cd-0.0085 As-0.34	0.009 45.00 4.5 5.4-8.55 8.00 - 90 0.0036 0.009 0.009 0.036	Cr-0.01 BOD-50.00 O & G-5.0 Ph-6.0-9.5 COD-100.00 DO- TSS-100 Hg-0.004 Pb-0.01 Cd-0.01 As-0.04			
	The Air and Noise *Dust Pollution due to Blasting, Delivery Trucks and Operation*	TSP, PM10, SO2, NO2	Sampling	Semi-annual	Refer to Table 2-77 of the EIS Main Report	PCO	None	Refer to Table 2-54 of the EIS Main Report	Refer to Table 2-54 of the EIS Main Report	Refer to Table 2-54 of the EIS Main Report	Dusty Area water sprinkling in the access and open area	Immediate watering of open areas and no activity during heavy winds	Minimal Dust present, regular sweeping of road and watering of inner road within the project
	Due to equipment use, hauling and delivery	Decibel	Sampling	Semi-annual	Refer to Table 2-77 of the EIS Main Report	PCO	None	Refer to Table 2-56 of the EIS Main Report	Refer to Table 2-55 of the EIS Main Report	Refer to Table 2-56 of the EIS Main Report	Check noise barrier	Immediate repair	Regular maintenance
	The People *SDMP implementation*	SDMP Plan	Actual	Annual	Refer to Chapter 5.0 of the EIS Main Report	ComRel	1.5% of the Operating Cost	Refer to Chapter 5.0 of the EIS Main Report Yearly Accomplishment based on the approved SDMP	Refer to Chapter 5.0 of the EIS Main Report Yearly Accomplishment based on the approved SDMP	Refer to Chapter 5.0 of the EIS Main Report Yearly Accomplishment based on the approved SDMP	Regular Monitoring	Regular Monitoring	Regular Monitoring
	The People *Safety of Workers*	Safety	Actual	Annual	Refer to Chapter 3 IMP	PCO		Refer to Chapter 3.0 of the EIS Main Report	Refer to Chapter 3.0 of the EIS Main Report	Refer to Chapter 3.0 of the EIS Main Report	Regular Monitoring	Regular Monitoring	Regular Monitoring
III. ABANDONMENT PHASE	**The Land** *Construction debris*	Debris	Observation	One Time Only	Project	PCO	NA	NA	NA	NA	Cleaning	Cleaning	NA

Proponent:	Consultant:	Project Title and Location:	Sheet Content:
Roxanna S. Go MPSA Holder 167 Sumulong Highway, Antipolo City	CEnSE Technical Consultancy Services Unit 405, Yrreverre Square Building, 888 Mindanao Avenue, Quezon City	Pozzolan Quarry (MPSA 347-2010-IVA) Barangay Maybancal, Morong and Barangay Dalig, Teresa Municipality of Rizal	Air and Noise Sampling Map *Figure 6-1*

Figure 6-1. Locations of Air and Noise Monitoring stations



Proponent:	Consultant:	Project Title and Location:	Sheet Content:
Roxanna S. Go MPSA Holder 167 Sumulong Highway, Antipolo City	CEnSE Technical Consultancy Services Unit 405, Yrreverre Square Building, 888 Mindanao Avenue, Quezon City	Pozzolan Quarry (MPSA 347-2010-IVA) Barangay Maybancal, Morong and Barangay Dalig, Teresa Municipality of Rizal	Surface Water Sampling Monitoring Map *Figure 6-2*

Figure 6-2. Locations of Surface Water Monitoring Stations

7.0 DECOMMISSIONING/ ABANDONMENT/ REHABILITATION POLICY

The project is not expected to be abandoned within the next ten (10) years from its planned quarry operations, however, Progressive Rehabilitation shall be implemented by the proponent through developing it into Farm lot Subdivision project. Final Mine Rehabilitation and Decommissioning Plan (FMRDP) shall be prepared consistent with the provisions and relevant rules and regulations of the Philippine Mining Act of 1995.

Progressive Rehabilitation Framework

The proponent will conduct a progressive rehabilitation from the quarry area during the entire operation while performing the desired elevation for the development a farm lot.

Bamboo forestation shall be implemented along the buffer zones prior to start of quarry operation, it is expected that 100% bamboo trees shall be planted, this is in line with DENR's project utilizing bamboos as protection and erosion control measures;

Temporary re-greening of the section of the mined area shall be done before land development's desired final land use in a form farm lots while quarrying is still going-on to other phase or section. This pattern shall continue until such time that quarry has ceased its operation.

Reinvestigation on the site and another assessment shall be done in a form of geohazards to identify if the proposed land use plan is already suitable for implementation.

However, if abandonment is necessary due to urgent reasons, the proponent will perform an Abandonment Plan. The following scenarios may become reasons to abandon the project:

- Closure order from National and Local Government agencies

As such, the proponent will allocate sufficient time and available resources for proper dismantling and removal of structures and equipment from the site to minimize possible or further threats to the surrounding environment. Other activities that will be done during this event are the following:

- Secure necessary government clearances related to abandoning and closure of the project
- Removal of machineries, dismantling of equipment and clean-up
- Removal of solid, liquid, and hazardous wastes within the site through a DENR-certified waste transporter/treater; and
- Clean-up and possible remediation of the site, if future evaluations and testing suggest such activity is necessary.

8.0 INSTITUTIONAL PLAN FOR EMP IMPLEMENTATION

The operator of the quarry shall form an Environmental Unit (EU) for the purpose of monitoring quarry operation assigning a Pollution Control Officer (PCO) under the supervision Managing Head who reports directly to the Mining Engineer and Community Relations Officer (CRO) to effectively monitor the implementation of the environmental and social impact management measures, ***Figure 8-1*** presents the Organizational Chart of the company.

Functions:

During Construction and Operation Phase

The Pollution Control Officer (PCO) shall be responsible for the implementation of the recommended Environmental Management Measures and Environmental Monitoring Plan as stated in this report. He shall direct all contractors and sub-contractors in case they have observed the alert and action situation for immediate corrective measures. In addition, Community Relations and Safety Officer shall likewise be assigned. He shall be responsible for the regular submission of the compliances report to the EMB Region 4A and Central Office.

The Organizational Chart

President of the Quarry Operator

Like in any other normal organization, the Quarry Operator is headed by its President shall be the responsible for planning, organizing, leading and controlling of the company.

Mining Engineer

The Mining Engineer shall report directly to the head of the Environmental Unit (EU) who shall be responsible for the overall quarry operation of the project as well as leading to the management of the people and environment.

Managing Head

The Managing Head shall ensure compliance with the requirements of PD 1586, RA 6969, RA 8749, RA 9003, RA 9275.

Pollution Control Officer (PCO)

Pollution Control Officer (PCO) who shall be reporting directly to him and shall be responsible for the implementation of the environmental management plan of the quarry and crushing plant project.

Community Relations Officer (CRO)

The Community Relations Officer (CRO) shall be responsible for community activities and the implementation of the Social Development and Management Plan (SDMP).

Health and Safety Officer

The health and safety shall include administration of the following:

- safety practices of the workers inside the quarry and crushing plant
- point person in the disaster management plan
- emergency needs of the workers

Progressive Rehabilitation Plan

The Environmental Unit (EU) of the operator shall be responsible for the implementation of the Progressive Rehabilitation Plan.

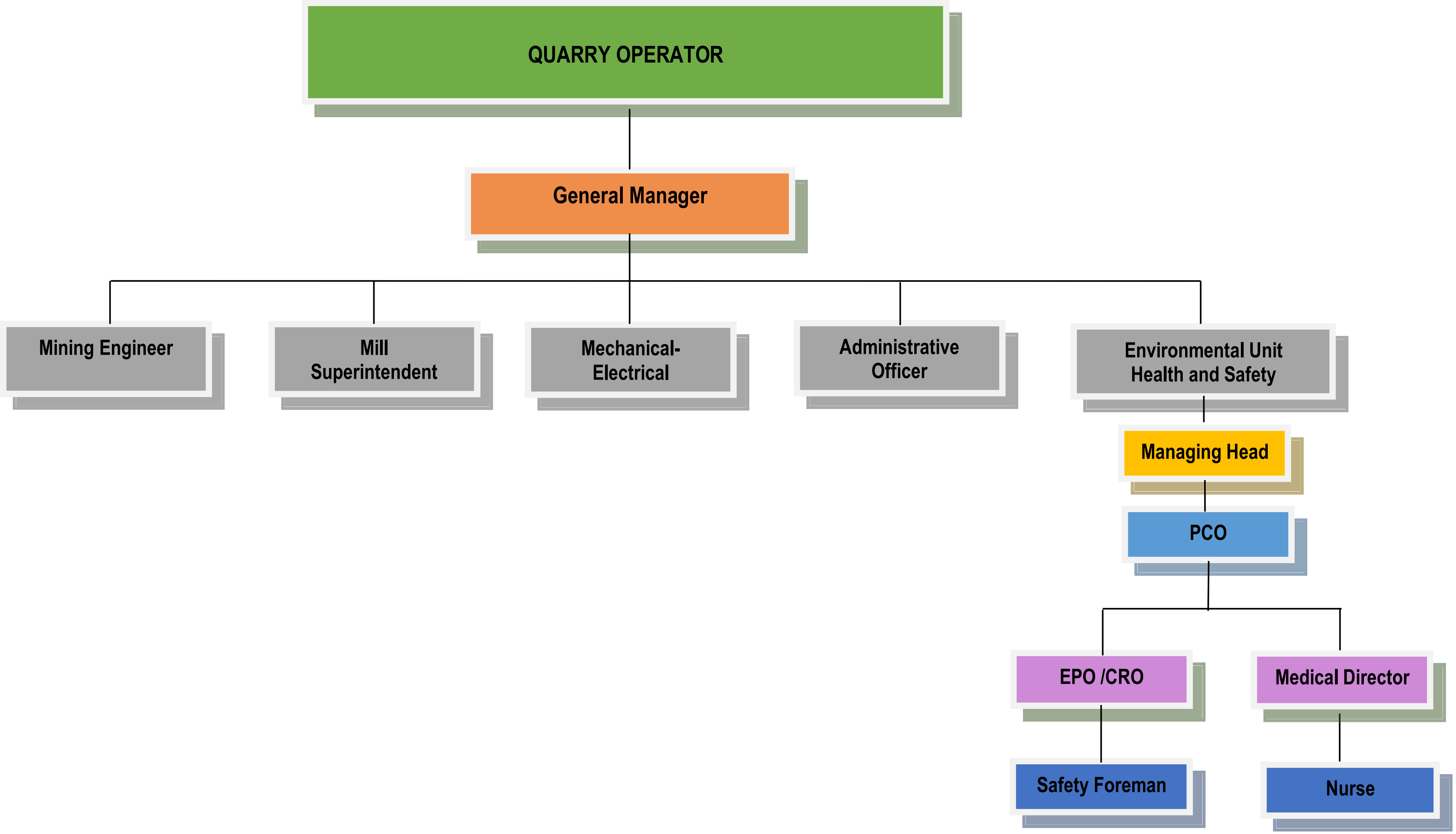


Figure 8-1 Organizational Chart of the Environmental Unit (EU)