Resource Development (Phils.) Inc.

ENVIRONMENTAL PERFORMANCE REPORT AND MANAGEMENT PLAN

Balabag Gold-Silver Project

Sitio Balabag, Brgy. Depore, Municipality of Bayog, Province of Zamboanga del Sur, Philippines, 7011

June 2022
Revision 02

ACRONYMS

ACECI	Archeological Cultural and Environmental Consultancy, Inc.	**IFC**	International Finance Corporation
AD	Absolute Dominance	**IP**	Indigenous People
ADSDPP	Ancestral Domain Sustainable Development Protection Plan	**IPCC**	Intergovernmental Panel on Climate Change
AEGL	Acute Exposure Guideline Levels	**IPDP**	Indigenous Peoples Development Plan
AEPEP	Annual Environmental Protection and Enhancement Program	**IUCN**	International Union for Conservation of Nature
AET	Apparent Effects Threshold	**IV**	Importance Value
AF	Absolute Frequency	**KP**	Knight Piésold Consulting
AIA	Archeological Impact Assessment	**LC**	Least Concern
ALOHA	Areal Locations of Hazardous Atmospheres	**LC50**	Lethal Concentration 50
AMC	Antecedent Moisture Condition	**LEL**	Lower Explosive Limit
AMD	Acid Mine Drainage	**LGU**	Local Government Unit
ANFO	Ammonium Nitrate-Fuel Oil	**MCE**	Maximum Credible Earthquake
ARB	Agrarian Reform Beneficiaries	**MEPEO**	Mine Environmental Protection and Enhancement Office
ARC	Agrarian Reform Community	**MGB**	Mines and Geosciences Bureau
ASHP	Annual Safety and Health Program	**MMT**	Multipartite Monitoring Team
AuEq	Gold Equivalent	**MOSSMA**	Monte de Oro Small Scale Mining Association
BAF	Bio-Accumulation Factor	**MPSA**	Mineral Production Sharing Agreement
BaP	Benzo (a) pyrene	**MRFC**	Mine Rehabilitation Fund Committee
BFAR	Bureau of Fish and Aquatic Resources	**MRF**	Mine Rehabilitation Fund
BIR	Bureau of Internal Revenue	**MRL**	Maximum Residue Limits
BOD	Biological Oxygen Demand	**MSDS**	Material Safety Data Sheet
BSWM	Bureau of Soils and Water Management	**MT**	Metric Ton
CADT	Certificate of Ancestral Domain Title	**MTPD**	Metric Ton Per Day
CAP	Community Action Planning	**MWMP**	Meteoric Water Mobility Procedure
CARP	Comprehensive Agrarian Reform Program	**MWTFRF**	Mine Waste and Tailings Fees Reserve Fund
CCO	Chemical Control Order	**NAAQGV**	National Ambient Air Quality Guideline Value
CDP	Community Development Program	**NAMRIA**	National Mapping and Resource Information Authority

CENRO	Community Environment and Natural Resources Office	**NCIP**	National Commission on Indigenous Peoples
CIP	Carbon in Pulp	**NGO**	Non-Governmental Organization
CITES	Convention on International Trade in Endangered Species	**NHMRC**	National Health and Medical Research Council of Australia
CLRF	Contingent Liability and Rehabilitation Fund	**NO**	Nitric Oxide
CMT	Crisis Management Team	**NO2**	Nitrogen Dioxide
CN	Cyanide	**NOAA**	National Oceanic and Atmospheric Administration
CO	Carbon Monoxide	**NOEL**	No Observed Effect Level
CO2	Carbon Dioxide	**NPR**	Neutralization Potential Ratio
COD	Chemical Oxygen Demand	**NT**	Near Threatened
CR	Critically Endangered	**NWRB**	National Water Resources Board
CRO	Community Relations Office	**O&G**	Oil and Grease
DAO	Department Administrative Order	**PAGASA**	Philippine Atmospheric, Geophysical Astronomical Services Administration
DAR	Department of Agrarian Reform	**PAH**	Polycyclic Aromatic Hydrocarbon
DENR	Department of Environment and Natural Resources	**PCO**	Pollution Control Officer
DO	Dissolved Oxygen	**PEL**	Permissible Exposure Limit
DOC	Degradable Organic Carbon	**PHILVOCS**	Philippine Institute of Volcanology and Seismology
DTM	Digital Terrain Model	**PM10**	Particulate Matter (less than 10 microns in diameter)
EC	Estimated Total Cover	**PMF**	Probable Maximum Flood
ECA	Environmentally Critical Area	**PRA**	Participatory Resource Appraisal
ECC	Environmental Compliance Certificate	**PRECIS**	Providing Regional Climates for Impact Studies
ECP	Environmentally Critical Project	**RC**	Relative Cover
EIA	Environmental Impact Assessment	**RCF**	Rehabilitation Cash Fund
EIS	Environmental Impact Statement	**RD**	Relative Dominance
EMB	Environmental Management Bureau	**RF**	Relative Frequency
EN	Endangered	**SDMP**	Social Development and Management Program
EPEP	Environmental Protection and Enhancement Program	**SEC**	Securities and Exchange Commission
ERA	Environmental Risk Assessment	**SO2**	Sulfur Dioxide
ERL	Effect Range-Low	**TDS**	Total Dissolved Solids
EPRP	Emergency Preparedness and Response Program	**TNT**	Trinitrotoluene
ERT	Emergency Response Team	**TSF**	Tailings Storage Facility

EW	Extinct in the Wild	**TSP**	Total Suspended Particulates
EX	Extinct	**TSS**	Total Suspended Solids
FAO	Food and Agriculture Organization	**TVIRD**	TVI Resource Development Phils., Inc.
FMB	Forest Management Bureau	**UEL**	Upper Explosive Limit
FMRDF	Final Mine Rehabilitation and Decommissioning Fund	**UNDP**	United Nations Development Program
FMR/DP	Final Mine Rehabilitation and/or Decommissioning Plan	**UNFCCC**	United Nations Framework Convention on Climate Change
FOD	First Order Decay	**URTI**	Upper Respiratory Tract Infection
FPIC	Free, Prior and Informed Consent	**USD**	United States Dollar
GHG	Greenhouse Gases	**USEPA**	United States Environmental Protection Agency
HCN	Hydrogen Cyanide	**USGS**	United States Geologic Survey
HLURB	Housing and Land Use Regulatory Board	**VU**	Vulnerable
IEC	Information, Education and Communication	**WAD**	Weak Acid Dissociable

PROJECT FACT SHEET

Project Name	Balabag Gold-Silver Project
Project Location	Sitio Balabag, Barangay Depore, Municipality of Bayog, Zamboanga del Sur
Project Proponent	TVI Resource Development Phils., Inc.
Project Type	Gold and Silver Mining and Metallic or Ore Processing Project is classified as an Environmentally Critical Project (ECP) based on Environmental Management Bureau (EMB) Memorandum Circular 2014-005, under Resource Extractive Industries. The project falls under sub-project 2.1.2 (Extraction of metallic minerals On-Shore) with an extraction rate greater than 100,000 Metric Tons per annum and sub-project 2.1.6.a (Metallic Mineral Ore Processing) with a processing rate greater than 70,000 MT per annum.
ECC Issued	On October 01, 2013, TVIRD was granted an Environmental Compliance Certificate (ECC-CO-1301-0004) covering 180 hectares for the mining and processing of gold and silver ore. It has an estimated maximum annual extraction rate of two (2) million metric tons of ore and waste materials using open pit mining while the mill and processing plant shall have a maximum daily production capacity of two thousand (2,000) metric tons per day. On June 03, 2020, another Environmental Compliance Certificate (ECC-OL-R09-2020-0131) was issued for the Housing and Camp Facilities of TVIRD covering an area of 4.5 hectares within the MPSA. Subsequently, on June 22, 2021, an Environmental Compliance Certificate (ECC-R09-2021-0131) was issued for the Company's Multi-Facilities covering an area of 4.9095 hectares. The multi-facilities include additional housing and camp facilities, clinic, motor pool, fuel farm, contractors' facilities and laydown area, nursery area, hazardous waste facility, material recovery facility, and security barracks. The total Area under ECC is now 189.4095 hectares.

Proposed Expansion / Project Size

Project Components	Existing ECC-allowed size	Additional Area/Capacity in the Proposed EPRMP Expansion	Total Area Applied in this EPRMP
Area Coverage	189.4095 ha	1987.5909 ha	2,177 ha
Extraction Rate (Ore-Waste)	2 MMTPY	9 MMTPY	11 MMTPY
Surface Mine Area	13.5 ha	21.50 ha	35.0 ha
Mill and Processing Plant Capacity	2,000 Metric Tons per day	500 Metric Tons per day	2,500 Metric Tons per day
Tailings Storage Facility	20.5 ha	55.5 ha	76 ha
Waste Dump Area	13 ha	37.0 ha	50 ha

Summary of Project Components / Expansion

Project Components	ORIGINAL EIS AND ECC		EPRMP 2022	
	No. of Units	Specifications (Area or Capacity)	No. of Units	Specifications (Area or Capacity)
Mill and Processing Plant	1	Initially at 500 MTPD and 0.5 ha in the 2012 EIS. Final Area of 2.34 ha for Mill Processing	1 (No change, Mill Plant can accommodate the increase in throughput)	2.34 ha for processing 2,500 MTPD of ore
Main Warehouse Building	1	Initially 15,000 sqm in the 2012 EIS. Currently 5,000 sqm	1	5,000 sqm
Ancillary Facilities	TOTAL	12.0 ha	TOTAL	12.0 ha
Chemicals and Reagents Storage Facility	1	2,350.0235 sqm	1	2,350.0235 sqm
Power Supply (Multiple Diesel Engine Generator Sets)	4 (Two 1.5 MW and two 2.0 MW)	4.5-5.6 MW for 2,000 TPD Throughput	6 (Four 1.5 MW and two 2.0 MW)	5.8 MW for 2,500 TPD Throughput

	Water Supply	1	80 lps	1	80 lps
	Water Demand		22.34 lps		27.93 lps
	Materials/ Supplies Warehouse	1	0.1760 ha	1	0.1760 ha
	Access Road	1 lot 10 m wide (min)	9 ha	1 lot 10 m wide (min)	30 ha
	Housing and Camp Facilities	1	2.5 ha, expanded to 4.5 ha under ECC-OL-R09-2020-0131	2	4.5 ha + areas under multi-Facilities
	Administration Facility	1	2.5 ha	1	2.5 ha
	Multi-Facilities	TOTAL	4.9095 which include additional housing and camp facilities, clinic, motor pool, fuel farm, contractors' facilities and laydown area, nursery area, hazardous waste facility, material recovery facility, and security barracks under ECC-R09-2021-0131	TOTAL	4.9095 which include additional housing and camp facilities, clinic, motor pool, fuel farm, contractors' facilities and laydown area, nursery area, hazardous waste facility, material recovery facility, and security barracks under ECC-R09-2021-0131
	Contractors' Facilities	4	0.9305 ha	4	0.9305 ha
	Security Barracks	1	1.252 ha	1	1.252 ha
	Nursery	1	0.5155 ha	1	0.5155 ha
	Materials Recovery Facility	1		1	

	Hazardous Waste Facility	1		1	
	Housing and Camp Facilities	1	1.7038 ha	1	1.7038 ha
	Clinic	1 (3-bed capacity as per DOLE DO 2018-198)	0.5077 ha	1 (3-bed capacity as per DOLE DO 2018-198)	0.5077 ha
	Motorpool	1		1	
	Fuel Farm	1 (4 tanks with 98, 280 L gasoline capacity)		1 (6 tanks with 158,760L diesel and 15,120L gasoline capacity)	
	Assay and Metallurgical Laboratory	1	374.30 sqm	1	374.30 sqm
	Explosive Magazine				
	Dynamite	2	36 tons @ 18 tons each	2	36 tons @ 18 tons each
	ANFO	3	54 tons @ 18 tons each	3	54 tons @ 18 tons each
	Blasting Cap and Accessories	1	2 tons	1	2 tons
Total Project Cost	One Billion and Seventy-Two Million Pesos (PHP 1.074B); increase of P169.5 Million Pesos for the expansion.				
Total Manpower	687 directly hired employment, excluding the out-source workers; increase of 143 employees from the previous ECC.				
Project Schedule	Under commercial operation for 2 years since (2021) with initial plant components already completed. Full expansion is expected to be completed by 2027 Life of Mine.				

BRIEF SUMMARY OF THE EIA PROCESS

Background Information	On October 01, 2013, TVIRD was granted an Environmental Compliance Certificate (ECC-CO-1301-0004) covering 180 hectares for the mining and processing of gold and silver ore for its Balabag Gold-Silver Project. The Project lies within the 4,779 hectares area is covered by Mineral Production Sharing Agreement (MPSA) No. 086- 97-IX located in Sitio Balabag, Brgy. Depore, Bayog, Zamboanga del Sur. The ECC allows an estimated maximum annual extraction rate of two (2) million metric tons of ore and waste materials using

	surface mining method (side cut) while the mill and processing plant shall have a maximum daily production capacity of two thousand (2,000) metric tons per day but will be expanded to two thousand five hundred (2,500) metric tons per day. On June 03, 2020, another Environmental Compliance Certificate (ECC-OL-R09-2020-0131) was issued for the Housing and Camp Facilities of TVIRD covering an area of 4.5 hectares within the MPSA. Subsequently, on June 22, 2021, Environmental Compliance Certificate (ECC-R09-2021-0131) was issued for the Company's Multi-Facilities covering an area of 4.9095 hectares. The multi-facilities include additional housing and camp facilities, clinic, motor pool, fuel farm, contractors' facilities and laydown area, nursery area, hazardous waste facility, material recovery facility, and security barracks.
	The Balabag Gold-Silver Project will expand the annual ore production from the current 2.0 million metric tonnes to 11.0 million metric tonnes while expanding the mining area from 13.5 hectares to 35 hectares. The Expansion Project will also expand the area coverage of the current project from 189.4 ha to 2,177 ha located within the MPSA area (see Figure 1-2). There will be no changes from the existing mining and processing methods involved with the increase in production capacity. The same tailings management operations will be practiced but the tailings storage facility will likewise increase in size with the increased annual ore production and with the opportunity to include all facilities attached to the TSF. All mining operations will still be anchored within the MPSA boundaries and project support from the Subanen Indigenous Peoples, host and neighboring communities, and Local Government Units remains favorable.
Terms of Reference of the EIA Study	The Philippine Environmental Impact Statement System (PEISS), under Presidential Decree No. 1586, is the key planning tool for any major project that needs the incorporation of sustainable development. The main purpose of sustainable development activities is to support the project's intended business interest, while preserving or minimizing its negative effects to its surrounding environment and host communities. The Proponent, TVIRD, has been granted an ECC for its Balabag Gold-Silver Project and, based on its initial operations over the last two years while other facilities are being scaled up, requires an increase in its ECC approved area (still within its MPSA) and extraction and mill and processing rates without a change in its plant and mill equipment. In essence, TVIRD has strategically found a way to increase mill and processing plant capacity without changing the process equipment which will require a greater extraction rate and a larger ECC-approved area within its MPSA. Definitely, with the increase in extraction rate, the waste rock and overburden stockpile and the TSF areas will also increase as well as the mining area based on its approved 2018 Declaration of

<table>
<tr><td></td><td>Mining Project Feasibility (DMPF) submitted to the Mines and Geosciences Bureau (MGB).

The Proponent is required to apply for an amendment of its Environmental Compliance Certificate (ECC) from the DENR-EMB Central Office in order to increase its mill and processing capacity and extraction rate. Pre-requisite to the acquisition of the ECC for the project is the submission of an Environmental Performance Report and Management Plan (EPRMP) as stated on the EMB Memorandum Circular No. 2014-005 (Guidelines for Coverage Screening and Standardized Requirements under the Philippine Environmental Impact Statement System amending relevant portions of MC 2007-002). This EPRMP used the standard EIS Scoping and Screening Form as a guide in the impact analysis and details the performance of the mining operations in the first two years.</td></tr>
<tr><td>Legal Framework</td><td>Prepared based on the following laws and regulations and documents:
- DENR Administrative Order (DAO) 2003-30 otherwise known as the Implementing Rules and Regulations (IRR) for the Philippine Environmental Impact Statement (EIS) System;
- Revised Procedural Manual for DAO 2003-30;
- EMB Memorandum Circular No. 2014-005 Re: Guidelines for Coverage Screening and Standardized Requirements under the Philippine Environmental Impact Statement System amending relevant portions of MC 2007-002;
- DAO 2010-21, Revised Implementing Rules and Regulations of R.A. 7942, otherwise knowns as the Philippine Mining Act of 1995;
- DAO 2016-08 and DAO 2021-22 or the Revised Effluent Standards;
- DAO 2000-81, the IRR for RA 8749 Clean Air Act;
- DAO 2005-10, the IRR of RA 9275 Clean Water Act;
- DAO 2017-015 Guidelines on Public Participation under the Philippine Environmental Impact Statement (PEIS) System;
- RA 9003 Ecological Solid Waste Management Act;
- Requirements of the Local Government Units;
- Prescribed best practices and procedures;
- Other applicable and/or mandated laws and regulations; and
- Needs and expectations of interested parties that the Company regards as relevant.</td></tr>
<tr><td>EIA Study Team</td><td><table>
<tr><th>Consultant</th><th>Expertise</th></tr>
<tr><td>Mr. Allan Plete</td><td>Team Lead</td></tr>
<tr><td>Mr. Samuel S. Sendon</td><td>Geo-technical Reviewer</td></tr>
<tr><td>Mr. Aldwin Camance</td><td>General Ecology and Risk Assessment</td></tr>
<tr><td>Mr. Jake G. Foronda</td><td>Metallurgy</td></tr>
<tr><td>Mr. Edsel M. Abrasaldo</td><td>Exploration and Geology</td></tr>
</table></td></tr>
</table>

	Mr. Leo A. Sosa	Exploration and Geology
	Ms. Jesalyn A. Guingguing	Environmental Planning and Management
	Mr. Paulo Dino P. Fulong	Mining Engineering
	Mr. Jurby S. Jumawan	Metallurgy
	Ms. Agnes L. Goze	Chemical and Environmental Engineering
	Mr. Jjam S. Cutillas	Environmental Planning and Management
	Mr. Crisologo B. Luza	Civil Engineering
	Ms. Sharon Rose A. Surem	Permits and Licenses
	Mr. Lowie M. Gonzales	Mining Engineering
	Ms. Alyzza B. Mariquit	Geology
	Ms. Estela Q. Cuadrado	Environmental Science
	Ms. Genevieve D. Alindeg	Mining Engineering and Compliance Obligations

EIA Study Schedule

The EIA Study Schedule was conducted from February to June 2022 across areas in the project site.

EIA Study Milestones	Date	Remarks
Information, Education and Communication (IEC) Activities	February 04 to 27, 2022	Communities in Bayog, IPs, Subanen Tribe, Stakeholders in Barangay Dimalinao, Community in Barangay Dipili, Barangay Depore, Barang Pulang Bato
Public Scoping	April 08, 2022	Completed
Technical Scoping at EMB Central Office	April 27, 2022	Completed
Screening of EPRMP	Submitted May 11, 2022	Reverted back May 17, 2022
Technical Review	June 06, 2022	Completed

EIA Methodologies

Prepared based on the stipulated provisions of DAO 2003-30 otherwise known as the Implementing Rules and Regulations (IRR) for the Philippine Environmental Impact Statement (EIS) System, Revised Procedural Manual for DAO 2003-30, EMB Memorandum Circular No. 2014-005 Re: Guidelines for Coverage Screening and Standardized Requirements under the Philippine Environmental Impact Statement System amending relevant portions of MC 2007-002, and other relevant applicable laws and regulations.

	In general, the main stages that the Company carried out for the assessment are as follows: • Planning and Data Review • Screening for Coverage and Amendment Requirements • Information, Education, and Communication • Public Scoping • Technical Scoping • Primary and Secondary Data Gathering • Preparation of Report and Evaluation
Land	Investigation of the existing environmental setting was done to compile and assess data for impact identification, prediction, and assessment. Environmental component on Land includes Land Use and Classification and Geology wherein the methodology and approach involve the review of CLUPs, data on protected areas and the areas under the CADT, review of reports and information from MGB, PHIVOLCS, PAGASA, and NAMRIA to assess impacts on the compatibility, protection afforded in the area and susceptibility of the area to natural hazards.
Water	For Water, the impact assessment on the construction activities comprises baseline survey for Hydrology and Hydrogeology where CLUP of the host LGU and other data taken from MGB, NAMRIA and PHIVOLCS were reviewed. Also, fresh water quality, where water samples were collected and analyzed for physicochemical analyses with reference to the guidelines set by DAO 2016-08, were considered.
Air and Noise	Baseline survey for air includes collection and review of existing literature and maps of the project from PAGASA station for Meteorology and Climatology. Other data were gathered from the conduct of ambient air and noise quality monitoring where impacts of the construction and operation phase were assessed on the existing local environment. Further, Air and Noise Dispersion Modelling Report as required in the original ECC was considered.
People	This involves review of CLUP, ADSPDPP, relevant studies from PSA where critical data was gathered for this study to assess impacts and risks of the project activities. Review of socio-economic profile of the communities in the impact areas and the implementation of the Social Development and Management Program of TVIRD were also incorporated.

EIA SUMMARY

PROJECT ALTERNATIVES

Different Project alternatives and variations were defined and evaluated with respect to economic, technical feasibility, social and environmental impacts, and post-mining sustainability.

Table E-1: Summary of Major Project Feature Alternatives and Variations for Mining and Waste Management

Project Component	Alternatives and Variations	Decision Criteria
Mine Area	No changes in chosen option: Location: Miswi-Tinago Area of Balabag Mining Method: Surface Mine Area will increase from 13.5 ha to 35 ha	There are no alternative locations for the mine area since it is dependent on where the ore deposit exists. The surface mining method is preferred since the geology and mineralization within the area are shallow and suggest a surface mining approach with respect to technical issues and economics. Deeper veins are also evident below the shallow ore. The increase in mining area is primarily to accommodate additional potential resources as indicated in the approved DMPF dated May 2018.
Waste Dump Area	Alternative 1: South and East of the Surface Mine	The area south and east of the surface mine area has been identified as potential areas for additional ore resources. This area will be subject to further exploration in the future. The area south of the surface mine is within a different watershed thereby increasing the environmental impact footprint.
	Alternative 2: West of the Surface Mine	This area is located within a different watershed thereby increasing the environmental impact footprint. Transportation will be more difficult with corresponding higher costs. The site is not considered.
	Alternative 3: North of the Surface Mine (Selected Alternative)	The area is adjacent to the surface mine resulting in reduced transportation time and lower costs. It is also located within the same watershed as the other major

Project Component	Alternatives and Variations	Decision Criteria
		facilities thereby reducing the environmental impact footprint. Surface water runoff is captured by the Tailings Storage Facility for treatment and water quality management.
	Increase in area from 13.5 ha to 35 ha	The increase in mine waste disposal is compelled by the increase in mineral extraction rate to 11MMT per year, which would mean a greater amount of waste and overburden rock to shift from the mining area to the disposal area.
Tailings Storage Facility	Alternative 1: 1km Southwest of the Surface Mine. Alternative 2: 800m Southwest of the Surface Mine	Both Alternative 1 and 2 are in different watershed thereby increasing the environmental impact footprint. Both sites require high embankments to provide sufficient tailings storage capacity. Tailings conveyance facilities from the processing plant will be long and subject to higher costs, additional maintenance and increased environmental risk.
	Alternative 3: L 800 m East of the Surface Mine (Selected Alternative)	Alternative 3 is located within the same watershed as the other facilities thereby minimizing the environmental impact footprint. The tailings storage capacity is the greatest relative to the other alternatives. Access to the processing plant is the most favorable. The location also allows the capture of sediment from the surface mine and waste dump areas and provides for centralized water quality management capabilities.
	Alternative 4: 1.3 km Southeast of the Surface Mine	Alternative 4 is in a different watershed thereby increasing the

Project Component	Alternatives and Variations	Decision Criteria
		environmental impact footprint. This site requires a higher embankment to provide sufficient tailings storage capacity. Tailings conveyance facilities from the processing plant will be long and subject to higher costs, additional maintenance and increased environmental risk. An increase in TSF is warranted by the 25% increase in mineral processing rate, which will need a larger and expanded TSF Area. This also includes all the appurtenances required for the TSD such as pipelines and emergency spillways.

Table E-2: Summary of Major Project Feature Alternatives and Variations for Mill and Processing Operations

Project Component	Alternatives and Variations	Decision Criteria
Mill Process	Alternative 1: Heap Leaching	The Heap Leaching alternative is hindered by several technical and environmental constraints. Suitable flat topographic areas are limited. High precipitation hinders operations and presents potential environmental management concerns. Test work did not indicate a robust metals recovery regime.
	Alternative 2: Gravity Separation	Alternative 2 has the least environmental impact potential. Recovery of gold and silver however is low and in the range of 30% to 35% and 4% to 5% respectively. As a result, the economic viability is low.
	Alternative 3: Standard Cyanidation Process	Cyanide leaching is the most viable option for the type of ore present at Balabag. Sodium cyanide would be used to recover gold and silver.

Project Component	Alternatives and Variations	Decision Criteria
		Significant metallurgical testing was done to fully characterize the process and establish design and operating parameters.
	Alternative 4: Combined Gravity Separation and Cyanidation (Selected Alternative)	Metallurgical testing identified a combined Gravity Separation and Cyanidation process as producing the highest recoveries and resulting in the most robust economic operation. Constraints associated with this alternative include increased environmental management protocols and the need for tailings detoxification due to the use of sodium cyanide. There will be no changes in the mill and processing plant as installed based on the previous ECC since the same configuration of mill and plant can take an increase of 25% throughput without any problem.
Tailings Disposal	Alternative 1: Thickened Tailings Disposal within an Impoundment Alternative 2: Paste Tailings and Disposal within an Impoundment Alternative 3: Filtered Tailings and Disposal within an Impoundment	The objective of Alternatives 1, 2, and 3 is to reduce the volume of tailings due to increased tailings densities and reduce the water volume within the tailings impoundment. The height of the tailings containment structure may be reduced thereby reducing capital costs. Additional equipment is required within the process plant to produce thickened tailings resulting in an increased capital cost. Conveyance of the tailings will be more difficult due to the high solids concentration. Watershed sediment storage within the impoundment will

Project Component	Alternatives and Variations	Decision Criteria
		negate some benefits derived from increased tailings densities.
	Alternative 4: Combined Mine Waste and Process Tailings and Disposal within and Impoundment	Combined waste disposal improves the geotechnical properties of the material and increases mechanical strength. May improve the final rehabilitation and reclamation programs. Less volume is required for combined waste disposal versus two distinct waste disposal sites. Limited operational data on the effectiveness of this method. Tailings disposal areas are very limited with respect to storage capacity. Addition of waste rock is not viable.
	Alternative 5: Conventional Wet Tailings Deposition within an Engineered Tailings Storage Facility (Selected Alternative)	Conventional tailings disposal method with defined operating parameters and facility construction programs familiar to the TVIRD operations staff. Limited storage capacity at all alternative tailings storage facility sites negates the addition of waste rock. Storage efficiency at all sites is poor and increased densities will not significantly affect the size of the dam embankment. Some tailings thickening (Alternative 1) is planned within the mill process for water recycling.

SUMMARY OF BASELINE CHARACTERIZATION, KEY ENVIRONMENTAL IMPACTS AND MANAGEMENT AND MONITORING PLAN

Table E-3: Summary of Baseline Characterization

Module	Baseline Characterization
LAND	

Land Use and Classification	The Project is in Barangay Depore and Barangay Dimalinao which is considered as a mining area and the Project's operation will not result to any changes in the land use plan. In the original ECC, the Project was anticipated to disturb approximately 89.5 hectares in total. This represents 1.87% of the entire MPSA and 2.58% of the mining reserve area allocation within the Municipality of Bayog. As of May 2022, the total disturbed area is 112.5 hectares which is 2.35% of the MPSA and 3.24% of the mining reserve allocation. In the proposed amendment to the ECC, the total disturbed area is estimated to be 246.47 hectares which is about 5.16% of the MPSA and 7.10% of the mineral reserve area.
Topography and Drainage	The overall Project area encompasses a moderate to rugged mountainous topography with slopes generally ranging from 30% to 45%. Some slopes within the Project area however are considerably steeper than this due to the small-scale mining activities and removal of material for processing. Elevations range from 200 meters above sea level at the eastern part of the MPSA area and rise to a maximum of 900 meters above sea level near the central part of the Project area.
Terrestrial Flora	There were only 161 species observed in 2020 compared to 338 species in 2011. Diversity in 2020 is 3.83 while in 2011 was 4.367. A total of 33 species were considered as threatened of which three species, *S. palosapis Hopea acuminata*, and *Toona calantas*, were listed as critically endangered while *Medinilla magnifica* and *Litsea leytenensis*, *Diospyros blancoi* were considered as endangered. Disturbance and continuous degradation of the dipterocarp forests are apparent. The stressors include: - Tree cutting for fuelwood and lumber which is a major source of livelihood by the residents. - Annual burning due to the highly combustible underbrush cover. - Ground clearing and disturbance due to mining operations.
Terrestrial Fauna (Avifauna)	From the 63 avian species of 28 families observed in October 2020, the number goes up by 17.4% to 74 species from 36 families. It might be possible that there are improvements in the vegetation cover of the area than it was in 2011. The 2020 study provides additional twenty-one species not listed in the previous updating the lexicon to a total of 83 birds within the MPSA. Majority of the observed avifauna species were endemic constituting to about 51% and is about 45% higher than those listed in the 2011 monitoring (recorded 14 endemic).

	Forty-two (42) avifauna species are endemic and nine (9) in the threatened classification by IUCN. Several species (11%) are found to be important as these falls within the threatened classification of IUCN. Seven species fall in the near-threatened and one in the vulnerable classification. The presence of these threatened species signifies the importance of maintaining important habitat for these species within the MPSA.
Terrestrial Fauna (Mammal)	Thirteen (13) species of mammals were observed in 2011 while there were only 12 in the 2020 study. The Philippine Tarsier (*Carlito syrichta*) was also reported in the area preliminary survey recorded this species last 2011. However, during the sampling period, this species was not encountered, according to the informant this species is rarely sighted and still present in the area, particularly in the forested area of Unao-Unao sampling site.
Terrestrial Fauna (Amphibian)	The number of amphibian species observed in 2011 and 2020 was the same at 9 species and all are Philippine Endemic. The five species have a decreasing population, three have a stable population and one unknown trend of population.
WATER	
Hydrology	The MPSA is located within two river watersheds: the Kabasalan River (Basin Code Number 09394) in the west and the Sibugay River (Basin Code Number 09395) in the east. Both rivers are part of the Sibugay- Ingin Basin as identified by the Western Mindanao Framework Plan. The Project area is located entirely within the Sibugay River basin. Local rivers and creeks within the vicinity of the Project area include Dimalinao Creek, Unao-Unao Creek, Genaro (Naro) Creek, Dipili River and Depore River. The Project area is drained by the Dipili River on the east and Depore River on the south and west. All the Project features are located within the Unao-Unao Creek watershed which is a tributary of the Dipili River.
Water Quality	Groundwater samples collected are all within the standards of PNSDW. Based on the 2021 monitoring results of TVIRD to the various rivers and creeks near the project site, all the stations failed to meet the water quality guideline for fecal coliform and phosphate. There are also some stations that exceeded the limit for TSS and oil and grease.

Fresh Water Ecology	Similar to the previous survey period in August 2010, the number of fishes in freshwater bodies sampled during the present survey period last March 2022 was again very low. No fish and other aquatic species were caught in the highland stations of Dimalinao Creek (BS1), Unao-Unao Creek (BS2), Dipili Creek (BS3) and Depore River (BS4). These stations are located within and around the Balabag Gold-Silver Project and at higher elevations where these creeks and rivers are quite narrow, very shallow and water flow is commonly fast and generally murky. Fishes were only caught mostly on the stations at lower elevations [Genaro (Naro) Creek (CS1), Malagak Creek (CS2), Dipili River (OS1) and Sibugay River (OS2)] where the body of water is generally wider and deeper. Water current in these creeks and rivers are also weaker which is likely to be a more favorable habitat for fish. In Genaro (Naro) Creek (CS1), the catch is dominantly represented by a cyprinid carp or paitan (*Puntius binotatus*) followed by unidentified gobies, frogs and crabs. In Malagak Creek (CS2), paitan, gobies and frogs were caught. Sibugay River (OS2) is represented mainly by juveniles/fingerlings of tilapia and paitan while Dipili River at spillway (OS1) is solely represented by paitan of different sizes (from juveniles to adults).
AIR	
Ambient Air Quality and Noise	The ambient air quality monitored in 2021 across all the stations are within the DENR National Ambient Air Quality Standards (NAAQS) based on DAO 2000-81. The ambient noise levels observed in all the stations were within the DENR standards.
PEOPLE	
	Based on the 2020 census data of the Philippine Statistics Authority, the population in the Municipality of Bayog is 34,519 of which 1,816 are from Barangay Depore. Subanen is the most dominant ethnographic grouping in the region. In Zamboanga del Sur, they comprise almost 75% of the total IP population, according to data from NCIP. Subanen are also dominant in the other areas of the region such as Zamboanga del Norte, Zamboanga Sibugay, and Zamboanga City. The second most dominant grouping is the Yakan. The more distributed second most dominant are the Samal or Sama; majority of them are in Zamboanga del Norte and Zamboanga City. In Barangay Depore, there are about 106 households that have access to Level 3 water system, 195 households with Level 2 and 62 households with

	Level 1. There are still 62 households that use doubtful sources. In Purok 5 and 6, there are no available Level 3 system while in Purok 7, all the households only have access to Level 1 system which are also considered as doubtful sources. In 2019, about 18% of the total households in Barangay Depore does not have access to sanitary toilet facilities. Most of these households are in Purok 6,5,7 and 1. The main power supply service provider in the municipality is the Zamboanga del Sur Electric Cooperative II (ZAMSURECO II). All barangays in the municipality have access to electricity.

Table E-4: Integrated Summary of Main Impacts

Project Activities	Environmental Component Likely to be Affected	Potential Impacts	Proposed Mitigating Measures	Performance/Target Efficiency
CONSTRUCTION PHASE				
Site Preparation and Clearing Construction of Mine Infrastructure including Mill and Processing Plant, Tailings Storage Facility, Camp Facility Pre-Stripping Activities at the Surface Mine Area and the Waste Dump Area	Land	Vegetation Removal and Loss of Faunal Habitat. Loss of Topsoil and Overburden Materials. Threat to Existence of Important Local Species. Threat to Abundance, Frequency and Distribution of Important Local Species. Change in Surface Topography Change in Soil Quality Inducement of Landslides or Other Natural Hazards. Soil Erosion. Contamination of Soils from Oil and Fuel Leaks from Construction Equipment Use. Improvement to Land Stability by Removing Small Scale Mining Tunnels and Non-Engineered Soil Control Structures.	Vegetation Removal and Loss of Limiting the Area of Disturbance to Only the Planned Area for Development. Removed Topsoil to be Stockpiled for Progressive Rehabilitation Activities. Management and Control of the Topsoil Storage Areas. Wildlings of Important (Critically Endangered, Endangered, and Vulnerable) Floral Species will be Collected Prior to Disturbance and will be Maintained at the Plant Nursery Until Ready for Planting within Planned Rehabilitation Areas. Proper Storage and Disposal of Waste Materials (Hazardous and Non-Hazardous) Within Designated Areas. Steep Slopes (>30°) Will Require Benches, Terraces, or Other Slope Controls to Reduce Surface Water Runoff Velocity During	>90%

Project Activities	Environmental Component Likely to be Affected	Potential Impacts	Proposed Mitigating Measures	Performance/Target Efficiency
			Rainfall Events. Other Surface Treatment to Control Erosion. Storage and Work Areas shall be Provided with Secondary Containment for Collection of Fuel and Oil Leaks. Regular Maintenance of Construction Equipment.	
	Air	Dust Generation from Movement of Equipment During Clearing and Construction Activities Contribution to Greenhouse Gas Emission as a Result of Vegetation Removal and Fossil Fuel Emissions.	Use of Dust Suppression Techniques such as Watering of Exposed Surfaces, Reduction of Vehicle Travel Speeds and Limit Exposed Areas. Timely Progressive Rehabilitation Activities for Areas No Longer Part of Construction or Not Needed for Operations.	>90%
	Water	Sedimentation and Siltation Local Rivers and Creeks. Increased Turbidity Levels within Local Rivers and Creeks. Changes in Drainage Patterns.	Provision of Buffer Zones between the Areas of Disturbance and Rivers and Creeks. Operations Involving Soil Disturbance, Such as Overburden Stripping, to Incorporate a Buffer Zone of at Least 20 Meters Away from Creeks and Rivers.	>90%

Project Activities	Environmental Component Likely to be Affected	Potential Impacts	Proposed Mitigating Measures	Performance/Target Efficiency
		Change in Watershed Base Flow and Runoff Yields. Changes in Flood Characteristics. Loss of Riparian and Aquatic Habitat Areas. Water Quality Degradation due to Potential Leaks or Spills of Oils and Fuels. Removal of Tailings Ponds Used by Small Scale Miners. Removal of Adits and Tunnels Within the Surface Mine Area.	Establish Erosion Control Measures Including Diversion Canals, Soil Stabilization Programs, and Re-Vegetation of Disturbed Areas to Reduce the Soil Loss Potential. Construction of Sediment Ponds and Overland Flow Retention Structures to Trap Soil and Reduce Siltation. Develop Master Infrastructure Drainage Plan for the Project Area. Establish Stream Flow Monitoring Stations at Selected Locations on Unao-Unao Creek, Dimalinao Creek, Dipili River, and Genaro (Naro) Creek. Develop Stream Flow Measurement Data Base and Master Flood Control Plan.	
OPERATION PHASE				
Mining Operation: Extraction of Ore	Land	Provision of Buffer Zones between the Areas of Disturbance and Rivers and Creeks Operations Involving Soil Disturbance, Such as Overburden Stripping, to Incorporate a Buffer	Establishment of Benches in Accordance with the Surface Mine Design. Installation of Drainage Canal System to Prevent Erosion of Benches and Other Areas.	>90%

Project Activities	Environmental Component Likely to be Affected	Potential Impacts	Proposed Mitigating Measures	Performance/Target Efficiency
		Zone of at Least 20 Meters Away from Creeks and Rivers Establish Erosion Control Measures Including Diversion Canals, Soil Stabilization Programs and Re-Vegetation of Disturbed Areas to Reduce the Soil Loss Potential. Construction of Sediment Ponds and Overland Flow Retention Structures to Trap Soil and Reduce Siltation. Develop Master Infrastructure Drainage Plan for the Project Area. Establish Stream Flow Monitoring Stations at Selected Locations on Unao-Unao Creek, Dimalinao Creek, Dipili River and Genaro (Naro) Creek. Develop Stream Flow Measurement Data Base and Master Flood Control Plan.	Progressive Rehabilitation of Disturbed Areas by Placement of Soil Cover, Soil Conditioning and Vegetative Cover Placement. Vegetative Cover will Include Fast Growing Species Intercropped with Cash Crops and Endemic Species. Timely Progressive Rehabilitation Activities for Areas No Longer Part of Construction or Not Needed for Operations.	
	Water	Leaching of Metals to Surface Water Runoff and Potential Generation of Acid Mine Drainage.	Conduct Water Quality Monitoring and Assessment of Mine Surface Water Runoff on a Regular Basis.	100%

Project Activities	Environmental Component Likely to be Affected	Potential Impacts	Proposed Mitigating Measures	Performance/Target Efficiency
			Construction of Passive Wetland Treatment Facilities, if necessary, for Natural Treatment of Surface Water Runoff. Conduct Groundwater Sampling and Water Quality Monitoring on a Regular Basis. Additional AMD Laboratory Testing of Different Overburden and Waste Materials.	
	Air	Dust Generation from Movement of Trucks During Hauling Operations and Heavy Equipment During Excavation and Loading Operations. Human Health Impacts within High Dust Production Areas.	Use of Dust Suppression Techniques such as Watering of Exposed Surfaces, Reduction of Vehicle Travel Speeds and Limit Exposed Areas. Provision of Personal Protective Equipment. Conduct of TSP, and PM_{10} measurement as would be included in the Annual Ambient Air Quality Monitoring. Timely Progressive Rehabilitation Activities for Areas No Longer Part of Construction or Not Needed for Operations.	>90%
Mining Operation: Blasting Activities	Air	Dust Generation from Fine Particles. Health and Safety Risk due to Fly Rocks.	Placement of Safety Nets within the Affected Area in Order to Prevent Fugitive Rock Dispersal.	100%

Project Activities	Environmental Component Likely to be Affected	Potential Impacts	Proposed Mitigating Measures	Performance/Target Efficiency
		Noise Generation.	Blasting Activities to be Done by Qualified and Licensed Companies and Personnel. Provide Multiple Warnings to the Community TVIRD Personnel and Other People within the Danger Area in Accordance with Regulations and Protocols Before any Blasting is Done. Provision of Personal Protective Equipment to Blasting Personnel.	
Milling and Processing: Use of Resources	Land	Tree Cutting and Use of Lumber. Loss and Reduction in Number of Tree Species within the Watershed. Extraction of Ore Minerals. Removal of Vegetation, Change in Soil Quality, Loss of Topsoil and Overburden Materials. Loss of Faunal Habitat Areas. Reduction of Uncontrolled Tree Cutting by Community Residents.	Minimize Vegetation Removal within Project Facility Areas Planned for Development. Increase Ground Cover by Reforestation with Local Important Species. Collection of wildlings of Endangered and Endemic Floral Species for Propagation in the Plant Nursery. Prepare a Biodiversity Management Plan. Maintain Forest Corridors for Wildlife Movement.	>90%

Project Activities	Environmental Component Likely to be Affected	Potential Impacts	Proposed Mitigating Measures	Performance/Target Efficiency
Milling and Processing Operations: Use of Resources	Water	Use of Surface Water Sources for Domestic and Industrial supply. Resource Competition with Downstream Users and Reduction in Stream Flows Due to Diversions.	Implementation of Recycling Programs, Improvements Within the Processing Operations to Minimize Water Use. Establishment of Other Water Conservation Measures to be Implemented by TVIRD and Individual Employees. Preparation and Implementation of a Water Resource and Watershed Management Plan.	100%
Milling and Processing Operations: Use of Chemicals and Reagents Generation of Wastes	Land	Health and Safety Risks from Use, Handling, Storage and Disposal of Chemicals and Reagents. Potential Soil Contamination, Change in Soil Quality, Arising from Accidental Spills or Leaks of Chemicals and Reagents. Generation of Hazardous Wastes such as Acids, Bases, Spent Oils, and Chemical Contaminated Containers.	Provision of Personal Protective Equipment to Employees. Employee Orientation of the Material Safety Data Sheets. Education and Implementation of Proper Handling, Storage and Disposal Protocols. Provision of Bund Walls to Contain at Least 110% the Capacity of the Largest Storage Tank, in the Case of a Spill, Leak or Process Area Washing. Regular Inspection of Storage Tanks, Containers, Pipelines for Signs of Leaks,	100%

Project Activities	Environmental Component Likely to be Affected	Potential Impacts	Proposed Mitigating Measures	Performance/Target Efficiency
			Corrosion, Structural Instability, Malfunctioning Valves and Fittings. Hazardous Wastes will be Labeled and Stored According to the Regulatory Guidelines and Protocols. Transport and Disposal will be through Accredited and Licensed Hazardous Waste Management Contractors.	
	Water	Potential Surface Water Contamination and Degradation of Surface Water Quality due to Accidental Spills or Leaks. Potential Groundwater Contamination and Degradation due to Percolation of Chemicals, Reagents, Oils and Fuels from Accidental Releases. Release of Chemicals and Reagents Due to Drainage System Failure.	Provision of Bund Walls within Chemicals and Reagent Storage Areas to Contain Releases and Minimize Pathways to the Environment During Occurrences of Spill or Leaks. Establish Surface Water Monitoring Program to Collect and Test Samples on a Regular Basis. Establish a Groundwater Monitoring Program to Collect and Test Groundwater Samples on a Regular Basis.	>90%

Project Activities	Environmental Component Likely to be Affected	Potential Impacts	Proposed Mitigating Measures	Performance/Target Efficiency
			Develop Drainage and Surface Water Control Plan to Contain Contaminated Surface Water and Manage Hazardous and Non-Hazardous Storage and Containment Areas. Preparation of Site Remediation Plan for Occurrences of Surface and Groundwater of Contamination and Soil Contamination.	
Milling and Processing: Use of Chemicals and Reagents Generation of Wastes	Air and Noise	Generation of Noise and Air Emissions from the Use of Mill Equipment, Generator Sets and Operation of the Assay Laboratory.	Provision of Fume Scrubber and Dust Collector at the Assay Laboratory to Control Emissions During Sample Preparation and Laboratory Analysis. Provision of Continuous Emission Monitoring System for Exhaust Systems found to generate emissions above the standards.	100%
Milling and Processing: Waste Materials and Generation Management	Land	Change in Land Use within the Waste Rock and Overburden Disposal Area and the Tailings Storage Facility Area.	Limiting the Disturbance to the Planned Operations Area. Restoration of Final Landforms to Stable Conditions and Useable Topographic Conditions to Support Post Mining Rehabilitation Programs.	>90%

Project Activities	Environmental Component Likely to be Affected	Potential Impacts	Proposed Mitigating Measures	Performance/Target Efficiency
		Change in Surface Topography. Increased Soil Erosion. Change in Soil Quality and Fertility. Loss of Topsoil and Overburden Materials.	Increase in Ground Cover Vegetation by Reforestation. Implementation of Progressive Rehabilitation Programs to Support and Enhance the Post Mining Rehabilitation.	
	Water	Generation of cyanide contaminated tailings from Mill Operations. Potential leaks due to tailings pipeline breach from the Mill Plant to detoxification facility	Establishment of detoxification facility to degrade cyanide in tailings to acceptable levels prior to discharge to tailings facility. Provision of berms around the pipeline to prevent tails runoff in case of leak. Regular visual inspection of tailings pipeline for any signs of cracks and breaks that will lead to failure.	>90%
Milling and Processing Operations Waste Materials and Tailings Generation Management	Water	Spillage or Overflow of Tailings into Unao-Unao Creek from Mill and Processing Facilities or Failure of the Tailings Conveyance Pipeline. Release of Tailings from the Tailings Storage Facility Due to Dam Breach or Re-suspension of Tailings and Release through the Spillway.	Proper Design of the Mill and Processing Plant Facilities. Proper Design and Construction of the Tailings Storage Facility to contain tailings waste. Establish Erosion Control Measures Including Diversion Canals, Soil stabilization	>90%

Project Activities	Environmental Component Likely to be Affected	Potential Impacts	Proposed Mitigating Measures	Performance/Target Efficiency
		Increased Heavy Metals, TSS/ TDS or Cyanide Concentration within Unao-Unao Creek and Downstream Rivers and Creeks Resulting from Releases from the Tailings Storage Facility Spillway. Increased Sedimentation and Siltation of Downstream Rivers and Creeks.	Programs and Re-vegetation Programs for Disturbed Areas to Reduce the Soil Loss Potential. Construction of Sediment Ponds and Overland Flow Retention Structures to Trap Soil and Reduce Siltation. Maintain Continuous Water Cover Over the Tailings within the Impoundment to eliminate Re-suspension of Tailings. Provide Containment Berms Adjacent to the Pipeline(s).	
Site Operations and Maintenance	Land	Generation and Disposal of Solid Wastes. Generation of Sewage Waste	Development of Solid Waste Management (i.e, Reduction, Reuse, Recycling Activities) Program Activities for Company Wide Implementation Including TVIRD Operations and Contractor Operations. Construction of Solid Waste Management Facility and Engineered Septage Facility for Appropriate Storage of Generated Wastes.	100%

Project Activities	Environmental Component Likely to be Affected	Potential Impacts	Proposed Mitigating Measures	Performance/Target Efficiency
			IEC Programs on Solid Waste Management for both Hazardous and Non-Hazardous Waste Materials.	
	Water	Reduction or Depletion of Local Water Resource Supply.	Implement Water Recycling and Conservation Programs. Prepare and Monitor Water Balance Data to Determine Input and Output Requirements in the Process Operation and Determine Areas for Potential Water Conservation Measures. IEC Programs for Water Use and Water Conservation.	>90%

Project Activities	Environmental Component Likely to be Affected	Potential Impacts	Proposed Mitigating Measures	Performance/Target Efficiency
Storm and water Management	Water	Increased Sedimentation and Siltation of Downstream Rivers and Creeks. Potential downstream flooding.	Development of overall Drainage Plan to balance volume flow of water within the Project site. Natural drainage features and patterns in undisturbed areas will be retained. Identification of areas with high risk of erosion to divert or reduce runoff through that area. Construction of diversion and drainage canals. Installation of cross drainage or culverts. Landscaping and reforestation of exposed areas to reduce water runoff volume.	>90%
ABANDONMENT/DECOMMISIONING				
Decommissioning Activities.	Land	Soil Contamination from Equipment Removal. Stability of the Tailings Storage Dam, Surface Mine and Waste Rock and Overburden Stockpiles.	The Majority of the Impacts During Closure will have been Addressed and Reduced by Progressive Rehabilitation Activities Implemented During the Operations Phase.	>90%

Project Activities	Environmental Component Likely to be Affected	Potential Impacts	Proposed Mitigating Measures	Performance/Target Efficiency
Disposal of Equipment and Scrap Materials. Disposal of Unconsumed Chemicals and Hazardous Wastes. Closure of the Surface Mine, Mill and Processing Plant, Tailings Storage Facility Removal or Rehabilitation of Administration Buildings, Staff Housing, Warehouses and Access Roads.		Consistency in the Land Use Plan of the Project with the Subanen and Local Government. Aesthetic Value. Exposure of Decommissioned Buildings and Structures.	Similar Programs will be Implemented During Closure. Preparation of a Final Mine Rehabilitation and Decommissioning Plan. Implement Soil Remediation Measures, if Necessary, After Conduct of Soil Monitoring Programs. Conduct Geohazard Assessment of the Tailings Dam; Surface Mine and Overburden Waste Stockpiles. Consultation Activities with Respect to Land Use will be Conducted during the Operational Phase Prior to Closure. Soil Conditioning of Exposed Areas Prior to Revegetation. Planting of a Large Variety of Plant Species within the Disturbed Areas Using Indigenous, Endemic Species in Accordance with the Final Land Use Plan of the Area.	

Project Activities	Environmental Component Likely to be Affected	Potential Impacts	Proposed Mitigating Measures	Performance/Target Efficiency
	Water	Potential Water Quality Degradation from Clearing Activities. Localized Erosion from the Mine Structures Undergoing Rehabilitation.	Water Discharges and Washings from the Mill and Processing Plant will Pass Through Detoxification Facilities and Sediment/Neutralization Ponds. Reduce Slopes and Maintain as Much Vegetation Cover as Possible for Erosion Control. Establish Water Quality Monitoring Program During Mine Closure Activities.	>90%
	Social	Community Issues on Turnover of Rehabilitated Areas, Life-After Mining Opportunities and Sustainability Programs.	Management of Community Issues during the Operations Phase of the Project Using Continuous Stakeholder Dialogue. Long Term Livelihood Programs Introduced During the Operations Phase and Combined with SDMP Projects. Exploration of Private Sector Participation in Post Mining Sustainability and Business Model Preparation. Assistance in Governance Training and Development and Financial Management.	>90%

Project Activities	Environmental Component Likely to be Affected	Potential Impacts	Proposed Mitigating Measures	Performance/Target Efficiency
			Continued Presence of TVIRD After the Closure of Mining Operations and Transition of Rehabilitated Lands, SDMP and Sustainability Programs to the Community.	

Table E-5: Risks and Uncertainties

Environmental Aspects	Potential Impact Associated with Open Pit Mining	Residual Effects after Applying Mitigating Measures	Risk and Uncertainties relating to the Finings and Implications for Decision Making
Geohazards	Construction of the TSF may cause a reduction of the frequency of flooding in downstream areas;	Potential for slope failures and TSF issues will be significantly reduced or eliminated with engineering measures.	Risks are associated with uncertainties in geotechnical properties of soils and rocks that may be encountered during construction. These can be minimized with the continuation of geotechnical investigations and minimized by phasing the construction schedule
	Breach in TSF may cause flash flooding, high-density flows, and spillage of mine tails in downstream areas;		
Terrestrial Vegetation and Wildlife	Construction of the mine components will require stripping of vegetation	With the implementation of mitigation measures, the status of terrestrial flora and fauna within the vicinity of the Project will be improved since there will be active rehabilitation and protection.	None
	Removal of vegetation may disturb habitat and food source of wildlife and people		
	Site clearing for Project development will result in the reduction of wildlife population and may decrease the number of species growing within the footprint.		

Environmental Aspects	Potential Impact Associated with Open Pit Mining	Residual Effects after Applying Mitigating Measures	Risk and Uncertainties relating to the Finings and Implications for Decision Making
Hydrology	The development of the TSF over time may result in changes to surface hydrology leading to a reduction of stream volumetric flows along drainage channels located downstream of these facilities; and	With mitigation, the potential water resource and supply issues are resolved, and potential impacts are minimized. Surface drainage, diversion and sedimentation controls, and water quality management strategies can be planned before the pit is developed.	Risk is related to uncertainties in the projections of climate change effects in the country which means that the TSF must be designed to withstand these risks.
	Reduction of vegetation cover would result in an increase in surface runoff.		
Water Quality	Effluents and process waters enriched in metals and other pollutants may be released from the TSF and mill and be discharged into receiving water bodies;	Minimize or eliminate impacts	Risks are associated with the release of deleterious substances from the process or the TSF which were not previously identified in the mine planning and design. The risks will be eliminated by continued technical studies and pilot testing which will be conducted before the mine operates.
	Hydrocarbon leaks and spills from vehicles, fuel tanks and used oil storage may contaminate ground and stream water; and		
	Non-mine wastewater from support facilities particularly the administration and accommodations complex and the various warehouses may contaminate surface water bodies.		
Climate, Air Quality and Noise	Removal of vegetation would decrease carbon sequestration potential within the Project area	None	None

Environmental Aspects	Potential Impact Associated with Open Pit Mining	Residual Effects after Applying Mitigating Measures	Risk and Uncertainties relating to the Finings and Implications for Decision Making
	Blasting, vehicular movement, and equipment operations will increase ambient noise levels		
	Land clearing, blasting, and vehicular movement will increase the amount of fugitive dust and particulates in the air		
	Metal-rich particulate matter liberated from mineralized materials as a result of mining activities will increase the ambient concentrations of elements suspended in the air;		
	Vehicle and equipment operation (e.g. diesel generators) will emit additional NOx, SOx, heavy metals, and other greenhouse gases (GHGs) from the combustion of fuels.		
Socioeconomics, Public Health, and Safety	Inhabitants and properties within the project site may be displaced which may lead to adverse impacts regarding the cohesion of their community, the quality of life, fears, apprehensions and perceptions of the receiving community and local government units where they will be transferred, and competition for basic	Minimize or eliminate impacts in relation to in- migration, waste management, and resource competition. At the same time, benefits from the mine will be enhanced with appropriate measures	Risks are associated with negative perceptions and conflicts with stakeholders (grievance) which may occur if commitments or measures included in the EIS and SDMP are not fulfilled. Other risks are associated with security. These risks could entail the provision of additional resources and manpower to

Environmental Aspects	Potential Impact Associated with Open Pit Mining	Residual Effects after Applying Mitigating Measures	Risk and Uncertainties relating to the Finings and Implications for Decision Making
	utilities, public services, and other limited resources		community-related issues and security, enhanced coordination with stakeholders and government agencies, and additional measures to manage issues and concerns not previously identified in the EIA. Mining- related guarantee funds and programs, such as the Contingent Liability and Rehabilitation Fund (CLRF) and the Social Development and Management Program (SDMP), are prescribed in the Philippine Mining Act of 1995 (Republic Act 7942) and its implementing rules and regulations DENR Administrative Order (DAO) 96-40.
	Payment of government dues in the local level would bring additional operational funds for local government units (LGUs)		
	Hiring of a significant number of locals will bring a steady source of income and contribute to poverty reduction in the impact barangays		
	Mining operations will open a market for support services such as security, housekeeping, catering, etc. that can foster local entrepreneurship and contribute to poverty alleviation;		
	Business opportunities created by the presence of the Project may encourage in-migration to the host barangays / municipalities, causing both positive (hiring) and negative (competition for work resources, service, etc.) socio-economic effects in these areas;		
	In-migration can lead to higher risk of spread of communicable diseases and resource competition;		

Environmental Aspects	Potential Impact Associated with Open Pit Mining	Residual Effects after Applying Mitigating Measures	Risk and Uncertainties relating to the Finings and Implications for Decision Making
	Higher income generation due to direct and indirect contribution from the Project can boost local purchasing power, as well as increase the incidence of theft, drugs, alcohol, gambling, and prostitution		
	Mine activities will lead to an increase in vehicular traffic leading to the Project site, providing better transportation, as well as increasing accident and health risks to the communities		
	Mining operations and in- migration would increase production of human and non-human wastes.		

Table E-6: Summary of Environmental Monitoring Plan

Key Environmental Impacts (Per Project Phase)	Potential Impacts (Per Environmental Sector)	Parameter to be Monitored	Sampling Measurement Plan			Lead Person	Estimated Cost (PHP)	EQPL Management Scheme					
								EQPL Range			Management Measure		
			Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
Construction and Operation													
Clearing of vegetation	Loss of habitats due to vegetation Clearing	Success rate, survival rate and growth rate of reforestation/ rehabilitation areas and recolonization of wildlife	Periodic inventory of planted seedlings / Photo-transect / survival rate	Semi- annually	Offset areas and areas that will be progressively rehabilitated	Pollution Control Officer/ Environmental Officer	Approximately PhP 80,000 per hectare	Decline (~10%) in the abundance, in the abundance, frequency and distribution of vegetation monitored compared to initial seedlings planted.	Evident decline (~15%) in the abundance, in the abundance, frequency and distribution of vegetation monitored compared to initial seedlings planted.	Highly evident decline (~20%) in the abundance, frequency and distribution of vegetation monitored compared to initial seedlings planted.	Investigate possible cause of the observation	Investigate cause of decline in parameter being monitored.	Investigate cause of decline in parameters being monitored and coordinate with the PAMBs, LGUs and MMT the possible causes and increase frequency of monitoring / Review rehabilitation strategies
Construction activities/ Mining Operations	Ambient and Surface water quality	Parameters from DAO 2016-08 and 2021-19	Water quality Monitoring Manual for Ambient Water Quality Monitoring	Monthly	Groundwater monitoring stations	Pollution Control Officer/ Environmental Officer	100,000/sampling station	Minor change in the aesthetic quality of the water (I.e. visible coloration	within 80% of the limits under DAO 2016-08 Class A and DO 2021-19	within 90% of the limits under DAO 2016-08 Class A and DO 2021-20	Check and monitor the performance of sediment control traps and settling ponds and manage stockpiles	Identify the source of pollution / identify which parameters are near the limit and check the efficacy of controls	Identify the source of pollution / identify which parameters are near the limit and check the efficacy of controls. If the source is the construction / operation, temporarily stop the operations/ construction in the affected areas

Key Environmental Impacts (Per Project Phase)	Potential Impacts (Per Environmental Sector)	Parameter to be Monitored	Sampling Measurement Plan			Lead Person	Estimated Cost (PHP)	EQPL Management Scheme					
								EQPL Range			Management Measure		
			Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
Construction and Operation													
	Ambient Groundwater Quality	Parameters from DAO 2016-08 and 2021-20	Water quality Monitoring Manual for Ambient Water Quality Monitoring	Monthly	Water monitoring stations	Pollution Control Officer/ Environmental Officer	100,000/sampling station	Minor change in the aesthetic quality of the water (I.e. visible coloration	within 80% of the limits under DAO 2016-08 Class A and DO 2021-20	within 90% of the limits under DAO 2016-08 Class A and DO 2021-21	Check and monitor the performance of sediment control traps and settling ponds and manage stockpiles	Identify the source of pollution / identify which parameters are near the limit and check the efficacy of controls	Identify the source of pollution / identify which parameters are near the limit and check the efficacy of controls. If the source is the construction / operation, temporarily stop the operations/ construction in the affected areas
	Freshwater biota	Abundance and composition of aquatic organism s	Scientifically approved methods used for wadable streams (kick-net and periphyton sampling).	Semi-annual covering the wet and dry season	Stations in the primary impact areas that are concurrent with the water quality	Pollution Control Officer/ Environmental Officer	100,000/sampling station	Significant decrease (based on applicable statistical test) in the abundance relative to the previous monitoring period covering the same season. / Appearance of pollution indicator	Significant decrease (based on applicable statistical test) for the two consecutive monitoring periods covering the same season. Dominance of pollution indicator taxa.	Significant decrease (based on applicable statistical test) for the two consecutive monitoring periods covering the same season. Dominance of pollution indicator taxa.	Continue monitoring and investigate possible cause of decrease.	Continue monitoring and coordinate with MMT in the investigation of the cause of decline	Investigate if cause of decline is the project. If not, continue the monitoring activities at the same frequency. If source of decline is project, temporarily stop activities in the vicinity of the monitoring station where adverse impact was observed and implement clean-up measures.

Key Environmental Impacts (Per Project Phase)	Potential Impacts (Per Environmental Sector)	Parameter to be Monitored	Sampling Measurement Plan			Lead Person	Estimated Cost (PHP)	EQPL Management Scheme					
								EQPL Range			Management Measure		
			Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
Construction and Operation													
Large equipment and generators	Generation of particulate matter (PM), NOx, SOx, and CO from fuel combustion of stationary sources	Particulate Matter (PM-10), SOx, NOx, CO,	Methods for sampling as defined under the Clean Air Act	Quarterly, or as required by EMB	Generator set/s	Pollution Control Officer/ Environmental Officer	PhP 90,000	noticeable dark emissions from the genset	within 80% of the parameters for emission sampling as set by DENR	within 90% of the parameters for emission sampling as set by DENR	Continue monitoring	Continue monitoring; Investigate cause of complaint, determine, and address the root cause/ Check maintenance schedules	Continue monitoring; Investigate cause of complaint, determine, and address the root cause/ Check maintenance schedules. Additional pollution control devices may be required
	Fugitive dusts emission	Particulates TSP PM10	Methods for sampling as defined under the Clean Air Act	Quarterly, or as required by EMB	Existing ambient air quality and noise monitoring stations	Pollution Control Officer/ Environmental Officer	PhP 2,000,000/year	Noticeable dust and/ or presence of haze	Complaint lodged by community	Multiple complaints lodged by community	Continue monitoring	Continue monitoring; Investigate cause of complaint, determine and address the root cause/ more frequent dust mitigation	Continue monitoring; Investigate cause of complaint, determine and address the root cause/ more frequent dust mitigation

Key Environmental Impacts (Per Project Phase)	Potential Impacts (Per Environmental Sector)	Parameter to be Monitored	Sampling Measurement Plan			Lead Person	Estimated Cost (PHP)	EQPL Management Scheme					
			Method	Frequency	Location			EQPL Range			Management Measure		
								Alert	Action	Limit	Alert	Action	Limit
Construction and Operation													
	Increase in ambient noise level	Noise level, dB	Approved method of noise measurement	Quarte rly, or as require d by EMB	Existing ambient air quality and noise monitoring stations	Pollution Control Officer	PhP 10,000 per sampling event	Negative feedback reported	Complaint lodged by community and/or by contractor or employees	Multiple complaints lodged by community and/or by contractor or employees	Investigate or inspect subject of negative feedback	Investigate or inspect cause of complain to determine and address the root cause	Conduct noise audit of equipment and machineries that generate noise
	SDMP	Projects initiated by the Proponent under the SDMP	Community Coordination and Regular Project Evaluation through Stakeholder Consultations Community responses through the MMT.	Quarterly to annually, or as required by EMB	Impact barangays	Communit y Relations Officer	SDMP budget as approved under MGB	Negative verbal feedback to the Proponent	Formal complaint lodged by the community	Multiple complaints by the community captured by the local media organization s	Proponent to investigate/ inspect subject of negative feedback.	Investigate cause of complain to, determine and address the root cause.	Release official statement for general consumption and employees and to address the issue to the affected communities. / Conduct regular consultation with relevant and concerned stakeholder s of the community. Coordinate with and update MMT

1. PROJECT DESCRIPTION

On October 01, 2013, TVIRD was granted an Environmental Compliance Certificate (ECC-CO-1301-0004) encompassing 180 hectares for the mining and processing of ore for gold and silver production. The area covered of the mining activities is within the 4,779-hectare area that is covered by the Mineral Production Sharing Agreement (MPSA) No. 086- 97-IX located in Sitio Balabag, Brgy. Depore, Bayog, Zamboanga del Sur. The ECC allows an estimated maximum annual extraction rate of two (2) million metric tons of ore and waste materials using surface mining method (side-cut) while the mill and processing plant shall have a maximum daily production capacity of two thousand (2,000) metric tons per day.

On June 03, 2020, another Environmental Compliance Certificate (ECC-OL-R09-2020-0131) was issued for the Housing and Camp Facilities of TVIRD covering an area of 4.5 hectares within the MPSA. Moreover, June 22, 2021, an Environmental Compliance Certificate (ECC-R09-2021-0131) was issued for the Multi-Facilities of TVIRD covering an area of 4.9095 hectares. The multi-facilities include additional housing and camp facilities, clinic, motorpool and fuel farm, contractor facilities, nursery area, hazardous waste facility, material recovery facility, and security barracks.

The Balabag Gold-Silver Project will expand the mining area from 13.5 hectares to 35 hectares and the annual extraction rate from the current 2.0 Million Metric Tonnes to 11.0 Million Metric Tonnes and increase the mine processing facility throughput from 2,000 TPD to 2,500 TPD. As a result of increased extraction rate, the waste dump area and tailing storage facility will also increase correspondingly. The Expansion Project will also expand the area coverage of the current Project from 189.4 ha to 2,177 ha located within the MPSA Area (See Figure 1-2). There will be no changes from the existing mining and processing methods involved with the increase in production capacity. The same tailings management operation will also be practiced. The mining operations and activities will continue to be located within the MPSA boundaries and project support from the Subanen Indigenous Peoples, host and neighboring communities, and Local Government Units remain Favorable.

Table 1-1: Summary of Major Changes in Area and Capacity Applied for in this EPRMP

	Existing ECC-Allowed Size	**Additional Area/Capacity in the Proposed EPRMP Expansion**	**Total Applied for in this EPRMP**
ECC Area Coverage	189.4095 ha	1987.5905 ha	2,177 ha
Extraction Rate	2 MMTPY	9 MMTPY	11 MMTPY
Mining Method	Surface Mining	Surface Mining	Surface Mining
Mining Area	13.5 ha	21.5 ha	35 ha
Waste Dump Area	13 ha	37 ha	50 ha
Method	Hybrid Circuit of Flotation, Merill Crowe, and CIL Processes	Hybrid Circuit of Flotation, Merill Crowe, and CIL Processes	Hybrid Circuit of Flotation, Merill Crowe, and CIL Processes

	Existing ECC-Allowed Size	Additional Area/Capacity in the Proposed EPRMP Expansion	Total Applied for in this EPRMP
Mill and Processing Plant Capacity	2,000 MTPD	500 MTPD	2,500 MTPD
Tailings Storage Facility	20.5 ha	55.5 ha	76 ha

1.1. PROJECT LOCATION AND AREA

1.1.1. Project Location

The Balabag Gold-Silver Project located within the Province of Zamboanga del Sur of Mindanao is the second operating mine planned for development by TVI Resource Development Phils., Inc. (TVIRD). This Project follows the Canatuan Mining Project located in Siocon, Zamboanga del Norte which has been in operation since Year 2003 until its mine closure in 2014. The Balabag Gold-Silver Project location is shown on Figure 1-1.

The tenement covering the Balabag property comprises a Mineral Production Sharing Agreement (MPSA 086- 97-IX) previously assigned to Zamboanga Minerals Corporation which was issued on November 20, 1997. The MPSA was subsequently deeded to TVIRD in 2009. It encompasses a total area of 4,779 hectares with the MPSA address identified as Guinoman, Diplahan, Zamboanga del Sur (now in Zamboanga Sibugay).

The addition of Zamboanga Sibugay Province in the Zamboanga Peninsula in Year 2001 brought about changes in the political boundaries of some municipalities in the region. At present, there is a boundary dispute between the Municipalities of Bayog in Zamboanga del Sur, Diplahan now in Zamboanga Sibugay and Godod in Zamboanga del Norte as to who has the rightful claim over the MPSA. The dispute between the three municipalities remains pending in the local court.

The MPSA is located between Latitude 7˚51'30" and 7˚55'30" North and between Longitude 122˚53'30" and 122˚58'00" East. When plotted on government maps, the MPSA is located within the Municipality of Bayog in Zamboanga del Sur and the Municipality of Kabasalan in Zamboanga Sibugay. For this EPRMP, the address of the Project will follow the MPSA document issued by the Department of Environment and Natural Resources (DENR) in 1997. Baseline studies including both environmental and social sectors will reference the Municipality of Bayog where the Project is geographically located.

A portion of the MPSA is also located within a Certificate of Ancestral Domain Title (CADT) issued by the National Commission of Indigenous Peoples (NCIP) to the Subanon Indigenous people. The CADT encompasses a total of 47,720 hectares both within and outside the MPSA. Approximately 15% of the northernmost portion of the MPSA is located within the CADT area. The coordinates of the respective MPSA corner points are shown in Table 1-2.

TVIRD is likewise applying to increase its ECC-approved area from 189.4 hectares, which does not fit its current facilities anymore, to 2,177 hectares as provided in the following maps and table.

Table 1-2: MPSA Corner Point Coordinates

Corner Point	Latitude	Longitude
1	7˚55'30"N	122˚54'00"E
2	7˚55'30"N	122˚58'00"E
3	7˚51'30"N	122˚58'00"E
4	7˚51'30"N	122˚57'30"E
5	7˚52'00"N	122˚57'30"E
6	7˚52'00"N	122˚54'00"E
7	7˚52'30"N	122˚54'00"E
8	7˚52'30"N	122˚53'30"E
9	7˚53'30"N	122˚53'30"E
10	7˚53'30"N	122˚54'00"E

Source: TVIRD MPSA-086-97-IX

Table 1-2: Geographic Coordinates of All Project Components

Project Component	Latitude	Longitude
Mill and Processing Plant	7°53'37"N	122°57'21"E
Main Warehouse Building	7°53'34"N	122°57'26"E
Assay Lab	7°53'35"N	122°57'25"E
Gensets	7°53'34"N	122°57'26"E
Hazardous Waste Facility	7°53'15"N	122°57'29"E
Material Recovery Facility	7°53'15"N	122°57'29"E
Waste Dump (1) Waste Dump (2)	7°53'55"N 7°53'58"N	122°56'46"E 122°56'57"E
Tailings Storage Facility	7°53'44"N	122°57'17"E
Housing and Accommodations	7°52'59"N	122°57'57"E
Fuel Farm	7°53'28"N	122°57'35"E
Motorpool	7°53'26"N	122°57'35"E
Explosives Magazine	7°53'55"N	122°56'35"E
Water Supply	7°52'52"N	122°57'21"E
Nursery	7°53'12"N	122°57'30"E
Helipad	7°53'00"N	122°58'00"E

Figure 1-1: Balabag Gold-Silver Project Location Map

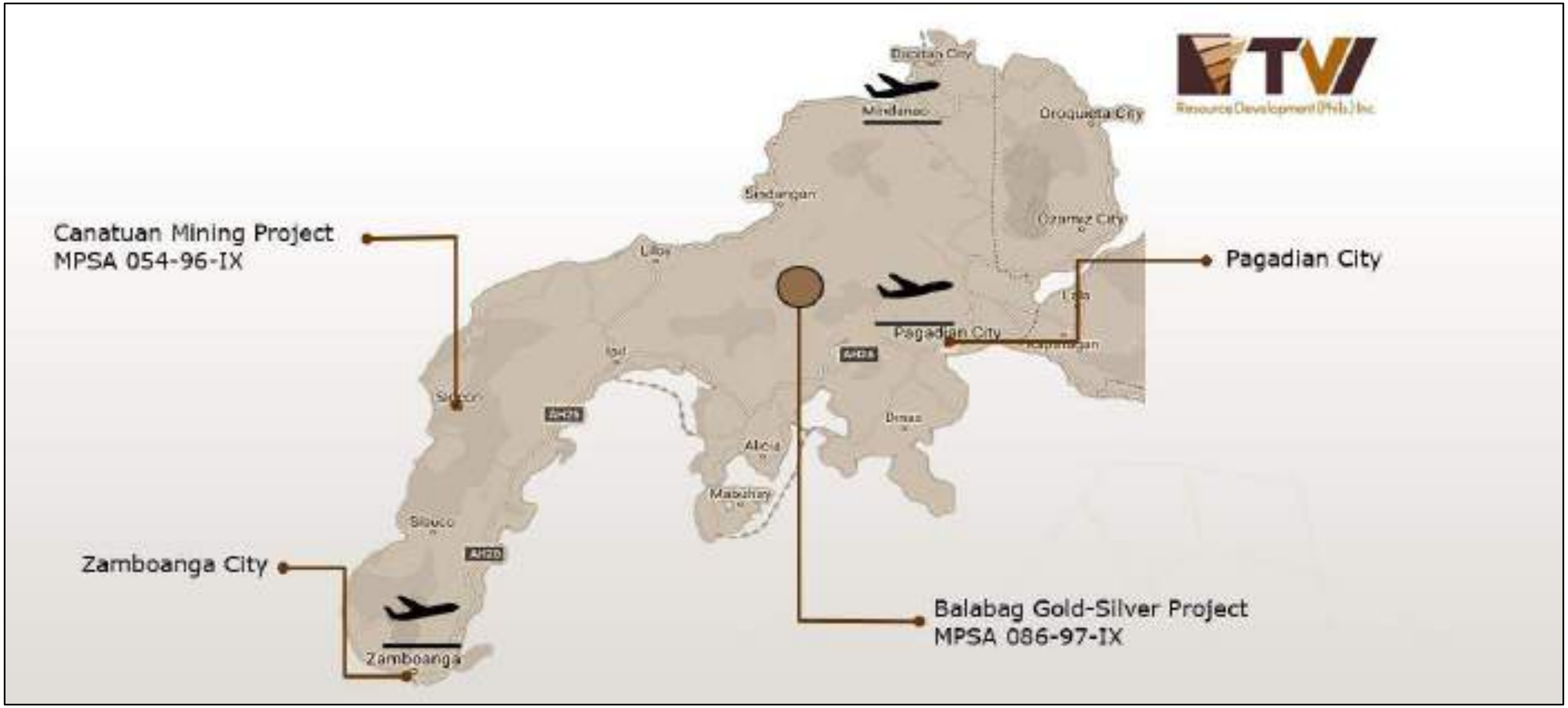


Figure 1-2: Balabag Gold-Silver Project MPSA Location Map with Respect to Barangay Boundaries

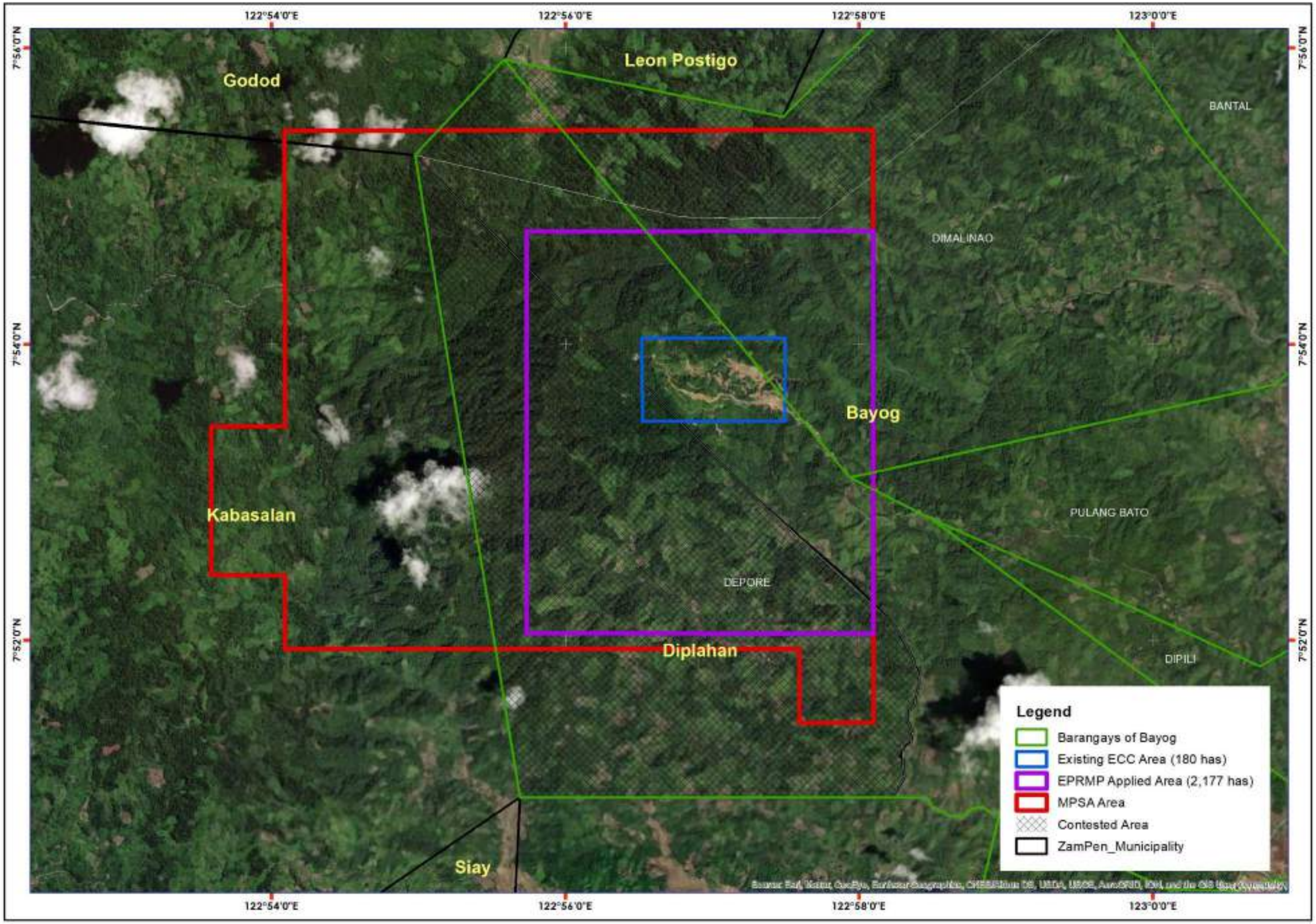


Figure 1-3: Balabag Gold-Silver Project MPSA Location Map within Municipalities

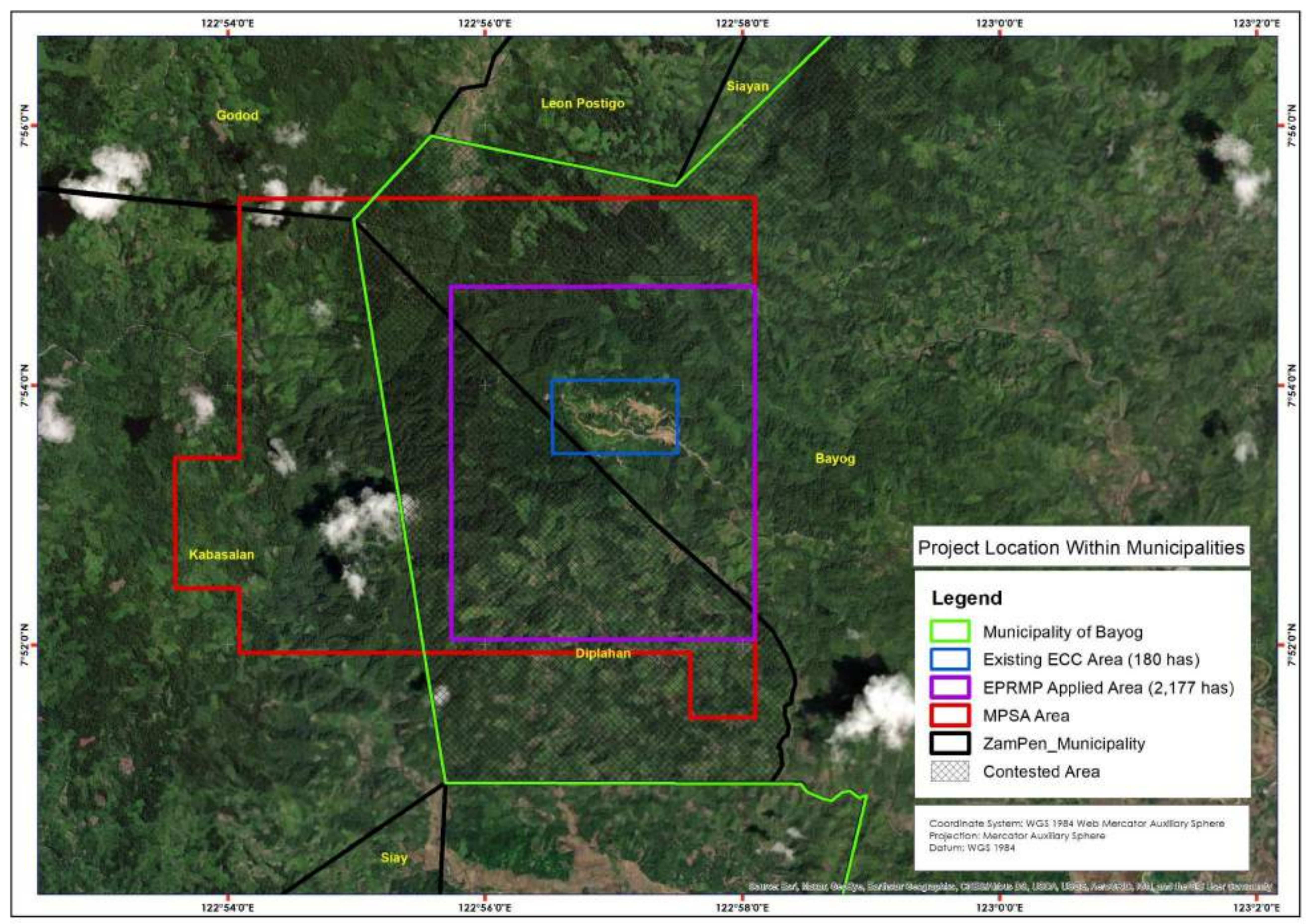


Table 1-4: Geographic Coordinates of ECC Expansion Area

Point	Latitude	Longitude
Point A	7°52'6.18"N	122°55'38.18"E
Point B	7°54'48.35"N	122°55'38.43"E
Point C	7°54'48.90"N	122°58'0.16"E
Point D	7°52'6.13"N	122°57'60.00"E

1.1.2 Project Direct and Indirect Impact Areas

Primary impacts are often called direct impacts, while secondary impacts are referred to as indirect or induced impacts. The term does not mean to imply secondary importance or secondary significance of the impact but rather, secondary refers to timing and scope of these impacts. Primary impacts of a development action are those effects that are caused by that action and generally occur at the same time and place as the action. They are usually associated with the construction, operation, maintenance of a facility or activity, and are generally obvious and quantifiable. Secondary impacts of a development action span the potential effects of additional changes that are likely to occur later in time or at a different place as a result of the implementation of the development. These include additional construction or development, traffic increases, and changes in population growth and migration. The direct and indirect impact areas as defined by DAO 2017-15 are provided below.

In the existing ECC, the primary environmental impact area of the Project is Sitio Balabag, Brgy Depore located within the Municipality of Bayog. Further, baseline political boundaries also identified Brgy Depore as the host impact community of the Project while Brgy. Pulangbato, Brgy. Dimalinao, and Brgy. Dipili was considered as primary impact communities. Then, the identified secondary impact communities were Brgy Poblacion, Kahayagan, Salawagan, Damit, Lamare, San Isidro and Depase in the Municipality of Bayog, Zamboanga del Sur and Brgy. Guinoman in the Municipality of Diplahan, Zamboanga Sibugay.

With the project expansion, primary environmental impact area is still the same but the hosts impact community will now be two (2) Barangays namely Brgy. Depore and Brgy. Dimalinao of Municipality of Bayog. Considering that Brgy. Dimalinao is now a host impact community, only Brgy. Pulangbato and Brgy. Dipili will be identified as primary impact communities while the rest of the secondary impact communities will remain the same.

The changes in the host impact communities were attributed to the changes in the political boundaries of the Municipality of Bayog by virtue of the approved Cadastral Map dated April 23, 2015.

1.1.2.1 Direct Impact Area for Air Quality

Direct Impact Areas for Air Quality include areas where projected ground level concentrations of emissions are higher than the ambient standards based on expected air emissions from the construction and operations. Air pollution modelling of the generator sets shows the predicted incremental 98th percentile ground level concentrations do not exceed the applicable DAO 2000-81 standards.

The major emissions to be expected from the mine are dust emissions which will be larger than TSP or PM10 and will not be suspended in air, and will eventually fall very near the areas where they are released. Likewise, air dispersion models indicate no ground level concentrations that will exceed the standard but that NOx concentrations will be close to the standards. Thus, a 200-meter radius from the roads and mine was determined to be the direct impact area which will contain both the probable dust emissions and the maximum NOx concentrations.

Figure 1-4: Air Emissions Direct Impact Areas of 200 meters

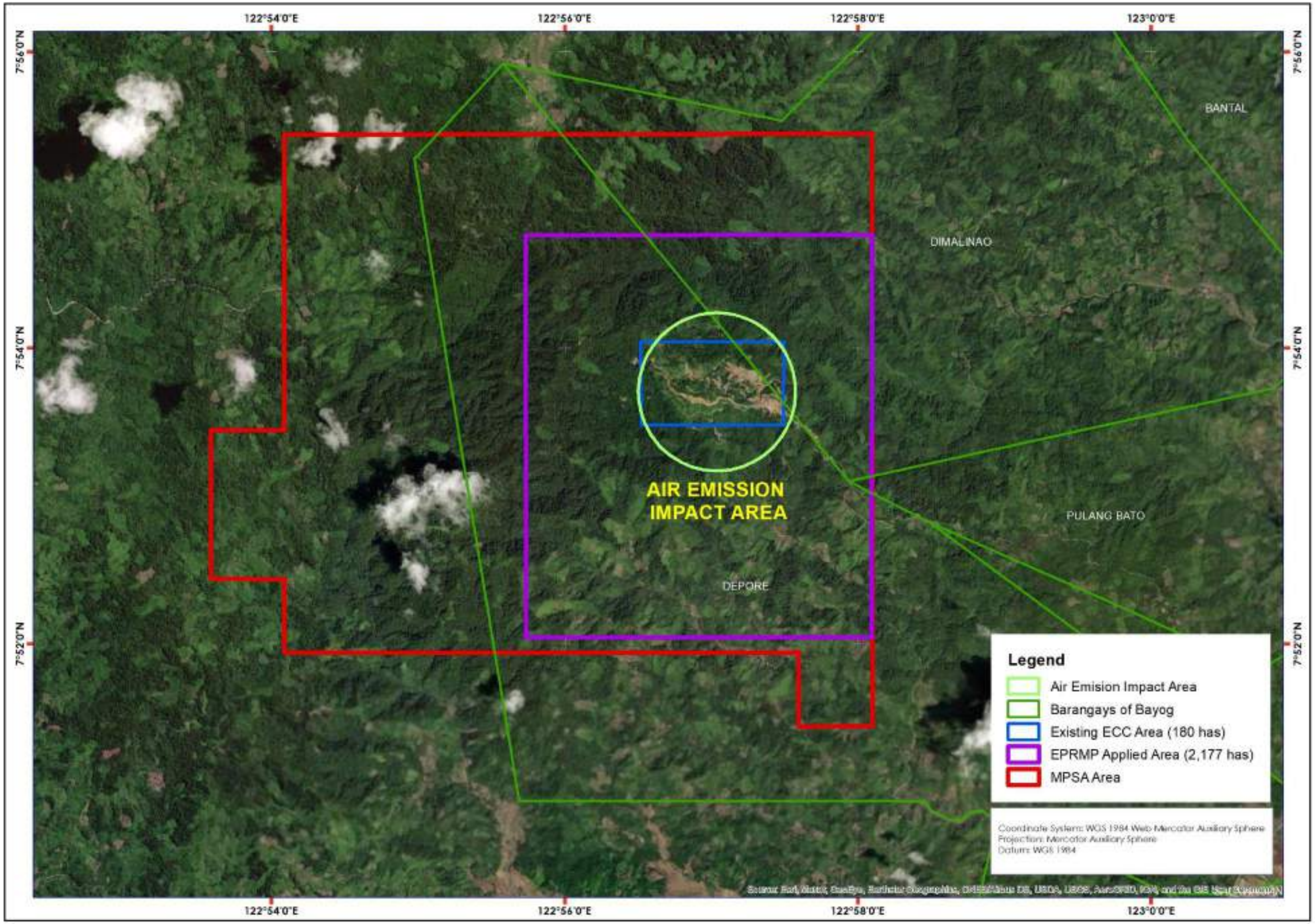
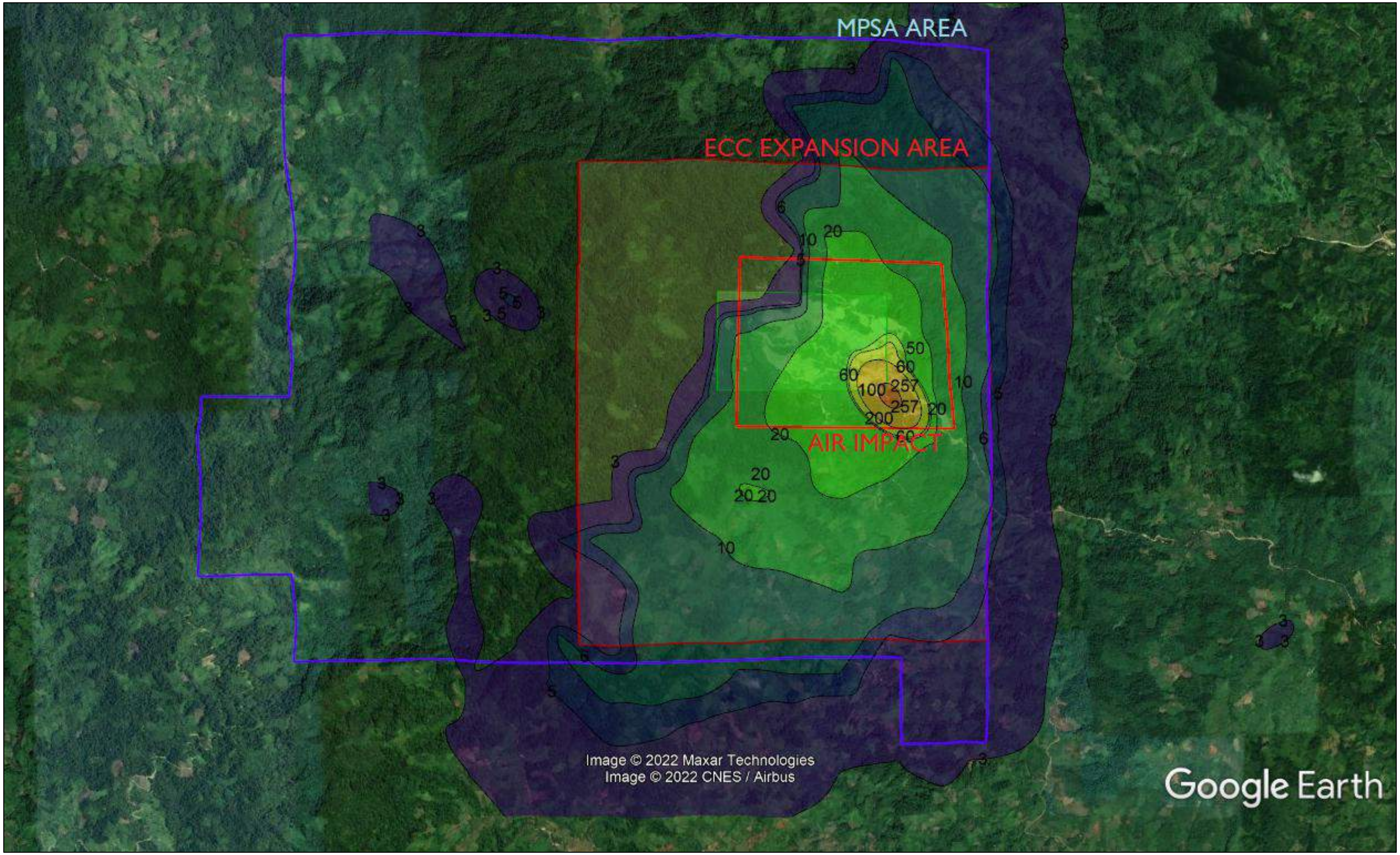


Figure 1-5: NOx Dispersion Model within the Project Area



Source: TVIRD 2022 Air Dispersion Model

1.1.2.2 Direct Impact Area for Water Quality and Quantity Impacts

Direct Impact Areas for Water Quality are where water quality is projected to exceed ambient standards, or the marine environment could be contaminated. Of primary interest are the Dipili and Depore Rivers including the sitios and barangays adjacent to the rivers. These rivers are two of the major tributaries to the Sibugay River which eventually discharges to Sibugay River. The two figures (Figure 1-6 and Figure 1-7) below shows the location of the rivers, the buffer zones and assisted natural regeneration areas within the creeks in the area.

1.1.2.3 Direct Impact Area for Land

Direct Impact Areas on Land are those directly vulnerable to potential flooding or which may cause changes in the deposition of sand in the shores of the area. As can be seen, there are no high flood potential areas in the site. However, since mining will involve the removal of vegetation, topsoil, and rock from the ground, the direct impact areas will be the main areas that will be disturbed (See figure 1-8 and Figure 1-9).

1.1.2.3 Direct Impact Area on People

Direct Impact Areas for People Sector include the populations in the barangays and municipality which will benefit from the generation of taxes, royalties, social development fund provisions, and permit fees during the life of the project. The primary impact area of the Balabag Gold-Silver Expansion Project is Barangay Depore and Brgy. Dimalinao located within the Municipality of Bayog. The major project components of the Project are still Surface Mine, Mill and Processing Plant, Waste Dump Area and Tailings Storage Facility. The new EPRMP applied area has been mapped to be contained entirely in Bayog. It will also intersect parts of the CADT (CADT-RO9-SIN-0908-75) issued to the Subanen Indigenous People.

Figure 1-6: Water Direct Impact Area along Dipili and Depore Rivers

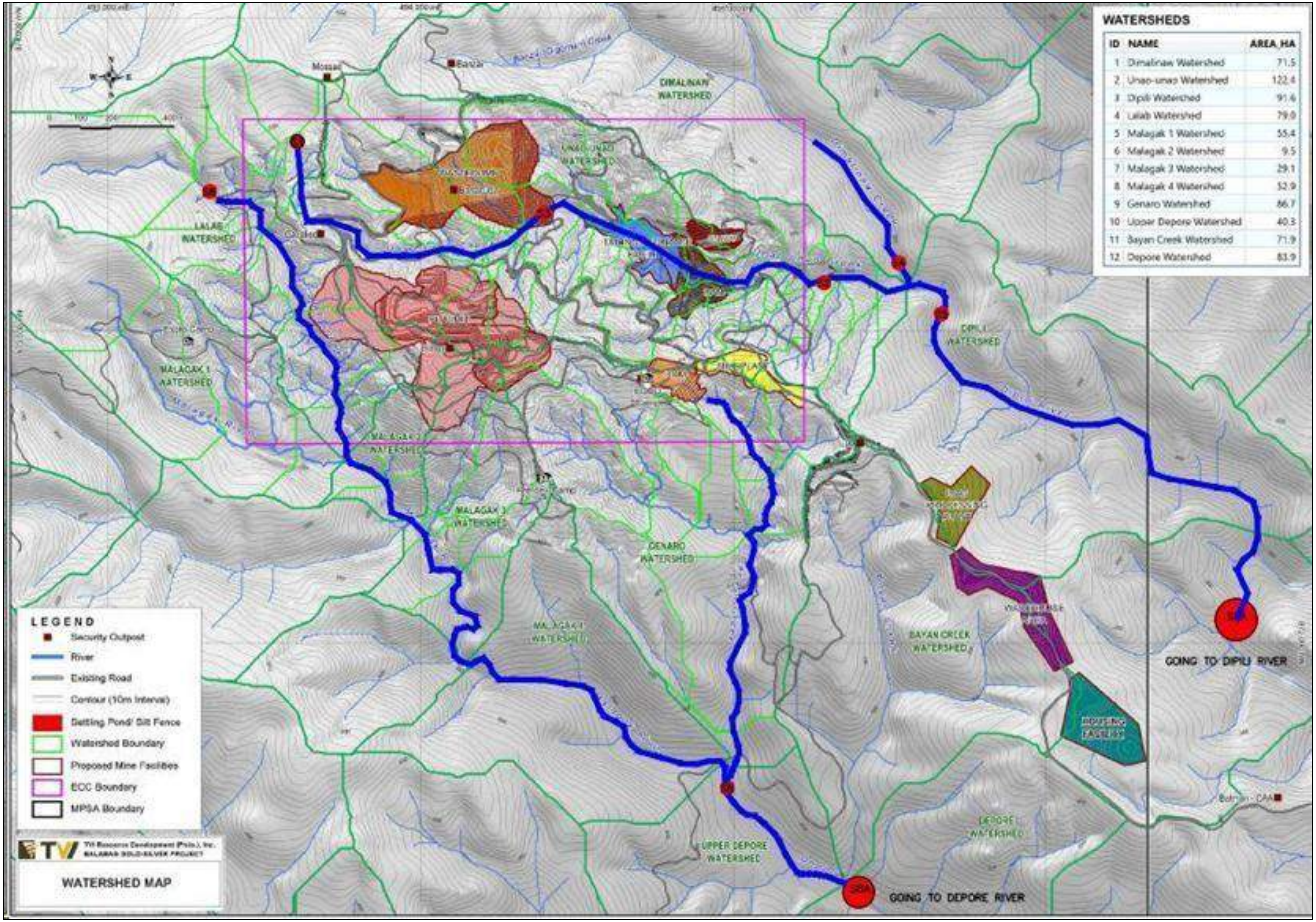


Figure 1-7: Buffer Zones along Creeks and Assisted Natural Regeneration Areas

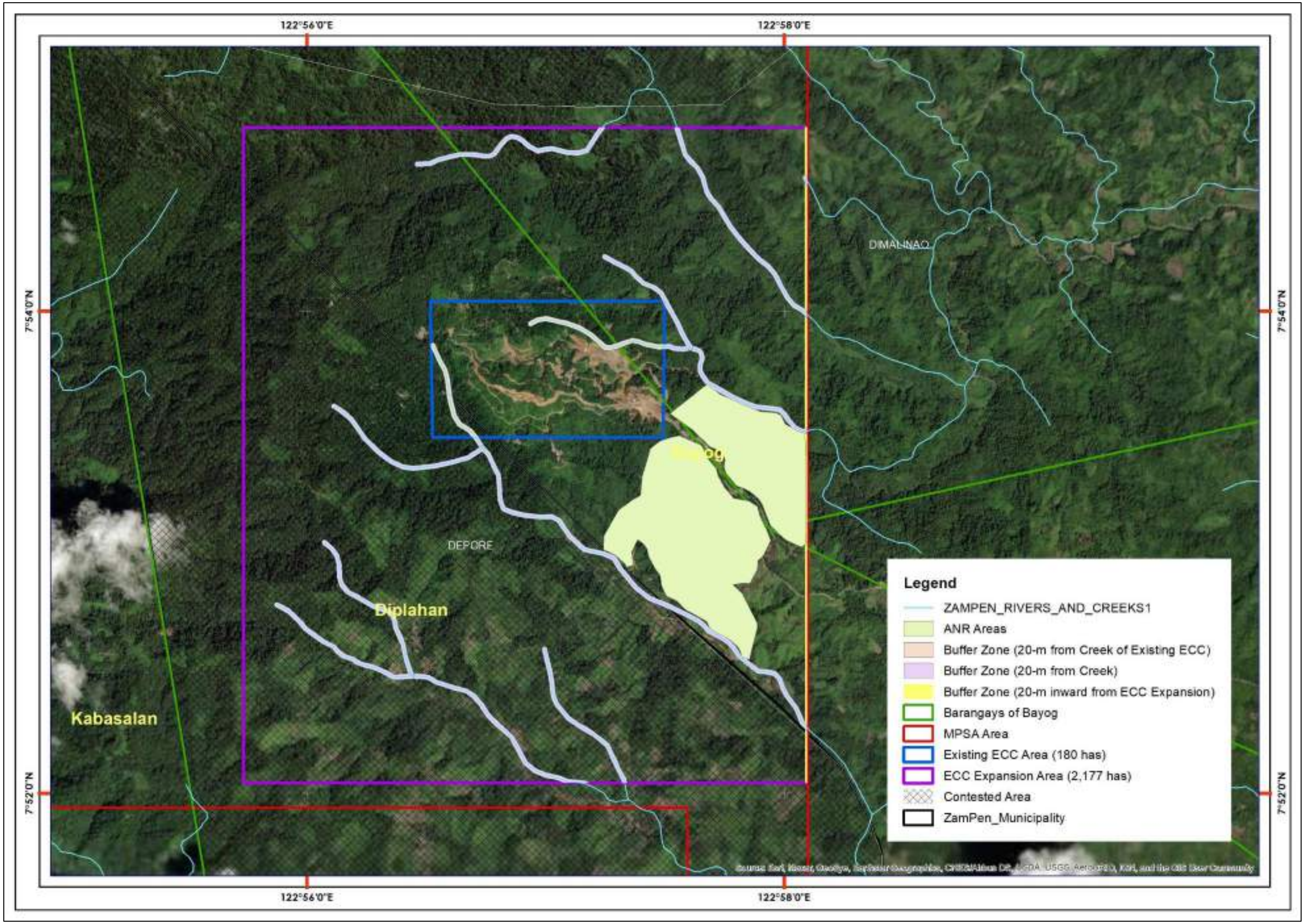


Figure 1-8: Flood Prone Areas in and Around the Site

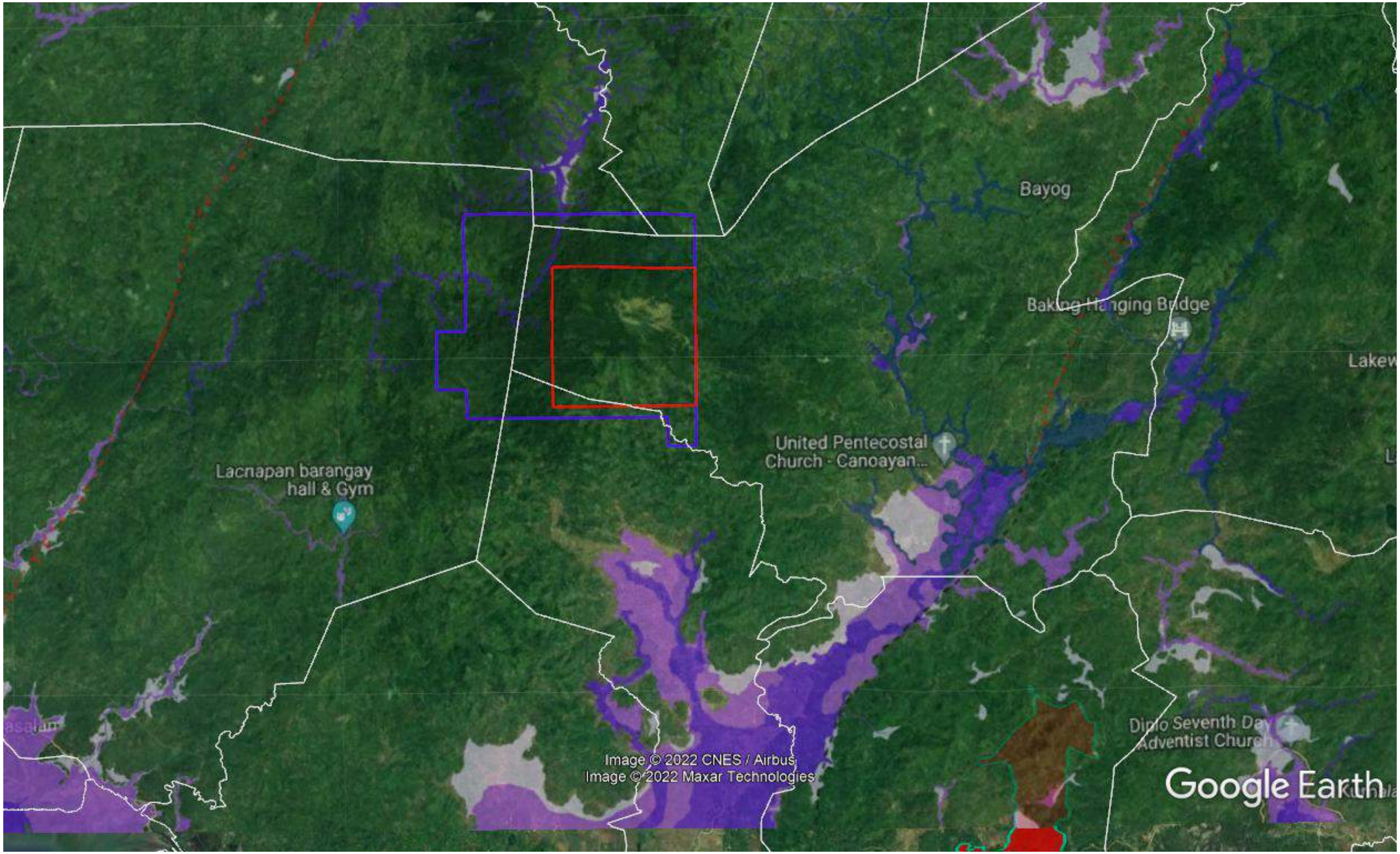


Figure 1-9: Direct Impact Are on Land including All Disturbed Areas

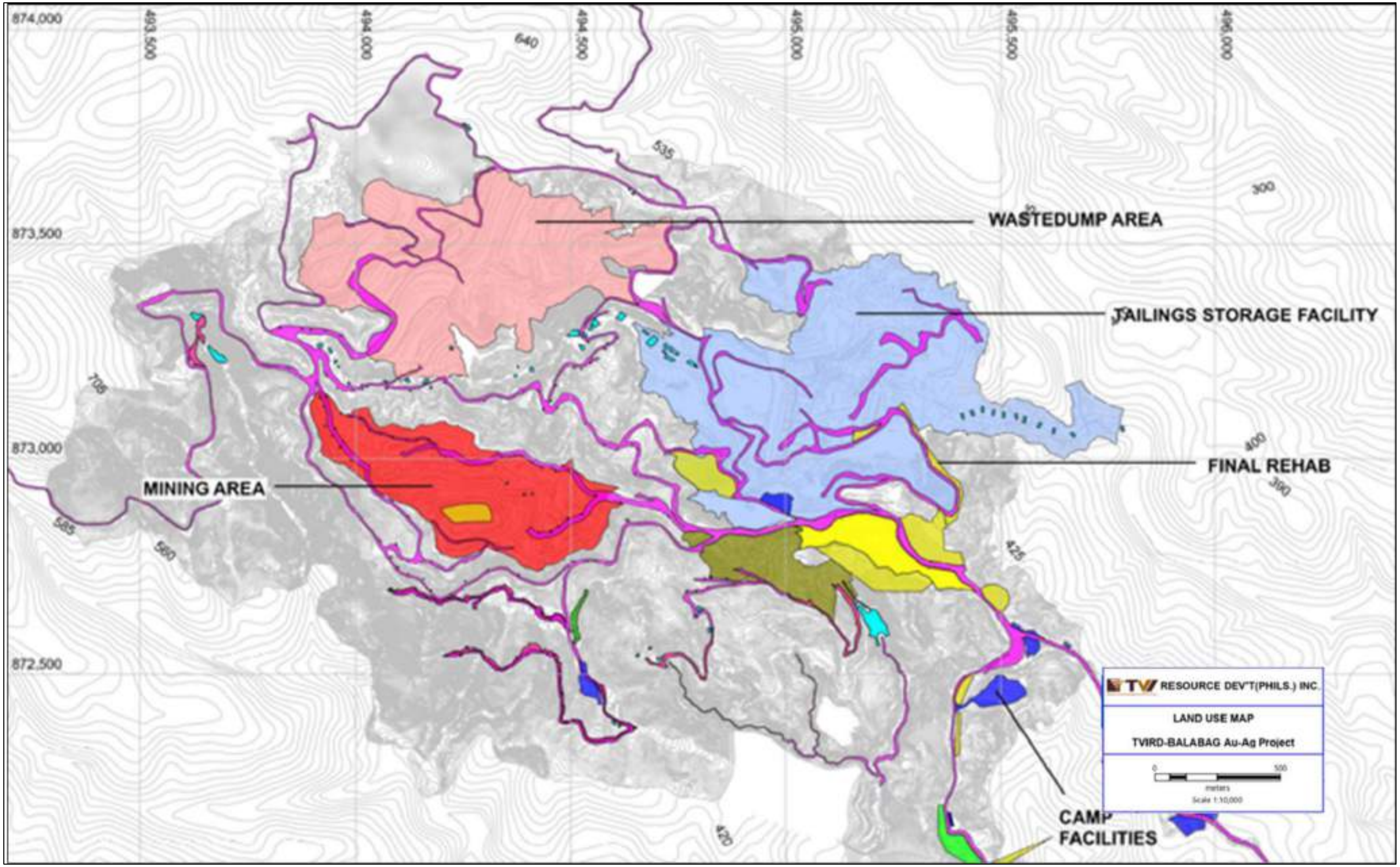


Figure 1-10: Balabag Gold-Silver project with Respect to Community (Social Impact Area)

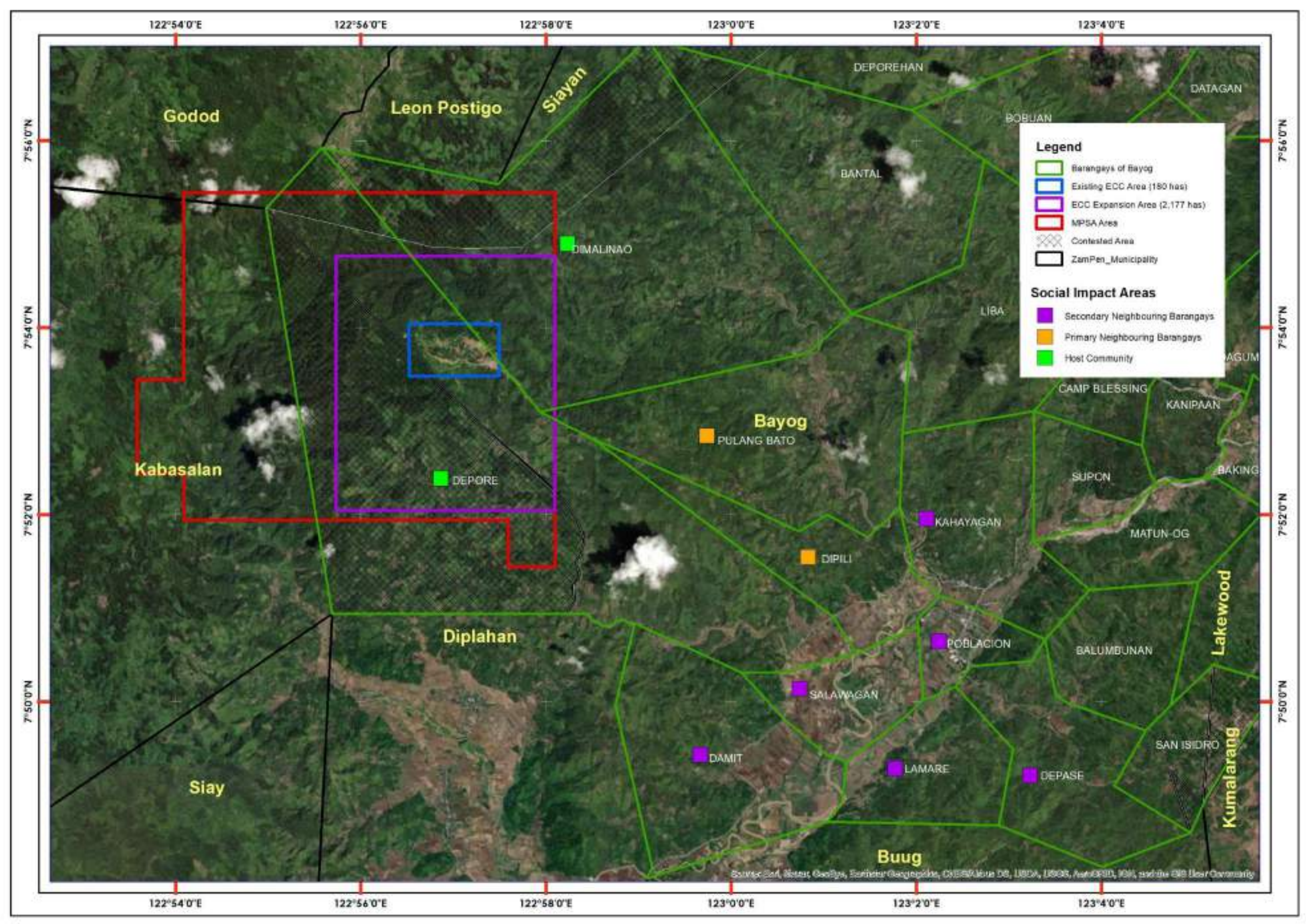
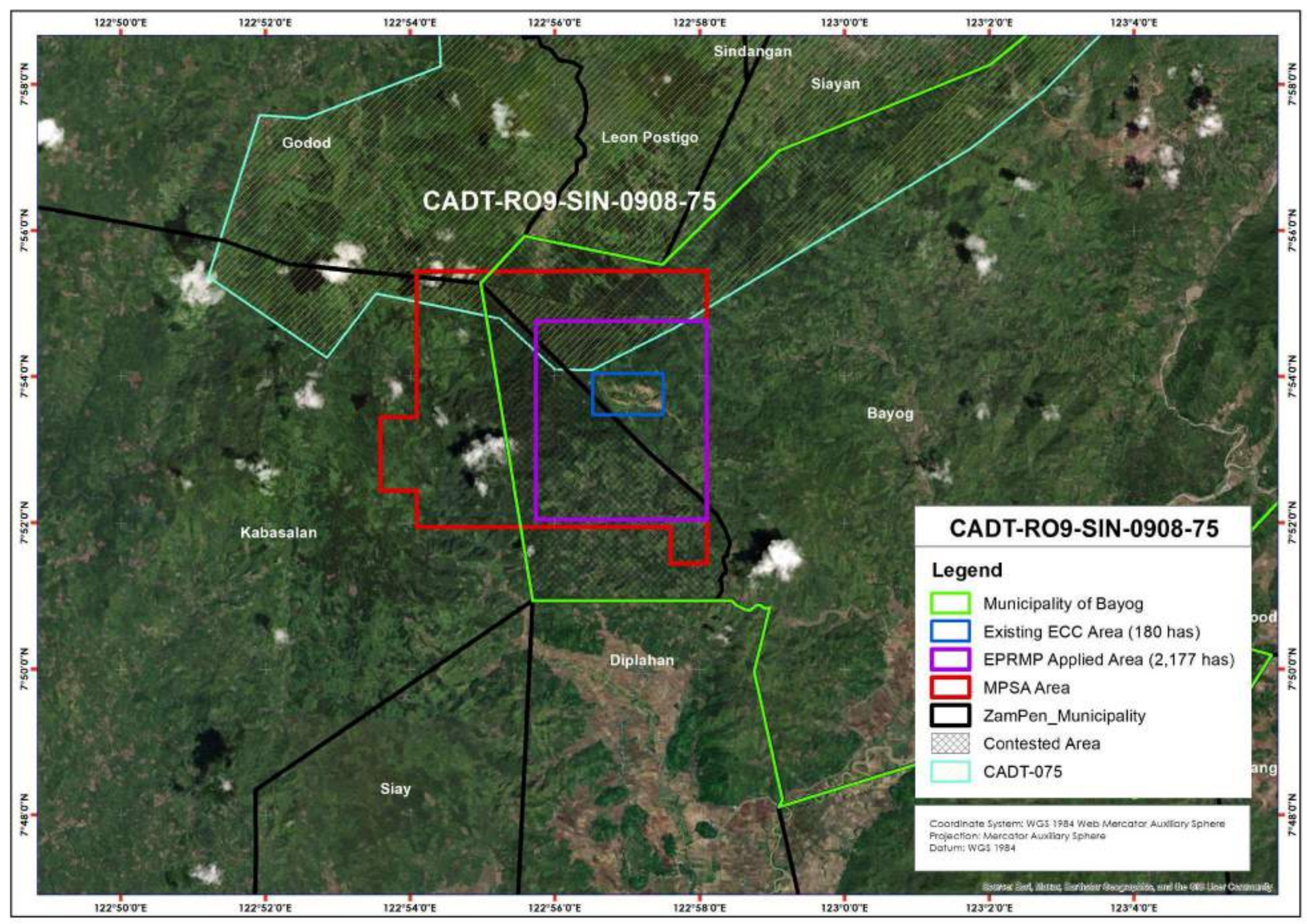


Figure 1-11: Balabag Gold-Silver Project vis-à-vis the CADT Area



1.1.3. Accessibility of the Project Site

The Project is accessible from Manila by air transport followed by land travel. Two airlines (Philippine Airlines and Cebu Pacific) maintain a regular schedule of 1 hour and 20-minute flights from Manila to Zamboanga City. Access to the Project from Zamboanga City is by a 5-hour drive via the Zamboanga-Dipolog National Highway passing through a paved road from Imelda Town to Barangay Guinoman, Municipality of Diplahan in Zamboanga Sibugay.

An alternative route to the Project is via Dipolog City which is serviced by one airline three times a week on a 1 hour and 30-minute flight from Manila. From Dipolog, access is by a 4-½ hour drive via the Zamboanga – Dipolog National Highway through Imelda Town to Barangay Guinoman in the Municipality of Diplahan.

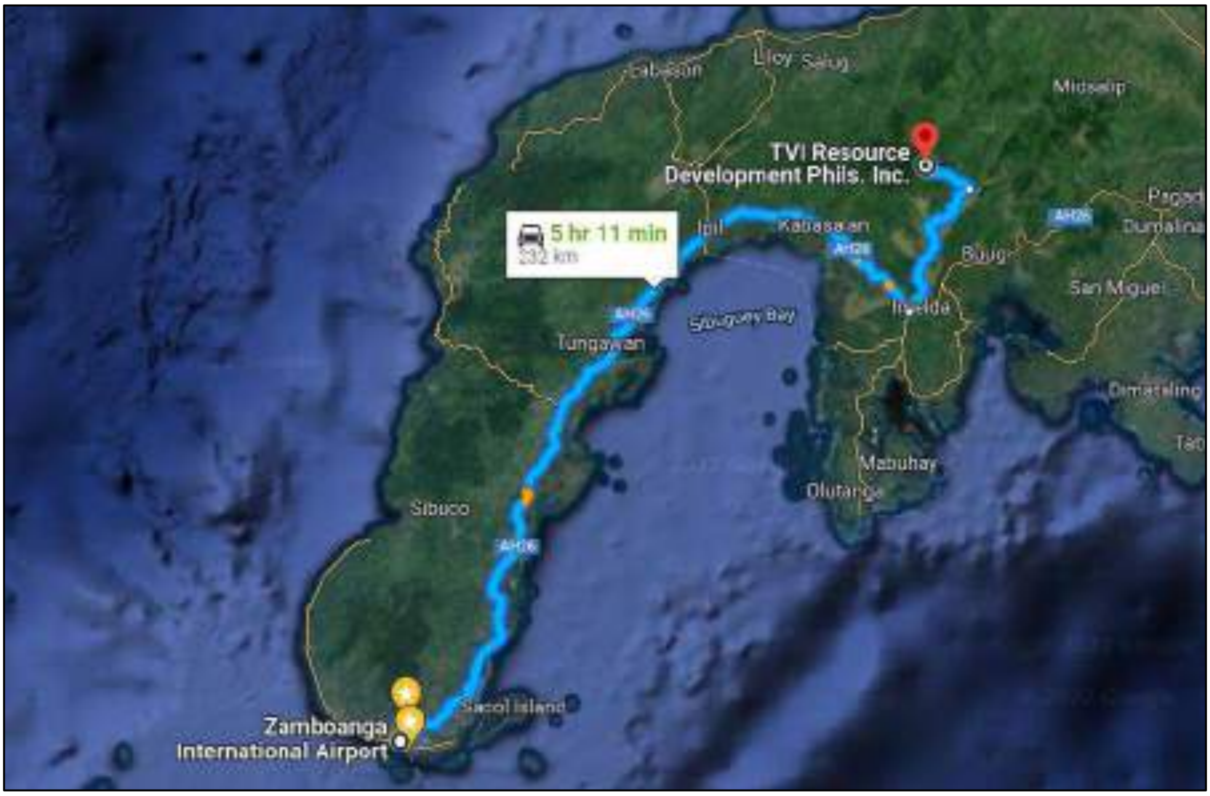
The Project area can also be accessed from Pagadian City via daily flights from Manila followed by land travel. From Pagadian the road goes through the Town of Buug followed by an unpaved road to the Poblacion proper of the Municipality of Bayog.

Illustrated in Figure 1-11 is the road network in and around the project site which shows a dearth of roads around the project site while Figure 1-12 and Figure 1-13 shows the distance and directions from Zamboanga Airport and from Dipolog Airport respectively.

Figure 1-12: Road Network in and around the Project Site

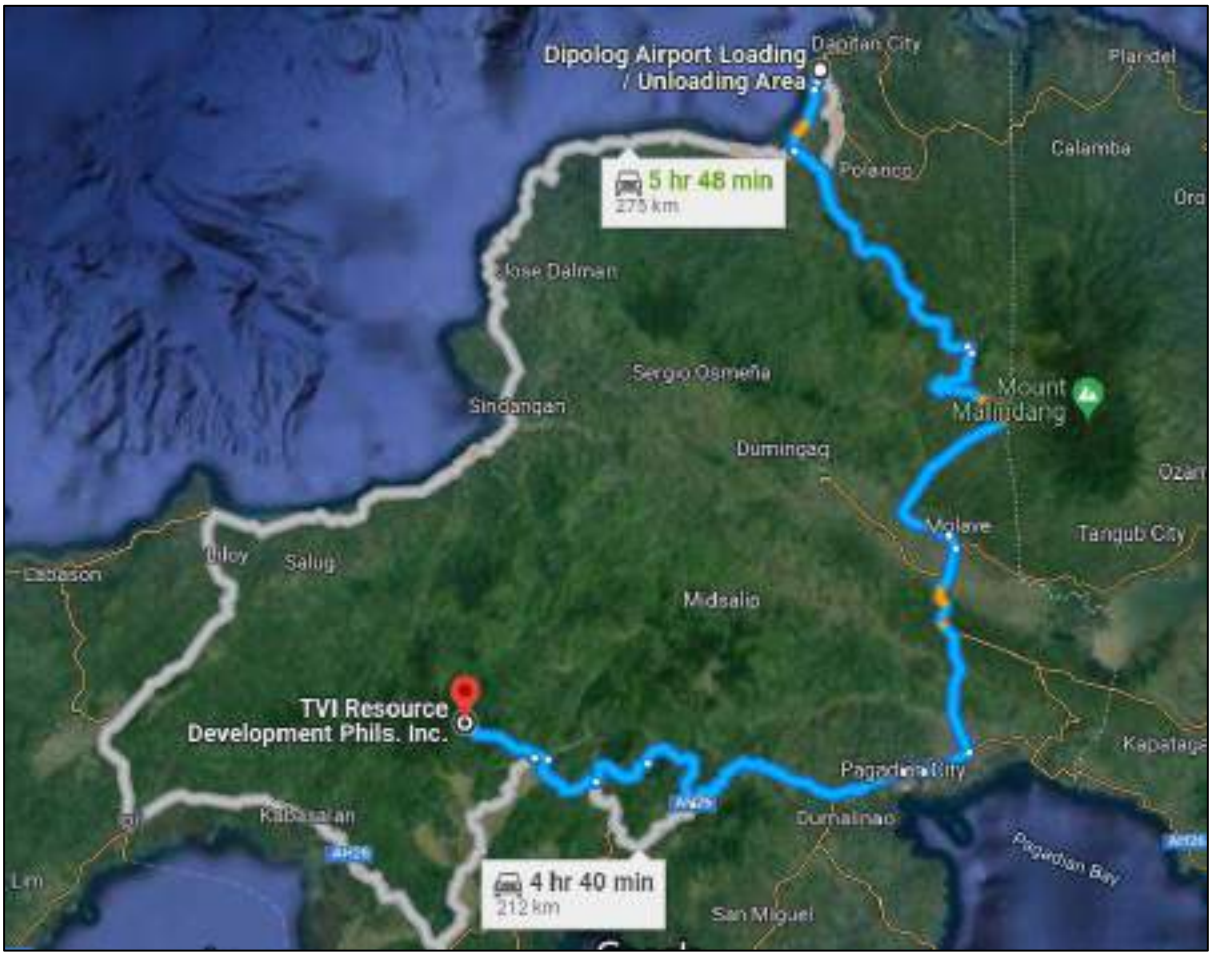
Source: NAMRIA KMZ File

Figure 1-13: Project Location Access Road Map via Zamboanga International Airport



Source: Google Maps

Figure 1-14: Project Location Access Road Map via Dipolog Airport



1.2 PROJECT RATIONALE

The Zamboanga Peninsula has an abundance of rich mineral deposits that have attracted small-scale and larger-scale mining companies throughout the years. The mining operations have provided benefits to the local and national economy, royalties to the indigenous people communities and livelihood programs to the host and adjacent municipalities.

In Year 2018, approximately USD 626 million was collected from the mining sector in the form of taxes, fees and royalties but decreased to USD 509 million in Year 2019. Of this amount, approximately 8% consisted of taxes and fees paid to the local government units and approximately 71% consisted of taxes collected by the National Government. The remaining 21% was collected in the form of excise taxes, fees, charges, and royalties. A summary of the taxes, fees and royalties collected from mining for the period 2017 through 1Q-3Q of 2020 is shown in Table 1-5.

The operation of another mining project within the Zamboanga Peninsula will provide additional taxes and fees to further improve the economic conditions within the host municipality and the province. Estimated benefits for the next three years of operations from 2023 to 2025 is shown in Table 1-6. Estimated Excise taxes for the next three years is P462,802,602 with gross royalties of P115,700,651 to the indigenous communities and SDMP budget of P78,581,424.

Table 1-5: Annual Taxes, Fess, and Royalties from Philippine Mining Industry (PhP Millions)

Category	2017	2018	2019	1Q-3Q 2020
Fees, Charges & Royalties Collected by DENR-MGB/ LGUs	1,408.4	1,730.5	1,911.9	1,609.0
Excise Tax Collected by BIR	2,250.9	4,918.0	5,452.8	Not yet available
Taxes Collected by National Government Agencies	19,373.7	22,228.6	15,288.4	Not yet available
Taxes and Fees Collected by LGUs	2,893.8	2,428.9	2,822.3	Not yet available
Total	25,926.8	31,306.1	25,475.4	1,609.0

Source: Mines and Geosciences Bureau, Mineral Industry Statistics, 2020

Table 1-6: Balabag Gold-Silver Project Estimated Direct Annual Economic Benefits for the Next Three Years

CATEGORY	CY2023	CY2024	CY2025	TOTAL	TOTAL (PhP)
Ore processed (MT)	730,000	541,147	474,500	1,745,647	
Gold grade (g/MT)	2.46	2.46	2.46	2.46	
Gold (oz)	52,263	38,742	33971	124,976	
	USD	USD	USD	USD	
Gross Revenue	100,800,108	74,722,844	65,520,070	241,043,022	11,570,065,056
Total Operating Cost	43,211,988	40,242,570	27,323,417	110,777,975	5,317,342,800

CATEGORY	CY2023	CY2024	CY2025	TOTAL	TOTAL (PhP)
Excise Tax at 4% Gross revenue*	4,032,004	2,988,914	2,620,803	9,641,721	**462,802,602**
Tax collected by National Gov't agencies (Income Tax)	10,577,811	5,788,892	7,066,671	23,433,374	1,124,801,952
Taxes and Fees Collected by LGUs at 0.2% gross revenue	201,600	149,446	131,040	482,086	23,140,130
Indigenous People Royalty Payment at 1.0% Gross revenue**	1,008,001	747,228	655,201	2,410,430	**115,700,651**
SDMP Expenditure	638,601	594,718	403,794	1,637,113	**78,581,424**

Note: Exchange Rate: 1 USD = PhP 48
**Revenue Regulations No. 1-2018, Section 3 amending Section 5 of RR No. 13-94*
*** CDAO 2010-21, Section 16.*

Meeting the Project economic parameters and off take agreements are the primary reasons behind the need to increase the production capacity. An in-house estimate and re-optimization of the mine design had been made considering the increase in gold price yielding to an increase in ore and waste tonnages. Some of the marginal ore classified from previous estimates have been considered for processing. To mine these marginal ore, waste stripping has also increased thus the overall material movement per annum. Table 1-7 shows the projected mine production target for the life of mine.

This increase in production capacity will cause an increase in the annual extraction rate previously identified. A maximum of 11 million wet metric tons of materials movement will occur this 2024 compared to the 3.2 million tons previously projected. Based on a 2,500 tons per day throughput and given the remaining 2.5 million tons the mine life will be until 2025. Environmental management programs identified in the 2013 EIS remain applicable to potential impacts resulting from by the operational changes.

Table 1-7: Mine Production Schedule

		2021 TOTAL	2022 TOTAL	2023 TOTAL	2024 TOTAL	2025 TOTAL	2026 TOTAL	2027 TOTAL	TOTAL
Ore Mixed	tons	179,749.00	623,106.00	771,925.00	509,253.00	442,446.00	223,382.00	223,382.00	2,973,243.00
Au Grade	g/t	1.670	2.21	2.21	2.22	3.65	0.48	0.48	2.13
Ag Grade	g/t	72.150	70.51	36.63	60.74	67.03	11.67	11.67	51
AUEq Grade	g/t	2.570	3.1	2.67	2.98	4.49	4.49	4.49	3.15
Waste Mined	tons	1,820,251	5,841,990	6,893,060	10,476,330	3,766,260	-	-	**28,797,891.00**
Total Material Mined	tons	2,000,000	6,465,096	7,664,85	10,985,583	4,208,706	-	-	**31,324, 235**

		2021 TOTAL	2022 TOTAL	2023 TOTAL	2021 TOTAL	2025 TOTAL	2026 TOTAL	2027 TOTAL	TOTAL
Ore Milled tonnes	tons	160,332.00	620,500.00	730,000.00	541,147.00	474,500.00	223,382.00	223,382.00	2,973,243.00
AU Grade	g/t	1.92	2.46	2.46	2.46	2.46	0.48	0.48	2.13
Al Grade	g/t	68.69	58.94	58.94	58.94	58.94	11.67	11.67	51.00

1.3 PROJECT ALTERNATIVES

Table 1-8: Summary of Major Project Features, Its Alternatives and Variations for Mining and Waste Management

Project Component	Alternatives and Variations	Decision Criteria
Mine Area	No changes in chosen option: Location: Miswi-Tinago Area of Balabag Mining Method: Surface Mine Area will increase from 13.5 ha to 35 ha	There are no alternative locations for the mine area since it is dependent on where the ore deposit exists. The surface mining method is preferred since the geology and mineralization within the area are shallow and suggest a surface mining approach with respect to technical issues and economics. Deeper veins are also evident below the shallow ore. The increase in mining area is primarily to accommodate additional potential resources as indicated in the approved DMPF dated May 2018.
Waste Dump Area	Alternative 1: South and East of the Surface Mine	The area south and east of the surface mine area has been identified as potential areas for additional ore resources. This area will be subject to further exploration in the future. The area south of the surface mine is within a different watershed thereby increasing the environmental impact footprint.
	Alternative 2: West of the Surface Mine	This area is located within a different watershed thereby increasing the environmental impact footprint. Transportation will be more difficult with corresponding higher costs. The site is not considered.
	Alternative 3: North of the Surface Mine (Selected Alternative)	The area is adjacent to the surface mine resulting in reduced

Project Component	Alternatives and Variations	Decision Criteria
		transportation time and lower costs. It is also located within the same watershed as the other major facilities thereby reducing the environmental impact footprint. Surface water runoff is captured by the Tailings Storage Facility for treatment and water quality management.
	Increase in area from 13.5 ha to 35 ha	The increase in mine waste disposal is compelled by the increase in mineral extraction rate to 11MMT per year, which would mean a greater amount of waste and overburden rock to shift from the mining area to the disposal area.
Tailings Storage Facility	Alternative 1: 1km Southwest of the Surface Mine. Alternative 2: 800m Southwest of the Surface Mine	Both Alternative 1 and 2 are in different watershed thereby increasing the environmental impact footprint. Both sites require high embankments to provide sufficient tailings storage capacity. Tailings conveyance facilities from the processing plant will be long and subject to higher costs, additional maintenance and increased environmental risk.
	Alternative 3: L 800 m East of the Surface Mine (Selected Alternative)	Alternative 3 is located within the same watershed as the other facilities thereby minimizing the environmental impact footprint. The tailings storage capacity is the greatest relative to the other alternatives. Access to the processing plant is the most favorable. The location also allows the capture of sediment from the surface mine and waste dump areas and provides for centralized water quality management capabilities.

Project Component	Alternatives and Variations	Decision Criteria
	Alternative 4: 1.3 km Southeast of the Surface Mine	Alternative 4 is in a different watershed thereby increasing the environmental impact footprint. This site requires a higher embankment to provide sufficient tailings storage capacity. Tailings conveyance facilities from the processing plant will be long and subject to higher costs, additional maintenance and increased environmental risk. An increase in TSF is warranted by the 25% increase in mineral processing rate, which will need a larger and expanded TSF Area. This also includes all the appurtenances required for the TSD such as pipelines and emergency spillways.

Table 1-9: Summary of Project Features Alternatives and Variations for Mill and Processing Operation

Project Component	Alternatives and Variations	Decision Criteria
Mill Process	Alternative 1: Heap Leaching	The Heap Leaching alternative is hindered by several technical and environmental constraints. Suitable flat topographic areas are limited. High precipitation hinders operations and presents potential environmental management concerns. Test work did not indicate a robust metals recovery regime.
	Alternative 2: Gravity Separation	Alternative 2 has the least environmental impact potential. Recovery of gold and silver however is low and in the range of 30% to 35% and 4% to 5% respectively. As a result, the economic viability is low.

Project Component	Alternatives and Variations	Decision Criteria
	Alternative 3: Standard Cyanidation Process	Cyanide leaching is the most viable option for the type of ore present at Balabag. Sodium cyanide would be used to recover gold and silver. Significant metallurgical testing was done to fully characterize the process and establish design and operating parameters.
	Alternative 4: Combined Gravity Separation and Cyanidation (Selected Alternative)	Metallurgical testing identified a combined Gravity Separation and Cyanidation process as producing the highest recoveries and resulting in the most robust economic operation. Constraints associated with this alternative include increased environmental management protocols and the need for tailings detoxification due to the use of sodium cyanide. There will be no changes in the mill and processing plant as installed based on the previous ECC since the same configuration of mill and plant can take an increase of 25% throughput without any problem.
Tailings Disposal	Alternative 1: Thickened Tailings Disposal within an Impoundment Alternative 2: Paste Tailings and Disposal within an Impoundment Alternative 3: Filtered Tailings and Disposal within an Impoundment	The objective of Alternatives 1, 2, and 3 is to reduce the volume of tailings due to increased tailings densities and reduce the water volume within the tailings impoundment. The height of the tailings containment structure may be reduced thereby reducing capital costs. Additional equipment is required within the process plant to produce thickened tailings resulting in an increased capital cost. Conveyance of the tailings will be

Project Component	Alternatives and Variations	Decision Criteria
		more difficult due to the high solids concentration. Watershed sediment storage within the impoundment will negate some benefits derived from increased tailings densities.
	Alternative 4: Combined Mine Waste and Process Tailings and Disposal within and Impoundment	Combined waste disposal improves the geotechnical properties of the material and increases mechanical strength. May improve the final rehabilitation and reclamation programs. Less volume is required for combined waste disposal versus two distinct waste disposal sites. Limited operational data on the effectiveness of this method. Tailings disposal areas are very limited with respect to storage capacity. Addition of waste rock is not viable.
	Alternative 5: Conventional Wet Tailings Deposition within an Engineered Tailings Storage Facility (Selected Alternative)	Conventional tailings disposal method with defined operating parameters and facility construction programs familiar to the TVIRD operations staff. Limited storage capacity at all alternative tailings storage facility sites negates the addition of waste rock. Storage efficiency at all sites is poor and increased densities will not significantly affect the size of the dam embankment. Some tailings thickening (Alternative 1) is planned within the mill process for water recycling.

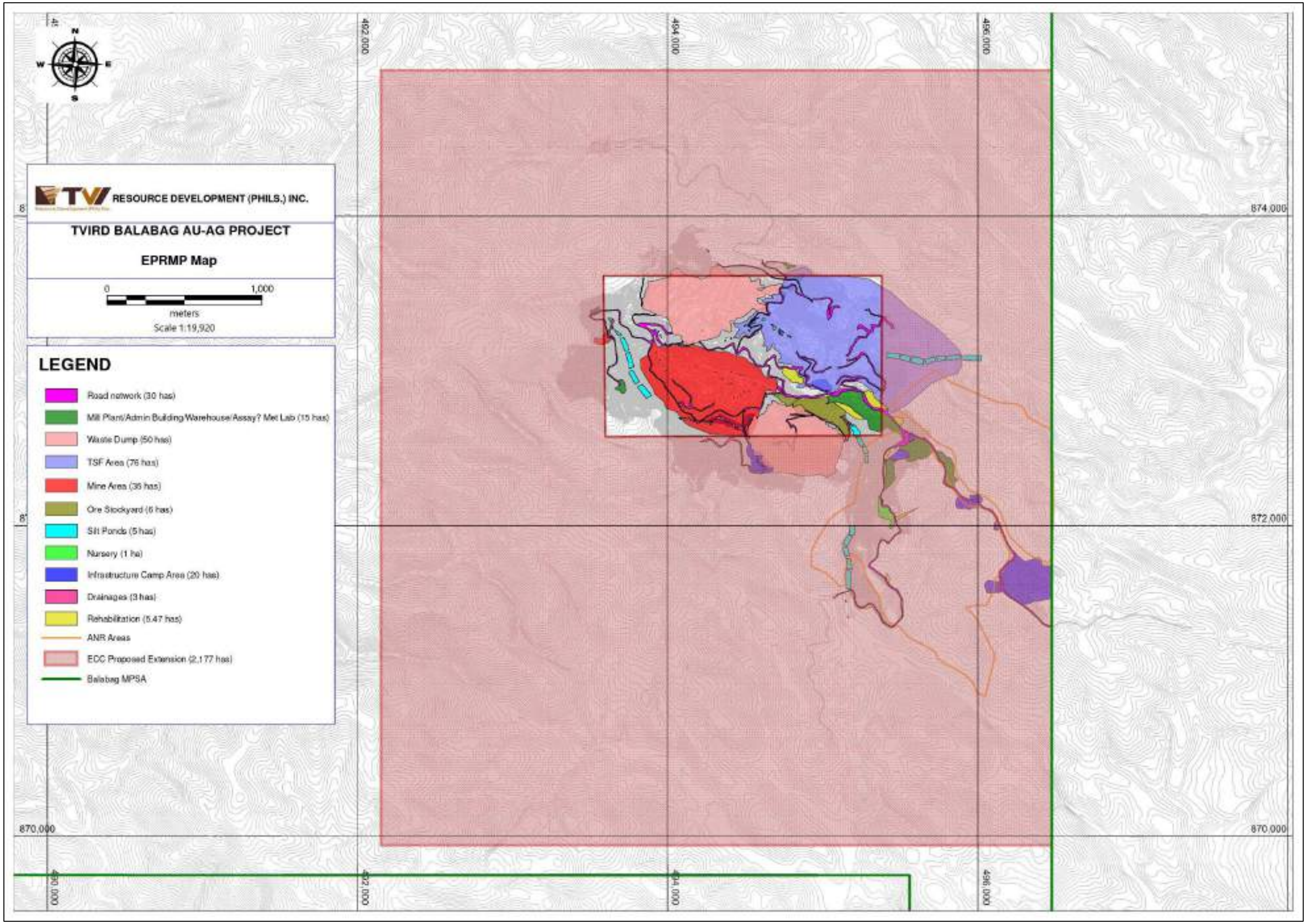
1.4 PROJECT COMPONENTS

Table 1-10: Major Features of the Existing and Proposed Expansion Projects

Project Components	ORIGINAL EIS AND ECC		EPRMP 2022	
	No. of Units	**Specifications (Area or Capacity)**	**No. of Units**	**Specifications (Area or Capacity)**
Mill and Processing Plant	1	Initially at 500 MTPD and 0.5 ha in the 2012 EIS. Final Area of 2.34 ha for Mill Processing	1 (No change, Mill Plant can accommodate the increase in throughput)	2.34 ha for processing 2,500 MTPD of ore
Main Warehouse Building	1	Initially 15,000 sqm in the 2012 EIS. Currently 5,000 sqm	1	5,000 sqm
Ancillary Facilities	TOTAL	12.0 ha	TOTAL	12.0 ha
Chemicals and Reagents Storage Facility	1	2,350.0235 sqm	1	2,350.0235 sqm
Power Supply (Multiple Diesel Engine Generator Sets)	4 (Two 1.5 MW and two 2.0 MW)	4.5-5.6 MW for 2,000 TPD Throughput	6 (Four 1.5 MW and two 2.0 MW)	5.8 MW for 2,500 TPD Throughput
Water Supply	1	80 lps	1	80 lps
Water Demand		22.34 lps		27.93 lps
Materials/ Supplies Warehouse	1	0.1760 ha	1	0.1760 ha
Access Road	1 lot 10 m wide (min)	9 ha	1 lot 10 m wide (min)	30 ha
Housing and Camp Facilities	1	2.5 ha, expanded to 4.5 ha under ECC-OL-R09-2020-0131	2	4.5 ha + areas under multi-Facilities
Administration Facility	1	2.5 ha	1	2.5 ha

Multi-Facilities	TOTAL	4.9095 which include additional housing and camp facilities, clinic, motor pool, fuel farm, contractors' facilities and laydown area, nursery area, hazardous waste facility, material recovery facility, and security barracks under ECC-R09-2021-0131	TOTAL	4.9095 which include additional housing and camp facilities, clinic, motor pool, fuel farm, contractors' facilities and laydown area, nursery area, hazardous waste facility, material recovery facility, and security barracks under ECC-R09-2021-0131
Contractors' Facilities	4	0.9305 ha	4	0.9305 ha
Security Barracks	1	1.252 ha	1	1.252 ha
Nursery	1	0.5155 ha	1	0.5155 ha
Materials Recovery Facility	1		1	
Hazardous Waste Facility	1		1	
Housing and Camp Facilities	1	1.7038 ha	1	1.7038 ha
Clinic	1 (3-bed capacity as per DOLE DO 2018-198)	0.5077 ha	1 (3-bed capacity as per DOLE DO 2018-198)	0.5077 ha
Motorpool	1		1	
Fuel Farm	1 (4 tanks with 98, 280 L gasoline capacity)		1 (6 tanks with 158,760L diesel and 15,120L gasoline capacity)	
Assay and Metallurgical Laboratory	1	374.30 sqm	1	374.30 sqm
Explosive Magazine				
Dynamite	2	36 tons @ 18 tons each	2	36 tons @ 18 tons each
ANFO	3	54 tons @ 18 tons each	3	54 tons @ 18 tons each
Blasting Cap and Accessories	1	2 tons	1	2 tons

Figure 1-15: Development Map showing Location of Mine Facilities



1.4.1 Surface Mine Design Criteria

The surface mine was delineated using conservative economics and surface mine design parameters. A cut-off grade of 0.80 grams per metric tonnes of gold was used in defining the initial limits of the mine pit. This cut-off grade was based on a set of conservative operating parameters and was a product of a mine valuation done in the initial stages of pre-development. The mine pit limits were further refined using a set of engineering design criteria and included provisions for haul roads and safety berms. The expansion Project have no modification on the design criteria in the mining design. These similar criteria and design parameters are identified below.

Overall Mine Pit Slope

The maximum mine pit slope is 45˚ or 1H:1V, measuring from crest to crest or toe to toe. The 45˚ criterion was applied only when defining the initial limits of the pit (using the cut-off grade). Inclusion of haul roads and safety berms results in flatter overall pit slope of approximately 38˚.

Bench Design

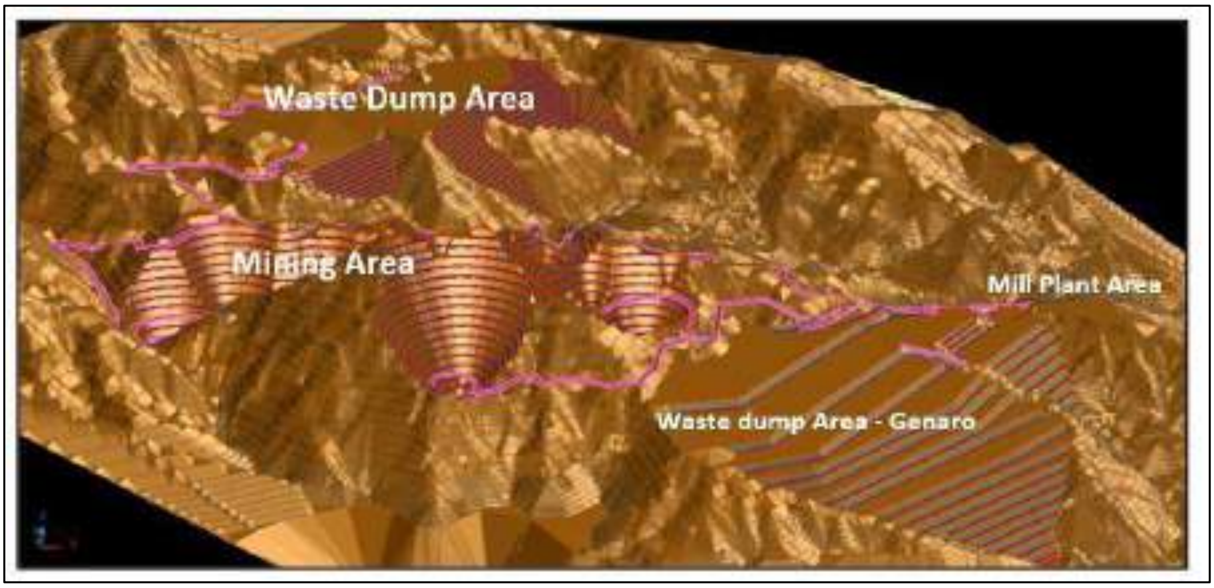
The design bench slope is 60˚ or 1H:2V with a bench height of 5 meters and a minimum berm width of 5 meters. To efficiently use the berms, double benching will be employed with a 5-meter berm established every 2nd bench.

Haul Road

The haul roads have a minimum width of 10 meters and a maximum gradient of 10%. The standard road width is 3 times the width of the widest equipment to be used. For this project, it was assumed that the mine will be using 10-wheeler dump trucks and mid-size excavators (CAT 336 and 320). Initial estimates in the 2012 EIS shows that the haul rounds will cover an estimated area of 9 hectares. As of now the road networks cover an area of 21.37 hectares.

The surface mine contains approximately 1.3 million metric tonnes of ore and 13.3 million metric tonnes of waste. This is expected to increase as further exploration and ore reserve modeling continues.

Figure 1-16: Starter Pit Design and Other Mine Facilities such as Waste Dump and Run-of-Mine Ore Pad



1.4.2 Surface Mine Support Infrastructure

Infrastructure required to support the mining operations will be placed within close proximity to the surface mine to minimize the overall footprint of the Project and reduce operating costs. These include the residential camp and administration facilities, warehousing and materials management facilities, power supply generators and fuel storage areas, water supply and conveyance infrastructure, run of mine and ore blending storage areas and equipment storage and maintenance yards. Characteristics of the Project area that are key influential factors are topography, potential mineralization zones and haul distances between the surface mine and mill and from the surface mine to the waste rock and overburden disposal area.

a. Topography

The property has a rugged terrain, which results in limited flat areas to accommodate the space required by the Mill and Processing Plant as well as other structures. This requires efficient design and construction to maximize the available space and minimize the amount of slope cutting and filling. The valleys and natural depressions were considered for impoundment zones for mine waste rock and overburden and mill process tailings.

b. Potential Mineralization

The extent of the Balabag Deposit, specifically the vein systems of Miswi and Lalab remain open for further delineation. Permanent mine infrastructure should not be placed on top of potentially mineralized areas. Furthermore, condemnation holes will be drilled in the areas before construction can begin.

c. Haul Distance

The Mill and Processing Plant, Waste Rock and Overburden Disposal Area and the Tailings Storage Facility were placed within proximity to the surface mine to minimize overall haul distances and costs.

1.4.3 Waste Dump Area

The Waste Dump Area will serve as the final storage area for waste rock and overburden materials extracted from the surface mine starter pit.

1.4.3.1 Alternative Locations

The site selection for Waste Rock and Overburden Disposal Area was significantly influenced by the general topography of the area and estimated volume of material to be disposed. Natural depressions and valley-type sites were considered the best candidates as these could best accommodate the volume of waste rock excavated from the surface mine. Three sites were initially considered for the mine waste dump however one area (Site 2) was removed from consideration.

a. Site 1 - Southeast

This site is located southeast of the surface mine and provides a large storage capacity that can well accommodate the anticipated volume of waste. However, the site is within close proximity to the Miswi vein. Geologic exploration data and projections suggest the possibility of the ore deposit extending within the area.

b. Site 3 - North

Site 3 is located within in a valley directly north of the surface mine. Although this site has a smaller storage capacity than Site 1, it can still accommodate the anticipated volume of waste. This area is now considered the primary site for the waste rock and overburden materials. A series of condemnation holes will be drilled to prove the ground sterile.

1.4.3.2 Design Criteria

The Waste Rock and Overburden stockpile was designed based on the following criteria:

a. Overall Slope

The maximum slope of the stockpile is 26˚ or 2H:1V as measured from crest to crest or toe to toe.

b. Material Placement Methods

Each bench will have a maximum slope of 50˚ or 1horizontal to 1vertical with a maximum lift height of 5 meters. The minimum berm width is 5 meters. This is similar to the overall criteria used for the Surface Mine.

c. Haul Roads

The haul roads have a minimum width of 10 meters and a maximum gradient of 10%. The standard road width is 3 times the width of the widest equipment to be used. For this project, it was assumed that the mine will be using 10-wheeler dump trucks and mid-size excavators (CAT 336 and 320). These design parameters were set with the primary objective of maintaining the stability stockpile. The slopes and lift heights however can be expected to vary depending on specific waste rock characteristics as encountered during the mining operations.

1.4.3.3 Waste Rock and Overburden Stockpile Footprint

Approximately 30.5 million tons of waste rock and overburden materials are anticipated to be generated throughout the operation from mining operations and facility construction. The disposal area footprint was established based on the estimated volume of waste and the above design criteria. The location and footprint of the disposal area is shown on figure 1-17. The maximum area encompassed by the waste rock and overburden disposal is approximately 50 hectares.

Although Site 3 has less volume capacity compared to Site 1, several options can be considered which could potentially reduce the overall footprint of the Site 3 waste dump and provide some flexibility in future mining and disposal operations. These include the following:

Part of the mine waste can be used as construction fills, road surfacing materials and random fill for the Tailings Storage Facility. The volume of waste which can be used for these purposes will depend on the timing and volume and quality of materials required.

Low-grade materials (below the cut-off grade) which could be stored in a separate stockpile area, which can easily be accessed and recovered should the metal prices increase.

Topsoil and soil layers immediately below the topsoil will be stored separately for future reclamation and rehabilitation activities.

1.4.4. Mill and Processing Plant

The metallurgical testing for the Project was initially performed in 2007 by SGS Lakefield, Canada in support of a comprehensive scoping study prepared by Genivar consultants. The initial process flow sheet and general mill plant layout were designed to handle a 2,000 metric tonnes per day throughput. A similar plant design was adopted for the planned operations with some modifications identified by subsequent metallurgy testing. Further testing during the initial operations stage show that the same plant can handle a throughput of 2,500 metric tons per day with no additional facilities/components/process equipment. See Process Flow Diagram of Mill and Processing in Annex 1-2 and Annex 1-2.

The Project has a Mill and Processing Plant in which the extracted ore was being process into doré bars. The plant consists of a conventional grinding circuit followed by a gravity separation circuit and then a conventional cyanidation leaching circuit. It also includes a flotation circuit with an Electro-winning or Merrill-Crowe circuit. The plant is located northwest of the Surface Mine and was initially estimated to cover an area of 0.5 hectares. The final area after construction was found to be 2.34 hectares.

1.4.5. Tailings Storage Facility

A Tailings Storage Facility (TSF) was constructed to impound the tailings produced by the mill process. The initial 2012 EIS estimated the overall area of the impoundment, dam and spillway will be approximately 20.5 hectares which is defined by an earth embankment dam within the Unao-Unao Creek valley. Approximately 780,000 metric tonnes of tailings are anticipated to be generated from the operations. All the tailings is conveyed from the processing plant to the TSF by pipeline and discharged within the impoundment using a series of pipeline spigots.

The discharge of the tailings is subaqueous and will remain below the water surface. A high-level permanent spillway will maintain a fixed water level within the impoundment. Sufficient water cover is maintained to reduce the potential for re-suspension of tailing materials by wave action.

TVIRD engaged the services of an international engineering company, Knight Piesold consultants, for the design of the TSF and preparation of construction plans and specifications. This work was completed in early 2012 and is based on similar TSF designed and constructed at the TVIRD Canatuan Project. The dam was constructed to retain the tailings is a zoned earth fill embankment dam with an overflow spillway located within one abutment of the dam.

The TSF was constructed in two stages to maximize the project economics and to maximize construction during the dry season. The first stage was constructed prior to actual operation mining and milling operations. Stage 2 is also planned to be completed within a 5-month period given continuous favorable weather conditions. Waste rock generated by the surface mine operations was used for construction. Additional earth materials used in the construction were sourced from other areas both within and outside the MPSA. Source location of these materials were part of the development plan of the tailings facility. With the proposed expansion of the Project, image below shows the extent of the Stage 3 construction of the Tailings Storage Facility will cover is shown. The expansion of the Tailings Storage Facility (TSF) will increase its volume capacity and will be more than sufficient to contain the resulting plant tailings from the mineral reserves.

The expansion of the tailings storage facility towards the east of the existing structure, and the additional storage of stripped rock from the mines towards Genaro on the south will require that the permitted be expanded from 189.4 hectares to 2,177 hectares and the TSF from 20.5 to 76 ha.

The table below presents the characteristics of the TSF such as dam height elevation, dam capacity, volume of impounded tailings, remaining volume of the TSF and the impoundment area for the first seven years of the mine until 2027. The tabulation shows that TSF Impoundment capacity on year 1 is 156,343.35 cubic meter with only 145,756.36 cubic meters impounded tailings wherein it has 10,586.99 cubic meter remaining volume capacity, allowing to accommodate about 6.8 percent of solids from runoff water from upstream side during rain. While on the seventh year or end of Mine life having total capacity of 2,764,454.54 cubic meter with only 2,717523.82 expected tailings will be deposited from the Mill.

Table 1-11: Data on Tailings Storage Capacity

Year	Dam Height Elevation (m)	Capacity (m^3)	Volume (m^3) of Impounded Tailings	Remaining Volume (m^3)	Impoundment Area (Ha)
1 (2021)	434.0	156,343.35	145,756.36	10,586.99	1.72
2 (2022)	450.5	748,951.06	724,422.91	24,528.15	5.93
3 (2023)	460.0	1,430,057.44	1,388,059.27	41,998.17	8.43
4 (2024)	465.0	1,885,704.46	1,880,011.09	5,693.37	9.78
5 (2025)	469.5	2,355,686.40	2,311,374.73	44,311.67	11.12
6 (2026)	471.0	2,526,342.11	2,514,449.27	11,892.84	11.58
7 (2027)	473.0	2,764,453.54	2,717,523.82	46,929.72	12.20

Figure 1-17: Waste Rock and Disposal Area

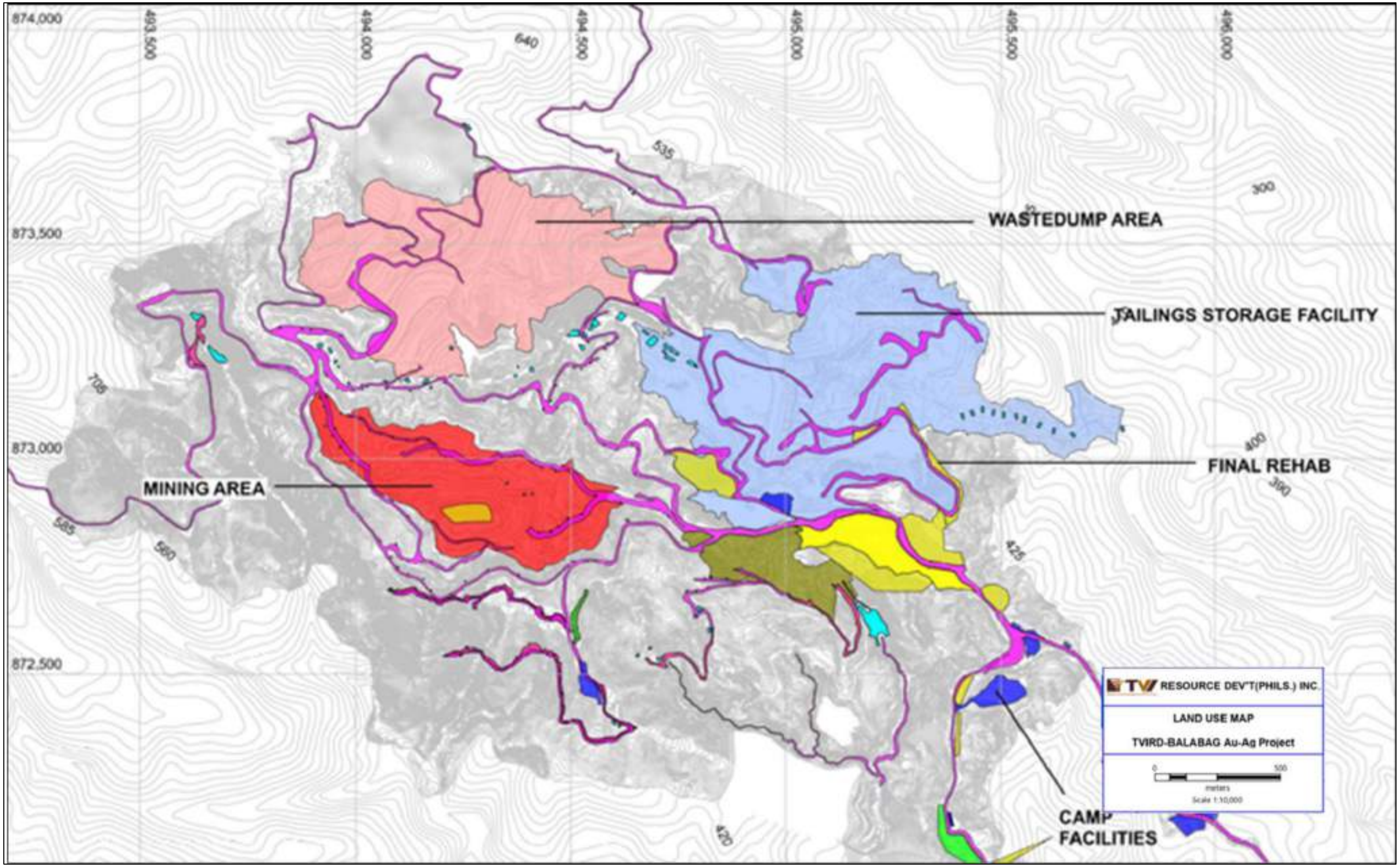
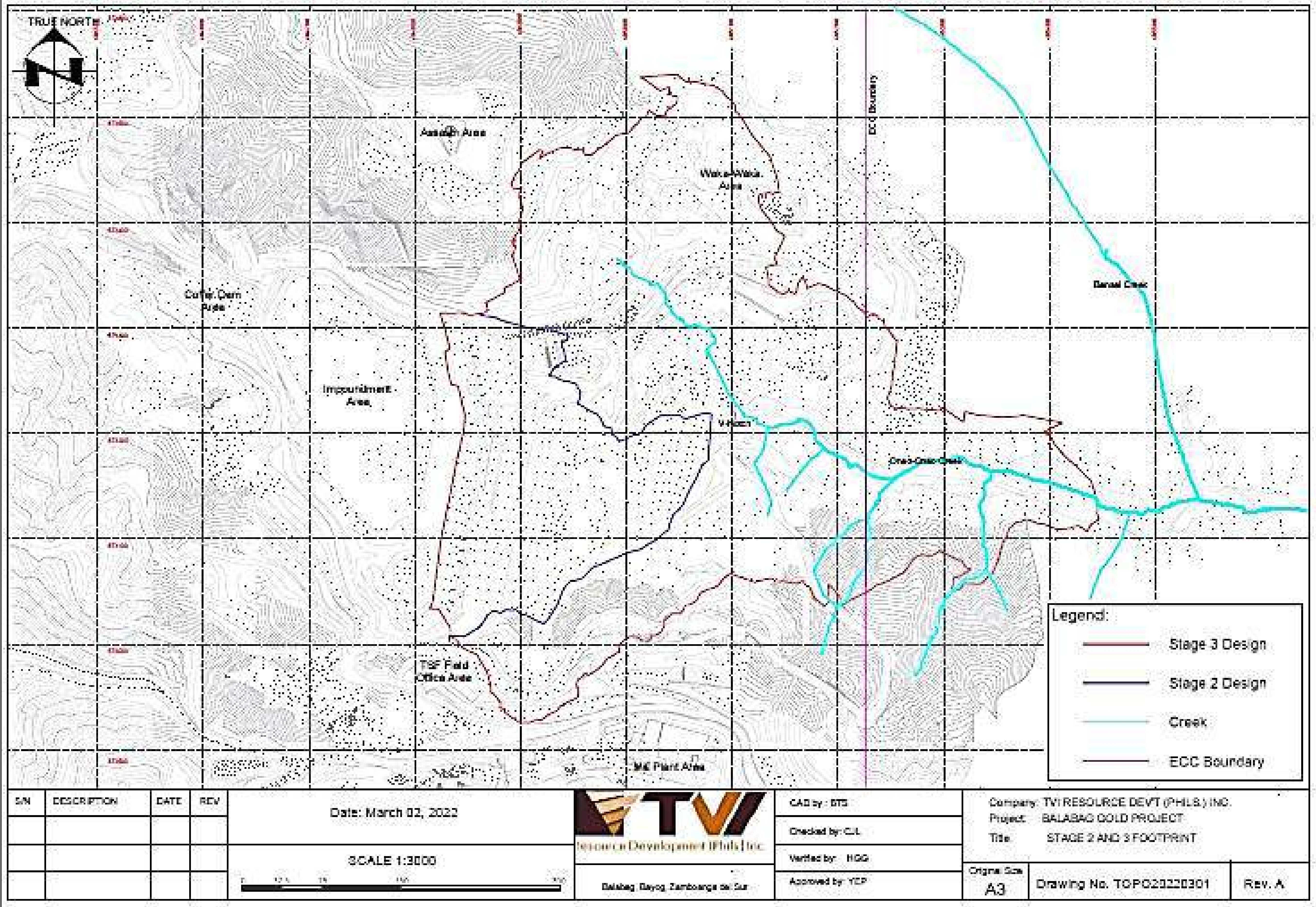


Figure 1-18: Extent of the Stage 3 Tailings Storage Facility (TSF)



1.4.5.1 Tailings Storage Facility Location

Four potential storage sites were identified in the initial scoping study prepared by Genivar consultants in 2008. Subsequent field investigations conducted by TVIRD and Knight Piesold in 2011 identified a preferred site immediately east of the surface mine. This area is within the Unao-Unao Creek watershed which is currently affected by the small-scale mining operations.

At this location, the drainage area tributary to the TSF is approximately 85 hectares. This includes the Waste Rock and Overburden Disposal Area, Surface Mine and the Mill and Processing Plant area. Surface water runoff and sediment produced by disturbed areas within the drainage area will affect the design and operation of the TSF. The storage characteristics of the TSF site indicate a maximum impoundment volume of approximately 2.0 million cubic meters and an effective storage volume of approximately 1.5 million cubic meters when flood surcharge and freeboard requirements are subtracted. The volume of tailings generated and placed within the TSF is estimated to be approximately 600,000 cubic meters (780,000 metric tonnes).

Condemnation drilling was done in 2011 to confirm there were no underlying ore resources. Geotechnical drilling and foundation soils/rock sampling within the footprint of the dam and spillway were also completed by Knight Piesold and TVIRD in 2011. Samples were sent to the Knight Piesold laboratory for testing.

1.4.5.1 Tailings Storage Facility Design

As part of the TSF design activities, testing of the tailings generated by the mill and processing plant metallurgical work was done by Knight Piesold to determine the geotechnical properties of the tailings. This included settling and consolidation testing, permeability testing and tailings strength testing. Laboratory testing was done at the Knight Piesold Laboratory in the United States.

Seismic data collection and evaluation to determine the MCE were based on the geologic fault maps specific to the Balabag Project area, earthquake and seismic event data from the Philippine Institute of Volcanology and Seismology (PHIVOLCS), and historic seismic data from the United States Geologic Survey (USGS). Hydrologic and flood event analysis were based on data and procedures from the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA) and the World Meteorological Organization (WMO).

Key design data and values for different components of the TSF are summarized in Table 13 to Table 15. These are based on the design criteria identified in Table 12, standards identified by the Canadian Dam Association, laboratory testing data and site-specific data related to seismicity and hydrology.

Table 1-12: Summary of Primary Design Criteria for Tailings Storage Facility

Parameter	Description	Criteria	Comments
Hydrology	Runoff Curve Number Method of Analysis Antecedent Moisture Condition (AMC) Rainfall Distribution Design Storm Events	Inflow and Outflow Hydrographs AMC II AMC III Type 3 Event 100-year Event Probable Maximum Precipitation Event	US Soil Conservation Service Method of Analysis based on synthetic hydrograph generation Flood events less than or equal to the 100-year Flood events greater than 100-year event Most intense rainfall distribution During mining operations Post mining operations
Embankment	Crest Width Upstream Slope Downstream Slope Minimum Factor of Safety Design Seismic Event Maximum Deformation Freeboard	10 meters 2H:1V 2H:1V 1.5 Maximum Credible Earthquake (MCE) 30 centimeters 0.5 meters	Minimum width during and post construction Minimum slope. May be increased to 2.5H:1V Minimum slope. May be increased to 2.5H:1V Static Factor of Safety. Canadian Dam Association Horizontal Ground Acceleration = 0.40 g. Event Probability = 1 in 10,000 years Permanent slope deformation for MCE event During routing of the PMF event

Source: Knight Piesold, 2012

Table 1-13: Summary of Primary Embankment Design Values for Tailings Storage Facility

Parameter	Description	Design Values			
Embankment	Zoned Earth Embankment	Upstream and Downstream Shells, Core Zone, Filter Drain Blanket, Chimney Drain, Rip Rap Slope Protection on Outer Shells			
Material Strength Characteristics	Zoned Materials	Saturated Unit Weight (kN/m^3)	Effective Cohesion (kPa)	Effective Angel of Friction (degrees)	Hydraulic Conductivity (cm/sec)
		18	0	20	-
	Tailings	20	0	36	1.0×10^{-5}
	Random Fill	21	0	30	1.0×10^{-6}
	Core	21	0	40	1.0×10^{-2}
	Drain Filter	20	0	36	1.0×10^{-3}
	Foundation	20	0	33	1.0×10^{-5}
Seepage Analysis	Downstream Toe	Flux = 6.7 x 10-4 liters per second per meter of embankment length			
Stability Analysis	Embankment	Embankment Slope (H:V)	Static Factor of Safety	Deformation under MCE	Peak Ground Acceleration
	Downstream Slope	2.0H:1.0V	1.59	5 to 10 cm	0.40 g
	Upstream Slope	2.0H:1.0V	1.97	1 cm	0.40 g

Source: Knight Piesold, 2012

Table 1-14: Summary of Primary Spillway Design Values for Tailings Storage Facility

Parameter	Description	Design Values	
Spillway Type	Earth Channel within Left Abutment	Uncontrolled spillway crest and earth discharge channel construction. Channel to be lined with erosion resistant materials for high velocities during the design storm events	
Hydrology	Tributary Watershed Area	Design Flood Event Operations Period (Probability)	Design Flood Event Post Operations Period (Probability)
Unao-Unao Creek	84.5 hectares	100 yr event	Probable Maximum Flood Event
24-hr Rainfall		360 mm	1,635 mm
Design Peak Flow		67.5 m^3/sec	307.5 m^3/sec

Source: Knight Piesold, 2012

Table 1-15: Summary of Primary Impoundment Design Values for Tailings Storage Facility

Parameter	Description	Design Values			
Impoundment Type	Valley Containment Structure	Valley containment formed by construction of an earth fill embankment dam. The volume available within the impoundment is based on site topography and height of the dam embankment			
Tailing Characteristics	In-Place Density (metric tonnes/m^3)	Specific gravity	Solid concentration (%)	Void ratio (e)	Permeability Drained Settling (cm/sec)
	1.1 to 1.3 w/ flocculant 0.73 to 0.84 w/o flocculant	2.7	52.5%	2.157	1.8×10^{-6}
Impoundment Characteristics	Elevation Dam Crest (m)	Embankment height (m)	Maximum Volume (m^3)	Effective Solids Volume (m^3)	Flood Surcharge/Freeboard (m)
	385	75	1,975,588	1,540,480	5

Source: Knight Piesold, 2012

A plan view and maximum section drawing of the TSF as prepared by Knight Piesold is shown on Figure 1-19 and Figure 1-20. Elevation-storage and area graphs are shown on Figure 1-21 and Figure 1-22.

In terms of Structural integrity, the TSF Dam is designed under the following Design Criteria. The design criteria for the Balabag TSF are summarized in Table 1-10. GHD have developed the design criteria in accordance to the Australian National Committee on Large Dams (ANCOLD) guidelines.

Figure 1-19: Tailings Storage Facility Plan View

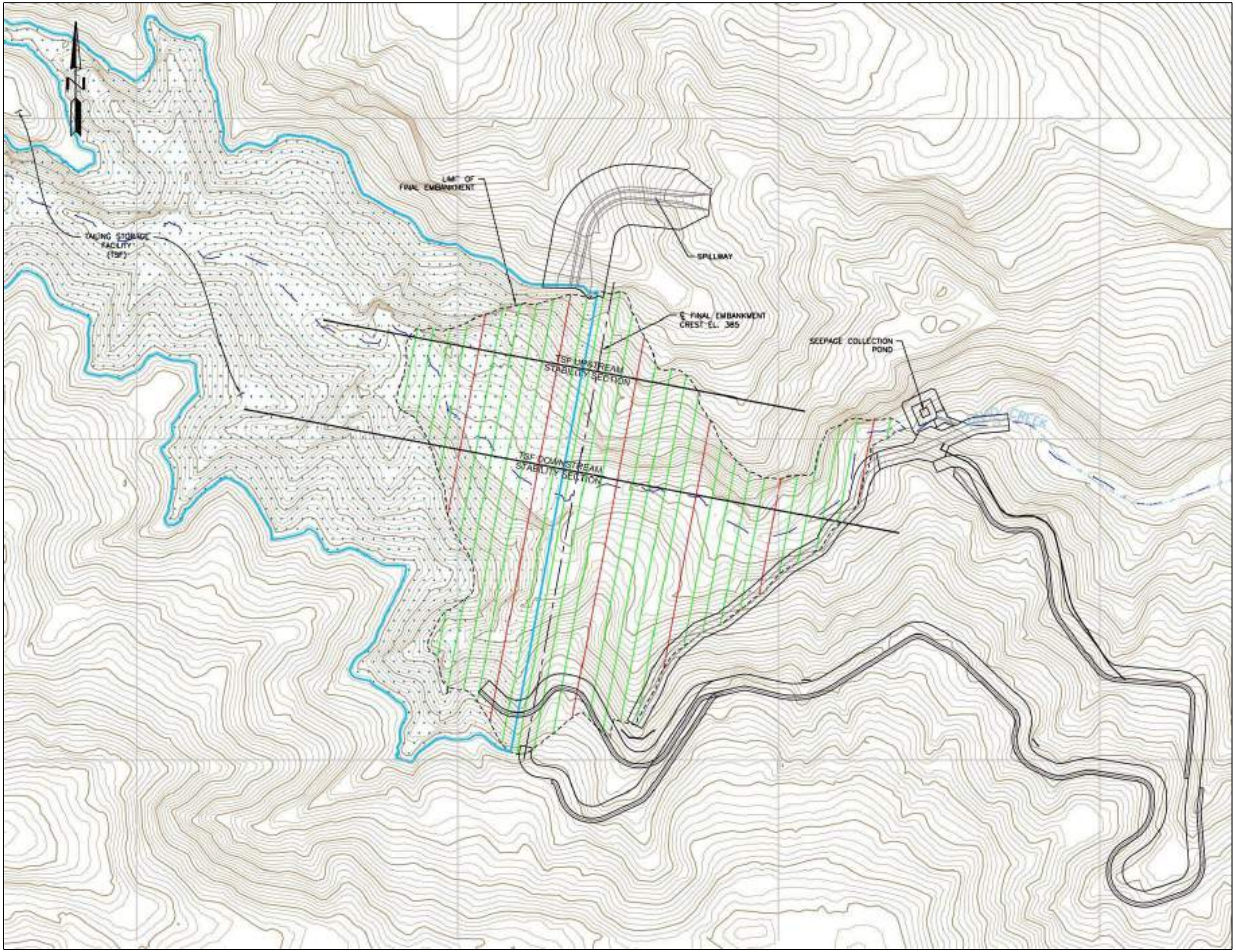


Figure 1-20: Tailings Storage Facility Maximum Section

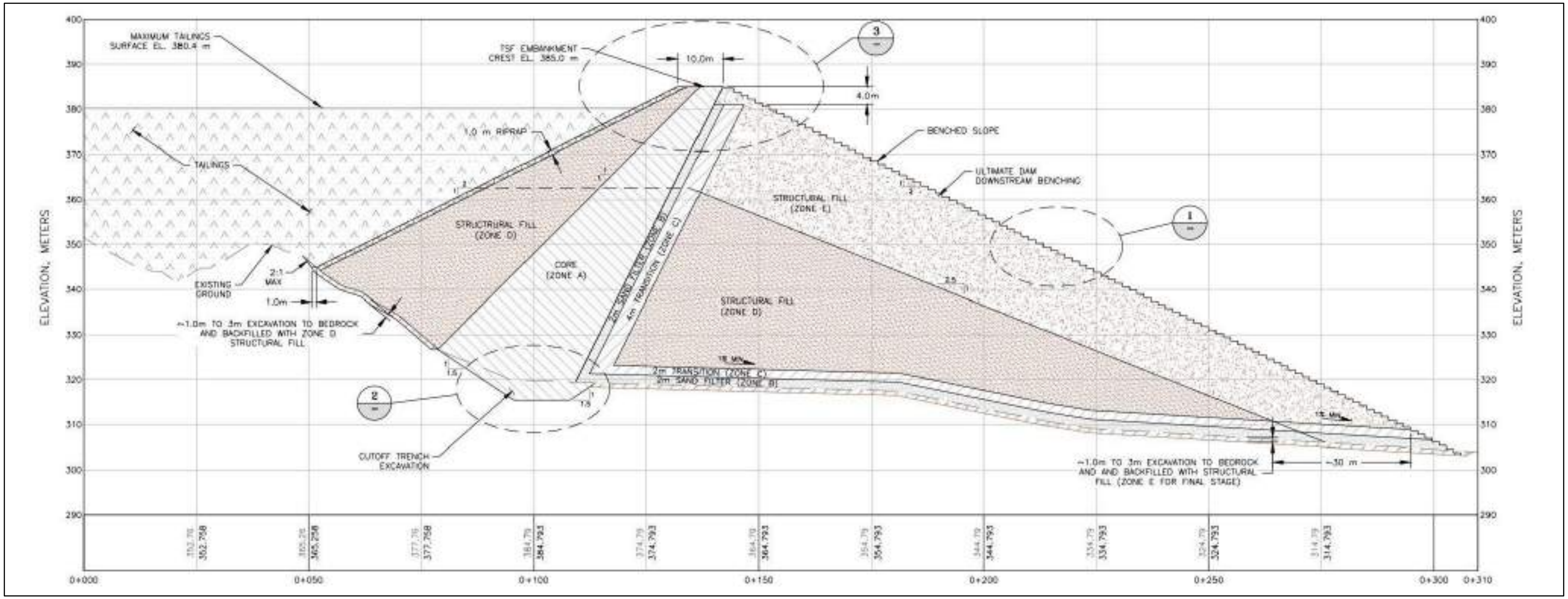


Figure 21: Tailings Storage Facility Storage/Elevation Curve

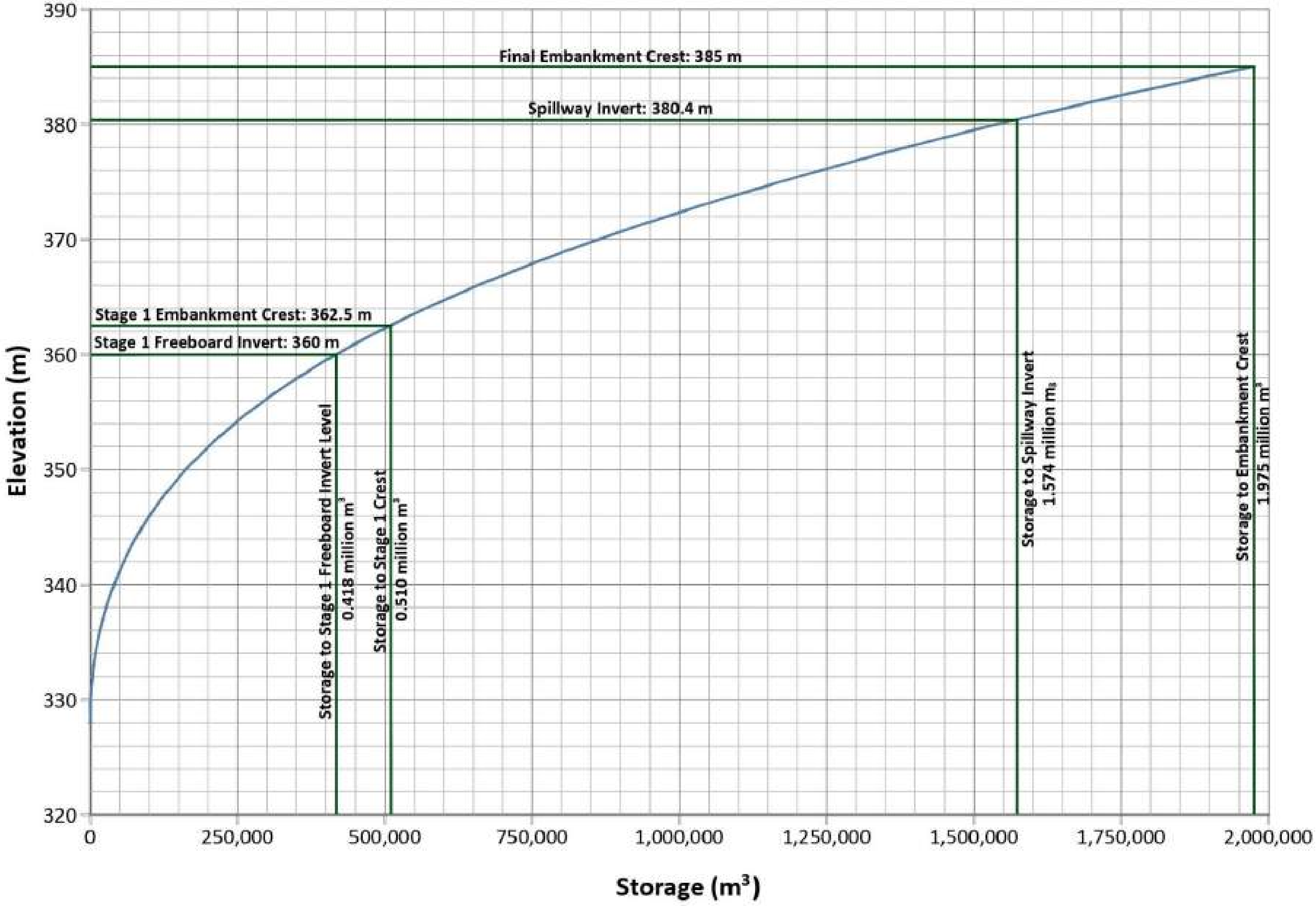


Figure 1-22: Tailings Storage Facility Embankment Fill Curve

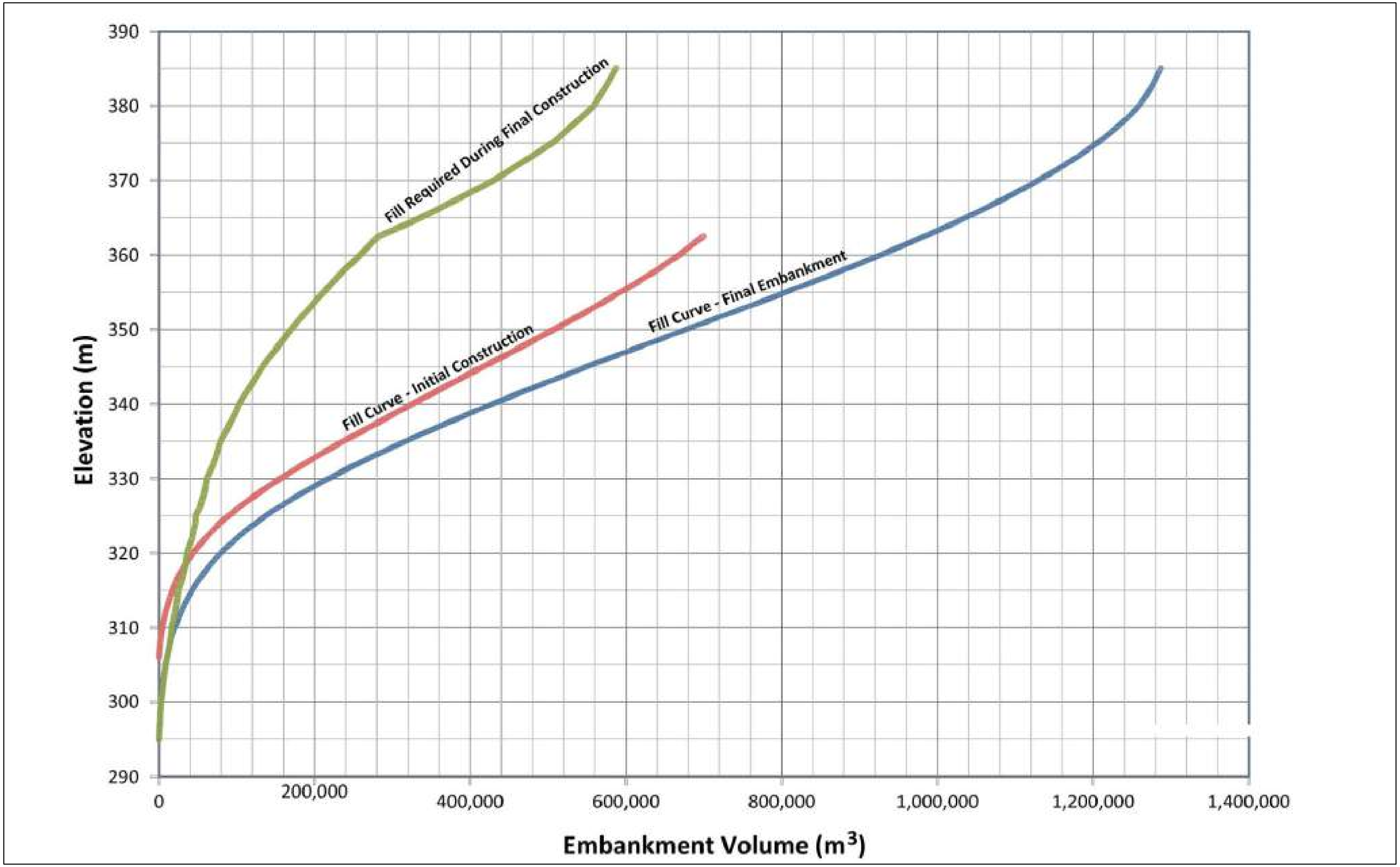


Table 1-16: Tailings Storage Facility Design Criteria (GHD)

ITEM	DESIGN CRITERIA
Dam Failure Consequence Category (DFCC)	Stage 1A before /initial tailings placement – 'Low', becoming 'Significant' as the tailings discharge commences; Stage 1 before / initial tailings placement – 'Low', becoming 'High' as tailings discharge commences; Stage 2 – 'High A'
Dam Spill Consequence Category (DSCC)	'Low' with current understanding of water quality. To be reviewed once filling of TSF commences.
Water Management	30m wide overtopping spillway to be raised progressively, maintain a minimum 5m freeboard below spillway to store and pass a 1:1000 AEP initially for Stage 1A; Stage 1 and 2, flood requirement increased to 1:100,000 AEP flood with wave run up allowance for 1:10 AEP wind throughout mine operation until closure spillway is constructed.
Embankment Seismic Loading	Operating Basis Earthquake (OBE) of 1:1000 AEP and Safety Evaluation Earthquake (SEE) of 1:10,000 AEP during operation; Maximum Credible Earthquake (MCE) for closure
TSF Embankment	Downstream raise method. Integrating waste rock disposal to the downstream shell; Low permeabilitycut-off trench and clay core to minimize seepage; Structural fill for downstream and upstream shells; Vertical filter and horizontal filter blankets for clay core/ foundation piping failure protection Transition Zone (Zone A1) is required for the upstream zone between clay core and Zone 3A; Transition Zone (Zone 3A) is required between the filter and Zone 3B rock from open pit.
Drains and Seepage Collection	Filter drains and valley drain to be constructed to collect and drain seepage from the dam; Seepage collection pond to be constructed at the embankment toe Toe drains to be constructed to divert runoff away from the embankment, to the downstream of the seepage collection pond so that the seepage from the TSF can be measured correctly.
TSF Closure	Closure spillway to be constructed. TSF to be drained and capped

1.4.6 Materials Management Storage Facilities

Several ancillary facilities will be constructed within the Project area specifically for materials handling and storage purposes. This will include facilities for raw materials and supplies, chemicals, and fuel.

1.4.6.1 Materials Warehouse

A supplies' warehouse building is constructed to contain equipment, equipment spare parts, and supplies for maintenance and construction activities. Included will be pumps, filters, pipes and fittings, valves, and motors, among others. The facilities are maintained by the Warehousing/ Purchasing Department.

1.4.6.2 Chemical Storage Area

Chemical storage areas were constructed prior to Project operations. Chemicals with similar Material Safety Data Sheets (MSDS) are grouped together. Hazardous chemicals or those requiring special storage or handling needs are stored apart from other chemicals. Sodium Cyanide used in the mill process plant is stored within a dedicated warehouse.

Cyanide warehouse storage is designed to meet the requirements provided in DAO 97-39: Chemical Control Order for Cyanide and Cyanide Compounds. Floors of all warehouses are constructed with impervious material such as concrete or steel. Drainage facilities are constructed within the immediate area to protect structures and contents from flooding and rainfall. The warehouses containing hazardous or toxic materials also include secondary containment structures and bund walls to contain possible spillages or accidental releases.

The size and storage capacities of the chemical storage areas was based on a three-month volume inventory as required by the Mill and Processing Plant. No additional facilities will be constructed even with the increase in throughput to 2,500 tonnes per day. The process plant and the reagent storage were constructed to handle 2,500 tonnes daily throughput. Annex 1-2 listed the chemical stored, engineering controls, mixing dozing facility and consumption from the current operations and proposed expansion.

1.4.6.3 Fuel Storage Area

Approximately 24,000 liters per day of diesel fuel is needed to operate the generator sets and provide the power requirement for the operation. Another 2,800 liters per day will be used for equipment and transportation. Additional diesel fuel storage tanks will be constructed on-site to ensure continuous fuel inventory for use in the operations. Tanks with a minimum of 3 days of generator set storage and 7 days of equipment and vehicle use will be constructed within the Project area. Storage tanks will also be provided for gasoline to supplement the 82 liters daily consumption. The fuel storage tank capacities that will be used in the Project are provided in Table 1-17.

Each constructed tank was provided with safety control devices such as leak alarm monitors and automatic flow regulators to prevent potential explosions, leaks, and spillages. The constructed fuel storage area was be provided with bund walls to serve as secondary containment for potential leaks or spills.

Table 1-17: Fuel Storage Tank Volume

Storage Tank	Original ECC and EIS			EPRMP 2022		
	No of Units	Volume storage per tank, liters	Total Volume Storage	No of Units	Volume storage per tank, liters	Total Volume Storage
Generator set Diesel Fuel Storage Tank	2	37,800	75,600	2	36,000	72,000
Equipment and Vehicle Diesel Fuel Storage Tank	1	22,680	22,680	3	14,667	44,001
Additional Equipment and Vehicle Diesel Fuel Storage Tank				4	38,000	152,000
Elution Column Storage Tank				1	32,000	32,000
Gasoline Storage Tank	1	15,120	15,120	0	0	0

1.4.7 Access Roads

A network of roads is established within and outside the Project area for access and operations. The existing 18-kilometer road from Barangay Guinoman to the Project area was previously rehabilitated by TVIRD and is used for general Project area access. A recently constructed 10-kilometer road from Barangay Dipili to the Project area will also be available. Internal roads will be constructed with a width ranging from 6 to 10 meters depending on the type of use. All roads will include provisions for drainage, lighting, and safety measures.

The haul roads will be "all-weather" roads and will connect the Surface Mine to the Run-of-Mine Stockpile, Mill, Waste Rock, and Overburden Stockpiles and the TSF. These will be constructed with a width of 10 meters and a maximum gradient of 10% to 12%.

Common practice dictates the design of the roads will be adapted to the largest piece of equipment expected to use the road. A minimum 3:1 ratio with respect to road width versus equipment width will be implemented to promote safer driving conditions. Mining will be done using mid-size equipment (i.e., 10 metric tonne trucks and CAT 336 excavators), with an overall width of approximately 3 meters. This suggests a road width of 9 to 10 meters.

Short and steeper haul roads may be established within the Surface Mine from time to time, to provide access for mining and haulage via the shortest haulage route.

1.4.8. Pollution Control Devices

Several pollution control devices are installed within different operations areas to promote safe operations, monitor the potential release of hazardous substances, and protect the health and welfare of the workers and local community. These devices are also intended to protect the environment and provide a means to monitor operations.

1.4.8.1 Waste Rock and Overburden Disposal Area

A total of approximately 28.7 million metric tonnes of overburden and waste rock materials will be generated during the mining activities. The waste will be stripped and/or excavated at a daily rate ranging from 15,000 to 19,000 metric tonnes. The excavated materials will be placed in dump trucks and transported to the disposal area. The material will be deposited, spread, and compacted by bulldozers and soil compactors The material will be deposited, spread and compacted by bulldozers and soil compactors. The waste material moved from the startup is at 1.7 million dry metric tonnes while the projected waste generation from 2022 to 2025 is at 25.7 million metric tonnes. Below is the table breakdown of the projected waste movement to LOM. Some waste generation maybe capitalized for TSF development.

Table 1-18: Generated Waste Movement from July 2021 to May 2022

Year	2021	2022	Total
Waste Movement, MT	1,820,251	1,217,704.80	3,037,956

Table 1-18a: Projected Waste Movement from July 2022 until December 2027

Year	2021	2022	2023	2024	2025	2026	2027	Total
Waste Movement, MT		4,624,285.2	6,893,060	10,476,330	3,766,260	-	-	25,759,935.20

1.4.8.2 Gaseous Waste Management

Gaseous wastes from the Project include chemical fumes from reagent mixing during the flotation, cyanidation and leaching process, gaseous emissions from the Assay and Metallurgical Laboratory and exhaust from generator sets. The plant is designed to be open to allow air flow in the area during reagent mixing and mill processing activities. Ambient air quality and work environment monitoring is conducted on Fan annual basis to ensure compliance to environmental and occupational safety and health standards.

The gaseous emissions from the Assay Laboratory will be controlled by fume scrubber installed at the laboratory stack to neutralize acidic or basic emissions and hazardous gases.

Emission from the generator stack and fume scrubber will be monitored on an annual basis with reference to DAO 2000-81: Implementing Rules and Regulations of Philippine Clean Air Act. Instead of installing a Continuous Emission Monitoring System (CEMS) to monitor potential exceedance of the pollutant concentration standards prescribed by DAO 2000-81. A third party will be tapped semi-annually to monitor the emission rates of the installed generator sets. Parameters to be measured and monitored on a 24–hour continuous basis will include carbon monoxide, particulate matter, total suspended particles, sulfur oxides and nitrogen oxides.

Table 1-19: Capacity of the Generator Sets

GENSET NO.	CAPACITY	Mode of Operations
Genset 1	2 MW	Continuous
Genset 2	2 MW	Continuous
Genset 3	2 MW	Continuous
Genset 4	1 MW	Continuous
Genset 5	1 MW	Continuous

Genset 6 (additional genset for a 2,500 tpd capacity of mill plant)	2 MW	Continuous

The Sulphur content of the diesel used for the operationalization of our generator sets is at 0.005%. Thus, our generator operations will likely not exceed the emission standards for sulphur.

1.4.8.3 Fume Scrubber

An Assay Laboratory is constructed to handle the wet and dry analysis of ore minerals and environmental samples. The chemical testing and handling will generate fumes as part of the different testing procedures. A fume scrubber is incorporated within the laboratory design to remove hazardous gases, fumes, and other pollutants within the workplace environment and prior to release to the natural environment. The equipment is commonly used within industrial or scientific settings to remove by-products from processes that could potentially be harmful to people or to the environment.

The gases releases from fume scrubber are subject to monitoring and testing relative to air quality standards and workplace environmental standards. Fumes from the Assay Laboratory pass through the fume scrubber prior to emission.

1.4.8.4 Continuous Emission Monitoring System

No CEMS will be installed in the Project.

1.4.8.5 Cyanide Detoxification Facility

As part of the cyanidation process to extract gold and silver from the ore, sodium cyanide is used as one of the process reagents. As such, the tailings waste containing residual cyanide from the milling and processing operations are deposited and impounded within the TSF.

Although the Philippine regulatory standards do not address allowable cyanide concentrations within a TSF, some international standards have been established. Cyanide detoxification facility is included in the ore processing and all tailings subject to cyanide contamination are subject to detoxification prior to discharge to the TSF. The primary objective of the detoxification facility is to reduce the cyanide concentration levels of the tailings slurry to environmentally acceptable limits and allow the water component of the slurry (supernatant) and surface water runoff from the TSF to be discharged to the environment.

The detoxification facility will use the SO2-Air Process commonly used throughout the mining industry. This process allows the tailings slurry to be aerated and mixed with SO2 in the form of sodium metabisulfite. The reaction of oxygen and SO2 with the addition of a catalyst, within a pH-controlled environment, causes the oxidation and decomposition of the cyanide complexes.

1.4.8.6 Sewage Management System

The domestic liquid wastes generated from the Project will be disposed through an onsite disposal system. All the liquid wastes are transported by a sewer line to large, engineered septic tanks. The effluent from the septic tank will be directed to leach drains where it will be biologically treated. Discharges from the drains are monitored relevant to effluent water quality regulations. There are 10 functional engineered septic tanks at the project area. Each tank has a capacity of approximately 15cu.m. and is totally sealed. An accredited sewage collection company collects the sewage sludge generated. Additional engineered septic tanks will be constructed during the expansion project. Sewage sludge is collected by a private sewage disposal contractor. The sewage disposal system was constructed apart from the stormwater runoff drainage.

1.4.8.7 Hazardous Waste Management

Each waste is segregated, and separate storage containment areas are provided. A decontamination area will be included within the storage area for chemical contaminated containers. Decontamination is limited to acid/ base reagent bottles and containers. Acid/base wastes generated from the operation of the Assay Laboratory. The amount of waste is minimal since only small amounts of these reagents will be used in the analyses. Other containers are stored in their original containers until disposal through accredited hazardous waste management contractor.

Used oils and lubricants generated from the maintenance activities of the power supply generators, transportation vehicles and various pieces of equipment used within the Mill and Process Plant. The volume generated depends on the maintenance frequency and efficiency of the generators, vehicles and other equipment items.

Medical wastes generated from the operation of the TVIRD clinic include but are not limited to used syringes, blood-contaminated wastes, and medicine ampoules. The preferred method of management and disposal will be encapsulation or disposal through an accredited hazardous waste management company.

Other hazardous wastes generated during operation include oil-contaminated rags, filters, and containers that cannot be decontaminated. The quantities are dependent on the frequency of cleaning and maintenance activities. These are likewise be stored within specific areas with final disposal done by an accredited hazardous waste management company.

Table 1-20: Hazardous Wastes Produced at Mine Site

HAZARDOUS WASTE	QUANTITY (as of 1st Quarter 2022)
Chemical Contaminated Containers and Toxic Waste Containers	2.11 tonnes / quarter
Acid/ Base Wastes	0.042 tonnes / quarter
Used Oil	9,040 liters / quarter
Medical Wastes (Pathological and Infectious Waste)	0.0175 tons / quarter

1.4.8.8 Solid Waste Management

The constructed solid waste management facility serves as a final disposal facility for solid wastes other than waste rock, overburd,en and tailings. Consisting of three components: a Material Recovery Facility for sorting and recycling activities, a Composting Facility to manage organic and other wastes that may be used for soil conditioning, and an engineered Landfill for those materials that cannot be recycled or composted. Based on monitoring data from the Canatuan Project, the overall solid waste generation rate is estimated to be 0.35 kilograms per day per person.

Waste segregation is implemented as part of the Environmental Management System of the Company. Recyclable wastes are stored in a Material Recovery Facility and will be sold as scrap to accredited buyers. Examples of recyclable materials anticipated to be recovered from the Project include paper materials, plastics, and scrap metals. Of the total waste generation, materials that could be sold or recycled are expected to account for approximately 60% of the total waste generated. Non-recyclable materials that are considered biodegradable are disposed of at the compost Facility for decomposition. This includes food wastes, timber products not reused, and paper-based materials. This solid waste component is expected to account for approximately 15% of the total waste generated. The remaining waste (25%) is disposed of within the Landfill. Operation of the landfill include compaction, provisions for daily cover, and leachate collection and treatment. Options to expand the storage capacity of the landfill for use by the community after the mine operations is being considered.

1.4.9 Project Utilities

1.4.9.1 Power Requirements

Power requirements for the Project are sourced from multiple diesel-engine generator sets located on-site. The total daily power load is 2.3 MW during the initial 500 metric tonnes per day plant throughput and increase to approximately 5.8 MW for the maximum plant throughput at 2,500 metric tonnes per day. The Mill and Processing Plant is the primary energy users and will account for nearly 95% of the load. The remaining 5% of the load is associated with the TVIRD administration facilities, residential and camp services needs and the local community. The power supply and energy needs are summarized in Table 1-21.

The total energy supplied by the generators over the course of the Project is approximately 70 million kW-hr. This translates into a total diesel consumption of approximately 20 million liters. This is based on the data from the Canatuan Project operations using similar generators and operating parameters (0.28 liters per kW-hr).

An initial examination of the potential for installation of a micro-hydropower plant at the Tailings Storage Facility was made. Although the available head is significant, the streamflow and spillway discharge are limited due to the small tributary watershed. The installed capacity of the facility would be less than 50 KW. Currently, the cost benefit evaluation for the short mine life is not favorable for this facility. Should the mine life be increased and/or there is a significant increase in the cost of fuel, a more detailed study will be conducted.

Power distribution within the immediate project area will be done by TVIRD. Transmission facilities and power lines will be constructed and maintained by TVIRD.

Table 1-21: Estimated Daily Power Demand Schedule

Throughput (metric tonnes/day)	Mill and Plant Load (MW)	Secondary Use load (MW)	Total Daily Load (MW)	Daily Energy Consumption (MW)
500	1	0.4	1.40	33,600.00

1,000	2.2	0.4	2.60	62,400.00
1,500	3.5	0.4	3.90	93,600.00
2,000	4.6	0.4	5.00	120,000.00
2,500	5.4	0.4	5.80	139,200.00
Source: from Jan to April 2022 Actual load	*Mill plant	*Assay *Workshop *Warehouse *Accommodation *Old Exploration Camp *Genaro Water Source		*Total kW-hr for 24 hours operation

Table 1-22: Estimated Generator Set Provision

YEAR	DAILY LOAD RANGE	NO. OF UNITS		TOTAL NO. OF UNITS
		1.5 MW	2.0 MW	
Year 1	2.3 – 3.4		2	2
Year 2	4.5 – 5.6	2	2	4

1.4.9.2 Water Source and Demand

Water demands include plant and process water, domestic and potable water, and environmental management water. The Mill and Processing Plant demands is significantly greater than the others. This demand will increase as the plant throughput increases. A significant component of the plant demand (approximately 70% to 75%) will be satisfied by recycled water from the plant itself and the Tailings Storage Facility. The remaining plant demand will be fresh make-up water sourced from the nearby springs and surface water systems. The ratio of freshwater make up to the recycled/ recovered water is 1.85 during the 500 metric tonnes per day operation and increases to 2.33 during the 1,000 metric tonnes per day up to the 2,500 metric tonnes per day operation. The daily water demands are summarized in table 1-23 relative to the production throughput schedule.

Table 1-23: Estimated Daily Water Demand Schedule

Mill and Processing Plant Throughput (MTPD)	Mill and Plant Primary Demand (cu.m)	Secondary and Other Demands (cu.m)	Total Primary and Secondary Demand (cu.m)	Recycled and Recovered Water (cu.m)	Freshwater and Make-up Water Demand (cu.m)	Liters/ second for make up water	Combined Daily Yield of Genaro (Naro) Creek and Dimalinao Creek (cu.m)
ORIGINAL EIS AND ECC							
500	1,279	100	1,379	896	483	5.590277778	8,862
1,000	3,014	200	3,214	2,248	966	11.18055556	8,862
1,500	4,520	300	4,820	3,372	1,448	16.75925926	8,862
2,000	6,027	400	6,427	4,496	1,931	22.34953704	8,862
EXPANSION (EPRMP)							
2500	7,648	500	8,148	5734	2,414	27.93402778	8,862

Source: TVIRD, 2012

Note: Combined daily yield of Genaro (Naro) Creek and Dimalinao Creek at low flow range. Genaro (Naro) and Dimalinao Creek are the nearby springs and surface water systems

To satisfy the domestic and potable water demands of the operations and personnel, a water treatment facility is installed to treat and disinfect the local water supply sources. A reverse osmosis plant similar to the one used at the TVIRD Canatuan Project is used. Water not used for drinking but used for other domestic sources will be treated using slow sand filtration and a powder chlorine system for disinfection.

Table 1-24: Specifications of Project Components with Nearby Bodies of Water

<table>
<tr><th>Project Components</th><th>No. of Units</th><th>Specifications
(area or capacity)</th><th>Bodies of Water Nearby</th></tr>
<tr><td rowspan="2">Surface Mine Area</td><td rowspan="2">1</td><td>26.1 ha</td><td rowspan="2">Kabasalan River, Sibugay River, Dipili River, Depore River, Dimalinao Creek, Unao-Unao Creek, Genaro (Naro) Creek, Malagak Creek, Sibugay Bay</td></tr>
<tr><td>11 MMTPY of ore & waste</td></tr>
<tr><td rowspan="2">Mill and Processing Plant</td><td rowspan="2">1</td><td>2.34 ha (Fig. 1-4)</td><td rowspan="2">Kabasalan River, Sibugay River, Dipili River, Depore River, Dimalinao Creek, Unao-Unao Creek, Genaro (Naro) Creek, Malagak Creek, Sibugay Bay</td></tr>
<tr><td>2,500 MTPD of ore</td></tr>
<tr><td>Main Warehouse Building</td><td>1</td><td>1,000 sq m.</td><td>Kabasalan River, Sibugay River, Dipili River, Depore River, Dimalinao Creek, Unao-Unao Creek, Genaro (Naro) Creek, Malagak Creek, Sibuguey Bay</td></tr>
<tr><td>Materials Management Facilities</td><td></td><td>12.0 ha</td><td rowspan="5">Kabasalan River, Sibugay River, Dipili River, Depore River, Dimalinao Creek, Unao-Unao Creek, Genaro (Naro) Creek, Malagak Creek, Sibugay Bay</td></tr>
<tr><td>Chemicals and Reagents Storage Facility</td><td>1</td><td>2350.0235 ha.</td></tr>
<tr><td>Power Supply (Multiple Diesel-Engine Generator Sets)</td><td>6</td><td>5.8 MW for 2500 tpd throughput</td></tr>
<tr><td>Water Supply</td><td>1</td><td>80 lps</td></tr>
<tr><td>Materials/Supplies Warehouse</td><td>1</td><td>0.1760 ha.</td></tr>
<tr><td>Access road</td><td></td><td>10 m wide (min.)</td><td>Unao-Unao Creek and Genaro (Naro) Creek</td></tr>
<tr><td>Housing and Camp Facilities</td><td>2</td><td>4.5 ha + areas covered under Multi-Facilities</td><td>Unao-Unao and Genaro (Naro) Creek</td></tr>
<tr><td>Administration Facility</td><td>1</td><td>2.5 ha</td><td>Kabasalan River, Sibugay River, Dipili River, Depore River, Dimalinao Creek, Unao-Unao Creek, Genaro (Naro)</td></tr>
</table>

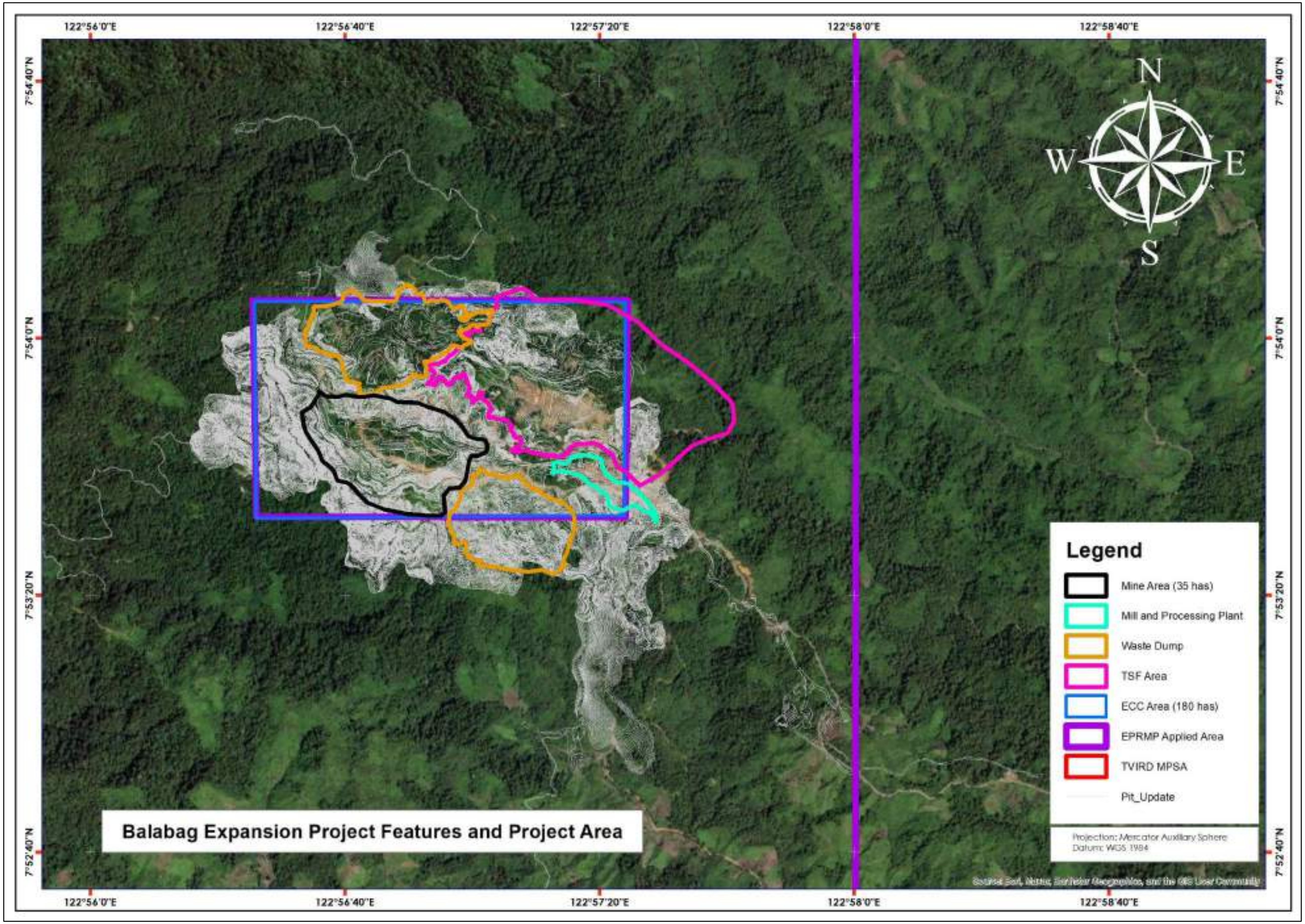
Project Components	No. of Units	Specifications (area or capacity)	Bodies of Water Nearby
			Creek, Malagak Creek, Sibugay Bay
Multi-Facilities		4.9095 – areas covered by envi facilities & Materials Mgmt Facilities & the add'l housing and camp facilities	Kabasalan River, Sibugay River, Dipili River, Depore River, Dimalinao Creek, Unao-Unao Creek, Genaro (Naro) Creek, Malagak Creek, Sibugay Bay
Contractors' Facilities	4	0.9305 ha.	
Security Barracks	1	1.252 has.	
Nursery	1	0.5155 ha.	
Materials Recovery Facility	1		
Hazardous Waste Facility	1		
Housing and camp facilities	1	1.7038 has.	
Clinic	1	0.5077 ha.	
Motorpool	1		
Fuel Farm	1		
Assay & Metallurgical Laboratory	1	374.30 sqm	Kabasalan River, Sibugay River, Dipili River, Depore River, Dimalinao Creek, Unao-Unao Creek, Genaro (Naro) Creek, Malagak Creek, Sibugay Bay
Explosive Magazines			Unao-Unao Creek
Dynamite	2	36 tons @ 18 tons each	
ANFO	3	54 tons @ 18 tons each	
Blasting Cap & Accessories	1	2 tons	

Table 1-25: Specifications for Environmental/Pollution Control Facilities with Nearby Bodies of Water

Project Components	No. of Units	Specifications (area or capacity)	Bodies of Water Nearby
Waste Rock & Overburden Disposal Areas	1	13.0 ha (Figs. 1-4 & 1-6) or 34.7 ha (1.4.3.3, p. 1-17)	Kabasalan River, Sibugay River, Dipili River, Depore River, Dimalinao Creek, Unao-Unao Creek, Genaro (Naro) Creek, Malagak Creek, Sibugay Bay
		30.5 MMT of waste rock & overburden materials	
	1	97.38 ha (Fig. 1-4)	

Project Components	No. of Units	Specifications (area or capacity)	Bodies of Water Nearby
Tailing Storage Facility and Spillway		2,717,523 MT of tailings	Kabasalan River, Sibugay River, Dipili River, Depore River, Dimalinao Creek, Unao-Unao Creek, Genaro (Naro) Creek, Malagak Creek, Sibugay Bay
Multi-Facilities:		4.9095 ha – areas covered by Multi-Facilities above	Unao-unao Creek / Genaro (Naro) Creek
Nursery Area	1		
Hazardous Waste Storage Facility	1		
Materials Recovery Facility/Solid Waste Management Facility	1		
Oil-Water Separator	6	5 units 11. 66cu.m capacity and 1 unit 60 cu.m capacity a total of 118.3 cu.m capacity	Unao-Unao Creek and Genaro (Naro) Creek
Settling/Siltation Ponds	28	33,609 cu.m. total capacity	Unao-Unao Creek and Genaro (Naro) Creek
Stream Flow Monitoring Station	21		Unao-Unao Creek, Dipili River, Genaro (Naro) Creek, Malagak Creek, Depore River, Sibugay River
Diversion and Drainage Canals		1m x 1m	Unao-Unao Creek, Dipili River, Genaro (Naro) Creek, Malagak Creek, Depore River, Sibugay River
AMD Laboratory Testing (Assay lab)	1	0.03743	Unao-Unao Creek, Dipili River, Genaro (Naro) Creek, Malagak Creek, Depore River, Sibugay River
Cyanide Detoxification Facility	1	SO2-Air Process	Unao-Unao Creek, Dipili River, Genaro (Naro) Creek, Malagak Creek, Depore River, Sibugay River
Fume Scrubber	1		-
Engineered Septic Tanks	10	15 cu.m. capacity each for a total of 150 cu.m.	Unao-Unao Creek and Genaro (Naro) Creek

Figure1- 23: Balabag Gold-Silver Project Features



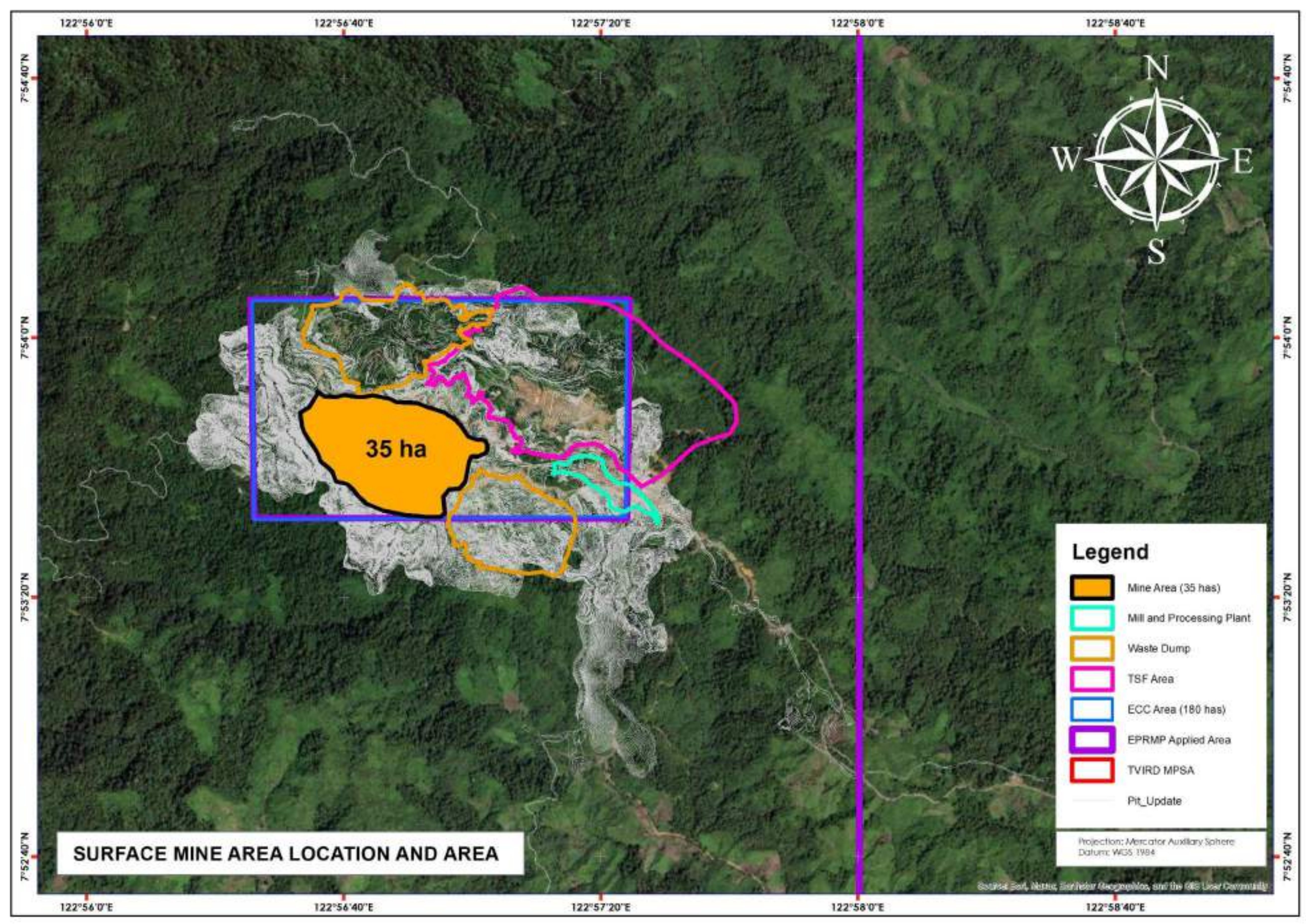
1.5 PROCESS/TECHNOLOGY

1.5.1 Surface Mining

The Balabag deposit is characterized by a shallow, gently-dipping vein system, with relatively thin overburden. The topography and shape of the deposit lends itself to extraction by surface mining techniques.

The mining operations and mine area will be centered within the Tinago Vein area. This is considered the largest and most densely-drilled portion of Balabag deposit. The objective is to gain access to the relatively shallow, high-grade ore in the area to support the economics of initial Project operation. Placement of the starter pit in this area also allows for easier expansion once the potential of the entire deposit has been identified and mining limits delineated. The location and topographic characteristics of the mine area are shown on figure 1-24. The minimum area encompassed by the surface mine is approximately 13.5 hectares. This EPRMP is applying to increase this area to 35 hectares.

Figure 1-24: Surface Mine Area Location



1.5.1 Ore and Mineral Processing

The Mill and Processing Plant is composed of conventional grinding and cyanidation/leaching circuits along with a conventional gravity separation facility. The process design and flow sheets have undergone several revisions following the initial concept design activities and metallurgical testing. The planned throughput has also gone through several revisions based on the metallurgy work as well as the ore resource evaluation and the Project economic evaluation. Throughput initially started at 500 metric tonnes per day and will be increased in intervals to a maximum of 2,500 metric tonnes per day.

The Mill consist of a two-stage crushing circuit using a primary and secondary jaw crusher to produce coarse ore stockpile. A two-stage closed-circuit grinding component completes the comminution circuit with a portion of the primary cyclone product reporting to a secondary ball mill and two-stage gravity concentration circuit.

The plant will use flotation combined with a cyanidation/leaching and carbon adsorption process to recover gold and silver from the ore. Cyanidation is the most common process for gold extraction and was used during the Gossan Phase of the TVIRD Canatuan Project.

In the flotation process, frothers and collectors are added to float the metals-cyanide complex. Further reaction is developed at the leaching process. The pregnant solution is clarified, deaerated and precipitated with zinc. Gold-silver precipitates are then conveyed to the Filter Press circuit. The metal precipitates are then refined into the form of gold-silver dore (“gold-silver bars”) which are then ready for shipment.

The tailings from the bulk flotation process are processed separately by leaching with sodium cyanide in a series of tanks. Product from the main leaching circuit will pass through CIP tanks for adsorption of dissolved gold and silver on to the activated carbon. Loaded carbon will then undergo acid washing prior to stripping. The pregnant solution from the stripping process is fed to the elution process and several electrowinning cells. The deposited gold and silver sludge will be refined further in the refinery until a dore is produced for shipment.

The mill process at 500 metric tonnes per day and a maximum production of 2,500 metric tonnes per day will generally follow the same process except that at 500 metric tonnes per day, only one grinding unit will be used, and the ore will not pass-through bulk flotation and silver concentrate leaching. Instead, the underflow from the primary cyclone will directly report to a thickener before processing in the main leaching tanks up to the refinery. The additional cyclone, bulk flotation and silver concentrate leaching process will be incorporated in the process as the mill production capacity increases to 2,500 metric tonnes per day.

1.5.2.1. Crushing

Run-of-mine ore is transported to a static bar grizzly at the head of the mill circuit. Oversize material undergo manual breaking while the undersize material will be stored in a coarse ore dump. A variable-speed apron feeder removes the ore from the coarse ore dump pocket then transfers it to a vibrating grizzly feeder attached with a weight-o-meter. The ore will then be dumped into a vibrating grizzly with the oversize material discharged into a jaw crusher. The undersize material of the vibrating grizzly and product discharge of the jaw crusher will be classified using a vibrating screen circulating the oversize material. The oversize material will be fed into a secondary jaw crusher and the undersize material will be dumped to stacker conveyor then transported to the coarse ore stockpile area. The crushing circuit will operate on two 8-hour shifts per day.

1.5.2.2. Grinding

Coarse ore material from the fine ore bin is removed by a feed tunnel conveyor and discharged to a primary ball mill feed hopper. Grinding will occur inside two ball mills which will reduce the product size to 75 microns. Lime will be added in solution form to achieve a high pH of the pulp required for the flotation process. Classification of the primary grinding product discharge will be done by a four-cluster, two-operating, primary hydro cyclone. The overflow is directed to a four- clustered secondary hydro cyclone. Slurry bleeding done at the underflow of the primary hydro cyclone will extract approximately 10% of the material for feed to the gravity concentration circuit. The overflow material from the secondary hydro cyclone will be sent directly to the flotation circuit.

1.5.2.3 Gravity Concentration

The gravity concentration circuit incorporates a concentrator and a shaking table. Tails from the two gravity concentrators will be returned to the secondary ball mill discharge box. The gold and silver recovered will be subsequently fluxed and smelted.

1.5.2.4. Bulk Flotation

The overflow material from the secondary hydrocyclone will be passed through a conditioning tank wherein collectors and frother reagents will be added. The pH will be maintained at pH 11. After reagent mixing, the slurry will be passed through a series of bulk flotation cells. Tailings generated from the bulk flotation will be directed to a process thickener while the bulk concentrate will be processed further in another batch of 2- stage cleaner flotation. The silver concentrate produced from the second stage will be pumped to a concentrate thickener while the tailings from the first stage will be conveyed back to the conditioning tank. Tails from the second stage will be returned back to the first stage cleaner flotation cells.

1.5.2.5 Silver Concentrate Leaching

The underflow from the concentrate thickener will be transferred to a conditioning tank and added with sodium cyanide. The pH will be maintained at 10.5 to 11 to prevent the formation of hydrogen cyanide gas. Lead nitrate will also be added to the slurry. After a 2-hour reaction period, the slurry is conveyed to a series of mechanically agitated leach tanks with a 30 hour reaction time. Oxygen and needed sodium cyanide make up amounts will also be introduced within the leaching circuit.

The leached materials will then enter a thickener. After thickening, the overflow materials will be directed to the pregnant solution tank and the underflow will pass through a drum filter. The recovered filtrate will also be directed to the pregnant solution tank.

1.5.2.6 Merill-Crowe Precipitation

The unclarified pregnant solution recovered from a two-stage dewatering system will be treated in the Merrill- Crowe process. The solution will be pumped into a pressure clarifier and the clarified pregnant solution produced will undergo a significant decrease in oxygen concentration in a deaeration tower. Zinc powder will then be added resulting in a rapid cementation process between the filter press feed pumps and the filter press.

A Plate and Frame Filter Press will then be used to recover gold-silver precipitate. The barren solution from the filter press will be recycled and pumped to a water tank for later reuse within the process. The zinc precipitate containing the gold and silver will then be smelted to dorè bars.

1.5.2.7 Tailings Stream Leaching

The bulk flotation tailings and the residue cake from drum filter will be treated in a leaching circuit to further extract the gold and silver that was not recovered during the bulk flotation circuit. The underflow bulk tailings from the thickener will be pumped to a series of conditioning tanks wherein the slurry will be added with lime, oxygen and lead nitrate and introduced with air. This will result in the precipitation of free metal ions to metal oxides and the oxidation of silver and gold associated sulphide material. Leaching will follow in mechanically agitated tanks for a total of 72 hours. Cyanide will be dosed at the first leaching tank while the whole system will be completely aerated.

1.5.2.8 Carbon Adsorption

The product of the tailings leaching circuit will be fed to a series of Carbon in Pulp (CIP) tanks. The addition of activated carbon and a 24-hour contact time will promote adsorption of the dissolved gold and silver. Fresh carbon will be added at the last tank in a countercurrent flow to the first tank where loaded carbon will be harvested by a Carbon Recovery Screen into acid wash column. Barren pulp will be discharged to the detoxification circuit for cyanide destruction.

1.5.2.9. Stripping and Electro-Winning

The loaded carbon will be transferred directly to an acid wash column for acid washing with hydrochloric acid. Acid washing is conducted to remove any acid-soluble deposits from the loaded carbon prior to stripping. To ensure complete reaction of the acid with the carbon, the solution in the column will be circulated for a period of 1 hour. A water wash stage will follow to thoroughly remove residual acid solution from the carbon and prevent the formation of hydrogen cyanide gas during the following stages.

The washed carbon, now at neutral pH, will be transferred into the stripping column by water eductor. Stripping solution or eluant which is used to dissolve the gold and silver adsorbed onto the carbon, will be pumped from eluant tank through a preheat heat exchanger and a final heat exchanger to increase the temperature at specified level prior entering the stripping column containing the loaded carbon. The pregnant solution will be discharged from stripping column and will be fed to electrowinning cells where dissolved gold and silver are electrodeposited. The barren solution is then returned to eluant tank. The flow of eluant in closed loop with the stripping column and electrowinning cells will continue until gold and silver are totally stripped from carbon.

The deposited gold and silver will be recovered manually from electrowinning cells after a specified cycle time. A high pressure, low volume water spray will remove the gold and silver from individual cathodes of electrowinning cells and sludge at the bottom of the cells and then collected in a sludge container. The diluted sludge will be decanted and manually filtered in the filter paper and dried in an oven. The dried sludge will be mixed with appropriate quantities of fluxes before being charged into a melting furnace.

The barren carbon will be discharged from the stripping column through a horizontal vibrating screen where dewatering and removal of carbon fines occurs before being sent to a kiln feed hopper. Carbon will be charged to a regeneration kiln at a rate of 350-500 kilograms per hour. The reactivated carbon will then be discharged to a quench tank before being returned to the carbon adsorption stage by an eduction vessel.

1.5.2.10 . Detoxification Process

The detoxification process will be used for the purpose of cyanide destruction. Barren pulp from the carbon adsorption stage will be treated in two detoxification tanks. Lime, Sodium Metabisulfite and Copper Sulphate are the main reagents added for treatment during a minimum 2-hour retention time. Key parameters that will be monitored are pH, conductivity, dissolved oxygen, free cyanide, and WAD cyanide. The discharge of the detoxification process effluent will be conveyed to the downstream tailings storage facility.

An additional tank(s) and chemical addition circuit may be added to the cyanide detoxification plant for treatment and subsequent precipitation of metals that may adversely affect the effluent quality. The need for this circuit will be confirmed based on the water quality of the Tailings Storage Facility discharge and the pertinent water quality standards.

1.5.2.11. Refinery

The products of the different concentrate production circuits will be combined and processed within the Refinery. A crucible furnace operating at temperatures of up to 1,100°C will be used to melt the concentrates over a 3-hour time period. The resulting dorè will be cast into ingot molds designed to contain approximately 20-30 kilograms per ingot. The dorè ingots will be stored in an onsite vault for safekeeping prior to shipment.

1.5.2.12. Chemical Reagents and Processing Equipment

Several chemicals and reagents is used throughout the Mill and Processing Plant operations as previously described. As identified in DAO 2005-07: The Revised Priority Chemical List, only sodium cyanide and lead nitrate are considered priority chemicals by the DENR. Further, sodium cyanide is covered by a Chemical Control Order or otherwise known as DAO 97-39: Chemical Control Order for Cyanide and Cyanide Compounds. The CCO establishes procedures for use, import, handling and management of cyanide and cyanide compounds to reduce potential hazards to the health and the environment. Prior to purchase and use, a chemical control order registration will be secured from the DENR and will later be reported as part of the compliance to the Revised Priority Chemical List.

The other chemicals and reagents for use, such as the acid/ base compounds, require proper handling, storage and disposal procedures. This is implemented as part of the requirements of DAO 92-29: Implementing Rules and Regulations of RA 6969. The chemicals and reagents is bought through local suppliers or imported suppliers. If necessary, equivalent permit and approval will be secured from the DENR.

As indicated earlier, chemicals with similar MSDS characteristics will be stored together. Chemicals and reagents considered or classified as hazardous will be stored separate from the other chemicals and reagents. The use and quantities of reagents are reported to the EMB on a quarterly basis as part of the Multi Partite Monitoring Team activities and the Self-Monitoring reports required by the Regional EMB office.

Table 1-26: Chemical Reagents and Estimated Consumption for 2,500 MTPD Throughput

Item No.	Reagent	Classification and Purpose	Dosage (grams/metric tonnes)	Daily Consumption (kg)
1	Lime	pH regulator (Leaching, CN Detoxification)	3,250	6,500
2	Sodium Cyanide	Leaching agent, anion source for stripping (Leaching)	1,494	2,989
3	Magnafloc	Flocculant (Thickening)	30	60
4	Nasfroth HEL	Frother	40	80
5	Aerophine 3418A	Collector	48	96
6	Potassium Amyl Xanthate	Collector	12	24
7	Diatomaceous Earth	Filter aid (Merrill Crowe/EMEW)	4	8
8	Zinc Dust	Gold cementation (Merrill Crowe)	423	846
9	Lead Nitrate	For Zn-Pb couple (Merrill Crowe)	350	700
10	Carbon	Leached gold collector (CIP)	4,000	8,000
11	Hydrochloric Acid	Carbon inorganic washing (Carbon Regeneration)	0.032	0.064
12	Sodium Hydroxide	Anion source (Stripping)	2.5	5.0
13	Sodium Metabisulfite	Oxidant (Cyanide Detoxification)	3,000	6,000
14	Copper Sulfate	Catalyst (Cyanide Detoxification)	730	1,460
15	Borax	Flux (Smelting)	20	40
16	Soda Ash	Flux (Smelting)	42	84
17	Silica	Flux (Smelting)	22	44
18	Niter	Flux (Smelting)	22	44

1.6 PROJECT SIZE

The Balabag Gold-Silver Project consists of mining three distinct mineralized zones within the area known as the Tinago, Miswi and Lalab zones. The primary mining method is surface mining. A modest underground mining operation may be added later in the Project to access deeper ore from the vein systems of Lalab, Tinago and Miswi. As part of internal Project feasibility studies, a mineral resource estimate was prepared by TVIRD in August 2011 and is based on an exploration program completed through June 2011. This program identified an estimated resource of 1.69 million metric tonnes averaging 2.48 grams per metric tonne of gold and 75.5 grams per metric tonne of silver assuming a cutoff grade of 0.40 grams per metric tonne of gold.

A National Instrument 43-101 Technical Report was prepared and published in August 2012. This report identified an indicated reserve of 1,784,555 metric tonnes at 2.34 grams per metric tonne of gold and 72.3 grams per metric tonne of silver. On this basis, a Declaration of Project Mining Feasibility was obtained from the Mines and Geosciences Bureau which led to the development in 2019 of the Balabag Gold-Silver Mining Project and eventual operation in 2021.

In December 2021, additional exploration results were used to update the resource and presented in the updated Technical Report entitled "NI 43-101 Exploration Results and Mineral Resource Update Report on the Balabag Gold-Silver Project" prepared in accordance with National Instrument 43-101 – Standards of Disclosure for Mineral Projects ("NI 43-101") and filed under the Company's profile on SEDAR on July 20, 2021.

The estimated Measured and Indicated Mineral Resource for the Balabag mine as presented in the NI 43101 Technical Report and using a cut-off grade of 0.4 g/t Au equivalent is 4.35 million tonnes at 1.79 g/t Au and 43.08 g/t Ag for 2.36 g/t Au equivalent. This is equivalent to an approximate 331,000 oz of gold at metal prices of US$1,500/oz Au and US$20/oz Ag. The estimated Inferred Resource is 141,000 tonnes at 2.78 g/t Au and 64.11 g/t Ag for 3.63 g/t gold equivalent. The Remaining Mine Reserve as of January 1, 2022, based on the updated topography stands at 2,279,381 tonnes of ore at 2.52 g/t Au and 55.66 g/t Ag using a cut-off grade of 0.8 g/t Au equivalent. The waste to be moved is estimated to amount to 24,217,000 tonnes at 0.02 g/t Au and 0.41 g/t Ag.

The plant has been commissioned in July 2021 initially milling 500 t/d but rapidly ramped up to 1500 t/d by December 2021 while treating weathered ore near the mine surface. Plant commissioning works in July included the first discharge of tails to Stage 1 of the Tailings Storage facility, which continues to be constructed in stages to accommodate progressively increasing mineral resources as they may be defined and the ramp-up of production. The current focus of construction continues to be Stage 2. Stage 3 is currently being designed.

For the purposes of this EPRMP, the mine plan was re-designed to provide ore that the plant can process at 2,500 tonnes/day for years 2 and 3 and gradually reduce throughput as the ore gets harder towards the deeper part of the mine. The life-of-mine plan is shown in the Table 1-7. The ore reserves will be mined within the period of five (5) years. The peak material movement will occur in 2024 where some 11MMT will be moved. Marginal grade ore estimated to 0.44MT will be stockpiled for processing during the last two years of exploration.

1.7 DEVELOPMENT PLAN, DESCRIPTION OF PROJECT PHASES AND CORRESPONDING TIMEFRAMES

The Balabag Gold-Silver Project is on its second year of operation and is anticipated to be completed in year 2025. The decommissioning and mine closure plans are covered by the Final Mine Rehabilitation and Decommissioning Plan (FMRDP) submitted to DENR- MGB. The Operational Phase and Decommissioning/ Closure Phase comprise the remaining project phase of the Balabag Gold-Silver Project.

The Project is divided into four phases: Pre-Development, Development and Construction, Operation and Rehabilitation and Closure. Each stage includes activities which have the potential to cause some identifiable impacts to the environment. Management, mitigation, or adaptation options to address the impacts relevant to the Project are discussed in the succeeding sections.

1.7.1. Construction

Existing Project facilities such the Mill and Processing Plant, Surface Mine, Waste Rock and Overburden Area and the Tailings Storage Facility already cleared of trees and vegetation. The cutting trees was in consonant with the issued Special Tree Cutting Permit (STCEP). Topsoil within these areas was segregated and stored for future use in reclamation and rehabilitation. Lumber recovered from the clearing activities was donated to DENR. Expansion of Tailings Storage Facility and Waste Rock Dump will be constructed within the proposed expansion area following the same site preparation works.

Additional facilities such as additional fuel storage, generator set, additional housing facility and septic tanks are amongst those that will be constructed and installed to support the expansion project. Additional diesel fuel storage tanks will be constructed on site to ensure continuous fuel inventory for use in the operations. Additional gensets will be installed and operated especially when mill capacity is 2,500 MT. Moreover, additional housing facilities to house additional manpower. Septic tanks will be constructed for domestic wastewater discharges.

1.7.2. Operation

The expansion project will maintain the current mining and mill process. Operation of the surface mine will be continuous with an increased daily production rate from 2 million metric tonnes/day to 11 million metric tonnes/ day of ore and waste. Approximately 30.5 million tons of waste rock and overburden materials are anticipated to be generated throughout the operation from mining operations and facility construction. The maximum area encompassed by the waste rock and overburden disposal is approximately 76 hectares. The tailings storage facility will continuously be constructed in stages to increase its volume capacity and be able to contain the tailings generated from the processing plant.

1.7.3 Abandonment

Details of the Closure Phase of the Balabag Gold-Silver project are covered by the Final Mine Rehabilitation and Decommissioning Plan submitted to DENR-MGB. A Certificate of Approval issued by the Contingent Liability and Rehabilitation Fund (CLRF) Committee requiring an update of every two years once the document was approved. The FMRDP document was approved in Year 2016.

The initial FMRDP document identified a budget of Php 271.3 million for closure, reclamation and monitoring activities during the 5-year period. An initial deposit of Php 3.0 million was already placed in a government depository account as provided in the Certificate of Approval of the FMRDP.

This Phase will occur at the end of mine life. Final mine rehabilitation and decommissioning strategies will be prepared within 60 days after issuance of the Project Environmental Compliance Certificate. This is identified as the Final Mine Rehabilitation and Decommissioning Plan (FMRDP). Programs to be performed during the rehabilitation and closure period consist of the following:

- Structure Demolition/ Decommissioning
- Decontamination or Remediation
- Structural Improvements (erosion control, soil stabilization, re-vegetation, infrastructure support)
- Soil Treatment
- Re-vegetation and Reforestation

1.8 MANPOWER

The Balabag Project require approximately 687 personnel for the final operations stage of throughput (2,500 metric tonnes per day) and somewhat less for the first three incremental throughput stages. Of the estimated maximum number of 687, the distribution of personnel will consist of 156 staff and 531 non-staff (rank-and-file) personnel. This number and distribution exclude those that will be employed by the mine contractors.

Department managers and senior technical staff will be from BGSP as well as from local groups of competent professionals. Skilled and non-skilled workers will likely be recruited from qualified local residents from the host and nearby communities.

Table 1-27: Estimated Workforce Requirement by Project Phase

Department	Pre-Development		Development		Operation		Operation with expansion		Closure	
	Staff	Non-staff	Staff	Non-staff	Staff	Non-staff	Staff	Non-staff	Staff	Non-staff
Security	6	120	6	120	6	120	6	130	3	60
Project Construction	1	0								
Road Construction	1	18								
HRAD, Finance and Logistics	2	5	13	50	17	51	20	55	5	20
Community Relations	7	0	7	0	7		10		3	
Mining	5	6	7	16	21	28	30	40		
Mill/Process Plant Operations	3	6	4	6	12	109	20	130		

Department	Pre-Development		Development		Operation		Operation with expansion		Closure	
	Staff	Non-staff	Staff	Non-staff	Staff	Non-staff	Staff	Non-staff	Staff	Non-staff
Site Management			3	0						
Mill Maintenance			18	54	15	44	15	60		
Civil Engineering Services			5	18	5	18	7	24	3	12
Assay			5	12	8	19	12	30		
Materials Management			5	8	5	13	8	20		
Safety			2	4	2	4	8	12	1	2
Environment and Permitting			4	9	4	9	8	18	4	9
Overall Project Management					3					
Mobile					4	20	4	20	2	10
Total	**25**	**155**	**79**	**297**	**109**	**435**	**148**	**539**	**21**	**113**

1.9 INDICATIVE PROJECT COST

Table 1-28: Project Cost

Project Component	ORIGINAL EIS AND ECC	EPRMP 2022
	Cost PhP (million)	Cost PhP (million)
Pre-Development	22.5	22.5
Feasibility Studies (In-house)	13.5	13.5
Illegal Miner Relocation	90	90
Community Related Projects	4.5	4.5
Mine Development	135	150
Mill Plant and Infra	189	218.5
Tailings Storage Facility Initial Construction	225	225
Tailings Storage Facility Subsequent Construction	225	350
Total	**904.5**	**1,074**

2. ANALYSIS OF KEY ENVIRONMENTAL IMPACTS

2.1 THE LAND

2.1.1 Impact in Terms of Compatibility with Existing Land Use

The Project's MPSA is mostly located within the Municipality of Bayog in the Province of Zamboanga del Sur. Although a portion of the MPSA is located within the Municipality of Kabasalan, in the Province of Zamboanga del Norte, the planned expansion of the mining Project is entirely located within the Municipality of Bayog. Thus, this section will only cover the land use of the Municipality of Bayog.

The Municipality of Bayog has a total land area of 35,463.643 hectares distributed among 28 barangays. Barangay Dimalinao occupies the largest area in the municipality with 4,223 hectares while Barangay Dagum occupies the smallest area (42 hectares). The direct mining impact area is located in Sitio Balabag which is in Barangay Depore. Prior to Year 2012, there were nearly 700 small-scale mining associated residents within the Project area. Their operations encompassed approximately 22 hectares.

It can be noted that over 7,500 hectares is classified as a mineral reserve area and Barangay Depore is within the said area. Given that the project is located within Barangay Depore, the operation of the Project therefore will not result in any changes in the land use plan. As of June 2022, the total disturbed area is 112.5 hectares which is 2.35% only of the MPSA and 3.24% of the mining reserve allocation. In the proposed amendment to the ECC, the total disturbed area is estimated to be 246.47 which is about 5.16% of the MPSA and 7.10% of the mineral reserve area.

Table 2-1: Disturbed Areas in Previous ECC and in this EPRMP

Project Feature	Previous ECCs	This EPRMP
	Total estimated Disturbed Area (ha)	Total estimated Disturbed Area (ha)
Mill and Processing Plant	0.5	2.34
Administration Buildings	0.5	4.5
Materials Storage	1.5	0.5
Tailings Storage Facility	20.5	76
Surface Mine	13.5	35
Waste Rock Disposal Area	13	50
Camp Facilities	2.5	9.4095
Infrastructure/material storage	3	12
Access Roads	9	30
Total	**64**	**206.62**

Revegetation, reforestation, and structural / topographic modifications of the Mine Closure Plan are directed toward developing an environment consistent with the Comprehensive Land Use Plan of the host municipality and at the same time a plan which can support and sustain the terrestrial and aquatic habitat, reinforce long term sustainable livelihood programs and meet the stakeholder needs for regulatory and political requirements.

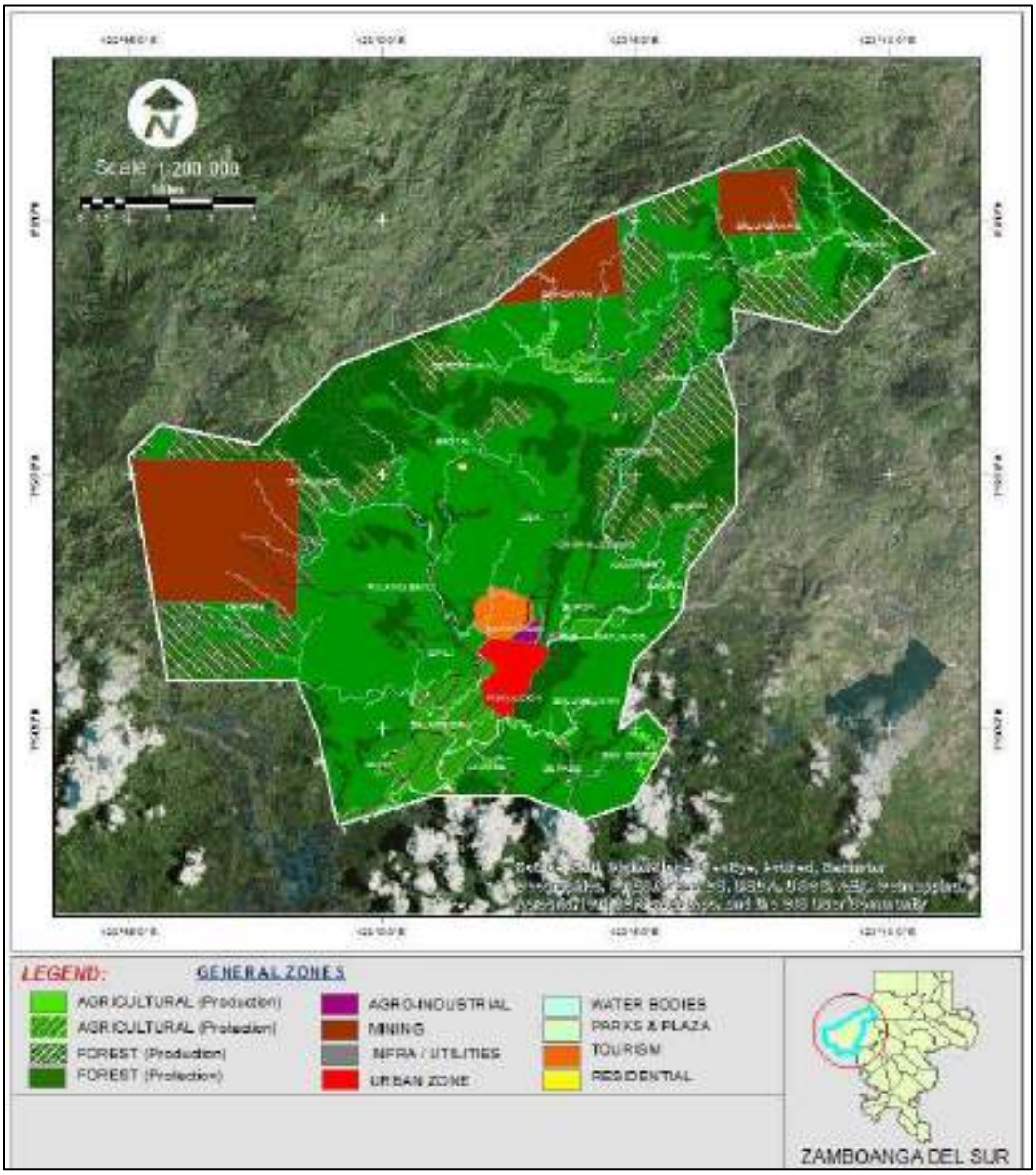
Table 2-2: Land Use Classification of Municipality of Bayog

LAND USES	AREA IN HECTARES	PERCENT TO TOTAL
A. General Land Use	**35,463.643**	**100.00%**
Settlements	248.513	0.70%
Agricultural		
Production	636.375	1.79%
Protection	1,586.675	4.47%
Forest		
Production	17,172.456	48.42%
Protection	7,383.204	20.82%
Industrial	16.369	0.05%
Mineral	7,556.614	21.31%
Tourism	53.052	0.15%
Water Bodies	413.252	1.17%
Roads	394.133	1.11%
Special Uses		
Cemetery	3.000	0.01%
B. Urban Land Uses	**277.974**	**100.00%**
Residential	138.456	49.81%
Socialized Housing	10.394	3.74%
Commercial	25.699	9.25%
Institutional	11.437	4.11%
Industrial	16.369	5.89%
Park & Open Spaces	1.332	0.48%
Roads	65.889	23.70%
Creeks	1.776	0.64%
River and Easement	6.622	2.38%

Nearly 4,600 hectares within the Municipality of Bayog is classified as a mining reserve area. The Project is located in Barangay Depore which is a mining area, hence the operation of the Project is not expected to result in any changes in the land use plan. In the original ECC, the Project is anticipated to disturb approximately 89.5 hectares in total. This represents 1.8% of the entire MPSA and 1.9% of the mining reserve area allocation within the Municipality of Bayog. As of June 2022, total disturbed area is 112.5 hectares which is 2.2% of the MPSA while 2.3% is the mining reserve area allocation. This EPRMP aims to increase the disturbed area to a proposed 206.6195 hectares.

Figure 2-1: Shows the land use plan of Bayog. Note that the boundaries of this plan and the NAMRIA official boundaries are different, as is sometimes the case between CLUPs and the official national government maps.

Figure 2-1: Land Use Map of Municipality of Bayog



Source: Bayog CLUP

2.1.1.1 Impact on Compatibility with Classification as an Environmental Critical Area (ECA)

The Revised Procedural Manual for DENR Administrative Order No. 2003-30: Implementing Rules and Regulations of PD 1586: Establishing the Philippine EIS System identifies twelve specific categories within which an area is considered an Environmentally Critical Area (ECA) based on the evaluation.

The Project area was evaluated based on these twelve categories and the resulting evaluation indicated the Project area is considered an ECA. A summary of the ECA assessment is provided in Table 2-3. Moreover, the project is considered ECA based on the cultural and social criteria as well as the geologic hazard criteria. Approximately 1,300 hectares of the northern portion of the MPSA are located within the 47,800 hectares of the CADT or approximately 30% of the whole MPSA. However, the CADT portions that overlap with the MPSA are not within the impact area. As such, there is no operations encroachment within the ECA. The Phase 1 operations will however encroach upon the ECA as defined by the geologic hazard criteria. The previous and current small scale mining operations within the area have resulted in creation of the geologic hazard. Implementation of the Project will include mitigation of this hazard and can be seen as a beneficial impact within an ECA.

Table 2-3: ECA Assessment of the Proposed Project Site Expansion

ECA Categories	Project Falls within Environmentally Critical Area Description?			Proof/ Evidence	Source of Information
	Yes	No	Uncertain		
Area declared by Law as National Parks, Watershed Reserves, Wildlife Preserves and Sanctuaries.		x		Nearest Protected area is 15 km away (Buug Natural Biotic Area)	https://www.geoportal.gov.ph/ Using Data from DENR
Areas Set Aside as Aesthetic, Potential Tourist Spots.		x		Nearest DOT tourist attraction is 33 km away (Lison Valley Waterfalls)	https://www.geoportal.gov.ph/ Using Data from Department of Tourism (DOT)
Areas which Constitute the Habitat for any Endangered or Threatened Species of Indigenous Philippine Wildlife (Flora and Fauna).	X			The Terrestrial Ecology Study found three species of flora that were endangered while no species of fauna were endangered or threatened	This Report
Area of Unique Historic, Archaeological, Geological or Scientific Interests.		x		Certification from NCIP.	NCIP
Areas which are Traditionally Occupied by Cultural Communities or Tribes.	X			CADT-RO9-SIN-0908-75 issued to the Subanon Indigenous People.	NCIP Appendix F
Areas Frequently Visited and/ or Hard-hit by Natural Calamities.					
Geologic Hazard Areas	x			Physical Inspection and Historical Landslides. High Susceptibility: Numerous old/inactive landslides present from HAZARDHUNTER. GEORISK. GOV.PH	MGB, Local Government Unit (Bayog). Also, Hazard assessment from https://hazardhunter.georisk.gov.ph/
Flood-prone Areas		x		No Identified Floodplain Maps. Hazard maps also do not show any potential flood prone areas	Local Government Unit (Bayog).

ECA Categories	Project Falls within Environmentally Critical Area Description?			Proof/ Evidence	Source of Information
	Yes	No	Uncertain		
Areas Frequently Visited or Hard Hit by Typhoons		x		Severe Wind Assessment: 88.1 - 117 kph (20-year return period); 88.1 - 117 kph (500-year return period)	PAGASA - Hazard assessment from https://hazardhunter.georisk.gov.ph/
Areas Prone to Volcanic Activities and Earthquakes			X	Nearest Active Volcano: Approximately 153.1 km west of Makaturing Nearest Potentially Active Volcano: Approximately 151.4 km south of Cuernos_de_negros; No immediate volcanic hazard threat	Phivolcs - Hazard assessment from https://hazardhunter.georisk.gov.ph/
Areas with Critical Slopes	x			Physical Inspection and Historical Landslides	TVIRD, MGB, Local Government Unit (Bayog).
Areas Classified as Prime Agricultural Lands			X	SAN 3D Program of Dept. of Agriculture	Dept. Of Agriculture
Recharge Areas of Aquifers			X	Non-Available	National Water Resource Board
Water Bodies	x			Non-Available	Classification of Sibuguey River as Class A/C
Mangrove Areas		x		Inland Area not Coastal Area.	NAMRIA Maps
Coral Reefs		x		Inland Area not Coastal Area.	NAMRIA Maps

Figure 2-2: Balabag Gold-Silver Project MPSA and Expansion Area and Nearest NIPAS Areas

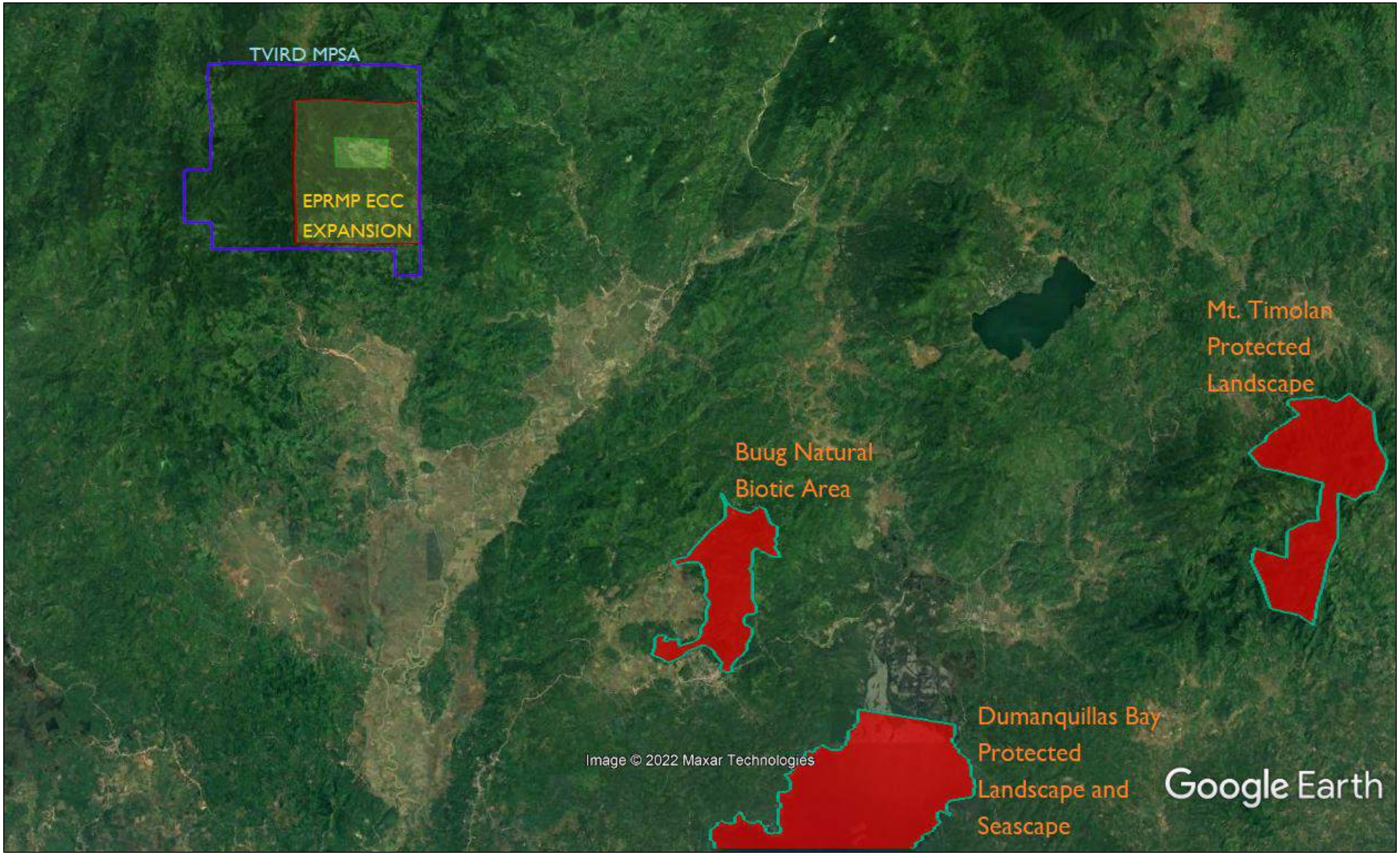


Figure 2-3: Nearest DOT Tourist Spots to the Project Area

2.1.1.2 Impact in Existing Land Tenure Issue/s

The National Government has developed the Comprehensive Agrarian Reform Program (CARP) which is intended to aid the agricultural and rural development of local farmers such that they can become globally competitive. To implement the objectives of the CARP, the Department of Agrarian Reform (DAR) developed the concept of Agrarian Reform Communities (ARCs). The DAR participates within these areas to increase farm production, improve household income and promote sustainable development.

In Bayog, the ARC's were named as the SAN 3D's and include the Barangays of San Isidro, Damit, Depore and Dipili. The SAN 3D's Special ARC has a total land area of 5,800 hectares with 4,400 hectares devoted to agriculture. The population within the ARC is 3,253 with 224 Agrarian Reform Beneficiaries (ARB).

The general land use within the SAN 3D's ARC is categorized as arable/agricultural, residential/build-up, nonagricultural, forest/ reservation and water area. Within Barangay Depore and Sitios Upper Depore and Balabag, the lands are categorized as non-agricultural. These are the lands within which the mining activities are located.
Although the Municipality of Bayog is primarily an agriculturally based community, some lands are recognized as being mining reserve areas. The Project is located outside of the CARP area and has no direct impact to the agricultural community.

2.1.1.3 Impairment of Visual Aesthetics

The Project operations will not cause any changes in the land use, since the MPSA is within the area classified as Mining Reserve. All infrastructure built and activities undertaken are related to mining operations. Therefore, it is aligned with the intended land use of the area.

There are changes however, in terms of visual aesthetics. During construction, activities such as the removal of vegetation, excavation and reshaping of the natural landform are among the activities that would lead to change in visual aesthetics. The establishment of offices, accommodation facilities, Mill Plant and other necessary facilities is also a significant change of the visual aesthetics in the area. During operation, the open pits and waste rock disposal areas will also create major changes. Open pit mining disturbs large areas, and thus has large visual and physical impacts.

Figure 2-3a: Change in Visual Aesthetics of the Project Site (Top Left photo) prior to Development and Along to the Course of Development (Bottom Right)

To minimize disturbance however, mining activities, including site clearing and excavation, is limited to those areas identified in the Mine Plan. To enhance the visual aesthetics, progressive rehabilitation is undertaken in areas that are considered inactive mining sites. Denuded areas are subjected to thorough study for future re-vegetation programs. Reforestation programs and landscaping will also improve the visual aesthetics within the Project area. Access roads within the Project area will be planted with fast growing trees. The planted and grown trees will then be serving as vegetation screens to mitigate or offset the visual impacts of the mining operations. Good housekeeping and proper storage of overburden wastes and topsoil storage is observed and implemented at all times. Containment of stockpile areas and regular clean-up of any spills is also a continuous activity.

2.1.1.4 Devaluation of Land Value as a Result of Improper Solid Waste Management and other Related Impacts

A total of approximately 30.5 million metric tons of overburden and waste rock materials will be generated during the mining activities. Other than waste rock, overburden, and tailings, domestic solid wastes from the workers and the operation of the administration building are generated the project site.

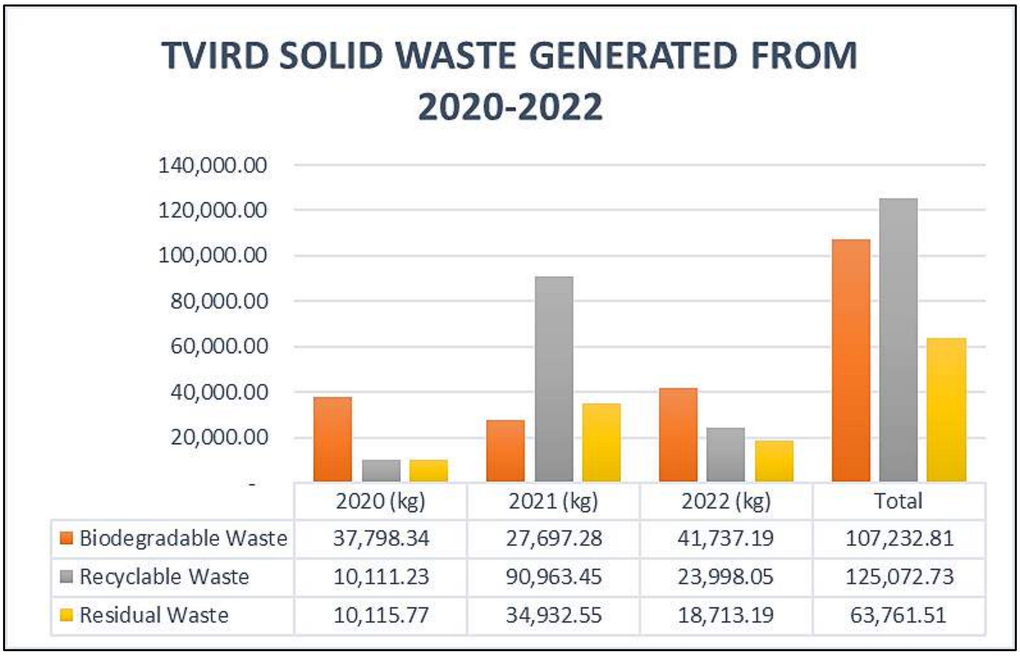
A solid waste management facility will be constructed to serve as a final disposal facility for solid wastes other than waste rock, overburden and tailings. The facility will consist of three components: a Material Recovery Facility for sorting and recycling activities, a Composting Facility to manage organic and other wastes that may be used for soil conditioning and storage for materials that cannot be recycled or composted. Waste segregation will be implemented as part of the Environmental Management System of the Company. Recyclable wastes will be stored in a Material Recovery Facility and will be sold as scrap to accredited buyers.

2.1.1.4.1 Solid Waste Generation

Prior to project operation, potential solid wastes to be generated along the course of the Project were identified. Among the identified solid wastes are recyclable materials, biodegradable materials, residual wastes and special wastes. The said wastes specifically include paper, plastics, scrap metal, food waste, and timber wastes among others.

The graph below shows the data of the actual Solid Waste generation on site during the operation phase.

Figure 2- 3b: TVIRD's Solid Waste Generation from Year 2020-2022



	2020 (kg)	2021 (kg)	2022 (kg)	Total
Biodegradable Waste	37,798.34	27,697.28	41,737.19	107,232.81
Recyclable Waste	10,111.23	90,963.45	23,998.05	125,072.73
Residual Waste	10,115.77	34,932.55	18,713.19	63,761.51

Source: TVIRD's internal monitoring data 2022-2022

In year 2020 the most generated waste type is biodegradable waste. A significant change on the generation of waste occur in 2021 wherein recyclable wastes were generated more compared to other types of waste. The increase of recyclable waste in 2021 can be attributed to the waste generated from the construction of facilities, as the final stage of the development of facilities was in this period. The 2022 date reflected in the graph covers only the first semester period of the year. More biodegradable wastes were collected in the first semester of 2022 as many employees were accommodated inside the camp facilities due to mandatory lack down.

To manage this impact, a solid waste management plan is being implemented in line with RA 9003 also known as the Ecological Solid Waste Management Act of the Philippines. Presently, the company's waste management program is anchored on the following objectives:

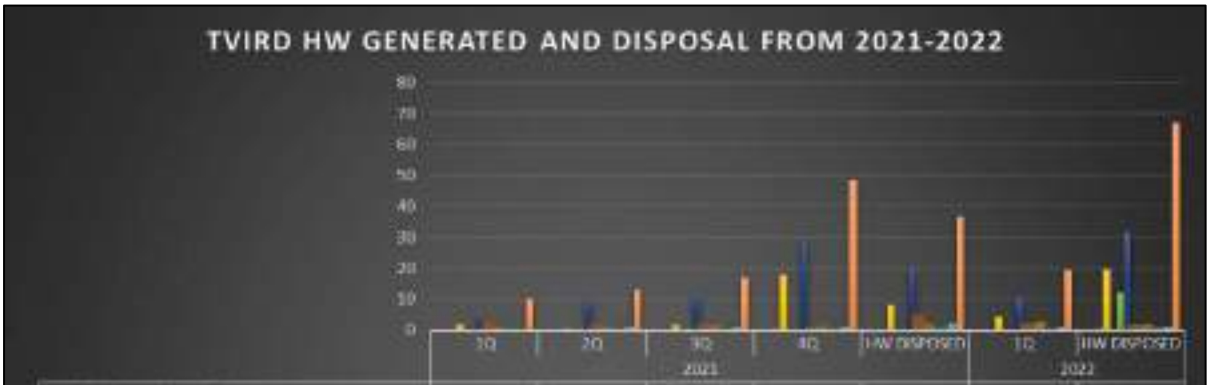
1. Recycling/Upcycling of Recyclable Waste Generation for Landscaping Materials
2. Conversion of Biodegradable Waste Generation into Fertilizer/Soil Ameliorants

3. Annual Reduction of Per Type of Waste in kg per capita

2.1.1.4.2 Hazardous Waste Generation

The figure below shows the data on the actual hazardous waste generated in the Project between 2021 to 2022. There are fourteen (14) types of hazardous waste on site, classified based on DENR-EMB' classification of hazardous wastes

Figure 2-3c: TVIRD's Hazardous Waste Generated and Disposed from Year 2021- 2022



	2021 1Q	2021 2Q	2021 3Q	2021 4Q	2021 HW DISPOSED	2022 1Q	2022 HW DISPOSED
A101 Waste with cyanide	0	0	0	0.055	0	0	0.055
B208 Organic acid	0	0	0	0	0	0.017	0
B299 Other acid waste	0	0	0	0.4	0	0.025	0.4
D406 Lead Compounds	1.56	0.36	1.08	18.02	8.19	4.21	19.7
D407 Mercury and Mercury Compounds	0.05	0.082	0.012	0	0.122	0.00725	0.014
H802 Grease waste	0	0	0.4	0	0	0	12.16
I101 Oil	5.2	9.89	12.16	29	20.46	10.556	31.519
I102 Vegetable Oil including Sludge	2.66	1.46	1.3	0.011	4.367	1.46	1.049
I104 Oil-contaminated materials	0.46	0.82	0.69	0.18	2.82	0.891	0.86
L201 Containers previously containing toxic chemical substances	0.08	0.2	0.64	0.566	0.431	2.11	1.026
M501 Pathological or Infectious Wastes	0.03	0.06	0.103	0.012	0.105	0.0315	0.102
M506 Waste Electrical and Electronic Equipment	0.01	0.01	0.05	0.009	0.88	0	0.059
M507 Special Wastes	0	0.18	0.09	0.023	1.3	0.02	0.071
Average Total	10.11	12.802	17.035	48.413	36.555	19.30775	66.944

Based on the data above, waste oil (I101) is the most generated type of hazardous waste. The storage and disposal of these hazardous wastes are all in compliance with RA 6969 or the Toxic Substances and Hazardous and Nuclear Waste Control Act of 1990.

Generation, storage, transport, and treatment of hazardous waste is being managed through the implementation of Waste Management Procedure. An engineered hazardous waste storage facility is built for proper storage and a DENR-EMB accredited transporter and treater are contracted to transport and treat the waste off-site.

2.1.2 Geology/ Geomorphology

2.1.2.1 Regional Geological Setting

Tectonic Setting

The Philippines lies within the West Pacific Region. Here, the movements of three lithospheric plates - the Eurasian, Indo-Australian and Pacific Plates (including the Philippine Sea Plate), are responsible for the tectonic development of the Philippines. The Pacific Plate, which is mainly composed of the oceanic crust, is moving west to west-northwest direction.

The Eurasian Plate is moving at north-northeast with some marginal basins on its eastern periphery and the Indo-Australian Plate, part oceanic and part continental, is moving northward (Figure 2-4). Movements between these plates have produced the "Philippine Mobile Belt" (Gervasio,1966), a complex zone consisting of transcurrent faults, collision zones and subduction zones.

The Philippine archipelago is bounded on the eastern side by the East Philippine Arc, a west- dipping subduction zone located along the Philippine Trench. On the western side, it is bounded by the West Philippine Arc, an east dipping subduction zone where the Eurasian Plate subducts.

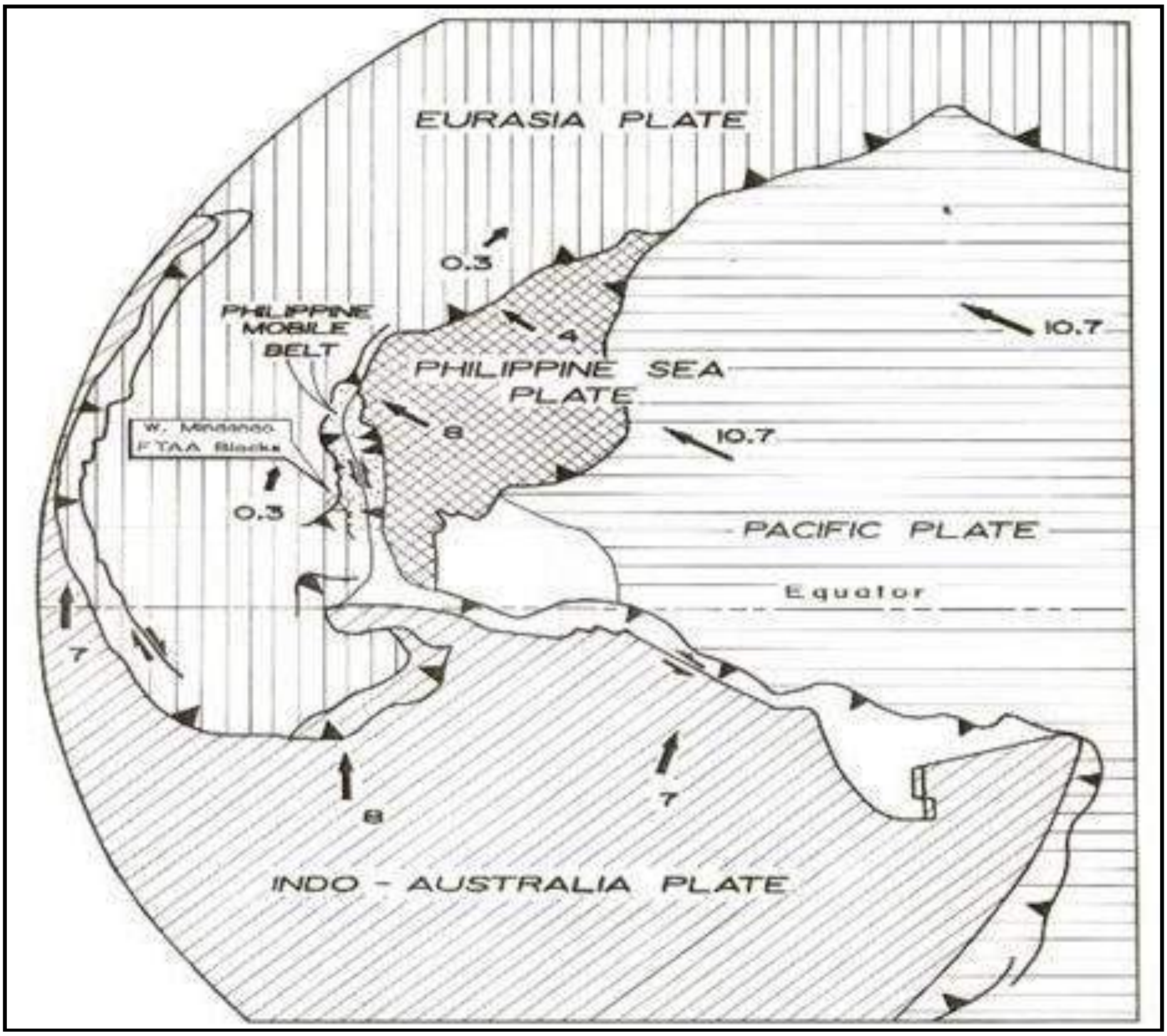
The West Philippine Arc can be traced from the Manila Trench down to the Mindoro-Panay Area marked by collision zones related to the Palawan Micro Continental Block and continuous down to offshore Negros Trench and then to Zamboanga area where another collision zone occurred between the Sulu-Zamboanga Arc and the West Philippine Arc. This zone is represented by the Sindangan Fault system, a suture zone between two arcs: the northeast trending Sulu-Zamboanga Arc located west of the Sindangan Fault and the NNW trending West Philippine Arc located east of the Sindangan Fault (Pubellier, et. al., 1991). Transecting the archipelago is the Philippine Fault Zone which is a left lateral strike slip fault that can be traced from northern Luzon to southern Mindanao (Figure 2-5).

Regional Stratigraphy

The Zamboanga Peninsula is divided into three distinct rock-stratigraphic assemblages, namely: the SW-Zamboanga Zone; the Cotabato-Sindangan Collision Zone; and the NE-Zamboanga Zone. The SW-Zamboanga Zone, where the Balabag MPSA is located, consists of the NE-trending relatively older suite of rock stratigraphic units. This includes the pre-Tertiary basement complex consisting of Triassic schists and other metamorphics (Tungawan Schist), and the Cretaceous ultramafics and ophiolitic rocks (Bungiao Melange). Paleocene to Miocene sediments (Sirawai and Anungan Formation) and volcanics (Soleplep Volcanic Complex) unconformably overlie the basement complex. Miocene intrusives and hypabyssal rocks (Vitali Diorite) intrude the pre-existing rocks. Another episode of active volcanism occurred during Plio- Pleistocene which deposited NE trending andesitic to basaltic plugs and pyroclastic flow deposits of the Sta. Maria Volcanic Complex (Figure 2-6 and Figure 2-7).

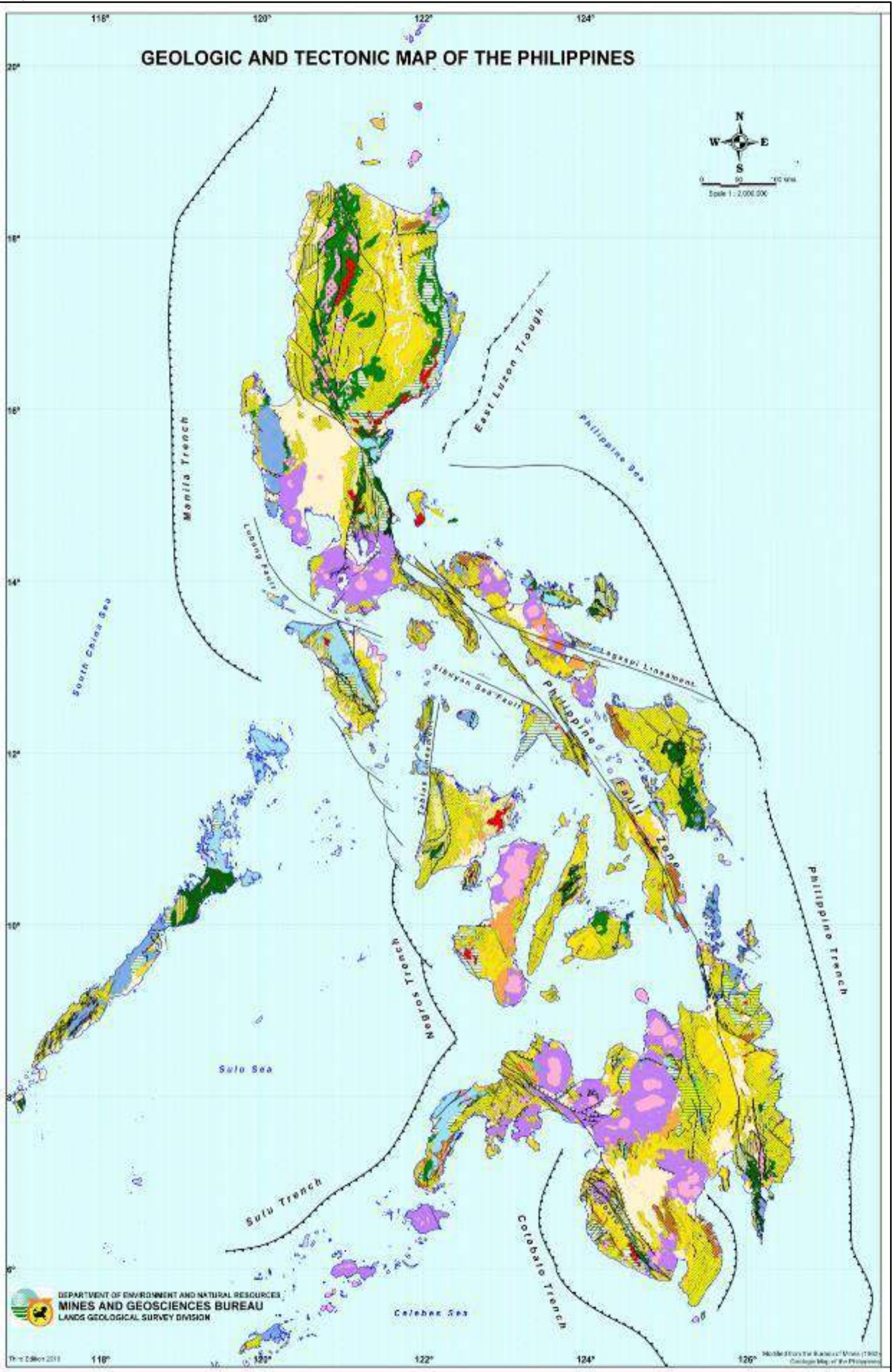
The Cotabato-Sindangan Collision Zone is characterized mostly by NW-trending braided or anastomosing sinistral faults and similarly trending lithostratigraphic units. Rock suites comprise Cretaceous ultramafics and ophiolitic rocks, Paleocene-Eocene sediments, and Oligocene to Miocene volcanics and sediments, Miocene intrusive and hypabyssal rocks, Quaternary igneous sequences (both intrusive and extrusive), and alluvium comprise the youngest sequences. The northeast Zamboanga Zone is mostly covered with the Pleistocene Malindang Volcanic Complex and related lahar and alluvial deposits which have the same age as the Sta. Maria Volcanic Complex of the southwest Zamboanga Zone.

Figure 2-4: Location of the Philippine Mobile Belt with Respect to Adjacent Tectonic Plates



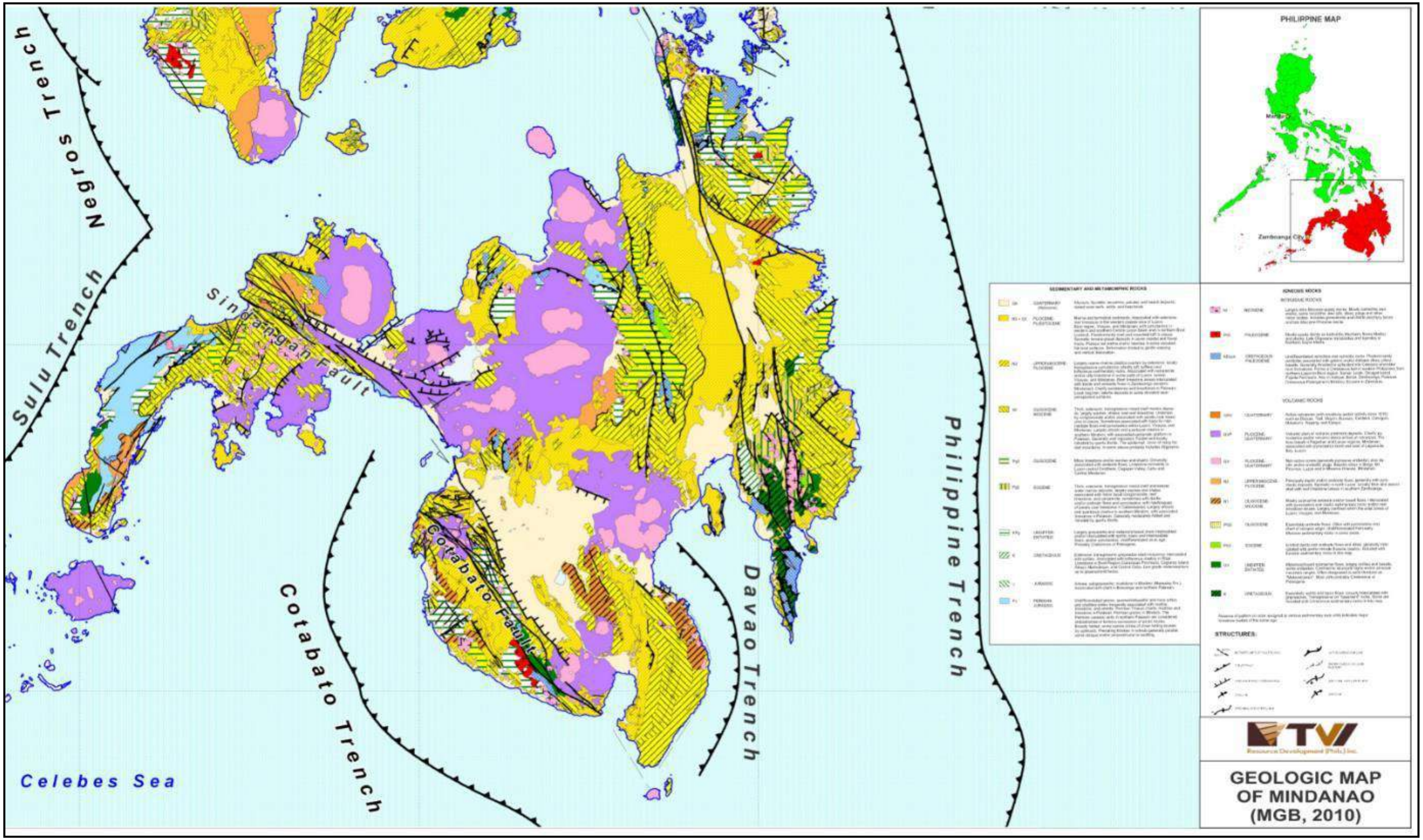
Source: Geology of The Philippines, 2nd Edition, 2010, Mines and Geosciences Bureau

Figure 2-5: Tectonic Map of the Philippines



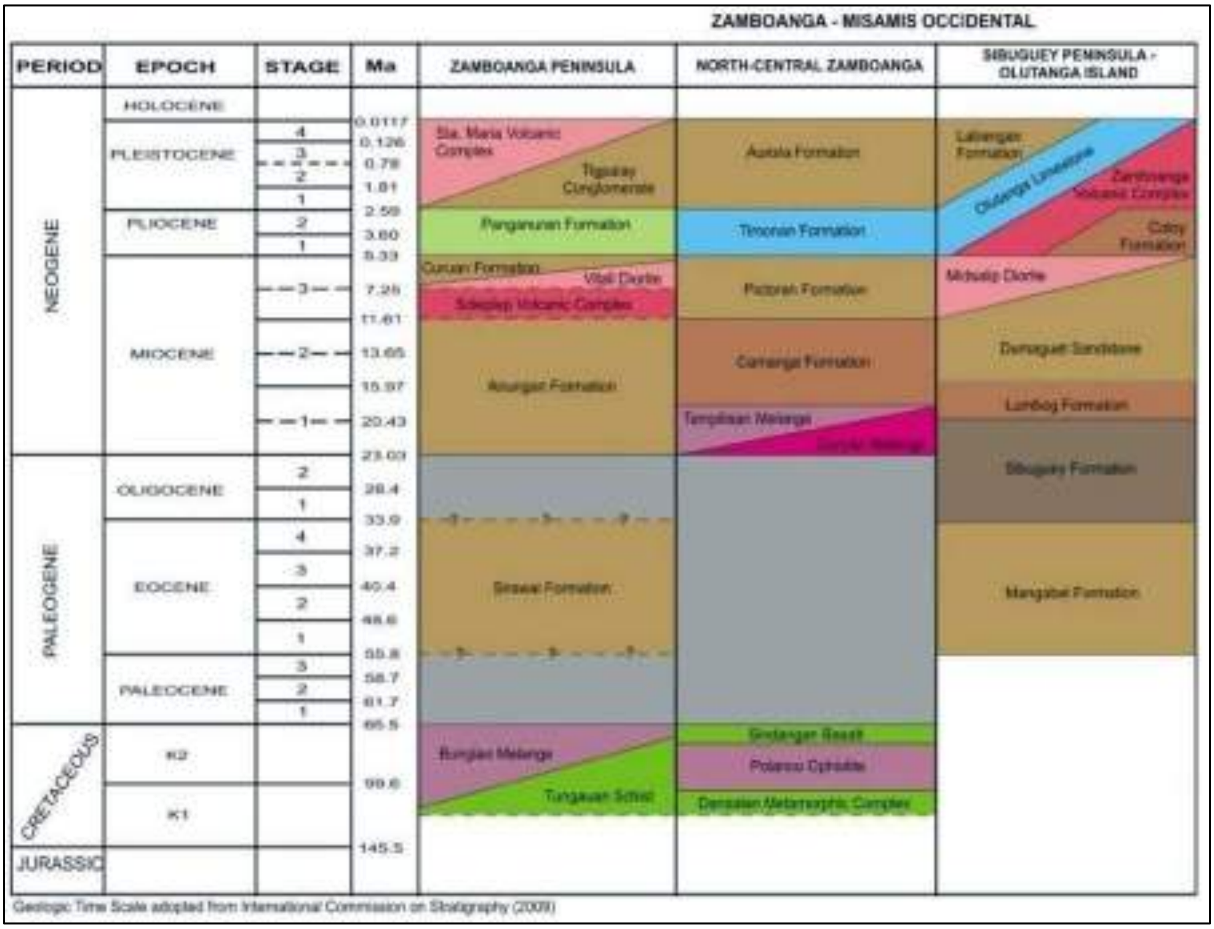
Source: Geology of The Philippines, 2nd Edition, 2010, Mines and Geosciences Bureau

Figure 2-6: Regional Geologic Map of Mindanao



Source: Geology of The Philippines, 2nd Edition, 2010, Mines and Geosciences Bureau

Figure 2-7: Stratigraphic Column for Zamboanga Peninsula: North-Central Zamboanga Peninsula-Olutanga Island

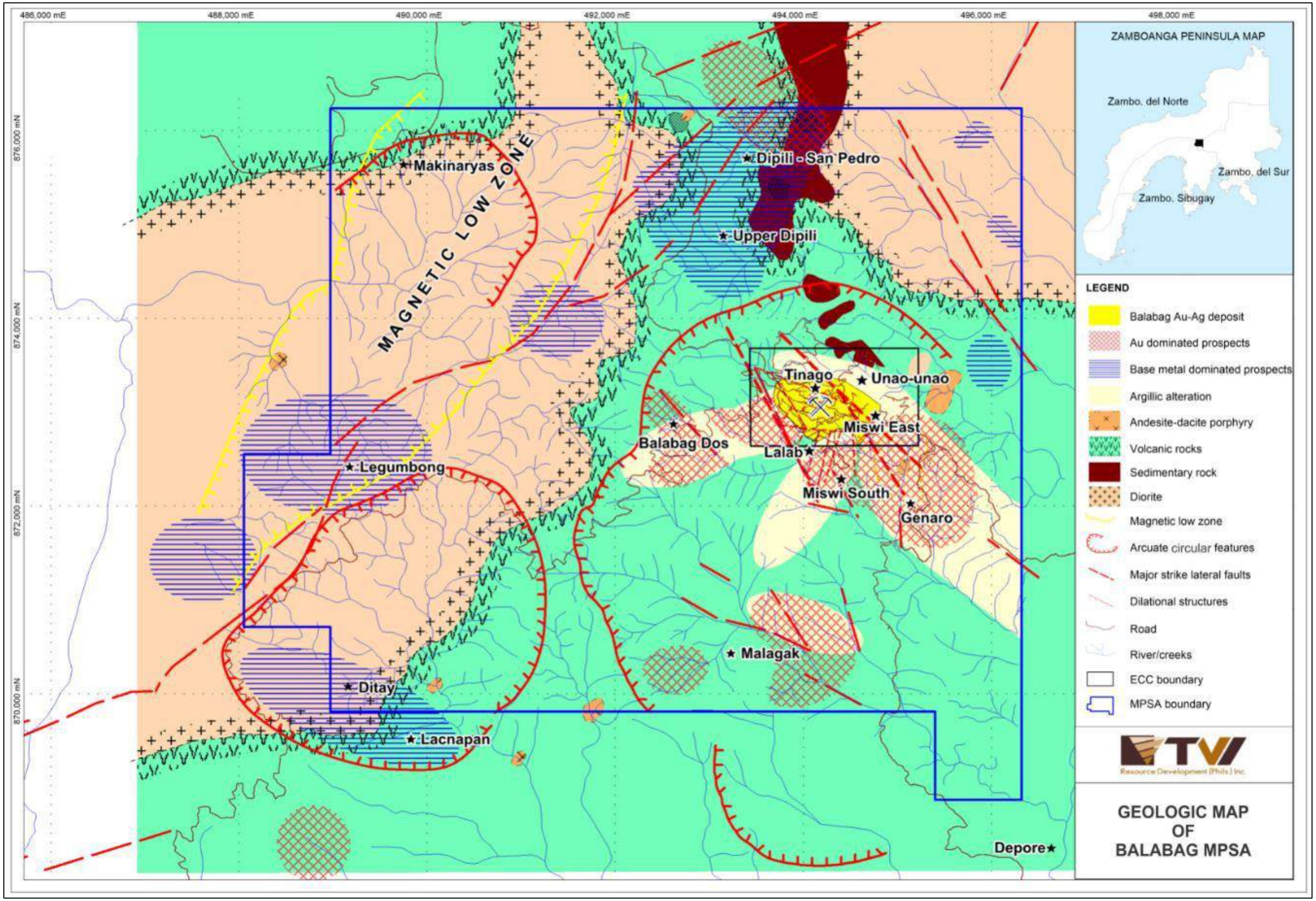


Source: Geology of The Philippines, 2nd Edition, 2010, Mines and Geosciences Bureau

2.1.2.2 Local Geology

Four main lithologic / formational units were identified within the Balabag MPSA tenement - the sedimentary rocks correlative to the Paleocene Sirawai Formation and the Early Miocene Anungan Formation; the volcanic rocks of the Late Miocene Soleplep Volcanic Complex; the Late Miocene Vitali Diorite; and, andesite-dacite porphyry which can be correlated to the Pliocene-Pleistocene Sta. Maria Volcanic Complex (Figure 2-8).

Figure 2-8: Local Geologic Map of Balabag Gold-Silver Project MPSA



Source: RTEPC, 1997

2.1.2.2.1 Sedimentary Rocks (Early to Middle Miocene)

The sedimentary rocks consist of a well-indurated sequence of bedded calcareous mudstone-siltstone-sandstone-conglomerate intercalated with limestone. Outcrops were noted north of the Upper Dipili River. Mudstone is thinly laminated and brown to dark gray in color. Sandstone consists of lithic fragments cemented by a calcareous matrix. The conglomerate is poorly sorted and usually contains clasts of limestone and other sedimentary rocks. The limestone is white to gray and crystalline. Beds generally strike to northwest and dip 60-70 southwest.

Paleontological analysis of samples BL-65765 and BL-65766 (Figure 2-9) have identified several fossils of foraminifera (Lepidocyclina, Miogypsina, and Cycloclypeus) with some algae and corrals, with age range of Early to Middle Miocene.

Figure 2-9: Photo of Sample BL-65765 and Sample BL-65766

2.1.2.2.2 Volcanic Rocks (Late Miocene)

The observed volcanic rocks in the area consist of altered volcanic flows and pyroclastic rocks. The volcanic flows are massive and fine grained to porphyritic. They range in composition from andesite to basalt. Pyroclastic rocks occur as interlayered with the volcanic flows. They include tuffs and volcanic breccia. The volcanic breccia consists of fragments of altered andesite and basalt embedded in a tuffaceous matrix. Basalt is fine grained and magnetic with magnetite being altered to hematite and other ferromagnesian minerals altered to chlorite. It is vesicular and amygdaloidal.

Figure 2-10: Photo of Amygdaloidal Basalt Sample

2.1.2.2.3 Intrusive Rocks (Late Miocene)

Like most of the Philippines' precious metal mineralization which occurred during the Middle to Late Miocene period, active subduction-related arc volcanism brought about by the Sulu Trench enabled the intrusion of diorite rocks at Sulu-Zamboanga Arc. These intrusive rocks along with active volcanism served as a heat source for precious and semi-precious mineralization in the area.

Although no diorite outcrop has been mapped yet at the MPSA area, an altered plagioclase phyric diorite clast within a hydrothermal vein breccia was identified from drillhole BLDH-10-145 at 147.8 meters and an altered diorite porphyry from drillhole BLDH-10-150 at 153.7 meters located north and west of the Tinago area, respectively.
K-feldspars of the plagioclase phyric diorite are pervasively altered to sericite-illite. Very fine- grained tourmaline is noted locally, enclosed by mosaic quartz intergrown with illite of wall rock replacement.

An altered micro-diorite was also noted from a wall rock sample at the Unao-Unao area that was subjected to petrographic identification by the MGB. It has hypidiomorphic texture as exhibited by fine to medium-grained twinned sodic plagioclase + augite + enstatite. Poikilitic texture has at times been observed in smaller augite crystals enclosed by larger plagioclases. Accessory opaques occur as blocky to elongate/ acicular and web-like disseminations. Plagioclase are altered with clay and some chlorite while pyroxenes are mostly or partly altered by chlorite.

The MGB interpreted the ghosted hypidiomorphic plagioclase and less abundant ghosted amphibole and relict or recrystallized primary quartz among wall rock material enclosed by silica/silicate cement/fill as an indication of a high-level intrusion.

2.1.2.2.4 Andesite to Trachyandesite

Andesites vary from fine grained to porphyritic with well-defined flow bands, and some exhibits vesiculated and amygdaloidal texture. Some amygdules are filled with calcite. Andesite mineralogy is mostly plagioclase with chlorite patches. Thin sections of altered porphyritic andesite samples show complete replacement of plagioclase phenocrysts by fine-grained, dense sericite. Hornblende is replaced by quartz and/or chlorite.

The andesite volcanic flow (trachyandesite) is characterized by pseudomorphed plagioclase and amphibole phenocrysts contained within ghosted, plagioclase-rich trachytic to pilotaxitic textured groundmass. The relict apatite together with pseudomorphed magnetite present in the ghosted pilotaxitic to trachytic textured groundmass indicate probable intermediate igneous classification.

In addition, ghosted plagioclase and amphibole crystal clasts together with plagioclase and amphibole porphyritic lithic fragments defining clastic rock types may represent tectonic brecciated andesite and trachyandesite or volcanic rock types.

Figure 2-11: Photo of porphyritic Andesite Sample

2.1.2.2.5 Pyroclastic Rocks and Volcanic Breccias

The pyroclastic rocks are medium to coarse grained tuffaceous sandstone, flow breccias, agglomerates and tuffs. The tuffs are further subdivided into ash tuff, lithic tuff, and crystal tuff. The ash tuff is buff to cream and thinly bedded. The lithic tuff is well indurated, greenish to grayish black and propylitic. Flow breccias are either monomictic or polymictic. Monomictic breccias are poorly sorted, matrix to clast supported and contain andesitic clasts cemented by an andesitic sandy matrix. The polymictic breccias are poorly sorted, matrix supported and contain clasts of limestone, porphyritic andesite, aphanitic andesite, and some mudstone and clastic rocks.

The identified volcanic breccia is composed of abundant small to large (millimeter to centimeter sized) angular to subrounded lithic fragments, mostly porphyritic andesite but also including micro-dacite porphyry. This coarse volcanic breccia is inferred to have been sourced from mixed intermediate to acid volcanic and subvolcanic terrain.

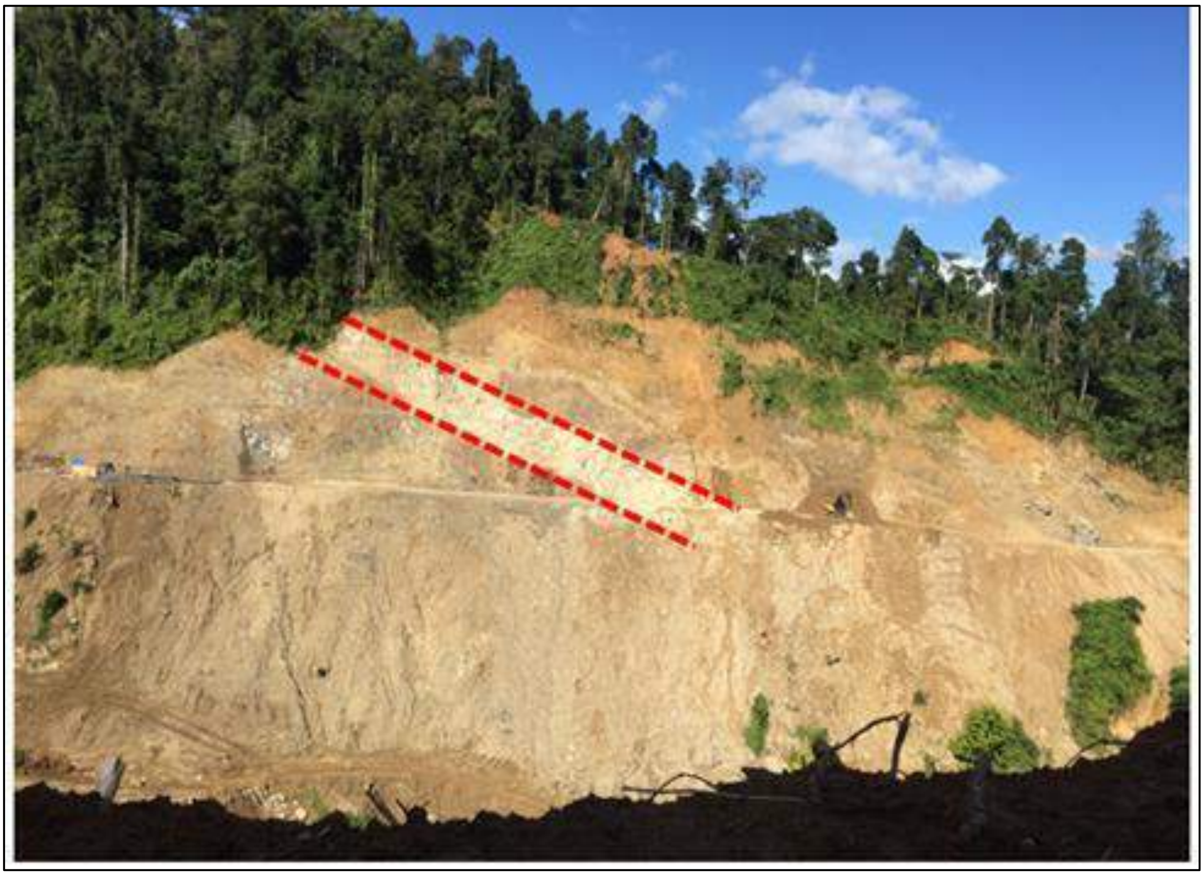
Figure 2-12: Photo of Weathered and Oxidized Outcrop of Volcaniclastic Breccia

2.1.2.2.6 Dacite-Andesite Porphyry

During the Pliocene-Pleistocene period, another episode of active volcanism occurred, thus the emplacement of the northeast trending andesitic to basaltic plugs and pyroclastic flow deposits. Precious metal mineralization may have also occurred during this period. Some of these hypabyssal intrusives observed in the vicinity of Balabag Hill and some drill cores have dacitic composition. Like most wall rocks associated with Balabag Au – Ag mineralization, the phenocryst and groundmass minerals are mostly altered or totally replaced by illite-sericite.

Figure 2-13: Photo of Altered Dacite from Drill Hole BDDH-07-63 at 134.18 m Depth

Figure 2-14: Photo of an Outcrop of Dacite Dike Intruding Volcaniclastic Diatreme Breccia Sequence Outcropping in Unao-Unao Area



2.1.2.2.7 Diatreme Breccia

A recently identified rock unit within the Balabag MPSA is composed of poorly sorted, rounded to subrounded heterolithic clasts of older rock units with varying sizes (millimeter to meters sizes) consisting of stratified but disorientated tuffaceous sedimentary rocks, pyroclastic fallout and breccias, diorite and limestone within a fine ash-rich, tuffaceous sedimentary matrix Initially the rock suite was identified as conglomerate but was later interpreted as a diatreme breccia due to the presence of clasts of carbonized wood fragments, surrounding pyroclastic volcanic ejecta and accretionary lapilli tuff, large slumped large blocks of limestone and sub- rounded clasts of subvolcanic porphyries and/or diorite which were interpreted as a result of explosive events related to the intrusion of subvolcanic dacitic dikes and possible event of phreatomagmatic explosion.

Outcrops of the diatreme breccia were observed directly at the northeast side of the Balabag Hill gold deposit. with a projected thickness of 50 meters. Based on cross- cutting relationships and composition of its clasts, this unit is assigned to the Pliocene- Pleistocene age. Brecciation may have occurred during the period of active volcanism in the Pliocene-Pleistocene epoch. The diatreme breccia has no identified mineralization. Existing diatreme breccia models show that it is common for these structures to be intimately related to high-level magmatic intrusions, their apophysis or feeder dikes. In the case of Balabag Diatreme Breccia, several dacite dike outcrops were mapped at the vicinity of the proposed tailings storage facility area where this rock unit crops out.

Figure 2-15: Photos of Drill Core Sample of Diatreme Breccia (left), Diatreme Breccia Outcrop along Unao-Unao Creek with Carbonized Wood Fragments (Middle to Right)

2.1.2.3 Structural Geology

The Sindangan-Cotabato-Daguma Lineament is a northwest-southeast trending left lateral strike-slip fault that separates the island-arc-related eastern-central Mindanao and Zamboanga Peninsula with continental affinity (Yumul et. al., 2004). The lineament is believed to be the product of the 'soft' collision between Sundaland and the Philippine Mobile Belt, during Late Miocene to Pliocene (Pubellier et al. 1997). The sinistral movements along the Siayan-Sindangan-Suture-Zone forms and controls the structural grain of the north Zamboanga area (Bobis, 2011).

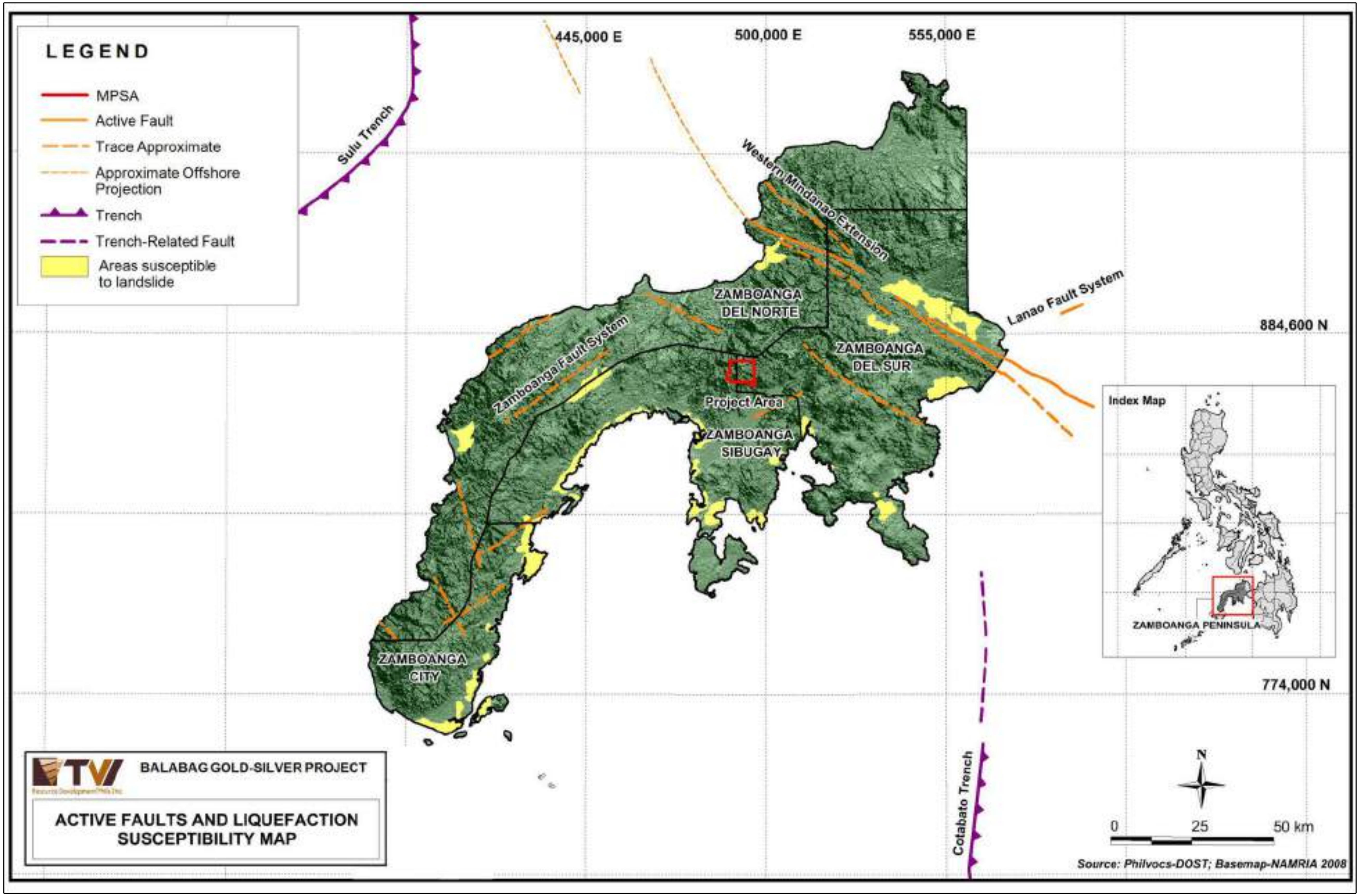
Stresses along this northwest trending collision zone produced northeast trending dilatant zones (tension gashes) and northwest trending fault jogs, dilational splays, dilational bends and northwest striking dilatant zones in reverse and normal faults. These resultant structures acted as passageways for mineralized hydrothermal fluids where precious and semi-precious metals were deposited as in the case of Balabag.

Inside the Balabag MPSA are northwest and east-north-east trending faults which act as boundaries and guideways to gold-silver mineralization (Figure2-16). A major northeast- southwest dextral strike-slip fault known as the Kabayugan Fault, was interpreted to have passed by the northwest portion of the MPSA. Several northwest-southeast trending strike slip faults with related normal fault and low-dipping fault component traverses the central and southeast corner of the MPSA.

Figure 2-17 shows an interpreted structural scenario within Balabag Hill gold mineralization and vicinity. Two (2) northwest trending sinistral strike faults transect the Depore, Unao-Unao and Miswi areas. These faults are generally characterized by the presence of gouges, and are geomorphologically manifested by northwest trending ridges and straight stream courses bounding the northeast and southwest portion of Balabag Hill. Concomitant to these structures are numerous dilatant zones and/or fault structures that control the gold mineralization as veins and breccias in the Balabag Hill.

The known mineralization zones at Balabag Hill area either have an east-north-east (Tinago and Unao-Unao), northeast (Miswi) or north-northeast (Lalab) trend. The east-northeast mineralization zones have gentle dips (37-50°) to the north or northwest while the north- northeast and northeast trending vein zones are moderately to steeply dipping (50-80°) to the northwest. The east-northeast to east-west trending and gently to moderately dipping vein zones occur as tension fractures or gashes while the northeast and north-northeast trending ones are the extension fractures which were filled with silica-quartz-sulfide veins.

Figure 2-16: Active Faults and Liquefaction Susceptibility Map



Source: Philvocs-DOST; Basemap- NAMRIA 2008

Figure 2-17: Interpreted Structural Map of Balabag MPSA on Satellite Imagery

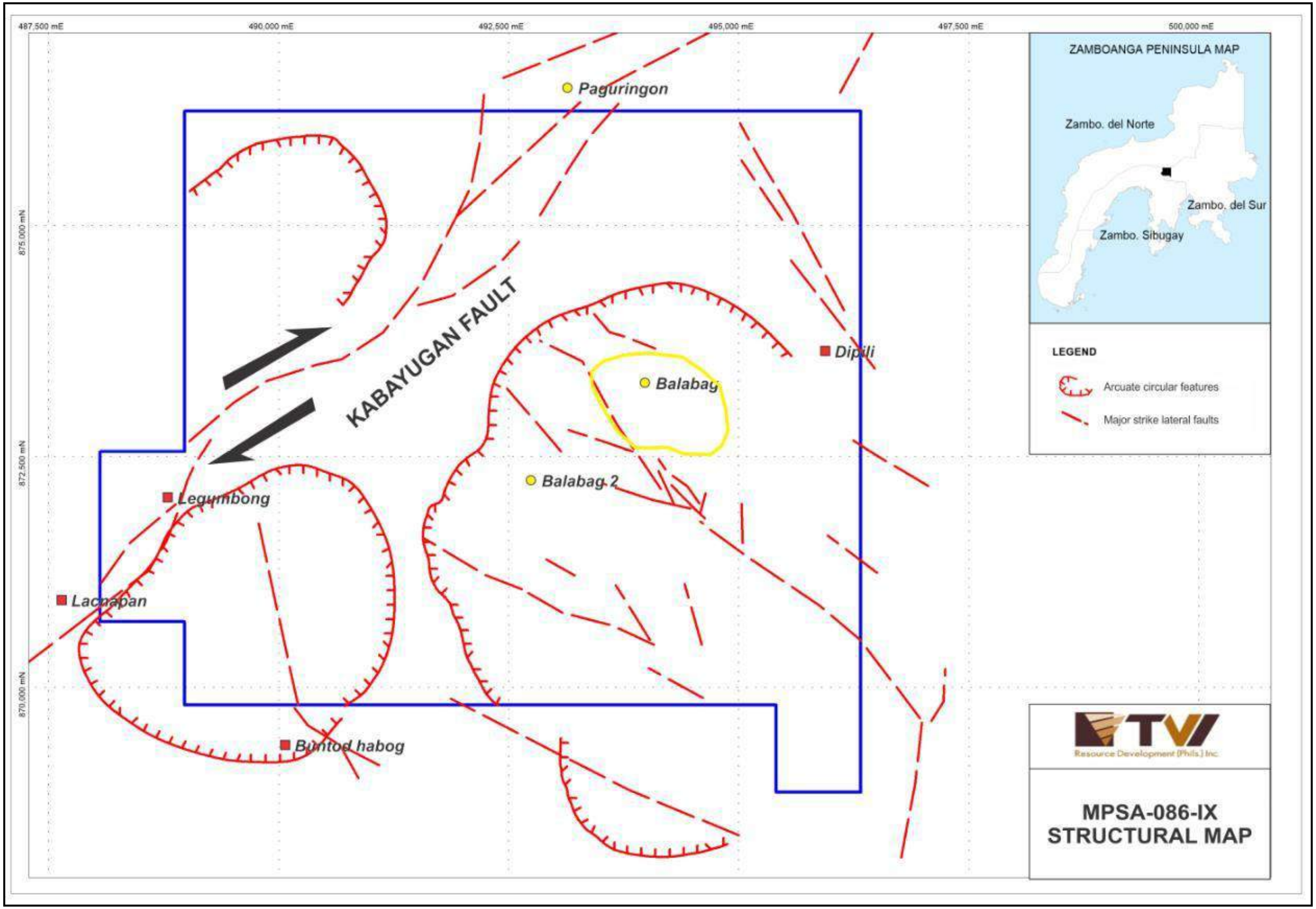
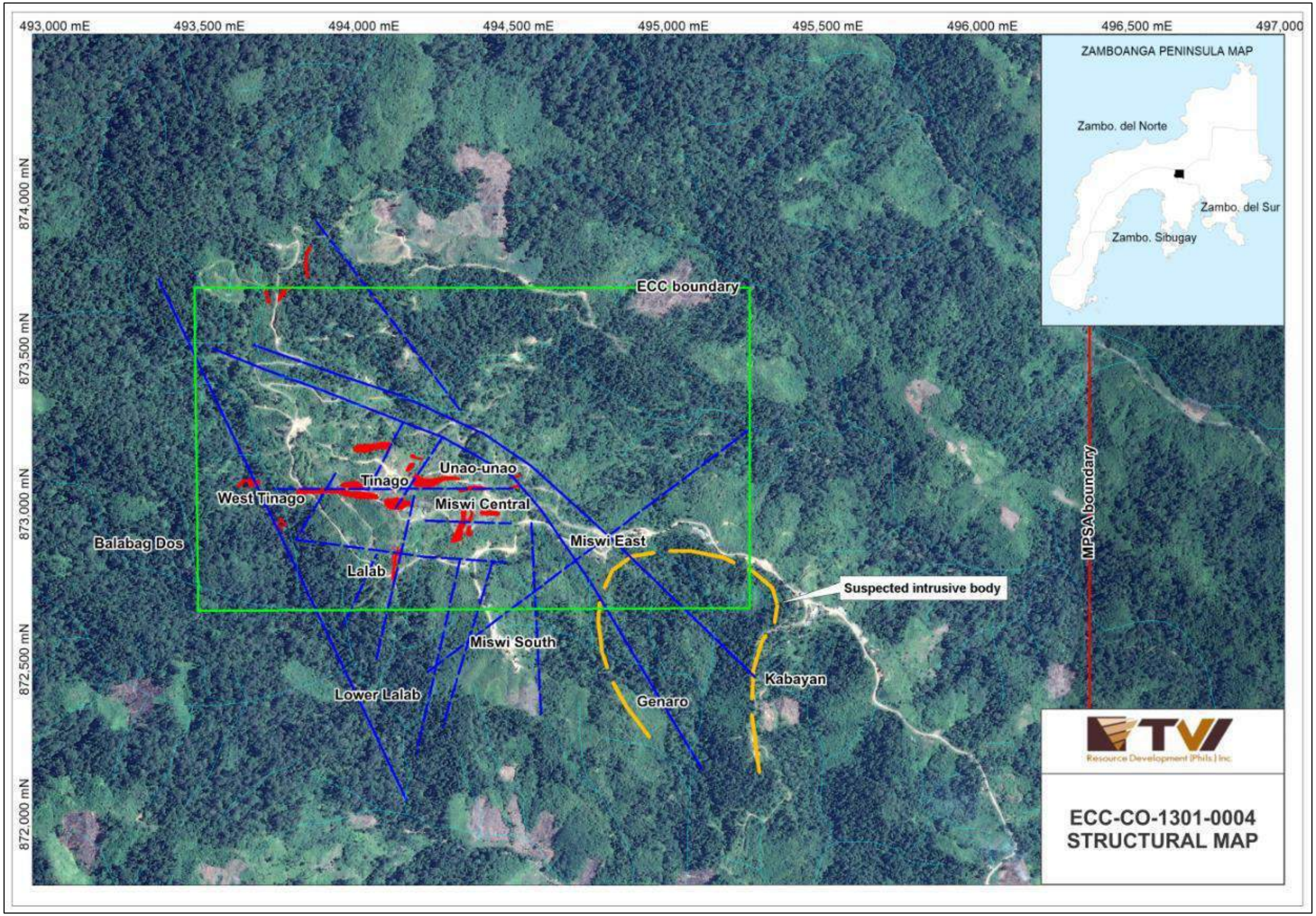


Figure 2-18: Interpreted Structural Map within Balabag Gold-Silver Project



Source: Leo A. *Sosa*, November 2018

2.1.2.4 Mineralization Type and Style

The Balabag gold-silver mineralization is interpreted as a low-sulfidation epithermal vein system hosted in andesitic lava flows and pyroclastics. Multiple-stage massive to crustiform banded fracture-fill and breccia cement assemblages mostly comprising of chalcedonic to mosaic quartz, in paragenetic association with less abundant adularia, chlorite, illite and carbonate enclosing and dispersed with only minor amounts of sulphide, define a low-sulphidation epithermal environment of precious metal mineralization. The mineragraphic study of APSAR in 2018 further indicates that the hydrothermal fluid flow and resulting mineralization have taken place at around 220 to 240°C.

Three (3) major quartz vein systems identified in the Balabag Hill area are the Tinago-Unao-Unao- Yoyon veins to the north, the Miswi veins in the east, and the Lalab veins to the south (Figure 2-19). The veins exhibit various epithermal quartz vein textures such as colloform, crustiform, massive, drusy, vuggy, comb and cockade textures. Multiphase brecciation textures are also dominant probably because of several pulses of rising hydrothermal fluids. Quartz stringers and quartz stockworks also occur adjacent to most quartz veins ranging from hairline to centimeter sizes. The geometry of the veins and the associated stockworks is generally sub- horizontal at the Tinago and Miswi areas while a sub-vertical attitude of veins is exhibited in the Lalab area

Free gold or electrum dominates the gold-rich precious metal mineralogy of low-sulphidation epithermal systems. The electrum/gold mostly occurs as interstitial to or as inclusions within mosaic-chalcedonic quartz and less abundantly interstitial to or enclosed by adularia, chlorite and illitic clay. Whilst also identified as intergrowths with and overgrowths to base metal sulphides, relatively minor amounts of free gold/electrum are identified as inclusions within pyrite, chalcopyrite, sphalerite, galena, argentite, and other unresolvable telluride and/or sulphosalt minerals. Whereas pyrite and base-precious metal sulphides and possible sulphosalts are leached and replaced by supergene hematite, hydrated Fe-oxides, and cuprite in relation to localized oxidation, native gold appears to remain in situ and essentially unmodified. In terms of the gold and silver alloy, electrum, silver may have been mobilized leaving residual and less mobile gold in place (APSAR, 2018).

Repeated phase separation in association with rapid cooling of hydrothermal fluid including some probable magmatic volatile contributions, is interpreted to have been a main cause for precious and base metal mineral deposition (APSAR, 2018). Occurrence of gold and silver are common in open space fillings such as in vughs, drusy cavities, cockscomb textures, crustifications and colloform banding.

Figure 2-19: Balabag Structural Map

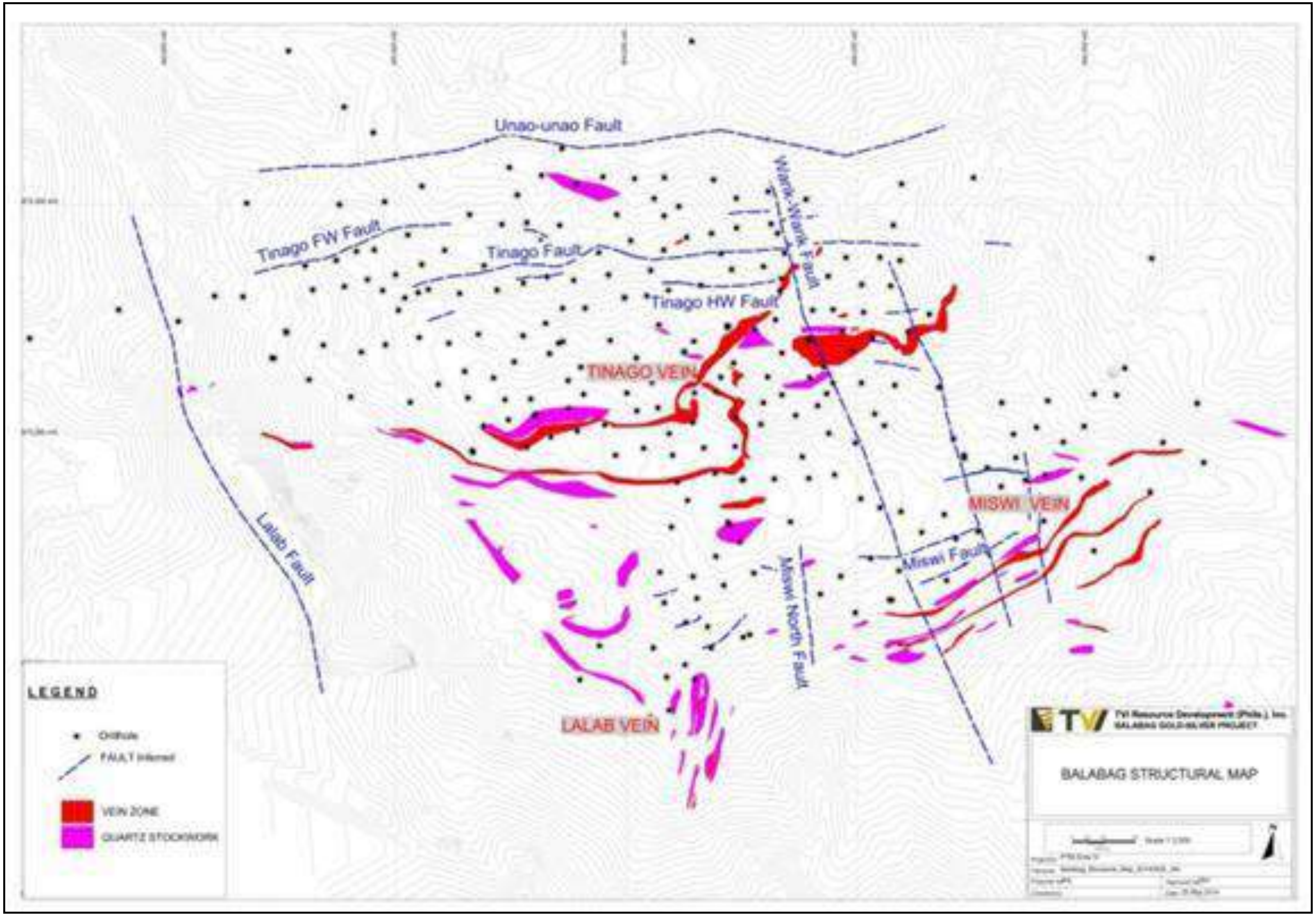
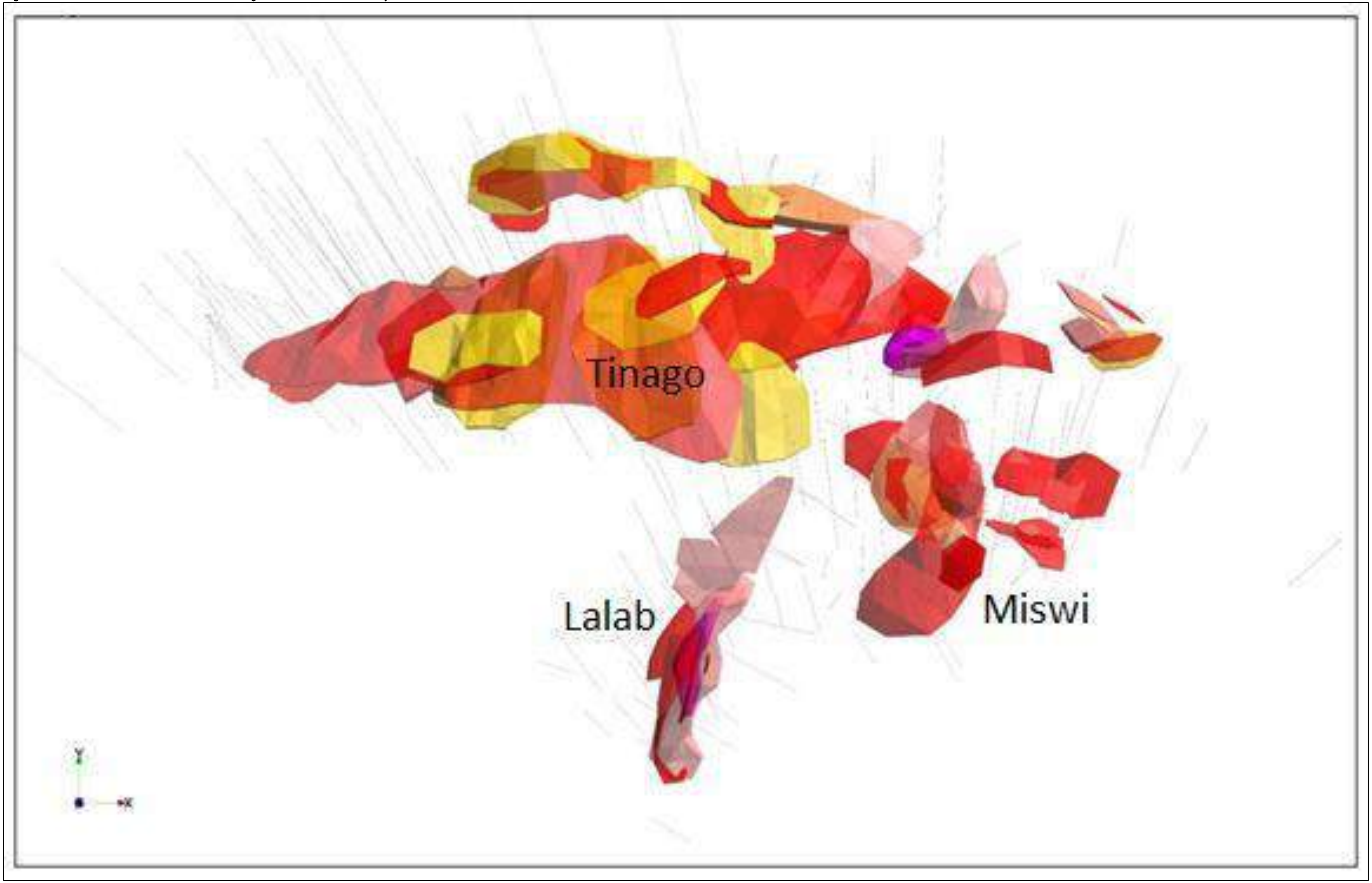


Figure 2-20: Three-Dimensional View of Balabag Gold-Silver Main Vein System



2.1.2.5. Geomorphology

The MPSA area revealed two distinct morphologic features: the eastern half which is defined by parallel NW -SE trending long ridges; and, the western half which is characterized by NE-SW trending short ridges. Both ridges have pronounced steep slopes with cliffs and steep escarpments that descend to deep, mostly V-shaped valleys. Hill slopes usually form a straight, linear to concave shape while the ridges are usually narrow, hilly to undulating. These typical landforms are commonly exhibited within a volcanic environment.

Elevation at the western half of the MPSA ranges from 300 to as high as 959 meters above sea level (masl) while the eastern half of the MPSA has elevations ranging from 200 to 800 masl. The Balabag gold-silver deposit, located on the eastern half of the MPSA, is characterized by an almost east-west elongated hill with a peak elevation of 685 masl.

The western section of the MPSA is incised by numerous, short, deep gullies and streams with water flowing and converging to the main Kabasalan River. These gullies and creeks, that represent one of the headwaters of Kabasalan River, form a random branching pattern that is commonly exhibited by a dendritic drainage pattern. The drainage pattern indicates that it is not structurally controlled drainages and that the underlying rocks could be homogeneous, or one rock type dominates the area. The major Kabasalan River flows west and south and eventually discharges its load into Sibuguey Bay near the town of Kabasalan.

The eastern and southern sections of the MPSA exhibited a different drainage pattern wherein the topography is incised by long NW -SE trending parallel streams that seems to have been regularly spaced and in turn are fed by numerous, short gullies and creeks. A typical parallel drainage pattern is exhibited in this portion of the MPSA which implies that the drainages are structurally controlled and that the underlying rocks are of different lithologies. The northern drainages drained towards Dipili River while the southern drainages are draining towards Depore River. Both Dipili and Depore Rivers are major tributaries of the Sibuguey River, a major river that flows south and west and eventually discharges into Sibuguey Bay near the towns of Siay, Payap and Kabasalan.

The presence of steep slopes, high elevation and rugged topography make the area prone to active mass-movement processes including soil and rock erosion, rockfall and rainfall-induced localized landslide which result to siltation and flooding of the lower grounds.

2.1.2.6 Project Area Topography and Drainage

The overall Project area encompasses a moderate to rugged mountainous topography with slopes generally ranging from 30% to 45%. Some slopes within the Project area however are considerably steeper than this due to the small-scale mining activities and removal of material for processing. Some slopes are nearly vertical and show definitive signs of instability.

Elevations range from 200 meters above sea level at the eastern part of the MPSA area and rise to a maximum of 900 meters above sea level near the central part of the Project area. The slope of the proposed project site is presented in Figure 2-22.

The topography of the MPSA and surrounding area are shown on 1:50,000 scale maps produced by NAMRIA. Both the MPSA and the initial phase of the Project are located on the Kabasalan River NAMRIA map dated 1956. The contour interval for this map is 20 meters. More up to date topographic mapping was done by TVIRD within the Phase 1 Project area in 2011 and 2012. These maps were developed at a contour interval of 5 meters.

The overall MPSA is drained by three river systems, the Depore River and the Dipilli River in the east the Kabasalan River in the west. The Kabasalan River flows west and south and eventually discharges into Sibuguey Bay near the Town of Kabasalan. There are no Project related activities planned within the Kabasalan River watershed. Both the Depore and Dipilli Rivers flow to the southeast and eventually drain to the Sibuguey River east of the MPSA. The Sibuguey River flows south and west and eventually discharges into Sibuguey Bay near the towns of Siay, Payap and Kabasalan.

The Project area in particular is drained by the Dipili River. Smaller tributaries to this river include Unao-Unao Creek and Dimalinao Creek. Unao-Unao Creek is the primary drainage within the Project area. The majority of Project components and activities are focused within the Unao-Unao Creek watershed. Naro Creek. A tributary of the Depore River, may be used for supplemental water supply for the Project needs. A topographic and drainage map of the Project area is shown on Figure 2-23.

Figure 2-21: Balabag Gold-Silver Project Topographic Map

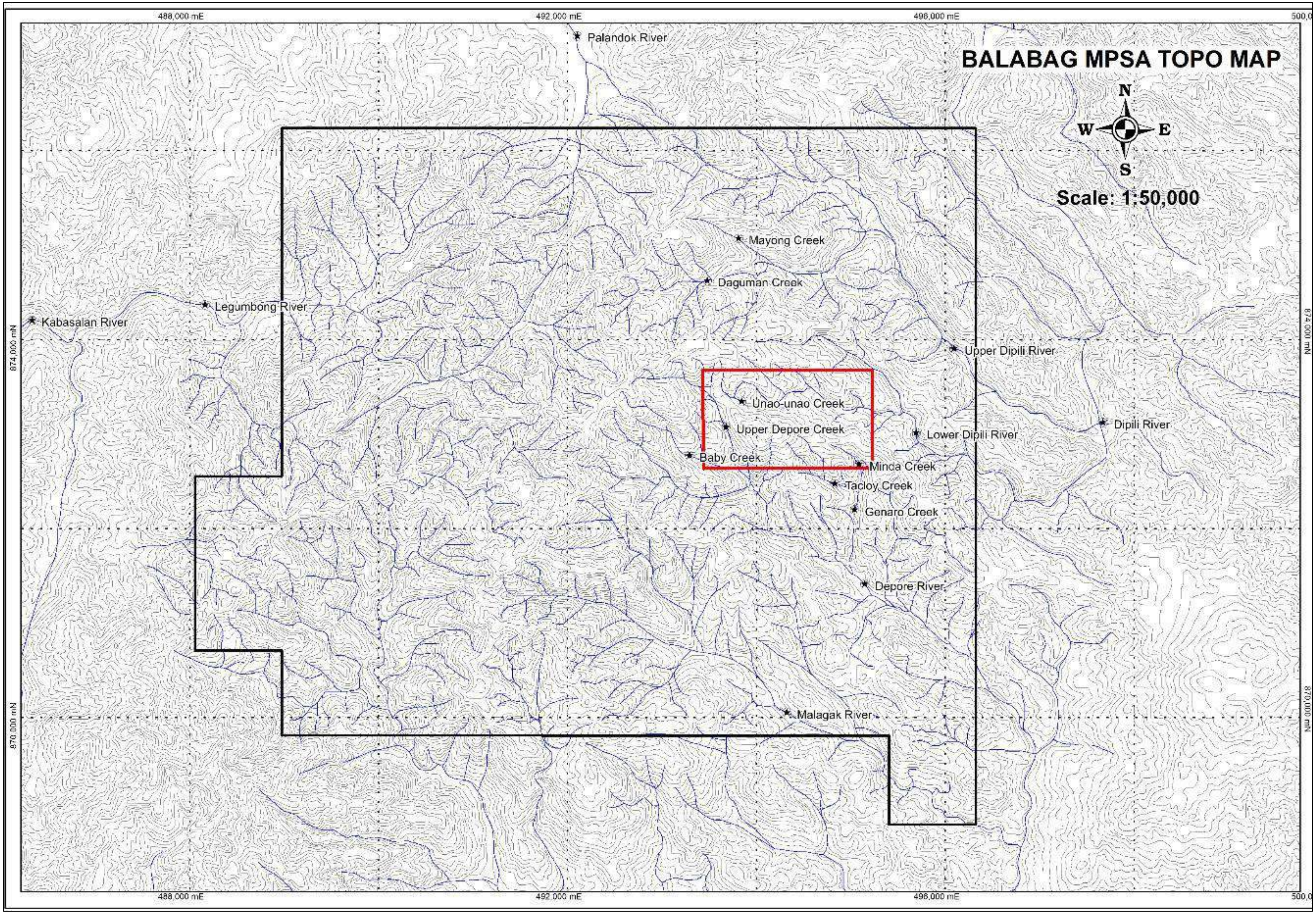


Figure 2-22: Slope Map of the Project Area

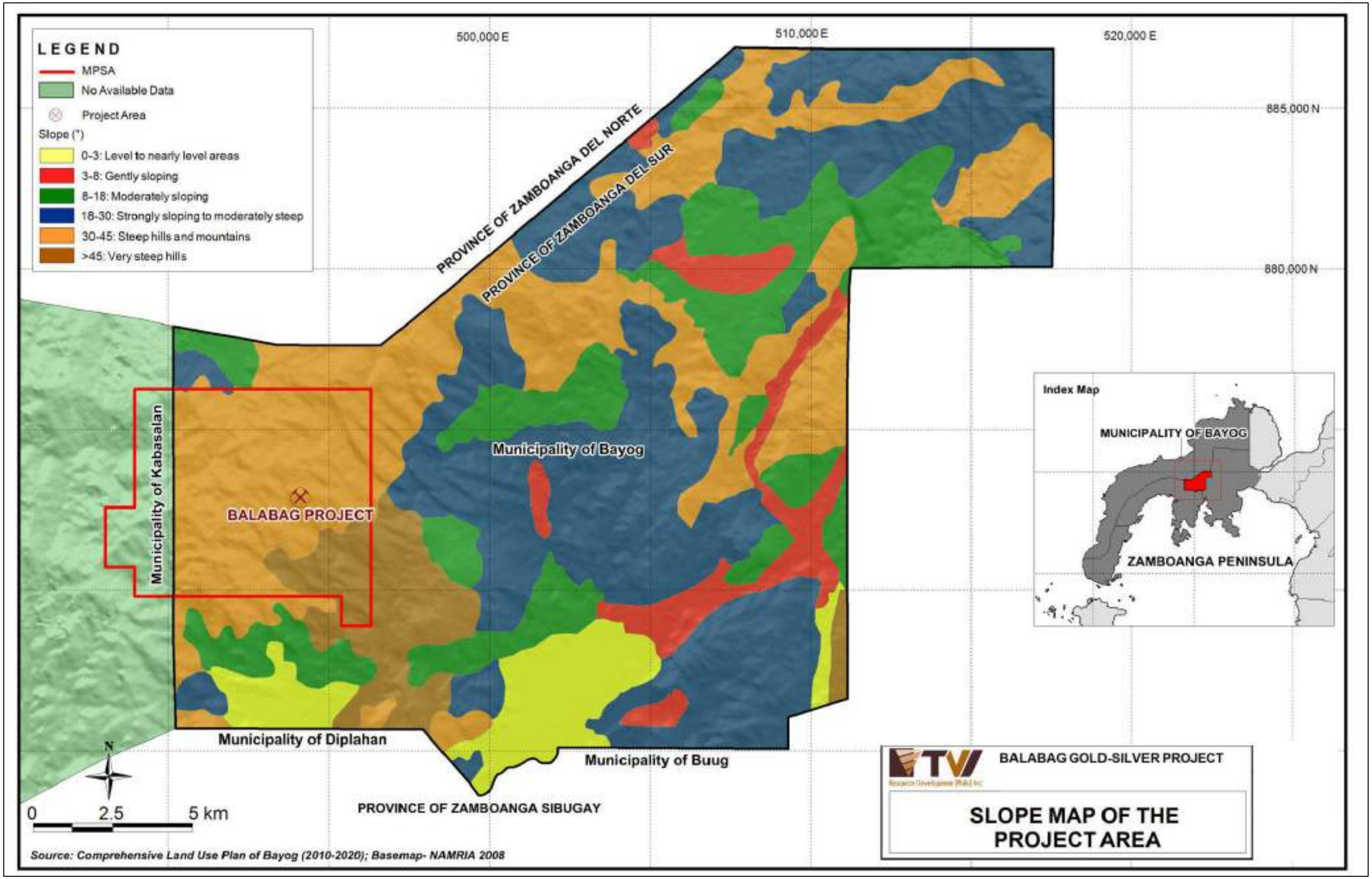
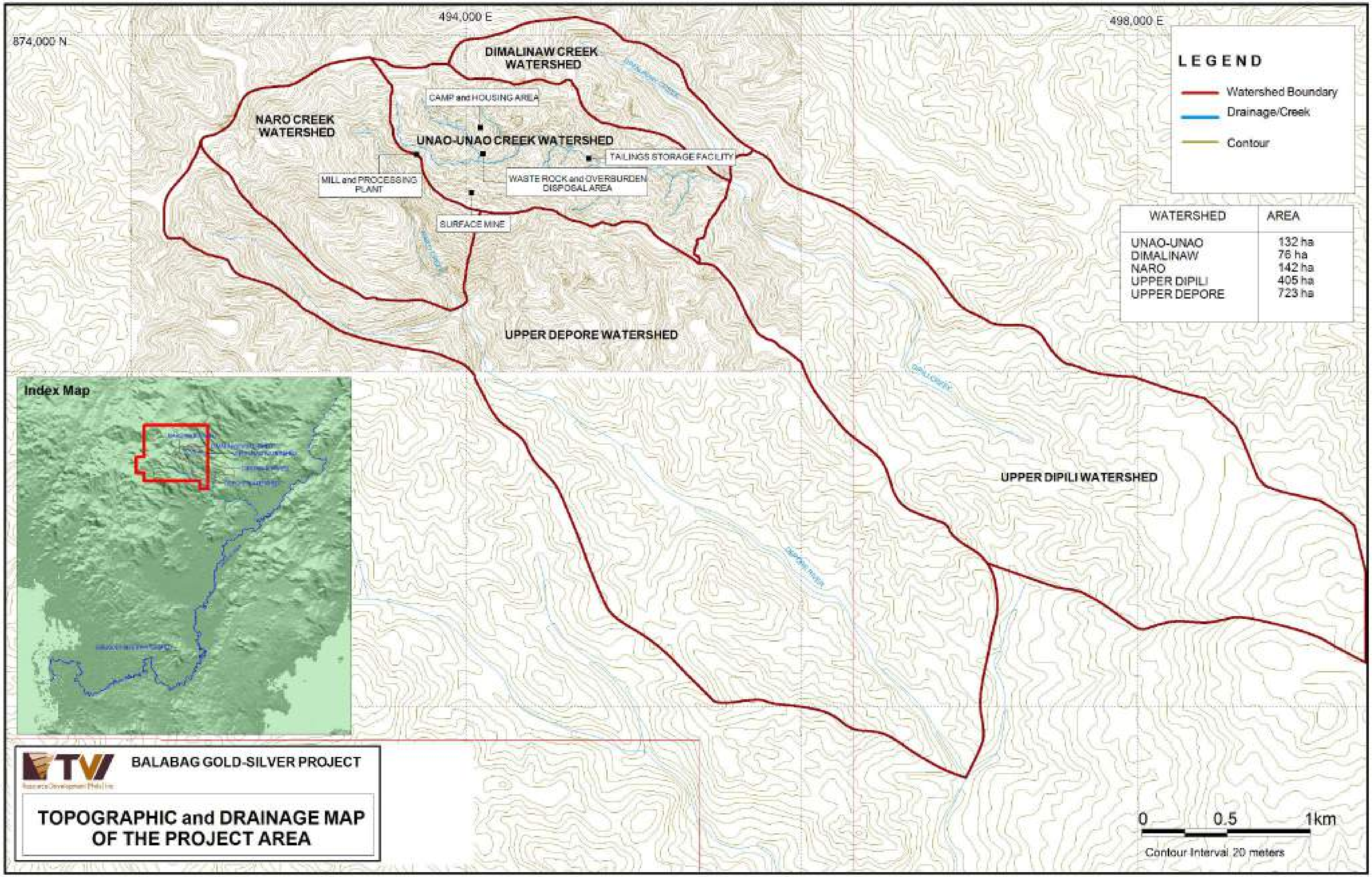


Figure 2-23: Topographic and Drainage Map



2.1.2.7 Change in Surface Landform/Geomorphology/Topography/Terrain/Slope

The alteration in surface landforms and topography is an unavoidable impact of surface mining operation. This is attributed to excavation of earth materials as part of stripping and mining activities and construction of the additional project components. In the case of the mine, waste rock dump and tailings storage facility, the changes in landforms and topography will be permanent. The total disturbed area will be limited to approximately 246.47 hectares with the most significant permanent landform changes encompassing approximately 232 hectares. Figure 2-24 shows the areas that will undergo decommissioning and rehabilitation upon mine and the proposed final land uses of each area.

The landform alterations from mine development are managed by limiting the earth movement to the resource areas according to the mine plan. Progressive rehabilitation activities of the mined-out areas will immediately follow to stabilize the area and prepare for vegetation establishment, or any land use preferred by the stakeholders as determined in the Final Mine Rehabilitation Plan document

Progressive rehabilitation involves the staged treatment of disturbed areas during the mining operation rather than implementing a one-time rehabilitation activity at the planned mine closure. This reduces the amount of work and cost in implementing structural improvements, slope stability measures and erosion control during closure. It also provides an opportunity for testing rehabilitation practices that may or may not work on the site. This will allow improvements to be made prior to final closure. Visual impacts will also be improved as the disturbed area footprint is reduced on a regular basis. Progressive rehabilitation will focus in the areas that will no longer be used for succeeding year's operation. Rehabilitation methods will include the following activities:

- Topsoil management and plant nursery operations
- Surface preparation related to site and soil conditioning
- Revegetation related to the type and distribution of plant species
- Maintenance activities to limit plant mortality rates and encourage continued plant growth

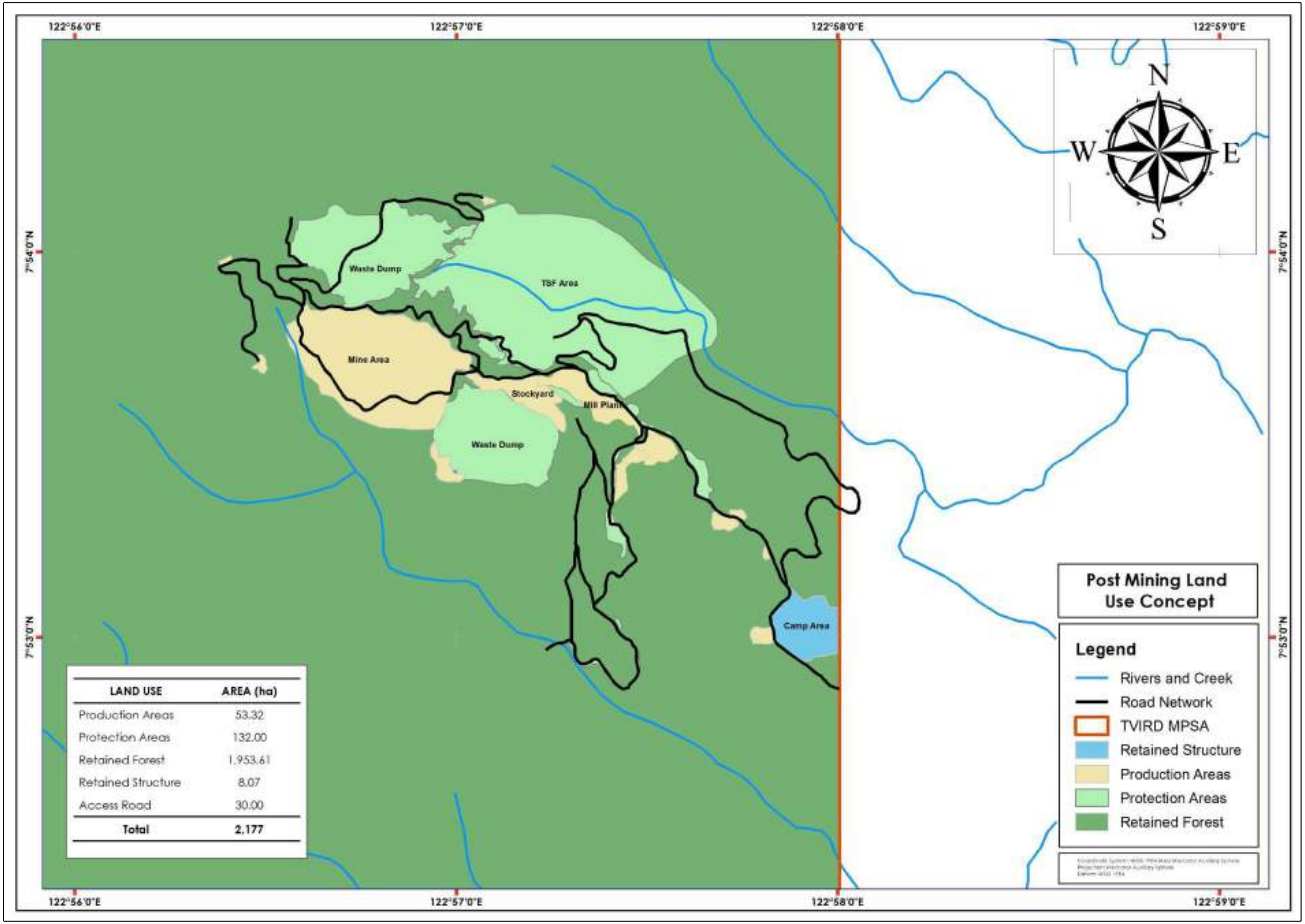
Rehabilitation and reclamation closure activities will focus on structural improvements relative to land stability, erosion and drainage control using various engineering protocols, similar to what was done during the operation and progressive rehabilitation activities. Steep slopes will be re-contoured with benches to address long term stability issues. Final drainage canals will be constructed in a manner to allow effective operation with minimal maintenance. Land surfaces will be graded to conform with the topography of the adjacent areas. Other earthwork activities such as road rehabilitation and topographic contouring are also included under reclamation and closure activities.

Reclamation activities will also focus on re-shaping the land, restoring topsoil and planting native grasses, trees or ground cover to reduce soil erosion and support long term forest growth. Each disturbed area will have varying reclamation and closure activities.

Revegetation, reforestation, and structural/topographic modifications of the Mine Closure Plan are Directed toward developing an environment consistent with the comprehensive land use plan of the host Municipality and at the same time, a plan which can support and sustain the terrestrial and aquatic habitat, reinforce long term sustainable livelihood programs and meet the Stakeholder needs for regulatory and political requirements.

The general land use concept to be implemented as part the closure activities will be an Agri-Forest Ecosystem. The overall land use plan will be subject to stakeholder review and modification during the operations period. This will include changes in the LGU land use plan. Incorporation of the Ancestral Domain Sustainable Development and Protection Plan (ADSDPP) and implementation of field research activities relative to revegetation, reforestation, and water quality control.

Figure 2-24: Post Mining Land Use Concept and Areas



2.1.2.8 Natural Hazards

2.1.2.8.1 Volcanic Hazards

Based on data from the Philippine Institute of Volcanology (Phivolcs), several volcanoes are located within the Zamboanga Peninsula. These data indicate there are 26 inactive volcanoes within the region. Inactive volcanoes are those that have no record of eruptions, and their physical form has been changed by weathering and erosion. This is generally characterized by the formation of deep and long gullies on the terrain. There are no active or potentially active volcanoes identified within the Project area or the immediately surrounding area.

The nearest inactive volcano is approximately 25 kilometers east of the MPSA and has been named as Volcano Wood. Several active volcanoes have been identified within central and southern Mindanao however these are far from the Project area. The locations of inactive volcanoes within the region, relative to the MPSA, are shown in Figure 2-25.

Hazards associated with volcanic activity include pyroclastic flows, ash fall and seismic or earthquake events. Given the distance from the Project area to the identified active volcanoes, pyroclastic flows and ash fall may be considered a minimal risk. Seismic events related to volcanic activity may be considered a marginal hazard depending on the seismic intensity and ground motion characteristics.

2.1.2.8.2 Mass Movement Hazards

Mass wasting, sometimes called mass movement, is the downward movement by gravity of rock, regolith (loose, weathered rock) and/or soil on the sloped top layers of the Earth's surface. It is a significant part of the process of erosion because it moves material from high elevations to lower elevations. It can be triggered by natural events like earthquakes, volcanic eruptions and flooding, but gravity is the driving force.

Although gravity is the driving force of mass wasting, it is impacted mainly by the soil/rock material strength The topography of the MPSA is generally rugged with long, steep slopes commonly forming cliffs. Dominant rock types identified in valley slopes include volcanic rock series often showing deep weathering resulting to reddish residual soil, usually sandy, friable, non -cohesive soil mixed with cobble to boulder size volcanic rocks. Some of the rocks were highly fractured and faulted making them prone to erosion. Such geomorphologic condition of the MPSA make it prone to mass movement hazard in the form of soil erosion, rock fall and landslides. Triggering factor to such mass movement hazard include the occurrence of a heavy rainfall event and ground movement due to earthquake. Phivolcs and MGB have both identified the MPSA area as highly susceptible to landslides.

During the past exploration activities within the Project area, landslides were frequent during heavy rainfall events. They generally occurred along roadways going to the Project area. Similarly, landslides occur frequently within the small-scale mining area. Several lives have been lost in the recent past due to landslides.

The Project area has been identified by Phivolcs to be of high susceptibility to earthquake triggered landslides. The MGB has also categorized the Project area as highly susceptible to landslides. Areas with high landslide susceptibility ratings have active or recent landslides and tension cracks that may directly affect the community.

The area has also steep slopes and drainages that are prone to landslide damming and creation of debris flows. The Phivolcs Earthquake Triggered Landslide Susceptibility Map is shown in Figure 2-26.

2.1.2.8.3 Hydrologic Hazards

With the steepness of the topography of the MPSA, the occurrence of long, continuous, and intense rainfall event could trigger hydrologic hazard in the form of gulley erosion, landslides, and flooding.

Within the MPSA Area, the dominant hydrologic hazard includes gulley erosion and landslides as it is in a high elevation and having a rugged topography. These hazards often result to deposition of eroded soil and rocks along nearly flat ground and generally in lower grounds outside of the MPSA area. Though there are still thrive primary growth forest that could hold the soil in place, the very steep slope of the topography has helped and contributed much to the erosive power of the downflowing rainwater. Localized landslides occurred in steep slope zones underlain by highly weathered and fractured rocks which is further induced by the downslope movement of rainwater.

With much rainfall intensity, downflowing water from hillslopes and accumulated in numerous creeks and gullies and streams, commonly resulted to flash flood carrying within loads of silts, rocks and fallen trees. These events have aggravated the flooding problem when it overtopped the riverbanks and flooded the nearby communities lying in lower grounds.

The rain-induced landslide and flood susceptibility map of the proposed project site is shown in Figure 2-27. As shown, the MPSA has high susceptibility to landslide.

2.1.2.8.4 Seismic Hazards

The Celebes Sea/Sulu Sea region, located southwest and northwest of the Zamboanga Peninsula respectively, is characterized by deep basins and submarine ridges, which have resulted from intensive, large-scale strike-slip, thrust, and block faulting. The tectonics are complex, and there are several fault zones in the region that can produce major earthquakes. The most significant of these are the Sulu Trench, located in the Sulu Sea, and the Cotabato Trench, located in a subduction area that crosses the Celebes Sea and the Moro Gulf in southern Mindanao. These can generate deep-focus earthquakes along the NNE axis of the Celebes Sea basin into the southern Philippines. Shallow-focus earthquakes also occur between this axis and the southwestern side of the Philippine trench, refer to Figure 2-6.

The Balabag project area is highly seismic, and the design needs to make provision for the significant events that will impact the project area. The Global Seismic Hazard Assessment Program (GSHAP) was established in 1992 and publishes maps providing guidance on peak ground acceleration for an earthquake having a return interval of 475 years, assuming the site is underlain by rock. For the area in which the Balabag Project is located, the peak ground acceleration for the 475-year recurrence interval event is shown to be between 3.2 and 4.0 m/sec2 (0.33g to 0.41g), which would correspond to a major event, likely having a magnitude of around M = 8.0.

The USGS National Earthquake Information Center (NEIC) also maintains a database of earthquakes in the Zamboanga Region dating back to January 1973. The number of earthquakes exceeding a given magnitude within various radii of the project site are summarized in Table 2.4.

Table 2-4: Earthquake in NEIC Database within Specified Distance of the Project Site

Event Magnitude	Approximate Distance from Project Site			
	200 km	100 km	50 km	25 km
> M3	1,253	170	17	3
> M4	1,212	167	17	3
> M5	336	71	5	0
> M6	33	9	0	0
> M7	6	1	0	0
> M8	0	0	0	0

Table 2-4 indicates that there have been three significant earthquakes within 25 km of the project site over the past 40 years, and that there were more than 1,200 within 200 km of the project site. Four of the most significant earthquakes recorded in this area are listed in Table 2-5. The Dapitan Earthquake listed in Table 2-5 is the largest recorded event, but as it occurred during the late 1800's, the data that is available from it is limited. Table below illustrates that major earthquakes can and do affect the project area.

Table 2-5: Select Significant Earthquakes in Zamboanga Peninsula

Name of Earthquake	Date	Magnitude	Lat.	Long.	Distance from Site	Focal Depth
Dapitan Earthquake	20 Sep 1897	8.7	~ 6.0˚ N	~ 122.0˚ E	~ 234	~ 33
Lanao, Ozamiz, Cotabato Earthquake	31 Mar 1955	7.6	8.1˚N	123.2˚E	120	96
Moro Gulf Earthquake	17 Aug 1976	8.0	6.30˚ N	124.1˚ E	219	59
Cotobato Trench Earthquake	06 Mar 2002	6.8	6.1˚ N	124.0˚ E	177	15

2.1.2.8.5 Liquefaction

Liquefaction is a phenomenon in which the strength and stiffness of a soil is reduced by earthquake shaking or other rapid loading. Liquefaction and related phenomena have been responsible for tremendous amounts of damage in historical earthquakes around the world.

Liquefaction occurs in saturated soils, that is, soils in which the space between individual particles is filled with water. This water exerts a pressure on the soil particles that influences how tightly the particles themselves are pressed together. Prior to an earthquake, the water pressure is relatively low. However, earthquake shaking can cause the water pressure to increase to the point where the soil particles can readily move with respect to each other. As shown in Figure 2-16, most of the areas identified to be prone to liquefaction are those near the shorelines. Types of soil in these areas are primarily sandy or silt particles that are susceptible to liquefaction. Further, the map indicates the MPSA, and the Project area are not susceptible to liquefaction.

Figure 2-25: Volcano Survey within Zamboanga Peninsula

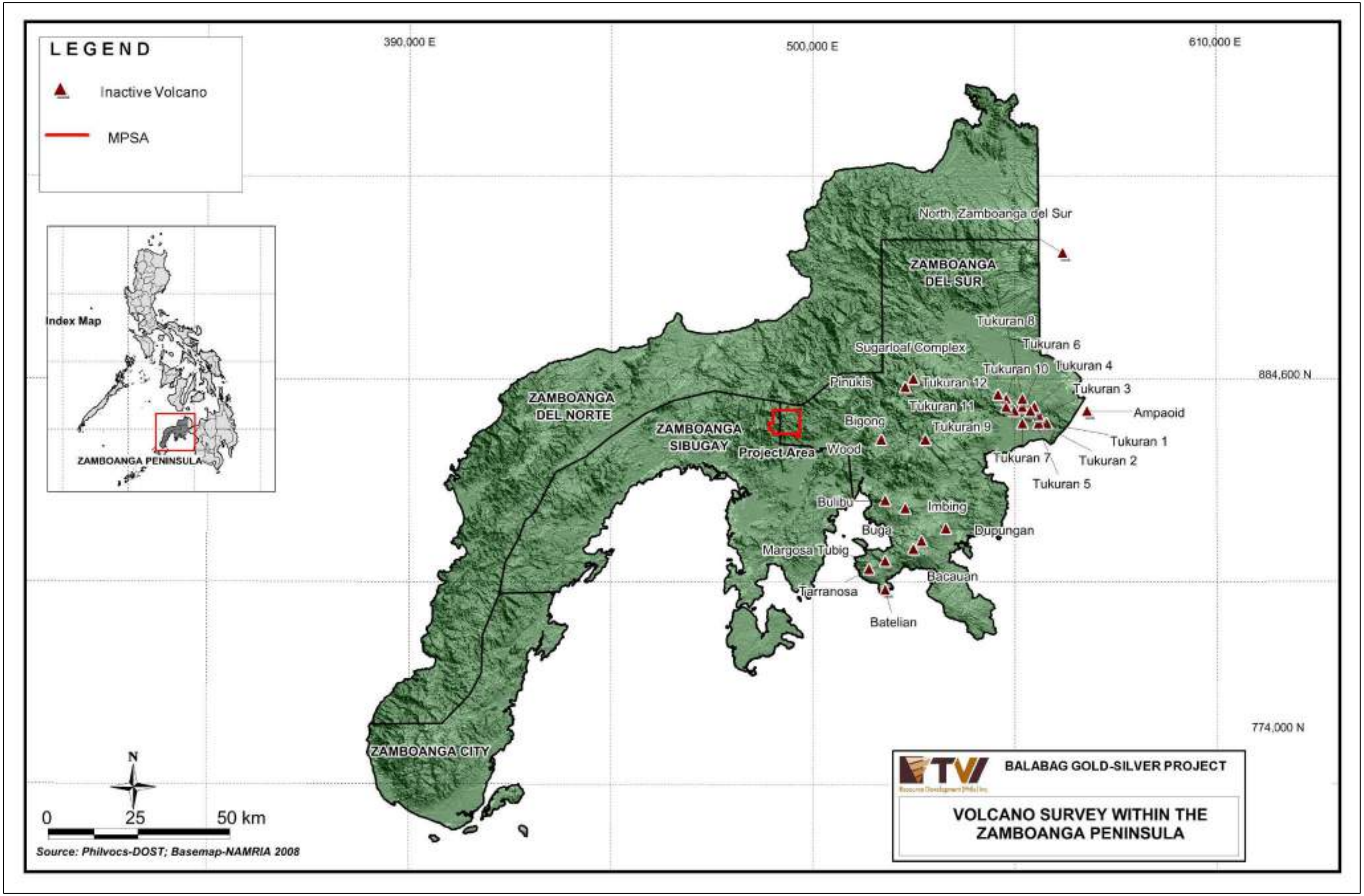


Figure 2-26: Earthquake Triggered Landslide Susceptibility Map

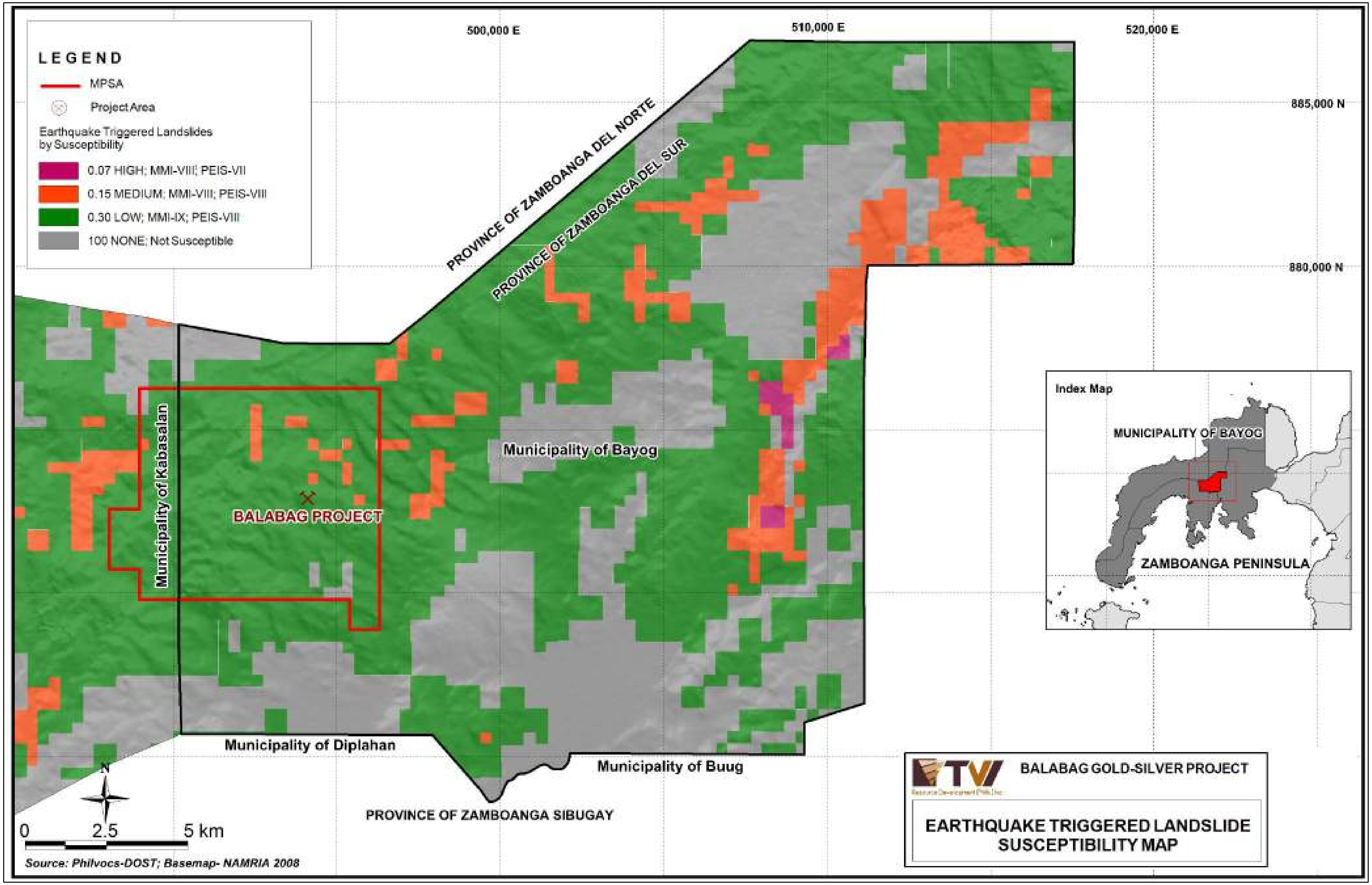


Figure 2-27: Rain-Induced Landslide

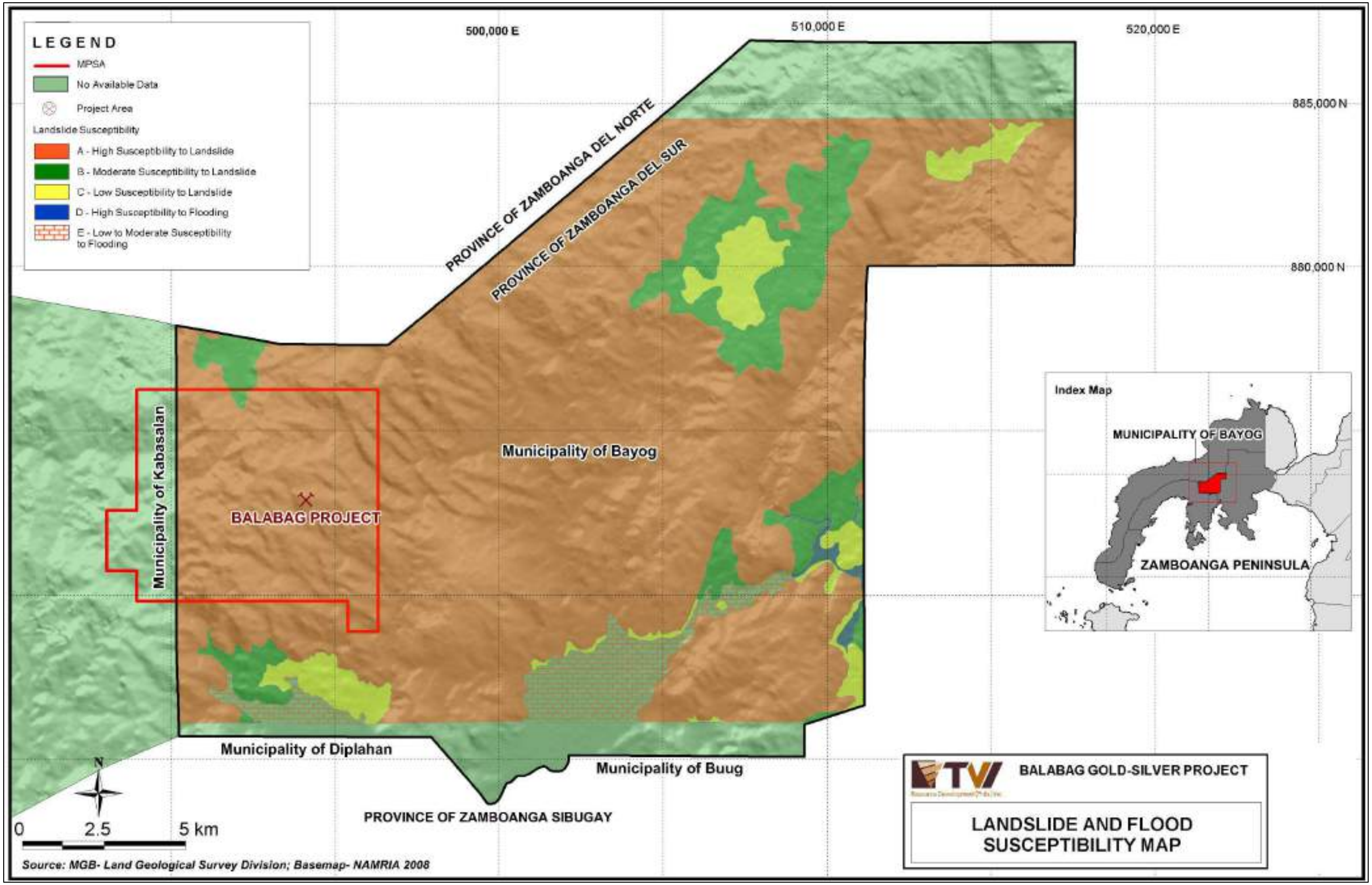
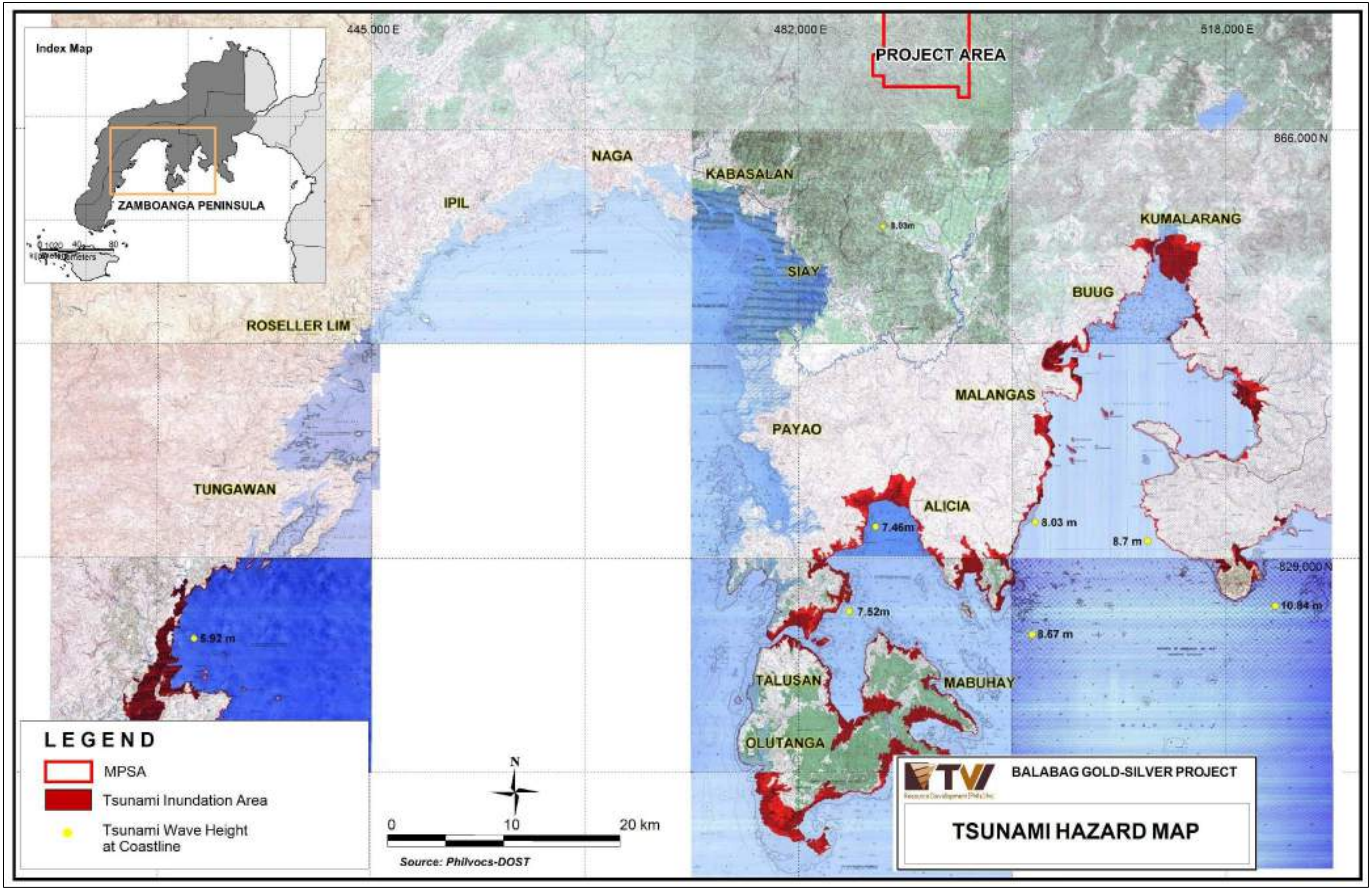


Figure 2-28: Tsunami Hazard Map



2.1.2.9 Inducement of Subsidence, Liquefaction, Landslides, Mud/Debris Flow

Mine subsidence is the movement of the earth's surface resulting from natural causes such as earthquakes and from human activities such as underground mining or the extraction of groundwater from aquifers. Over time, gravity and the weight of rock overlying the voids cause the layers of rock to shift and collapse into the void. The collapse and void may continue upward toward the ground surface where it may cause the creation of sinkholes, cracks, tilting and sags. The extent and degree of subsidence depends on the surface topography, geologic conditions and distance between the mine workings and ground surface. Mine subsidence can occur abruptly or gradually over many years. Subsidence and collapse activity is minimal from surface mining as compared with underground mining. Impacts are generally localized in extent affecting a relatively small area within the overlying surface.

Within the Project area, potential subsidence and surface collapse will likely be the result of tunnel construction and excavations created by the small-scale miners. Evidence suggests this has already been the case prior to implementation of the TVIRD operations. This situation will likely be exacerbated if small scale mining activities continue. Concerns relative to community safety issues during and after small scale mining operations will continue. Excavation and operation of a surface mine within the area of small-scale mining will expose the tunnels and will remove the overburden that would have potentially collapsed at some time in the future. As such, development of a surface mine will provide a mitigation measure for the immediate and long-term future.

Geologic hazards in the form of slope failures, mass movement and landslides may occur within the Project area in the absence of sound engineering practices and the absence of proper implementation during all phases of the Project. This may be avoided by planning, incorporation of sound engineering and mining best practices and environmental management.

To reduce the risks of these hazards to the project, the following measures are implemented:

- Minimize disturbance of vegetation and soils by limiting activities to the planned areas of development
- Steep slopes (>30°) will require benches, terraces or other slope controls to reduce surface water runoff velocity during rainfall events
- Installation of drainage canal systems to prevent the erosion of benches and other areas. Designs are in accordance with surface water runoff conditions and rainfall intensities
- Topsoils are stockpiled in a benched manner adjacent to the Waste Rock and Overburden Stockpile Area
- Design and operating criteria used to develop the TSF are based on international standards and standards of the Canadian Dam Association. The primary design considerations are based on the Probable Maximum Flood (PMF) and the Maximum Credible Earthquake (MCE).

2.1.3 Pedology

Knowledge of the basic soil types and their characteristics within an area is necessary relative to the selection of the best use of the land and identifying those activities best suited for the specific soil types. Some data are available from Land Use Planning documents prepared by the Municipality of Bayog. Supplemental data was gathered by TVIRD through field sampling and laboratory testing for soils within the Project area.

2.1.3.1 Soil Type

The soils within the Municipality of Bayog are classified into two types: the San Miguel Silt Loam and the Alimodian Clay. The soil in the lowland areas is classified as San Miguel Silt Loam. This type of soil is best suited in the cultivation of lowland rice, corn, vegetables, legumes and other diversified crops. The pH of this type of soil based on records of the Municipality ranges from 6.0 to 7.0.

The soil within the upland areas is of the Alimodian Clay type. This type of soil is best suited for corn, rice, coffee, fruit trees and rubber. The upland soil is usually low in fertility due to high rates of leaching and generally low organic matter content.

In terms of land capability, the Municipality of Bayog falls under the A and D Classification as defined by the Department of Agriculture. Land capability classification is a scheme for grouping soils based on their capability to produce common cultivated crops without deteriorating over a long period of time. The classification indicates the relative suitability of land for agriculture and the corresponding land management requirements. This serves as one of the important factors in recommending land use, especially for areas to be retained for agriculture. Four major factors considered in capability classification include the following:

- Soil Properties
- Slope and Topography of the Land
- Degree of Erosion
- Drainage and Flooding Hazards

Under Classification A, the soils have some restrictions associated with their land use. These soils are less prone to damage or erosion and can be adapted to almost any crop common in the area. A land capability classification D indicates that this type of soil is good arable land but is subject to severe erosion from surface water runoff. This particular class requires very careful management and is best suited for pasture, tree farms and forest land uses. Upland soils belong to this type of land capability.

An inventory of soil types and land capability within the Municipality of Bayog is provided in Table 2-6. A soil map of the Municipality of Bayog is shown on Figure 2-29.

Table 2-6: Soil Type and Land Capability Classification of Municipality of Bayog

SOIL TYPE	BARANGAY	pH	LAND CAPABILITY	SOIL SUITABILITY
Alimodian Clay Loam	Poblacion, part of Canoayan, Dipili (upland), other upland Barangays	6.3	Class D	Corn, Upland Rice, Coffee, Fruit Trees, Rubber Trees.
San Miguel Silt Loam	Pobalcion (lowland), Bobuan, Pulangbato, Deporehan, Canoayan (lowland), Dipili (lowland, other lowland Barangays	6.0	Class A	Low Land Rice, Corn.

Source: Comprehensive Land Use Plan, 2011, Municipality of Bayog

2.1.3.2 Soil Investigation

Soils were collected by TVIRD from four sampling areas within the Project area. These samples were submitted to the Bureau of Soils and Water Management of the Department of Agriculture to undergo physical analysis. Duplicate samples were also sent to SGS Philippines Inc. for chemical analysis. The soil sampling locations are shown on Figure 2-30.

Soil samples were collected at various depths to determine the root zone of thriving plants in the area as well as soil quality in the different soil stratum. One composite sample was collected from a mixture of each sample collected at different depths to determine the overall soil properties.

Results of the physical analyses classified the soils as clay and clay loam. Clay loams have the most even distribution of sand, silt and clay among the different soil textural grades. These clay soils have greater strength especially when dry but are susceptible to water logging due to poor infiltration. This also contributes to poor aeration (Mullins et al. 1990). Poor physical properties that result in limited water movement, poor root development and inadequate aeration, have been reported as resulting in less crop yield (Wallace and Nelson 1986). The data collected from the four sampling areas confirms the classification of the upland soils in the Municipality of Bayog as Alimodian Clay. A summary of the sampling and laboratory testing results are shown in Table 2-7.

Most of the vegetation observed during the soil sampling consisted of grasses and shrubs. A few grass roots were observed at a depth of 0 to 30 centimeters, but none were observed beyond that. Soil color varied from orange to reddish brown. The proportion of the soil type composition, being neither clayey nor sandy, makes the soil easier to manage and better suited for wider applications. These include uses such as agriculture, infrastructure sites and road construction. A summary of physical characteristics of the soils and soil conditions observed during the sampling activity is shown in Figure 2-31. Based on these data, the depth of topsoil within the Project area can be considered to be a maximum of approximately 30 centimeters

Table 2-7: Structural Classification of Soil Samples in Balabag

No.	Coordinates		Type/ Depth	Sand 0.05-2.0 mm	Silt 0.05-.002 mm	Clay less 0.002 mm	Textural Class
1	N 7°53.783	E 122°56.691	Composite	23.6	34.8	41.6	clay
	N 7°53.783	E 122°56.691	0-30 cm	23.6	34.8	41.6	clay
	N 7°53.783	E 122°56.691	30-60 cm	25.6	32.8	4.6	clay
	N 7°53.783	E 122°56.691	60-90 cm	21.6	34.8	43.6	clay
2	N 7°53.653	E 122°57.137	Composite	35.6	32.8	31.6	clay loam
	N 7°53.653	E 122°57.137	0-30 cm	23.6	36.8	39.6	clay loam
	N 7°53.653	E 122°57.137	30-60 cm	41.6	30.8	27.6	clay loam
	N 7°53.653	E 122°57.137	60-90 cm	41.6	30.8	27.6	clay loam
3	N 7°53.83	E 122°56.631	Composite	15.6	32.8	51.6	clay
	N 7°53.83	E 122°56.631	0-30 cm	19.6	32.8	47.6	clay
	N 7°53.83	E 122°56.631	30-60 cm	7.6	28.8	63.6	clay
	N 7°53.83	E 122°56.631	60-90 cm	13.6	26.8	59.6	clay
4	N 7°53.815	E 122°57.739	Composite	23.6	30.8	45.6	clay
	N 7°53.815	E 122°57.739	0-30 cm	11.6	28.8	59.6	clay
	N 7°53.815	E 122°57.739	30-60 cm	11.6	34.8	53.6	clay
	N 7°53.815	E 122°57.739	60-90 cm	19.6	34.8	45.6	clay

Figure 2-29: Soil Map of the Municipality of Bayog

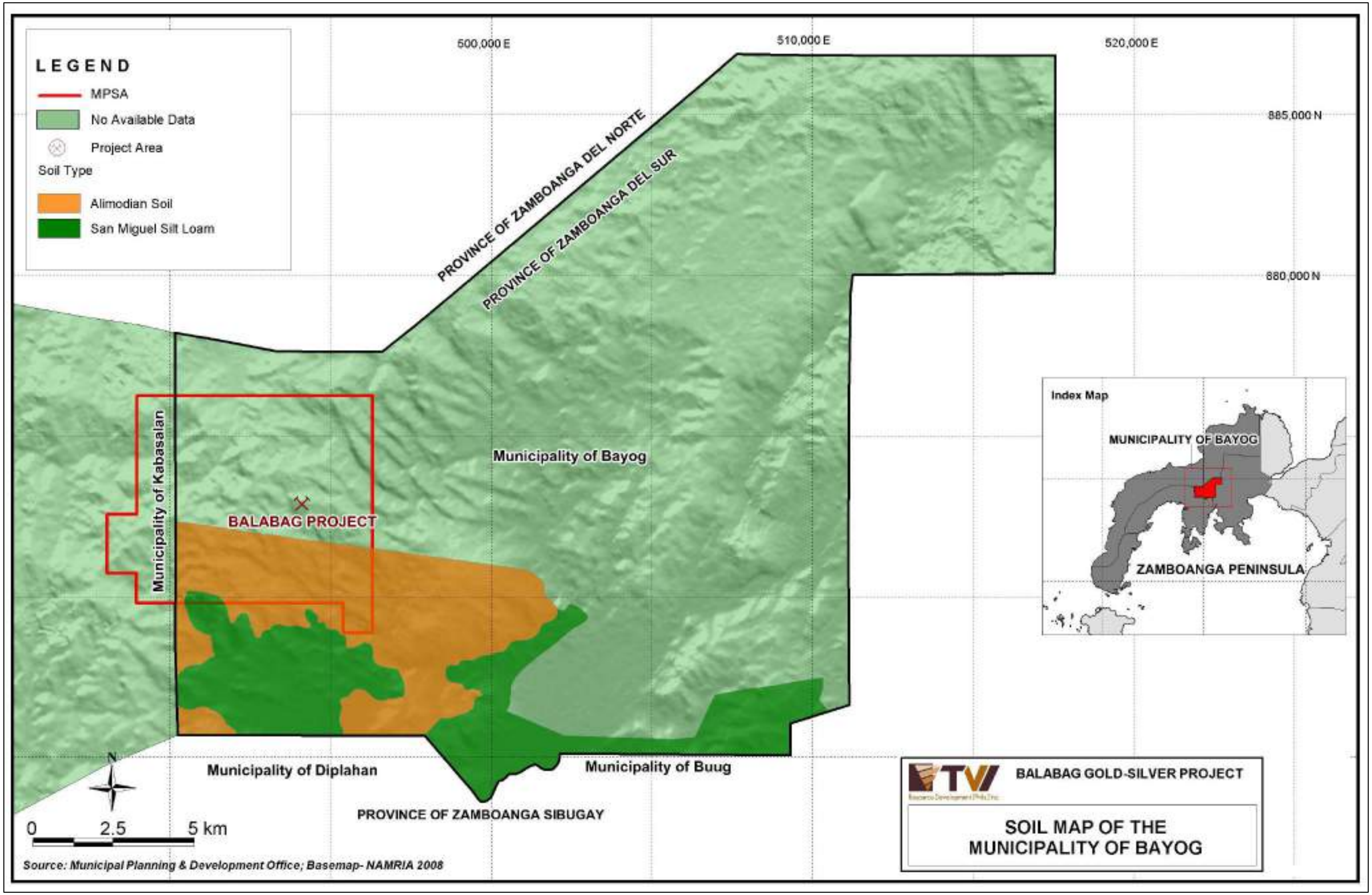
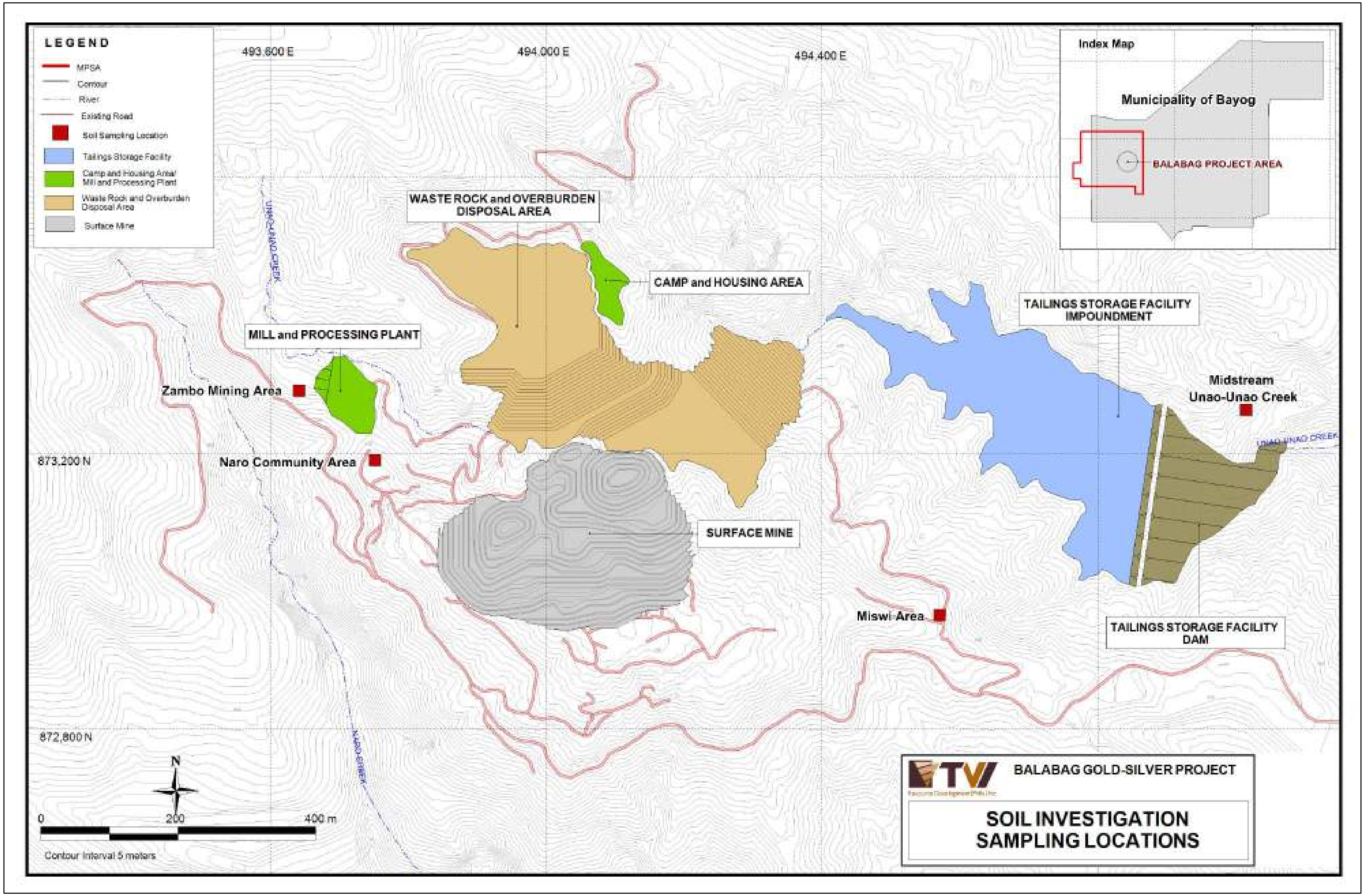


Figure 2-30: Soil Investigations Sampling Location



Source: TVIRD Balabag Gold-Silver Project EIS

Figure 2-31: Photo Showing Tabulated Physical Characteristics of Soil Samples Collected Within the Project Site

Characteristic	Sample 1			Sample 2		
Location and Project Feature(s)	Near Zambo Mining. Area identified for Waste Rock and Overburden Disposal			Naro Community. Area identified within the boundaries of the Surface Mine		
Geographical Coordinates	N 7'53.83' E 122'56.631'			N 7'53.775' E 122'56.691'		
Vegetation Present During Sampling	Grassy with ferns and other shrubs.			Grassy with banana trees.		
Sample Depth	0-30 cm	30-60 cm	60-90 cm	0-30 cm	30-60 cm	60-90 cm
Root Size and Abundance	Medium High	None None	None None	Thin Grass Few	None None	None None
Excavation Difficulty (Easy and Difficult)	Easy, Sticky but Soft	Difficult, Hard and Sticky	Difficult, Hard and Sticky	Easy, Soft, No Stones	Easy Soft, No Stones	Easy Soft, No Stones
Soil Stickiness (Easy and Difficult)	Difficult	Difficult	Difficult	Easy	Easy	Difficult
Color (Dark/ Black, Red, Gray, Orange)	Brown	Orange	Reddish Brown	Orange-Brown	Orange-Brown	Yellow Orange

Characteristic	Sample 3			Sample 4		
Location and Project Feature(s)	Unao-Unao Creek Valley Area for Tailings Storage Facility			Miswi Area		
Geographical Coordinates	N 7'53.815' E 122'57.379'			N 7'53.653' E 122'57.137'		
Vegetation Present During Sampling	Grassy with thick vegetation on slope.			Grassy with shrubs.		
Sample Depth	0-30 cm	30-60 cm	60-90 cm	0-30 cm	30-60 cm	60-90 cm
Root Size and Abundance	Thin Grass Few	None None	None None	Thin Grass Few	Thin Grass Few	None None
Excavation Difficulty (Easy and Difficult)	Difficult, Hard and Sticky	Difficult, Hard and Sticky	Difficult, Hard and Sticky	Difficult, Hard	Easy, Sticky but Soft	Easy, Sticky but Soft
Soil Stickiness (Easy and Difficult)	Difficult	Difficult	Difficult	Easy	Difficult	Difficult
Color (Dark/ Black, Red, Gray, Orange)	Orange-Brown	Orange-Brown	Orange-Brown	Orange	Orange	Orange

Source: TVIRD, March 2011
Note: Easy - loose, no stones; Difficult - many stones, hard soil
Note: Easy - not sticky; Difficult - sticking to the tool

Source: TVIRD Balabag Gold-Silver Project EIS

2.1.3.3 Erodibility Potential

The erosion potential varies among different soil groups as a function of infiltration, permeability, water capacity, dispersion and abrasion. Soil structure, organic matter and texture also contribute to the erosion potential. Clay loams, as found within the Project area, are moderately susceptible to erosion. The erosion potential within the Project area however is further increased due to the topography and steep slopes.

A soil erodibility factor to better define the erosion potential for soils was developed by Stewart et al. (1975), as reported by Mills et al. (1985) Mitchell and Bubenzer (1980). The magnitude of this factor, identified as the K-factor, is a function of organic matter content and soil structural class. As indicatedin Table 2-8, the soils sampled within the Project area consist of clays and clay loams. K-factors for these soils range from 0.21 to 0.28 for clay loams and from 0.13 to 0.20 for clays. These factors are moderate to low when compared to other soil types and suggest a higher resistance to erosion.

2.1.3.4 Soil Erosion/ Loss of Topsoil/Overburden

Baseline data indicate the Project Area soils are primarily clays and clay loam. These soils are considered moderately erodible. The topography of the area increases the erosion potential due to the steep slopes and lack of vegetation cover within some small-scale mining areas.

Mass wasting, slumping and other forms of erosion are already occurring in the area. This is due in part to natural environmental processes but have been accelerated and increased as a result of the small-scale mining activities, logging and vegetation removal to support these activities. Kaingin activities are also present within and around the Project area and further contribute to the erosion potential.

Climate change and global warming may also contribute to soil erosion. Several soil processes may be accelerated by increasing temperatures and increasing rainfall intensity. Higher temperatures will increase mineralization (loss) of organic matter and result in increased carbon dioxide release, especially from organic soils, while mineralization of wetter soils may result in an increase in methane emissions. Warmer, wetter soils are likely to result in increased nitrogen oxide emissions from nitrogen-fertilized soils, as these conditions favor denitrification (the conversion of nitrate to nitrogen gas). Increased rainfall intensity will result in greater potential for soil detachment and transport thereby increasing the rate of erosion.

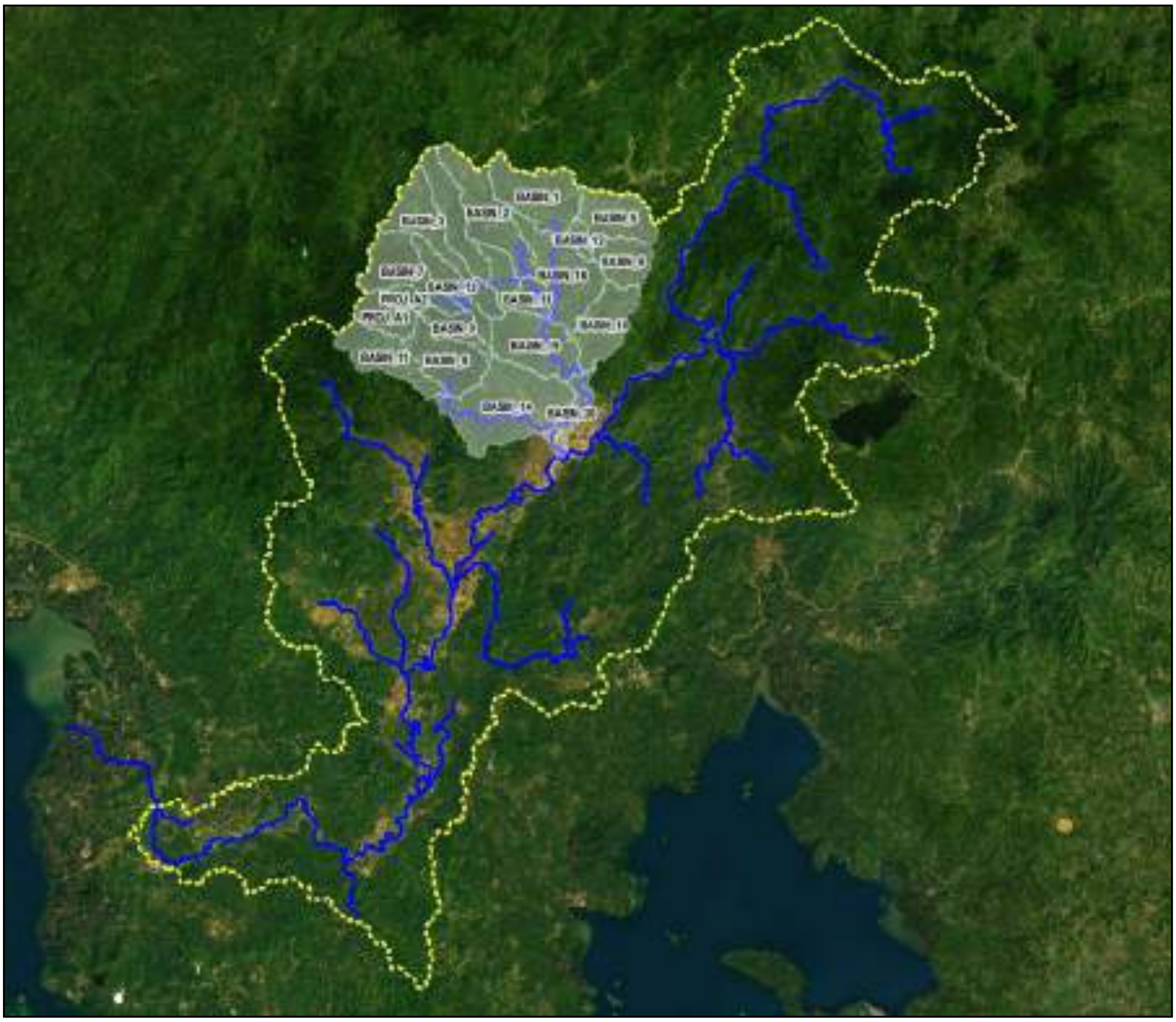
2.1.3.4.1 Sediment Modelling Loads within the Dipili Watershed

The study aims to quantify, based on available secondary information, the potential soil erosion and sediment yield due to rainfall events through the upstream sub-basins of Sibugay River by using the rainfall-runoff hydrologic model, HEC-HMS. Aside from historical rainfall and other hydro-meteorological data, some of the secondary data that were used in the model setup and simulations are digital elevation model (DEM) terrain data, rainfall, soil data, and land use data.

The project study area is the sub-basin of Dipili River, which is one of the upstream tributaries of Sibugay River, located in Zamboanga Peninsula, specifically within the municipality of Bayog, in Province of Zamboanga del Sur, see below. Sibugay River System receives runoff from a drainage basin measuring approximately 823.42 km^2, with upstream Dipili River covering a watershed area of some 159.18 km^2.

One of the major problems affecting Sibugay River system is the accelerated soil erosion in the watershed, which is one of the main contributors to siltation downstream. With the planned Balabag Gold-Silver Project of TVIRD specifically targeting the upstream watershed area of Dipili River, a tributary of the larger Sibugay River, sediment loadings in these river systems may significantly increase if no mitigating measures to control erosions are in place. To support sedimentation studies in the project area located in Dipili River watershed, this section presents the preliminary estimation of sources and sinks of sediment using the HEC HMS model.

Figure 2-32: Extent of Sibugay River Basin (Dashed yellow line), with Upstream Sub-Basins Subject of this Study



2.1.3.4.1.1 Methods and Materials

2.1.3.4.1.1.1 HEC HMS Model Description

HEC-HMS is a rainfall-runoff model developed by the US Army Corps of Engineers (USACE) to simulate the hydrological process of a dendritic watershed. The latest version of HEC-HMS can simulate the erosion and sediment yield process of the sub-basin (USACE 2016b). The HEC-HMS model is used in a wide range of watershed areas for solving various problems such as flood hydrology, erosion, and sediment deposition (USACE 2016b).

The HEC-HMS model for the basin is developed by dividing the hydrological model and erosion model into several components. It comprises different methods to represent the runoff process, erosion, and sediment yield. In this study for the hydrological component of the model, Hamon method (Hamon, 1963) has been selected to calculate evapo-transpiration and is based on an empirical relationship where saturated water vapor concentration, at the mean daily air temperature, adjusted by a day length factor, is proportional to potential evapotranspiration.

Soil Moisture accounting (SMA) is the loss method used to estimate direct runoff. SMA uses several layers to represent the dynamics of water movement thru the soil profile. These layers include canopy interception, surface depression storage, upper zone and tension zone soil storage, upper and lower groundwater storages. The mechanics on how portions of precipitation flow as surface runoff, lateral inflow and percolation to groundwater depends on the maximum and available water storages along different layers. Considering the characteristics of Dipili River as a data-poor basin, Clark Synthetic Unit Hydrograph (Clark SUH) has been selected for separating direct runoff, with its parameters derived from topographic information such as the length of the mainstream, and slope of the catchment using Geographic Information System (GIS). Recession Method has been used to simulate total base flow for the watershed. The Muskingum–Cunge method has been used for routing the channel flow.

For the run-off components, HEC-HMS model requires daily values of precipitation, average temperature, solar radiation, relative humidity and wind speed. Meteorological data over the project area have been collected from PAGASA for the period 2007–2018 which were used for rainfall-runoff modeling. To simulate the runoff process, hydrologic elements such as sub-basin, reach, sink, junction, and reservoir are composed of the basin model. The sub-basin used as a drainage basin where precipitation falls, and surface runoff obtained. The sub-basin outflow is estimated by subtracting the precipitation losses (infiltration, evapotranspiration, and storage).

For the sediment component of HEC-HMS, the widely used MUSLE has been selected to simulate erosion from surface runoff. The modified USLE method (Williams, 1975) was adapted from the original Universal Soil Loss Equation (USLE). The original equation was based on precipitation intensity, and consequently could not differentiate between storms with low or high infiltration. With high infiltration, there is little surface runoff and little accompanying surface erosion. Conversely, low infiltration events have relatively more surface runoff and consequently more surface erosion. The modifications to the original USLE equation changed the formulation to calculate erosion from surface runoff instead of precipitation.

The other components of the original formulation remained the same. The sediment transport capacity of the flow can be calculated from the flow parameters and sediment properties. If the sediment transport capacity at a section is greater than the available sediment in streamflow, the erosion from stream bed will occur. If the sediment transport capacity is less than available sediment in streamflow, the deposition will occur to the reach bed.

The transport potential method specifies how the sediment carrying capacity of the stream flow will be calculated for non-cohesive sediments. Many methods have been proposed for calculating the transport potential. Each method is developed for a particular sediment grain-size distribution and environmental conditions. The same transport potential method will be used at all reaches within the basin model. A cohesive transport potential method can also be selected. When selected, transport of cohesive sediment is computed in addition to the non-cohesive sediment.

Among the available methods for estimating transport potential function for a reach in HEC-HMS, Engelund Hansen method (Engelund & Hansen 1967) has been used for all streams. In this method, erosion is modelled using an excess shear stress approach, where excess shear stress is the shear above the critical value for initiation of erosion. For cohesive transport potential, Krone-Partheniades method is used, which is the only available option yet in HEC-HMS.

In addition, in-channel sediment routing methods are included in the HEC-HMS, to model the translation and attenuation of the sediment load along with deposition and erosion processes occurring in the channel. For this study, sediment routing is based on linear reservoir approach.

Some of the spatial inputs used for rainfall-runoff and sediment modules of HEC-HMS include:

- Digital elevation model (DEM) - the DEM of the Dipili River Basin used in this study has a spatial resolution of 10 m provided by the client.
- Soil Erodibility Factor - Soil Erodibility Factor, K is a measure of the resistance of the soil to sheet and rill erosion. K factor may be estimated from data on the soil's physical and chemical properties.
- The soil map of the study area and its corresponding attributes data e.g., particle size distribution, organic matter content of the topsoils were derived from the regional soil map downloaded from the website, www.philgis.org. From these data, the K-factor grid was derived via the formula used by David (1988), which is a simplified equation of Wischmeier and Mannering (1969) for estimating the soil erodibility index.
- Hillslope Length and Slope Steepness Factors - Hillslope Length Factor, L is defined as the ratio of soil loss from the field slope length to that lost from a 22.13 m length under otherwise identical conditions. The hill length factor is supposed to represent the increasing runoff volume (and thus eroding power) down-slope. Slope Steepness Factor, S measures the effect of slope stiffness on sheet and rill erosion. A grid of slope in degrees was created from the DEM, which were then used to generate the slope factor based on the equations developed by Rosewell, (1993) as follows (Wilkinson, et al, 2004):

$$S=10.8 * \sin\theta + 0.03 \qquad \delta \leq 9\%$$

$$S=16.8 * \sin\theta - 0.50 \qquad \delta \leq 9\%$$

Where θ is the slope angle

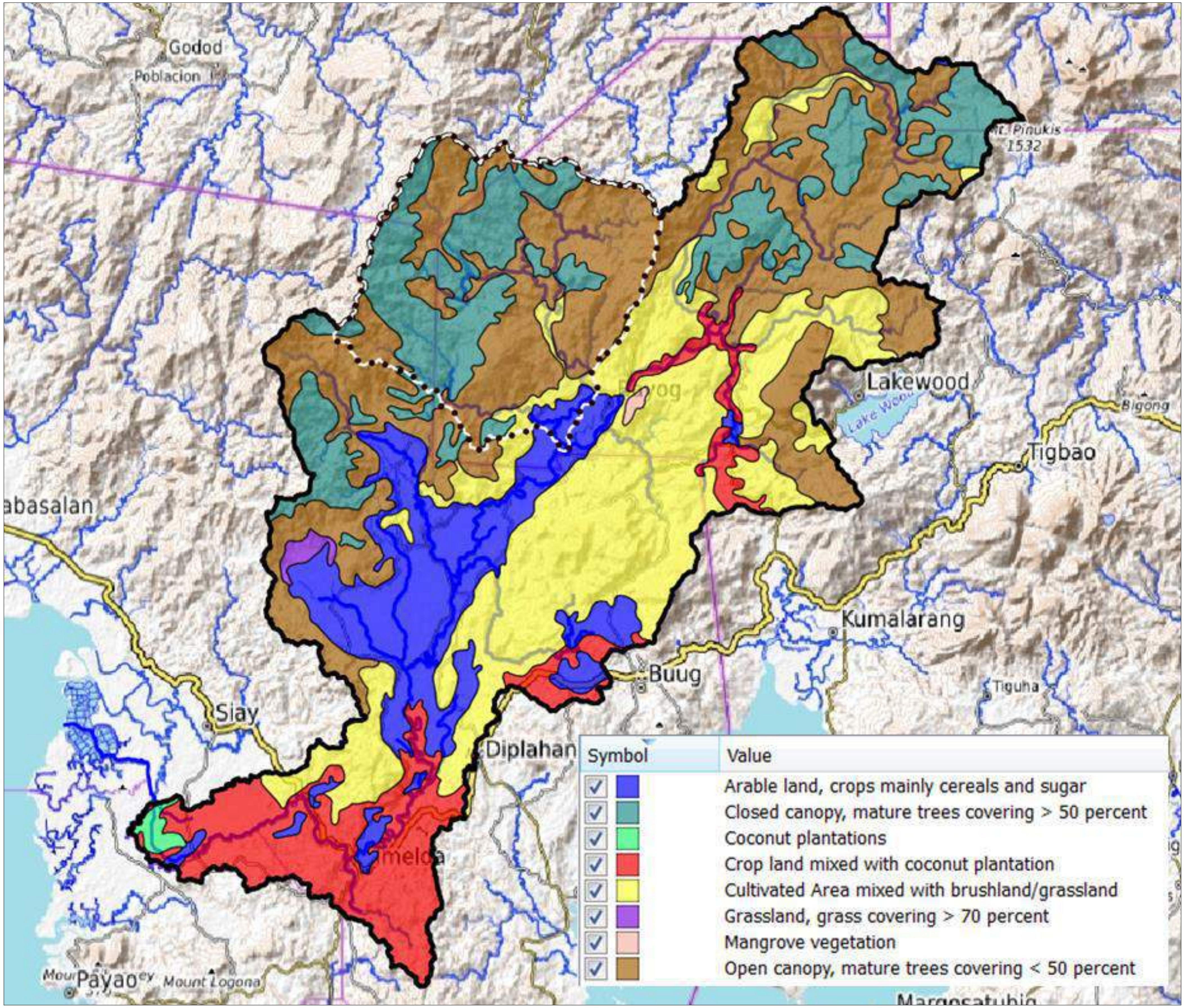
- Cover Factor (C) - in the absence of a detailed land use for the area, the land use grids for the catchment are based on vegetation cover downloaded from the internet (www.philgis.org). The land cover types were then assigned a representative cover factor for each cover class to create a grid of C values. The values used were taken from the estimated crop cover coefficient or C values for the common cover conditions of Philippine watersheds (David, 1998). The C-factor represents a comparison of soil loss with that expected from freshly tilled or bare soil (C = 1).

- As the land cover classification available in the study area is very broad compared to those in the table prepared by David (1998), assumptions were made in assigning C-factor values. Table 2-8 lists the C-Factors used for the model simulation under the current condition scenario.
- Land Use - As previously mentioned, the land cover map for the study area was clipped from the downloaded land cover classification map for the entire country. As shown in Table 2-8, from the total of 821.79 km^2 of delineated watershed of Sibuguey River, open canopy (mature trees covering less than 50 percent) cover the largest area in the watershed with a total of 264.76 km^2 followed by cultivated area mixed with brushland/grassland with 209.39 km^2, closed canopy (mature trees covering more than 50 percent) with 135.30 km^2, while other land cover types such as arable land, crop land mixed with coconut plantation, coconuts plantations, grasslands, combining about one-fourth of the total watershed area.

Table 2-8: Estimated C-Factor for the Land Use Cover in the Study Area

2003 Land Cover Classification	% Catchment Area	Crop Factor, C
Arable land, crops mainly cereals and sugar	13.25%	0.27
Closed canopy, mature trees covering > 50 percent	16.46%	0.013
Coconut plantations	0.41%	0.285
Crop land mixed with coconut plantation	11.68%	0.325
Cultivated Area mixed with brushland/grassland	25.48%	0.325
Grassland, grass covering > 70 percent	0.37%	0.2
Mangrove vegetation	0.13%	0.001
Open canopy, mature trees covering < 50 percent	32.22%	0.019

Figure 2-33: Land Cover Classification Map for the Watershed of Sibugay and Dipili Rivers (Shown as Dotted Polygon)

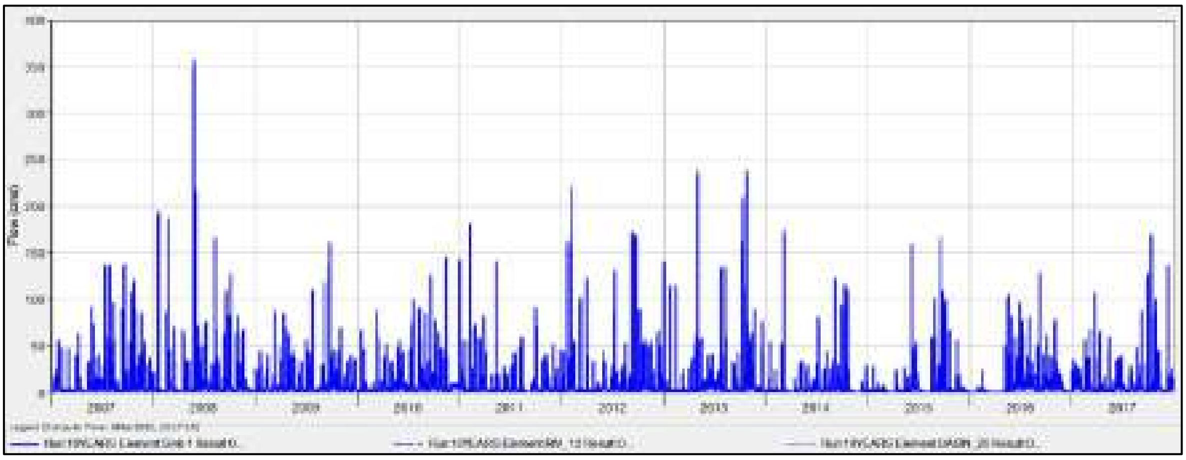


2.1.3.4.1.1.2 Results and Discussion

The model has been used to simulate a 11-year baseline period from 2007 to 2017 to quantify flow and sediment loads for these periods. The first one year was used as initial runs to remove the influence of initial conditions in the model computations. The analysis of results is then based on 2008 to 2017 simulated data.

Shown below is the time series of simulated semi-hourly discharge at the outlet of Dipili River, at its confluence with the larger Sibuguey River. The peak discharge rate is predicted to be about 354.466 m3/s occurred May 26, 2008, while the average discharge rate for the whole 10-year simulation period is about 6.41 m3/s.

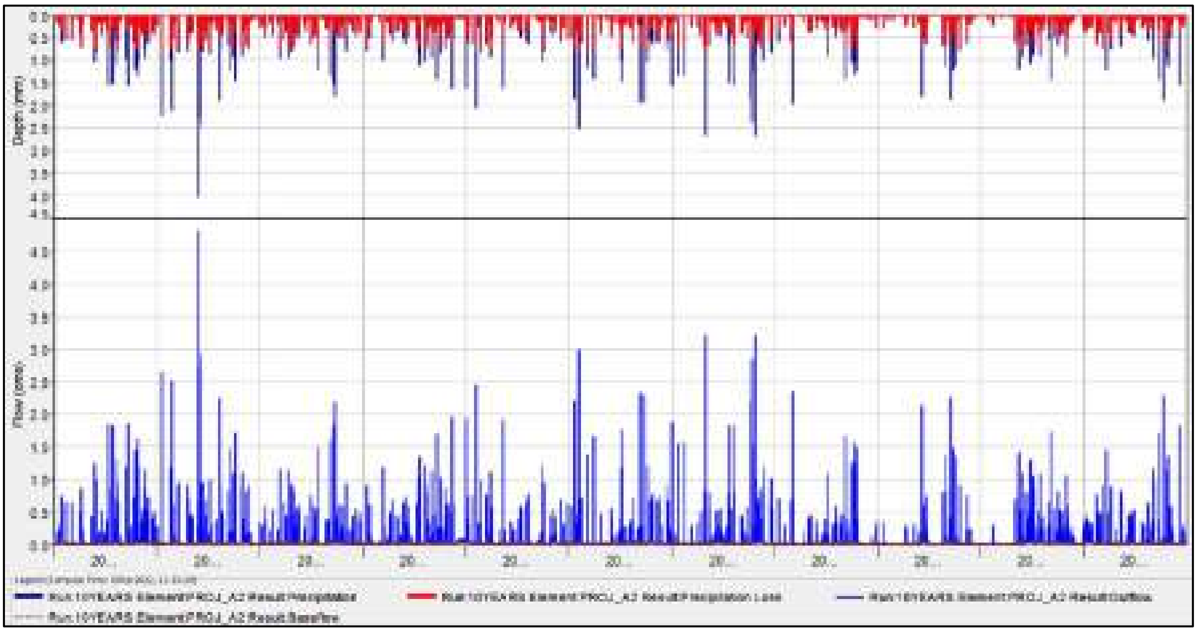
Figure 2-34: Simulated Discharge Hydrographs at the Outlet of Dipili River Basin



The next graph shows the depths of precipitation and losses (due to evapo-transpiration, canopy, depression storage), as well as the simulated discharge hydrographs at the outlet of the specific sub-basin where the TVIRD mining project area is located within Dipili River watershed.

Based on the summary of 11-year simulation results for this particular sub-basin, the total precipitation depth is about 16,209.75 mm, the losses accounts for about 5,297.70 mm (about 33% of the total precipitation), the baseflow is about 3,421.88 mm (about 23.8% of total streamflow) and a peak discharge rate of about 4.813 m3/s.

Figure 2-35: Simulated Discharge Hydrographs in one of the Sub-Basins of Dipili River Basin where Project is Located



The next table summarizes the simulated annual average discharge rates, in cubic meters per second, for each of the 22 individual sub-basins of Dipili River (including the sub-basins PROJ_A1 and PROJ_A2, where the project is located), as well as the discharge results at the outlet of said river.

These simulated discharge data were then used to estimate the sediment loadings at each of these sub-basins, as well as sediment erosion and deposition at channel networks as these flows area routed downstream.

Table 2-9: Simulated Annual Average Discharges for each of the Sub-Basins of Dipili River Basin

SUB-BASIN ID	SIMULATED ANNUAL DISCHARGE RATE (m3/s)										
	CY 2008	CY 2009	CY 2010	CY 2011	CY 2012	CY 2013	CY 2014	CY 2015	CY 2016	CY 2017	AVERAGE
BASIN_1	0.665	0.441	0.457	0.400	0.558	0.613	0.337	0.310	0.322	0.440	0.454
BASIN_2	0.694	0.460	0.476	0.418	0.581	0.641	0.352	0.324	0.336	0.460	0.474
BASIN_3	0.482	0.319	0.331	0.290	0.403	0.444	0.244	0.225	0.233	0.319	0.329
BASIN_4	0.458	0.304	0.315	0.276	0.384	0.423	0.232	0.214	0.222	0.304	0.313
BASIN_5	0.475	0.315	0.326	0.286	0.398	0.438	0.241	0.222	0.230	0.315	0.324
BASIN_6	0.337	0.224	0.233	0.203	0.283	0.311	0.171	0.158	0.163	0.224	0.231
BASIN_7	0.545	0.361	0.375	0.328	0.457	0.502	0.276	0.254	0.264	0.361	0.372
BASIN_8	0.530	0.351	0.365	0.319	0.445	0.488	0.268	0.247	0.256	0.351	0.362
BASIN_9	0.222	0.147	0.153	0.134	0.187	0.205	0.112	0.104	0.108	0.147	0.152
BASIN_10	0.491	0.326	0.338	0.296	0.412	0.453	0.249	0.229	0.238	0.326	0.336
BASIN_11	0.500	0.331	0.344	0.301	0.419	0.461	0.253	0.233	0.242	0.331	0.342
BASIN_12	0.106	0.070	0.073	0.064	0.089	0.098	0.054	0.049	0.051	0.070	0.072
BASIN_13	0.324	0.215	0.224	0.196	0.273	0.299	0.164	0.151	0.157	0.215	0.222
BASIN_14	1.120	0.741	0.765	0.673	0.932	1.038	0.566	0.523	0.541	0.741	0.764
BASIN_15	0.124	0.082	0.086	0.075	0.105	0.115	0.063	0.058	0.060	0.082	0.085
BASIN_16	0.695	0.460	0.475	0.418	0.579	0.644	0.352	0.325	0.336	0.460	0.474

SUB-BASIN ID	SIMULATED ANNUAL DISCHARGE RATE (m3/s)										
	CY 2008	CY 2009	CY 2010	CY 2011	CY 2012	CY 2013	CY 2014	CY 2015	CY 2016	CY 2017	AVERAGE
BASIN_17	0.185	0.123	0.127	0.111	0.155	0.170	0.094	0.086	0.089	0.122	0.126
BASIN_18	0.199	0.132	0.137	0.120	0.167	0.183	0.101	0.093	0.096	0.132	0.136
BASIN_19	0.653	0.433	0.448	0.394	0.547	0.603	0.331	0.305	0.316	0.433	0.446
BASIN_20	0.221	0.145	0.150	0.132	0.183	0.205	0.111	0.103	0.106	0.145	0.150
PROJ_A1	0.262	0.174	0.181	0.158	0.221	0.242	0.133	0.122	0.127	0.174	0.179
PROJ_A2	0.127	0.084	0.088	0.077	0.107	0.117	0.064	0.059	0.062	0.084	0.087
DIPILI OUTLET	9.243	6.071	6.290	5.510	7.689	8.540	4.628	4.278	4.422	6.072	6.274

2.1.3.4.1.1.2.1 Simulated Sediment Loads for Baseline Condition

The simulated sediment loadings from each of the sub-basins, and as these are routed downstream, are highly dependent on the accuracy of data used in the simulations, of which in this case, is greatly lacking in detail.

On the use of C factor for example, estimates had to be made on the representative C factor for such a broad land use classification used in this study, and it appears that scenarios are sensitive to the choice of C factor. Better estimates could have been made if more information on the land use categories would have been available. However, it is believed that the assumed C values are fair estimates for the land use categories considered.

Based on the results of MUSLE Sediment Erosion Method in HEC-HMS using above-mentioned inputs, the total annual average sediment supply from the Dipili River Basin was predicted to be about 1,005,649.29 tons/yr. or an average of about 6,317.69 tons/km^2 per year. Of the total sediment loads, around 73% is composed of sand and silt, while around 23% and 4% are clay and gravel materials, respectively. The composition of sediment though is based on soil gradation of the topsoil from the regional soil map, in the absence of site-specific soil data.

Table 2-10: Sediment Loads from Watershed of Dipili River for Baseline Condition

YEAR	TOTAL SEDIMENT LOAD	CLAY	GRAVEL	SAND	SILT
2008	1,660,203.95	388,720.12	64,084.15	665,210.49	542,189.19
2009	955,474.63	223,714.81	36,881.48	382,839.56	312,038.78
2010	931,162.17	218,022.29	35,943.02	373,098.04	304,098.82
2011	833,501.41	195,156.00	32,173.30	333,967.33	272,204.78
2012	1,284,308.24	300,707.91	49,574.51	514,596.60	419,429.22
2013	1,412,418.65	330,703.67	54,519.60	565,927.88	461,267.50
2014	691,237.82	161,846.41	26,681.90	276,965.16	225,744.36
2015	653,648.95	153,045.35	25,230.96	261,904.05	213,468.59
2016	683,633.37	160,065.90	26,388.36	273,918.20	223,260.90
2017	950,903.68	222,644.57	36,705.04	381,008.07	310,546.00
MEAN	1,005,649.29	235,462.70	38,818.23	402,943.54	328,424.81
MIN	653,648.95	153,045.35	25,230.96	261,904.05	213,468.59

YEAR	TOTAL SEDIMENT LOAD	CLAY	GRAVEL	SAND	SILT
MAX	1,660,203.95	388,720.12	64,084.15	665,210.49	542,189.19

The next set of tables show the monthly averaged sediment loadings at the two sub-basins of Dipili River system, where the TVIRD project is located, as well as the sediment exported to the river mouth. These two sub-basins contribute a combined sediment loadings of about 17,112.69 tons/yr. or a mere 1.70% of the total upstream sediment loads. Of the total sediment loadings of 1,005,649.29 tons/yr. from the watershed of Dipili River, the total sediment load exported to the river mouth is reduced to an average of about 374,462.99 tons/yr. or about 37.20% of upstream load. The reduction of sediment loadings is due to the deposition along the river stretches upstream. Note that the slope in the midstream area of Dipili River is gently sloping terrain, such that higher sediment deposition is expected in this area.

Table 2-11: Monthly Sediment Loadings for Upstream Tributaries (Near Project Area, PROJ_AI) od Dipili River Basin (in tons)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
2008	1,804.24	2,709.57	526.34	925.36	5,715.92	3,479.55	1,049.14	2,124.91	2,155.22	2,633.55	1,070.03	-	24,193.83
2009	297.94	280.94	1,037.85	1,163.95	1,124.68	-	1,953.82	-	4,075.14	892.01	577.56	242.29	11,646.17
2010	857.08	-	695.20	708.94	809.93	288.17	2,473.43	1,781.04	1,721.48	1,725.70	1,605.52	-	12,666.49
2011	2,226.96	2,209.21	1,618.68	270.57	1,232.76	-	560.98	1,312.87	734.67	1,010.89	280.61	730.13	12,188.32
2012	1,969.90	2,763.02	1,879.84	233.74	256.49	-	1,494.82	426.04	4,055.22	2,801.29	1,405.76	2,068.88	19,355.00
2013	1,002.55	974.97	-	663.33	2,746.45	710.39	2,101.19	1,689.29	276.95	8,058.86	1,954.38	1,228.00	21,406.39
2014	467.57	394.49	1,569.41	-	-	-	638.41	290.54	1,804.06	3,242.37	-	-	8,406.85
2015	-	-	-	-	-	2,378.85	-	1,901.26	3,666.65	1,317.31	465.44	-	9,729.51
2016	-	-	-	-	2,083.87	1,413.87	1,921.35	387.60	1,361.74	1,439.96	288.44	-	8,896.84
2017	-	511.80	1,388.15	485.27	1,016.33	212.69	-	372.68	1,786.36	3,742.75	306.64	1,172.44	10,995.12
AVE	862.62	984.40	871.55	445.12	1,498.64	848.35	1,219.31	1,028.62	2,163.75	2,686.47	795.44	544.17	13,948.45
MIN	-	-	-	-	-	-	-	-	276.95	892.01	-	-	8,406.85
MAX	2,226.96	2,763.02	1,879.84	1,163.95	5,715.92	3,479.55	2,473.43	2,124.91	4,075.14	8,058.86	1,954.38	2,068.88	24,193.83

Table 2-12: Monthly Sediments Loadings for upstream Tributaries (near the Project Area, PROJ_A2) of Dipili Basin (in tons)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
2008	644.47	869.49	-	-	1,957.51	725.50	89.63	534.53	539.46	615.30	-	-	5,975.87
2009	-	-	249.42	231.71	-	-	321.68	-	1,299.73	-	-	-	2,102.54
2010	-	-	264.14	-	-	-	576.29	286.41	609.60	99.54	452.88	-	2,288.86
2011	448.81	590.80	222.38	-	438.63	-	-	-	297.02	-	-	-	1,997.64
2012	524.59	745.97	665.30	-	-	-	585.18	-	1,368.14	275.71	-	427.36	4,592.25
2013	351.50	345.67	-	-	804.20	-	421.17	417.98	-	2,539.86	273.57	93.70	5,247.65
2014	-	-	560.04	-	-	-	224.11	-	681.35	1,265.37	-	-	2,730.88
2015	-	-	-	-	-	504.34	-	381.10	879.43	363.76	-	-	2,128.63
2016	-	-	-	-	513.53	344.93	382.25	-	397.18	190.62	-	-	1,828.52
2017	-	-	312.64	-	-	-	-	-	657.25	1,361.91	-	417.77	2,749.57

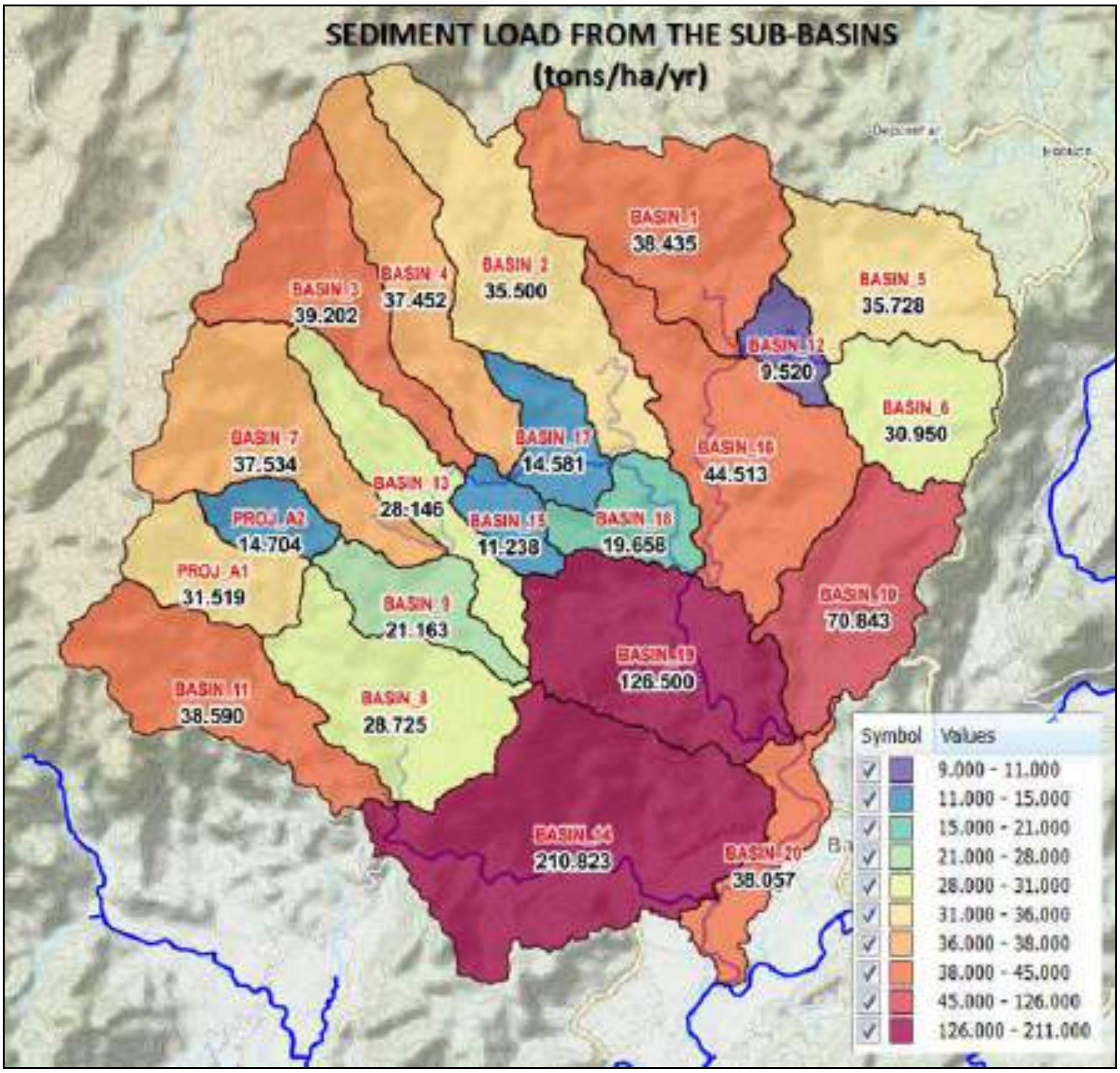
YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
AVE	196.94	255.19	227.39	23.17	371.39	157.48	260.03	162.00	672.91	671.21	72.65	93.88	3,164.24
MIN	-	-	-	-	-	-	-	-	-	-	-	-	1,828.52
MAX	644.47	869.49	665.30	231.71	1,957.51	725.50	585.18	534.53	1,368.14	2,539.86	452.88	427.36	5,975.87

Table 2-13: Monthly Sediment Supply at the mouth of Dipili River System (In tons)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
2008	62,285.43	88,012.39	28,448.75	37,651.45	182,048.59	98,069.67	40,810.55	60,662.78	52,406.08	69,278.18	25,673.56	1,719.49	747,066.91
2009	8,955.19	7,219.27	25,504.49	34,736.84	25,058.97	4,118.67	47,316.11	4,131.82	109,204.54	24,511.70	20,711.32	10,957.52	322,426.44
2010	18,003.28	421.97	18,585.03	21,953.89	16,635.66	12,128.29	66,859.42	49,029.32	48,025.62	39,169.82	44,201.78	1,302.94	336,317.01
2011	54,018.16	55,949.85	35,418.51	5,523.57	32,247.66	3,601.98	12,851.79	25,445.42	18,526.69	26,153.86	10,200.81	13,708.83	293,647.13
2012	50,340.40	68,815.38	46,490.50	6,915.54	4,632.88	3,795.95	46,624.34	12,527.14	105,826.37	55,710.54	25,960.04	44,777.13	472,416.22
2013	28,587.07	24,162.49	1,751.98	14,152.03	64,986.70	18,547.18	51,197.34	38,655.20	10,344.35	211,814.95	43,404.81	25,010.79	532,614.90
2014	9,222.60	7,645.09	39,154.51	407.42	7,559.70	1,326.64	20,576.30	15,510.90	49,760.10	93,685.76	84.69	4,366.50	249,300.21
2015	2,051.83	81.41	0.18	1,450.16	1,615.37	58,563.47	251.00	40,845.72	94,690.35	34,822.11	8,777.97	185.01	243,334.59
2016	0.47	1,088.88	31.46	0.00	45,305.96	37,157.61	44,539.02	14,586.57	37,021.25	30,526.63	14,402.62	553.47	225,213.96
2017	18,845.02	12,693.55	45,034.01	11,054.83	19,529.92	17,661.44	1,829.34	9,133.61	50,002.20	97,504.13	7,754.34	31,250.18	322,292.57
AVE	25,230.95	26,609.03	24,041.94	13,384.57	39,962.14	25,497.09	33,285.52	27,052.85	57,580.75	68,317.77	20,117.20	13,383.18	374,462.99
MIN	0.47	81.41	0.18	0.00	1,615.37	1,326.64	251.00	4,131.82	10,344.35	24,511.70	84.69	185.01	225,213.96
MAX	62,285.43	88,012.39	46,490.50	37,651.45	182,048.59	98,069.67	66,859.42	60,662.78	109,204.54	211,814.95	44,201.78	44,777.13	747,066.91

The next figure shows the spatial distribution of the relative contributions of each of the sub-basins of Dipili in the total sediment yields of the basin. From this figure, it appears that higher contributions of TSS yields of the watershed are mainly coming from the downstream sub-basins (shown as dark red) which are individually supplying more than 100 tons/ha per year. This map may be useful in targeting areas and/or identifying priority sub-basins for reforestation, related sediment erosion works to minimize sediment loss in the basin.

Figure 2-36: Map of Individual Contributions of the Sub-Basins to Total Sediment Supply (tons/hectare per year)



2.1.3.4.1.1.2.2 Simulated Sediment Loads during TVIRD Balabag Gold-Silver Operations

To consider changes in the sediment loadings from the Dipili River watershed as a result of TVIRD mining operations, the land use cover of the extent of the project area (mining pit, roads, waste dump, part of TSF) was converted to bare land classification. The influence of land use and management is often parameterized in the cover-management factor (C-factor). The C-factor is among the five factors that are used to estimate the risk of soil erosion within the Universal Soil Loss Equation (USLE) and its modified version, the MUSLE. The C-factor is perhaps the most important factor with regard to policy and land use decisions, as it represents conditions that can be most easily managed to reduce erosion. C-factor accounts for how land cover, crops and crop management cause soil loss to vary from those losses occurring in bare fallow areas. The bare plot (no vegetation) with till up and down the slope is taken as a reference condition, with a C-factor value of 1. The soil loss from different land-cover types is compared to the loss from the reference plot and the results are given as a ratio. The C-factor value for a particular land-cover type is the weighted average of those soil loss ratios, and ranges between 0 and 1.

In this scenario setup, the cover factor for the project area is set at C= 1, representing bare soil. C-factors outside of the project area which were considered in the baseline condition scenario remain unchanged, such that any changes in the amount of sediment loads can be attributed exclusively to the changes in land use classification of the watershed during the operational phase of the project.

From the model results, the total sediment loads from the watershed of Dipili River increases from the annual average of 1,005,649.29 tons/yr. to about 1,051,085.13 tons/year, or about 4.52% increase in sediment load, as a result of the operations of the project.

Table 2-14: Sediment Loads from the Watershed of Dipili River once the Project is Operational

YEAR	TOTAL SEDIMENT LOAD	CLAY	GRAVEL	SAND	SILT
2008	1,743,533.58	408,230.92	67,300.69	698,599.00	569,402.97
2009	988,459.52	231,437.89	38,154.70	396,055.94	322,810.98
2010	966,864.33	226,381.60	37,321.13	387,403.18	315,758.43
2011	865,833.71	202,726.29	33,421.33	346,922.24	282,763.86
2012	1,349,145.00	315,888.78	52,077.22	540,575.39	440,603.60
2013	1,485,708.86	347,863.84	57,348.61	595,293.80	485,202.61
2014	726,573.39	170,119.88	28,045.86	291,123.41	237,284.24
2015	684,527.94	160,275.36	26,422.89	274,276.64	223,553.04
2016	710,847.48	166,437.82	27,438.83	284,822.36	232,148.48
2017	989,357.48	231,648.14	38,189.37	396,415.74	323,104.24
MEAN	1,051,085.13	246,101.05	40,572.06	421,148.77	343,263.24
MIN	684,527.94	160,275.36	26,422.89	274,276.64	223,553.04
MAX	1,743,533.58	408,230.92	67,300.69	698,599.00	569,402.97

For the baseline scenario, the total sediment supply from watershed of Dipili River system is about 374,462.99 tons per year on average. Once the project is operational, the total sediment supply increases to about 377,916.58 tons/year, or a marginal increase of about 0.92% in existing sediment supply.

In terms of supply of different soil classes, clay and silt sediment increases by 1.30% and 0.91% respectively, while coarse grained sediments of gravel and sand decreases by 0.35% and 0.41% respectively.

Table 2-15: Sediment Supply from the Watershed of Dipili River for the 'with Project' and 'without Project' (or baseline) Scenarios

YEAR	WITH PROJECT SCENARIO, in tons					BASELINE SCENARIO				
	TOTAL SEDIMENT SUPPLY	CLAY	GRAVEL	SAND	SILT	TOTAL SEDIMENT SUPPLY	CLAY	GRAVEL	SAND	SILT
2008	760,872.35	310,864.58	1,468.08	53,944.26	394,595.43	747,066.91	303,996.56	1,475.56	54,551.40	387,043.39
2009	325,191.17	127,390.14	692.67	39,208.92	157,899.44	322,426.44	125,896.89	694.63	39,342.01	156,492.92
2010	336,519.14	127,964.56	1,284.32	45,933.52	161,336.73	336,317.01	127,965.59	1,286.31	45,948.58	161,116.54
2011	296,080.37	116,713.83	576.81	33,072.61	145,717.12	293,647.13	115,249.98	578.76	33,189.43	144,628.96
2012	478,472.28	191,271.57	983.82	46,732.62	239,484.27	472,416.22	188,112.45	988.10	46,999.91	236,315.76
2013	539,803.70	215,759.45	1,150.75	51,936.48	270,957.03	532,614.90	211,585.05	1,157.75	52,216.78	267,655.32
2014	250,019.05	98,480.35	489.86	27,247.35	123,801.50	249,300.21	98,082.66	491.34	27,291.29	123,434.91
2015	242,165.78	95,157.22	525.65	26,437.60	120,045.31	243,334.59	95,170.68	525.64	26,438.93	121,199.34
2016	225,636.36	88,513.42	412.66	26,073.50	110,636.79	225,213.96	88,209.96	413.74	26,098.10	110,492.15
2017	324,405.60	128,526.11	589.08	35,404.74	159,885.67	322,292.57	127,133.46	590.95	35,514.97	159,053.19
Mean	377,916.58	150,064.12	817.37	38,599.16	188,435.93	374,462.99	148,140.33	820.28	38,759.14	186,743.25
Min	225,636.36	88,513.42	412.66	26,073.50	110,636.79	225,213.96	88,209.96	413.74	26,098.10	110,492.15
Max	760,872.35	310,864.58	1,468.08	53,944.26	394,595.43	747,066.91	303,996.56	1,475.56	54,551.40	387,043.39

2.1.3.4.1.1.3 Conclusion

From the model results and analysis of the land use of the basin, it is estimated that the sediment yield of the Dipili River Basin (total area of 159.18 km^2) towards the confluence of the larger Sibuguey River is about 1,005,649.29 tons/yr. or an average of about 6,317.69 tons/km^2 per year.

The TVIRD project is located in the two adjoining sub-basins of Dipili River upstream, denoted as PROJ_A1 (area is 4.425 km^2) and PROJ_A2 (area 2.152 km^2). The sediment loadings for the sub-basins, PROJ_A1 and PROJ_A2, is estimated at an average of about 13,948.45 tons/yr. and 3,164.24 tons/yr., respectively, for the baseline (or existing) scenario. Once the project is in place, the average sediment loadings from these same sub-basins are estimated at about 27,951.00 tons/yr. and 33,342.64 tons/yr., respectively. This translates to a sediment load increase from 3,151.91 tons/km^2/yr. to 6,316.04 tons/km^2/yr. for PROJ_A1, and from 1,470.37 tons/km^2/yr. to 15,493.79 tons/km^2/yr. for PROJ_A2 due to the planned operation of the project.

Table 2-16: Sediment Loads from the Two Sub-Basins where the Project Area is Located, for the 'with Project' and 'without Project' (or baseline) Scenario

YEAR	SUB-BASIN, PROJ_A1 (in tons/year)			SUB-BASIN, PROJ_A1 (in tons/year)		
	WITH PROJECT	BASELINE	DIFFERENCE	WITH PROJECT	BASELINE	DIFFERENCE
2008	48,481.47	24,193.83	24,287.65	62,969.70	5,975.87	56,993.82
2009	23,337.50	11,646.17	11,691.33	22,155.16	2,102.54	20,052.62
2010	25,382.09	12,666.49	12,715.61	24,118.43	2,288.86	21,829.57
2011	24,423.91	12,188.32	12,235.59	21,049.81	1,997.64	19,052.17
2012	38,785.06	19,355.00	19,430.06	48,390.05	4,592.25	43,797.80
2013	42,895.80	21,406.39	21,489.40	55,296.22	5,247.65	50,048.57
2014	16,846.31	8,406.85	8,439.46	28,776.20	2,730.88	26,045.31
2015	19,496.76	9,729.51	9,767.24	22,430.04	2,128.63	20,301.41
2016	17,828.18	8,896.84	8,931.34	19,267.72	1,828.52	17,439.20
2017	22,032.88	10,995.12	11,037.76	28,973.09	2,749.57	26,223.52
Ave	27,951.00	13,948.45	14,002.54	33,342.64	3,164.24	30,178.40
Min	16,846.31	8,406.85	8,439.46	19,267.72	1,828.52	17,439.20
Max	48,481.47	24,193.83	24,287.65	62,969.70	5,975.87	56,993.82

It must be noted that the above estimate of sediment yields in the sub-basins do not consider the tailings storage facilities (TSF) and other additional mitigating measures to minimize or prevent soil erosion during the operational phase of the project. Thus, the simulated changes in sediment processes in the sub-basins may be considered higher than what is to be expected if the proposed mitigating measures proved to be effective and operational.

It must be stressed also that the HEC-HMS model requires much more input information (especially in terms of land use classification, actual flow data, rainfall intensity, etc.) than is currently available for the study area. For example, scenarios may be sensitive to the choice of C factor; estimates had to be made on the representative C factor for such a broad land use classification used in this study. Although the model is transparent in showing what the impact might be if these estimates diverge significantly from reality.

This leads to the opinion that the model output should be treated with caution under the present conditions of relatively poor information. The HEC-HMS Model, though relatively easy to apply, cannot claim to produce accurate results, and to the extent that more information will become available, a repeated simulation may produce better sediment estimates. The work done, nevertheless, is an important contribution towards better knowledge and documentation of the sedimentation processes of the project area.

2.1.3.5 Soil Quality

Soil Quality in addition to the erosion potential evaluation, the soil samples collected within the Project area were also analyzed with respect to chemical qualities for agriculture and for metals contamination. Given the small-scale mining operations within the Project area, the lack of environmental management programs may have contributed to soil contamination. The results are summarized in Table 2-17 and Table 2-18.

The pH of all soil collected within the Project area was within a range of 4 to 5. This is considered extremely acidic to very strongly acidic. The optimum range for most plants to survive in soils is between 6 and 7.5. An acidic environment also affects the availability of nutrients in the soil. The optimum level of the nutrient phosphorous in soils is between 8 to 15 milligrams per kilogram of soil. The phosphorous concentrations within the soil samples were significantly lower than this. This may be attributed to the strongly acidic condition of the soil and further supports the poor agricultural potential assessment.

With respect to metals contamination, various criteria for the assessment and remediation of contaminated soils have been developed especially in industrialized countries, including the United States, Germany, United Kingdom, Australia, Canada, Netherlands, Japan and Taiwan. However, there are there are no guidelines established in the Philippines. Nonetheless, many national governments who lack their own guidelines have used the Dutch standards in assessing potentially contaminated sites. For the purpose of this EPRMP, soil quality baseline assessments are based on the Dutch standards. The values were based on standard soils (with 10% organic matter and 25% clay) with serious contamination.

Two values are considered in regulating the level of heavy metals in soils, a target value (upper value of the normal or natural level) and the intervention value (values which mean that the soil needs remediation measures). The heavy metal concentration of the collected soil samples and comparison to the Dutch standards are shown Table 2-18.

Composite samples taken near Zamboanga Mining (Sample 1, proposed waste rock disposal) and the Miswi area (Sample 4) indicated concentrations equal to the target value or normal level for copper and mercury. The composite sample taken from the (Genaro) Naro Community (Sample 2) indicated copper concentrations significantly higher than the target value but still within the intervention values. These results indicate the soils within the Zamboanga Mining, Miswi and (Genaro) Naro Community areas have high concentrations of copper and mercury. This could be a natural geologic condition or contamination by the small-scale mining operations.

Table 2-17: Chemical Properties of Soils Collected within the Project Area

Sample Identification	pH	Water Holding Capacity (mm/cm depth of soil)	Phosphorous (Olsen and Bray) (ppm)	Organic Carbon (%)	Organic Material (%)	Total Nitrogen (%)	Potassium (K) (meq/100 g soil)	Exchangeable Acid	Cation Exchange Capacity (NH4OAc)
1a	4.5	61.5	0.1	0.58	1	0.02	0.3	17.9	11.6
1b	4.4	62.9	not detected	0.83	1.43	0.04	0.4	18.7	11.4
1c	4.2	59.5	not detected	0.37	0.64	0.02	0.1	19.9	11.9
1d	4.3	62.1		0.34	0.58	0.02	0.1	18.9	11.9
2a	4.4	57.6	1.6	0.47	0.81	0.03	0.2	18.9	13.9
2b	4.6	64.5	1.8	0.69	1.19	0.05	0.2	18.1	15
2c	4.5	54	2	0.4	0.69	0.03	0.2	17.9	13.2
2d	4.6	58		0.37	0.64	0.02	0.2	17.9	13.5
3a	4.3	64.7	0.1	0.71	1.22	0.03	0.2	18.9	8.9
3b	4.3	61.4	not detected	0.9	1.55	0.04	0.3	18.9	9.2
3c	4.3	67.3	not detected	0.55	0.95	0.02	0.2	18.9	9.9
3d	4.3	65.6		0.48	0.83	0.02	0.2	18.9	10.2
4a	4.7	57.4	1.5	0.63	1.08	0.03	0.1	16.9	10.6
4b	4.6	62.2	not detected	0.56	0.96	0.02	0.1	17.9	10.6
4c	4.7	61.2	not detected	0.68	1.17	0.04	0.1	17.9	9.9
4d	5	61		0.53	0.91	0.02	0.1	15.9	10.2

Table 2-18: Heavy Metal Concentration of Soil Samples Collected within the Project Areas (mg/kg)

Sample Identification	Arsenic (As)	Cadmium (Cd)	Chromium (Cr)	Copper (Cu)	Mercury (Hg)	Nickel (Ni)	Lead (Pb)	Zinc (Zn)	Iron (Fe)	Manganese (Mn)
1a	6.5	6.7	<10.0	36.0	0.2	11	<10	0.29	53.24	133.62
1b	4.7	11.3	<10.0	32.2	<0.1	11.8	<10	0.53	102.01	148.87
1c	3.3	6.5	<10	25.5	0.2	<10	<10	0.1	16.75	27.74
1d	3.2	8.3	<10	33.7	<0.1	11.6	<10	0.08	5.37	5.57
2a	3.1	6.2	<10	41.2	<0.1	14.5	<10	3.69	23.05	24.07
2b	2.6	9.9	<10	32.2	0.2	17.5	<10	0.66	50.06	23.69
2c	2.5	9.6	24.7	50.2	0.2	19.0	<10	3.88	12.44	18.36
2d	2.9	9.0	<10	35.4	<0.1	15.0	<10	1.29	13.26	18.77
3a	2.3	9.9	<10	28.4	<0.1	<10	<10	0.20	46.31	5.77
3b	4.1	8.0	<10	26.6	<0.1	<10	12.2	0.37	69.56	7.16
3c	3.0	8.7	<10	27.8	<0.1	<10	<10	0.12	27.95	4.71
3d	2.4	9.2	<10	28.1	<0.1	<10	<10	0.14	18.36	3.61
4a	2.6	12.5	<10	34.2	0.3	<10	<10	0.39	39.98	13.99
4b	2.1	9.2	<10	33.6	0.1	<10.0	<10	0.1	17.14	1.98
4c	1.3	10.1	<10	25	0.3	11	<10	0.12	46.72	2.57
4d	1.7	10.4	<10	34.2	0.1	<10	<10	0.08	19.38	5.96
Dutch Target Values (mg/kg)	29.0	0.8	100.0	36.0	0.3	35.0	85.0	140	None indicated	
Dutch Intervention Values (mg/kg)	55.0	12.0	380.0	190.0	10.0	210.0	530.0	720	None indicated	
Note: Samples collected March 30, 2011. Red values exceed the Dutch Soil Contamination Criteria. Note: Sample Identification Key: a denotes composite sample, b denotes sample at 0-30 cm depth, c denotes sample at 31-60 cm depth, d denotes sample at greater than 60 cm depth										

Source: Target Values and Intervention Values based on Dutch Standards. Laboratory Testing by SGS Philippines Inc.

2.1.3.6 Change in Soil Quality/Fertility

Soil quality is at risk from land use changes and construction programs supplemental to the changes. Disturbance of the surface by compaction, vegetation removal or addition of other nutrients can destroy the ability of the soil to perform according to its function.

Compaction is often the result of heavy equipment and other pieces of large machinery moving across the landscape. As the soil is compacted, there are fewer pore spaces for oxygen and water to move through the soil profile, minimizing the potential for vegetation establishment. Alternatively, vegetation removal and loss of topsoil lowers the overall fertility of the soil and increases water movement through the soil and landscape. This further provides a less optimal environment for plant growth by creating imbalances in nutrient supply. Changes in soil quality and fertility are however localized and reversible in the short term.

Changes in soil fertility will occur once the topsoil is removed. Given the shallow topsoil layer and low nutrients, the underlying soils are expected to have low fertility rates. The low pH and low Cation Exchange Capacity also suggest a poor soil. This becomes more of an impact relative to post mining closure and re- vegetation of the Surface Mine and the Waste Rock and Overburden Disposal area. It is unlikely these areas will be able to support a revegetation and/or a reforestation program without the addition of soil conditioning agents and fertilizers.

Although removal and stockpiling of topsoil for future reclamation activities is preferred, the fertility of the soil will degrade over time and may need to be enhanced with soil conditioning or fertilizers.

Another potential risk to soil quality and fertility are incidences of chemical spills or leaks from process piping, tanks or storage areas. The severity of the impact of contaminants is variable and dependent on the volume of chemicals spilled or leaked, type of chemical, contaminant pathways and the characteristic of the environment receptors.

Some organic contaminants released to the environment can undergo chemical changes or degrade into products that may be more or less toxic than the original compound. Different contaminants are also variable with respect to their affinity to water, soils and the atmosphere. The characteristics of the soil also affect the degree of impact of potential contaminants. This includes soil mineralogy and clay content, pH of the soil, amount of organic matter in the soil, moisture levels, temperature, and the presence of other chemicals.

Some contaminants also have bioavailability components which can cause direct effects on plants, animals, or humans. In some cases, not all contaminants found in soil is biologically available. The bioavailability of a contaminant depends on many characteristics of the soil and site conditions. How tightly the contaminant is held by soil particles and its solubility (how much of it will dissolve in water) affect the bioavailability. Greater solubility usually means that more of the contaminant is available and also indicates the contaminant is more likely to leach out of the soil. Certain chemicals show an “aging effect” and can become less available the longer they remain in soils.

Within the Project area and operations activities, accidental spills or leaks of diesel fuel, oils and cyanide contaminated water pose the most significant potential impact. Diesel fuel and oil spills or leaks from the fuel tanks or other handling activities can result in elevated levels of contaminants such as benzene, toluene and xylene in the soil. Some of these chemicals are unlikely to remain in the surface soil due to their volatility. Other compounds in diesel which will tend to be more persistent and more bound to solid particles will include the polycyclicaromatic hydrocarbons (PAHs), alkyl PAHs and alkyl benzenes. Higher concentrations of heavier PAHs will tend to be in adjacent contaminated soils than migrate to the groundwater. Benzo (a) pyrene (BaP), which is present as a trace component in diesel, is largely immobile in soil and unlikely to migrate from a spill site into either the soils or groundwater (Irwin, 1997). In surface soils, diesel may have an impact on humans, animals or plants. Diesel in surface and near-surface soils will biologically degrade using soil oxygen that would normally be available to plant roots. This may result in vegetation distress in the immediate vicinity.

In addition to diesel fuel and oils, cyanide contaminated water and tailings resulting from ore processing, may be released to the soil environment. Cyanide in the soil may be partitioned between the solid, liquid and gas phases. The vapor phase diffusion of hydrogen cyanide is dominant. Cyanide attenuation in soils occurs due to adsorption and precipitation. Both are equally effective mechanisms under saturated and unsaturated conditions. Tests on bio attenuation of cyanides indicated they move only short distances through the soil before being biologically converted to nitrates then to ammonia and then to nitrates.

The distribution coefficient for soil and sediment absorption by cyanide (sodium cyanide at pH 10.5) indicates the Free Cyanide (CN-) ion can bind to these media. Cyanide mobility is relatively low in soils with a high concentration of free iron oxides and clays such as kaolin, chlorin, gibbsite (Callahan, et al, 1979). Alesii and Fuller (1976) indicated that soils with a high anion-exchange capacity, soils with higher concentration of manganese and hydrous oxides of iron, are more likely to attenuate cyanide.

The mobility of cyanide is greater in soils with high pH, high concentration of free calcium carbonate and low clay content. The soils sampled within the Project area have a lower pH and are relatively acidic. Some also exhibit a high anion-exchange capacity. This indicates a low mobility of cyanide within the Project area soils. However, as per Chatwin (1998), cyanide may be converted to cyanate in the soil on the surface of organic and inorganic materials and potentially in solutions. This is due in part to biologic processes which consume cyanide and generate cyanate. This is a less toxic product brought about by the oxidation of the cyanide compound.

Table 2-19: Results of Soil Quality Analysis

Sample Identification	pH	Water Holding Capacity (mm/cm depth of soil)	Phosphorous (Olsen and Bray) (ppm)	Organic Carbon (%)	Organic Material (%)	Total Nitrogen (N) (%)	Potassium (K) (meq/100 g soil)	Exchangeable Acid	Cation Exchange Capacity (NH4OAc)
1a	4.5	61.5	0.1	0.58	1	0.02	0.3	17.9	11.6
1b	4.4	62.9	not detected	0.83	1.43	0.04	0.4	18.7	11.4
1c	4.2	59.5	not detected	0.37	0.64	0.02	0.1	19.9	11.9
1d	4.3	62.1		0.34	0.58	0.02	0.1	18.9	11.9
2a	4.4	57.6	1.6	0.47	0.81	0.03	0.2	18.9	13.9
2b	4.6	64.5	1.8	0.69	1.19	0.05	0.2	18.1	15
2c	4.5	54	2	0.4	0.69	0.03	0.2	17.9	13.2
2d	4.6	58		0.37	0.64	0.02	0.2	17.9	13.5
3a	4.3	64.7	0.1	0.71	1.22	0.03	0.2	18.9	8.9
3b	4.3	61.4	not detected	0.9	1.55	0.04	0.3	18.9	9.2
3c	4.3	67.3	not detected	0.55	0.95	0.02	0.2	18.9	9.9
3d	4.3	65.6		0.48	0.83	0.02	0.2	18.9	10.2
4a	4.7	57.4	1.5	0.63	1.08	0.03	0.1	16.9	10.6
4b	4.6	62.2	not detected	0.56	0.96	0.02	0.1	17.9	10.6
4c	4.7	61.2	not detected	0.68	1.17	0.04	0.1	17.9	9.9
4d	5	61		0.53	0.91	0.02	0.1	15.9	10.2

2.1.4 Terrestrial Ecology

A terrestrial flora and fauna assessment within the project site was conducted in 2020. The same sampling plots during the 2011 survey were reviewed by the third party commissioned by TVIRD. The study covered the assessment of nine forested areas and included riparian habitat and ridges of secondary mixed dipterocarp forest. Three major forested areas were delineated and covered a total area of 367 hectares. Location coordinates of the sampling plots are identified in Table 2-20. Figure 2-37 the location of the sampling plots.

Table 2-20: Details of Terrestrial Flora and Fauna Sampling Plot

Study Area	Station	Location	Elevation (asl)
Area 1 - Dimalinao and Unao-Unao Creeks	1	N 7 53.844 / E 122 57.378	401
	2	N 7 53.876 / E 122 57.391	430
	3	N 7 53.883 / E 122 57.343	446
	4	N 7 53.913 / E 122 57.233	514
Area 2 - Naro and Depore Creeks	1	N 7 53.598 / E 122 56.460	567
	2	N 7 53.311 / E 122 56.776	399
	3	N 7 53.735 / E 122 56.225	648
	4	N 7 53.823 / E 122 56.307	750
	5	N 7 53.824 / E 122 56.307	745
	6	N 7 53.984 / E 122 56.100	821
	7	N 7 54.030 E 122 56.312	713
Area 3 - Depore River	1	N 7 53.271 / E 122 57.316	352
	2	N 7 53.422 / E 122 57.414	436
	3	N 7 53.247 / E 122 57.814	476
	4	N 7 52.293 / E 122 57.136	301

2.1.4.1 Methodology of Terrestrial Flora

Two kilometers transect was established in each identified site. Along the transect, five (5) plots were established measuring 20x20 meters. These plots were used to measure the species richness and Diversity of the flora. Smaller subplots measuring 5 x 5 meters were also employed for the lower canopy and ground cover. All species of flora was accounted inside the established plot. Transect walk was also done between plots. The transect walk is a rapid biodiversity assessment technique that employs a hike, recording of species, and physical attributes. This method seeks all major ecosystems, determines stratified zones, and map the areas across.

Species dominance of the plant communities within quadrats and sub-quadrats along transect lines was assessed in terms of the estimated total cover (EC), relative ground cover (RC), number of times the individual species (i) occurred, absolute frequency (AF) and relative frequency (RF) of individual species encountered in the sampling plots. The summation of the relative ground cover and relative frequency (RC + RF) reflects the importance values (IV) for that species. Individuals with high IV are considered as the dominant species in a given plant community. Discussions of the different species identifiers and characteristics are provided below.

2.1.4.2 Methodology of Terrestrial Fauna

Faunal species observed during the terrestrial biology monitoring included amphibians, reptiles, birds and mammals like bats, murids and medium-large mammals. Herping activity was done during daytime in all the forest patches. Avifaunal species were surveyed by traversing all available habitats which were usually along river/creeks and ridge tops of secondary lowland dipterocarp forest. Mistnets about 6 to 10 meters in length were established to capture cryptic and shy bird species that were difficult to observe during the daily observations. Mistnests were also used to sample mammals and specifically bats. Nets were set on ridge tops, across and parallel to trails, across forest gaps or openings and across rivers and creeks. Murid species were sampled using live traps set along passageways, under fallen logs, root tangles and alongside of murid holes. Medium to large mammals were identified through actual sightings and examination of fresh tracks and droppings. Four Study Areas were established for monitoring and are shown on Figure 2-37.

Site 1 is located within the Unao-Unao Creek watershed near the forested ridgeline boundary with the Dimalinao Creek watershed. Site 2 is located within the Naro Creek watershed near the Depore River. Site 2 was subdivided into Sites 2a and 2b. Site 3 is located near a logging road to the Dipili River and the Lower Depore River. Site 4 is located near the Exploration Camp within the upstream portion of the Unao-Unao Creek watershed.

2.1.4.3 Results of Terrestrial Flora

Inventory of the species in all sampling sites (15 plots and transect walk) revealed a total of 161 Species, 142 Genera in 62 Families (Table 2-21). Among the group of plants, 135 species were classified as Angiosperms and 26 were Pteridophytes. As to plant habit, majority of the identified angiosperms were trees (49.63%) followed by shrubs (22.22%), herbs (20 %) and vines with 8.15%. The families with the greatest number of species were Dipterocarpaceae, Moraceae and Araceae respectively.

An assessment of the status of the different plant species was carried out to establish a foundation for their protection, conservation and monitoring based on the IUCN red list of threatened species. A total of 33 species were considered as threatened of which three species, *S. palosapis Hopea acuminata*, and *Toona calantas*, were listed as critically endangered. *Medinilla magnifica* and *Litsea leytenensis*, *Diospyros blancoi* were considered endangered while 26 species were vulnerable. The remaining species are considered as least concern (LC) species and with widespread distribution, but with decreasing population trend due to continuous exploitation and conversion of this ecosystem.

Table 2-21: List of Threatened Species in TVIRD Balabag, Zamboanga del Sur

Species	Local Name	Family Name	Conservation Status (IUCN 2019)
Aflezia rhomboides	Tindalo	Fabaceae	Vulnerable
Anisoptera thurifera	Palosapis	Dipterocarpaceae	Vulnerable
Begonia bolsterii	Begonia	Begoniaceae	Vulnerable
Cananga odorata	Ilang-ilang	Meliaceae	Vulnerable
Canarium luzonicum	Pili-pili	Burseraceae	Vulnerable
Canarrium ovatum	Pili	Burseraceae	Vulnerable
Cinnamomum mercadoi	Kalingag	Lauraceae	Vulnerable
Cyathea contaminans	Gantaw	Cyatheaceae	Vulnerable
Dillenia philippinensis	Katmon	Dilleniaceae	Vulnerable
Diplodiscus paniculatus	Balobo	Malvaceae	Vulnerable
Dipterocarpus grandiflorus	Apitong	Dipterocarpaceae	Vulnerable
Dracontemelon edule	Lamio	Anacardiaceae	Vulnerable
Hopea acuminata	Magasusu	Dipterocarpaceae	Vulnerable
Hopea acuminata	Mangachapoi	Dipterocarpaceae	Critically Endangered
Hopea philippinensis	Gisok	Dipterocarpaceae	Vulnerable
Litsea leytensis	Bantuling	Lauraceae	Endangered
Mangifera altissima	Pahutan	Anacardiaceae	Vulnerable
Medinilla magnifica	Kapa-kapa	Melastomataceae	Endangered
Ormosia calavensis	Bahai	Fabaceae	Endangered
Palaqium philippense	Lukos	Sapotaceae	Vulnerable
Palaqium luzoniense	Nato	Sapotaceae	Vulnerable
Parashorea malaalonan	Bagtikan	Dipterocarpaceae	Vulnerable
Podocarpus nerifolia	Subing	Podocarpaceae	Endangered
Securinega flexuosa	Anislag	Euphorbiaceae	Vulnerable
Shorea almon	Almon	Dipterocarpaceae	Vulnerable
Shorea contorta	Danlugan	Dipterocarpaceae	Vulnerable
Shorea negrosensis	Red lawaan	Dipterocarpaceae	Vulnerable
Shorea palosapis	Mayapis	Dipterocarpaceae	Critically Endangered
Shorea polysperma	Tanguile	Dipterocarpaceae	Vulnerable
Shorea stylosa	Yakal	Dipterocarpaceae	Vulnerable
Toona calantas	Diyak	Meliaceae	Critically Endangered
Vitex parviflora	tugas	Lamiaceae	Vulnerable
Vitex quinta	kulipapa	Lamiaceae	Vulnerable

Of the total 161 plant species that were listed, 118 are found to be indigenous in the Philippines of which 43 species or (26.70%) were endemic or are exclusively found only in the country. Twenty-six (26) percent of the enumerated species were classified as introduced in the area either for rehabilitation or ornamental purposes. Among the list of endemic species includes Shorea negrosensis, Parashorea malaanonan, Caryota cumingii, Canarium luzonicum, Begonia copelandii, Homalomena philippeninsis ,Stenochlaena palustris and Drynaria descensa. Some of these Philippine endemic species were also threatened and endangered and it must be given sufficient protection measures in order to ensure their continued existence in the wild.

Table 2-22: List of All Species of Flora Identified across Sampling Sites in 2020 Study

Scientific Name	Local Name	Family Name	Distribution Status
ANGIOSPERMS			
Adinandra robinsonii	Sagimsim	Theaceae	
Aflezia rhomboides	Tindalo	Fabaceae	Endemic
Allocasia portei	Wild gabi	Araceae	
Alocasia clypeolata	Gabi-gabi	Araceae	
Alpinia haenkii	Torch zengir	Maranthaceae	
Alstonia scholaris	Diyak	Apocynaceae	
Anacardium sp.	Manga-manga	Anacardiaceae	
Anisoptera thurifera	Palosapis	Dipterocarpaceae	
Aralia bipinnata	Suha-suha	Aralliaceae	
Artocarpus blancoi	Tipolo	Moraceae	Endemic
Ascarina philippinensis	Babakag	Chloranthaceae	
Ascideria zamboangensis	Orchid	Orchidaceae	Endemic
Begonia bolsterii	Begonia	Begoniaceae	
Begonia cumingii	Mamangpang	Begoniaceae	
Begonia copelandii	Begonia	Begoniaceae	
Bridelia glauca	Talan	Euphorbiaceae	
Bulbophyllum sp.	Orchid	Orchidaceae	
Calamus merrilii	Oway	Arecaceae	Endemic
Callophylum inophylum	Bitanghol	Clusiaceae	
Cananga odorata	Ilang-ilang	Meliaceae	
Canarium aspermum	Pagsahingin	Burseraceae	
Canarium luzonicum	Pili-pili	Burseraceae	Endemic
Canarrium ovatum	Pili	Burseraceae	Endemic
Caryota cumingii	Pugahan	Arecaceae	
Castanopsis philippinensis	Ulayan puti	Fagaceae	Endemic
Chromolaena odorota	Hagonoy	Verbenaceae	
Cinnamomum mercadoi	Kalingag	Lauraceae	Endemic
Clerodendrum macrostegium	Lindang-lindang	Verbenaceae	
Commelina diffusa	Balibatang	Commelinaceae	
Costus speciosus	Tiwasi	Costaceae	
Cratoxylum sumatranum	Ulingon	Myrrtaceae	
Daemonorps mollis	Oway	Arecaceae	
Dendrochilum sp.	Orchid	Orchidaceae	
Dillenia philippinensis	Katmon	Dilleniaceae	Endemic

Scientific Name	Local Name	Family Name	Distribution Status
Dinochloa pubiramea	Bulukawe	Poaceae	
Diospyros blancoi	Kamagong	Ebenaceae	Endemic
Diplodiscus paniculatus	balobo	Malvaceae	Endemic
Dipterocarpus grandiflorus	apitong	Dipterocarpaceae	
Donax cannaeformis	ban-ban	Maranthaceae	
Dracontemelon edule	Lamio	Anacardiaceae	
Duabanga moluccana	Loctob	Lythraceae	
Elaeocarpus calomala	santiol-santol	Elaeocarpaceae	
Elaeocarpus sp.	bakan	Elaeocarpaceae	
Elatostema pulchellium	lalambing	Urticaceae	
Entada sp.	salimbagon	Fabaceae	
Erythrina orientalis	dap-dap	Fabaceae	
Etlingeria elatior	tagbak	Zngeberaceae	
Falcataria paraseriantes	falcata	Fabaceae	
Falcataria paraseriantes	balete	Moraceae	
Ficus congesta	Tibig	Moraceae	
Ficus minahassae	hagimit	Moraceae	
Ficus nota	Lagnob	Moraceae	
Ficus psuedopalma	malapapaya	Moraceae	Endemic
Ficus septica	Hawili	Moraceae	Endemic
Ficus ulmifolia	is-is	Moraceae	
Ficus variegata	tangisang baya	Moraceae	
Freycinetia multiflora	baras	Pandanaceae	
Freycinetia sp.	Pandan	Pandanaceae	
Garcinia binucao	kandiis	Clusiaceae	
Garcinia ituman	ituman	Clusiaceae	
Heterospathe philippinensis	karupay	Arecaceae	
Homalomena philippeninsis	pusaw	Araceae	Endemic
Hopea acuminata	magasusu	Dipterocarpaceae	Endemic
Hopea acuminata	Mangachapoi	Dipterocarpaceae	Endemic
Hopea philippinensis	gisok	Dipterocarpaceae	Endemic
Hoya melliflua	Hoya	Dischidiaceae	
Impatiens montalbanica	Silangka	Balsaminaceae	
Imperata cylindrica	cogon	Poaceae	
Iria sp.	orchid	Orchidaceae	
Knema glomerata	tambalaw	Myristicaceae	Endemic
Laportea myeniana	alingatong	Urticaceae	
Leukosyke capitilata	anagase	Urticaceae	
Lithocarpus sulitii	ulayan	Fagaceae	
Litsea leytensis	bantuling	Lauraceae	Endemic

Scientific Name	Local Name	Family Name	Distribution Status
Litsea leytensis	bintoko	Rutaceae	
Macaranga bicolor	binunga	Euphorbiaceae	
Macaranga sp.	hindang	Euphorbiaceae	
Magnolia philippinensis	ngilo	Magnoliaceae	Endemic
Mangifera altissima	pahutan	Anacardiaceae	Endemic
Medinilla magnifica	kapa-kapa	Melastomataceae	Endemic
Melastoma malabathricum	hantutuknaw	Melastomataceae	
Melicope acuminata	bintuko	Rutaceae	
Mikania cordifolia	mote-mote	Convulvolaceae	
Mucuna gigantea	lubid	Fabaceae	
Musa parasiadica	agutay	Musaceae	
Musa parasiadica	duguan	Myristicaceae	Endemic
Neonauclea formicaria	hambabalod	Rubiaceae	
Nephelleum sp.	malarambutan	Sapindaceae	
Omalantus populneus	bayante	Euphorbiaceae	
Omalantus populneus	bahai	Fabaceae	
Osmoxylon diversifolium	binliw	Aralliaceae	
Palaqium philippense	lukos	Sapotaceae	Endemic
Palaqium luzoniense	nato	Sapotaceae	Endemic
Pandanus odorotissimus	pandanus	Pandanaceae	Endemic
Pangium edule	pangi	Flacouriaceae	
Parashorea malaalonan	bagtikan	Dipterocarpaceae	
Paspalum conjugatum	meligoy	Poaceae	
Phellodendron sp.	Katay	Araceae	
Phrynium philippinensis	hagithit	Zngeberaceae	Endemic
Pilea melastomoides	Handalamay	Urticaceae	
Pinanga insignis	Kalubi	Arecaceae	Endemic
Pinanga maculata	palm	Arecaceae	Endemic
Piper aduncum	buyo-buyo	Piperaceae	
Podocarpus nerifolia	subing diwata	Podocarpaceae	Endemic
Poikilospermum suaveolens	nopol	Urticaceae	
Pollia secundiflora	commellina	Commelinaceae	
Polysias nodusa	Hagdang uwak	Aralliaceae	
Pometia pinnata	giburagat	Sapindaceae	
Psychotria ramossisimma	talimughat	Rubiaceae	
Pterospermum diversifolium	Bayog	Sterculiaceae	
Pterospermum obliquum		Sterculiaceae	
Radermachera pinnata	banai-banai	Bignoniaceae	
Raphidophora monticola	labid	Araceae	
Rapidophora sp	labid	Araceae	

Scientific Name	Local Name	Family Name	Distribution Status
Robus moloccanus	bariw	Rosaceae	
Salomonia ciliata	bino-bino	Polygalaceae	
Schefflera alvarezii	tagima	Aralliaceae	
Schismatoglotis calyptrata	payaw	Araceae	
Securinega flexuosa	anislag	Euphorbiaceae	Endemic
Shorea almon	almon	Dipterocarpaceae	
Shorea contorta	danlugan	Dipterocarpaceae	Endemic
Shorea negrosensis	red lawaan	Dipterocarpaceae	Endemic
Shorea palosapis	mayapis	Dipterocarpaceae	Endemic
Shorea polysperma	tanguile	Dipterocarpaceae	Endemic
Shorea stylosa	yakal	Dipterocarpaceae	Endemic
Smilax chinensis	banag	Smilacaceae	
Syzygium sp.	lumboy-lumboy	Myrtaceae	
Terminalia foetida	Talisay gubat	Combretaceae	
Terminalia nitens	magatalisay	Combretaceae	
Ternstroemia megacarpa	Tagilumboy	Theaceae	
Toona calantas	Diyak	Meliaceae	Endemic
Trema orientales	hanagdong	Cannabaceae	
Vitex parviflora	tugas	Lamiaceae	
Vitex quinta	kulipapa	Lamiaceae	
Voacangaglobosa	bayag usa	Apocynaceae	Endemic
PTERIDOPHYTES			
Angiopteris palmiformes	Giant Fern	Marattiaceae	
Antrophyum latifolium	butitay	Vittariaceae	
Asplenium decorum	fern	Aspleniaceae	
Asplenium musifolium	asplenium	Aspleniaceae	Endemic
Asplenium nidus	birds' nest	Aspleniaceae	
Belvisia glauca	fern	Polypodiaceae	
Blechnum fraserii	fern	Blechnaceae	
Blechnum orientale	blechnum	Blechnaceae	
Christensenia aesculifolia	fern	Marratiacea	
Conniogramma sp.	fern 2	Sinopteridaceae	
Cyathea contaminans	gantaw	Cyatheaceae	Endemic
Davallia solida	fern	Davalliaceae	
Dicranopteris liniaris	agsam	Gleicheniaceae	
Diplazium esculentum	pako	Athyriaceae	
Drynaria quercifolia	kabkab	Polypodiaceae	Endemic
Lycopdium cernuum	ikog ering	Lycopodiaceae	
Lygodium circinnatum	nito	Schizaeceae	
Lygodium japonicum	nito	Schizaeceae	Endemic

Scientific Name	Local Name	Family Name	Distribution Status
Marratia sylvatica	Giant Fern	Marattiaceae	
Nephrolepis bisserata	Sword fern	Oleandraceae	
Pyrrosia pelosilloides	katay	Polypodiaceae	
Selaginella delicatula	selaginella	Sellaginellaceae	
Selaginella plana	selaginella	Sellaginellaceae	
Stenochlaena palustris	katay	Oleandraceae	Endemic
Sticherus laevata	agsam	Gliecheniaceae	
Tectaria dissecta	tectaria	Aspidiaceae	
Tectaria meliflua	tectaria	Aspidiaceae	

Table 2-23: Comparison of Flora Assessment for Year 2022 and Year 2011

Particular	2020 Findings	2011 Findings
Species Composition	161	338
Dominant Species	Shorea palosapis	Piper arborescens
Number of Threatened Species	33 (3) (3)	36 (10) (8)
Endemicity	26.79	
Number of Genera	142	219
Number of Families	62	80
Dominant Families	Dipterocarpaceae	Moraceae
Diversity	3.83	4.367

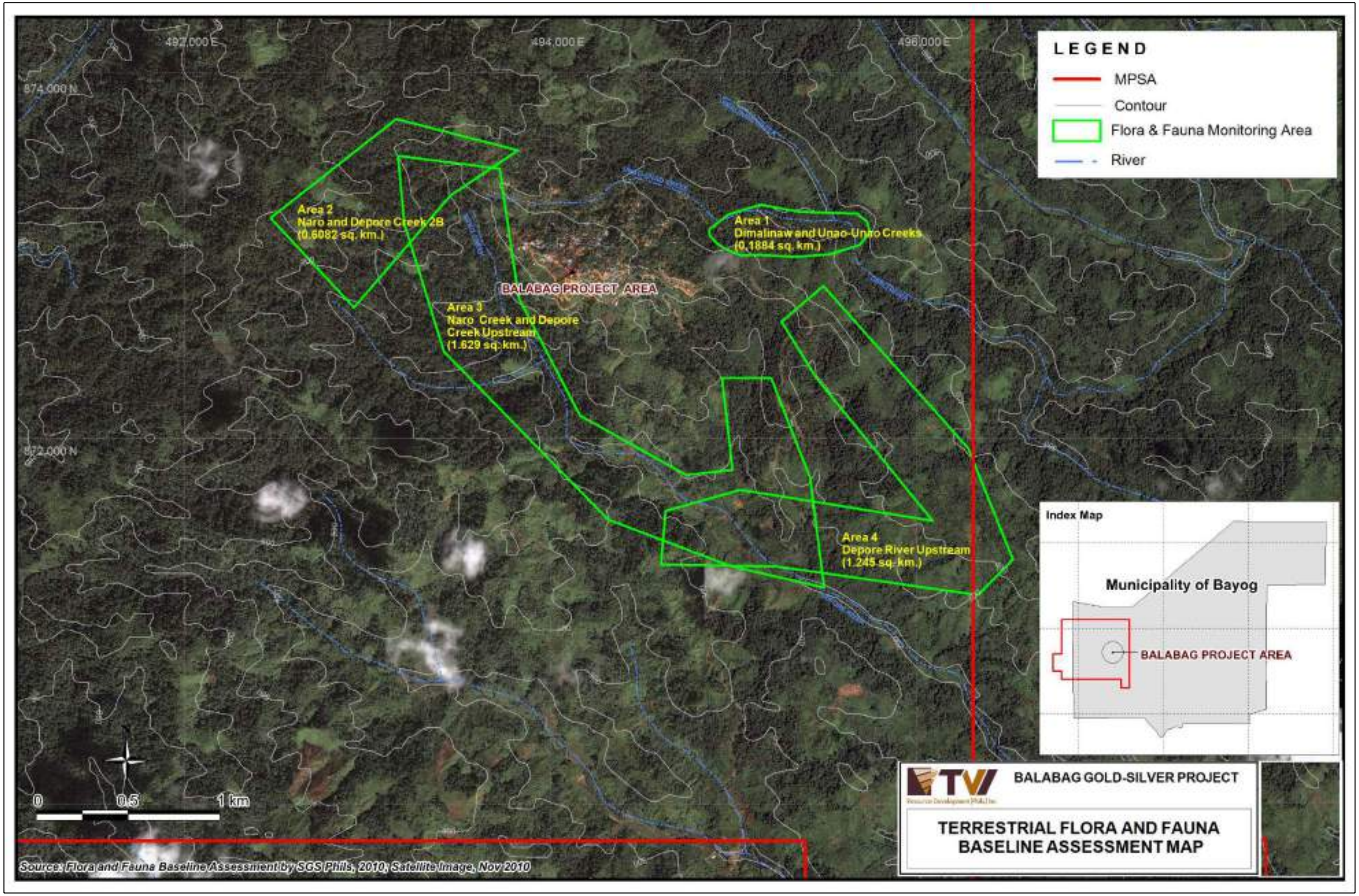
2.1.4.4 Results of Terrestrial Fauna

2.1.4.4.1 Avifauna Community

The birds, reptiles, and mammals within the mining, stockyard, and accommodations sites were also assessed. Table 2-24 provides the list, range description, conservation status and distribution of avifauna in the three sampling sites within the TVIRD's Balabag MPSA.

The recent monitoring had recorded a total of seventy-four (74) species of birds with around 594 individuals from thirty-six (36) families. The families Dicaeidae, Columbidae, Cuculidae, Nectariniidae and Muscicapidae had the greatest number of species with nine (9), six (6), five (5), five (5) and four (4) species respectively. In terms of abundance, the flowerpeckers (family Dicaeidae) had the highest number of individuals observed (n = 104) followed by the sunbirds (Nectariniidae) with 46 individuals, the babblers (family Timaliidae) with 43 individuals, the pigeons and doves (Columbidae) with 41 individuals and the swifts (Apodidae) with 34 individuals (Table 2-25). *During the* monitoring, the Brown Tit Babbler (Macronus striaticeps) was observed with the greatest number of individuals (n = 43) followed by the Redkeeled Flowerpecker (Dicaeum australe) with 30 individuals. Coleto or the Sarcops calvus ranks third in terms of abundance with 29 individuals followed by the Purple-throated Sunbird (Leptocoma sperata) with 23 individuals and the Buzzing Flowerpecker (Dicaeum hypoleucum) with 22 individuals.

Figure 2-37: Terrestrial Flora and Fauna Baseline Assessment Map



Source: TVIRD Balabag Gold-Silver Project , EIS

Table 2-24: List, Range Description, Conservation Status, and Distribution of Avifauna

FAMILY	SCIENTIFIC NAME	COMMON NAME	RANGE	IUCN
Accipitridae	Accipiter trivirgatus	Crested Goshawk	R	LC
Nectariniidae	Aethopyga linaraborae	Lina's Sunbird	E	NT
Nectariniida	Arachnothera clarae	Naked-faced Spiderhunter	E	LC
Nectariniidae	Arachnothera flammifera	Little Spiderhunter	E	LC
Psittaculidae	Bolbopsittacus lunulatus	Guaiabero	E	LC
Muscicapidae	Brachypyeryx montana	White-browed Shortwing	R	LC
Bucerotidae	Buceros hydrocorax	Rufous Hornbill	E	NT
Cuculidae	Cacomantis merulinus	Plaintive Cuckoo	R	LC
Cuculidae	Cacomantis sepulcralis	Rusty-breasted Cuckoo/Brush Cuckoo	R	LC
Cuculidae	Centropus melanops	Black-faced Coucal	E	LC
Cuculidae	Centropus viridis	Philippine Coucal	E	LC
Alcedinid ae	Ceyx argentatus	Southern Silvery Kingfisher	E	NT
Columbid ae	Chalcophaps indica	Common Emerald Dove	R	LC
Chlorops idae	Chloropsis flavipennis	Philippine Leafbird	E	VU
Nectariniidae	Cinnyris jugularis	Olive-backed Sunbird	R	LC
Apodidae	Collocalia esculenta	Glossy Swiftlet	R	LC
Apodidae	Collocalia troglodytes	Collocalia troglodytes	E	LC
Muscicapidae	Copsychus mindanensis	Oriental MagpieRobin	E	LC
Corvidae	Corvus enca	Slender-billed Crow	R	LC
Picidae	Dendrocopos maculatus	Philippine Pygmy Woodpecker	E	LC
Dicaeidae	Dicaeum aeruginosum	Striped Flowerpecker	E	LC
Dicaeidae	Dicaeum australe	Red-keeled Flowerpecker	E	LC
Dicaeidae	Dicaeum bicolor	Bicolored Flowerpecker	E	LC
Dicaeidae	Dicaeum hypoleucum	Buzzing Flowerpecker	E	LC
Dicaeidae	Dicaeidae	Olive-capped Flowerpecker	E	LC
Dicaeidae	Dicaeum proprium	Whiskered Flowerpecker	E	NT
Dicaeidae	Dicaeum pygmaeum	Pygmy Flowerpecker	E	LC
Dicaeidae	Dicaeum trigonostigma	Orange-bellied Flowerpecker	R	LC
Dicruridae	D Dicrurus hottentottus	Spangled Drongo	R	LC
Picidae	Dryocopus javensis	White-bellied Woodpecker	R	LC
Pittidae	Erythropitta erythrogaster	Red-bellied Pitta	R	LC
Cuculidae	Eudynamys scolopaceus	Common Koel	R	LC
Coraciidae	Eurystomus orientalis	Oriental Dollarbird	R	LC
Rallidae	Gallirallus torquatus	Barred Rail	R	LC
Phasianidae	Phasianid ae	Red Junglefowl	R	LC
Columbidae	Geopelia striata	Geopelia striata	R	LC
Acanthizidae	Gerygone sulphurea	Golden-bellied Gerygone	R	LC
Alcedinidae	Halcyon smyrnensis	White-throated Kingfisher	R	LC

FAMILY	SCIENTIFIC NAME	COMMON NAME	RANGE	IUCN
Trogonidae	Harpactes ardens	Philippine Trogon	E	LC
Hirundinidae	Hirundini dae	Hirundini dae	M	LC
Hirundinidae	Hirundini dae	Pacific Swallow	R	LC
Monarchidae	Hypothymis azurea	Black-naped Monarch	R	LC
Pycnonotidae	Hypsipetes rufigularis	Zamboanga BulbulB	E	NT
Campephagidae	Lalage melanoleuca	Black-and-white Triller	E	LC
Campephagidae	Lalage nigra	Pied Triller	R	LC
Laniidae	Lanius cristatus	Brown Shrike	M	LC
Nectariniidae	Leptocoma sperata	Purple-throated Sunbird	E	LC
Psittaculid ae	Loriculus philippensis	Philippine Hanging Parrot	E	LC
Timaliidae	Macronus striaticeps	Brown Tit-Babbler	E	LC
Columbidae	Macropygia tenuirostris	Philippine CuckooDov	NE	LC
Apodidae	Mearnsia picina	Philippine Needletail	E	NT
Megalaimidae	Megalaima haemacephala	Coppersmith Barbet	R	LC
Locustelli dae	Megalurus palustris	Striated Grassbird	R	LC
Meropidae	Merops viridis	Blue-throated Bee-eater	R	LC
Muscicapidae	Monticola solitarius	Blue Rock Thrush	R, M	LC
Motacillidae	Motacillatschutschensis	Yellow Wagtail	M	LC
Muscicapi dae	Muscicapagriseisticta	Grey-streaked Flycatcher	M	LC
Cisticolidae	Orthotomus castaneiceps	Philippine Tailorbird	E	LC
Bucerotidae	Penelopides affinis	Mindanao Hornbill	E	LC
Campephagidae	Pericrocotus divaricatus	Ashy Minivet	M	LC
Columbidae	Phapitreron amethystinus	Amethyst Brown Dove	E	LC
Columbidae	Phapitreron leucotis	White-eared Brown Dove	E	LC
Phylloscopidae	Phylloscopus olivaceus	Philippine Leaf Warbler	E	LC
Dicaeidae	Prionochilus olivaceus	Olive-backed Flowerpecker	E	LC
Pycnonotidae	Pycnonotus goiavier	Yellow-vented Bulbul	R	LC
Pycnonotidae	Pycnonotus urostictus	Yellow-wattled Bulbul	E	LC
Sturnidae	Rhabdornis mystacalis	Stripe-headed Rhabdornis	E	LC
Bucerotida e	Rhabdotorrhinus leucocephalus	Writhed Hornbill	E	NT
Rhipiduridae	Rhipidura nigritorquis	Philippine Pied Fantail	E	LC
Sturnidae	Sarcops calvus	Sarcops calvus	NE	LC
Sittidae	Sitta oenochlamys	Sulphur-billed Nuthatch	E	LC
Columbidae	Spilopelia chinensis	Spotted Dove	R	LC
Accipitridae	Spilornis holospilus	Philippine Serpent Eagle	E	LC
Zosteropidae	Zosterops montanus	Mountain White-eye	R	LC

Table 2-25: Species Found in 2020 which was found in 2011

No.	Species	2011	2020
1	Corvus enca	-	/
2	Geopelia striata	-	/
3	Gallus	-	/
4	Hypsipetes rufigularis	-	/
5	Rhipidura nigritorquis	-	/
6	Chalcophaps indica	-	/
7	Copsychus mindanensis	-	/
8	Dendrocopos maculatus	-	/
9	Eudynamys scolopaceus	-	/
10	Gerygone sulphurea	-	/
11	Macropygia tenuirostris	-	/
12	Arachnothera clarae	-	/
13	Brachypteryx montana	-	/
14	Dicaeum aeruginosum	-	/
15	Dicaeum nigrilore	-	/
16	Erythropitta erythrogaster	-	/
17	Gallirallus torquatus	-	/
18	Lalage nigra	-	/
19	Accipiter trivirgatus	-	/
20	Aethopyga linaraborae	-	/
21	Bolbopsittacus lunulatus	-	/
22	Hypsipetes philippinus	/	
23	Corvus macrorhynchos	/	
24	Haliastur indus	/	
25	Microhierax erythrogenys	/	

2.1.4.4.2 Herpetofauna

Microhabitats such as forest floors, falling logs, rotten logs, and leaf litters at the site provide a suitable place for the herpetofauna species in the ecosystem of Balabag. A total of 228 individuals of herpetofauna were collected and recorded in the three sampling sites belonging to 13 families, 19 genera, and 21 species.

It is noteworthy to report that all herpeto fauna collected are all Philippine endemics. For anurans, a total of 194 individuals (85.09%) and nine species belonging to six families: Bufonidae, Ceratobatrachidae, Dicroglossidae, Megophryidae, Ranidae, and Rhacophoridae. All the species are categorized as Least Concern and Philippine endemics, and only L. magnus is categorized as Near Threatened. The five species have a decreasing population, three have a stable population, and one unknown trend of population. The decreasing population of the species could be due to the illegal hunting for trading and food consumption, changes and expansion of land-use utilization. Hence, it is suggested to strengthen the people's awareness on biodiversity conservation and management.

For reptiles, there were 34 individuals accounting for 14.91% of the collected samples of herpetofauna. A total of 16 individuals (7.02%) and six species of snakes comprised of four families, namely: Colubridae, Natricidae, Pseudoxyrhophiidae, and Viperidae. The four species have a decreasing population trend, one stable, and one not evaluated. The family Natricidae composed of three species collected. These are Rhabdophis lineatus, Tropidonophis dendrophiops, and Psammodynastes pulverulentus. Four of the species are least concern, one not evaluated (P. pulverulentus) and only S. muelleri is categorized as near threatened.

Lizards yielded 17 individuals (7.46%) and five species belonging to two families, Agamidae and Scincidae. Family Scincidae has the greatest number of species recorded namely: Eutropis multicarinata, Sphenomorphus fasciatus, Sphenomorphus variegatus, and Tropidophorus misaminius. The Draco bimaculatus species were the only agamid species recorded. All are least concern and Philippine endemics, and three have a stable population. The two species have an unknown population trend.

Table 2-26: List of Herpetofauna Collected in the Study Area and Corresponding Details

Family	Scientific Name	Common Name	Conservation Status	Distribution Status	Current Population Trend
ANURANS (Frog) (S=9)					
Bufonidae	*Ansonia muelleri*	Mueller's Toad	LC	PE	Decreasing
Ceratobatrachidae	*Platymantis corrugatus*	Rough-Backed Forest Frog	LC	PE	Stable
Dicroglossidae	*Limnonectes leytensis*	Leyte Wart Frog	LC	PE	Decreasing
Dicroglossidae	*Limnonectes magnus*	Mindanao Fanged Frog	NT	PE	Decreasing
Megophryidae	*Megophrys stejnegeri*	Mindanao Horned Frog	LC	PE	Unknown
Ranidae	*Pulchrana grandocula*	Big-eyed-frog	LC	PE	Stable
Ranidae	*Staurois natator*	Mindanao Splash Frog	LC	PE	Decreasing
Rhacophoridae	*Philautus surdus*	Forest Tree Frog	LC	PE	Stable
Rhacophoridae	*Rhacophorus bimaculatus*	Mindanao Flying	LC	PE	Decreasing
SQUAMATA (SNAKES) (S=6)					
Colubridae	*Stegonotus muelleri*	Muller's Wolf Snake/Philippine Ground Snake	NT	PE	Decreasing
Natricidae	*Rhabdophis lineatus*	Zigzag-lined Water Snake	LC	PE	Decreasing
Natricidae	*Tropidonophis dendrophiop*	Spotted Water Snake	LC	PE	Decreasing

Family	Scientific Name	Common Name	Conservation Status	Distribution Status	Current Population Trend
Natricidae	*Psammodynastes pulverulentus*	Common Mock Viper	NE	PE	Not evaluated
Pseudoxyrhophiid	*Oxyrhabdium modest*	Non-banded Philippine Burrowing	LC	PE	Decreasing
Viperidae	*Trimeresurus flavomaculat*	Philippine pit viper	LC	PE	Stable
SQUAMATA (LIZARDS) (S=5)					
Agamidae	*Draco bimaculatus*	Two-spotted Flying Lizard	LC	PE	Stable
Scincidae	*Eutropis multicarinata*	Northern TwoStriped Mabuya	LC	PE	Unknown
Scincidae	*Sphenomorphus fasciatus*	Banded Sphenomorph	LC	PE	Stable
Scincidae	*Sphenomorphus variegat*	Black-Spotted Sphenomorph	LC	PE	Unknown
Scincidae	*Tropidophorus misami*	Mindanao waterside s	LC	PE	Stable
TESTUDINES (TURTLES) (S=1)					
Trionychidae	*Pelodiscus sinensis*	Chinese Softshell	VU	IAS	Decreasing
Legend: LC – Least Concern, NT – Near Threatened, VU – Vulnerable, NE – Not Evaluated; IAS – Invasive Alien Species, PE – Philippine Endemic.					

2.1.4.4.3 Mammalian Fauna

During the 2020 assessment, twelve (12) mammalian species belonging to eight (8) Families were recorded, represented by seven (7) non-volant mammals namely: Philippine warty pig (Sus philippensis mindanensis), Philippine long tailed macacaque (Macaca fasicularis philippensis), Asian civet cat (Paradoxurus hermaphroditus), Philippine Tarsier (Carlito syrichta), Philippine Pygmy squirrel (Exilisciurus concinnus), Common field rat (Rattus tanezumi), and Mindanao Bullimus (Bulimus bagobus).

All of these recorded non-volant mammal species were not captured during the sampling period however their notable occurrence was observed in the area, where indices of presence are detected such as foot markings and other remnants of species' activities.

Also, knowledge from informants who frequently observed and encountered the said species in sampling sites. Additionally, a total of 101 individuals of fruit bat was captured in the area represented by four (4) species belonging to Mega-chinoptera; Cynopterus brachyotis, Megaerops wetmorei, Ptenochyrus jagori, and Ptenochyrus minor. This survey also recorded one (1) Dermoptera; Philippines Flying lemur (Cynocephalos volans), this species was not captured during the sampling period. In terms of conservation status, two (2) species were categorized as Vulnerable and one (1) species identified Near Threatened, and nine (9) were Least Concern.

Table 1-27: List of Mamalian Species Recorded in TVIRD's MPSA in Balabag, Zamboanga del Sur

Family	Scientific Name	Common Name	Occurrence	Range (Resident)	Conservation Status
Sciuriade	Exilisciurus cf concinnus	Philippine Pygmy squirrel	Seen	E	LC
Sciuriade	Sus philippensis mindanensis	Philippine warty pig	Indices of presence	E	V
Cercopith ecidae	Macaca fasicularis philippensis	Philippine long tailed macacaque	Heard	E	LC
Viveridae	Paradoxurus hermaphroditu s	Asian Palm Civet cats	Indices of presence	NE	LC
Cynocep halidae	Cynocephalos volans	Philippine Flying lemur	Informant	E	LC
Pteropidae	Cynopterus brachyotis	Short-nosed fruit bat	Captured	NE	LC
Pteropidae	Megaerops wetmorei	Whitecollard fruit bat	Captured	R	V
Pteropidae	Ptenochyrus jagori	Greater musky fruit bat	Captured	E	LC
Pteropida e	Ptenochyrus minor	Lesser musky fruit bat	Captured	E	LC
Muridae	Bullimus bagobus	Mindanao Bullimus/ Mindanao large rat	Indices of presence	E	LC
Muridae	Rattus tanezumi	Common field rat	Informant	NE	LC
Tarsiidae	Carlito syrinchta	Philippine Tarsier	Informant	E	NT

2.1.4.5 Vegetation Removal and Loss of Habitat

Vegetation removal is one of the unavoidable impacts of mining and consequently the loss of habitat of faunal species. To minimize this impact, the clearing of vegetation and earth movement activities are limited only to development areas such as surface mine area, waste dump, tailings storage facility and mining operations support facilities in accordance with the approved mine plan. The total disturbed area will be approximately 246.47 hectares.

The consequent loss of vegetation will cause a loss of habitat for the wildlife species in the area. The baseline information however is indicative of the current disturbance within the area. Low turnout of bats and some species of birds are assumed to be indicators of disturbance within the vicinity of the Project area. Kaingin, logging and small-scale mining activities are presumed to contribute also to the wildlife profile of the area.

2.1.4.6 Threat to Existence of Important Local Species

A total of 33 species were considered as threatened of which three species, *S. palosapis Hopea acuminata*, and *Toona calantas*, were listed as critically endangered. *Medinilla magnifica* and *Litsea leytenensis*, *Diospyros blancoi* were considered endangered.

Majority of the observed avifauna species were endemic constituting to about 51% and is about 45% higher than those listed in the 2011 monitoring (recorded 14 endemic). Endemic birds are dominated by those species in the family Dicaeidae followed by the family Nectariniidae. Endemic birds entail the uniqueness and importance of an area inhabited by species found only in the Philippines. Forty-two (42) avifauna species are endemic and nine (9) in the threatened classification by IUCN. More than half of the species recorded in the recent monitoring are endemic. Most of the endemic birds belongs to the family Dicaeidae followed by the family Nectariniidae with eight (8) and four (4) species respectively. The most abundant endemic is the Brown Tit Babbler (M. striaticeps) with 43 individuals followed by Redkeeled Flowerpecker (Dicaeum australe) with 30 individuals.

Several species (11%) are found to be important as these falls within the threatened classification of IUCN. Seven species fall in the near-threatened and one in the vulnerable classification. The presence of these threatened species signifies the importance of maintaining important habitat for these species within the MPSA

2.1.4.7 Threat to Abundance, Frequency, and Distribution of Important Species

Disturbance and continuous degradation of the dipterocarp forests are apparent. The stressors include:

- Tree cutting for fuelwood and lumber which is a major source of livelihood by the residents.
- Annual burning due to the highly combustible underbrush cover.
- Ground clearing and disturbance due to mining operations.

These stressors accelerate soil erosion and sedimentation. The ability of saplings to grow in the areas downslope of the disturbance is impaired by these two factors. The Expansion Project will open up new areas. These areas will be the new sources of eroding sediment. Without the proper erosion and sediment control measures, the effects of the expansion on the remnant forests will be severe. In addition to the measures already discussed, the following should be implemented by TVIRD:

- Designation within the Project site of showcase and enrichment areas for the various forest types, i.e., molave, and dipterocarp. The areas should not be impacted in any way by the mining operations. They should be protected by the company from all forms of stressors.
- Conduct of a 100 % inventory of the residuals and saplings of all floral species within the showcase areas.
- Conduct of enrichment planting using suitable endemic species within the open patches of the showcase areas. Topsoil or compost should be used to improve the soil condition.
- The showcase areas, if properly managed, will be the source of planting materials for progressive rehabilitation and buffer zone establishment.

From the 63 avian species of 28 families observed in October 2020, the number goes up by 17.4% to 74 species from 36 families. It might be possible that there are improvements in the vegetation cover of the area than it was in 2011. The 2020 study provides additional twenty-one species not listed in the previous updating the lexicon to a total of 83 birds within the MPSA. Four of the species listed previously were not encountered in the current efforts which might be attributed to the rapid nature of the assessment. The difference may be attributed to the limited sampling efforts as depicted in the species accumulation plot. The species that were not sighted during the February 2020 sampling were the Philippine bulbul (*Hypsipetes philippinus*), Large-billed Crow (*Corvus macrorynchos*), Brahminykite (*Haliastus indus*) and Philippine falconet (*Microhierax erythrogenys*). Among these species, there is a very high chance that the Brahminykite and Large-billed Crow can still be found in the transects. This species can tolerate disturbed areas.

The number of amphibian species observed in 2011 and 2020 was the same at 9 species and all are Philippine Endemic. The five species have a decreasing population, three have a stable population and one unknown trend of population. The decreasing population of the species could be due to illegal hunting for trading and food consumption, changes, and expansion of land-use utilization. Hence, it is suggested to strengthen the people's awareness on biodiversity conservation and management.

The *P. sinensis* is the only turtle captured in the sampling sites during 2020 sampling and it was not found it 2011 data. It is identified as invasive alien species of the Philippines, but the population trend is decreasing and categorized as vulnerable species.

From the 15 amphibian species recorded (mostly lizards), 8 of which are endemic were observed in 2011. The number went down in 2020, wherein only 11 species (mostly lizards) and all of which are Philippine Endemic. Only *Stegonotus muelleri* and *Limnonectes magnus* were regarded as near threatened by IUCN 2018. Removal of the herpetofauna from any habitat will lead to disturbance in predator-prey dynamics, invertebrate populations, algae communities, leaf litter decomposition, and nutrient cycling (Ali et al., 2018). Herpetofauna, particularly the snakes are one of the most feared animals; hence, people tend to kill them when encountered. Anurans also were illegally captured for food consumption. With the anthropogenic-related activities, the population of herpetofauna is depleting. Thus, it is suggested that monitoring projects and empirical studies that focus on the land-use changes for biodiversity monitoring that will increase the awareness of concerned people in safeguarding not only herpetofauna but other vertebrates and invertebrate species.

Thirteen (13) species of mammals were observed in 2011 while there are only 12 in 2020 study. Same with 2011, the 2020 survey recorded Philippine warty pig (*Sus philippensis mindanensis*) this species is a member of Suidae family with two pairs of warts and with a tuft of hair extending outwards the warts closest to the jaw. The conservation status of this species categorized as Vulnerable.

The Philippine Tarsier (*Carlito syrichta*) was also reported in the area preliminary survey recorded this species last 2011. However, during the sampling period, this species was not encountered, according to the informant this species is rarely sighted and still present in the area, particularly in the forested area of Unao-unao sampling site.
In 2020, the Philippine long tailed macacaque (*Macaca fasicularis philippensis*). It was not observed in 2011. With the least concern conservation status, this mammal is a sub-species of the crab-eating macaque.

2.1.4.8 Hindrance to Wildlife Access

The stressors to terrestrial flora such as tree cutting for fuel wood and lumber by the residents, annual burning due to the highly combustible underbrush cover, and ground clearing and disturbance by mining operations also act as stressors to the wildlife. The other stressors are dust and noise from the mining operations and hunting by the local residents.

The February 2020 faunal assessment already documented a major decline in species sightings at the Project-disturbed areas including the proposed mining area. With the Expansion Project and assuming no changes in the Environmental Management Plan (EMP), the identified stressors to wildlife will intensify. The consequence is further outmigration of species from the Project disturbed areas. The components of the EMP relevant to terrestrial fauna can be extracted from the 2011 EIS. These are the programs for:

- Erosion and sediment control
- Waste management
- Dust and noise management
- Terrestrial flora management

The buffer zone is a 20-m strip of vegetated area surrounding the Project facilities, e.g., roads, stockyards, accommodations, offices, workshops, and mining areas. The preferred species for propagation are endemic: Fruit and Dipterocarp and Moraceae species. These species will be complemented by Vetiver and napier grass along the slopes. Topsoil or compost will be used to improve the soil condition.

The purpose of the buffer zone is four-fold. These are prevention or containment of dust and noise, slope stabilization (using Vetiver and Napier grass), terrestrial ecological enhancement, and visual aesthetics. The terrestrial ecological enhancement is not meant solely to enrich the floral species. The terrestrial fauna can be protected if not enhanced as well. This is achieved by looking at the plantations as wildlife habitats. Within the habitats, patterns and connectivity of vegetative patches that support the movement of faunal species and the transfer of energy and nutrients among the habitats must be created. Buffer zones are delineated to surround each existing and proposed Project facility. Where the resulting vegetative patch is isolated, a vegetative corridor is added to connect the patch to an existing vegetated area.

2.1.5 Impact Assessment for the Land Sector

Potential Impacts	Phases				Options for Prevention or Mitigation or Enhancement
	Preconstruction	Construction	Operation	Closure	
Impacts in terms of compatibility with existing land use					
Short-term (equivalent to Project life) or temporary land use change will occur in areas that will be occupied by the access and haul roads, mill, TSF, Waste and Overburden, topsoil stockpile, administration buildings, accommodation units, and water retention areas.	✓	✓	✓	✓	Approximately 206.6195 ha of surface disturbances is expected to have a similar post-mining land use capability to pre-mining land use capability after post-closure and decommissioning after the mine's 25-year lifetime is exhausted. Rehabilitation planning will be conducted in accordance with the Final Mine Rehabilitation and Decommissioning Plan (FMRDP) that will be developed for the project in consultation with key stakeholders and in fulfilment of the requirements of the Declaration of Mine Project Feasibility (DMPF) prior to construction.
Change in surface landform / geomorphology / topography / terrain / slope					
The natural terrain of the area will be altered due to open pit mining and rehabilitation		✓	✓	✓	Careful planning of mine development will ensure that only necessary disturbance will be made. Progressive Rehabilitation of Disturbed Areas by Placement of Soil Cover, Soil Conditioning and Vegetative Cover Placement. Vegetative Cover Will Include Fast Growing Species Intercropped with Cash Crops and Endemic Species.
The modification of the original topography will cause alterations to hydrologic balance in the area		✓	✓	✓	Only 206.6195 hectares will be used for mine and surface facilities out of the 2,177 hectares ECC area applied for. The modifications will be small compared to the total area applied for and will be rehabilitated according to the requirements under the FMRDP Installation of Drainage Canal System to Prevent Erosion of Benches and Other Areas.
Soil erosion / loss of topsoil / loss of overburden					

Potential Impacts	Phases				Options for Prevention or Mitigation or Enhancement
	Preconstruction	Construction	Operation	Closure	
Earthworks, construction activities, and movement of heavy equipment will weaken and induce the natural erosion susceptibility of the soil cover particularly for areas with > 18% slopes or critical slopes		✓	✓		At any given time, the mine will stockpile topsoil. In order to prevent soil erosion, these stockpiles will be conserved for use in backfilling, roadworks, landscaping and revegetation activities.
					Slopes will be strengthened to prevent erosion using slope strengthening such as seeding and mulching, silt fences or brush barriers, retaining walls, and/or erosion control blankets or armoring.
Downstream sedimentation and increased soil erosion may occur during mine development activities particularly on ground clearing and preparation, the removal of topsoil in development areas and various earthmoving activities		✓	✓	✓	Ground preparation and clearing will be conducted progressively to minimize the total area of soil cover and land that will be disturbed at any one time, where practical.
					Soil conservation will be undertaken for soil material that will be removed from development areas for re-use during closure.
					Placement of Erosion and Sediment Control facilities such as sediment traps, sediment basins, and sediment fences to manage downstream sedimentation.
Removal of soil will occur within the areas covered by the mine and project- related infrastructure such as in the Process facilities and infrastructures		✓	✓		Topsoil will be stored prior to use for any rehabilitation activities. Procedures listed in the FMRDP shall be followed
					Soil conservation shall be undertaken for soil material that will be removed from development areas for re-use during closure.
					Erosion of such topsoil dumps shall be managed using slope and erosion management techniques such as sediment traps and fences, among others
					Soil material removed during disturbance activities will be conserved during the 25-year mine life by using them for reforestation or for vegetative planting during

Potential Impacts	Phases				Options for Prevention or Mitigation or Enhancement
	Preconstruction	Construction	Operation	Closure	
Change in soil quality / fertility					
Soil quality will decrease in the mining area especially along the disturbed area		✓	✓		Only about 206.6195 hectares will be used for mine and surface facilities out of the 2,177 hectares ECC area applied for. The modifications will be small compared to the total area applied for and will be rehabilitated according to the requirements under the FMRDP
Soil quality in the recommended soil stockpile may decrease due to unfavorable conditions in storage and stockpiling and erosion and consistency loss		✓	✓	✓	Stockpiled 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. This area will be planted with vegetables whenever possible.
Soil quality may be impacted due to passage of vehicles and heavy equipment passing over soil-covered areas over the course of the project.		✓	✓		Trucks carrying materials will be covered and will not travel at high speeds along areas with vegetative cover
					Vegetative species that will be used for reforestation and for vegetative cover are those that are endemic to the area or highly tolerant of recovering or marginal environments.
Enhancement of climate change impacts					

Potential Impacts	Phases				Options for Prevention or Mitigation or Enhancement
	Preconstruction	Construction	Operation	Closure	
Intensified rainfall events would cause temporary flooding or water-saturation, hence reduced organic matter decomposition, to many soils of low- level areas brought by excavation and other earthmoving activities within the project site.		✓	✓	✓	TVIRD will employ flood mitigating structural measures that include dams, channel levees and construction of proper drainage and canals.
Increased rainfall due to climate change could lead to significant increases in runoff, which would result to higher susceptibility to soil erosion and soil loss		✓	✓	✓	An Erosion Control Plan, incorporating Best Management Practices will be implemented to manage erosion in all development/construction sites that would include details on soil excavation slope and surface drainage management and stockpiling requirements.

2.2 The Water

2.2.1 Hydrology and Hydrogeology

The MPSA is located within two river watersheds: the Kabasalan River (Basin Code Number 09394) in the west and the Sibuguey River (Basin Code Number 09395) in the east. Both rivers are part of the Sibuguey- Ingin Basin as identified by the Western Mindanao Framework Plan. The Project area itself is located entirely within the Sibuguey River basin. Hydrologic and hydrogeologic data are available for this basin as part of the Western Mindanao Framework Plan. These data are however somewhat dated as the document was published in 1983. Nonetheless, the hydrologic description of the basin is useful and certain hydrologic conditions remain the same.

The Sibuguey River has a tributary watershed of 959 square kilometers with a mean annual runoff depth of approximately 1,874 millimeters (1,797 million cubic meters) based on a runoff coefficient of 0.69. The mean annual rainfall is estimated to be nearly 2,700 millimeters. The dependable stream flow at the 80% probability level is in the range of 20.0 to 20.4 liters per second per square kilometer within the Project area.

The average static groundwater level within the basin was approximately 8.5 meters in 1983 with a specific capacity of approximately 1.84 liters per second per meter. This has likely changed since 1983. The estimated safe groundwater yield of the region is estimated to be 4,600 liters per second although this too has likely changed since 1983.

A gauging station is located on the Sibuguey River near the Town of Imelda in Zamboanga del Sur and is maintained by the Department of Public Works and Highways. River discharge data are available for the period 1993 through 2010. The mean annual discharge is 66 cubic meters per second and the mean annual yield is 2,081 million cubic meters. The tributary drainage area is 759 square kilometers.

2.2.1.1 Watershed Characteristics

Local rivers and creeks within the vicinity of the Project area include Dimalinao Creek, Unao-Unao Creek, Naro Creek, Dipili River and Depore River. The Project area itself is drained by the Dipili River on the east and Depore River on the south and west. Both are tributaries of the Sibuguey River. A watershed map of the area is shown on Figure 2-38.

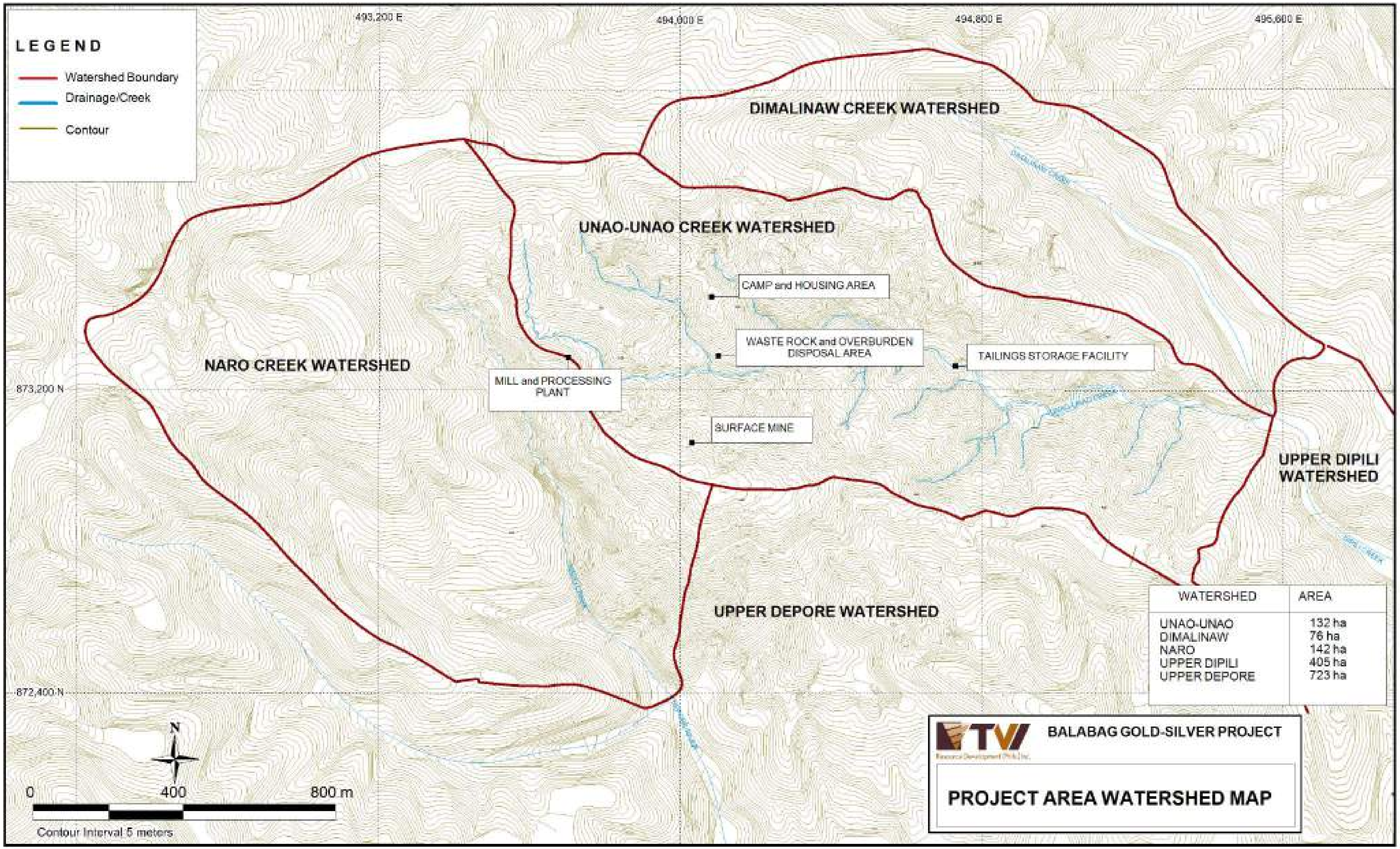
All the Project features are located within the Unao-Unao Creek watershed which itself is a tributary of the Dipili River. This watershed can be considered the primary impact watershed with the Dipili River and the Sibuguey River watersheds considered the secondary impact watersheds. Watershed rainfall-runoff characteristics for Unao-Unao Creek and the other local watersheds are shown in Table 2-28 Watershed yields are based on rainfall and runoff coefficients for the Sibuguey River watershed.

Table 2-28: Local Watershed Rainfall Characteristics

Local Watershed	Drainage Area (sq. km)	Mean Annual Rainfall (mm)	Mean Annual Runoff Depth (mm)	Coefficient of Runoff	Estimated Annual Losses (MCM)	Annual Run- off (MCM)
Unao-Unao Creek	1.3	2,700	1,864	0.69	1.07	2.44
Upper Depore River	7.2	2,700	1,864	0.69	5.95	13.49
Dipili River	4.4	2,700	1,864	0.69	3.63	8.25
Dimalinao Creek	0.8	2,700	1,864	0.69	0.66	1.50
Naro Creek	1.4	2,700	1,864	0.69	1.16	2.62

Values based on data for Sibugay-Ingin Basins, Western Mindanao Framework Plan, 1983

Figure 2-38: Project Area Watershed Map



WATERSHED	AREA
UNAO-UNAO	132 ha
DIMALINAW	76 ha
NARO	142 ha
UPPER DIPILI	405 ha
UPPER DEPORE	723 ha

2.2.1.2 Stream Flow Characteristics

The creeks and rivers within the Project area are ungauged resulting in the unavailability of historical stream flow and runoff data. However, stream flow measurements were conducted by TVIRD in March 2011 for the local streams and rivers. Other streams and rivers more distant to the immediate Project area were not measured due to security threats in those locations.

The velocity area stream flow method was used to estimate the stream velocity and convert this to discharge. Stream flow velocity was estimated by timing the passage of a float over a set stream reach (10-meter length). Total discharge is calculated by integrating the stream velocities with the cross-sectional area of the stream profile defined by the stream cross section.

The cross-sectional area of the stream was estimated by using a steel tape to measure both the stream width and depth. Each stream was divided into three subsections: 0.3 meters from one end of the stream reach, the mid-section of the stream reach and 0.30 meters from the other end of the stream reach. The average cross section of the stream is obtained by summing of the width of each subsection multiplied by the average depth. A correction factor to account for the surface velocity being faster than the average stream velocity was applied to the calculations. The location of each measured reach is shown on Figure 2-39 and the measurement results are summarized in Table 2-29.

Table 2-29: Summary of Stream flow Measurement within the Project Area

Stream Name	Tributary Watershed (km2)	Stream Width (m)	Flow Area (m2)	Mean Velocity (m/s)	Discharge (m3/s)	Unit Discharge (m3/s/km2)
Naro Creek	1.2	1.45	0.07	0.475	0.03	0.025
Unao-Unao Creek	1.0	4.14	0.20	0.331	0.06	0.060
Depore River	4.5	4.97	0.63	0.490	0.26	0.058
Dipili River	2.2	3.03	0.21	0.448	0.08	0.036

Source: TVIRD, 2011

2.2.1.3 Watershed Yield

As indicated previously, the streams and rivers within the MPSA and the Project area are ungauged. As such, watershed yields have been estimated indirectly using long term discharge measurements for the Sibuguey River. Long term watershed yield data are also available for the TVIRD Canatuan Project in Zamboanga del Norte. These data are from the Canatuan Creek watershed which is similar in size and characteristics as those within the Project area.

Mean monthly base flow for the local streams and rivers were estimated using watershed area ratios based on the Sibuguey River data and the Canatuan Creek data. These data and the estimated monthly watershed yields are shown in Table 2-30 and Table 2-31. A low range value is shown and represents the estimates based on the Canatuan Creek data and a high range value is shown which represents the estimates based on the Sibuguey River data. Graphical representations of the watershed yields are shown on Figure 2-39.

The Canatuan Creek data is from a small 24-hectare watershed that has been monitored for base flow on a daily basis since early 2004. The watershed is undeveloped and well forested. The annual runoff coefficient based on rainfall records at the Canatuan Mine is approximately 70%. This is similar to past studies performed by the National Water Resource Council for the Siocon River (82%).

The rainfall distribution for the Canatuan area is slightly different than the Project area and the Sibuguey watershed. As such, the watershed yield comparison, notwithstanding the size difference, is expected to be somewhat different on a monthly basis. The comparison however does allow the monthly watershed yields to be bracketed between a high and low value and is more representative of the smaller watersheds within the Project area.

The overall MPSA is drained by three river systems, the Depore River and the Dipilli River in the east the Kabasalan River in the west. The Kabasalan River flows west and south and eventually discharges into Sibuguey Bay near the Town of Kabasalan. There are no Project related activities planned within the Kabasalan River watershed. Both the Depore and Dipilli Rivers flow to the southeast and eventually drain to the Sibuguey River east of the MPSA. The Sibuguey River flows south and west and eventually discharges into Sibuguey Bay near the towns of Siay, Payap and Kabasalan. The Project area is drained by the Dipili River. Smaller tributaries to this river include Unao-Unao Creek and Dimalinao Creek. Unao-Unao Creek is the primary drainage within the Project area. The majority of Project components and activities are focused within the Unao-Unao Creek watershed. Naro Creek. A tributary of the Depore River, may be used for supplemental water supply for the Project needs.

Table 2-30: Estimated Mean Monthly Stream Baseflow for Project Area Rivers and Creeks (cu.m per second)

River or Creek	Discharge Units	Drainage Area (sq. km)	Jan	Feb	Mar	Apr	May	Jun	Jul	August	Sep	Oct	Nov	Dec
Sibuguey River (1993-2010)	m^3/s	759	37.71	34.15	37.80	56.11	78.95	88.55	92.42	82.30	72.57	77.63	76.63	59.19
Sibuguey River Unit Streamflow	$m^3/s/km^2$	-	0.050	0.045	0.050	0.074	0.104	0.117	0.122	0.108	0.096	0.102	0.101	0.078
Canatuan Cree (2004-2011)	m^3/s	0.24	0.011	0.009	0.008	0.009	0.011	0.011	0.011	0.012	0.013	0.014	0.012	0.013
Canatuan Creek Unit Streamflow	$m^3/s/km^2$	-	0.046	0.037	0.033	0.038	0.044	0.046	0.047	0.050	0.054	0.060	0.051	0.052
Unao-Unao Creek Range of Stream Flow	m^3/s	1.3	0.06	0.06	0.06	0.10	0.14	0.15	0.16	0.14	0.12	0.13	0.13	0.10
			0.06	0.05	0.04	0.05	0.06	0.06	0.06	0.06	0.07	0.08	0.07	0.07
Dimalinao Creek Range of Stream Flow	m^3/s	0.8	0.04	0.04	0.04	0.06	0.08	0.09	0.10	0.09	0.08	0.08	0.08	0.06
			0.04	0.03	0.03	0.03	0.04	0.04	0.04	0.04	0.04	0.05	0.04	0.04
(Genaro) Naro Creek Range of Stream Flow	m^3/s	1.4	0.07	0.06	0.07	0.10	0.15	0.16	0.17	0.15	0.13	0.14	0.14	0.11
			0.06	0.05	0.05	0.05	0.06	0.06	0.07	0.07	0.07	0.08	0.07	0.07
Upper Dipili River Range of Stream Flow	m^3/s	4.4	0.22	0.20	0.22	0.33	0.46	0.51	0.54	0.48	0.42	0.45	0.44	0.34
			0.20	0.16	0.14	0.17	0.19	0.20	0.21	0.22	0.24	0.27	0.23	0.23
Upper Depore River Range of Stream Flow	m^3/s	7.2	0.36	0.32	0.36	0.53	0.75	0.84	0.88	0.78	0.69	0.74	0.73	0.56
			0.33	0.26	0.24	0.27	0.32	0.33	0.34	0.36	0.39	0.43	0.37	0.38

Table 2-31: Estimated Mean Watershed Base Flow Yield for Project Area Rivers and Creeks (Cubic Meters)

Month	Unao-Unao Creek (1.3 km^2) Monthly Yield (cubic meters)		Dimalinao Creek (0.8 km^2) Monthly Yield (cubic meters)		Naro Creek (1.4 km^2) Monthly Yield (cubic meters)		Upper Dipilli River (4.4 km^2) Monthly Yield (cubic meters)		Upper Depore River (7.2 km^2) Monthly Yield (cubic meters)	
	Low Range	High Range	Low Range	High Range	Low Range	High Range	Low Range	High Range	Low Range	High Range
January	160,836	172,995	98,976	106,458	173,208	186,302	544,368	585,522	890,784	958,126
February	114,920	141,502	70,720	87,078	123,760	152,387	388,960	478,931	636,479	783,706
March	114,603	173,408	70,525	106,713	123,419	186,747	387,887	586,919	634,724	960,413
April	128,469	249,102	79,058	153,293	138,352	268,263	434,819	843,114	711,523	1,379,641
May	153,743	362,184	94,611	222,882	165,570	390,044	520,361	1,225,853	851,500	2,005,942
June	155,071	393,120	95,428	241,920	166,999	423,360	524,854	1,330,560	858,853	2,177,280
July	164,862	423,978	101,453	260,909	177,543	456,591	557,993	1,435,001	913,080	2,348,184
August	173,927	377,552	107,032	232,340	187,306	406,595	588,675	1,277,869	963,287	2,091,058
September	180,295	322,176	110,951	198,262	194,164	346,959	610,228	1,090,443	998,555	1,784,361
October	209,757	356,128	129,081	219,156	225,892	383,523	709,946	1,205,358	1,161,730	1,972,403
November	172,977	340,201	106,448	209,354	186,283	366,370	585,462	1,151,449	958,029	1,884,189
December	181,974	271,535	111,984	167,098	195,972	292,422	615,913	919,041	1,007,857	1,503,885
Annual	1,911,434	3,583,881	1,176,267	2,205,465	2,058,467	3,859,564	6,469,468	12,130,059	10,586,402	19,849,188

Note: The low range watershed yields are based on unit discharge values from the Canatuan Creek data. The high range watershed yields are based on unit discharges from the Sibuguey River data.

Figure 2-39: Estimated Monthly Watershed Base Flow Yields (Cubic Meters)

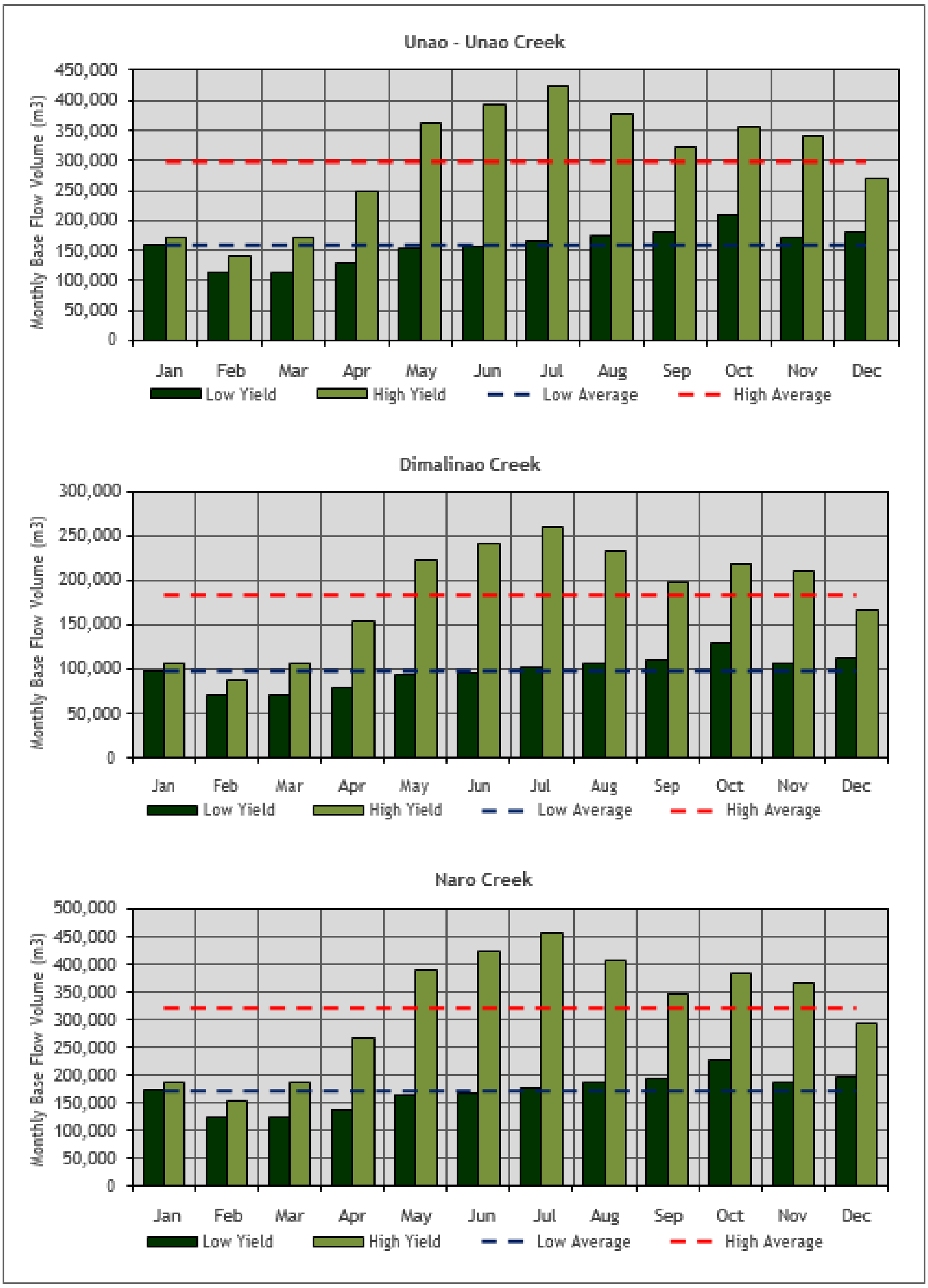
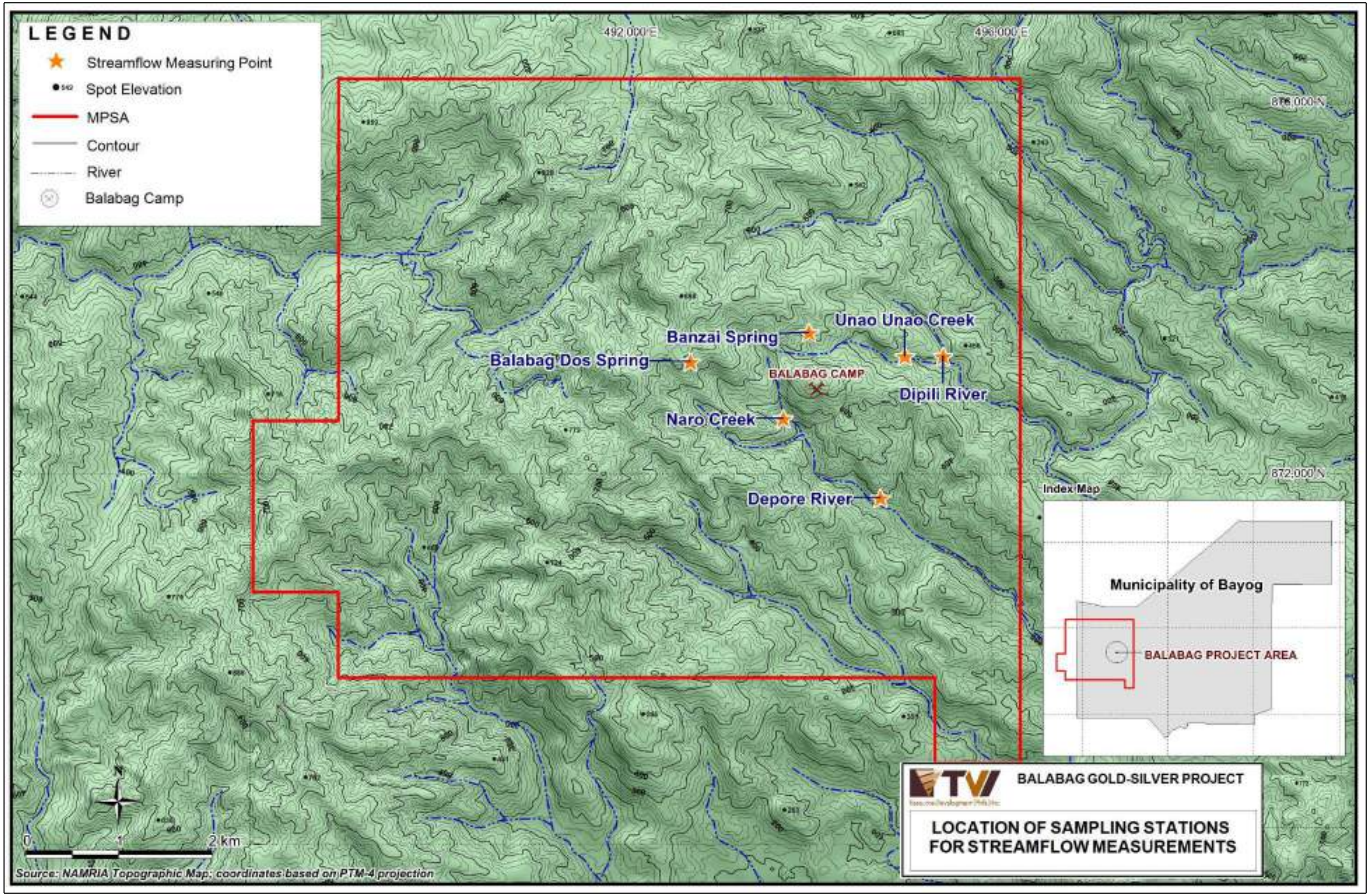


Figure 2-40: Location of Sampling Stations for Stream Flow Measurements



2.2.1.4 Flood Events

There are no data or historical records for flood events within the Project area. As a result, flood hydrographs and estimated peak flows were determined for different return periods using synthetic hydrograph computer models. The Hydrologic Monitoring System (HEC-HMS) version 3.5 developed by the US Army Corps of Engineers Hydrologic Engineering Center was selected to model the different watersheds. The model is capable of developing hydrographs and peak flows based on variable watershed physical characteristics and rainfall events of different intensities and probabilities. Rainfall data used for each return period are based on data derived from the PAGASA Synoptic station located in Malangas, Zamboanga Sibugay. These data are shown in Table 2-32 and represent 24-hour rainfall depths. The Probable Maximum Rainfall shown in the Table 2-32 represents the potential maximum rainfall that could occur and is based on data and procedures from the World Meteorological Organization.

Table 2-32: Rainfall Depths for Flood Event Analysis

Return Period	Rainfall Depth 24 Hours (mm)	Return Period	Rainfall Depth 24 Hours (mm)	ReturnPeriod	Rainfall Depth 24 Hours (mm)
2 -Years	120.0	25-Years	280.8	100-Years	360.0
10-Years	228.0	50-Years	321.6	Probable Maximum Rainfall	1,635.0

Table 2-33: Summary of Flood Peak Flows for Different Return Periods (cu.m per second)

Watershed River or Creek	Watershed Area (sq.km)	2 Year	10 Year	25 Year	50 Year	100 Year	Probable Maximum Flood
Unao-Unao	1.3	19	30	36	44	64	487
Dimalinao	0.8	11	18	22	2	39	299
Naro	1.4	20	32	38	48	68	524
Upper Dipili	4.4	45	73	87	109	156	1,167
Upper Depore	7.2	43	69	81	101	144	1,123

Source: TVIRD, 2012

2.2.1.5 Domestic Water Supply Sources

A groundwater availability map of the Zamboanga Peninsula is shown as Figure 2-41 and shows the approximate extent of shallow wells, deep wells, and difficult areas.

The Municipality of Bayog, where the Project is located, is considered a shallow well area with wells having depths not greater than 20 meters. The static water levels are generally within 6 meters below the ground surface. The average static water level in the municipality is approximately 1.83 meters and the average specific capacity is 0.11 liters per second per meter as determined from low discharge wells. There are two registered groundwater wells constructed in the municipality based on the rapid assessment done by the National Water Resource Board (NWRB) in 1982. The average capacity of these two wells is 0.60 liters per second.

There are no existing deep wells located within the Project area. There are two shallow dug wells within the Project area. One was initially a drill hole for the exploration activities and has a depth of 2 meters. It has since been used as an alternative domestic water supply source by the exploration team and a domestic water supply source for the local community. The estimated yield is 0.2 to 0.5 liters per second. Groundwater locations within the Project area were estimated on a 10-to-15-meter depth from the spring water sources.

A second drill hole constructed as part of the Tailings TSF geotechnical investigation and has since been developed as a monitoring well/piezometer. The hole is located along the Unao-Unao Creek and has a water depth of 3.5 to 4.5 meters below the ground surface. Water levels at this piezometer are read on a regular basis.

The domestic supply of the small-scale mining community is primarily sourced from surface or spring water sources within the MPSA. Some smaller streams were identified during the baseline studies that could serve as potential fresh water sources once the Project begins operation. Two streams have been identified within the general area of the Project. These are identified as the Balabag Dos area and Banzai area. The discharges from these two streams were determined in the field and ranged from 0.16 to 0.21 liters per second. This results in a daily yield on the order of 14 to 18 cubic meters at each source. The location of these two sources is shown on Figure 2-40.

2.2.1.6 Downstream Water Uses and Demands

Given the predominant agriculturally based economy within the Bayog area and downstream of the Project area, water used for irrigation and domestic supplies affects the characterization of the local and regional water resource environment. A significant amount of irrigated agricultural lands is located within the watersheds downstream of the Project area. Most notable are lands within the immediate Sibugay River watershed. Data relative to water rights and diversions were obtained from the NWRB and are summarized in Table 2-34.

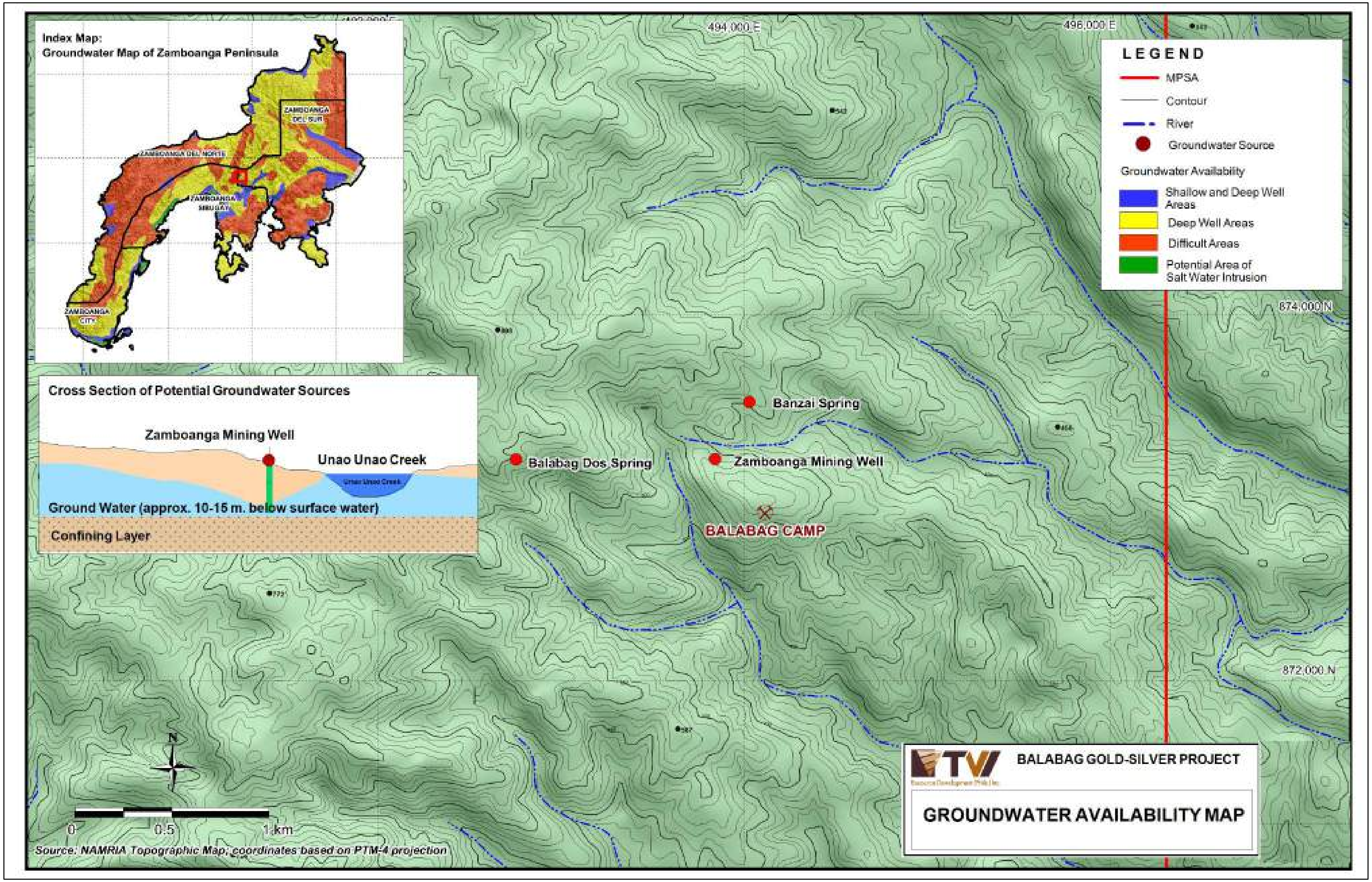
Table 2-34: Summary of Irrigation Surface Water Rights and Diversion Downstream of the Project Area

Location	Grantee	River	Volume (lps)	Purpose
Kalayagan, Bayog	National Irrigation Administration	Sibuguey River	3,500	Irrigation
Lindang, Malangas	A.Casamayor	Sibuguey River	20	Irrigation
Lagping, Siay	FSDC	Sibuguey River	192	Irrigation
Laith, Siay	Primtivo F. Acebron	Sibuguey River	5.4	Irrigation

Source: National Water Resource Board. List of Water Permit Grantees from January 1975 to December 2009

There is only one approved Water Rights Permit holder within the Municipality of Bayog which uses water from the Sibuguey River for agricultural purposes. This is the National Irrigation Administration which hasa diversion right of 3.500 liters per second (3.5 cubic meters per second). The Depore River and Dipili River are also used for agricultural irrigation downstream of the Project area. There are no known permit grantees from these water sources.

Figure 2-41: Groundwater Availability Map



2.2.1.7 Change in Draining Morphology/Inducement of Flooding/Reduction in Stream Volumetric Flow

Construction and operation of the Waste Rock Disposal Area, Surface Mine and the Unao-Unao Creek Tailings Storage Facility will have the most visible and pronounced impacts on the watershed(s) drainage patterns. These will be direct and both short term and long term. They are also unavoidable and can likely be considered as irreversible.

Approximately 0.9 kilometers out of 1.3 kilometers of stream length of Unao-Unao Creek will be filled with waste rock material and tailings. The creek will be rechanneled upstream of the TSF within the waste rock disposal area and will become a lake/impoundment within the Unao-Unao Creek TSF. Natural stream flows as they currently exist will no longer be present. The peak flows during rainfall events will likely be higher due to the removal of vegetation and faster watershed response times for surface water runoff. Construction of drainage control facilities and conveyance canals will also increase the watershed response time and contribute to higher flow velocities and peak discharges. This will be mitigated somewhat by the Unao-Unao Creek TSF which will attenuate the stream flows before they join with the stream flow at the confluence with Dimalinao Creek.

Removal of vegetation and exposure of the underlying rock at the Surface Mine will reduce the infiltration capacity and water holding capacity within the watershed. This will result in less vadose zone and groundwater storage and may reduce the longer-term flows from springs and seeps. This in turn may reduce the longer-term watershed base flow. This will likely be reversible once the progressive rehabilitation programs are initiated, and the post mining closure and reforestation activities are implemented.

The more significant impact to watershed base flow yields is associated with trans-basin diversion of water from one watershed into another. This may occur as operations water demands exceed the available water with the Unao-Unao Creek watershed. Water may be diverted from one of the other four immediate watersheds. The impact will likely be limited due to the close proximity of each watershed and the confluence of all potentially affected creeks or rivers within a short reach downstream of the Project area.

Land use changes, re-channelization of Unao-Unao Creek and construction of the Tailings Storage Facility will impact the watershed response times and flood hydrographs. However, given the small watershed area the impact of the flood hydrographs will not be significant. This will be a reversible impact in the long term after the mining operations have ended and post mining closure programs are implemented.

Construction of the Unao-Unao Creek TSF may prove to be a beneficial impact. Downstream flood hydrographs and flood peak flows may be attenuated and reduced somewhat due to the impoundment storage benefits. Determination of flood peaks at the Waste Rock Disposal Area and the Tailings Storage Facility will be key design parameters for both the operation and post operation periods.

2.2.1.8 Depletion of Water Resources/Competition in Water Use

According to the United Nations Development Program (UNDP) Human Development Report 2006, from year 1998 to 2002, the average daily water consumption per person in the Philippines was 165 liters per day. Using this data, the estimated domestic water consumption during the development stage of the Project is approximately 65 cubic meters day. During the operation stage, this will increase to 90 cubic meters per day due to additional employment. Industrial water demands for the mill and process plant needs will also occur during the operations stage. Although the use of recycled water will be maximized, a continuous freshwater supply will be needed as make-up. This will vary as the plant throughput increases, beginning at approximately 500 cubic meters per day at a throughput of 500 metric tons per day and increasing to 2,500 cubic meters per day at a throughput of 2,500 metric tons per day.

The primary make-up water source will be the Tailings Storage Facility. Secondary sources will be Naro Creek and Dimalinao Creek. Both watersheds have sufficient base flow to meet the secondary demand. The two streams at Balabag Dos and Banzai will not be sufficient to meet either the secondary or plant process demands. Water diverted from the area streams and rivers will be returned to the environment as part of domestic waste discharge and tailings discharge from the mill and process plant operations. Consumptive use will reduce the amount of return water by 3% to 6%. This is primarily associated with operation of the Tailings Storage Facility and consists of evaporation losses and tailings void/pore water retention. This lost water will impact only Unao-Unao Creek. The impact will be small and within the stream flow variations exhibited by low rainfall and high rainfall periods.

The loss of water from the surface water environment would range from approximately 15,000 cubic meters per month for the initial throughput of 500 metric tons per day to 60,000 cubic meters per month during the maximum throughput of 2,500 metric tons per day. This will be a local, short-term impact and will be reversible after the mining operations end.

The PAGASA 2020 rainfall projection has not been used in the water resource computation since the baseline data for Zamboanga del Sur is interpolated from Zamboanga City and Dipolog City synoptic stations. This data does not represent an accurate characterization of the Project area due to distance of these stations. Instead, water resource computations were based on the Malangas rainfall data which is nearer to the Project. Comparing the PAGASA 2020 rainfall projections with the rainfall data for Malangas, Malangas rainfall data is higher which indicates probable higher water yield for the same area.

A Water Rights Permit was secured from the NWRB to allow the Company to divert and use water from a single or multiple sources. Competition for the water supply within the MPSA will be limited to the remaining residents of the community. Potential water supply competition downstream of the Project area is considered minimal given the small diversion quantities and consumptive use relative to the overall watershed yields.

Control strategies relative to impacts to water use demands and water supply competition will be managed through the implementation of recycling programs to minimize make-up water requirements. It is estimated that about 50% of the water requirement of the processing plant shall be supplied by the recycled water from the plant itself and the TSF. The remaining plant demand will be fresh make-up water sourced from nearby springs and surface water systems.

2.2.2 Oceanography

This subsection is not applicable to the project since there are no jetty/port and/or subsea structures that will change the bathymetry in the area. Also, as shown in Figure 2-42, the project area is located about 30 kilometers away from the nearest bay that is the Sibugay Bay.

Figure 2-42: Map Showing Distance from Nearest Bay to the Project Area

2.2.3 Water Quality

2.2.3.1 Degradation of Water Quality

Water samples were collected from two spring sources (Balabag Dos and Banzai) and two groundwater sources. The samples were analyzed by the Zamboanga City Water District for physical, biological and chemical analysis. Separate samples were sent to SGS Philippines Inc for metals analyses. The two spring sources and the well at the Zamboanga Mining Area are currently used by the local community for domestic water supply. Results of the laboratory analyses are shown in Table 2-35.

Table 2-35: TVIRD Groundwater and Spring Water Baseline Water Quality Sampling and Testing

Parameter	Units	Balabag Dos Spring Source	Zamboanga Mining Well	Banzai Spring Source	TSF Monitoring Well	PNSDW 2017
pH		8.040	7.89			6.5-8.5
Turbidity	NTU	41.3	678.0			5.0
Color	TCU	189	1.0			10.0
Iron	mg/L	2.011	0.035	0.22	10.3	1.0
Chloride	mg/L	2.50	2.5			250.0
Copper	mg/L	0.101	0.04	<0.05	<0.05	1.0
Manganese	mg/L	0.100	0.20			0.4
Calcium Hardness	mg/L	15.0	25.0			
Magnesium Hardness	mg/L	20.0	25.0			
Total Hardness	mg/L	35.0	50.0			300
Sulfate	mg/L	10.2	0.80			250
Silica	mg/L	25.1	28.8			
Nitrate	mg/L	2.1	1.1			50
Nitrite	mg/L	0.005	0.002			3.0
Calcium	mg/L	6.0	10.0			
Arsenic	mg/L	<0.001	<0.001	<0.001	0.004	0.01
Cadmium	mg/L	<0.01	<0.01	<0.01	<0.01	0.003
Zinc	mg/L	<0.05	<0.01	<0.01	0.12	5.0
Lead	mg/L	<0.05	<0.05	<0.05	0.11	0.01
Mercury	mg/L	<0.001	<0.001	<0.001	0.0037	0.001
Chromium	mg/L	<0.1	<0.001	<0.1	<0.1	0.05
Colony Count	MPN/mL	16	16			10

Source: Metals testing by SGS Philippines Inc. Physical, chemical and biological testing by Zamboanga City Water District

Water quality testing results indicate the water sources in Balabag Dos, Banzai and the Zamboanga Mining Well are generally within the drinking water standards relative to metals concentrations as provided under Philippine National Standards for Drinking Water. Parameter exceptions are color for the Balabag Dos sample and turbidity for Balabag Dos and Zamboanga Mining Well sources. Both of these sources exhibited highly turbid qualities caused by the presence of suspended matter. In terms of color, the spring source at the time of sampling exhibited color level above the standards. This may be caused by decaying leaves, plants, organic matter, copper, iron or manganese. Biological testing results suggest the need for disinfection. Additional treatment will be needed relative to physical and biological parameters to meet the drinking water standards. Water collected from the TSF monitoring well did not meet the drinking water standards due to elevated concentrations of iron, lead and mercury.

Potential water quality impacts to the groundwater and springs within the area are associated with mining operations and introduction of geologic pathways for pollutant transport. This also includes the potential for acid mine generation. Pollution sources from domestic waste and chemicals, reagents and fuel oil releases to the environment also present a potential impact as well as seepage from the Tailings Storage Facility.

2.2.3.1.1 Mining Operations

Springs and groundwater pollution can occur both directly and indirectly as a result of surface mining. Direct water quality degradation can occur downhill or down gradient from a surface mine by the flow of contaminated drainage from the surface or underground mine. This mine drainage can come from the surface mine, ponds, or from rainfall infiltration and groundwater flow during mining operations and after project reclamation.

Indirect impacts to the ground water could result from blasting, which causes a temporary shaking of the rock and results in new rock fractures near working areas of the mine. Blasting can cause pre-existing rock fractures to become more open or permeable by loosening mineral debris or cement in these fractures. This could affect nearly vertical fractures located up to several hundred feet away from the surface mine causing vertical leakage of mine drainage to underlying aquifers.

2.2.3.1.2 Acid Mine Drainage

The acid producing potential of the ore materials are a factor in the potential generation of acid mine drainage and potential pollution of both the surface water and groundwater environment. The acid base accounting testing of the ore material by Knight Piesold indicated it is unlikely to be acid generating.

2.2.3.1.3 Domestic Waste, Chemical Reagents, and Fuel Oils

Domestic waste will be conveyed and treated by septic systems or other wastewater treatment methods. Effluent discharge will be to the surface water environment and will not present a significant impact to the groundwater resources within the Project area. Leachate from solid waste management programs (landfill operation) may enter the groundwater environment through a seepage pathway. This however can be mitigated by proper design and operation of the solid waste landfill facility. The distance of a groundwater supply source from a surface mine is also critical in determining the severity of any pollution. A rule of thumb is that most wells and springs with more than 100 mg/1 of sulfate are likely to be contaminated by mine drainage sources located within a few hundred feet up-gradient. Wells and springs with less than 100 mg/1 sulfate are either not affected or are not considered to be significantly contaminated by mine drainage. Wells appear to be especially susceptible to contamination with mine drainage if they are located near an apparent rock fracture zone that also extends to a nearby mine. Such fracture zones would allow groundwater to move rapidly away from a mine, creating more severe mine-drainage pollution. The baseline data from the Balabag Dos spring and the Zamboanga Mining well indicate sulfate concentrations significantly lower than 100 mg/l. Given the lack of solid waste management facilities and controls in the area, it is unlikely the incorporation of these controls by TVIRD during operations will result in domestic waste contamination. Chemicals, reagents and petrochemical products used in support of the Project operations may be released to the environment and seep into the groundwater within the immediate area. Structural failures, human error and lack of secondary containment facilities would be the primary causes for this to occur. These can be mitigated by implementation of proper design and construction and adherence to operations protocols.

2.2.3.1.4 Seepage from Tailings Storage Facility

Water will be impounded within the Tailings Storage Facility during the course of Project operations and during the post mining period. Seepage through the tailings may result in leaching of metals and transport to the groundwater environment. The type of soil underlying the impoundment has a low permeability and will limit the seepage quantities. Filter drains within the dam embankment and at the base of the embankment will facilitate collection and conveyance of water trapped within the tailings and surface water infiltration from the impoundment.

2.2.3.2 Degradation of Surface Water Quality

The water quality baseline assessment initiated by TVIRD was focused on the rivers and creeks within the immediate area that could potentially be affected by the Project operation as well as those that had previously been included in the government agency sampling programs. Several locations not likely to be affected by the Project activities were also included to serve as control stations for future monitoring during the operations and post operations periods.

Seven watersheds were monitored and included Unao-Unao Creek, Dimalinao Creek, Naro Creek, Dipili River, Depore River, Sibuguey River and Malagak Creek. Both Dimalinao and Naro Creek are used for agricultural and domestic source uses by the local community.

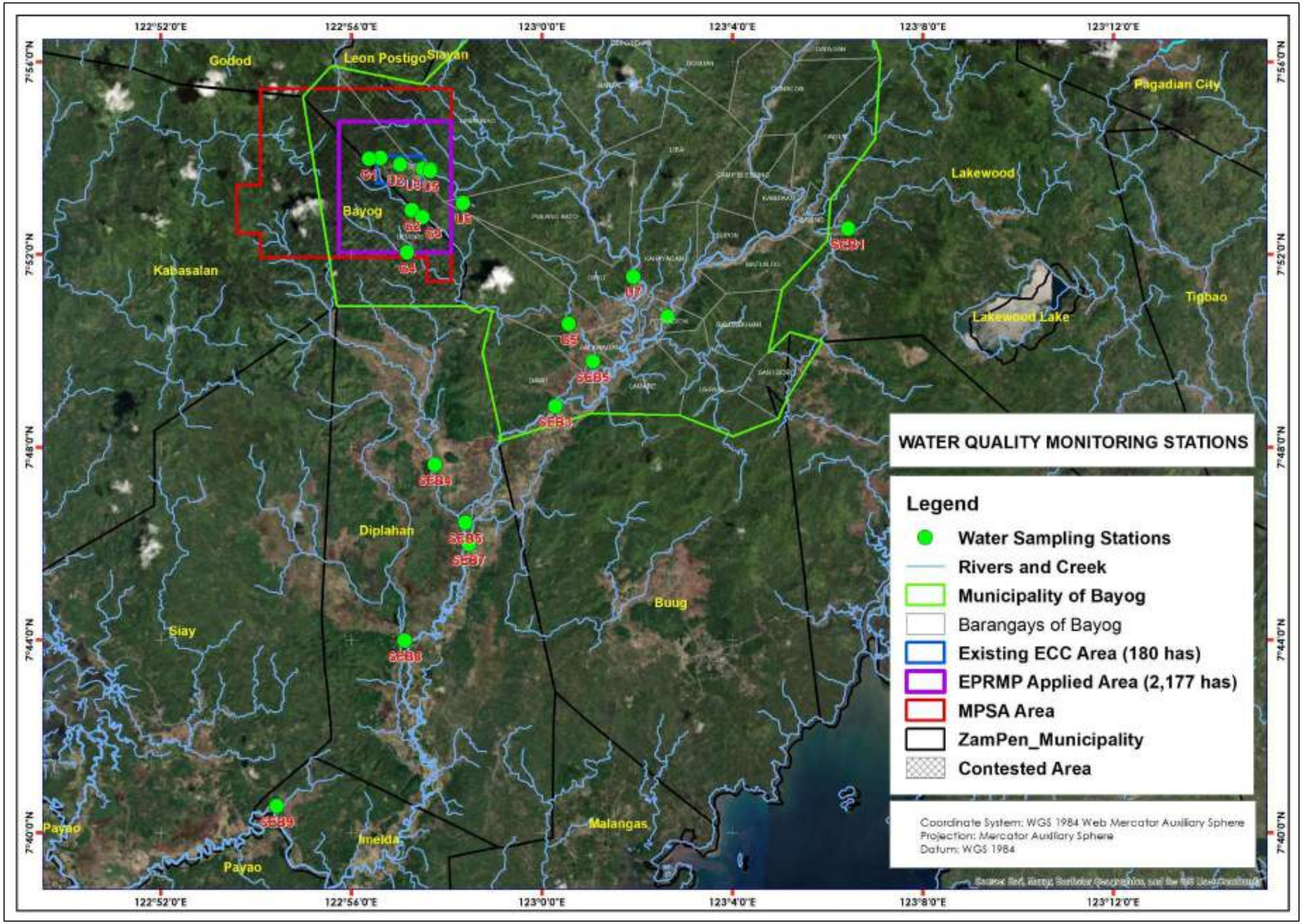
Unao-Unao Creek is not used for potable water supply or irrigation due to the existing water quality conditions. The Dipili, Depore and Sibugay Rivers are primarily irrigation sources downstream of the Project area and subject to water quality impacts that may result from the Project. A number of sand, gravel and other quarry resources were also identified in these rivers. Malagak Creek is located outside the area of influence of the Project and serves as a control station. The location of these sampling stations is shown on Figure 2-43 and a summary of the locations and parameters tested is shown in Table 2-36.

Table 2-36: Summary of TVIRD Surface Water Quality Sampling Stations

Stations	Latitude	Longitude	Description
U-1 (S1)	7°54’0.456” N	122°56’36.852” E	Upstream Unao-Unao Creek
U-2 (S3)	7°53’52.932” N	122°57’3.486” E	Midstream Unao-Unao Creek before TSF
U-3 (S2)	7°53’44.676” N	122°57’34.686” E	Downstream Unao-Unao Creek after TSF
U-4 (S4)	7°53’46.764” N	122°57’39.216” E	Downstream Dimalinao Creek
U-5 (S5)	7°53’43.62” N	122°57’44.322” E	Upstream Dipili River
U-6 (S2A)	7°53’17.532” N	122°58’16.344” E	Downstream Unao-Unao Creek before Batman
U-7 (S7)	7°51’28.77” N	123°1'56.364” E	Dipili River (Dam Section)
(G-1) S6	7°53’55.518” N	122°56'31.224” E	Upstream Lalab before Surface Mine

Stations	Latitude	Longitude	Description
G-2 (S8)	7°52'52.116" N	122°57'21.342" E	Lalab-Genaro Confluence
G-3 (S8A)	7°52'58.206" N	122°57'22.596" E	Downstream Genaro Creek
G-4 (S9)	7°52'12.012" N	122°57'14.106" E	Malagak River
G-5 (S11)	7°50'28.35" N	123°0'36.204" E	Depore River (Bridge Section)
SEB-1 (S19)	7°52'26.976" N	123°6'28.908" E	Sibugay River (Pobalcion)
SEB-2 (S18)	7°52'37.296" N	123°2'41.616" E	Sibugay River (Bulawan Lakewood)
SEB-3 (S10)	7°48'45.51" N	123°0'18.126" E	Sibugay River (Bayog-Diplahan)
SEB-4 (S12)	7°47'33.99" N	122°57'48.354" E	Sampoli River (Bridge Section)
SEB-5 (S13)	7°49'27.786" N	123°1'7.95" E	Sibugay River (Salawagan-Bayog)
SEB-6 (S14)	7°45'55.158" N	122°58'30.378" E	Buug Muyo Creek (Paradise, Diplahan)
SEB-7 (S15)	7°45'52.182" N	122°58'28.242" E	Sibugay River (Paradise, Diplahan)
SEB-8 (S16)	7°43'52.896" N	122°57'6.294" E	Balagon River (Brgy. Minsulao)
SEB-9 (S17)	7°40'28.068" N	122°54'24.69" E	Sibugay River (Diplahan-Siay)

Figure 2-43: Surface Water Quality Sampling Locations



The results of the surface water quality monitoring in 2021 are summarize in Table 2-40. The results were compared to the water quality guidelines of DENR as per DAO 2016-08 and DAO 2021-19 for Class C. As shown, all the stations failed to meet the water quality guideline for fecal coliform and phosphate. There are also some stations that exceeded the limit for TSS and oil and grease.

Potential surface water quality impacts are associated with the discharge of tailings and release of water from the Unao-Unao Creek Tailings Storage Facility, watershed sediment from disturbed areas increasing the potential siltation within the Project area creeks and rivers, discharge of domestic waste effluent and accidental release of chemicals, reagents and petrochemical products to the environment during operations. The introduction of acid mine drainage is also a potential impact to the surface water environment.

Although the footprint area of the Project is small and the Project features are limited to the Unao-Unao Creek watershed, the potential impacts could extend to the downstream hydrologic environment. An assessment of the downstream impact potential and capacity of the natural environment is a part of the impact assessment. Also, it should be noted that the water quality of the creeks and rivers within the Project area have been significantly impacted by the illegal mining activities. Water quality of both Unao-Unao Creek and the Dipili River has been the most impacted and is far from meeting the Class C stream standards.

2.2.3.2.1 Surface Mine Area Drainage or Dewatering

Three watersheds will be draining the surface mine area and the contributing area is distributed as follows: Unao-Unao creek (13 has), Naro creek (7 has) and Depore River (7 has).

Water resource control strategies relative to the operation of the surface mine area will be focused on the establishment of stable benches, provision of drainage canals on each bench and provision of sediment control ponds around the pit area. Drainage canals will be directed to sediment ponds to be constructed relative to the location of active mine areas throughout the life of the Project. This will manage and control the surface water runoff from the mining activities.

2.2.3.2.2 Tailings Storage Facility

Operation of the Tailings Storage Facility within the Unao-Unao Creek watershed will introduce a potential pathway for surface water pollution during construction, operation and the post mining period. During construction the primary impact will be associated with sediment deposition and siltation within Unao-Unao Creek and the downstream Dipili River. During operations the primary impact will be associated with potential metals and cyanide discharge from the Tailings Storage Facility Spillway and the internal filter drain discharge from the dam embankment. Re-suspension of tailings within the impoundment and discharge through the spillway is also a potential water quality impact during operation. Post mining surface water pollution impacts will focus on closure plans and operations in the post closure period to re-establish the natural riparian habitat of Unao-Unao Creek. Sedimentation and siltation will be the primary potential pollutants.

Construction of the dam and spillway will require excavation and materials removal within the creek bed and will result in suspension of silts, sands and gravels. This is an unavoidable impact but is considered short term and within a limited impact area. Cofferdams and diversions will be constructed upstream of the dam to maintain dry conditions within the dam footprint for construction. This will allow for clean water to be diverted around the construction area. Construction of the dam is expected to take 10 to 12 months and may be done in stages. The greatest water quality impact potential will occur during the dam foundation construction within a 4-to-6-week period. Operation of the Tailings Storage Facility will be as a flow through impoundment with a high level, uncontrolled spillway outlet. While the tailings from the plant process will be deposited and retained within the impoundment, the supernatant water will flow out of the TSF on a continual basis.

Surface water runoff from rainfall events and stream flow from upstream Unao-Unao Creek will also enter the impoundment, combine with the tailings supernatant and flow out through the spillway. Re-suspension of tailings may occur should the operations water cover over the tailings be reduced or the tailings become exposed. Flood events entering the impoundment or wind induced waves could result in some tailings being carried through the spillway and deposited within Unao-Unao Creek downstream of the dam and spillway. Recent studies suggest a water cover depth in the range of 0.2 to 2.5 meters could reduce the potential for re-suspension depending on site specific conditions (Manlagint, 2008).

Post mining surface water quality impacts are associated with the same tailings re-suspension concern and downstream deposition. There is also a potential for acid mine drainage to develop in the post mining period should the tailings become exposed. Re-suspension may be an issue however post mining reclamation of the tailings surface would eliminate this impact. This has been successfully implemented at the TVIRD Canatuan Mine.

A sample of the tailings produced by the planned gold-silver extraction process was collected and shipped to Knight Piesold for geochemical testing. The tailings had also been subjected to the planned cyanide detoxification process prior to shipment. The resulting tailings sample was considered a replica of the tailings expected to be deposited during the Project operation. The tailings supernatant water quality was analyzed as well as the meteoric water (rainfall runoff) using the Meteoric Water Mobility Procedure (MWMP). The results from both tests indicated the water quality was within the Class C standards with the exception of total dissolved solids. A summary of the results is shown in Table 2-37 and includes a comparison with Philippine standards and World Bank (IFC) standards.

Table 2-37: Balabag Process Tailings Geochemical Test Results (All values in mg/l except pH)

Parameter	Tailings Supernatant	MWMP (Total)	Net Acid Generation	Class C Stream	Effluent Standard	IFC Standards
pH	8.61	8.03	8.7	6.5 – 9.0	6.0 – 9.5	6.0 – 9.0
Bicarbonate	91	140	49	-	-	-
Carbonate	5.4	<1.0	4.8	-	-	-
Hydroxide	<1.0	<1.0	<1.0	-	-	-
Total Alkalinity	84	120	48	-	-	-
Chloride	15	6.0	1.1	350	450	-
Fluoride	<1.0	<0.50	<0.10	1	2	-
Sulfate	4,600	2500	17	275	550	-
Total Dissolved Solids	7,100	3,900	140	-	-	-
WAD Cyanide	0.29	0.22	-	-	-	0.50
Aluminum	0.091	0.072	1.1	-	-	-
Barium	0.13	0.062	<0.010	3	6	-
Beryllium	<0.001	<0.001	<0.001	-	-	-

Parameter	Tailings Supernatant	MWMP (Total)	Net Acid Generation	Class C Stream	Effluent Standard	IFC Standards
Boron	<0.10	<0.10	<0.10	0.75	3	-
Cadmium	<0.001	<0.001	<0.001	0.005	0.01	0.05
Calcium	320	240	7.5	-	-	-
Chromium (6+)	<0.005	<0.005	0.035	0.01	0.2	0.1
Copper	<0.05	<0.05	<0.05	0.02	0.04	0.3
Iron	0.70	0.59	<0.01	1.5	7.5	2.0
Magnesium	2.9	4.9	<0.50	-	-	-
Manganese	0.66	0.57	<0.005	0.3	2	-
Nickel	<0.01	<0.01	<0.01	0.2	1	0.5
Potassium	40	27	<2.5	-	-	-
Silver	<0.005	<0.005	<0.005	-	-	-
Sodium	2,100	980	17	-	-	-
Zinc	<0.010	<0.010	<0.01	2	4	0.5
Mercury (Total)	0.0003	0.00069	0.00076	0.002	0.004	0.002
Antimony	<0.0025	<0.0025	<0.0025	-	-	-
Arsenic	0.014	0.0087	0.0085	0.02	0.04	0.1
Lead	<0.0025	<0.0025	<0.0025	0.05	0.1	0.2
Selenium	0.0096	0.0059	<0.005	0.02	-	-
Thallium	<0.001	<0.001	<0.001	-	-	-

Source: Knight Piesold Consulting. Western Environmental Testing Laboratory, 2012.

2.2.3.2.3 Watershed Sediment

Soil erosion and transport from disturbed areas will result in sedimentation and siltation of the creeks and rivers and impact the surface water quality. Disturbed areas will contribute significantly more sediment than undisturbed areas. This impact is not expected to be significant or long term. Given the small impact area, location of the Project features within the Unao-Unao Creek watershed and the location of the Tailings Storage Facility, erosion and siltation will be contained within the impacted watershed. Provision of sufficient sediment storage within the Tailings Storage Facility is critical to minimizing this impact.

Erosion and sedimentation from surface water runoff is anticipated during the development and operation of the disposal areas. Using the sedimentation rate data gathered from the Canatuan operations (0.28 ton/ha/mm of rainfall), approximately 123,500 tons of sediment will be potentially generated within the watershed from the four overburden waste stockpiles. The annual sediment yield estimates are summarized in Table 2-38. Sedimentation is anticipated to be reduced as soon as revegetation activities commence.

Table 2-38: Sediment Yield Estimated from the Waste Rock and Overburden Disposal Area

Year	Contributing Stockpile	Annual Disturbed Area (ha)	Cumulative Disturbed Area (ha)	Annual Sediment Yield (tons)	Cumulative Sediment Yield (tons)
1	Waste Dump 1	5.4	5.4	7,100	7,100
2	Waste Dump 1	5.4	10.8	14,200	21,200
3	Waste Dump 1	-	10.8	14,200	35,400

Year	Contributing Stockpile	Annual Disturbed Area (ha)	Cumulative Disturbed Area (ha)	Annual Sediment Yield (tons)	Cumulative Sediment Yield (tons)
4	Waste Dump 1	-	10.8	14,200	49,500
5	Waste Dump 2	2.7	13.5	17,700	67,100
6	Waste Dump 2 and 3	5.2	18.7	24,500	91,600
7	Waste Dump 4	5.7	24.4	32,000	123,500

Note: Annual erosion rate is based on the Canatuan Project Sedimentation rate and monthly rainfall based on the highest annual total rainfall

Interceptor canals and diversion ditches will be constructed along the crest and toe of the overburden waste stockpiles and along each slope bench (see Figure 2-44) They will serve as the initial control measure in protecting the bench surface. All sediment generated from the operation of the Waste Rock and Overburden Disposal Area and portions of the surface mine will be collected at the Tailings Storage Facility.

Construction of filter drains and underdrains will also be necessary to convey surface water runoff and prevent water infiltration to the stockpile. Underdrains shall consist of a combination of rock and perforated pipe systems placed at the bottom of the fill (see Figure 2-45). The rock materials will be sourced from nearby locations while the pipe underdrain shall be of non-corrosive material to ensure long term use. The underdrain system shall be designed to carry the anticipated streamflow from tributary areas upstream of the disposal area.

The filter drain will perform a similar function as the underdrain but will be more focused on capturing water from seepages and springs from the valley walls. The filter drain will be comprised of smaller rock materials that will prevent water migrating to the surface of the stockpile benches or stockpiled material. Water collected from the filter drain will be conveyed to the underdrain or will be discharged as a separate outlet away from the disposal area.

A water diversion dam will also be constructed to reduce the amount of sediment and surface water runoff and thus, reducing the potential for soil erosion and stability issues. Another dam will be constructed near the Mill and Processing Plant area to serve as potential water supply source. Design of the dams considers the total potential sediment generation from the tributary watershed, volume allocation for maximum daily rainfall event and a permanent pool water depth of at least three meters. The permanent pool volume provides a buffer within the dam to prevent resuspension of deposited sediments.

Figure 2-44: Erosion Control Management at the Waste Rock and Overburden Disposal Area

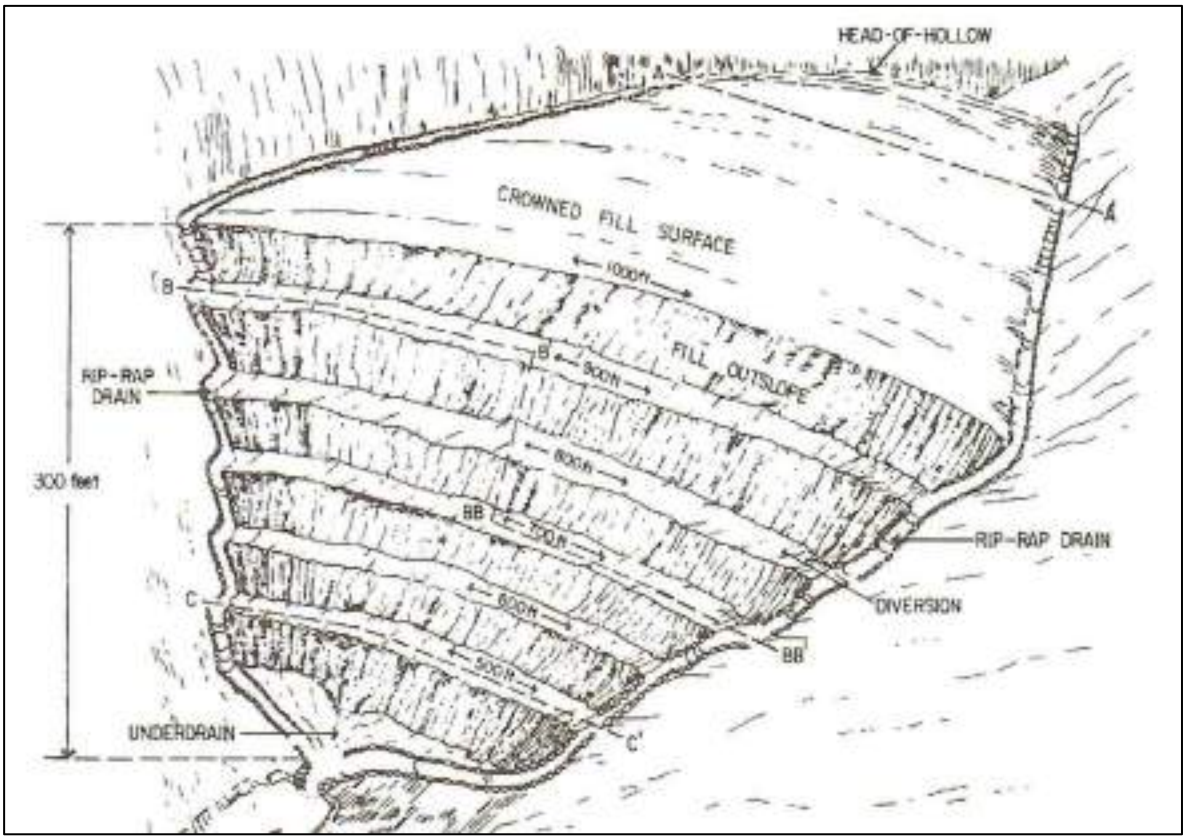
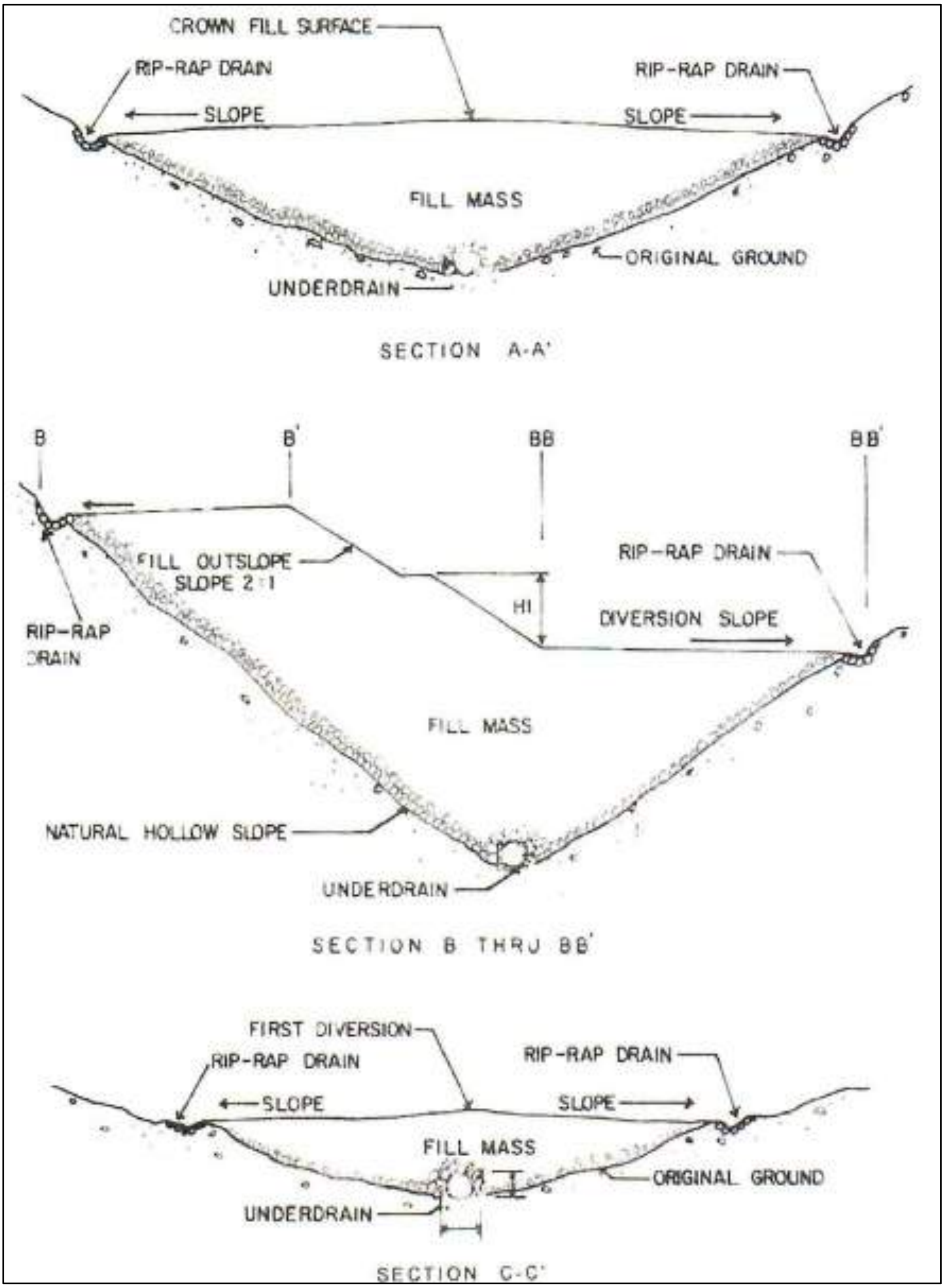


Figure 2-45: Underdrain Water Control Management



Sedimentation ponds are also constructed within the project area. The following were considered in the design of the sedimentation ponds:

- The sediment ponds will be desilted on an annual basis or more frequently thus, operating as retention pond.
- Sediment deposition within the sediment pond is assumed at a minimum depth of 1.5 to 2.0 meters.
- Sediment trap efficient of 80%
- Provision of a permanent pool to reduce resuspension of sediment during rainfall events

2.2.3.2.4 Domestic Wastewater

Domestic wastewater discharge is not expected to have a significant impact on the surface water quality. Septic tanks or other biological treatment reactors are incorporated in the Project design and construction to treat the wastewater effluent.

All the liquid wastes are transported by pipeline to large, engineered septic tanks. The effluent from the septic tanks is directed to leach drains where it will be biologically treated. Discharges from the drains will be monitored.

2.2.3.2.5 Chemicals and Petrochemical Products

Chemicals consisting of process plant reagents, laboratory reagents and chemicals and petroleum products may enter the surface water system through structural failure, inadequate design and/or human error. Redundant systems to contain and control any accidental releases are part of the design criteria to be used for the process plant and other infrastructure facilities. Similarly, operations protocols and training programs will be developed and implemented to minimize or eliminate human accidents.

2.2.3.2.6 Acid Mine Drainage

The potential for acid mine drainage development is low to nil based on Acid Base Accounting tests performed on the tailings by Knight Piesold. Results of the tests indicated the tailings are unlikely to generate acid. This is due to the lack of sulphide to be oxidized in combination with a high Net Neutralizing Potential. Results of the acid base accounting tests are shown in Table 2-39.

Similarly, sulfur grades of the core samples were analyzed to determine the potential for acid generation. The sulfur grades were determined to be relatively low with median values of 0.34% for mineralized samples and 0.22% for non-mineralized samples. These results suggest the overburden and mineralized zones could be classified as non-acid forming.

Table 2-39: Acid Base Accounting Results for Balabag Tailings Sample

Parameter	Value
Paste pH	8.75
CaCO3 (%)	0.407
Total Sulfur (Wt %)	0.08
Sulfate Sulfur (Wt %)	0.06
Pyritic Sulfur (Wt %)	<0.01
Organic Sulfur (Wt %)	0.02
Acid Generating Potential	<0.313
Neutralization Potential	4.07
Net Neutralization Potential	3.76
Neutralization Potential Ratio	13.0

2.2.3.2.7 Uncontrolled Tailings Releases from Pipelines

Uncontrolled tailings releases from conveyance pipelines and tanks could impact the surface water quality if not managed. The tailings pipeline conveyance route is approximately 1 kilometer long from the Process Plant to the Tailings Storage Facility. Nearly the entire length of the pipeline is adjacent to the Waste Rock Disposal Area and the Tailings Storage Impoundment. The potential for uncontrolled release or leakage affecting an undisturbed area is nil. Nonetheless, placement of berms on either side of the pipeline to contain any releases or leakage and regular inspection is implemented. Additionally, the pipeline operates under gravity flow conditions thereby eliminating potential mechanical risks associated with pump stations.

2.2.3.2.8 Downstream Assimilative Capacity

The assimilative capacity represents the capacity of a river or water body to receive waste waters or toxic materials without harmful effects and damage to the aquatic life and humans who consume the water. Another definition would be the maximum amount of pollutant load that can be discharged without impairing the water quality for the designated best usage. Various models can be used to determine or estimate the assimilative capacity of a river for different pollutants. They can range from very complex computer simulation models requiring considerable data input to simpler models using less data.

In the case of the surface water hydrologic environment within the Project area, the assimilative capacity for Unao-Unao Creek and the Dipili River immediately downstream are of primary interest. These two water bodies are subject to potential direct impacts. Evaluation and assessment of the impacts and the river capacity for additional pollutant loading would be based on the current Class C stream criteria. However, as noted during the baseline water quality investigation, the current water quality of these two water bodies is significantly worse than what the Class C standards require. As such, any assimilative capacity analysis would conclude that there is no longer sufficient assimilative capacity available to meet the Class C standards.

It is probable the current water quality conditions are a result of the illegal mining operations. Implementation of the Project would eliminate this pollutant source thereby improving the assimilative capacity.

Examination of the tailing supernatant and meteoric water quality from the plant process indicates the discharge from the process is of significantly higher quality than the current stream water quality as well the Class C standards. As such, discharge would not decrease the assimilative capacity. The only exception is total dissolved solids. This is a physical based parameter however and can be managed by plant processes as well as natural processes within the Tailings Storage Facility.

Table 2-40: CY 2021 Results of Water Quality Monitoring

STN	Location	TSS	pH	BOD	Fecal Coliform	Free Cyanide	Copper	Lead	Mercury	Arsenic	Cadmium	Zinc	Oil and Grease	Chloride	Phosphate	Nitrate
		mg/L		mg/L	MPN/100 mL	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
U-1 (S1)	US Unao-Unao Creek	5	6.6	2.5	8,882	<0.02	<0.003	0.006	<0.00004	<0.008	<0.001	<0.005	1	1.9	0.11	0.25
U-2 (S3)	MS Unao-Unao Creek Before TSF	72	7.1	1.5	1,093	<0.02	0.003	0.007	0.00056	<0.008	<0.001	<0.005	<1	3	0.07	0.23
U-3 (S2)	DS Unao-Unao Creek After TSF	38	6.8	1.5	15,633	<0.02	0.006	0.007	0.0007	<0.008	<0.001	0.16	<1	0.6	0.05	0.12
U-4 (S4)	DS Dimalinao Creek	253	7.0	2.0	4,770	<0.02	<0.003	<0.006	0.00029	<0.008	<0.001	<0.005	1	2.4	0.06	0.10
U-5 (S5)	US Dipili River	9	7.0	1.7	5,665	<0.02	<0.003	<0.006	0.00033	<0.008	<0.001	<0.005	2	3.4	0.05	0.08
U-6 (S2A)	DS Unao-Unao Creek Before Batman	35	7.0	3.0	3,175	<0.02	0.004	0.009	0.00036	<0.008	<0.001	<0.005	1	1.4	0.08	0.10
U-7 (S7)	Dipili River Dam Section	<2	7.2	2.0	11,925	<0.02	<0.003	<0.006	0.00035	<0.008	<0.001	<0.005	<1	2.6	0.08	0.08
(G-1) S6	US Lalab Before Surface Mine	39	7.0	2.3	185	<0.02	<0.003	<0.006	0.0003	<0.008	<0.001	<0.005	<1	0.8	0.12	0.12
G-2 (S8)	Lalab-Genaro Confluence	8	7.3	1.7	1,788	<0.02	<0.003	<0.006	0.00038	<0.008	<0.001	<0.005	<1	0.5	0.06	0.40
G-3 (S8A)	DS Genaro Creek	8	7.3	2.0	1,550	<0.02	<0.003	<0.006	0.00042	<0.008	<0.001	<0.005	2	0.5	0.05	0.10
G-4 (S9)	Malagak River	2	7.3	2.3	3,600	<0.02	<0.003	<0.006	0.0003	0.01	<0.001	<0.005	1	1	0.12	0.07
G-5 (S11)	Depore River Bridge Section	58	5.6	2.0	19,375	<0.02	<0.003	<0.006	0.00036	<0.008	<0.001	0.02	<1	<0.4	0.06	0.15
SEB-2 (S18)	Sibugay River (Bulawan Lakewood)	14	5.7	3.0	3,525	<0.02	<0.003	0.006	<0.00004	<0.008	<0.001	<0.005	1	0.8	0.04	0.15
SEB-1 (S19)	Sibugay River (Pobalcion)	19	5.6	2.5	6,125	<0.02	<0.003	<0.006	<0.00004	<0.008	<0.001	<0.005	2	1	0.06	0.14
SEB-3 (S10)	Sibugay River (Bayog-Diplahan)	128	7.3	1.7	3,779	<0.02	<0.003	<0.006	0.00039	<0.008	<0.001	<0.005	1	<0.4	0.08	0.08
SEB-4 (S12)	Sampoli River (Bridge Section)	44	7.2	2.3	9,800	<0.02	<0.003	<0.006	0.00013	<0.008	<0.001	0.01	<1	0.5	0.07	0.14
SEB-5 (S13)	Sibugay River (Salawagan Bayog)	94	5.4	2.0	16,500	<0.02	<0.003	<0.006	<0.00004	<0.008	<0.001	0.02	<1	0.6	0.08	0.10
SEB-6 (S14)	Buug Muyo Creek (Paradise Diplahan)	46	7.1	2.5	3,276	<0.02	<0.003	<0.006	<0.00004	<0.008	<0.001	<0.005	1	<0.4	0.06	0.40
SEB-7 (S15)	Sibugay River (Paradise Diplahan)	147	7.1	2.0	6,850	<0.02	<0.003	<0.006	<0.00004	<0.008	<0.001	<0.005	<1	0.5	0.07	0.30
SEB-8 (S16)	Balagon River (Brgy. Minsulao)	27	7.2	2.7	51,075	<0.02	0.019	<0.006	<0.00004	<0.008	<0.001	<0.005	<1	0.5	0.07	0.51
SEB-9 (S17)	Sibugay River (Diplahan-Siay)	<2	7.1	2.5	42,475	<0.02	0.0003	<0.006	<0.00004	<0.008	<0.001	0.01	2	<0.4	0.08	0.25
DAO 2016-08 Class C		**80**	**6.5-9.0**	**7**	**200**	**0.1**	**0.02**	**0.05**	**0.002**	**0.02**	**0.005**	**2**	**2**	**350**	**0.5**	**7**

Out of the twenty-one (21) sampling stations, only four (4) parameters exceeded the threshold limit prescribed by DAO-2016-08 for Class C Water Body Classification. Most exceedances of results recorded were Fecal Coliform Count. This can be attributed bacteria that are found in the soil, in water that has been influenced by surface water, and in human or animal waste. Also, presence of pig pens, carabaos and other livestock were also observed during sampling along the riverbanks and other freshwater sampling stations contributing to high coliform concentration in these areas. While the exceedances of Total Suspended Solids (TSS) on Station U-2 MS Unao-unao Creek Downstream after TSF Dam with 72 mg/L and U-4 DS Dimalinao Creek with 253 mg/L are inevitable because bulk of the earth movements are concentrated on these stations, especially during the development phase of the Project until its transition to commercial operation. Also, the topographic position of the slope at our Project Site is one of the considerable factors affecting these results and the great amount of rainfall rate leading to the development of erosion and consequently sediment transport from the active areas.

However, these are holistically being addressed by making sure that the last discharge points, Station U-6 DS Unao Unao Creek before Batman and Station G-3 DS Genero Creek, for the two (2) main drainage systems namely, Sotheast Drainage System-Dipili River and Southwest Drainage System – Depore River conforms within DENR Standard.

Environmental Structures put forth by the Company to reduce/prevent TSS and sedimentation in creeks and rivers that receives mine-derived sediments are: Settling Ponds, Collector Sumps, Drainage Canals, Gabion Check Dam, and Silt Fences. Additional medium for erosion control, drainage and filtration applications like Geotextile Filter Fabric, Geotextile Tubes, Coco-matting, and Gabions are integrated to stabilized soil structure and to augment prevention of sedimentation into the hydrological system. Further, all mitigating structures are being repaired and improved to maintain their capacity and integrity. Geotextiles are also replaced if necessary.

Oil and grease concentration at U-5 US Dipili River with 2 mg/L and G-3 DS Genaro Creek 2mg/L has exceeded the standard threshold limit due to ongoing construction of TSF Dam, fuel depot and heavy equipment where repairment usually could take place within construction site. While phosphate parameters exceeded in some stations within and outside the MPSA, this is due to man-made factors such as human and animal waste, detergents, and agricultural run-off during rain events. To note, during the exploration phase, baseline results of phosphate from all stations already had an exceedance and that the Project site was once a small-scale mining area.

2.2.3.3 Degradation of Coastal/Marine Water Quality

This subsection is not applicable since there is no nearby coastal water in the project site. As mentioned, the nearest bay in the project site is the Sibuguey Bay that is located about 30 kilometers away from the project site (see Figure 2-42).

2.2.4 Fresh Water Ecology

Heavy metals, like arsenic, cadmium, chromium, lead, mercury, nickel, etc. are among the waste products of the illegal mining operation within the Project area. Metals, after entering the water and sediment, may precipitate or adsorb on solid surfaces, remain soluble or suspended in the water or may be taken up by fauna or flora (Lande, 1977; Leland, 1977; Oehme, 1978; Reay, 1972; Reimers et al., 1975), which may be present in various streams, creeks and rivers within and around the Project area. These metals may accumulate in aquatic organisms that are consumed by humans (Gutherie et al., 1979; Oehme, 1978; Reay, 1972).

The first baseline study on heavy metals and cyanide concentrations in animal tissues and sediments in the area was carried out on 1 - 3 August 2010 by MEAESCF. The present survey represents the second baseline study conducted on 4 - 6 March 2022.The main objective of this present study was again to determine heavy metal and cyanide concentrations in the aquatic organisms and sediments from the selected creeks and rivers within and around the TVIRD Balabag Gold-Silver Project area including that of the neighboring areas along Dipili River and Sibugay River. Also, the data obtained will be compared to the data and information collected from the previous baseline survey period August 2010.

The scope of work to attain the objectives set for the baseline survey is to provide the following outputs:

- In-situ measurements of basic water quality parameters
- Animal tissue metal and cyanide analyses
- Sediment metal and cyanide analyses

The sampling activities were focused mainly along the selected aquatic environments within and around the TVIRD Balabag Gold-Silver Project and neighboring areas with a total of eight (8) sampling stations broken down as follows:

- The Balabag Site (BS) with a total of four (4) sampling stations: BS1, BS2, BS3 and BS4
- The Control (CS) or Reference Site with a total of two (2) sampling stations: CS1 and CS2
- The Observation Site (OS) with a total of two (2) sampling stations: OS1 and OS2

These sampling stations were established during the previous baseline survey in August 2010 and were re-sampled in this present survey in March 2022. All these stations are listed in Table 2-41, which also indicates their GPS coordinates, locations, sampling dates, and remarks. GPS coordinates taken were also plotted in Figure 2-46 showing approximate locations of these sampling stations. Snapshots of the features of the sampling stations can be seen in Figure 2-47.

Table 2-41: Freshwater Ecology Sampling Stations

Study Area	Station Designation	GPS Coordinates		Location	Sampling Period / Date		Remarks
		Latitude North	Longitude East		Previous (Aug. 2010)	Present (Mar. 2022)	
Impact Area	BS1	07°53.780'	122°57.475'	Dimalinaw Creek	01 Aug	04 Mar	New location/GPS coordinates; no aquatic biota/species collected; sediment samples collected
	BS2	07°53.820'	122°57.427'	Unao- unao Creek	01 Aug	04 Mar	New location/GPS coordinates; no aquatic biota/species collected; sediment samples collected
	BS3	07°53.731'	122°57.647'	Dipili Creek	01 Aug	04 Mar	Same location/GPS coordinates; no aquatic biota/species collected; sediment samples collected
	BS4	07°53.382'	122°57.251'	Depore River	01 Aug	05 Mar	Same location/GPS coordinates; no aquatic biota/species collected; sediment samples collected
Control/ Reference Area	CS1	07°53.848'	122°56.562'	Naro Creek	02 Aug	04 Mar	New location/GPS coordinates; previous location almost covered by a road construction; fish/ crabs/frogs and sediment samples collected
	CS2	07°51.983	122°57.221'	Malagak Creek	03 Aug	05 Mar	New location/GPS coordinates; clear fast running water with large rock and fine to coarse sand. Fish/frog and sediment samples collected
Observation Area	OS1	07°51.497'	123°01.896'	Dipili River at Spillway	03 Aug	06 Mar	Same location/GPS coordinates. clear water: fish and sediment samples collected
	OS2	07°48.644'	123°00.135'	Sibugay River	03 Aug	06 Mar	New location/GPS coordinates; murky fast flowing water; fish and sediment samples collected

Figure 2-46: Freshwater Ecology Assessment Sampling Station Map

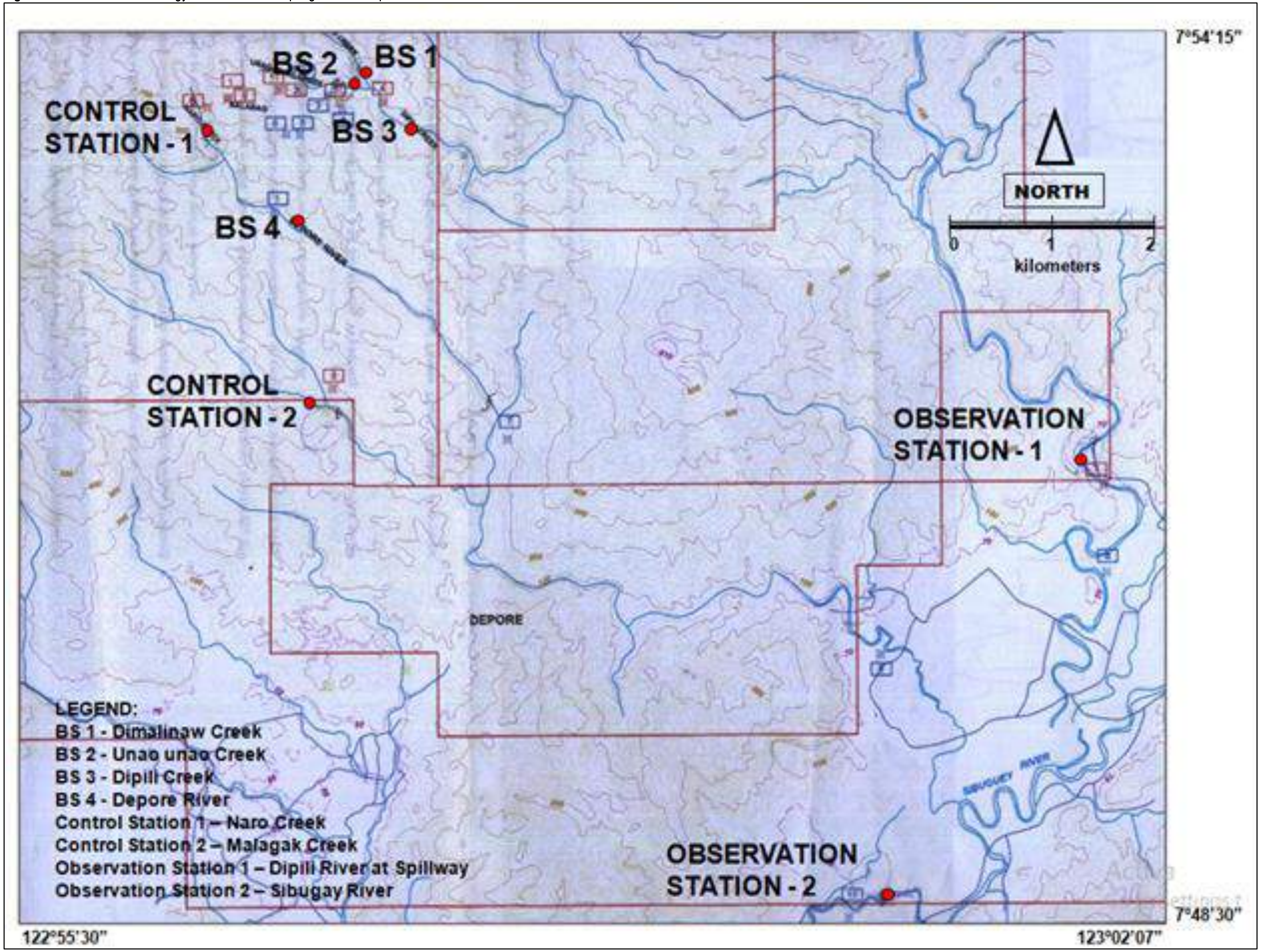
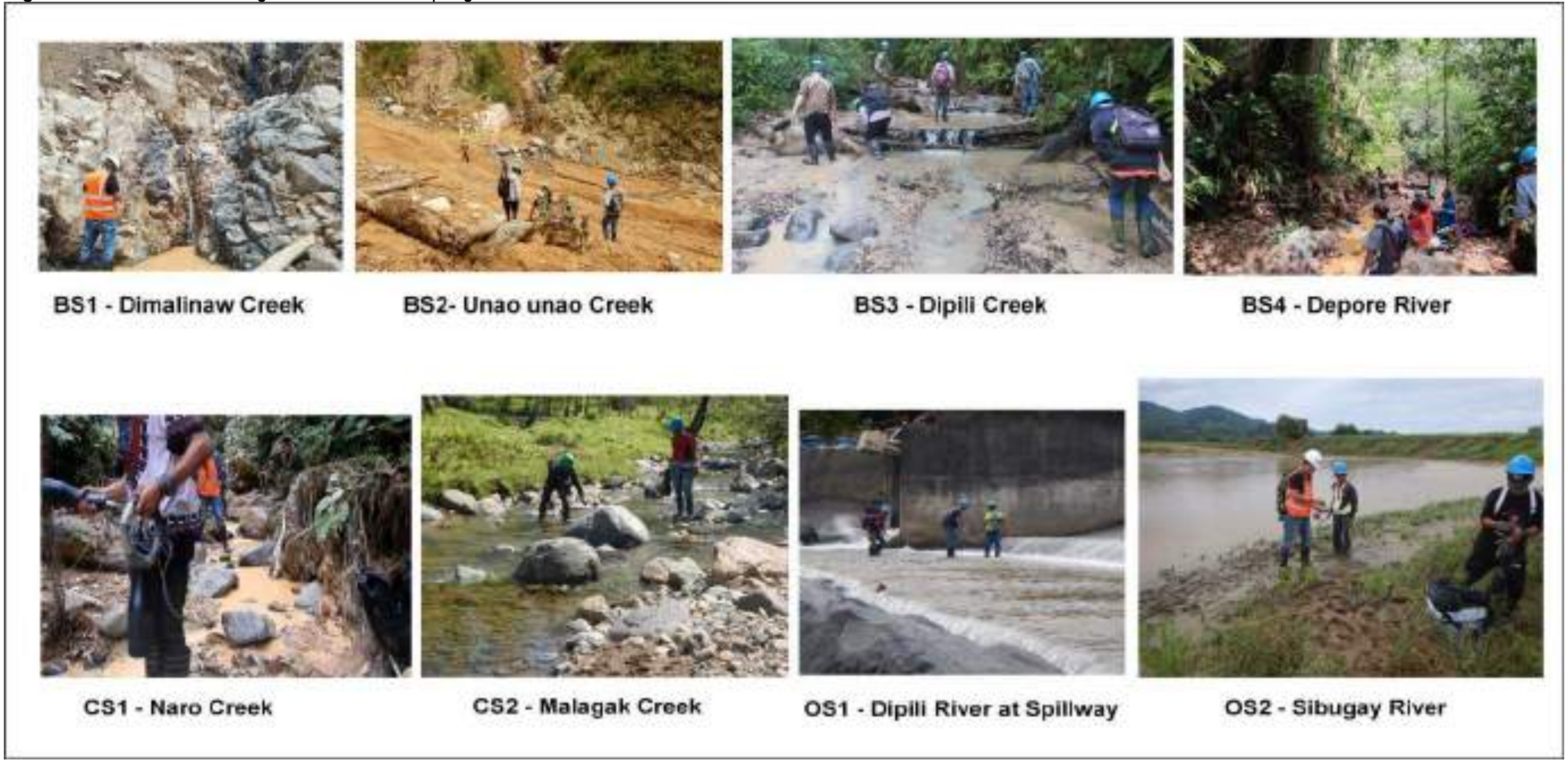


Figure 2-47: Photos Showing Creek//River Sampling Stations taken March 04-06, 2022



2.2.4.1 Filed Sampling Methods

2.2.4.1.1 In-Situ Measurements of Basic Water Quality Parameters

In-situ measurements of water temperature, dissolved oxygen (DO) and hydrogen-ion concentration (or pH) were measured in all sampling stations using a portable analyzer (Horiba YSI Water Quality Probe).

Figure 2-48: Photos Showing Conduct of Measuring Water Temperature, Dissolved Oxygen (DO), and pH Using Portable Analyzer (Horiba YSI Water Quality Probe)

Photo A and B at Station BS3- Dipili Creek; Photo C and D at Station OS2- Sibuyan River

2.2.4.1.2 Collection and Handling of Aquatic Species

Actual fishing activities were done using an electro fishing device (“koryente”) to collect fish samples for cyanide and metals analyses and also for characterization of the existing freshwater fauna of the various creeks and river systems in the area. Other freshwater organisms like frogs and crabs were collected by handpicking.

In the field, specimens were placed in clean sample containers (plastic bottles) and properly labeled. The samples were then brought to the field station and immediately stored in the freezer. After the completion of sampling, the frozen samples were then transferred to a small cooler to keep samples cold during transport from Balabag to Manila.

Figure 2-49: Photos Showing the Conduct of Electro Fishing Activities

Photo a at Station CS2 – Malagak Creek; Photo b at Station BS3 – Dipili River at Spillway

Figure 2-50: Photo Shows the Collection of Other Freshwater Organisms like Frogs by Handpicking at Station BS3 – Dipili Creek

2.2.4.1.3 Collection and Handling of Sediment for Heavy Metals and Cyanide

Sediment samples for metal and cyanide analyses were obtained with the use of hand trowel and plastic bag. The trowel was pushed into the substrate and all sediments were then slowly-hand shoveled into the plastic bag. While in the field, the samples were also stored in a cooler.

Figure 2-51: Photo Showing Conduct of Sediment Sampling for Heavy Metals and Grain-size Distribution Analyses

2.2.4.1.4 Collection and Handling of Sediment for Grain Size Analysis

Additional sediment samples were also collected at each station for grain-size analysis. Samples were placed in plastic bags and properly labeled.

2.2.4.2 Results and Discussion

2.2.4.2.1 In-situ Measurement of Basic Water Quality Parameters

All data for water temperature including dissolved oxygen and pH obtained from the eight (8) sampling stations during the previous and present sampling periods are shown in Table 2-42.

Table 2-42: Water Temperature, Dissolved Oxygen, and pH during March 2022 and August 2010 Survey Periods

Parameter	Survey Period	Sampling Station								DENR 2016-08 Water Quality Standards (Class C)
		BS1	BS2	BS3	BS4	CS1	CS2	OS1	OS2	
Temperature (°C)	March 2022	24.22	25.26	30.26	27.17	27.82	28.05	28.22	27.15	25 - 31
	August 2010	23.7	23.6	24	25.6	23.4	24	26.7	28.6	
Dissolved Oxygen (mg/L)	March 2022	7.41	5.79	5.91	6.33	6.35	7.35	6.6	6.73	5
	August 2010	13.6	13	-	-	-	-	7.78	13.78	
pH	March 2022	7.76	7.37	7.83	7.95	7.72	7.94	8.19	7.67	6.5 – 9.0
	August 2010	7.39	8.02	7.61	7.04	7.47	ns	7.07	7.3	

a. Temperature

Many important physical, chemical and biological processes are significantly influenced by the temperature of the water. The temperature of water varies with depth, location and season (or even sampling time).

The temperature of the creeks and rivers surveyed within and around TVIRD Balabag Gold Nickel Project during the previous August 2010 survey ranged from 23.4 to 25.6°C while those during the present March 2022 survey ranged from 24.22 to 30.26°C. Those at the control stations (CS1 and CS2) during August 2010 ranged from 23.4 to 24 °C while those during March 2022 ranged from 27.82 to 28.05°C. At the observation stations (OS1 and OS2) temperature during August 2010 ranged from 26.70 to 28.60°C while those during March 2022 ranged from 27.15 to 28.22°C. These ranges of values for water temperature are considered normal with those to be expected at the times of year for tropical marine, river, and estuarine waters in this region.

b. Dissolved Oxygen

Dissolved oxygen (DO) is the amount of oxygen dissolved in water and is usually expressed either in milligrams per liter (mg/L or ppm) or percent saturation. DO levels will vary through seasonal and daily phenomena, such as temperature fluctuations (seasonal) and through the activity of plants and other animals (daily).

The DO readings during the previous August 2010 ranged from 7.78 to 13.78 mg/L. Those within and around TVIRD Balabag Gold Nickel Project during the present March 2022 survey ranged from 5.79 to 7.41 mg/L while those at the control stations (CS1 and CS2) ranged from 6.35 to 7.35 mg/L. At the observation stations (OS1 and OS2) DO values obtained ranged from 6.60 to 6.73 mg/L. All these DO values obtained are above the DENR criterion of 5 mg/L for Class C water. For fish and aquatic life to survive, the water must have a minimum DO of 5 mg/L (Evans, 1989 as cited by Hingco, 1990).

c. pH

Most of the rivers and creeks surveyed during the previous August 2010 survey had pH values that ranged from 7.07 to 7.61. Those pH values recorded within and around TVIRD Balabag Gold Nickel Project during the present March 2022 ranged from 7.37 to 7.95 while those at the control stations (CS1 and CS2) ranged from 7.72 to 7.74. At the observation stations (OS1 and OS2) pH values obtained ranged from 7.67 to 8.19. All these pH values obtained are all within the DENR guideline of 6.5 to 9.0 for Class C water. Typically, river waters have pH ranging from 7.5 to 8.1 (Reid and Wood, 1976). A pH of 6.5 to 8.2 is optimal for most aquatic organisms (Tumanda et al., 2004).

2.2.4.2.2 Aquatic Species - Catch Composition

Occurrence of the various species caught at each station during the present baseline survey March 2022 is presented in Table 2-43. The species collected may be conveniently categorized into three (3) main groups composed of fishes (3 species), crabs (1 species), and frogs (2 species).

Similar to the previous survey period August 2010, the number of fishes in freshwater bodies sampled during the present survey period March 2022 was again very low. No fish and other aquatic species were caught in the highland stations of Dimalinaw Creek (BS1), Unao-unao Creek (BS2), Dipili Creek (BS3) and Depore River (BS4). These particular stations are located within and around the Balabag Gold-Silver Project and at higher elevations where these creeks and rivers are quite narrow, very shallow and water flow is commonly fast and generally murky.

Fishes were only caught mostly on the stations at lower elevations [(Naro Creek (CS1), Malagak Creek (CS2), Dipili River (OS1) and Sibugay River (OS2)] where the body of water is generally wider and deeper. Water current in these creeks and rivers are also weaker which is likely to be a more favorable habitat for fish.

In Naro Creek (CS1), the catch is dominantly represented by a cyprinid carp or paitan (Puntius binotatus) followed by unidentified gobies, frogs and crabs. In Malagak Creek (CS2), paitan, gobies and frogs were caught. Sibugay River (OS2) is represented mainly by juveniles/fingerlings of tilapia and paitan while Dipili River at spillway (OS1) is solely represented by paitan of different sizes (from juveniles to adults).

Table 2-43: Occurrence of Aquatic Species Caught From Different Sampling Stations During March 2022 and August 2010 Survey Periods

Aquatic Species	Sampling Station / Period															
	BS1		BS2		BS3		BS4		CS1		CS2		OS1		OS2	
	Aug 2010	Mar 2022	Aug 2010	Mar 2022	Aug 2010	Mar 2022	Aug 2010	Mar 2022	Aug 2010	Mar 2022	Aug 2010	Mar 2022	Aug 2010	Mar 2022	Aug 2010	Mar 2022
Fishes																
1. Paitan (*Puntius binotatus*)										X	X	X	X	X	X	X
2. Tilapia (*Oreochromis niloticus*)															X	X
3. Dalag (*Channa striata*)															X	
4. Biya (*Goby*)										X		X				
Freshwater Crabs																
1. Kagang (*Isolapotamon) mindanaoense*)	X								X	X						
Frogs																
1. Palaka (*Staurois natator*)									X							
2. Palaka sp.1										X		X				
3. Palaka sp.2										X						

Figure 2-52: Photos of Species Collected at Genaro (Naro) Creek (CS1)

a. Paitan; b. Gobies; c. Frogs; d. Crabs

Figure 2-53: Photos of Species Collected at Malagak Creek (CS2)

a. Paitan; b. Gobies; c. Frogs

Figure 2-54: Photo of Collected Mixed Juveniles Species of Tilapia and Paitan at Sibugay River (OS2)

Figure 2-55: Photos Collected Paitan of Various Sizes at Dipili River at Spillway (OS1)

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

Possible sources of freshwater contamination may be in the form of uncontained spills of reagent and petrochemical products (i.e., diesel fuel, drilling additives and fluids) used in the Project operations. Heavy metals and cyanide content of effluent tailings may also reach the water bodies through pipeline leaks or uncontrolled discharges from the Tailings Storage Facility. These substances contain chemicals that can alter the physical chemistry of water and affect the biological productivity of the creeks and rivers.

Aquatic species, when constantly exposed to polluted environment, can accumulate the pollutants through bio-accumulation. Pollutants can be accumulated through multiple exposure routes including respiration, ingestion, or direct contact with contaminated water, sediment, and pore water in the sediment. The total accumulation is dependent on the rate of intake and the organism's capability to eliminate them through excretion and metabolic processes.

2.2.4.4 Threat to Abundance, Frequency, and Distribution

Vegetation clearing and human activities from the Project operation may lead to increased soil erosion and transport of sediments to the local creeks and rivers. The impact on rivers and streams by siltation is related to both suspension of silt materials on or near the water surface (turbidity) and sediment deposition at the bottom of the creek or riverbed.

Suspension of silt materials may impair the feeding mechanism of filter feeders, by which they eat by straining suspended matter and food particles from water. This is common to many freshwater organisms such as fish, shrimps, crabs, worms, and mollusks. Turbid waters can also reduce the light penetration which is essential for photosynthetic processes of the food producers. At very high suspended sediment loads, clogging and abrasion of gills can interfere with oxygen uptake of fishes which can be fatal.

Heavier soil particles will be deposited at the bottom of creek and riverbeds, clogging the spaces between boulders and gravels. These areas serve as shelter and protection for juvenile fishes and other organisms. Compacted gravel and poor water quality also negatively impacts the freshwater environment and the reproduction conditions for fishes. Clogging of interstitial spaces prevents the proper flow of oxygenated water and can affect survival rates of fish eggs.

Nutrient influx from the soils (sediment) transported to the water, combined with shallower riverbeds creates good conditions for the potential growth of noxious weeds. Thick sediment deposits can also invite and increasing population of burrowing creatures such as worms and midget larvae resulting in a potential ecological imbalance within the affected freshwater system.

2.2.5 Marine Ecology

There is no nearby coastal area in the project site.

2.2.6 Impact Assessment for Water Sector

Potential Impacts	Phases: Preconstruction	Phases: Construction	Phases: Operation	Phases: Closure	Options for Prevention or Mitigation or Enhancement
Change in drainage morphology					
The surface mine will change the hydrologic balance of the area and there will be changes in the amount of water that will flow into creeks and rivers		✓	✓	✓	TVIRD will continue its reforestation activities which it started during the exploration stage and will follow all the requirements of any tree cutting permits required for the development of project facilities. As much as possible only the minimum amount of area will be disturbed
Change in Stream Water Depth/ Water resources user / competition in water uses					
Use of Surface Water Sources for Domestic and Industrial supply. Resource Competition with Downstream Users and Reduction in Stream Flows Due to Diversions.		✓	✓	✓	Implementation of Recycling Programs, Improvements within the Processing Operations to Minimize Water Use is continually maintained. Establishment of Other Water Conservation Measures to be Implemented by TVIRD and Individual Employees. Preparation and Implementation of a Water Resource and Watershed Management Plan
Inducement of flooding					
Release of TSF materials at full flood		✓	✓	✓	The TSF is designed with sufficient freeboard to contain any excess flows from the catchments. It will be designed according to climate change projections
Degradation of surface water quality					
The preparation, earthmoving activities, stockpiling, and maintenance of the mine area and facilities may release soil, sediments, rocks, minerals and windblown debris which may affect the water quality of the streams and creeks straddled by the mine footprint. The		✓	✓		Slopes is strengthened to prevent erosion using slope strengthening such as seeding and mulching, silt fences or brush barriers, retaining walls, and/or erosion control blankets or armoring. An Erosion Control Plan, incorporating Best Management Practices is implemented to manage erosion in all development/construction sites that would include details on soil excavation, slope and surface drainage management and stockpiling

Potential Impacts	Phases				Options for Prevention or Mitigation or Enhancement
	Preconstruction	Construction	Operation	Closure	
construction activities may also affect the stream water depth, volume and flow.					requirements. Whenever required, silt traps, rehabilitation of exposed areas and drainage channels and sandbags are employed. Water sprinkling of dirt roads is also being implemented.
					Water Quality Monitoring during the construction and operations phase as required is conducted on a regular basis.
Increased Heavy Metals, TSS/ TDS or Cyanide Concentration within Unao-Unao Creek and Downstream Rivers and Creeks Resulting from Releases from the Tailings Storage Facility Spillway.		✓	✓		Mine drainage gullies and catch berms are installed within the underground mine area to segregate contact and non-contact waters.
					Erosion control measures are conducted for the soil stockpiles.
					Erosion control and slope protection measures includes the installation of bench drains to minimize erosion are being done progressively.
					Water Quality Monitoring during the construction and operations phase as required are conducted on a regular basis
Spillage or Overflow of Tailings Into Unao-Unao Creek from Mill and Processing Facilities or Failure of the Tailings Conveyance Pipeline.			✓	✓	Proper Design of the Mill and Processing Plant Facilities and the TSF
					Monitoring the integrity of these structures is implemented regularly.
					An emergency response plan is in place to manage any possible failure
					Construction of Sediment Ponds and Overland Flow Retention Structures to Trap Soil and Reduce Siltation.
Hydrocarbon leaks, spills from vehicles, fuel tanks, used oil storage and oil-contaminated materials from the access roads, mine and mill areas, maintenance workshops, motor pool and other support facilities may contaminate surface		✓	✓	✓	Motor pool area, maintenance workshop, and fuel storage area is provided with proper drainage, Bunds and sorbents placed in the fuel and oil storage areas.
					Vehicle Wash Bay is equipped with its own oil separator.
					Proper handling of hydrocarbons and other hazardous materials and implementation of good housekeeping practices is enforced to workers.

Potential Impacts	Phases: Preconstruction	Construction	Operation	Closure	Options for Prevention or Mitigation or Enhancement
runoff, leading to surface water contamination.					Waste oils, oily water and other hazardous wastes will be stored in a proper hazardous waste storage area and collected and disposed offsite by an accredited third-party waste hauler.
Non-mine wastewater including domestic sewage discharges and residues from the administration and accommodation may contaminate the nearby streams if not properly handled.		✓	✓		A sewage treatment facility is built, the effluents of which is reused in the plant through the underground water pond A Waste Management Plan for non-mine wastes is continually implemented to address collection, handling, transport, treatment and disposal of generated wastes. An Ecological Composting Facility is established to handle wastes such as kitchen scraps, tree cuttings, and other relevant wastes. Composts from this facility will be used in the plant nursery and to support progressive rehabilitation activities.
Degradation of groundwater quality					
Groundwater inflow and rainwater may percolate into the mine area and interact with highly mineralized materials, thus contributing to soluble minerals in the groundwater and affecting the content and quality of the aquifers.		✓	✓	✓	Spring water monitoring systems is periodically done in order to monitor any changes in the spring water in the adjacent areas. Groundwater is not used for domestic purposes in the area

2.3 THE AIR

The Project area is not within a designated airshed. An airshed is defined by DAO 2000-81: Implementing Rules and Regulations for RA 8749 (otherwise known as the Philippine Clean Air Act) as areas with common weather or meteorological conditions and sources of air pollution which affect the interchange and diffusion of pollution in the surrounding atmosphere. There are currently only a few areas within the Philippines designated by the DENR as airsheds. Within Region 9, Zamboanga City and the adjacent municipalities are the only areas that have been designated as an airshed.

A baseline Ambient Air Quality Monitoring was conducted by SGS Philippines, Inc. in year 2012 within the Project Area. The main pollutants considered included total suspended particulates (TSP), Sulfur Dioxide (SO2), nitrogen dioxide (NO2), particulate matter less than 10 microns (PM10), particulate arsenic (As), particulate mercury (Hg), particulate lead (Pb), particulate cadmium (Cd), cyanide (CN), and carbon monoxide (CO). The said parameters are sampled in 6 strategic sampling locations around the project site.

During operations, quarterly third-party air quality monitoring is also done in compliance to air quality management regulations. There are years however without monitoring, since there are also no ongoing activities within this period. Below is a table showing the air quality data from 2012 to 2021.

2.3.1 Change in the Local Micro-Climate

2.3.1.1 Rainfall

Long term rainfall data within the region are available from the Malangas Station (1971-1988), Dipolog Station (1951-2010), WESMIARC-Ipil Station (2000-2010) and Canatuan (1994-2011). Mean monthly rainfall depths for each station are shown in Table 2-44 and Annual Climatic Rainfall data are shown in a Table 2-45.

Examination of these data indicates a climate more associated with a Type 3 Climate Classification at all stations. The early portion of the year has a more definitive dry season whereas the latter part of each year exhibits a rainy period. Annual rainfall is the highest at Canatuan and Malangas and lowest at Dipolog and Ipil.

Selecting a station that is most representative of the Project area is difficult. The Ipil and Malangas stations arethe closest to the Project area but are located along the coast at a low elevation. The Dipolog station has thelongest data record however it is the farthest from the Project area and is also located along the coast. The Canatuan area is most similar from the standpoint of elevation and orographic effects but is within a different climate zone. The data from the Ipil station and the Malangas station were considered due to their closer proximity to the Project area.

Monthly rainfall data from the WESMIARC station in Ipil are shown in Table 2-46 and monthly rainfall data from the Malangas station are shown in Table 2-47. Other meteorology and climate data for the Ipil station are shown in Table 2-48 Long term climatologic data from the Dipolog station are shown in Table 2-49.

Table 2-44: Mean Monthly Rainfall Data (mm)

MONTH	Malangas (1971-1988)	Dipolog (1951-2010)	WESMIARC-Ipil Station (2000-2010)	Canatuan (1994-2011)
January	84.3	138.1	83.4	120.9
February	94.0	81.5	62.3	86.6
March	96.6	82.5	102.1	184.9
April	164.7	97.2	123.2	248.4
May	274.0	173.2	161.0	298.9
June	330.4	260.3	205.5	301.9
July	368.7	229.7	243.7	300.9
August	287.0	213.3	247.7	318.8
September	273.8	217.0	199.2	312.3
October	292.5	296.9	223.0	390.0
November	244.2	357.8	163.0	296.8
December	161.0	307.9	134.6	186.0
Annual	2671.2	2455.4	1948.8	3046.3

Source: PAGASA, WESMIARC, TVIRD

Table 2-45: Annual Rainfall Climatic Data(mm)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JULY	AUG	SEPT	OCT	NOV	DEC	ANNUAL
2010	115.2	13.2	3.0	28.0	113.4	233.5	360.2	407.1	147.9	371.0	382.7	608.7	2783.9
2011	265.2	318.7	339.0	120.3	310.8	249.5	211.3	231.0	162.8	351.5	556.5	442.2	3558.8
2012	110.9	528.1	277.9	261.6	59.0	262.9	478.8	113.0	292.8	442.7	391.4	161.6	3380.7
2013	463.9	323.6	163.3	171.1	298.7	228.4	349.5	260.0	156.6	414.2	559.2	334.2	3722.7
2014	379.3	118.6	44.4	92.0	211.8	151.8	326.5	158.5	115.2	283.8	276.2	160.9	2319.0
2015	83.4	42.6	7.3	35.4	25.1	195.6	60.2	77.0	302.6	143.7	255.6	84.3	1312.8
2016	25.9	20.9	0.0	86.1	142.3	287.0	105.1	198.4	171.0	620.3	228.8	303.0	2188.8

2017	460.7	66.9	185.3	52.9	682.0	177.4	196.7	244.6	119.2	307.0	252.9	276.6	3022.2
2018	490.2	421.1	20.4	275.6	427.0	137.4	172.2	110.5	237.3	122.8	505.8	234.9	3155.2

Source: PAGASA – Dipolog Synoptic Station, Zamboanga del Norte

Table 2-46: WESMIARC Station Monthly Rainfall Data for Year 2000 to 2010

Year	Monthly Rainfall in mm												Annual
	Jan	Feb	Mar	Apr	May	Jul	Jun	Aug	Sept	Oct	Nov	Dec	
2000	81.30	169.10	151.20	224.20	180.70	161.90	227.30	249.90	166.80	294.10	270.80	205.40	2,382.7
2001	250.40	No data	187.80	87.10	131.70	203.70	138.30	117.00	52.10	237.00	212.10	56.20	1,673.4
2002	38.70	40.00	143.10	78.10	111.60	192.80	340.20	431.80	161.90	107.10	170.10	68.70	1,884.1
2003	9.30	22.30	73.40	176.40	252.00	155.40	337.50	267.20	272.40	253.70	101.30	73.10	1,994.0
2004	47.10	29.50	5.10	86.00	263.00	318.50	401.30	295.00	138.10	335.80	123.90	122.20	2,165.5
2005	No data	39.90	57.10	49.60	207.40	223.10	280.90	169.60	179.30	229.70	205.10	185.50	1,827.2
2006	49.50	71.90	143.90	72.30	153.30	354.40	167.30	355.30	316.00	327.50	78.70	167.60	2,257.7
2007	153.80	27.90	31.60	117.80	81.10	213.70	322.00	290.60	363.30	No data	No data	No data	1,601.8
2008	119.10	119.00	149.70	160.80	180.00	328.20	275.90	223.60	183.60	117.40	150.70	21.50	2,029.5
2009	54.20	98.90	180.30	236.10	162.30	72.80	136.90	194.03	317.60	170.00	19.00	6.40	1,648.5
2010	30.80	4.20	No data	67.20	47.70	36.00	52.90	131.00	40.50	158.00	298.40	439.20	1,305.9
Total	834.20	622.70	1123.20	1355.60	1770.80	2260.50	2680.50	2725.03	2191.60	2230.30	1630.10	1345.80	20,770.3
Maximum	250.40	169.10	187.80	236.10	263.00	354.40	401.30	431.80	363.30	335.80	298.40	439.20	2,382.7
Minimum	9.30	4.20	5.10	49.60	47.70	36.00	52.90	117.00	40.50	107.10	19.00	6.40	1,305.9
Mean Month	83.42	62.27	112.32	123.24	160.98	205.50	243.68	247.73	199.24	223.03	163.01	134.58	1,888.2
Maximum	250.40	169.10	187.80	236.10	263.00	354.40	401.30	431.80	363.30	335.80	298.40	439.20	2,382.7

Source: Department of Agriculture – Western Mindanao Integrated Agricultural Research Center (DA-WESMIARC)

Note: Red values represent "no data" or incomplete data.

Table 2-47: Malangas Station Monthly Rainfall Data for Year 171 to 1988

Year	Monthly Rainfall in mm												Annual
	Jan	Feb	Mar	Apr	May	Jul	Jun	Aug	Sept	Oct	Nov	Dec	
1971	ND	ND	ND	ND	ND	351.70	ND	ND	158.80	536.70	309.10	220.20	1,576.50
1972	135.20	69.00	187.50	197.10	369.20	No data	157.20	234.90	323.50	272.80	178.50	57.10	2,182.00
1973	24.60	49.70	44.50	156.00	255.60	266.90	414.70	320.30	512.50	269.80	367.60	108.00	2,790.20
1974	51.10	191.20	22.00	287.90	283.00	343.20	272.90	176.10	360.70	620.80	256.20	280.20	3,145.30
1975	No data	74.80	173.20	169.70	96.60	306.10	289.30	477.10	388.40	243.40	171.90	321.10	2,711.60
1976	85.90	89.10	143.40	326.50	329.10	425.40	293.00	455.10	361.00	213.90	417.80	195.70	3,335.90
1977	90.40	162.10	220.80	83.60	362.50	536.50	633.40	365.40	244.80	176.70	237.20	121.60	3,235.00
1978	30.30	69.90	54.80	161.30	347.30	ND	ND	493.80	368.10	452.60	213.50	228.60	2,420.20
1979	47.30	39.60	151.10	150.10	385.10	339.10	592.80	172.90	354.60	235.40	363.80	145.80	2,977.60
1980	148.80	92.50	29.90	95.60	219.40	386.10	ND	ND	184.60	341.90	322.10	110.00	1,930.90
1981	139.10	69.70	66.00	172.10	191.90	285.80	517.70	171.50	354.40	271.20	333.50	63.20	2,636.10
1982	72.80	114.30	31.20	178.80	153.90	467.50	252.50	412.20	71.10	259.20	189.00	135.30	2,337.80
1983	41.10	0.00	63.40	37.60	198.60	272.80	500.50	280.00	305.40	156.30	154.50	202.90	2,213.10
1984	98.30	142.90	140.10	212.70	305.20	339.80	341.50	147.10	234.40	285.80	113.00	89.90	2,450.70
1985	78.10	68.10	114.60	197.90	263.80	192.70	171.10	172.90	207.70	195.30	124.80	139.10	1,926.10
1986	209.30	197.40	85.10	86.20	ND	260.20	219.10	234.60	207.70	160.20	217.70	218.80	2,096.30
1987	0.00	53.20	39.90	ND	ND	ND	ND	205.80	182.80	170.20	134.70	99.20	885.80
1988	97.10	115.00	75.50	122.70	ND	ND	ND	ND	ND	ND	ND	ND	410.30
Mean	84.34	94.03	96.65	164.74	268.66	340.99	358.13	287.98	283.56	286.01	241.46	160.98	2,667.52
Maximum	209.30	197.40	220.80	326.50	385.10	536.50	633.40	493.80	512.50	620.80	417.80	321.10	633.40
Minimum	0.00	0.00	22.00	37.60	96.60	192.70	157.20	147.10	71.10	156.30	113.00	57.10	0.00
Monthly Rank	12	11	10	8	6	2	1	3	5	4	7	9	

Source: PAGASA. Note: ND: "no data" or incomplete data.

Table 2-48: Ipil, Zamboanga del Sur Mean Climate Data for Year 2001 to 2010

Month	Rainfall (mm)	Max Temp (°C)	Min Temp (°C)	Relative Humidity (%)
January	83.42	31.08	18.79	88.19
February	62.27	31.80	19.01	88.49
March	112.32	31.83	19.96	86.80
April	123.24	31.53	19.45	87.75
May	160.98	31.24	19.08	88.17
June	205.50	30.65	18.92	88.55
July	243.68	30.71	18.67	88.25
August	247.73	30.68	19.01	86.19
September	199.24	30.86	18.88	88.17
October	223.03	30.82	18.68	88.39
November	163.01	30.74	19.10	88.51
December	134.58	30.95	18.76	88.61

Source: Department of Agriculture – Western Mindanao Integrated Agricultural Research Center (DA-WESMIARC)

Table 2-49: Dipolog City Climatological Extremes for Years 1951 to 2010

Month	Temperature (deg C)				Greatest Daily Rainfall(mm)		Prevailing Wind (mps)		
	High	Date	Low	Date	Depth	Date	Speed	Dir	Date
January	35.0	01/04/72	18.4	1/12/71	226.5	1/23/84	16	ENE	01/09/68
February	35.2	02/20/70	18.0	02/04/76	149.8	2/06/99	18	ENE	02/20/07
March	35.6	03/15/70	17.0	03/20/97	123.6	03/29/09	20	NE	03/10/07
April	36.1	04/26/62	17.3	04/05/63	190.8	04/22/02	16	NW	04/04/94
May	36.6	05/22/58	19.0	05/17/03	135.4	05/17/60	15	WNW	05/17/04
June	37.2	06/11/63	18.5	06/22/03	190.5	06/09/80	26	SW	06/23/92
July	36.7	07/31/69	18.5	07/03/03	122.2	07/20/69	28	W	07/31/09
August	36.8	08/18/74	18.0	08/24/03	287.6	08/12/01	28	WNW	08/13/02
September	37.0	09/12/87	18.6	09/21/99	188.7	09/27/51	26	WNW	09/22/07
October	36.2	10/01/76	18.5	10/01/02	221.0	10/20/80	25	W	10/03/04
November	36.2	11/02/75	19.0	11/05/02	295.8	11/12/73	21	NW	11/27/07
December	35.6	12/16/70	17.4	12/28/50	181.9	12/22/88	15	W	12/10/98

Source: PAGASA

Based on the wind rose analysis for Dipolog City, the prevailing annual wind direction between Years 1971 to 2000 was northeasterly (from the northeast) with a mean speed of 1.6 meters per second. Calm conditions (wind speed below 0.6 mps) were observed 1.8 percent of the time. Northeasterly wind prevails during the months of January, February, March, April, May, November, and December. The remaining months are dominated by southeast or northwesterly winds. The prevailing wind direction or wind rose analysis gathered from Dipolog City PAGASA station was used since no data is available from the other meteorological stations near the Project area. The annual wind speed and direction frequency data for Dipolog City is shown in Table 2-50a and Table 2-50b.

Table 2-50a: Dipolog City Wind Speed and Direction Frequency Year 1971 to 2000

Wind Speed (mps)		Wind Direction							
		N	NNE	NE	ENE	E	ESE	SE	SSE
0	Calm								
1 to 4	Light	9.4	1.9	33.5	1.5	2.9	0.1	13.3	0.1
5 to 8	Moderate	0.0	0.0	0.9	0.1	0.1	0.0	0.0	0.0
9 to 12	Moderate to Strong	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13 to 16	Strong	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
>16	Very Strong	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total %		9.4%	1.9%	34.4%	1.6%	3.0%	0.1%	13.3%	0.1%

Source: Climate Data Section, PAGASA

Table 2-50b: Dipolog City Wind Speed and Direction Frequency Year 1971 to 2000

Wind Speed (mps)		Wind Direction							
		S	SSW	SW	WSW	W	WNW	NW	NNW
0	Calm								
1 to 4	Light	2.2	0.0	7.2	0.1	9.4	1.8	12.7	0.9
5 to 8	Moderate	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
9 to 12	Moderate to Strong	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13 to 16	Strong	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
>16	Very Strong	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total %		2.2%	0.0%	7.3%	0.1%	9.4%	1.8%	12.7%	0.9%

Source: Climate Data Section, PAGASA

2.3.1.2 Tropical Cyclones

The tropical cyclone map of the Philippines indicates the frequency of tropical cyclone occurrence within the Zamboanga Peninsula generally ranges from 0-10 typhoons per year (Years 1948 to 2000). This area is the least visited by typhoons and tropical cyclones within the Philippines. The area is further described by PAGASA as having a tropical cyclone occurrence frequency of 1 tropical cyclone in 12 years. The distribution and locations of tropical cyclones throughout the Philippines is shown on Figure 2-56 as well as the track through Zamboanga del Sur.

Six tropical cyclones passed through the Zamboanga del Sur area during the period 1948 to 2009. Data relative to each is shown in Table 2-51.

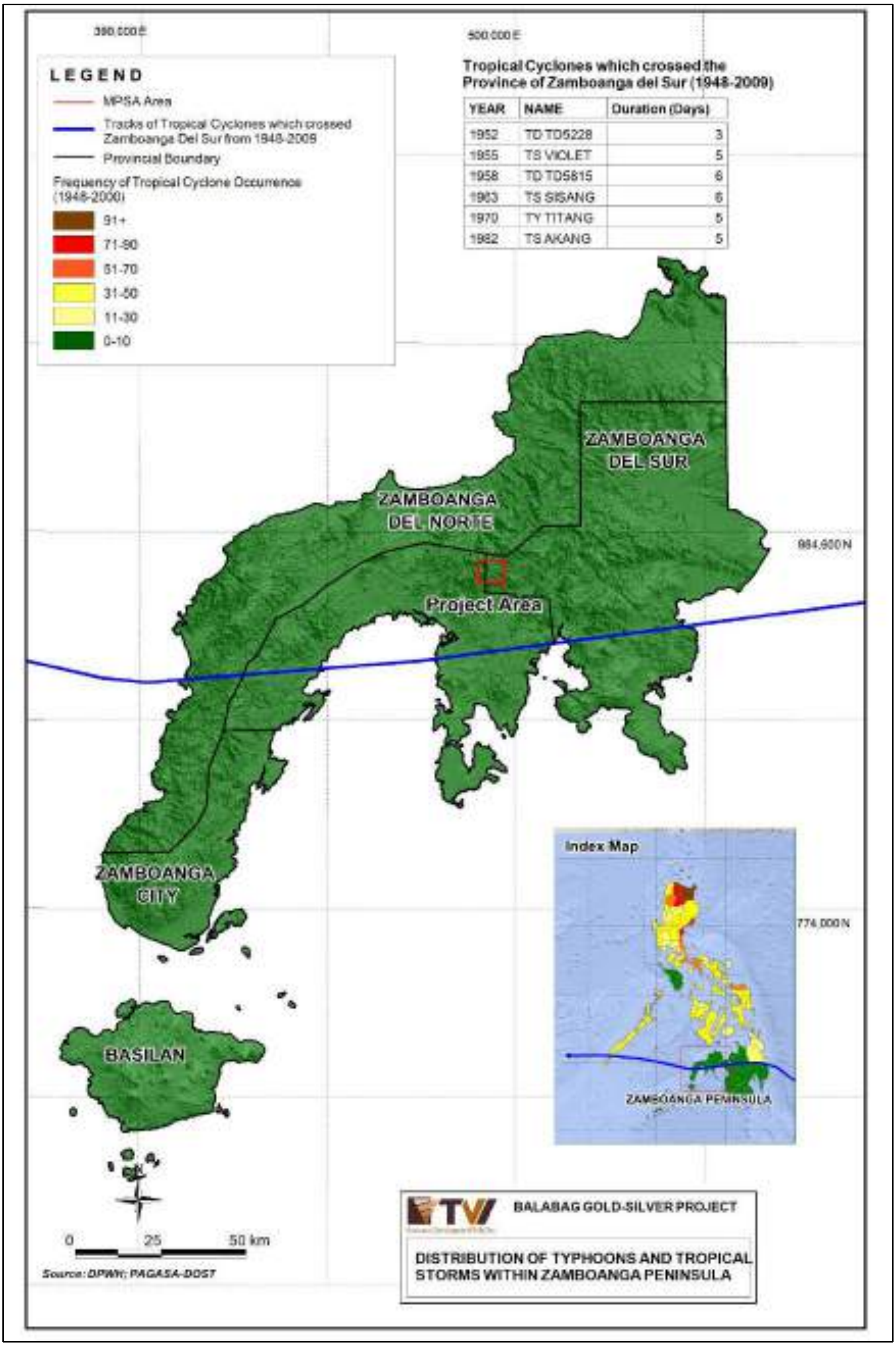
Table 2-51: List of Tropical Cyclones that Passed Through Zamboanga del Sur

Number	Year	Name	Period		
			Begin	End	Duration
1	1952	TD TD5228	12/29/1952	12/31/1952	3
2	1955	TS VIOLET	1/2/1955	1/6/1955	5
3	1958	TD TD5815	11/19/1958	2/14/1961	6
4	1963	TS SISANG	12/9/1963	12/14/1963	6
5	1970	TY TITANG	10/18/1970	10/22/1970	5
6	1982	TS AKANG	3/18/1982	3/22/1982	5

Source: PAGASA

Due to the small footprint of the Project and the short operations period, impacts to the meteorology and climate are considered to be negligible. This is the case for both local and global impacts. Nonetheless, recent guidelines within the Environmental Impact Assessment process have recommended these potential impacts oreffects be evaluated using climate change protocols and parameters issued by PAGASA. Predictions have beenmade by PAGASA relative to the impacts of climate change on rainfall, temperature, humidity and sea level pressure. These have been incorporated as part of the Project impact analysis.

Figure 2-56: Distribution of Typhoons and Tropical Storms within Zamboanga Peninsula



2.3.1.3 PAGASA Climate Change Model

In Year 2010, PAGASA released the results of its climate change impact study using the PRECIS (Providing Regional Climates for Impact Studies) Regional Climate Model developed for more than 40 Provinces. This study identified the impacts of climate change relative to rainfall, temperature, humidity, and sea level pressure for two-time frames; Year 2020 and Year 2050. Average climate baseline information and data collected for the period 1971 to 2000 were used as emission scenarios developed by the International Panel on Climate Change (IPCC).

The Year 2020 model simulation covered the period from 2006 to 2035 and Year 2050 model simulation covered the period from 2036 to 2065. Four seasons were analyzed and consisted of the following: December-January-February, March-April-May, June-July-August, and September-October-November. Four emission scenarios were identified relative to population and economic growth and technologies that may be attendant to the different socio-economic conditions. These are presented and defined in Table 2-52.

Table 2-52: Climate Change Emission Scenarios

SCENARIO	DESCRIPTION
A1	Very rapid economic growth; population peaks mid-century; social, cultural and economic convergence among regions; market mechanisms dominate.
	A1-F1- reliance on fossil fuels; A1-T- reliance on non-fossil fuels; A1-B- a balance across all fuel sources
A2	Self-reliance; preservation of local identities; continuously increasing population; economic growth on regional scales
B1	Clean and efficient technologies; reduction in material use; global solutions to economic, social and environmental sustainability, improved equity; population peaks mid-century
B2	Local solutions to sustainability; continuously increasing population at a lower rate than in A2; less rapid technological change than in B1 and A1

Source: International Panel on Climate Change

The A2 (high range), A1-B (mid-range) and B2 (low range) were the emission scenarios PAGASA used to run the model. The high range emission scenario suggests that society is based on self-reliance, with a continuously growing population, regionally oriented economic development but with fragmented per capita economic growth and technological change. The mid-range emission scenario envisions a future world of very rapid economic growth, with the global population peaking in mid-century and declining thereafter. There is also a rapid introduction of new and more efficient technologies with energy generation balances across all sources.

The A2 scenario is preferred by most countries. From an impacts and adaptation point of view, if man can adapt to a larger climate change, then adaptation to the smaller climate changes of the lower end scenarios can also be attained. The A1-B scenario is also considered primarily because the future climate will be significantly influenced by past emissions. (Climate Change in the Philippines, 2011)

Key findings of the PAGASA model relative to a mid-range scenario for future climates in Year 2020 and Year 2050 include the following:

- All areas of the Philippines will get warmer, more so in relatively warmer summer months.
- Seasonal mean temperatures will increase during the four seasons (DJF, MAM, JJA and SON) in all Provinces.
- There will be a reduction in rainfall in most Provinces during the summer season (MAM) making the usually dry season drier, while rainfall increases are likely in most areas in Luzon and Visayas during JJA and SON seasons. Rainfall will be a generally decreasing trend in most of the Provinces in Mindanao in Year 2050.
- The model has likewise predicted seasonal mean temperature, rainfall and extreme event changes per Province in Year 2020 and Year 2050.

2.3.1.4 Region 9 Zamboanga Peninsula Climate Change Model

Both the mid-range scenario (A1-B) and the high range scenario (A-2) were modeled for the Zamboanga Peninsula and Zamboanga del Sur in particular. Three parameters were evaluated and consisted of seasonal temperature changes, percent rainfall changes and frequency of extreme events. Extreme events include the number of days with temperatures exceeding 35 deg C, the number of dry days and the number of days with rainfall exceeding 150 millimeters. Comparison is made with the baseline period of 1971 to 2000. The model results are shown in Table 2-53, Table 2-54, and Table 2-55.

The seasonal mean temperature in Region 9 as shown in Table 2-53 indicates an increase in all seasons during the identified time scales. A maximum of 1.1 degree increase in the average temperature will be anticipated from Year 2006-2035 while a maximum of 2.2 degrees will be experienced from Year 2036-2065 under the mid-range scenario.

Zamboanga del Sur will experience the most significant temperature increase during the MAM months (March, April, May) with a range of 1.1 to 2.1 degrees. Results of the rainfall model are shown in Table 2-53 and indicate there is a significant change in the amount of rainfall that will be experienced by Region 9.

The percentage range will be between -3.2% to +22%. The region will experience a decrease in the amount of rainfall during the JJA (June, July, August) season but an increase in the remaining seasons. Using the mid-range scenario, the DJF (December, January, February) and SON (September, October, November) seasons will experience an increase in the amount of rainfall by 11.2% to 13.8% but the JJA (June. July, August) season will experience a decrease in the amount of rainfall by 0.4% from 2006 to 2035.

From Year 2036 to 2065, there will be a continued increase in the amount of rainfall that will be experienced but will be less than the 2006 to 2035 period. Baseline study gathered from nearby meteorological stations identified higher rainfall data which is more even if the percentage change is added to the baseline data of PAGASA.

This data was used for the Project area. Examination of the extreme events shown in Table 2-55 indicates the number of hot days (greater than 35 deg.) will increase in both Provinces of Zamboanga del Norte and Zamboanga del Sur. The greatest impact will be felt within Zamboanga del Norte. The rainfall influenced extreme events also indicate increased rainfall extreme events in both Provinces.

Table 2-53: Seasonal Temperature Increase in Province of Region 9, Zamboanga Peninsula (Values in ºC)

Provinces	Baseline (1971-2000), mm				A2 (high range) Emission Scenario								A1B (mid-range) Emission Scenario							
					Change in Year 2020 (2006-2035)				Change in Year 2050 (2036-2065)				Change in Year 2020 (2006-2035)				Change in Year 2050 (2036-2065)			
	DJF	MAM	JJA	SON	DJF	MAM	JJA	SON	DJF	MAM	JJA	SON	DJF	MAM	JJA	SON	DJF	MAM	JJA	SON
Zamboanga del Norte	27.0	27.9	27.6	27.5	0.8	0.7	0.7	0.8	1.8	1.7	1.7	1.9	1.0	1.1	1.1	1.0	2.0	2.1	2.2	2.0
Zamboanga del Sur	26.8	27.6	27.3	27.2	0.8	0.6	0.7	0.8	1.7	1.6	1.6	1.8	0.9	1.1	1.0	1.0	1.9	2.1	2.0	1.9
Zamboanga Sibugay	27.1	27.9	27.5	27.5	0.8	0.6	0.6	0.8	1.9	1.5	1.6	1.8	1.0	1.0	1.0	1.0	2.0	2.0	1.9	2.0

Table 2-54: Seasonal Temperature Increase in Province of Region 9, Zamboanga Peninsula (Values in ºC)

Provinces	Baseline (1971-2000), mm				A2 (high range) Emission Scenario								A1B (mid-range) Emission Scenario							
					Change in Year 2020 (2006-2035)				Change in Year 2050 (2036-2065)				Change in Year 2020 (2006-2035)				Change in Year 2050 (2036-2065)			
	DJF	MAM	JJA	SON	DJF	MAM	JJA	SON	DJF	MAM	JJA	SON	DJF	MAM	JJA	SON	DJF	MAM	JJA	SON
Zamboanga del Norte	324.5	279.7	599.1	718.1	-12.7	16.3	4.0	-7.6	-23.7	16.7	5.5	-2.5	11.0	3.2	-3.2	13.8	2.6	1.7	-0.7	5.4
Zamboanga del Sur	294.5	298.7	593.8	663.2	-16.3	14.6	6.6	-3.1	-24.2	17.3	9.6	6.3	11.2	2.2	-0.4	13.8	3.6	0.0	9.9	7.1
Zamboanga Sibugay	284.1	290.5	597.2	674.1	-7.7	14.6	8.7	-8.6	-15.1	18.3	11.0	0.1	9.9	6.6	6.5	14.8	4.8	10.3	22.0	8.9

Table 2-55: Frequency of Extreme Events using AI-B Emission Scenario in Provinces in Region 9, Zamboanga Peninsula

Provinces	Stations	No. of Days w/ Tmax > 35 OC			No. of Dry Days			No of Days w/ Rainfall		
		Baseline	2020	2050	Baseline	2020	2050	(1971-2000)	2020	2050
Zamboanga del Norte	Dipolog	217	2,155	4,004	7,481	5,384	5,470	10	13	9
Zamboanga del Sur	Zamboanga	54	114	714	8,531	7,058	6,781	1	8	9

Due to the short time frame of the Project, climate changes will only be a factor within the 2006-2035 climate change period. The potential increase in the seasonal main temperature in Zamboanga del Sur will range from 0.8 degrees to 1.1 degrees. This will not provide a significant impact to the implementation or operation of the Project. The mining and milling activities are not temperature dependent and may proceed despite the changes in temperature. Similarly, the short time frame of the Project will limit the impacts of rainfall changes within the 2006-2035 time period. Depending on the Emissions Scenario, the potential rainfall changes could be wide ranging from a -16.3% to +14.6%. Since the operation of the Processing Plant and the Tailings Storage Facility are water supply dependent, the rainfall changes may impact the operations. To evaluate this scenario, the operations at the Canatuan Mine were examined relative to the variation in the seasonal rainfall. The results are shown in Table 2-56 and present the variation in actual seasonal rainfall during the operations (Years 2004 to 2011) to the mean for the same PAGASA Model designated seasons.

As noted above, the variation in seasonal rainfall at Canatuan was significantly greater than projected in the PAGASA climate model for the Project area. The operations at Canatuan were able to successfully manage the variations through planning and redundant systems. This will be the case for the Balabag Gold-Silver project as well.

Table 2-56: Seasonal Rainfall Variation at Canatuan Mine Project 2004-2011

Season Mean Rainfall (mm)	Mean Rainfall (mm)	Maximum Rainfall (mm)	Minimum Rainfall (mm)	Variation (%)
Dec, Jan, Feb	375.1	594.8	106.2	-72% to +59%
Mar, Apr, May	700.6	1,143.5	374.0	-47% to +63%
Jun, Jul, Aug	920.9	1,125.0	540.0	-41% to +22%
Sep, Oct, Nov	934.0	1,149.0	681.5	-27% to +23%
Annual	2,930.6	3,530.8	2,291.4	-22% to +21%

2.3.2 Total Greenhouse Gas Emissions from Project Operations

The total GHG emissions from implementation of the Project are estimated to be 28,523 metric tons of CO2 equivalent per year of operation. Over the course of the 2-year Project period, including the pre-operation construction period, a total of approximately 89,281metric tons of CO2 equivalent GHG emissions will be added to the environment. The sector distribution and annual GHG contribution is summarized in Table 2-57.

The GHG emissions identified in Table 2-57 represent the gross amounts and do not take into consideration the potential carbon sequestration that will occur during progressive rehabilitation activities (reforestation), during operations, and post mining closure (reclamation and rehabilitation) programs. Over the long term, reforestation, and re-vegetation as part of the mine closure plan will re-establish the forest land use and potentially return the area to a carbon sink condition. For reference, the estimated annual GHG emission for the TVIRD Canatuan Project is more than 20,000 metric tons of CO2 equivalent. This will be significantly reduced in Year 2013 upon closure of the mine operations. Comparison of the Project GHG emissions relative to the Philippines as a whole suggests a negligible impact. The total GHG emission for the Philippines was estimated to be 118.6 million metric tons of CO2 equivalent in 1990 and 169.8 million metric tons in Year 2000 (World Resources Institute, 2009). The DENR estimated the Year 2008 emissions to be 195.1 million metric tons of CO2 equivalent. The annual contribution from the Balabag Gold-Silver Project would be less than 0.02% of the Year 2008 Philippine total. The total Project contribution (Years 0 to 2) would be less than 0.05% of the Year 2008 Philippine total GHG emission.

Table 2-57: Greenhouse Gas Emissions during Project Operation (Metric tons of CO_2 Equivalent)

Sector	Year 0	Year 1	Year 2	Total Project
Stationary Sources	12, 820	25, 820	35, 820	64, 550
Mobile Sources	1, 405	2, 809	2, 809	7, 023
Waste Production	42	83	83	208
Land Use Conversion	17, 500	28, 712	28, 712	89, 281
TOTAL	31, 857	28, 712	28, 712	89, 281

Source: TVIRD, 2012; IPCC 2006

Note: Year 0 represents 0-6 months construction period prior to the start of operations

2.3.2.1 Baseline Greenhouse Emissions

In order to determine the amount of greenhouse gases emitted to or removed from the atmosphere, greenhouse gas inventories are being formulated by countries around the world. These inventories are used to track emission trends, develop strategies and policies and assess progress. The Philippines has conducted two national greenhouse gas inventories, one for Year 1990 and the other for Year 1994. The 1990 Greenhouse Gas Inventory was initially undertaken under the US Country Studies Program wherein the Philippines is a participating country. Pursuant to an Article of the United Nations Framework Convention on Climate Change, non-Annex 1, parties, which include the Philippines, are required to report their 1994 National Greenhouse Gas Inventory as contained in their Initial National Communication. The Philippines generated their 1994 inventory through the Enabling Activity Project (titled "Enabling the Philippines to Prepare its First National Communication Program in Response to its Commitment to the United Nations Framework Convention on Climate Change) funded by the Global Environment Facility through the United Nations Development Program.

The National GHG Inventory was released in 1994 and reported in the Year 2000 Initial National Communication on Climate Change submitted to the United Nations Framework Convention on Climate Change (UNFCCC) Secretariat.

Gases that trap heat in the atmosphere are often called greenhouse gases. Some greenhouse gases such as carbon dioxide occur naturally and are emitted to the atmosphere through natural processes and human activities. The principal greenhouse gases that enter the atmosphere because of human activities are:

- Carbon Dioxide: Carbon dioxide enters the atmosphere through the burning of fossil fuels like oil, natural gas and coal, solid waste, trees and wood products, and also as a result of other chemical reactions. Carbon dioxide is also removed from the atmosphere when it is absorbed by plants as part of the biological carbon cycle.
- Methane: Methane is emitted during the production and transport of coal, natural gas, and oil. Methane emissions also result from livestock and other agricultural practices and by the decay of organic waste in municipal solid waste landfills.

- Nitrous Oxide: Nitrous oxide is emitted during agricultural and industrial activities as well as during combustion of fossil fuels and solid waste.
- Fluorinated Gases: Hydrofluorocarbons, perfluorocarbons and sulfur hexafluoride are synthetic powerful greenhouse gases that are emitted from a variety of industrial processes. These gases are typically emitted in smaller quantities, but because they are potent greenhouse gases, they are sometime referred to as High Global Warming Potential gases.

The 1994 inventory indicated that the Philippines released a total equivalent amount of 100,738 kilotons of carbon dioxide into the atmosphere. This is due to the combined effect of GHG emissions from four activity sectors: energy, industry, agriculture and wastes and from the net uptake of greenhouse gases from land use change and forestry sector.

The energy sector (50,000 kilotons) accounted for 50% of the total carbon dioxide equivalent emission to the environment, followed by agriculture at 33% (33,000 kilotons), industry at 10% (11,000 kilotons) and wastes at 7% (7 kilotons). The land use change and forestry sector provided a negative 126 kilotons of carbon dioxide equivalent. This is sequestered from the environment due to reforestation activities. Without the contribution of the land use change and forestry sector, the National Greenhouse Gas total emission amounted to 100,864 kilotons of carbon dioxide equivalent.

2.3.2.1.1 Project's GHG Emission Inventory

Table 58: Fuel Consumption Data (2017-2021)

Fuel Consumption	Indicator	2017	2018	2019	2020	2021	Total
Diesel							
Transport	Liter	0	736.39	350,681.29	1,459,126	462,379	2,272,922.68
Production	Liter	0	0	0.00	0.00	2,274,053	2,274,053.00
Electric Generation	Liter	0	0	28,107.00	552,077	1,761,409.10	2,341,593.10
B. Gasoline		0	0	0.00	0.00	-	-
Transport	Liter	0	143	158,075.79	0.00	-	158,218.79
Production	Liter	0	0	0.00	0.00	-	-
Electric Generation	Liter	0	2600	45,645.27	0.00	-	48,245.27
Total		-	3,479.39	582,509.35	2,011,203	4,497,841.10	7,095,032.84

The table above shows the data of fuel consumption per year. This data is used to determine the Project's actual GHG emissions. As shown in Table 2-59 there is an increasing trend in the usage of fuel along with the progress of the project activities. This is primarily due to the increase of activities involving the use of diesel fuel for transport, production and generation of electricity. From the period of 2018 to 2021, a total of 7,095,032.84 liters of fuel was consumed for the project operations.

2.3.2.1.2 Calculated Greenhouse Gas Emissions

Based on the recorded fuel consumption data from 2018 to 2021, and given the standard emission factors for CO2, CH4 and N2O, below are the calculated greenhouse gas emissions. A total of 19,118 TCO2e is generated by the project as of 2021.

Table 2-59: Calculated GHG Emission (2018-2021)

Parameter	2017	2018	2019	2020	2021	Total, TCO2e
A. Transportation						-
– CO2 emission (t)	-	2.28	1,291.74	3,878.98	1,229.20	6,402.20
– CH4 emission (t)	-	0.00	3.24	4.29	1.36	8.90
– N2O emission (t)	-	0.04	25.42	63.39	20.09	108.94
B. Production						-
– CO2 emission (t)					6,045.40	6,045.40
– CH4 emission (t)					6.69	6.69
– N2O emission (t)					98.79	98.79
C. Electric Generation						-
– CO2 emission (t)		5.91	178.52	1,467.66	4,682.58	6,334.67
– CH4 emission (t)		0.04	0.72	1.62	5.18	7.56
– N2O emission (t)		0.17	4.16	23.98	76.52	104.84
Total	**-**	**8.44**	**1,503.80**	**5,439.93**	**12,165.82**	**19,118.00**

Based on the projected GHG emissions, which was estimated to be 28,523 metric tonnes of CO2 equivalent per year of operation, it can be noted that the actual GHG emissions of the Project is way lower with only a total of 19,118.00 metric tonnes of CO2 in a period of 4 years. It is expected however that with the TSF construction, there will be an increase of activities which will also require increase in fuel consumption.

2.3.2.2 Baseline Greenhouse Gas Evaluation

Baseline data definition for the Project relative to greenhouse gas emissions focuses on the contribution of the existing land use sequestration of carbon from the environment. Carbon sequestration represents the overall process of removing carbon from the atmosphere and redistributing the carbon within plants, soils and water.

No other factor that would contribute to the baseline greenhouse gas inventory is considered within the Project area. The current small scale mining operations will later be removed once the Project has begun. Further, no data is available for on-site burning and kaingin practices that could contribute to the baseline greenhouse gas emission assessments. Data for use in carbon storage and sequestration analyses has been sourced from local studies which are summarized in Table 2-60. Study locations shown in Column 4 are the actual locations of the study on Philippine

Forest Ecosystems and Climate Change: Carbon stocks, Rate of Sequestration, and the Kyoto Protocol, by Rodel D. Lasco and Florencia B. Pulhin in 2003.

Table 2-60: Carbon Storage Sequestration Rates Based on Philippine Studies

LAND COVER	CARBON STORAGE (tons/ha)	CARBON SEQUESTRATION RATE (tons/ha/year)	STUDY LOCATION
Protection Forests Old Growth	165 - 260	No Data	IPCC Value
Secondary Forest (Mean)	207.9	1.1	Leyte, Makiling, Mindanao
Brushlands	29	4.29	Leyte
Grasslands (Mean)	12.1	No Data	Leyte
Agro-Forestry (Mean)	45.4	5.3	Cebu, Makiling, Isabela
Tree Plantation (Mean)	132.3	4.2	Makiling. Nueva Ecija, Leyte, Mindanao, Iloilo

Source: Lasco and Pulhin, 2003

The land use distribution of the area used to estimate the baseline carbon sequestration of the immediate Project area is based on the current land use and the Forest Inventory conducted by the DENR Region 9 through CENRO-Guipos. The forest cover encompasses an area of 182 hectares and consists of 104 hectares of Closed Canopy, Broadleaved Forest, 6 hectares of Open Canopy Broadleaved Forest and 72 hectares of Wooded Lands and Wooded Grasslands.

Using the carbon storage and sequestration data and the current forest distribution, the estimated annual baseline carbon sequestration value within the Project area is 122 tons of carbon.

2.3.3 Degradation of Air Quality

2.3.3.1 Existing Ambient Air Monitoring

Six locations within the immediate project area were chosen and being monitored for their ambient air quality. These represent areas with potential air pollution contribution including the exploration activities, the small-scale mining operation, and the community. A controlled station with minimal disturbance was also sampled. Weather conditions during the sampling period were fair to cloudy with occasional rains in late afternoon. The coordinates of the six sampling stations and descriptions of the baseline environment are provided in Table 2-61.

Table 2-61: Ambient Air Monitoring Locations

Location	Description	Wind Direction	Coordinates/ Elevation
Balabag Hill	Location of the housing camp during the Exploration Phase. Generator set was operating in full capacity from 6:00am to 12:00am.	Light to moderate easterly wind	07˚53'37.8 N 122˚56'53.3 E Elev: 676 m.
Tinago Plant Area	Location of existing small scale mining processing plants. The processing plants	Easterly wind	07˚53'47.3 N 122˚57'03.3 E

Location	Description	Wind Direction	Coordinates/ Elevation
	are operated 24 hours a day and run by diesel engine generator sets.		Elev: 527 m.
Miswi Detachment	Army detachment area.	Light to moderate easterly wind	07˚53'34.9 N 122˚57'13.2 E Elev: 541.7 m
Genaro (Naro) Area Community	Community area immediate to the base camp. No small-scale mining activities within the area.	Light to moderate easterly wind	07˚53'48.8 N 122˚56'41.1 E Elev: 615 m
Genaro (Naro) Controlled Station	Open area with minimal disturbance	Southeasterly wind	07˚53'44.9 N 122˚56'42.2 E Elev: 632 m.
Tinago Rodmill Houses Area	Location of small-scale mining rod milling equipment. Equipment is run 24 hours a day.	Easterly wind	07˚53'40.5 N 122˚56'58.8 E Elev: 641 m.

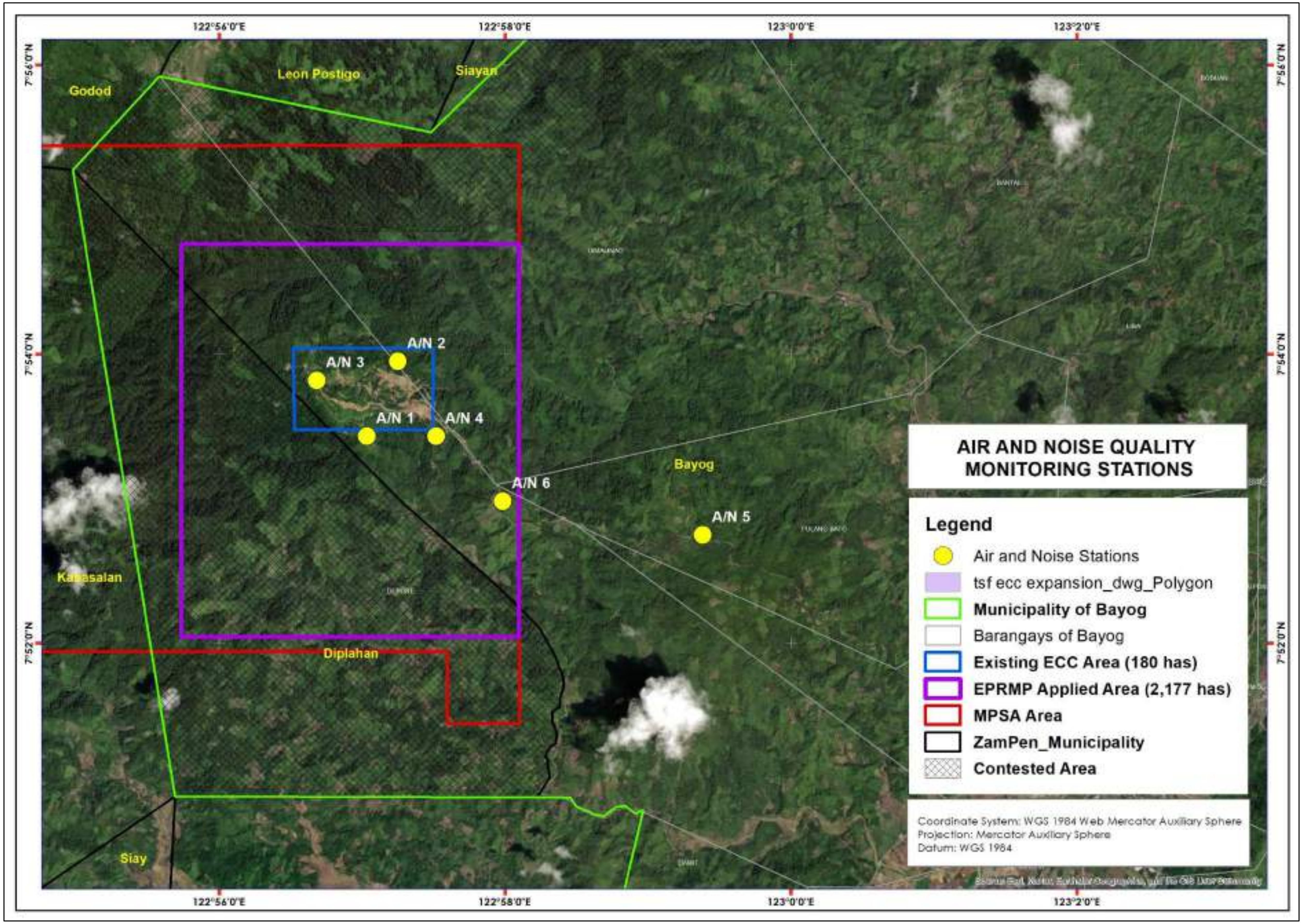
Ambient air sampling for each location were done at twenty-four hour averaging time for total suspended solids (TSP), particulate matter (PM-10), sulfur dioxide (SO2), and Nitrogen dioxide (NO2); and at eight-hour averaging time for carbon monoxide (CO). Methodologies based on DAO 2000-81 used to quantify the ambient air pollutants are shown in Table 2-62.

Table 2-62: Analytical Methodologies for Ambient Air Measurement

Parameter	Analytical Method
Sulfur Dioxide (SO2)	Pararosaniline
Nitrogen Dioxide (NO2)	Griess saltzman
Total Suspended Particulate (TSP)	Gravimetric
Particulate Matter (PM10)	Gravimetric
Carbon Monoxide (CO)	Nondispersive Infrared Sensor
Cyanide (CN)	Ion Selective Electrode
Metals (As, Hg, Cd, Pb)	Atomic Absorption Spectrophotometry

Source: DAO 2000-81

Figure 2-57: Ambient Air and Noise Quality Monitoring Stations



As presented in Table 2-63, the ambient air quality monitored in all the stations are within the DENR National Ambient Air Quality Standards (NAAQS) based on DAO 2000-81.

Table 2-63: Ambient Air Quality Monitoring Results (2021)

Stations	Location	Hg (2021)	Pb (2021)	As (2021)	SO2 (2021)	NO2 (2021)	PM10 (2021)	TSP (2021)
A1	Exploration Camp	<0.0000005	<0.00005	<0.000005	1.33	1.73	0.27	2.45
A2	Assasin	<0.00003	<0.002	<0.0003	<3.0	8.9	<1.7	<1.7
A3	Cavalier	<0.00003	<0.002	<0.0003	<3.0	7.2	<1.7	1.7
A4	Inter-Agency	<0.0000005	<0.00005	<0.000005	48.93	1.42	0.07	3.54
A5	Maglatin	<0.0000005	<0.00005	<0.000005	1.87	1.11	<0.07	22.27
A6	Permanent accommodation	<0.0000005	<0.00005	<0.000005	<0.12	1.56	<0.07	3.76
DENR Standards		-	20	0.02	180	150	150	230

Potential air pollution sources during the operation of the Project will include emissions from the operation of generator sets for power generation, fumes from chemical reactions in the mill processing circuit, emission from transportation exhausts like motorcycle, trucks and heavy equipment as well as dust generation from excavation activities and transport of vehicles. Potential noise pollution sources will include operation of the milling and grinding equipment, generator sets, transport of heavy equipment and blasting activities.

The impacts associated with air quality and noise impacts can be considered unavoidable. Other than the GHG emissions, the impacts will be reversible and limited to the immediate Project area.

Also presented in the following tables are comparative data of the ambient air monitoring from 2012 until 2021. There are gap years however (2013-2019), since there are no ongoing activities affecting ambient air quality during this period. Each table shows every parameter that is being measured.

Table 2-64: Air Quality Monitoring Data for Total Suspended Particulates (TSP) (2012-2021)

Stations	Location-TSP	EIS Stations	Calendar Year								
			2012	2020				2021			
				1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q
A1	Exploration Camp			35		24	3	15	34	0.27	2.45
		Balabag Hill	32.1								
		Tinago Plant Area	61.7								

Stations	Location-TSP	EIS Stations	Calendar Year								
			2012	2020				2021			
				1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q
		Naro Area Community	42.2								
A2	Assasin			11		15	13	31	40	<1.7	<1.7
A3	Cavalier	Naro (Control)	30.7	14		16	15	24	29	<1.6	1.7
A4	Inter Agency	Miswi Detachment	48.5	12		18	2	21	39	4.17	3.54
A5	Maglatin			104		20	2	40	52	4.61	22.27
		Tinago Rodmill Houses Area	57.1								

Table 2-65: Air Quality Monitoring Data for Particulate Matter (PM10) (2012-2021)

Stations	Location-PM10	EIS Stations	Calendar Year								
			2012	2020				2021			
				1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q
A1	Exploration Camp			19		6	2	1	11	<0.07	0.27
		Balabag Hill	18.6								
		Tinago Plant Area	31.6								
		Naro Area Community	20.4								
A2	Assasin			6		8	7	26	22	<1.7	<1.7
A3	Cavalier	Miswi Detachment	20.1	9		10	8	20	20	<1.6	<1.7
A4	Inter-Agency	Naro (Control)	17.8	6		9	1	2	6	<0.07	0.07
A5	Maglatin			26		14	2	2	8	<0.07	<0.07
		Tinago Rodmill	28.6								

Stations	Location-PM10	EIS Stations	Calendar Year								
			2012	2020				2021			
				1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q
		Houses Area									
A6	Permanent accommodation (simbol)							3	10	<0.07	<0.07
DENR Standards											

Table 2-66: Air Quality Monitoring Data for Nitrogen Dioxide (NO_2) (2012-2021)

Stations	Location-NO2	EIS Stations	Calendar Year								
			2012	2020				2021			
				1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q
A1	Exploration Camp			<0.4		1.7	0.7	0.4	2.3	0.99	1.73
		Balabag Hill	1.9								
		Tinago Plant Area	3.7								
		Naro Area Community	<1.9								
A2	Assasin			<1		4	5	<1	6	1.6	8.9
A3	Cavalier	Naro (Control)	2.4	<1		3	4	<1	6	1.8	7.2
A4	Inter-Agency	Miswi Detachment	<1.9	3.7		<0.4	0.5	0.7	1.6	1.03	1.42
A5	Maglatin			<0.4		1.1	0.8	<0.4	1.9	0.62	1.11
		Tinago Rodmill Houses Area	8.5								
A6	Permanent accommodation (simbol)							0.7	2	1.58	1.56
DENR Standards											

Table 2-67: Air Quality Monitoring Data for Arsenic (2012-2021)

Stations	Location	EIS Stations	Calendar Year								
			2012	2020				2021			
				1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q
A1	Exploration Camp			0.00013		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.000005
		Balabag Hill	0.0001								
		Tinago Plant Area	0.0003								
		Naro Area Community	<0.0001								
A2	Assasin			<0.001		<0.007	<007	<0.007	<0.007	<0.003	<0.003
A3	Cavalier	Naro (Control)	0.0001	<0.001		<0.007	<007	<0.007	<0.007	<0.003	<0.003
A4	Inter Agency	Miswi Detachment	<0.0001	<0.002		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.000005
A5	Maglatin	Naro (Control)	0.0001	0.00005		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.000005
		Tinago Rodmill Houses Area	0.0009								
A6	Permanent accomodation (simbol)							<0.0001	<0.0001	<0.0001	<0.000005
DENR Standards											

Table 2-68: Air Quality Monitoring Data for Lead (Pb) (2012-2021)

Stations	Location	EIS Stations	Calendar Year								
			2012	2020				2021			
				1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q
A1	Exploration Camp			<0.0006		0.023	<0.008	<0.08	<0.008	<0.005	<0.005
		Balabag Hill	<0.005								
		Tinago Plant Area	<0.005								

Stations	Location	EIS Stations	Calendar Year								
			2012	2020				2021			
				1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q
		Naro Area Community	<0.005								
A2	Assasin			<0.03		<0.4	<0.04	<0.4	<0.4	<0.01	<0.002
A3	Cavalier	Naro (Control)	<0.005	<0.03		0.4	<0.04	<0.4	<0.4	<0.01	<0.002
A4	Inter Agency	Miswi Detachment	<0.005	<0.0006		0.010	<0.008	0.021	<0.008	<0.00005	<0.00005
A5	Maglatin			<0.0006		0.016	<0.008	<0.008	<0.008	<0.00005	<0.00005
		Tinago Rodmill Houses Area	<0.005								
A6	Permanent accomodation (simbol)							0.014	<0.008	<0.00005	<0.00005
DENR Standards											

Table 2-69: Air Quality Monitoring Data for Mercury (2012-2021)

Stations	Location-Mercury	EIS Stations	Calendar Year								
			2012	2020				2021			
				1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q
A1	Exploration Camp			0.000019		0.002	0.0045	0.0345	0.0009	<0.000001	<0.0000005
		Balabag Hill	8E-04								
		Tinago Plant Area	9E-04								
		Naro Area Community	3E-04								
A2	Assasin			<0.002		0.032	<0.001	0.713	0.005	<0.00003	<0.00003

A3	Cavalier	Naro (Control)	4E-04	<0.002		0.051	<0.001	0.287	0.01	<0.00003	<0.00003
A4	Inter Agency	Miswi Detachment	2E-04	<0.000003		0.0016	0.0026	0.0456	0.0001	<0.000001	<0.0000005
A5	Maglatin			<0.000003		0.0011	0.0018	0.0163	0.0005	<0.000001	<0.0000005
		Tinago Rodmill Houses Area	0.001								
A6	Permanent accommodation (simbol)							0.0199	0.0005	<0.000001	<0.0000005
DENR Standards											

Table 2-70: Air Quality Monitoring Data for Carbon Monoxide and Cyanide (2012-2021)

Stations	Location	EIS Stations	Calendar Year	
			2012	
			CO	Cyanide
A1	Explation Camp			
		Balabag Hill	0.9	<0.001
		Tinago Plant Area	0	<0.001
		Naro Area Community	0.2	<0.001
A2	Assasin			
A3	Cavalier	Naro (Control)	0.3	<0.001
A4	Inter Agency	Miswi Detachment	0.1	<0.001
A5	Maglatin			
		Tinago Rodmill Houses Area	0.7	<0.001
A6	Permanent accommodation (simbol)			
DENR Standards				

2.3.3.2 Projected Air Pollutant

AERMOD Modeling System (AERMOD), a steady state Gaussian plume dispersion model, was used to predict the ground level concentrations (GLC) of pollutants from the Proposed Expansion of Balabag Gold-Silver Project of TVIRD Resource Development (Phils.) Inc. in Balabag, Depore, Bayog, Zamboanga del Sur.

The modeling domain included in the study area is a 10km x 10 km grid centered on the possible point sources (7.896221°, 122.952407°) as shown in Figure 2-58. The main emission sources from TVIRD are the crushers, haul roads, mine areas, and generator sets (Figure 2-59).

Figure 2-58: Site Domain Boundary

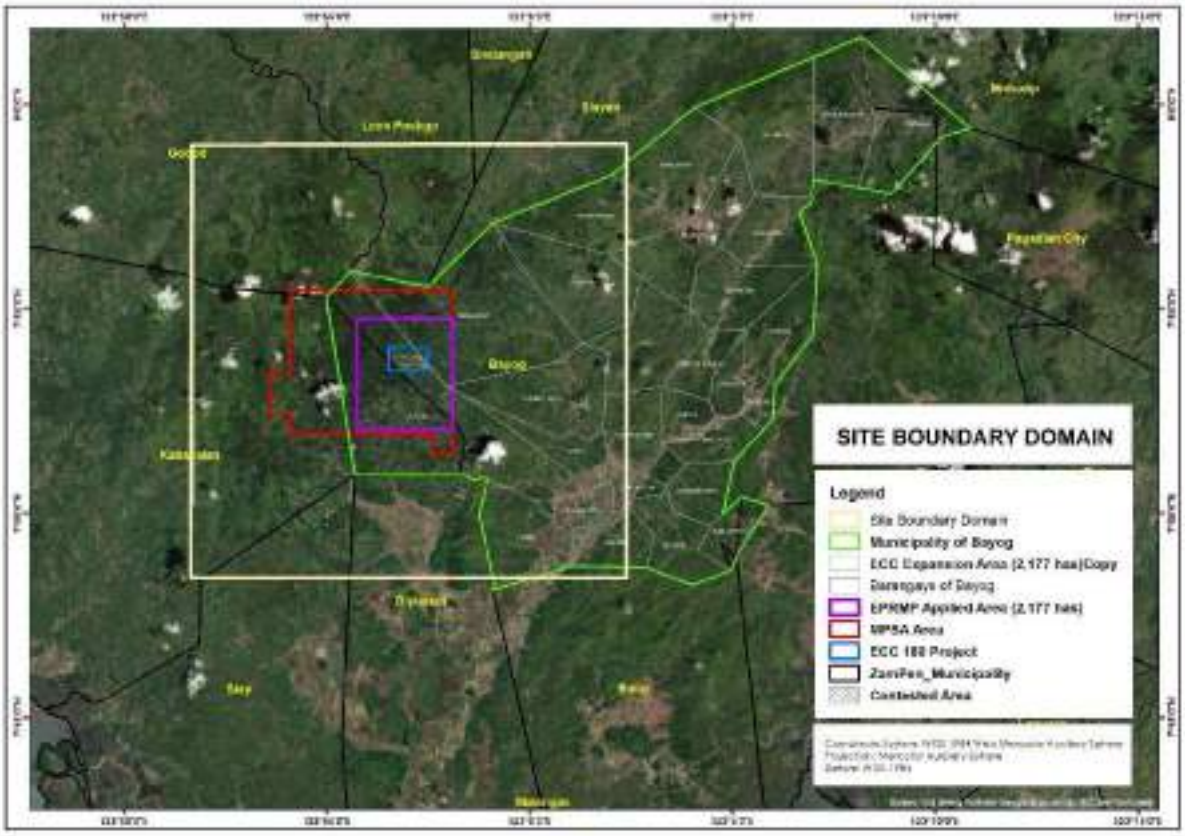
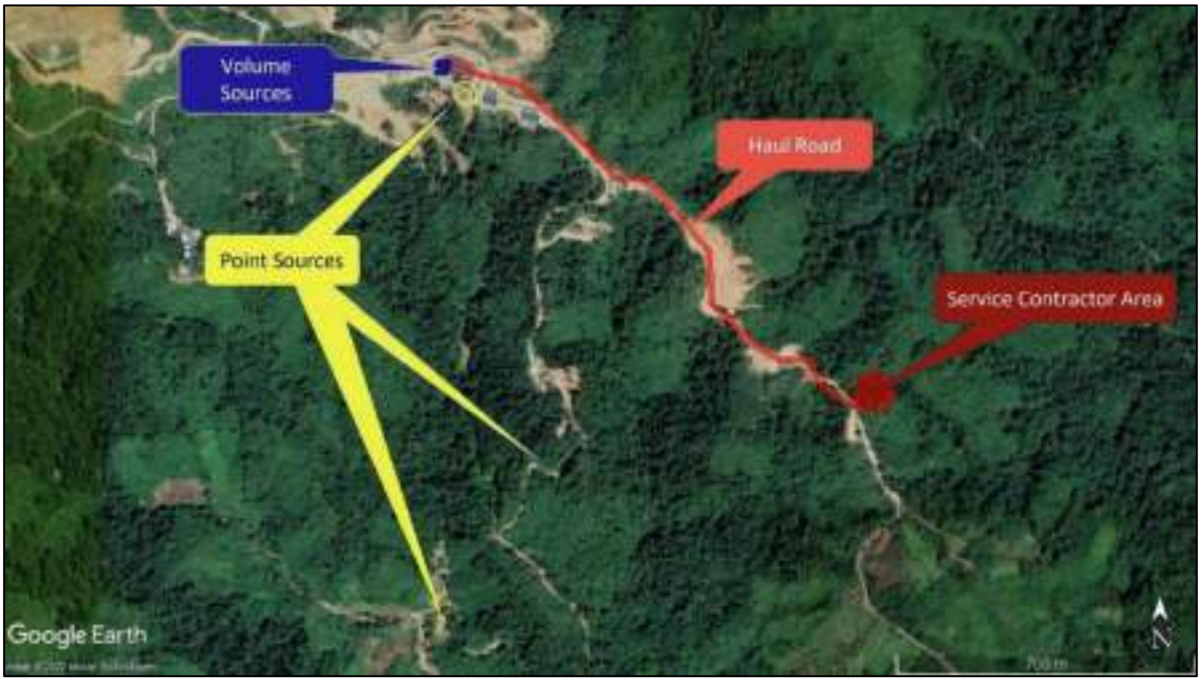


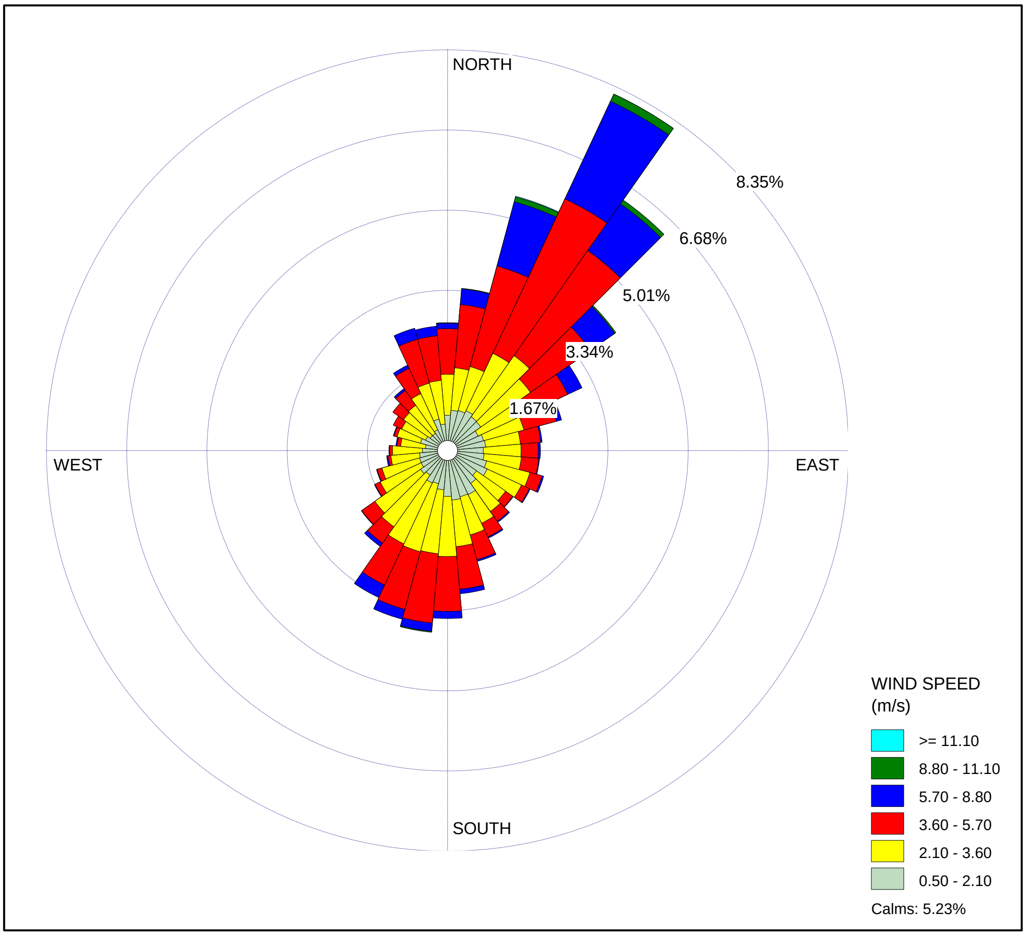
Figure 2-59: Balabag Gold-Silver Project Emission Sources



Given the nature of the project, the air pollutants considered in this study are total suspended particulates (TSP), particulate matter (PM10), Sulfur Oxides as SO2, Carbon Monoxide (CO), and Nitrogen Oxides as NO2. TSP and PM10 emissions are mainly due to the mining activities, haul roads, and milling equipment.

Aside from the pollution sources, the regional meteorological conditions will also influence the GLC of air emissions. The meteorological data used for this model was derived from a 3-year mesoscale regional meteorological model (MM5) of the model domain. The MM5 data was processed by AERMET, the meteorological data preprocessor of AERMOD. The wind rose diagram based on the MM5 data (Figure 2-60) indicates that the prevailing wind direction is in the northeasterly and southwesterly sectors.

Figure 2-60: Wind Rose Diagram based on Mesoscale Regional Meteorological Data



The terrain elevation data was produced using the Shuttle Radar Topography Mission (SRTM) tool produced by NASA. The elevation was processed using AERMAP, the terrain data preprocessor of AERMOD (Figure 2-61). The operations of TVIRD are situated in an elevated area ranging from 200 masl to 600 masl.

Figure 2-61: Digitized Terrain Map of the Study Area

AERMOD is recommended by the US Environmental Protection Agency (US EPA), International Finance Corporation (IFC), and the World Bank Group. The Department of Environment and Natural Resources – Environmental Management Bureau (DENR-EMB) also uses AERMOD as an air dispersion modeling tool for Environmental Impact Statements as stipulated in DENR EMB MC 2008-003, Guidelines for Air Dispersion Modeling.

2.3.3.3 Model Inputs

The point, volume, line, and area sources are listed in the following tables. All sources are assumed to operate 365 days per year to simulate worst-case scenario. Table 2-71 lists the emission rates of pollutants from the emission sources. The emission rates of the generator sets were taken from the monitoring reports commissioned by TVIRD. On the other hand, the emission rates of the line, volume, and area sources were based on emission factors in US EPA AP-42. The model assumes that particulate emissions from the crushers and haul roads are controlled by baghouse filters and regular water spraying, respectively; there are no control measures applied for the generator sets.

Table 2-71: Emission Rates

Sources	Emission Rates (g/s)				
	TSP	PM_{10}	SO_2	NO_2	CO
Ball Mill	0.36[a]	0.15[c]			
Sag Mill	0.36[a]	0.15[c]			
Generator Set 1 (Stack 1)	0.05[b]		0.006	1.09	0.11
Generator Set 1 (Stack 2)	0.03[b]		0.006	1.09	0.11
Generator Set 2 (Stack 1)	0.06[b]		0.006	1.04	0.11
Generator Set 2 (Stack 2)	0.03[b]		0.006	1.06	0.11
Generator Set 3 (Stack 1)	0.04[b]		0.006	1.05	0.11
Generator Set 3 (Stack 2)	0.05[b]		0.004	1.04	0.11
Generator Set 4 (Stack 1)			0.02	0.78	0.12
Generator Set 4 (Stack 2)			0.03	0.74	0.13

Sources	Emission Rates (g/s)				
	TSP	PM_{10}	SO_2	NO_2	CO
Generator Set 6				0.118	0.03
Generator Set 13				0.04	0.03
Haul Roads	0.448[a]	0.1185[a]			
Mining Area	0.0001[a]	0.000056[c]			

References:
a: US EPA AP 42
b: TVIRD Source Emissions Monitoring Report
c: Assumed to be 56% of TSP

Table 2-72: Input Data of Point Sources

Point Sources	Release Type	Release Height (m)	Gas Exit Temp (K)	Stack inside diameter (m)	Gas Exit Velocity (m/s)	Volumetric Flow Rate (Nm^3/s)
Generator Set 1 (Stack 1)	VERTICAL	5.81	682.85	0.33	31.72	2.7130
Generator Set 1 (Stack 2)	VERTICAL	5.81	690.15	0.33	31.99	2.7361
Generator Set 2 (Stack 1)	VERTICAL	5.81	698.95	0.33	29.84	2.5522
Generator Set 2 (Stack 2)	VERTICAL	5.81	684.45	0.33	30.86	2.6395
Generator Set 3 (Stack 1)	VERTICAL	5.81	672.55	0.33	29.59	2.5308
Generator Set 3 (Stack 2)	VERTICAL	5.81	675.35	0.33	28.83	2.4658
Generator Set 4 (Stack 1)	VERTICAL	4.97	653.35	0.22	29.59	1.1248
Generator Set 4 (Stack 2)	HORIZONTAL	3.5	622.45	0.22	29.59	1.1248
Generator Set 6	VERTICAL	3.76	273.15	0.11	31.99	0.304
Generator Set 13	VERTICAL	3.67	273.15	0.11	31.99	0.304

2.3.3.3.1 *Air Dispersion Modeling of Suspended Particulates*

The model considers the following sources of suspended particulates:

Table 2-73: Sources of Suspended Particulates

Sources	Type
Ball Mill	Volume Source
Sag Mill	Volume Source
Generator Set 1	Point Source
Generator Set 2	Point Source
Generator Set 3	Point Source
Generator Set 4	Point Source
Generator Set 6	Point Source
Generator Set 13	Point Source
Haul Roads	Line Area Source
Mining Area	Area Source

The ground level concentrations (GLC) of the particulate emissions are listed in Table 2-74. The GLCs are compared with the appropriate EMB ambient air quality standards stated on DENR Administrative Order (DAO) 2000-81: Implementing Rules and Regulations for RA 8749.

The isopleths in Figure 2-62 to Figure 2-67 show that GLCs are mainly due to emissions from the haul road. Assuming that mitigating measures are applied (i.e., road watering of haul roads), GLCs should remain below the applicable DENR standards.

Table 2-74: Predicted Incremental Maximum GLC of Particulates in the Study Area

Pollutants	Averaging time	Maximum GLC[a] (µg/m³)	UTM East (m)	UTM North (m)	NAAQSGV
TSP	1-hr	259.07	495256.20	872327.63	300
	24-hr	135.17	496253.06	871829.10	230
	Annual	27.39	495256.20	872327.63	90
PM_{10}	1-hr	92.68	495256.20	872327.53	200
	24-hr	73.16	496253.06	871829.10	150
	Annual	11.49	496253.06	871829.10	60

Figure 2-62: Isopleth of Incremental 98th Percentile TSP Concentrations (1-Hour Averaging Time)

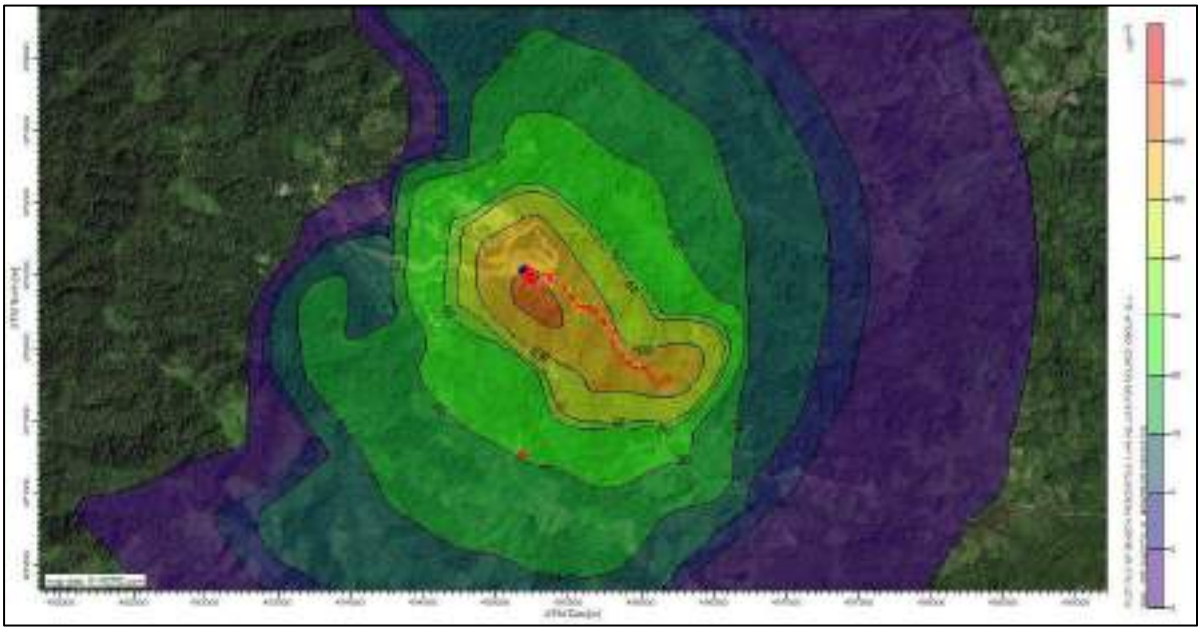


Figure 2-63: Isopleth of Incremental 98th Percentile TSP Concentrations (24-Hour Averaging Time)

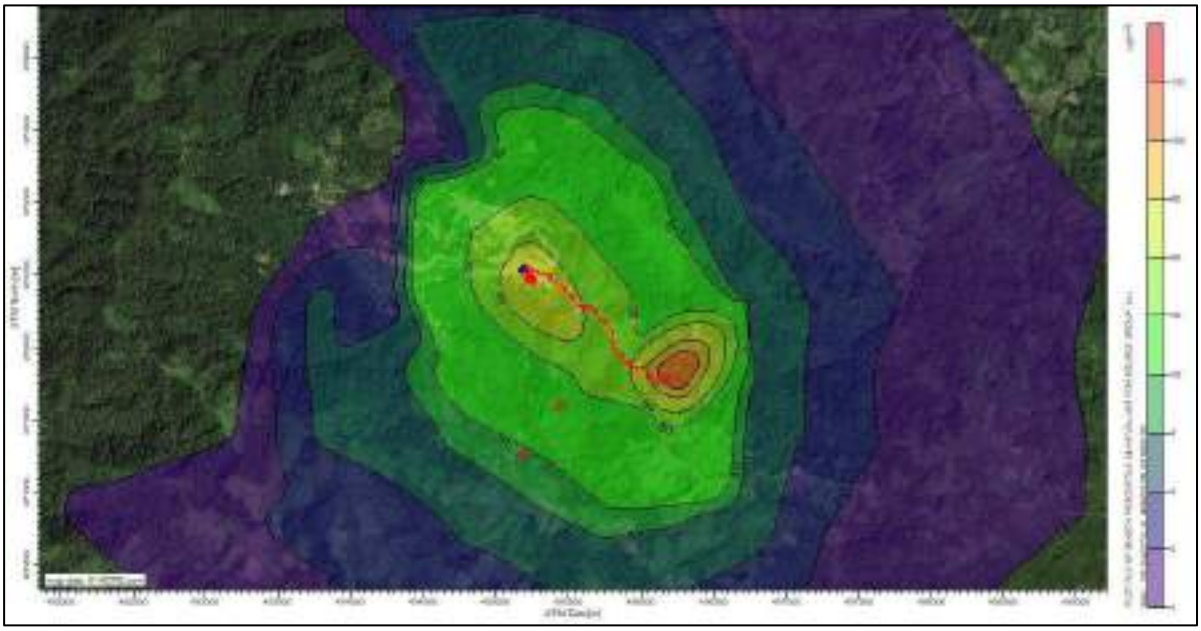


Figure 2-64: Isopleth of Incremental 98th Percentile TSP Concentrations (Annual Averaging Time)

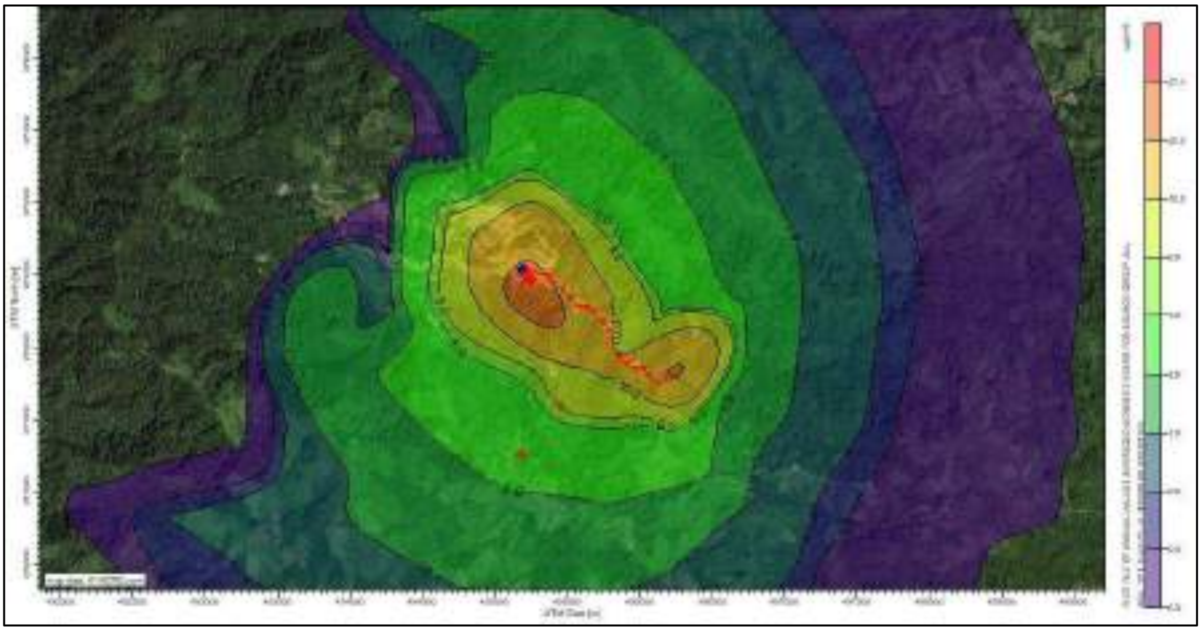


Figure 2-65: Isopleth of Incremental 98th Percentile PM_{10} Concentrations (1-Hour Averaging Time)

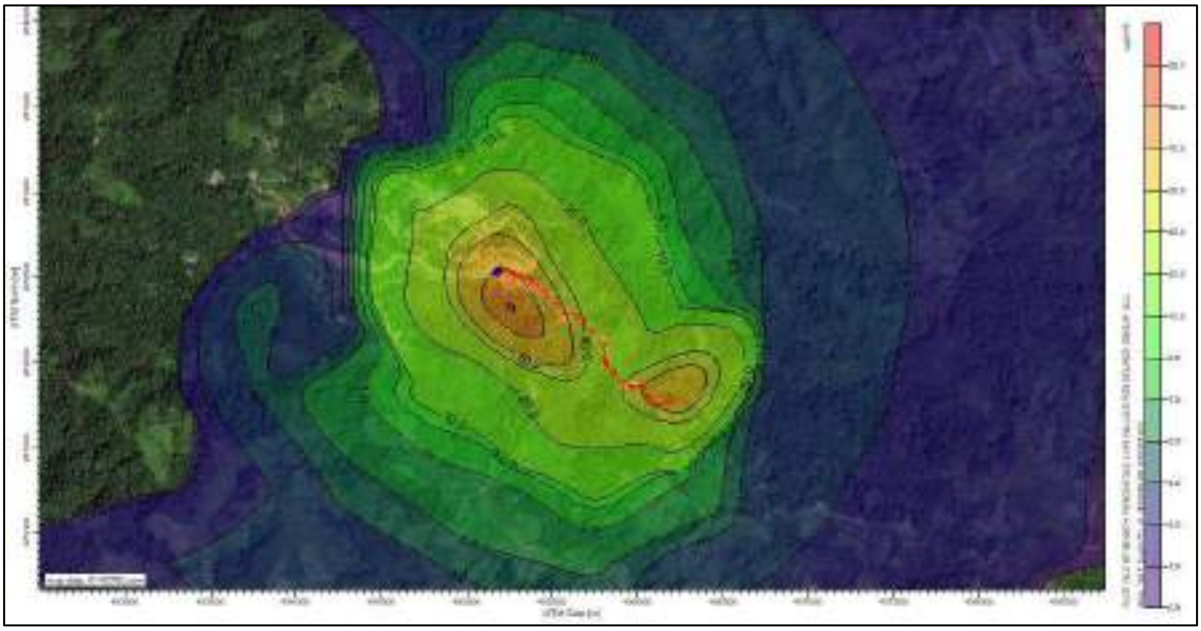


Figure 2-66: Isopleth of Incremental 98th Percentile PM_{10} Concentrations (24-Hour Averaging Time)

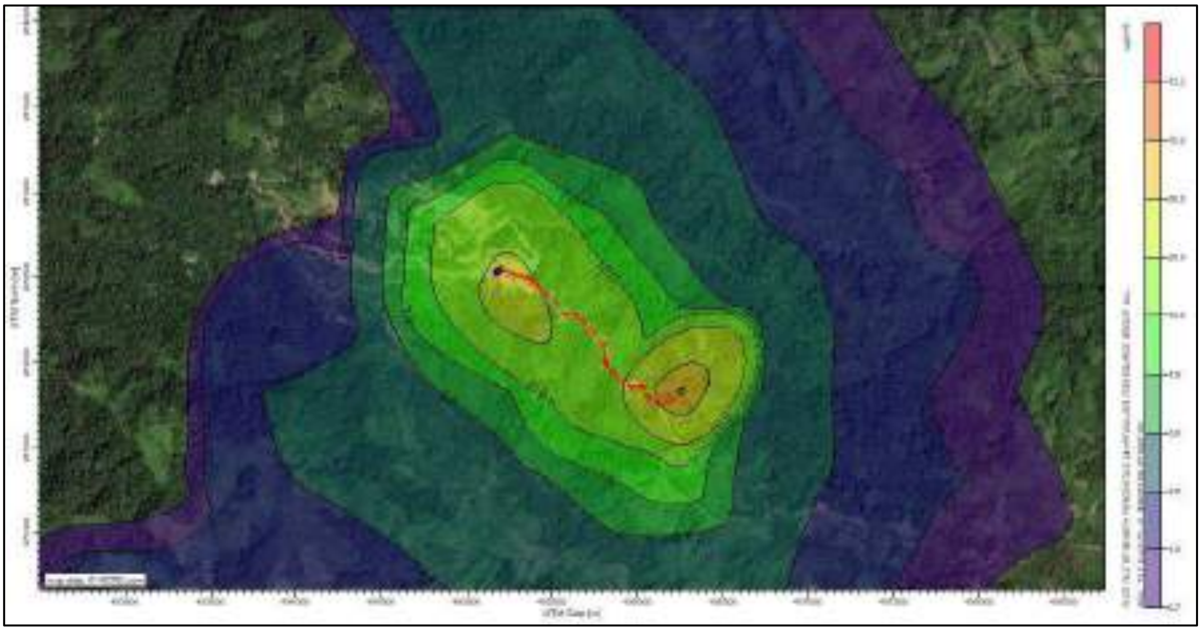
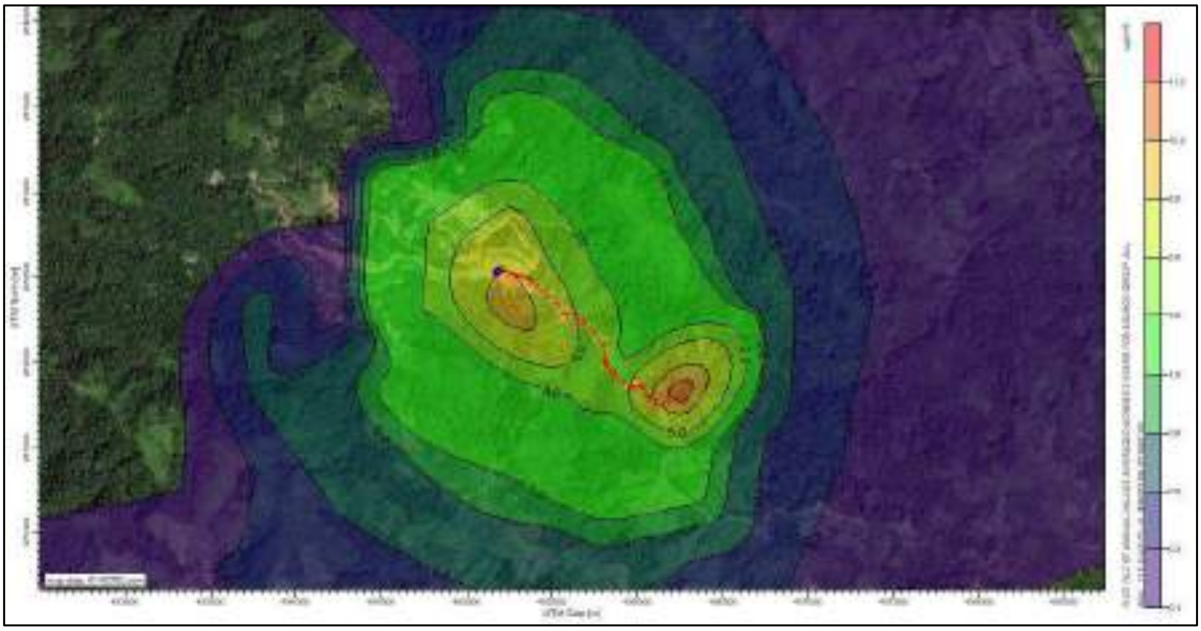


Figure 2-67: Isopleth of Incremental 98th Percentile PM_{10} Concentrations (Annual Averaging Time)



2.3.3.3.2 Air Dispersion Modeling of Gaseous Pollutants

Sources of gaseous pollutants (i.e., SO_2, CO, and NO_2) considered for the modeling are the generator sets. The maximum 98th percentile GLCs of gaseous air pollutants at various averaging times are listed in Table 2-75. The results are compared to applicable EMB ambient air quality standards stated on DAO 2000-81.

Figure 2-62 to Figure 2-75 shows the predicted incremental 98th percentile GLCs does not exceed the applicable DAO 2000-81 standards. However, it can be observed that NO_2 concentrations are close to the DAO 2000-81 standards. This is expected since NO_2 emissions is associated with use of generator sets. It must be noted that the model run assumed that the generator sets will run for 8,760 hours per year, instead of the typical 8,460 hours (generator sets 1, 2, and 3), 2,880 hours (generator sets 6 and 13), and 540 hours (generator set 4). TVIRD shall continuously maintain and monitor the performances of the generator sets to ensure that source emissions will not exceed DENR standards.

Table 2-75: Predicted Incremental Maximum GLC of Gaseous Emissions in the Study Area

Pollutant	Averaging time	Maximum GLC[d] (µg/m³)	UTM East (m)	UTM North (m)	CAA Standards (µg/m³)
CO	1-hr	28.30	496526.20	872327.53	35,000[a]
	8-hr	21.24	496526.20	872327.53	10,000[b]
NO_2	1-hr	257.08	496526.20	872327.53	260[a]
	24-hr	147.96	496526.20	872327.53	150[b]
	Annual	32.2	496526.20	872327.53	40[c]
SO_2	1-hr	2.79	496526.20	872327.53	340[a]
	24-hr	1.53	496526.20	872327.53	180[b]
	Annual	0.36	496526.20	872327.53	80[b]

[a] *Section 1, Rule XXVI Source Specific Ambient Air Quality Standards (DAO 2000-81)*

[b] *Section 1, Rule VII National Air Quality (DAO 2000-81)*
[c] *WHO guidelines*
[d] *98th percentile value*

Figure 2-68: Isopleth of Incremental 98th Percentile SO_2 Concentrations (1-Hour Averaging Time)

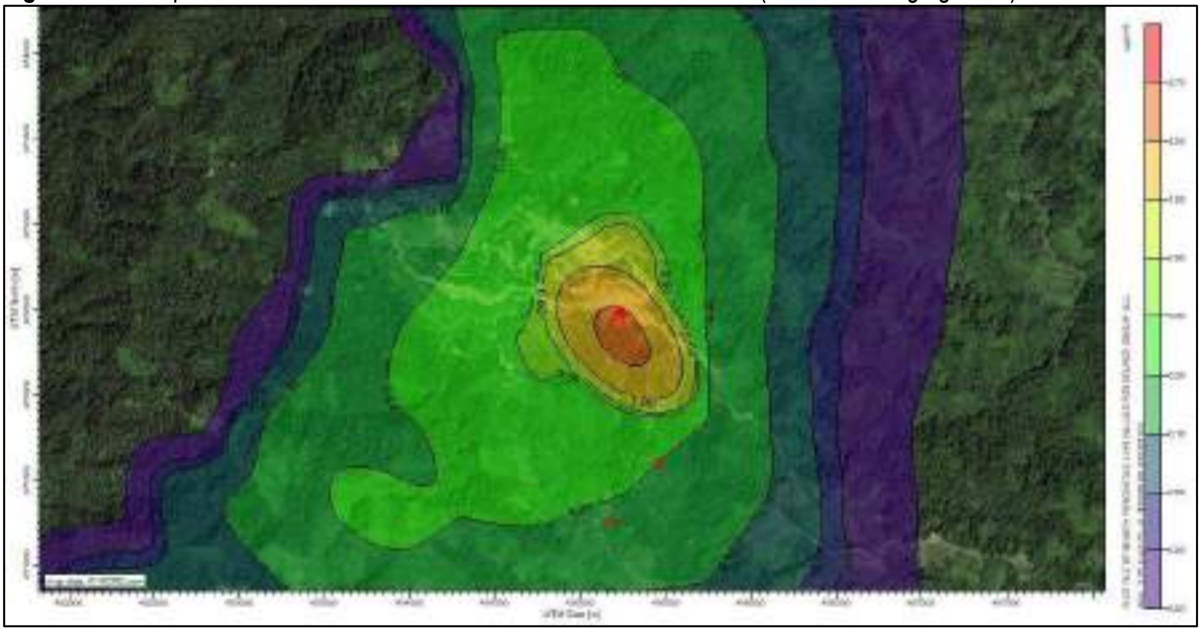


Figure 2-69: Isopleth of Incremental 98th Percentile SO_2 Concentrations (24-Hour Averaging Time)

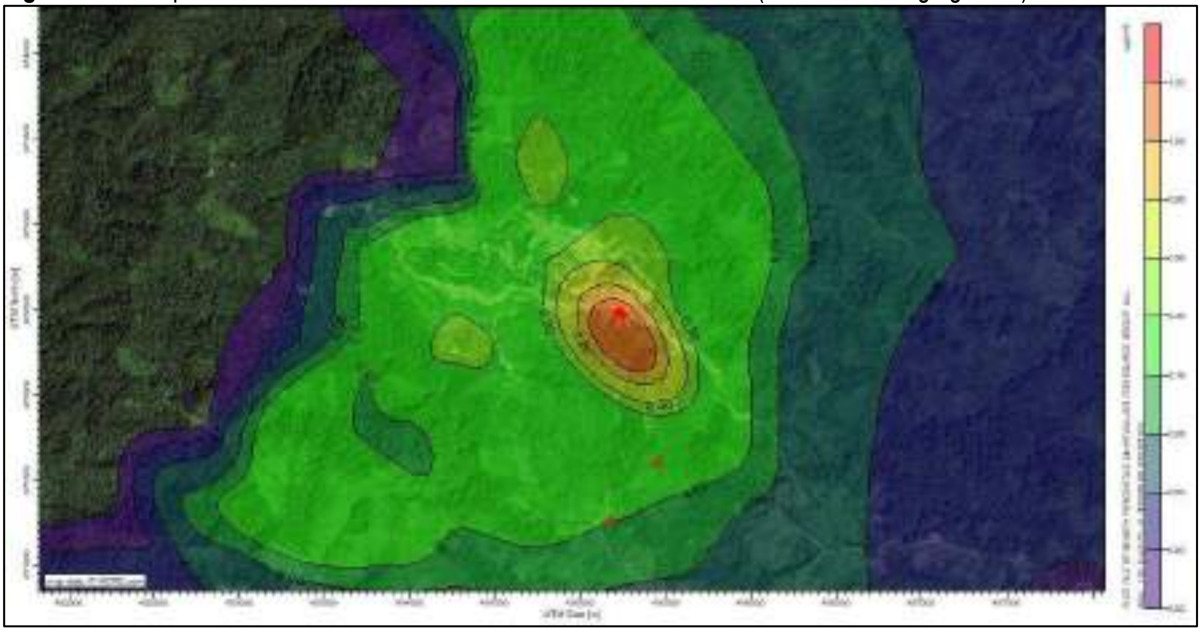


Figure 2-70: Isopleth of Incremental 98th Percentile SO_2 Concentrations (Annual Averaging Time)

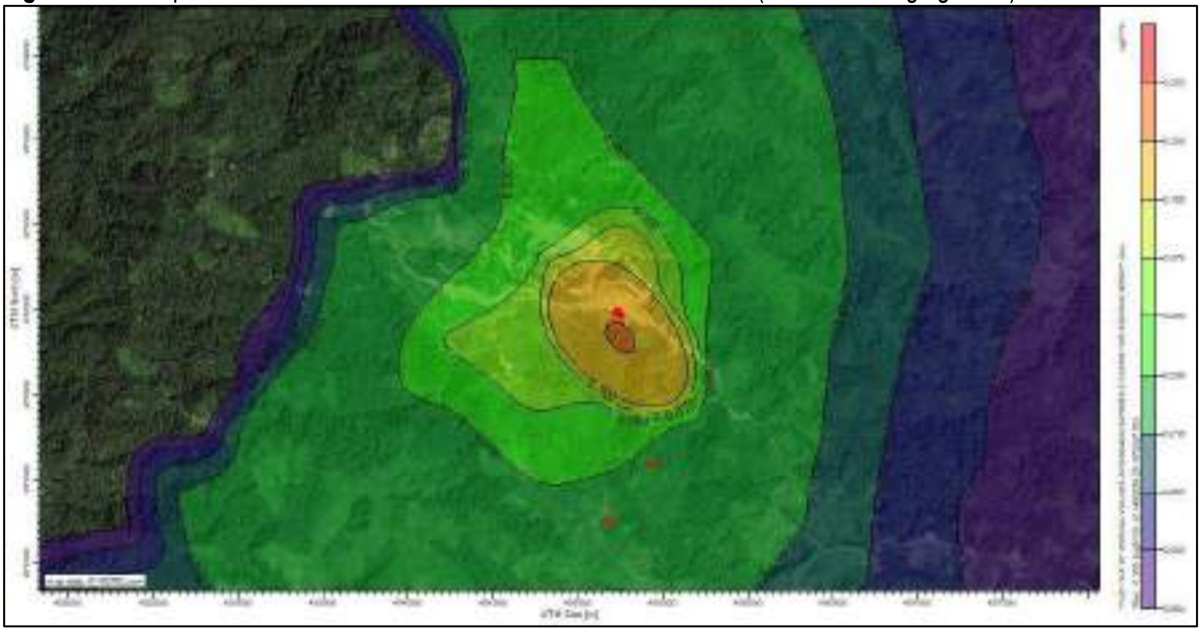


Figure 2-71: Isopleth of Incremental 98th Percentile NO_2 Concentrations (1-Hour Averaging Time)

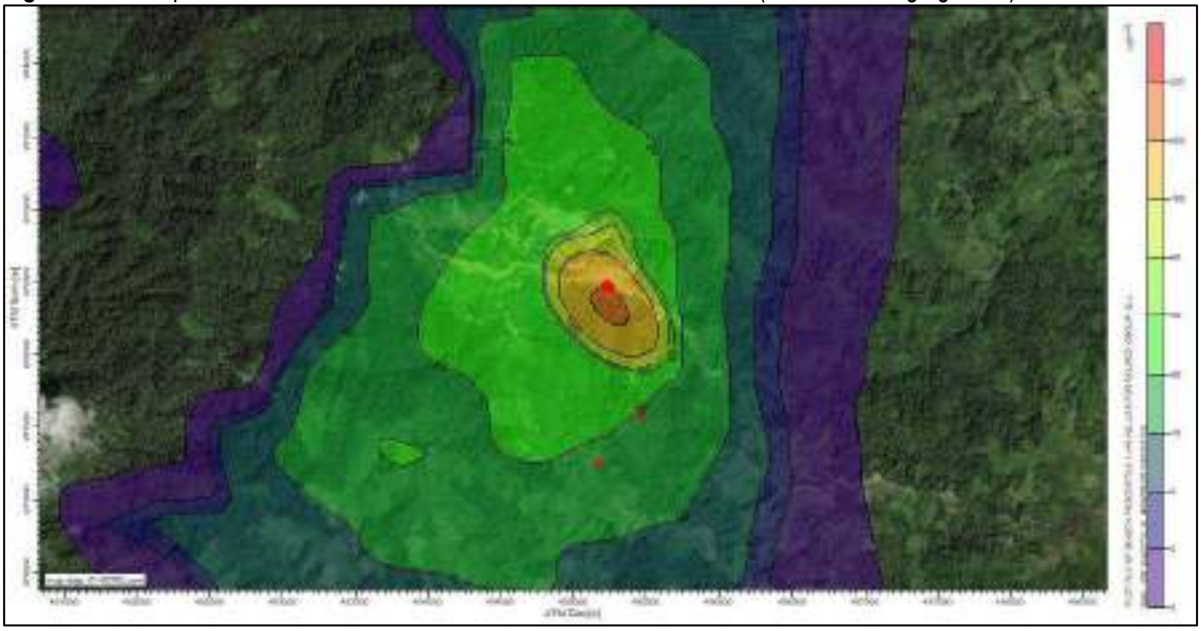


Figure 2-72: Isopleth of Incremental 98th Percentile NO_2 Concentrations (24-Hour Averaging Time)

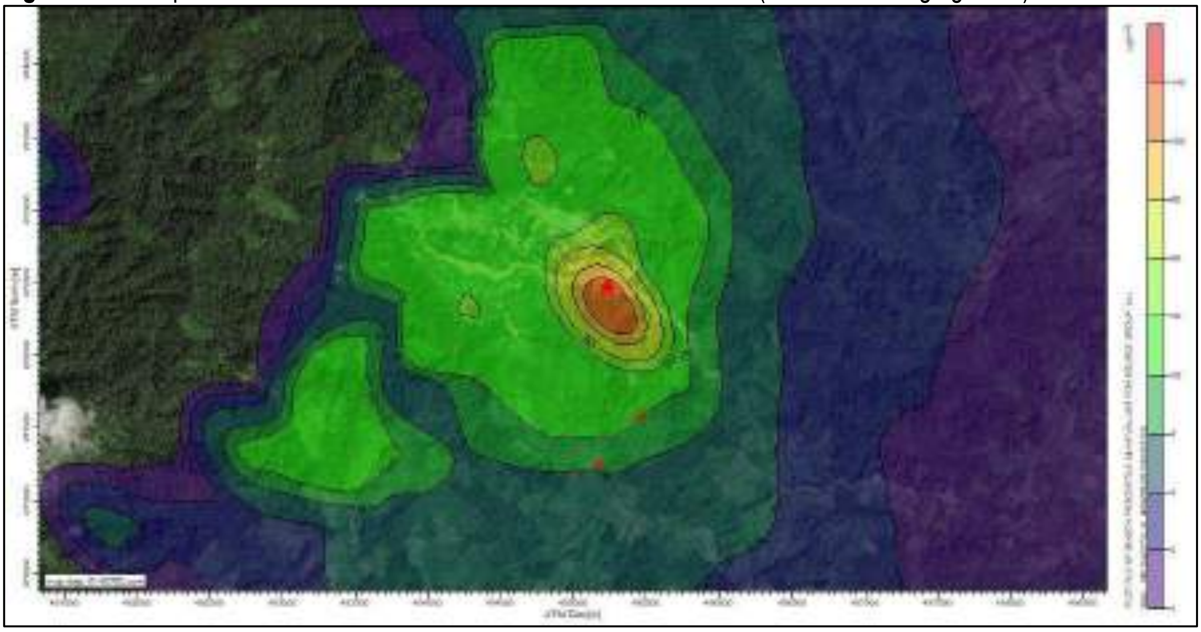


Figure 2-73: Isopleth of Incremental 98th Percentile NO_2 Concentrations (Annual Averaging Time)

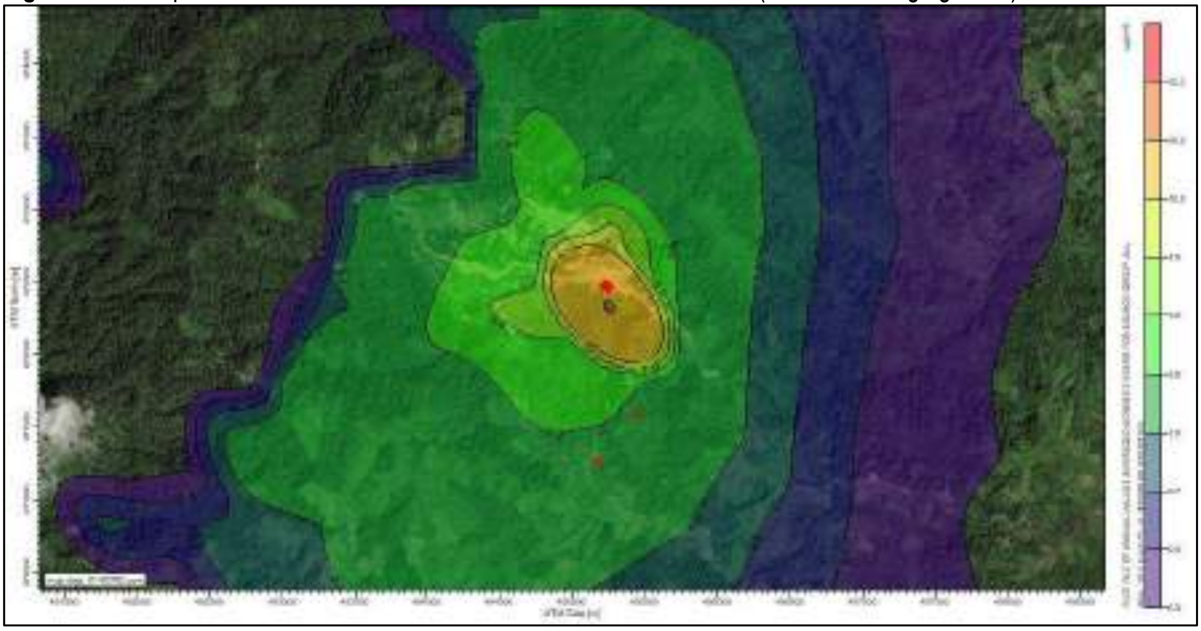


Figure 2-74: Isopleth of Incremental 98th Percentile CO Concentrations (1-Hour Averaging Time)

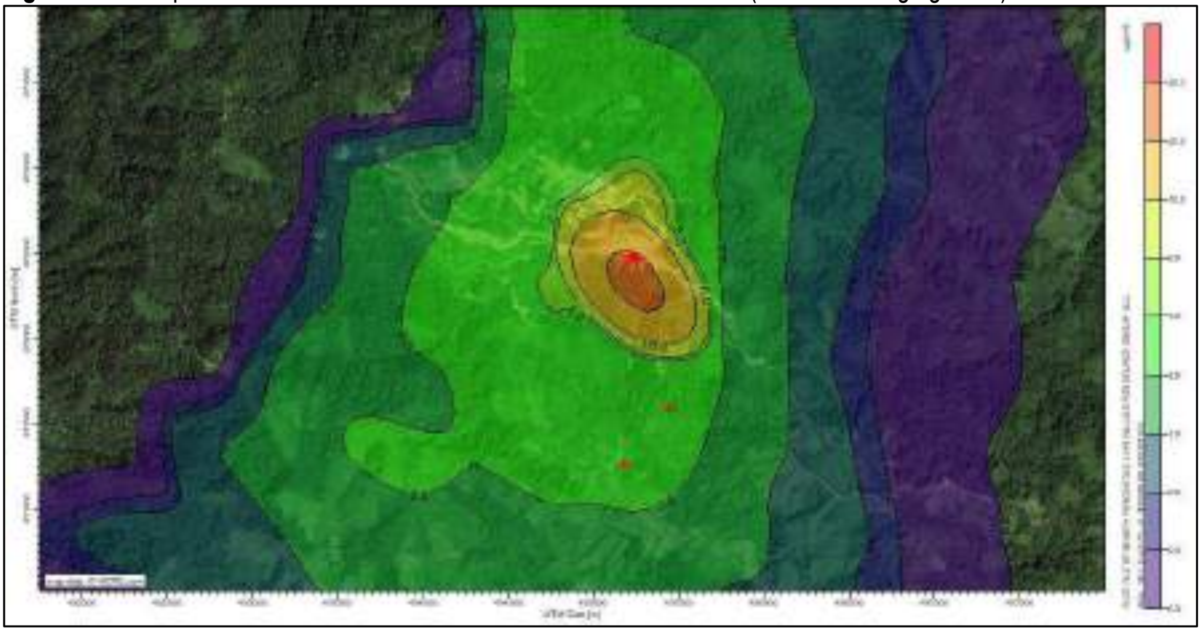
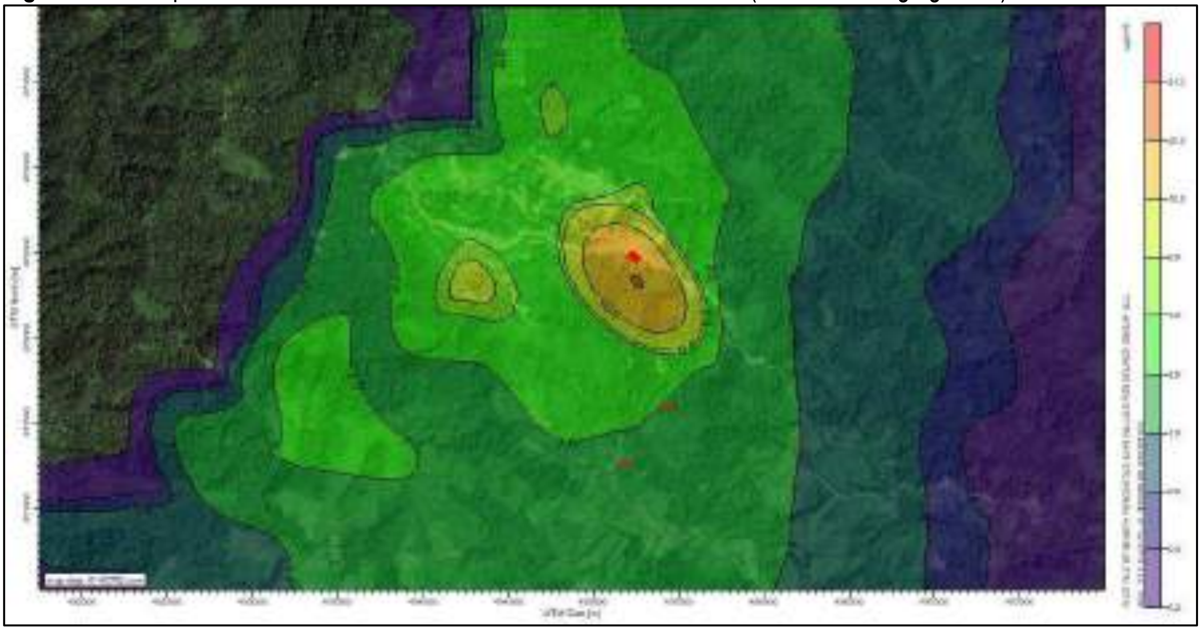


Figure 2-74: Isopleth of Incremental 98th Percentile CO Concentrations (8-Hour Averaging Time)



2.3.4 Increase in Ambient Noise Level

Noise level monitoring were also taken at the same locations for the ambient air quality monitoring. Direct measurements were made using a sound level meter during four periods, every morning (5:00am-9:00am), daytime (9am-6:00pm), evening (6:00pm-10:00pm), and nighttime (10:00pm- 5:00am) periods. The resulting noise levels recorded in 2021 are summarized in Table 2-76. The ambient noise levels observed in all the stations were within the DENR standards.

Table 2-76: Noise Level Monitoring Results (2021)

Stations	Location	Period	Noise level (dBA)	DENR Standards
A1	Exploration Camp	Morning	57	70.0
		Daytime	57	75.0
		Evening	57	70.0
		Nighttime	53	65.0
A2	Assasin	Morning		70.0
		Daytime	54	75.0
		Evening		70.0
		Nighttime		65.0
A3	Cavalier	Morning		70.0
		Daytime	54	75.0
		Evening		70.0
		Nighttime		65.0
A4	Inter-Agency	Morning	61	70.0
		Daytime	60	75.0
		Evening	60	70.0
		Nighttime	55	65.0
A5	Maglatin	Morning	55	70.0
		Daytime	52	75.0
		Evening	47	70.0
		Nighttime	44	65.0
A6	Permanent accommodation(simbol)	Morning	57	70.0
		Daytime	51	75.0
		Evening	51	70.0
		Nighttime	51	65.0

The following table presents the comparative data of the noise level monitoring from 2012 until 2021. There are gap years however (2013-2019), since there are no ongoing activities affecting ambient air quality during this period. Each table shows every parameter that is being measured.

Table 2-77: Noise Level Monitoring from 2012-2021

Station	Location	EIS Stations	Period	Calendar Year			DENR Standards (dBA)
				2012	2020	2021	
A1	Exploration Camp		Morning		50	57	70.0
			Daytime		53	57	75.0
			Evening		54	57	70.0
			Night Time		44	53	65.0
		Balabag Hill	Morning	58.3			70.0
			Daytime	58.2			75.0
			Evening	48.6			70.0
			Night Time	49.0			65.0
		Tinago Plant Area	Morning	69.2			70.0
			Daytime	48.5			75.0
			Evening	67.1			70.0
			Night Time	67.7			65.0
		Naro Area Community	Morning	58.6			70.0
			Daytime	56.7			75.0
			Evening	60.4			70.0
			Night Time	59.1			65.0
A2	Assasin		Morning				70.0
			Daytime			54	75.0
			Evening				70.0
			Night Time				65.0
A3	Cavalier	Naro (Control)	Morning	58.1			70.0
			Daytime	57.9		54	75.0
			Evening	59.2			70.0
			Night Time	58.1			65.0
A4	Inter-Agency	Miswi Detachment	Morning	55.1	50	61	70.0
			Daytime	63.2	55	60	75.0
			Evening	65.8	54	60	70.0
			Night Time	55.0	46	55	65.0
A5	Maglatin		Morning		70	55	70.0
			Daytime		75	52	75.0
			Evening		70	47	70.0
			Night Time		65	44	65.0
		Tinago Rodmill Houses Area	Morning	58.1			70.0
			Daytime	64.4			75.0

Station	Location	EIS Stations	Period	Calendar Year			DENR Standards (dBA)
				2012	2020	2021	
			Evening	58.4			70.0
			Night Time	58.6			65.0
A6	Permanent accommodation (simbol)		Morning			57	70.0
			Daytime			51	75.0
			Evening			51	70.0
			Night Time			51	65.0

Noise levels are also expected to increase due to heavy equipment use during the ore excavation, transport, and processing. Explosives will be used intermittently during blasting operations. Setting of explosives will be confined to the Surface Mine area. Explosive blasts will be performed during daylight hours with the noise confined within the mine area. Noise generated by the blast will range from 95 dBA to 110 dBA at a distance of 10 meters. This will quickly dissipate due to the mine walls which will serve as noise barriers. The length of the individual blasts is 1 to 2 seconds.

Diesel generators which will run for 24 hours daily will also contribute to noise pollution. Generator sets will be located within the Mill and Processing Plant area and near the staff housing complex. Power requirements of the Project will be supplied solely by generator sets. Noise levels during the operation of the generator sets and the processing plant is anticipated to range between 85 dBA to 95 dBA. The impact will be localized to the plant area and will be more relative to occupational health and safety noise protection issues.

Noise attributed to vehicular movement is also expected during material transport. Traffic noise due to vehicles on the road will be intermittent during daylight hours.

Noise resulting from individual construction projects and road maintenance within and around the Project area will occur throughout the mine operations life. The noise will be of short duration and localized. Impact is more significant relative to occupational health and safety protection. Table 2-78 lists the estimated specification noise emission levels of equipment and certain activities during the operation of the Project. The specification limit is expressed as the maximum noise level in dBA “slow” at a reference distance of 50 feet from the loudest side of the equipment.

Table 20-78: Equipment and Operation Noise Levels

Equipment	Maximum Noise Limit at 50ft (dBA, slow)
Excavator	85
Dozers	85
Backhoe	80
Grader	85
Compactor	80
Wheel Loader	80
Dump Truck	84

Pick Up Truck	55
Flat Bed Truck	84
Generator Sets	82
Blasting	94

Source: Construction Noise Handbook, US Department of Transportation

2.3.5 Impact Assessment to Air Sector

2.3.5.1 Impacts to Air

Potential air pollution sources during the operation of the Project will include emissions from the operation of generator sets for power generation, fumes from chemical reactions in the mill processing circuit, emission from transportation exhausts like motorcycle, trucks and heavy equipment as well as dust generation from excavation activities and transport of vehicles. Potential noise pollution sources will include operation of the milling and grinding equipment, generator sets, transport of heavy equipment and blasting activities.

The impacts associated with air quality and noise impacts can be considered unavoidable. Other than the GHG emissions, the impacts will be reversible and limited to the immediate Project area.

2.3.5.2 Impacts to Noise Level

Noise resulting from individual construction projects and road maintenance within and around the Project area will occur throughout the mine operations life. The noise will be of short duration and localized. Impact is more significant relative to occupational health and safety protection. Table 2-78 lists the estimated specification noise emission levels of equipment and certain activities during the operation of the Project. The specification limit is expressed as the maximum noise level in dBA “slow” at a reference distance of 50 feet from the loudest side of the equipment.

Table 2-79: Summary of Impact Assessment for Air Sector

Potential Impacts	Phases				Options for Prevention or Mitigation or Enhancement
	Preconstruction	Construction	Operation	Closure	
Impacts in terms of change in local microclimate					
The removal of vegetation, land use change, and topography and hydrology changes within the project site may trigger changes in local microclimate such as temperature, precipitation, and evapotranspiration. Effects include alteration of dispersal of air pollutants, changes in local temperature and precipitation, and changes in noise propagation due to absence of trees to block sound waves		✓	✓		The disturbance will cover only 246.47 hectares of the applied area, which is the area of the surface facilities. Reduction in vegetation will be minimal since most of the area is sparsely vegetated but reforestation efforts will continue in order to replace trees. Greenhouse gas emissions are expected to be a very small percentage of the total emissions for the region and will be insignificant to change the microclimate in the area.
Contribution in terms of greenhouse gas emissions					
Vegetation removal and land use change due to the construction of the underground mining, crushing and mine facilities such as the mill, copper contractor camp access roads, offices, and camps may decrease carbon sequestration potential in the project area.		✓	✓		Wherever feasible, the infrastructure is designed in such a way that vegetation clearing will be reduced. In instances where vegetation clearing is unavoidable, reforestation and revegetation in other parts of the area was done. Buffer zones are planted with local and endemic species

Potential Impacts	Phases: Preconstruction	Construction	Operation	Closure	Options for Prevention or Mitigation or Enhancement
Greenhouse gas emissions due to the consumption of fossil fuels by trucks and equipment		✓	✓	✓	Fuel and vehicle efficiency is considered prior to purchase and/or lease of vehicles for construction and operation activities. Proper maintenance schedules are maintained for vehicles at all times to increase efficiency and reduce fuel costs. Generators will initially be used for the construction and initial operations.
Degradation of Air Quality					
Fugitive emissions that may be generated from unpaved roads, hauling, storage and handling of materials, mine processing, blasting, construction activities, and wind erosion from exposed surfaces, stockpiles, may increase the ground level of TSP and PM10 and may degrade the air quality of the area.		✓	✓		TVIRD will maintain the allowable speed limit for heavy equipment, trucks and other vehicles also dust suppression using water to prevent the dust particles from going airborne. In the project site and near sensitive receivers, regular dust monitoring is carried out. Erosion control is applied, and stockpiles are vegetated with grass cover to prevent dust from being blown by wind to prevent the dispersion of dust. A buffer zone of 200 m is maintained for dust control
					Employees and residents near the plant and haul roads are given appropriate personal protection equipment to protect them from dusts - related disease, in accordance with BWC - DOLE Occupational Safety and Health Standards (Department of Labor and Employment, 1989).
Burning of fossil fuels in mining equipment, and processing of fossil fuel by vehicles can increase particulate matter (TSP and PM10), NOx, and SOx concentrations at ground level and may degrade air quality in the area.		✓	✓	✓	Sub-contractors are required to undergo and pass the government vehicle emission tests prior to contract award; Exhaust fumes from vehicles, mining equipment, and other fuel burning equipment will be managed through the use of low sulfur fuel where possible. Vehicles and mining equipment are regularly maintained to increase efficiency, reduce fuel use, and help reduce costs associated with equipment downtime.
Increase in ambient noise level					

Potential Impacts	Phases				Options for Prevention or Mitigation or Enhancement
	Preconstruction	Construction	Operation	Closure	
Noise levels are expected to increase from baseline levels during construction and mine operation due to blasting operations, vehicular movement, and equipment operations.		✓	✓		The host communities are kept informed of the time and duration of any noisy building and explosive activities. Movement and blasting activities of equipment are planned to prevent sensitive times as much as possible; The speed of vehicles is limited on roads and if necessary, the vehicle horn signals are maintained at a low volume in order to minimize the noise generated by vehicle entry or exit; Muffler or silencer will be provided to heavy equipment and machinery that produce high noise levels;
					Appropriate personal protective equipment (PPE) that conforms to the Procedural Guidelines Governing Occupational Safety and Health in the Construction Industry as per BWC-DOLE DO 1998-13 is provided to operators and workers who handle heavy equipment that generates high levels of noise; Work involving handling of noisy and/or vibrating power tools/equipment shall be a maximum of 2 hours per day (for 8- hour work, duty cycle should be 1:4) in conformity to the requirements of BWC- DOLE DO 1998-13 and the Occupational Safety and Health Standards (As Amended, 1989);
					Monitoring of the ambient noise level is performed regularly within the Project perimeter and close to the sensitive receptors.

2.4 THE PEOPLE

2.4.1 History

Bayog was originally recognized as a Barrio under the Municipality of Malangas. It adopted its name, as this place was originally known to the natives due to abundance of the "Bayog" trees in the locality. The area was then sparsely inhabited by Native Subanen until 1953 when large number of immigrants started to permanently settle in the area. It was accessible by means of either a bamboo or a wooden raft through the Sibuguey River which will take the inhabitants two to three days of travel

Bright opportunities in agriculture, business and employment attracted more settlers into the area, particularly during the year 1957 and 1958. The influx of settlers was driven by the construction of a forty-two-kilometer road, from Bobuan to its wharf in Pamintayan, by Samar Mining Company (SAMICO). By 1959, Bayog was already quite big for a barrio, so another barrio, Kahayagan was created. When the Municipality of Buug (also a former barrio of Malangas) was created in 1960, barangays Bayog and Kahayagan were placed under its jurisdiction.

By 1963, the population of Bayog already warranted the creation of a new Municipality, but it was only on November 14, 1964, when Bayog started to function as a corporate municipality separate and distinct from the Municipality of Buug by vitue of Executive Order No.112 issued by former President Diosdado Macapagal. However, on February 15, 1966, Bayog was dissolved and reverted as a Barangay of the Municipality of Buug by virtue of a Supreme Court decision in the case of former Senator Pelaez versus the then Auditor General. Pelaez contented that the creation of a new municipality through an executive Order was against the law as the same was a prerogative of Congress.

The continued support and cooperation of the people substantially contributed much to the rapid growth and development of the Bayog community. It was the late Congressmen Vincenzo Sagun who fought for the creation of the Municipality. Finally on May 8, 1967, Republic Act No. 4872 was enacted creating Bayog as a regular municipality.

2.4.2 The Community

The majority of the population within the Project area is generally Bisaya and Subanons, the Indigenous People of Zamboanga. A portion of the approved MPSA is within a CADT given to the Subanon in September 2008 although the Project area as a currently being developed is outside the CADT boundaries. The host impact community is Sitio Balabag, in Barangay Depore.

The primary and secondary impact areas are identified as those areas and communities subject to the direct and indirect impacts of the Project. These can be considered as both environmental and social impacts. In addition to Sitio Balabag, the primary impact areas are generally within a 2-kilometer radius of the major project features. Secondary impact areas are associated with the lands and forests adjacent to the Dipili and Depore Rivers as well as the rivers and creeks which may be affected by the Project operations. A map showing the location and extent of the impacted areas is shown in Figure 2-76.

Three levels of impact communities have been identified and are defined as follows:

- Host Communities – are the sitios directly affected by the mining operations. For this phase of the operation, the host will be the Sitio Balabag in Barangay Depore.
- Primary Impact Communities – are the barangays that are within the coverage of the MPSA. These include the Barangays of Depore, Dimalinao, Pulang Bato and Bantal.

- Secondary Impact Communities – are the barangays that are along the crucial route of transport for TVIDR's products, services, and personnel during the operation of the Project. These include the Barangays of Dipili, Poblacion, Depase and San Isidro.

Before the Project, there were nearly 700 small scale mining or mining related goods and services families within the project area. Prior to project development, negotiations between TVIRD and the small-scale miners were done with the objective to offer alternative employment as part of the TVIRD operations and to compensate th current small-scale miners for their equipment and building improvements.

Baseline data were gathered for the host community as well as the primary and secondary impact areas. These data were generally sourved from various local and regional government units and third-party consultants. Perception surveys were also conducted TVIRD to supplement the data.

2.4.3 Land Area

The Municipality of Bayog has a total land area of 37,473 hectares distributed among 28 barangays. Barangay Dimalinao occupies the largest area in the municipality (4,223 hectares) while Barangay Dagum occupies the smallest area (42 hectares). The direct mining impact area is located in Sitio Balabag which is within Barangay Depore. A summary of the Barangays and the area encompassed by each is shown in Table 2-80.

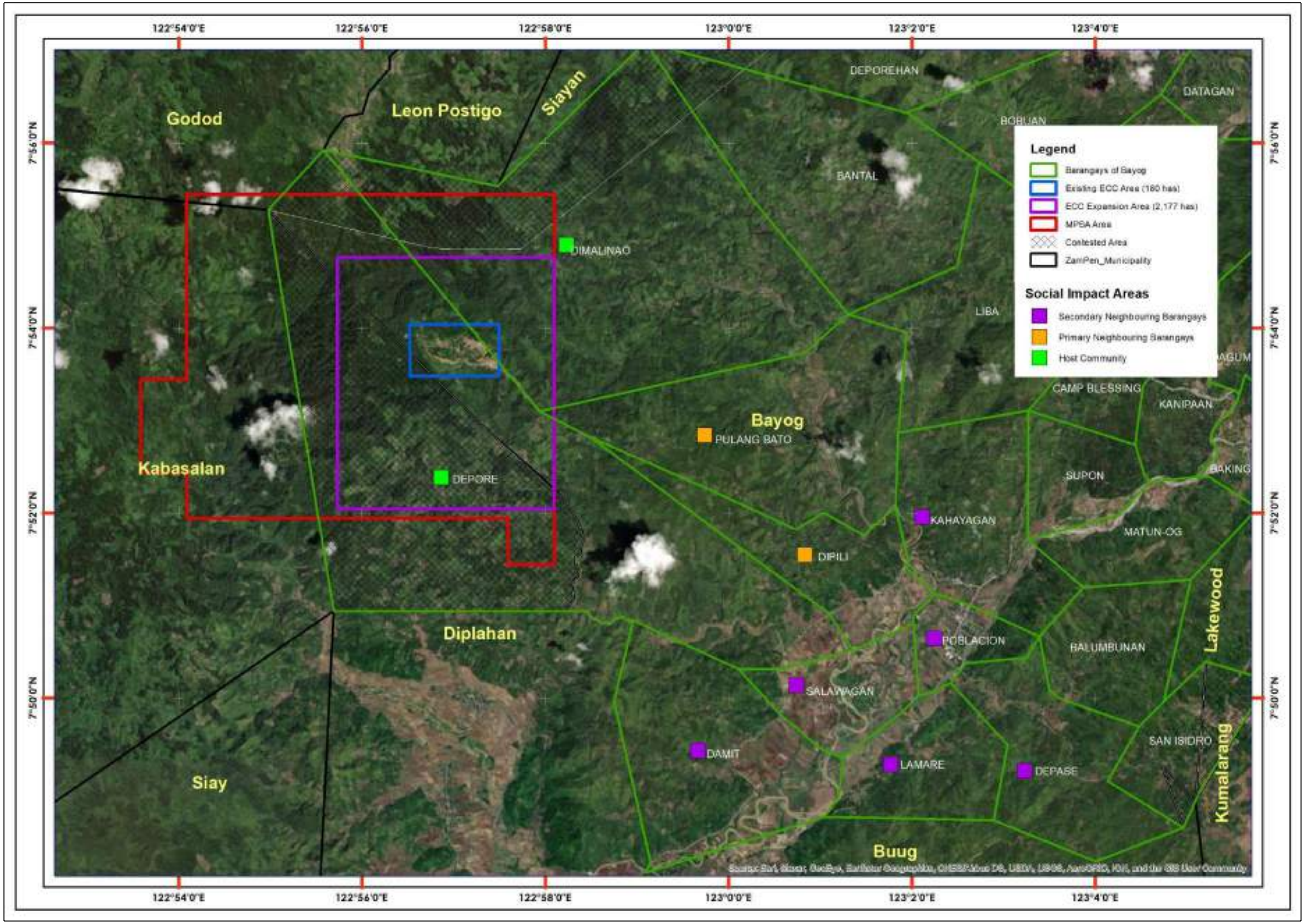
Table 2-80: Land Area per Barangay in the Municipality of Bayog

Barangay	Land Area (has)	%
Baking	361.8	0.9
Bobuan	1,411.3	3.8
Balukbahan	2,536.9	6.8
Balunbunan	710.5	1.9
Bantal	3,745.5	10.0
Camp Blessing	639.0	1.7
Canoayan	1,343.8	3.6
Conakon	841.5	2.2
Damit	1,921.0	5.1
Depore	1,796.0	4.8
Depase	714.1	1.9
Dagum	426.0	1.1
Datagan	479.5	1.3
Deporehan	3,413.3	9.1
Dimalinao	4,223.6	11.3
Dipili	1,486.3	4.0
Kanipaan	168.1	0.4
Kahayagan	1,208.6	3.2
Lamare	337.8	0.9
Liba	985.9	2.6
Matin-ao	1,483.7	4.0
Matun-og	723.8	1.9
Poblacion	739.9	2.0
Pulangbato	2,981.2	8.0
San Isidro	633.8	1.7

Sigacad	1,241.0	3.3
Salawagan	513.3	1.4
Supon	405.8	1.1
Total	37,473.00	100

Source: Socio-Economic Profile of Bayog, 2010

Figure 2-76: Location and Extent of Impact Areas



2.4.3 Demography

2.4.3.1 Population, Household, and Population Density

Based on the 2020 census data of the Philippine Statistics Authority, the population in the Municipality of Bayog is 34,519 of which 1,816 are from Barangay Depore (see Table 2-81). The average annual population growth rate of the municipality from 2015 to 2020 is about 0.57 percent.

Table 2-81: Barangay Population Data in the Municipality of Bayog (PSA 2020)

Barangay	Population	Barangay	Population
Baking	355	Dimalinao	802
Balukbahan	1,542	Dipili	957
Balumbunan	760	Kahayagan	4,143
Bantal	678	Kanipaan	640
Bobuan	1,645	Lamare	1,004
Camp Blessing	460	Liba	627
Canoayan	1,640	Matin-ao	854
Conacon	663	Matun-og	470
Dagum	371	Poblacion	4,783
Damit	2,115	Pulang Bato	919
Datagan	935	Salawagan	1,208
Depase	2,076	Sigacad	1,186
Deporehan	697	Supon	566
Depore	1,816	Pangi (San Isidro)	607
TOTAL			**34,519**

The average household size in the municipality is 4.9. With this, there are 7,045 households in the municipality in 2020. Furthermore, the population density in the municipality is 96 persons per square kilometer.

2.4.3.2 Gender and Age Profile

The 2015 gender and age profile of the population in the municipality is presented in Table 2-82. As shown, about 51% of the population is male while the remaining 49% are female. Furthermore, majority of the population has ages of 15 to 64 years old.

Table 2-82: Gender and Age Profile in the Municipality of Bayog (PSA 2015)

AGE	Both Sexes	Male	Female
Under 1	754	370	384
1 – 4	3,430	1,716	1,714
5 – 9	4,212	2,132	2,080
10 - 14	4,022	1,989	2,033
15 - 19	3,632	1,870	1,762
20 - 24	3,290	1,684	1,606
25 - 29	2,425	1,277	1,148
30 - 34	2,017	1,038	979
35 - 39	1,881	977	904

AGE	Both Sexes	Male	Female
40 - 44	1,749	923	826
45 - 49	1,603	854	749
50 - 54	1,322	722	600
55 - 59	1,029	513	516
60 - 64	760	365	395
65 - 69	561	268	293
70 - 74	369	186	183
75 - 79	264	129	135
80 years old and over	271	119	152
0 – 4	4,184	2,086	2,098
0 - 14	12,418	6,207	6,211
15 - 64	19,708	10,223	9,485
18 years and over	18,941	9,761	9,180
60 years and over	2,225	1,067	1,158
65 years and over	1,465	702	763
Total	**33,591**	**17,132**	**16,459**

As shown in Table 2-83 there are about 511 people who are considered as young dependents with age from 0 to 14 years old while 80 are old dependents with age above 65 years old. Lastly, there are about 1,098 who are in the labor force with ages from 15 to 64.

Table 2-83: Gender and Age Profile in Barangay Depore (2019)

AGE	Both Sexes	Male	Female
Young dependents (0-14)	511	288	223
Old dependents (65 and above)	80	42	38
Labor force (15-64)	1,098	562	536

Of the total population in the barangay, majority are Cebuano, followed by Illongo then Subaben. There are also some that ae Ilocano and Boholano.

2.4.3.3 Literacy rate and Profile of Educational Attainment

For its household population of 10 years old and over, literacy rate was at 92.9%. There were more literate males (51%) than females (49%). Table 2-84 the literacy of Bayog's household population 10 years old and over by age group and sex.

Table 2-84: Literacy of Bayog's Household Population 10 years old and over by Age Group and Sex (PSA 2015)

Age group	Household population 10 years old and over			Literate		
	Both sexes	Male	Female	Both sexes	Male	Female
Total	25,195	12,914	12,281	23,403	11,972	11,431
10 - 14	4,022	1,989	2,033	3,926	1,933	1,993
15 - 19	3,632	1,870	1,762	3,538	1,813	1,725
20 - 24	3,290	1,684	1,606	3,158	1,592	1,566
25 - 29	2,425	1,277	1,148	2,321	1,224	1,097
30 - 34	2,017	1,038	979	1,896	980	916
35 - 39	1,881	977	904	1,691	876	815

Age group	Household population 10 years old and over			Literate		
	Both sexes	Male	Female	Both sexes	Male	Female
40 - 44	1,749	923	826	1,553	826	727
45 - 49	1,603	854	749	1,454	769	685
50 - 54	1,322	722	600	1,184	656	528
55 - 59	1,029	513	516	917	457	460
60 - 64	760	365	395	647	310	337
65 years old and over	1,465	702	763	1,118	536	582

Bayog has a total of 15,156 persons who are the schooling age (5 – 24 years old) but only 68% of them are attending school. Least is observed on people ages 20-24 years which may be related to employment opportunities offered to these age bracket. As observed, starting at the age of 15 years old, which is the age of employment, persons who are attending school started to decline.

Table 2-85: Population Who Were Currently Attending School (PSA 2015)

Age Group	Household Population 5 to 24 Years Old			Household Who Were Currently Attending School		
	Both Sexes	Male	Female	Both Sexes	Male	Female
Total	15,156	7,675	7,481	10,322	5,154	5,168
5 – 9	4,212	2,132	2,080	3,769	1,900	1,869
10 – 14	4,022	1,989	2,033	3,806	1,870	1,936
15 – 19	3,632	1,870	1,762	2,222	1,134	1,088
20 – 24	3,290	1,684	1,606	525	250	275

In terms of highest educational attainment, among Bayog's total population, majority (47.6%) were able to reach elementary. Only about 5.7% are academic degree holders.

Table 2-86: Highest Education Completed by the Population in Bayog (PSA 2015)

Highest Grade/Year Completed, Sex	Total Population 5 Years Old and Over		
	Both Sexes	Male	Female
Total	29,407	15,046	14,361
No Grade Completed	2,643	1,371	1,272
Pre-School	897	456	441
Special Education	8	5	3
Elementary	14,014	7,621	6,393
1st - 4th Grade	8,408	4,700	3,708
5th - 6th Grade	2,853	1,506	1,347
Graduate	2,753	1,415	1,338
High School	7,630	3,741	3,889
Undergraduate	4,423	2,140	2,283
Graduate	3,207	1,601	1,606
Post-Secondary	294	155	139
Undergraduate	23	19	4
Graduate	271	136	135
College Undergraduate	2,198	993	1,205

Highest Grade/Year Completed, Sex	Total Population 5 Years Old and Over		
	Both Sexes	Male	Female
Academic Degree Holder	1,686	689	997
Post Baccalaureate	13	3	10
Not Stated	24	12	12

2.4.3.4 Displacement/Disturbance of Properties

The proposed expansion project will not cause displacement or disturbance of properties within the project area.

2.4.3.5 Change/Conflict in Land Ownership

The proposed expansion project is not expected to change or have conflict in land ownership since it will be located within the MPSA of the proponent.

2.4.4 In-Migration

In-migration is inevitable in any area where business and commerce are available. People tend to migrate where potential employment opportunities are abundant or where business enterprises may be profitable. Implementation of the Expansion Project will result in an influx of TVIRD personnel followed by those offering good and services. 'The cumulative impact will likely be an increase in the in-migration rates within Sitio Balabag and the surrounding primary and secondary impact areas.

In many cases an in-migration increase results in additional stress on the local infrastructure and local services. This will likely be tempered by an increase in infrastructure by TVIRD in support of the Project. Much of this infrastructure will likely remain after the Project comes to an end thereby improving the current conditions in the long term.

The short-term nature of the Project may present some impacts due to community population changes in a short time both at the beginning and the end of the project.

2.4.4.1 Proliferation of Informal Settlers

The proposed expansion project is not expected to proliferate informal settlers within the MPSA. Checkpoints will be established within the entry and exit points of the proposed project site.

2.4.4.2 Cultural/Lifestyle Change

Subanen is the most dominant ethnographic grouping in the region. In Zamboanga del Sur, they comprise of almost 75% of the total IP population, according to data from NCIP. Subanen are also dominant in the other areas of the region such as Zamboanga del Norte, Zamboanga Sibugay, and Zamboanga City. The second most dominant grouping is the Yakan. The more distributed second most dominant are the Samal or Sama; majority of them are in Zamboanga del Norte and Zamboanga City.

There are no cultural landscapes in the area that will be physically impacted by the Project operations or infrastructure constructed in support of the Project. There are no structures or landforms within the Project area considered sacred by the Subanen.

Cultural change, if any, will be a decision of the individual. Lifestyle profiles of the indigenous people may change due to an influx of additional people from TVIRD and those outside that migrate to the area to provide goods and services.

2.4.5 Impacts on Physical Cultural Resources

There are no literature or national/international publications found in the project area that have archaeological, paleontological, historical, aesthetical, or cultural, both tangible and intangible, significance, or immovable objects, below ground or underwater, sites, structures, groups of structures, and natural features.

2.4.6 Threat to Delivery of Basic Services/Resource Competition

Since in-migration is expected during the operation of the expansion project, it is possible that there will be a competition on the basic services within the area such as food, water, power and other local sources.

2.4.6.1 Water Supply

The LGU-run water system in the municipality provides Level 3 water supply system in barangays Poblacion, Kahayagan and Salawagan. There are also communal water supply systems that are being operated in other barangays (see Table 2-87).

Table 2-87: List of Water Service Providers in the Municipality of Bayog

Water Utility Name	Level of Service	Management Type
BARANGAY-BAKING	Level 2 only	LGU-Run Utility
BARANGAY-BALUKBAHAN	Level 2 only	LGU-Run Utility
BARANGAY-BALUNBUNAN	Level 2 only	LGU-Run Utility
BARANGAY-BANTAL.	Level 2 only	LGU-Run Utility
BARANGAY-BOBUAN	Level 2 only	LGU-Run Utility
BARANGAY-CAMP BLESSING	Level 2 only	LGU-Run Utility
BARANGAY-CANOAYAN	Level 2 only	LGU-Run Utility
BARANGAY-CONACON,SITIO-LOWER	Level 2 only	LGU-Run Utility
BARANGAY-DAGUM	Level 2 only	LGU-Run Utility
BARANGAY-DATAGAN	Level 2 only	LGU-Run Utility
BARANGAY-DEPASE.	Level 2 only	LGU-Run Utility
BARANGAY-DEPORE.	Level 2 only	LGU-Run Utility
BARANGAY-DEPOREHAN	Level 2 only	LGU-Run Utility
BARANGAY-DIMALINAO	Level 2 only	LGU-Run Utility
BARANGAY-DIPILI	Level 2 only	LGU-Run Utility
BARANGAY-KANIPAAN	Level 2 only	LGU-Run Utility

Water Utility Name	Level of Service	Management Type
BARANGAY-LAMARE	Level 2 only	LGU-Run Utility
BARANGAY-LIBA	Level 2 only	LGU-Run Utility
BARANGAY-MATIN-AO	Level 2 only	LGU-Run Utility
BARANGAY-MATUN-OG	Level 2 only	LGU-Run Utility
BARANGAY-PULANG BATO	Level 2 only	LGU-Run Utility
BARANGAY-SALAWAGAN	Level 2 only	LGU-Run Utility
BARANGAY-SAN ISIDRO	Level 2 only	LGU-Run Utility
BARANGAY-SIGACAD	Level 2 only	LGU-Run Utility
BARANGAY-SUPON	Level 2 only	LGU-Run Utility
DAMIT MULTI-PURPOSE COOPERATIVE	Level 2 only	Cooperative
DMPC	Level 2 only	Cooperative
MUNICIPAL LEVEL III WATER SYSTEM	Level 3 only	LGU-Run Utility

In Barangay Depore, there are about 106 households that have access to Level 3 water system, 195 households with Level 2 and 62 households with Level 1. There are still 62 households that use doubtful sources. In Puroks 5 and 6, there are no available Level 3 system while in Purok 7, all the households only have access to Level 1 system which are also considered as doubtful sources.

2.4.6.2 Sanitary Toilet Facilities

In 2019, about 18% of the total households in Barangay Depore does not have access to sanitary toilet facilities. Most of these households are in Puroks 6,5,7 and 1.

2.4.6.3 Power Supply

The main power supply service provider in the municipality is the Zamboanga del Sur Electric Cooperative II (ZAMSURECO II). All barangays in the municipality have access to electricity.

2.4.6.4 Education Facilities

There are 32 public elementary schools in the municipality that are located in all 28 barangays. Also, there are five national high namely Bayog National High School, Bobuan National High School, Damit National High School, Balukbahan National High School, and Mataga National High School.

In Barangay Depore, there is only one elementary school located within the barangay. Higher levels of schools are located 5 kilometers away from the barangay.

2.4.7 Threat to Health and Safety

Several studies provide information and data on the occupational health hazards of mining based on the type of mineral mined, the scale of mining operations and mining methods. Several studies report that small-scale mines are more hazardous than large scale mines in terms of risks of accidents or injuries.

Surface mine studies identify dust and respiratory health risks as the most common health issue while underground mines indicate heat and pressure as the cause for a range of health concerns. These include occupation heat stress, high blood pressure and hypertension. Based on the reviews made by Stephens and Ahern (2002) many studies indicated that in all types of mining, health risks occur with dust exposure. Respiratory impacts are the most studied and problematic of health impacts for workers. This can include incidences of tuberculosis, asthma, chronic bronchitis and gastrointestinal disease.

Community health impacts of the mining and minerals sector are less well defined than those faced by workers. There are problems not only in defining 'community', but also in conducting the kinds of epidemiological studies that might provide evidence of links between mining activities and health outcomes (Stephens and Ahern, 2002).

At the level of mine operations, the community may include those residents who live in immediate proximity to the mine. However, the community may extend far beyond the immediate local area as may occur with the transportation of pollutants from mining operations. Cases of accidental pollutant releases or environmental emergencies, environmental pathways like water, soil and air can easily extend the community. In this case, it is difficult to relate a health condition to an environmental incident unless with direct exposure.

Health studies on the local community population within the area of the TVIRD Canatuan Mine Project were conducted during the mining operations. These studies focused on the introduction of heavy metals within the human physiological system. The results did not indicate any detrimental effects.

2.4.7.1 Healthcare Facilities

There are no hospitals currently located within the Municipality of Bayog that will address the immediate health care needs of the people. The basic health services are only available under the Municipal Health Office (MHO).

At the barangay level, health services are addressed through the barangay health stations. One station is available at Barangay Depore. Services available at this station include preventive medical assistance and dental rehabilitative services. Other health services also include a tuberculosis control program, maternal and child health care, family planning, nutrition program and administrative services such as issuance of medical certificates, sanitary permits, death certificates and medico-legal examination. Complicated cases are referred to a Provincial medical hospital located in Pagadian City, 85 kilometers from Bayog. The common diseases in Barangay Depore include diarrhea, fever and cough.

2.4.8 Generation of Local Benefits from the Project

Operation of the Project is anticipated to provide many benefits to the local community under the provisions of the Philippine Mining Act, through the implementation of the 5-Year Social Development and Management Program (SDMP) and establishment of environmental management protocols.

The regulatory and legal requirements provide that Mining Projects allot a minimum of 1.5% of the operating costs to implement SDMP programs. Direct social programs account for 1.125%, programs for the Development of Mining

Technology and Geosciences account for 0.15% and IEC programs account for 0.225%. Benefits for the development of host and neighboring communities resulting from implementation of the SDMP include the following:

- Human Resource Development and Institutional Building
- Enterprise Development and Networking
- Assistance to Infrastructure Development and Support Services
- Access to Education and Educational Support Programs
- Access to Health Services, Health Facilities and Health Professionals
- Protection and Respect of Socio-Cultural Values

Use of facilities/services within the mine camp or plant site such as hospitals, schools, among others by the members of the host and neighboring communities, the expenditures of which shall be apportioned *pro-rata* according to the number of people from said communities accommodated in such facilities.

The Local Government Unit and the National Government will likewise benefit from the Project payments in the form of taxes such as excise tax, withholding tax and occupational taxes. Other income includes various permit fees and license fees.

In addition to SDMP programs, indigenous cultural communities (ICC) with their ancestral domain/s overlapping the MPSA area will benefit from royalty payments while the Project is in operation. The minimum amount is 1% of the gross revenue. During the Project operation, the total royalty payments are estimated to be USD 1.8 million (Php 81.3 million).

TVIRD uses a more holistic approach in providing social services. However, specific programs are also to be implemented for the legitimate ICC. These programs, which will comprise the Indigenous People Development Plan (IPDP), aim to address gaps in social justice, and preservation and protection of indigenous culture.

TVIRD, in coordination with NCIP and the local government units, aims to work closely with the legitimate ICC in providing economic opportunities to uplift them from poverty. The IPDP may even be utilized by the legitimate ICC as a framework in their formulation of their Ancestral Domain Sustainable Development and Protection Plan (ADSDPP).

2.4.8.1 Main Source of Income

According to the 2018 Family Income and Expenditure Survey (FIES), the average annual family income in region IX at current (2018) prices was at 228,000. For all income class, majority (43%) reported wage/salaries as their main source of income. Only 28.2% reported entrepreneurial activities while 28.6% cited other sources of income.

2.4.8.2 Employment rate/profile

There are a total of 11,058 gainful workers who are 15 years old and above in the municipality. Majority of these gainful workers are skilled agricultural forestry and fishery workers and followed by those engaged in elementary occupants.

Table 2-89: Gainful Workers 15 Years Old and Over in Bayog by Major Occupation Group, Age Group, and Sex, 2015

Major Occupation Group	Population
Managers	731
Professionals	477
Technicians and Associate Professionals	203
Clerical Support Workers	181
Service and Sales Workers	982
Skilled Agricultural Forestry and Fishery Workers	5,308
Craft and Related Trades Workers	522
Plant and Machine Operators and Assemblers	690
Elementary Occupations	1,879
Armed Forces Occupations	65
Other Occupation Not Elsewhere Classified	-
Not Reported	20
Total	**11,058**

In 2019, about 93.26% of the total labor force population were employed. The remaining 6.74% are either unemployed or those who do not have permanent jobs due to lack of skills.

2.4.8.3 Poverty Incidence

There are about 122 households or 33.7% of the total households in barangay that have income below the poverty threshold while 24.86% of the total households have income that is below the food threshold.

2.4.9 Traffic Congestion

The operation of the Project will not cause any traffic congestion in the area. Use of heavy equipment and transport vehicles will be concentrated at the Project area, away from community residents. Service vehicles and supplier vehicles passing through different barangays going to the mine site will be minimal and on a scheduled basis.

2.4.9.1 Road Network

The municipality has a total road network of 143.58 kilometers of which 15.70 km are concrete, 99.19 km are graveled and 28.70 are earth-filled.

2.4.9.2 Transportation Network

Available transportation in the municipality includes public utility vehicles, public utility jeepneys, tricycles, habal-habal and trisikads.

2.4.10 Impact Assessment for the People Sector

Potential Impacts	Phases: Preconstruction	Phases: Construction	Phases: Operation	Phases: Closure	Options for Prevention or Mitigation or Enhancement
Displacement of settlers					
No settlers will be displaced for the construction of the surface facilities and the mine since the area and the mountain is not inhabited However, the use of tribal lands ate properly compensated through the FPIC MOA and the SDMP	✓	✓	✓	✓	While there were no settlers and infrastructure that were displaced, the use of the tribal ancestral lands is compensated in the MOA with the tribe that concluded the FPIC process.
Possibility of conflict that will arise due to the settlement of workers and future land use	✓	✓	✓	✓	TVIRD regularly coordinates with DA, DAR, municipal assessors and planning officers, CENRO and PCA for land use, classification and tenure concerns.
In-migration					
Migration to the host municipalities/barangays in search of jobs and mining related economic opportunities is expected since there will be few persons within the tribe to meet the demand. These migrants will consist of single persons or families. Significant numbers of migrants could also diminish social cohesiveness and diminish traditional mechanisms of social control in host communities		✓	✓		TVIRD has endeavored to strengthen value-formation among current residents of host communities through seminars and other culturally appropriate forms of meetings
Cultural / lifestyle change					
Local cohesion may be affected because of the presence of local migrant workers		✓	✓	✓	Support local festivals and traditions by sponsorship and participation as part of CSR and SDMP so that local traditions will be preserved and local awareness of such traditions, particularly among the youth.

Potential Impacts	Phases: Preconstruction	Construction	Operation	Closure	Options for Prevention or Mitigation or Enhancement
With the potential introduction of migrants, there will be instances when the migrants may not have the same level of behavior as the current tribal communities and conflict mat arise.		✓	✓	✓	TVIRD provides protocols and guidelines for worker behavior for all contracted labor and conduct especially in local host communities. Such behavior protocols and guidelines are included in contracts/agreements and regularly discussed among employees and contractors through in-house IECs, management meetings, and values-formation discussions, this is inculcated it is Code of Conduct.
Traditional family and community life may be adversely impacted. With the increased capability to spend because of new work and business opportunities not only for basic needs but other forms of entertainment such as cable tv, internet connection, and mobile data, the traditional values typical of rural areas may be removed or overpowered by the influence of more modern and materialistic outlook in life. Contingent to this and as the needs of the stakeholders are filled, religious devotion may also be adversely affected with more modern beliefs with the stakeholders having more access to media.		✓	✓	✓	Strengthen value-formation among current residents of host communities through seminars and other culturally appropriate forms of meetings/IECs that highlight the respect and function of elders, importance of traditional leaders, and other traditional values.
Impacts on physical cultural resources					
Implementation of the Project may uncover artifacts or objects of physical cultural value		✓	✓	✓	The proponent has committed to following a protocol for chance finds and coordinate with the National Museum for any chance archaeological finds in the tribe ancestral lands
Threat to delivery of basic services / resource competition					
Public services may be stretched because of the influx of newcomers in search of		✓	✓		The SDMP, among other means of assistance, has helped in augmenting social services provided by government agencies.

Potential Impacts	Phases: Preconstruction	Construction	Operation	Closure	Options for Prevention or Mitigation or Enhancement
employment opportunities. Migrants may also compete with established local residents in the use of resources, e.g., springs, sources of firewood, game, etc.					Local government revenues have slowly increase because of the mining operations and these revenues can be used by the LGUs to expand public services
					Local hiring has likewise increase income levels which allow families to afford food from other sources and not just from subsidence farming
Threat to public health and safety					
Increase of human and non-human wastes due to in-migration (e.g., sewage and other domestic wastes from mine and contractor camps or accommodations and solid wastes from packaging, etc.)		✓	✓	✓	Enhance existing waste disposal systems and methods within communities and also within the plant and construction area by strict compliance to the provisions of RA 9003. This includes proper handling, storage and disposal of all kinds of wastes especially those produced by the plant and/or construction area. Increased local government revenues means that the LGU may be able to afford RA 9003 requirements such as MRF (barangay) and 100% collection (Municipal)
Prevalence and spread of communicable diseases due to in-migration; Prevalence of respiratory diseases may increase of dust during various phases of mine activities		✓	✓	✓	TVIRD to pushed LGUs for the establishment of health centers/clinics in the area; Increase provision and/or installation of sanitation or toilet facilities; Conduct IECS on safety, hygiene and sanitation to prevent diseases; dust suppression techniques will be instituted in and around the plant and mill
Increase in vehicle-related and work-related accidents due to increase in volume and frequency of trucks and other large vehicles that will be used of the mine and may pass by national roads.		✓	✓	✓	Established programs such as Occupational Safety and Health Program, Hazardous Waste Management Program and Emergency Response Program to all workers and conduct activities in relation to these programs. This includes the creation of an Emergency Response Team and creation of clinics that will be open to workers and families if required; Provide appropriate training to personnel who will be assigned to operate a particular equipment or machinery
Possible increase in pollution particularly of air, water and land due to influx of people and vehicles and start of mine activities		✓	✓	✓	Conduct Air Quality Monitoring initially and every quarter.

Potential Impacts	Phases: Preconstruction	Construction	Operation	Closure	Options for Prevention or Mitigation or Enhancement
Generation of local benefits from the Project					
About 100 additional workers are projected to be hired . These does not include indirect hiring by suppliers and contractors who will also need to hire for the project. The impact on employment, income, and poverty reduction will be significant.		✓	✓		TVIRD worked closely with the barangay and municipality to screen applicants for various positions and require contractors and subcontractors to hire locally when possible. TVIRD will continue to assist the local governments (particularly at the municipal and provincial levels) to develop and to assist their respective Public Employment Services Offices (PESOs). Institute a system of verification regarding local residency in respect to hiring. TVIRD to assist locals applying for jobs by pushing for TESDA training seminars near the area for the local residents. A farm school is planned to be established in the impact community to capacitate the local inhabitants on agricultural farming.
Local revenues and other forms of payments (e.g., royalties) will flow to host communities because of mining operations and due to the FPIC MOA. Local shares of national taxes will also increase.		✓	✓		
Traffic congestion					
During the construction and operations stages, there will be a significant increase of traffic volume involving heavy vehicles		✓	✓	✓	Crafted a traffic management plan with local authorities at barangay and municipal levels that includes the participation of community leaders, e.g., local school heads, establish appropriate signages, i.e., road warning devices, undertake safety education for drivers of vehicles and pedestrian and regular maintenance of roads

3. IMPACTS MANAGEMENT PLAN

A summary of the impacts and corresponding programs for prevention, mitigation or enhancement for the existing operation and the proposed expansion project are shown in Table 3-1. This follows the guidelines provided in the Revised Procedural Manual of DAO 2003-30 or the Implementing Rules and Regulations (IRR) for the Philippine Environmental Impact Statement (EIS) System.

Table 3-1: Impacts Management Plan

Project Activities	Environmental Components Likely to be Affected	Potential Impacts	Proposed Mitigating Measures	Target Performance/ Efficiency	Responsible Entity	Cost Allocation	Guarantee or Financial Agreements
Construction Phase							
Site Preparation and Clearing. Construction of Mine Infrastructure Including Tailings Storage Facility, Waste Dump Area, and Camp Facilities. Pre-Stripping Activities at the Surface Mine Area and Waste Dump Area.	Land	Vegetation Removal and Loss of Faunal Habitat.	Limiting the Area of Disturbance to cover only the Planned Area for Development. Earth Balling of Significant Species Prior to Land Grubbing and Translocation as Enrichment Planting Materials in the Identified Reference Ecosystem. Wildlings Collection from the Areas Targeted to be Stripped and Maintained in Established Nurseries for Future Rehabilitation. Seeds are Collected from Native Trees within the MPSA for Propagation in the Nurseries.	>90%	TVIRD	Construction and Project Development Cost. EPEP Cost	Development Plan Management of Design and Construction of Facilities in accordance with DAO 2010-21: Consolidated Department Orders for the Implementing Rules and Regulation of RA 7942: Philippine Mining Act of 1995 and the approved 3YDUWP. Compliance with DAO 2022-04: Enhancing Biodiversity Conservation and Protection in Mining Operations, PD 705 as Amended and EO 277.
		Loss of Topsoil and Overburden Materials.	Removed Topsoil to be Stockpiled for Progressive Rehabilitation Activities. Topsoil Management and Control of the Storage Areas. Soil Conditioning and Enhancement	>90%	TVIRD	Construction and Project Development Cost. EPEP Cost	Development Plan Management of Design and Construction of Facilities in accordance with DAO 2010-21: Consolidated Department Orders for the Implementing Rules and Regulation of RA 7942: Philippine Mining Act of 1995 and the approved 3YDUWP. MGB SHES Manual 2021

Project Activities	Environmental Components Likely to be Affected	Potential Impacts	Proposed Mitigating Measures	Target Performance/ Efficiency	Responsible Entity	Cost Allocation	Guarantee or Financial Agreements
							Compliance with DAO 2018-19: Guidelines for Additional Environmental Measures for Operating Surface Metallic Mines.
		Decrease of Carbon Pool in the Area which has the Capacity to Accumulate or Release Carbon	Establishment of Forest Carbon Project for Carbon Sink Enhancement. Identification of Reference Ecosystem which is 5% of the Approved MPSA Area. Progressive Rehabilitation and Temporary Revegetation.	>90%	TVIRD	EPEP Cost	Compliance with DAO 2021-43: Guidelines on the Establishment of the Carbon Accounting, Verification, and Certification System (CAVS) for Forest Carbon Project. Compliance with DAO 2022-04 Enhancing Biodiversity Conservation and Protection in Mining Operations.
		Increase Greenhouse Gas Emissions	Establishment of Forest Carbon Project for Carbon Sink Enhancement. Identification of Reference Ecosystem which is 5% of the Approved MPSA Area. Progressive Rehabilitation and Temporary Revegetation.	>90%	TVIRD	EPEP Cost	EPEP Compliance with DAO 2021-43: Guidelines on the Establishment of the Carbon Accounting, Verification, and Certification System (CAVS) for Forest Carbon Project. Compliance with DAO 2022-04: Enhancing Biodiversity Conservation and Protection in Mining Operations.
		Threat to Existence of Important Local Species.	Wildlings of Important (Critically Endangered, Endangered and Vulnerable) Floral Species will be	100%	TVIRD	Php 8.00 per Seedling; Annual Target Collection	EPEP Compliance with DAO 2022-

Project Activities	Environmental Components Likely to be Affected	Potential Impacts	Proposed Mitigating Measures	Target Performance/ Efficiency	Responsible Entity	Cost Allocation	Guarantee or Financial Agreements
		Threat to Abundance, Frequency and Distribution of Important Local Species.	Collected Prior to Disturbance and will be Maintained at the Plant Nursery Until Ready for Planting Within Planned Rehabilitation Areas. Identification of Reference Ecosystem which is 5% of the Approved MPSA Area. Hiring of Biodiversity Conservation Officer to Lead the Integration of Biodiversity Measures in Various Stages of Mining Operations.			is Php 25,00 or a total Cost of Php 2 Million over the Span of 10 Years EPEP Cost	04: Enhancing Biodiversity Conservation and Protection in Mining Operations.
		Change in Surface Topography.	Progressive Rehabilitation and Temporary Revegetation of Disturbed areas by Placement of Soil Cover, Soil Conditioning and Vegetative Cover. Use of Fast-Growing Tree Species and Intercropped with Endemic Species and Cash Crops for Livelihood Identification of Reference Ecosystem which is 5% of the Approved MPSA Area. Hiring of Biodiversity Conservation Officer to Lead the Integration of Biodiversity Measures in Various Stages of Mining Operations.	>90%	TVIRD	EPEP Cost	EPEP Compliance with DAO 2022-04: Enhancing Biodiversity Conservation and Protection in Mining Operations.
		Change in Soil Quality due to Improper	Proper Storage and Disposal of Waste Materials (Hazardous and Non-Hazardous) Within Designated Areas.	>90%	TVIRD	Construction and Project	EPEP Management of Waste

Project Activities	Environmental Components Likely to be Affected	Potential Impacts	Proposed Mitigating Measures	Target Performance/ Efficiency	Responsible Entity	Cost Allocation	Guarantee or Financial Agreements
		Management of Wastes	Topsoil Management and Control of the Storage Areas.			Development Cost.	Materials as Required by DAO 2013-22: Revised Procedures and Standards for the Management of Hazardous Wastes (Revising DAO 2004-36) MGB SHES Manual 2021. Compliance with DAO 2018-19: Guidelines for Additional Environmental Measures for Operating Surface Metallic Mines.
		Soil Erosion	Steep Slopes (>30°) Will Require Benches, Terraces, or Other Slope Controls to Reduce Surface Water Runoff Velocity During Rainfall Events. Other Surface Treatment to Control Erosion i.e., Slope Stabilization and Progressive Rehabilitation and Temporary Revegetation.	>90%	TVIRD and	Construction and Project Development Cost.	EPEP Use of Reputable and Experienced Engineering Design Consultants for Facility Design and Construction. Compliance with DAO 2018-19: Guidelines for Additional Environmental Measures for Operating Surface Metallic Mines.
		Contamination of Soils from Oil and Fuel Leaks from Construction Equipment Use	Storage and Work Areas shall be Provided with Secondary Containment for Collection of Fuel and Oil Leaks. Regular Maintenance of Construction Equipment.	100%	TVIRD	Construction and Project Development Cost.	EPEP Management of Waste Materials as Required by DAO 2013-22: Revised Procedures and Standards for the Management of Hazardous

Project Activities	Environmental Components Likely to be Affected	Potential Impacts	Proposed Mitigating Measures	Target Performance/ Efficiency	Responsible Entity	Cost Allocation	Guarantee or Financial Agreements
							Wastes (Revising DAO 2004-36)
	Air	Dust Generation from Movement of Equipment During Clearing and Construction Activities.	Use of Dust Suppression Techniques such as Watering of Exposed Surfaces, Reduction of Vehicle Travel Speeds and Limit Exposed Areas.	100%	TVIRD	Construction and Project Development Cost EPEP Cost	EPEP Conformance with DAO 2000-81: Implementing Rules and Regulations of RA 8749: Philippine Clean Air Act. Conformance with DAO 2010-01: Implementing Rules and Regulations of RA 9729: Climate Change Act.
	Water	Sedimentation and Siltation of Local Rivers and Creeks. Increased Turbidity Levels within Local Rivers and Creeks.	Provision of Buffer Zones Between the Areas of Disturbance and Rivers and Creeks. Operations Involving Soil Disturbance, Such as Overburden Stripping, to Incorporate a Buffer Zone of at Least 20 Meters Away from Creeks and Rivers. Establish Erosion Control Measures Including Diversion Canals, Soil Stabilization Programs and Re-Vegetation of Disturbed Areas to Reduce the Soil Loss Potential. Construction of Sediment Ponds and Overland Flow Retention Structures to Trap Soil and Reduce Siltation.	>90%	TVIRD	Construction and Project Development Cost EPEP Cost	EPEP Compliance with DAO 2016-08: Water Quality Guidelines and General Effluent Standard and DAO 2021-19: Updated Water Quality Guidelines and General Effluent Standard for Selected Parameters

Project Activities	Environmental Components Likely to be Affected	Potential Impacts	Proposed Mitigating Measures	Target Performance/ Efficiency	Responsible Entity	Cost Allocation	Guarantee or Financial Agreements
		Changes in Drainage Patterns.	Develop Master Infrastructure Drainage Plan for the Project Area.	>90%	TVIRD	Construction and Project Development Cost. EPEP Cost.	EPEP
		Change in Watershed Base Flow and Runoff Yields.	Establish Stream Flow Monitoring Stations at Selected Locations on Unao-Unao Creek, Dimalinao Creek, Dipili River and Naro Creek. Develop Stream Flow Measurement Data Base and Master Flood Control Plan.	>90%	TVIRD	Construction and Project Development Cost. EPEP Cost.	EPEP
		Changes in Flood Characteristics.	Provision of Stormwater Drainage System.	>90%	TVIRD	Construction and Project Development Cost. EPEP Cost.	EPEP
		Loss of Riparian and Aquatic Habitat Areas.	Provision of Siltation Ponds and other Environmental Structures	>90%	TVIRD	Construction and Project Development Cost. EPEP Cost.	EPEP
		Water Quality Degradation due to Potential Leaks or Spills of Oils and Fuels.	Storage and Work Areas shall be Provided with Secondary Containment for Collection of Fuel and Oil Leaks. Regular Maintenance of Construction Equipment.	100%	TVIRD.	Construction and Project Development Cost.	EPEP Compliance with DAO 2016-08: Water Quality Guidelines and General Effluent Standard and DAO 2021-19: Updated

Project Activities	Environmental Components Likely to be Affected	Potential Impacts	Proposed Mitigating Measures	Target Performance/ Efficiency	Responsible Entity	Cost Allocation	Guarantee or Financial Agreements
						EPEP Cost.	Water Quality Guidelines and General Effluent Standard for Selected Parameters
		Changes in the Pattern of affected Creeks in the Construction of TSF	Construction of Diversion Channels and Canals. Installation of Culvert to Direct the Silt Laden Runoff into the Constructed Settling Ponds.	100%	TVIRD	Construction and Project Development Cost. EPEP Cost.	EPEP Compliance with DAO 2016-08: Water Quality Guidelines and General Effluent Standard and DAO 2021-19: Updated Water Quality Guidelines and General Effluent Standard for Selected Parameters
	People	Occupational Health and Safety Hazards	Proper Training of Personnel and Provision of PPEs Employ Heavy Equipment Operators with Certifications Daily Safety Meetings, Toolbox Meetings, and Strict Adherence to all Safety Rules and Regulations	100%	TVIRD	Construction and Project Development Cost. ASHP Cost	Compliance with DAO 2000-98: Mine Safety and Health Standards and DOLE DO 198-18: IRR of RA 11058 "An Act Strengthening Compliance with Occupational Safety and Health Standards and Providing Penalties for Violations Thereof"
		Generation of Employment from the Local Population	Assist the Local Governments (particularly at the municipal and provincial levels) to Develop and Assist their Respective Public Employment Services Offices (PESOs). Institute a System of Verification Regarding Local Residency with Respect to Hiring. Training Programs for Required Skills for Residents of Host Communities. Training Programs for Local Governments on Revenue Generation	>90%	TVIRD	Construction and Project Development Cost.	Compliance with the Labor Code of the Philippines.

Project Activities	Environmental Components Likely to be Affected	Potential Impacts	Proposed Mitigating Measures	Target Performance/ Efficiency	Responsible Entity	Cost Allocation	Guarantee or Financial Agreements
			and Management.				
Operation Phase							
Mining Operation Extraction of Ore	Land	Loss of Topsoil and Overburden Materials.	Establishment of Benches in Accordance with the Surface Mine Design.	>90%	TVIRD	Project Operation Cost. AEPEP Cost.	This is Included in the Annual Environmental Protection and Enhancement Program (AEPEP). Approved 3YDUWP.
		Change in Land Use of the Surface Mine Area.	Incorporation of Changes of Land Utilization in the Land Use Plan Identification of Reference Ecosystem which is 5% of the Approved MPSA Area. Progressive Rehabilitation and Temporary Revegetation. Establishment of Forest Carbon Project	>90%	TVIRD	Project Operation Cost. AEPEP Cost.	This is Included in the Annual Annual Environmental Protection and Enhancement Program (AEPEP). Approved 3YDUWP. Compliance with DAO 2021-43: Guidelines on the Establishment of the Carbon Accounting, Verification, and Certification System (CAVS) for Forest Carbon Project. Compliance with DAO 2022-04: Enhancing Biodiversity Conservation and Protection in Mining Operations.
		Increased Soil Erosion	Installation of Drainage Canal System to Prevent Erosion of Benches and Other Areas. Other Surface Treatment to Control Erosion i.e., Slope Stabilization and Progressive Rehabilitation and	>90%	TVIRD	Project Operation Cost. AEPEP Cost.	Annual Environmental Protection and Enhancement Program (AEPEP). Use of Reputable and Experienced Engineering Design Consultants for Facility

Project Activities	Environmental Components Likely to be Affected	Potential Impacts	Proposed Mitigating Measures	Target Performance/ Efficiency	Responsible Entity	Cost Allocation	Guarantee or Financial Agreements
			Temporary Revegetation.				Design and Construction. Compliance with DAO 2018-19: Guidelines for Additional Environmental Measures for Operating Surface Metallic Mines.
		Reduction in Soil Fertility.	Removed Topsoil to be Stockpiled for Progressive Rehabilitation Activities. Topsoil Management and Control of the Storage Areas. Soil Conditioning and Enhancement	>90%	TVIRD	Project Operation Cost. AEPEP Cost.	Third Party Monitoring Every 1 to 2 years as Required by the ECC Conditions. MGB SHES Manual 2021 Compliance with DAO 2018-19: Guidelines for Additional Environmental Measures for Operating Surface Metallic Mines.
		Climate Change Contribution from the Removal of Vegetation	Progressive Rehabilitation of Disturbed Areas by Placement of Soil Cover, Soil Conditioning and Vegetative Cover Placement. Vegetative Cover Will Include Fast Growing Species Intercropped with Cash Crops and Endemic Species.	>90%	TVIRD	Project Operation Cost. AEPEP Cost.	This is Included in the Annual Environmental Protection and Enhancement Program (AEPEP).
		Change in Surface Topography, Terrain and Land Slope	Progressive Rehabilitation of Disturbed Areas by Placement of Soil Cover, Soil Conditioning and Vegetative Cover Placement. Vegetative Cover Will Include Fast Growing Species Intercropped with Cash Crops and Endemic Species.	>90%	TVIRD	Project Operation Cost. AEPEP Cost.	This is Included in the Annual Environmental Protection and Enhancement Program (AEPEP).
		Threat to Existence	Progressive Rehabilitation of Disturbed	>90%	TVIRD		This is Included in the Annual

Project Activities	Environmental Components Likely to be Affected	Potential Impacts	Proposed Mitigating Measures	Target Performance/ Efficiency	Responsible Entity	Cost Allocation	Guarantee or Financial Agreements
		of Important Local Species. Threat to Abundance, Frequency and Distribution of Important Local Species.	Areas by Placement of Soil Cover, Soil Conditioning and Vegetative Cover Placement. Vegetative Cover Will Include Fast Growing Species Intercropped with Cash Crops and Endemic Species. Minimize Vegetation Removal within Project Facility Areas Planned for Development. Increase Ground Cover by Reforestation with Local Important Species. Collection of Wildlings of Endangered and Endemic Floral Species for Propagation in the Plant Nursery. Preparation and Implementation of Biodiversity Management Plan. Maintain Forest Corridors for Wildlife Movement.				Environmental Protection and Enhancement Program (AEPEP). Third Party Monitoring Every 1 to 2 years as Required by the ECC.
	Water	Leaching of Metals to Surface Water Runoff and Potential Generation of Acid Mine Drainage.	Conduct Water Quality Monitoring and Assessment of Mine Surface Water Runoff on a Regular Basis. Construction of Passive Wetland Treatment Facilities, if necessary, for Natural Treatment of Surface Water Runoff.	100% Results of water quality monitoring are within the DENR Standards.	TVIRD through MEPEO	Project Operation Cost. AEPEP Cost.	Quarterly Review and Monitoring of the MMT. Third Party Monitoring Every 1 to 2 years as Required by the ECC.

Project Activities	Environmental Components Likely to be Affected	Potential Impacts	Proposed Mitigating Measures	Target Performance/ Efficiency	Responsible Entity	Cost Allocation	Guarantee or Financial Agreements
			Conduct Groundwater Sampling and Water Quality Monitoring on a Regular Basis. Additional AMD Laboratory Testing of Different Overburden and Waste Materials.				
		Potential Petroleum Leaks	Construction of Fuel Farm Complete with Sufficient Secondary Containment Bunds which is 110% of the Total Capacity of the Fuel tanks and Provision of Oil Spill Contingency Plan Oil Spills Containment Through Bunds, Drip Trays, and Oil-Water Separators	100%	TVIRD through MEPEO	Project Operation Cost. AEPEP Cost.	AEPEP Compliance with DAO 2016-08: Water Quality Guidelines and General Effluent Standard and DAO 2021-19: Updated Water Quality Guidelines and General Effluent Standard for Selected Parameters
	Air	Dust Generation from Movement of Trucks During Hauling Operations and Heavy Equipment During Excavation and Loading Operations. Human Health Impacts within High Dust Production Areas.	Use of Dust Suppression Techniques such as Watering of Exposed Surfaces, Reduction of Vehicle Travel Speeds and Limit Exposed Areas. Provision of Personal Protective Equipment. Conduct of TSP, PM10 Measurement which is Included in the Quarterly Ambient Air Quality Monitoring. Timely Progressive Rehabilitation Activities for Areas No Longer Part of Construction or Not Needed for Operations.	100% Ambient air quality monitoring results are within the DENR Standards.	TVIRD through Mines, Safety, and MEPEO	AEPEP Cost. ASHP Cost.	Part of AEPEP Third Party Monitoring Every 1 to 2 years as Required by the ECC.

Project Activities	Environmental Components Likely to be Affected	Potential Impacts	Proposed Mitigating Measures	Target Performance/ Efficiency	Responsible Entity	Cost Allocation	Guarantee or Financial Agreements
Mining Operation Blasting Activities	Air	Dust Generation from Fine Particles	Use of Dust Suppression Techniques such as Watering of Exposed Surfaces, Reduction of Vehicle Travel Speeds and Limit Exposed Areas. Blasting Notice: Restrictions Within 300m Radius During Blasting Provision of PPEs Application of Controlled Blasting	>90%	TVIRD through the Safety, MEPEO, CRO, Security, and Mines Department	Mine Operations Cost. Safety Operations Cost.	ASHP and AEPEP Compliance with DAO 2000-98: Mine Safety and Health Standards and DOLE DO 198-18: IRR of RA 11058 "An Act Strengthening Compliance with Occupational Safety and Health Standards and Providing Penalties for Violations Thereof" Standard Operating Procedures in Drilling and Blasting
	Noise	Noise Generation	Provision of Personal Protective Equipment to Blasting Personnel Blasting Notice: Restrictions Within 300m Radius During Blasting Application of Controlled Blasting	>90%	TVIRD through the Safety and Mines Department	Mine Operations Cost. Safety Operations Cost.	ASHP and AEPEP Compliance with DAO 2000-98: Mine Safety and Health Standards and DOLE DO 198-18: IRR of RA 11058 "An Act Strengthening Compliance with Occupational Safety and Health Standards and Providing Penalties for Violations Thereof" Standard Operating Procedures in Drilling and Blasting
	People	Health and Safety Risk due to Fly Rocks	Blasting Activities to be Done by Qualified and Licensed Companies and Personnel	100%	TVIRD through the Safety,	Mine Operations Cost.	ASHP and AEPEP Compliance with DAO 2000-

Project Activities	Environmental Components Likely to be Affected	Potential Impacts	Proposed Mitigating Measures	Target Performance/ Efficiency	Responsible Entity	Cost Allocation	Guarantee or Financial Agreements
			Provision of Personal Protective Equipment to Blasting Personnel and Blasting Shelter Blasting Notice: Restrictions Within 300m Radius During Blasting Application of Controlled Blasting		Security, and Mines Department	Safety Operations Cost.	98: Mine Safety and Health Standards and DOLE DO 198-18: IRR of RA 11058 "An Act Strengthening Compliance with Occupational Safety and Health Standards and Providing Penalties for Violations Thereof" Standard Operating Procedures in Drilling and Blasting
Milling and Processing Operations Use of Resources	Water	Use of Surface Water Sources for Domestic and Industrial supply. Resource Competition with Downstream Users and Reduction in Stream Flows Due to Diversions.	Implementation of Recycling Programs, Improvements Within the Processing Operations to Minimize Water Use. Water Conservation Measures. Preparation and Implementation of a Water Resource and Watershed Management Plan.	>90%	TVIRD through Process Plant, MEPEO, and GES Department.	Mill Operations Cost. AEPEP and GES Department.	Cost Savings and Economic Benefits from Recycling and Conservation Measures. Conditions Identified in the National Water Resources Board Water Permit.
		Pipeline Rupture Under Mechanical Failures	Installation of High-Quality High Dense Polyethylene (HDPE) Pipes. Establishment of Event Pond.	100%	TVIRD through the Process and Fixed Plant Department	Maintenance Cost	Process Plant Plan and Design Compliance with DAO 2016-08: Water Quality Guidelines and General Effluent Standard and DAO 2021-19: Updated Water Quality Guidelines and General Effluent Standard for Selected Parameters

Project Activities	Environmental Components Likely to be Affected	Potential Impacts	Proposed Mitigating Measures	Target Performance/ Efficiency	Responsible Entity	Cost Allocation	Guarantee or Financial Agreements
Use of Chemicals and Reagents. Generation of Hazardous and Non-Hazardous Wastes.	Land	Potential Soil Contamination, Change in Soil Quality, Arising from Accidental Spills or Leaks of Chemicals and Reagents.	Provision of Bund Walls to Contain at Least 110% the Capacity of the Largest Storage Tank, in the Case of a Spill, Leak or Process Area Washing. Regular Inspection of Storage Tanks, Containers, Pipelines for Signs of Leaks, Corrosion, Structural Instability, Malfunctioning Valves and Fittings.	>90%	TVIRD through Safety, Mill Operations and Mill Maintenance Department.	Mill Operations Cost. AEPEP Cost. ASHP Cost.	ASHP and AEPEP Processing Plant Design. Disposal of Hazardous Wastes Through DENR-EMB Accredited Transporter and Treater Hazardous Waste Generator Registration Certificate Compliance with DAO 2013-22: Revised Procedures and Standards for the Management of Hazardous Wastes (Revising DAO 2004-36)
		Generation of Hazardous Wastes such as Acids, Bases, Spent Oils, and Chemical Contaminated Containers.	Hazardous Waste Management Which Includes Proper Labeling, Storage, and Disposal.	100%	TVIRD through Process Plant and MEPEO Department		ASHP and AEPEP Disposal of Hazardous Wastes Through DENR-EMB Accredited Transporter and Treater Hazardous Waste Generator Registration Certificate Compliance with DAO 2013-22: Revised Procedures and Standards for the Management of Hazardous Wastes (Revising DAO 2004-36)

Project Activities	Environmental Components Likely to be Affected	Potential Impacts	Proposed Mitigating Measures	Target Performance/ Efficiency	Responsible Entity	Cost Allocation	Guarantee or Financial Agreements
	Water	Potential Surface Water Contamination and Degradation of Surface Water Quality due to Accidental Spills or Leaks.	Provision of Bund Walls within Chemicals and Reagent Storage Areas to Contain Releases and Minimize Pathways to the Environment During Occurrences of Spill or Leaks. Establish Surface Water Monitoring Program to Collect and Test Samples on a Regular Basis.	>90% Results of Surface Water Monitoring are Within DENR Standards	TVIRD through Assay, Process Plant, and MEPEO Department	Mill Operations Cost. AEPEP Cost Third Party Monitoring and Testing Consultants.	Monitoring Included in the Approved AEPEP. Laboratory Results of the Monitoring are Reported to Government Agencies through the Self-Monitoring Report (SMR), Compliance Monitoring Report (CMR), and Compliance Monitoring and Validation Report (CMVR). Non-Compliance May Lead to a Notice of Violation.
		Potential Groundwater Contamination and Degradation due to Percolation of Chemicals, Reagents, Oils and Fuels from Accidental Releases.	Establish a Groundwater Monitoring Program to Collect and Test Groundwater Samples on a Regular Basis.	100% Results of Monitoring are Within PNSDW Standards.	TVIRD through Assay, Process Plant, and MEPEO Department	Mill Operations Cost. AEPEP Cost Third Party Monitoring and Testing Consultants.	Monitoring Included in the Approved AEPEP. Laboratory Results of the Monitoring are Reported to Government Agencies through the Self-Monitoring Report (SMR), Compliance Monitoring Report (CMR), and Compliance Monitoring and Validation Report (CMVR). Non-Compliance May Lead to a Notice of Violation.
		Release of Chemicals and Reagents Due to Drainage System Failure.	Develop Drainage and Surface Water Control Plan to Contain Contaminated Surface Water and Manage Hazardous and Non-Hazardous Storage and Containment Areas.	>90%	TVIRD through Assay, Process Plant, and	Mill Operations Cost. AEPEP Cost	Emergency Preparedness and Response Plan (EPRP) Compliance with DAO 2013-22: Revised Procedures and

Project Activities	Environmental Components Likely to be Affected	Potential Impacts	Proposed Mitigating Measures	Target Performance/ Efficiency	Responsible Entity	Cost Allocation	Guarantee or Financial Agreements
			Preparation of Site Remediation Plan for Occurrences of Surface and Groundwater of Contamination and Soil Contamination. Establishment of Event Pond.		MEPEO Department Third Party Monitoring and Audit Programs.	Third Party Monitoring and Testing Consultants.	Standards for the Management of Hazardous Wastes (Revising DAO 2004-36)
	Air Quality and Noise	Generation of Noise and Air Emissions from the Use of Mill Equipment, Generator Sets and Operation of the Assay Laboratory.	Provision of Fume Scrubber and Dust Collector at the Assay Laboratory to Control Emissions During Sample Preparation and Laboratory Analysis. Quarterly Ambient and Noise Monitoring Through Accredited Third-Party Service Provider. Planting of Plants Within the Perimeter to Function as Sound Barriers and Air Phytoremediation	>90% Results of Ambient Air and Noise Quality are Within the DENR Standards	TVIRD through Assay, Process Plant, and MEPEO Department Third Party Monitoring and Audit Programs.	Mill Operations Cost. AEPEP Cost. Third Party Monitoring and Testing Consultants.	Maintain Compliance with DAO 2000-81: Implementing Rules and Regulations for RA 8749, Otherwise Known as "Philippine Clean Air Act of 1999" Compliance with the Conditions Stipulated in the Issued Permit to Operate for Air Pollution Source and Control Installations
	People	Health and Safety Risks from Use, Handling, Storage and Disposal of Chemicals and Reagents.	Provision of Personal Protective Equipment to Employees. Employee Orientation of the Material Safety Data Sheets. Education and Implementation of Proper Handling, Storage and Disposal Protocols. Provision of Trainings to Involved Personnel.	100%	TVIRD through the Safety Department.	Safety and Health	Maintain Compliance with DAO 2000-98: Mine Safety and Health Standards and DOLE DO 198-18: IRR of RA 11058 "An Act Strengthening Compliance with Occupational Safety and Health Standards and Providing Penalties for Violations Thereof"
Waste Materials and Tailings Generation	Land	Change in Land Use within the	Limiting the Disturbance to the Planned Operations Area. Restoration of Final	>90%	TVIRD through GES	TSF and Mill Operations Costs.	Included in the AEPEP as Approved by the MRFC and

Project Activities	Environmental Components Likely to be Affected	Potential Impacts	Proposed Mitigating Measures	Target Performance/ Efficiency	Responsible Entity	Cost Allocation	Guarantee or Financial Agreements
Management.	Water	Waste Dump Area and the Tailings Storage Facility Area.	Landforms to Stable Conditions and Useable Topographic Conditions to Support Post Mining Rehabilitation Programs. Increase in Ground Cover Vegetation by Reforestation. Implementation of Progressive Rehabilitation Programs to Support and Enhance the Post Mining Rehabilitation.		(TSF), Process Plant, and MEPEO Department	AEPEP Cost.	Monitored by the MMT. Payment of Mine Waste and Tailings Fee as per DAO 2010-21. 2-Year Mine Waste Utilization Program
		Change in Surface Topography.	Progressive Rehabilitation and Temporary Revegetation. Reforestation of Idle Areas and Utilization for Community and Social Development Work Whenever Possible.	100%	TVIRD through GES, Process Plant, MEPEO and CRO Department	EPEP Cost.	Included in the FMRDP as Approved by the MRFC CLRF-SC and Monitored by the MMT and MRFC.
		Increased Soil Erosion	Steep Slopes (>30°) Will Require Benches, Terraces or Other Slope Controls to Reduce Surface Water Runoff Velocity During Rainfall Events. Installation of Drainage Canal System to Prevent Erosion of Benches and Other Areas. Other Surface Treatment to Control Erosion i.e., Slope Stabilization and Progressive Rehabilitation and Temporary Revegetation.	>90%	TVIRD through GES (TSF), Process Plant, and MEPEO Department.	Operation Costs EPEP Cost	Annual Environmental Protection and Enhancement Program (AEPEP). Use of Reputable and Experienced Engineering Design Consultants for Facility Design and Construction. Compliance with DAO 2018-19: Guidelines for Additional Environmental Measures for Operating Surface Metallic Mines.

Project Activities	Environmental Components Likely to be Affected	Potential Impacts	Proposed Mitigating Measures	Target Performance/ Efficiency	Responsible Entity	Cost Allocation	Guarantee or Financial Agreements
		Change in Soil Quality and Fertility. Loss of Topsoil and Overburden Materials.	Removed Topsoil to be Stockpiled for Progressive Rehabilitation Activities. Topsoil Management and Control of the Storage Areas. Soil Conditioning and Enhancement	>90%	TVIRD	Project Operation Cost. AEPEP Cost.	Third Party Monitoring Every 1 to 2 years as Required by the ECC Conditions. MGB SHES Manual 2021 Compliance with DAO 2018-19: Guidelines for Additional Environmental Measures for Operating Surface Metallic Mines.
		Generation of Cyanide Contaminated Tailings from Mill Operations.	Establishment of Detoxification Facility to Degrade Cyanide Within Acceptable Levels Prior to Discharge at the Tailings Storage Facility. Provision of Berms Around the Pipeline to Prevent Tails Runoff in Case of Leak. Presence of Event Pond.	100%	TVIRD through the Process Plant and MEPEO Department	Mill Operations Cost. EPEP Cost.	Included in the AEPEP as Approved by the MRFC and Monitored by the MMT. Form Part of Compliance with DAO 2010-21. Compliance with the Conditions of CCO Registration Certificate and DAO 1992-29: IRR of RA 6969.
		Potential Leaks Due to Tailings Pipeline Breach from the Mill Plant to Detoxification Facility	Regular Visual Inspection of Tailings Pipeline for any Signs of Cracks and Breaks that will Lead to Failure. Presence of Event Pond.	100%	TVIRD through GES, Process Plant, and Fixed Plant Department	General Engineering Services Cost and Fixed Plant Cost	Sound Engineering Designs. Compliance with the Conditions of CCO Registration Certificate and DAO 1992-29: IRR of RA 6969.
	Water	Spillage or Overflow of Tailings in Unao-Unao Creek from	Proper Design of the Mill and Processing Plant Facilities.	100%	TVIRD through Process	Mill Operations and Fixed Plant Costs.	Included in the AEPEP as Approved by the MRFC and Monitored by the MMT.

Project Activities	Environmental Components Likely to be Affected	Potential Impacts	Proposed Mitigating Measures	Target Performance/ Efficiency	Responsible Entity	Cost Allocation	Guarantee or Financial Agreements
		Mill and Processing Facilities or Failure of the Tailings Conveyance Pipeline.	Proper Design and Construction of the Tailings Storage Facility to Contain Tailings Waste. Provide Containment Berms Adjacent to the Pipeline(s). Presence of Event Pond.		Plant, Fixed Plant and MEPEO Department Third Party Monitoring and Construction Monitoring.	AEPEP Cost. Third Party Consultants for Construction Management and Post Construction Monitoring.	Laboratory Results of the Monitoring are Reported to Government Agencies through the Self-Monitoring Report (SMR), Compliance Monitoring Report (CMR), and Compliance Monitoring and Validation Report (CMVR). Non-Compliance May Lead to a Notice of Violation. Compliance with the Conditions Stipulated in the Issued Wastewater Discharge Permit and RA 9275 Otherwise Known as the "Philippine Clean Water Act of 2004"
		Potential Seepage from TSF	Tailings Water Recovery System Implementation of the Design from the Third-Party Consultant and Utilization of the Specified Materials. Proper Design and Construction of the Tailings Storage Facility to Contain Tailings Waste.	100%	TVIRD through the TSF Department	TSF Operating Cost	TSF Design by Knight Piesold Consulting, a Highly Reputable Global Consulting Firm Included in the AEPEP as Approved by the MRFC and Monitored by the MMT. Compliance with DAO 2016-08: Water Quality Guidelines and General Effluent Standard and DAO 2021-19: Updated

Project Activities	Environmental Components Likely to be Affected	Potential Impacts	Proposed Mitigating Measures	Target Performance/ Efficiency	Responsible Entity	Cost Allocation	Guarantee or Financial Agreements
							Water Quality Guidelines and General Effluent Standard for Selected Parameters
		Release of Tailings from the Tailings Storage Facility Due to Dam Breach or Re-suspension of Tailings and Release through the Spillway.	Provide Containment Berms Adjacent to the Pipeline(s). Maintain Continuous Water Cover Over the Tailings within the Impoundment to eliminate Re-suspension of Tailings. Provision of Tailings Recovery System and Event Pond	100%	TVIRD through the TSF, Mines, and MEPEO Department Third Party Monitoring and Construction Monitoring.	TSF Operating Cost. AEPEP Cost. Third Party Consultants for Construction Management and Post Construction Monitoring.	TSF Design by Knight Piesold Consulting, a Highly Reputable Global Consulting Firm Included in the AEPEP as Approved by the MRFC and Monitored by the MMT. Compliance with DAO 2016-08: Water Quality Guidelines and General Effluent Standard and DAO 2021-19: Updated Water Quality Guidelines and General Effluent Standard for Selected Parameters Compliance with the Conditions Stipulated in the Issued Wastewater Discharge Permit and RA 9275 Otherwise Known as the "Philippine Clean Water Act of 2004"
		Increased Heavy Metals, TSS/ TDS or Cyanide Concentration within Unao-Unao Creek and	Proper Design and Construction of the Tailings Storage Facility to Contain Tailings Waste. Maintain Continuous Water Cover Over the Tailings within the Impoundment to	>90%	TVIRD through the TSF, Mines, and MEPEO Department	TSF Operating Cost. AEPEP Cost. Third Party	Included in the AEPEP as Approved by the MRFC and Monitored by the MMT. Compliance with DAO 2016-08: Water Quality Guidelines

Project Activities	Environmental Components Likely to be Affected	Potential Impacts	Proposed Mitigating Measures	Target Performance/ Efficiency	Responsible Entity	Cost Allocation	Guarantee or Financial Agreements
		Downstream Rivers and Creeks Resulting from Releases from the Tailings Storage Facility Spillway.	Eliminate Re-suspension of Tailings.		Third Party Monitoring and Construction Monitoring.	Consultants for Construction Management and Post Construction Monitoring.	and General Effluent Standard and DAO 2021-19: Updated Water Quality Guidelines and General Effluent Standard for Selected Parameters Compliance with the Conditions Stipulated in the Issued Wastewater Discharge Permit and RA 9275 Otherwise Known as the "Philippine Clean Water Act of 2004"
		Increased Sedimentation and Siltation of Downstream Rivers and Creeks	Construction of Sediment Ponds and Overland Flow Retention Structures to Trap Soil and Reduce Siltation. Establish Erosion Control Measures Including Diversion Canals, Soil stabilization Programs and Re-vegetation Programs for Disturbed Areas to Reduce the Soil Loss Potential.	>90%	TVIRD through the TSF, Mines, and MEPEO Department Third Party Monitoring and Construction Monitoring.	AEPEP Cost. Third Party Consultants for Construction Management and Post Construction Monitoring.	Included in the AEPEP as Approved by the MRFC and Monitored by the MMT. Laboratory Results of the Monitoring are Reported to Government Agencies through the Self-Monitoring Report (SMR), Compliance Monitoring Report (CMR), and Compliance Monitoring and Validation Report (CMVR). Compliance with DAO 2016-08: Water Quality Guidelines and General Effluent Standard and DAO 2021-19: Updated Water Quality Guidelines and General Effluent Standard for Selected Parameters

Project Activities	Environmental Components Likely to be Affected	Potential Impacts	Proposed Mitigating Measures	Target Performance/ Efficiency	Responsible Entity	Cost Allocation	Guarantee or Financial Agreements
							Compliance with the Conditions Stipulated in the Issued Wastewater Discharge Permit and RA 9275 Otherwise Known as the "Philippine Clean Water Act of 2004"
Site Operations and Maintenance	Land	Generation and Disposal of Solid Wastes.	Development of Solid Waste Management (i.e., Reduction, Reuse, Recycling Activities) Program Activities for Company Wide Implementation Including TVIRD Operations and Contractor Operations. Construction of Solid Waste Management Facility and Engineered Septage Facility for Appropriate Storage of Generated Wastes. IEC Programs on Solid Waste Management for both Hazardous and Non-Hazardous Waste Materials.	>90%	TVIRD	AEPEP Cost.	Included in the AEPEP as Approved by the MRFC and Monitored by the MMT. Compliance with DAO 2001-34: Implementing Rules and Regulations of RA 9003.
	Water	Reduction or Depletion of Local Water Resource Supply.	Implementation of Water Recycling and Conservation Programs. Prepare and Monitor Water Balance Data to Determine Input and Output Requirements in the Process Operation and Determine Areas for Potential Water Conservation Measures. IEC Programs for Water Use and	>90%	TVIRD	AEPEP Cost.	Cost Savings from the Recycling Activities. Compliance with the Approved National Water Resources Board Water Rights Permit.

Project Activities	Environmental Components Likely to be Affected	Potential Impacts	Proposed Mitigating Measures	Target Performance/ Efficiency	Responsible Entity	Cost Allocation	Guarantee or Financial Agreements
			Water Conservation.				
Storm Water Management	Water	Increased Sedimentation and Siltation of Downstream Rivers and Creeks. Potential Downstream Flooding.	Development of Overall Drainage Plan to Balance Volume Flow of Water within the Project Site. Natural Drainage Features and Patterns in Undisturbed Areas were Retained. Areas with High Risk of Erosion Rate were also Identified. Construction of Diversion and Drainage Canals. Installation of Cross Drainage or Culverts. Landscaping and Revegetation of Exposed Areas to Reduce Water Runoff Volume.	>90%	TVIRD through Civil Engineering, Mines and Environment Department	Operating Costs. AEPEP Cost.	Included as part of AEPEP.
Abandonment/Decommissioning							
Decommissioning Activities. Disposal of Equipment and Scrap Materials. Disposal of Unconsumed Chemicals and Hazardous Wastes. Closure of the Surface Mine, Mill and Processing Plant, Tailings Storage Facility	Land	Soil Contamination from Equipment Removal. Stability of the Tailings Storage Dam, Surface Mine Area, and Waste Dump Area. Consistency in the Land Use Plan of the Project with the Subanon and Local Government.	The Majority of the Impacts During Closure will be Addressed and Reduced by Progressive Rehabilitation Activities Implemented During the Operations Phase. Similar Programs will be Implemented During Closure. Implementation of Approved Final Mine Rehabilitation and/or Decommissioning Plan (FMR/DP). Implement Soil Remediation Measures, if Necessary, After Conduct of Soil Monitoring Programs.	100%	TVIRD .	Costs Identified in the FMR/DP. Cost from the Final Mine Rehabilitation and Decommissioning Fund (FMRDF)	Addressed in the Final Mine Rehabilitation and Decommissioning Plan Reviewed and Approved by the CLRF-SC. Allocation and Deposition of FMRDF. Certificate of Final Relinquishment to be Approved by the CLRF-SC, MGB, and DENR.

Project Activities	Environmental Components Likely to be Affected	Potential Impacts	Proposed Mitigating Measures	Target Performance/ Efficiency	Responsible Entity	Cost Allocation	Guarantee or Financial Agreements
Removal or Rehabilitation of Administration Buildings, Staff Housing, Warehouses and Access Roads.		Aesthetic Value. Exposure of Decommissioned Buildings and Structures.	Conduct Geohazard Assessment of the Tailings Dam; Surface Mine Area and Waste Dump Area. Consultation Activities with Respect to Land Use will be Conducted during the Operational Phase Prior to Closure. Soil Conditioning of Exposed Areas Prior to Revegetation. Planting of a Large Variety of Plant Species within the Disturbed Areas Using Indigenous, Endemic Species in Accordance with the Final Land Use Plan of the Area.				
	Water	Potential Water Quality Degradation from Clearing Activities. Localized Erosion from the Mine Structures Undergoing Rehabilitation.	Water Discharges and Washings from the Mill and Processing Plant will Pass Through Detoxification Facilities and Sediment/Neutralization Ponds. Reduce Slopes and Maintain as Much Vegetation Cover as Possible for Erosion Control. Establish Water Quality Monitoring Program During Mine Closure Activities.	100%	TVIRD	Costs Identified in the FMR/DP. Cost from the Final Mine Rehabilitation and Decommissioning Fund (FMRDF)	Addressed in the Final Mine Rehabilitation and Decommissioning Plan Reviewed and Approved by the CLRF-SC. Allocation and Deposition of FMRDF. Certificate of Final Relinquishment to be Approved by the CLRF-SC, MGB, and DENR.
Decommissioning Activities. Rehabilitated Lands	Social	Community Issues on Turnover of Rehabilitated Areas, Life-After	Management of Community Issues during the Operations Phase of the Project Using Continuous Stakeholder Dialogue.	100%	TVIRD	Costs Identified in the FMR/DP. Cost from the	Addressed in the Final Mine Rehabilitation and Decommissioning Plan Reviewed and Approved by

Project Activities	Environmental Components Likely to be Affected	Potential Impacts	Proposed Mitigating Measures	Target Performance/ Efficiency	Responsible Entity	Cost Allocation	Guarantee or Financial Agreements
Programs and Turnover to the Community. Establishment of Sustainability Programs. Community Governance and Financial Management.		Mining Opportunities and Sustainability Programs.	Long Term Livelihood Programs Introduced During the Operations Phase and Combined with SDMP Projects. Exploration of Private Sector Participation in Post Mining Sustainability and Business Model Preparation. Assistance in Governance Training and Development and Financial Management. Continued Presence of TVIRD After the Closure of Mining Operations and Transition of Rehabilitated Lands, SDMP and Sustainability Programs to the Community.			Final Mine Rehabilitation and Decommissioning Fund (FMRDF) Private Sector Business Enterprises	the CLRF-SC. Allocation and Deposition of FMRDF. Certificate of Final Relinquishment to be Approved by the CLRF-SC, MGB, and DENR.

4 ENVIRONMENTAL RISK ASSESSMENT

4.1 SCOPE AND COVERAGE

The objectives under the terms of reference for this Environmental Risk Assessment is as follows:

- Evaluates and mitigate the potential hazard related to handling, storage, disposal of hazardous materials and wastes, or other potential dangers to employees, communities, or natural habitats. This is guided by the requirement of Hazardous Materials Management Guideline with special concerns on:

  - Impacts of potential major incidents, which may occur at the installation and the surrounding area.
  - Dangerous materials related to the project and the hazards associated with their transportation, storage, and processing.
  - The means to prevent or mitigate the potential incidents.
  - A summary of the management systems to ensure safe design, construction, and operation of the project, as well as to maintain the effectiveness of emergency equipment and emergency response plan

- Predict and assess the project's likely impacts and identifies mitigation measures and any residual negative impacts that cannot be mitigated. Identify and estimate the extent and quality of available data, key data gaps, associated with predictions with special concerns on:

  - Fire prevention and firefighting facilities.
  - Occupational health and safety management.
  - First aid, emergency response, and medical facility.
  - Analysis of the responsibility for cleanup in case of spills
  - Preparation of a document that will comply with the requirements of the Philippine government on environmental risk assessments

- To identify the hazardous operations in the facility that will create extra-facility risks

- To identify all credible hazardous scenarios associated with the operations of the hazard facilities, which has potential to cause injuries or fatalities;

- To identify and assess practical and cost-effective risk mitigation measures as appropriate;

Since the original EIS already had a risk assessment based on a plant throughput of 2000 tons per day, this section of the EPRMP provides an update of the ERA with some of the original assumptions in the EIS.

4.1.1 Legal Requirements under the Philippine EIA System

The requirement for the conduct of ERA is defined at three (3) levels based on the guidelines of the Revised Procedural Manual of DAO 2003-30.

- Level 1 - for facilities that will use, manufacture, process, or store hazardous materials in excess of level threshold inventory shall be required to prepare an Emergency/ Contingency Plan based on the worst-case scenario. The Plan shall be based on a Hazard Analysis Study.
- Level 2 - for facilities that will use, manufacture, process, or store hazardous materials in excess of level threshold inventory shall be required to conduct a Quantitative Risk Assessment (QRA) and prepare an Emergency/ Contingency Plan based on the results of the QRA.

- Risk screening level - specific facilities or the use of certain processes shall require the conduct of a risk screening study even if the projected or estimated inventory does not reach the threshold levels.

Table 4-1: Level One and Level Two Threshold Inventory for Risk Assessment

CATEGORY	LEVEL 1 (tons)	LEVEL 2 (tons)
Explosives	10	50
Flammable Substances	5,000	50,000
Highly Flammable Substances	50	200
Extremely Flammable Substances	10	50
Oxidizing Substances	50	200
Toxic Substances (low)	50	200
Toxic Substances (medium)	10	50
Toxic Substances (high)	5	20
Toxic Substances (very high)	0.2	1
Toxic Substances (extreme)	0.001	0.1
Unclassified (Type A)	100	500
Unclassified (Type B)	50	200

Also, for manufacturing facilities, risk assessment should be undertaken such as:

- Facilities for the production or processing of organic or inorganic chemicals using several chemical processes as enumerated in Annex K of the guidelines.
- Installations for distillation, refining or other processing of petroleum products.
- Installations for the total or partial disposal of solid or liquid substances by incineration or chemical decomposition.
- Installations for the production or processing of energy gases, for example, METHANOL, LNG, SNG.
- Installations for the dry distillation of coal or lignite.
- Installations to produce metals or non-metals by a wet process or by means of electrical energy.

For those materials in excess of the levels in the above table, a QRA or Hazard Analysis Study is required. The classification of these materials is based on the following:

1. Explosive – a substance or preparation which creates the risk of an explosion by shock, friction, fire, or other sources of ignition. It is also pyrotechnic substance (or mixture of substances) designed to produce heat, light, sound, gas, or smoke or a combination of such effects through non-detonating self-sustained exothermic chemical reactions.
2. Flammable – substances and preparations having a flash point equal to or greater than 21°C and less than or equal to 55°C, capable of supporting combustion.
3. Highly flammable – are substances and preparations which may become hot and finally catch fire in contact with air at ambient temperature without any input of energy, or substances which have a flash point lower than 55°C and which remain liquid under pressure, where processing conditions, such as high pressure or high temperature, may create major-accident hazards.
4. Extremely flammable – are liquid substances and preparations which have a flash point lower than 0°C and the boiling point (or, in the case of a boiling range, the initial boiling point) of which at normal pressure is less than or equal to 35°C; gaseous substances and preparations which are flammable when in contact with air at ambient temperature and pressure, whether or not kept in the gaseous or liquid state under pressure; or, liquid substances or preparations maintained at a temperature above their boiling point.

5. Oxidizing – substances which give rise to highly exothermic reaction when in contact with other substances, particularly flammable substances.
6. Low, medium, high, very high and extreme toxicity of substances or preparation are classified as follows:
   a. A substance shall be considered as a liquid if vapor pressure is less than 1 bar at 20^{o}C.
   b. A substance shall be considered as a gas if vapor pressure is greater than 1 bar at 20^{o}C.
   c. The sum of (a) and (b) as provided in **Table 4-3** and
   d. **Table 4-4** shall determine the toxicity class as contained in **Table 4-2.**

7. Unclassified – are substances or preparations that react violently with water (Type A), and substances or preparations which release or liberate toxic gas in contact with water (Type B).

Table 4-2 : Table for Values to Determine Toxicity Class

a + b	Toxicity Class
6	Low
7	Medium
8	High
9	Very High
10	Extreme

Table 4-3 : Table for Values of (a) Based on LC50

LC50 rate 4 hours in ppm	Calculation number (a)
0.01-0.1	8
0.1-1	7
1-10	6
10-100	5
100-1000	4
1000-10000	3
10000-100000	2

Table 4-4: Table for Values of (b) Based on Physical Properties

Physical Properties		Calculation Number (b)
Liquids (Vapor Pressure at 20C)	<0.05 bar	1
	0.05 bar-0.3 bar	2
	0.3 bar-1 bar	3
Liquefied Gas, Compressed (Boiling Point)	>265K	3
	<265K	4
Liquefied Gas, Cooled	>245K	3
	<245K	4

4.2 PROJECT RISK MODEL

A Project Risk Model was developed which describes the events and materials that may affect the environment. Pathways and potential scenarios that affect the environment are defined as well as identification of the receptors. Once hazards and the pathways are identified, the exposure assessment, effects assessment and the risk characterization follow. Included in the assessments and characterization are analyses of available information to determine how often specified events may occur and the magnitude of their likely consequences. The result of the risk characterization serves as the basis for formulation of mitigation and management measures in reducing risks and controlling impacts.

The Project Risk Model and hazards identification focuses on four risk scenarios:

- Releases of Toxic Chemical Substances
- Flammable or Explosive Materials
- Mechanical Equipment Failure
- Structural Failure
- Disaster Risks

Hazardous materials associated with the Project include sodium cyanide, fuels, and explosive ingredients used for mine blasting operations. Other chemicals used during the operations may be considered hazardous but have not been included in the assessment process due to limited modeling information and the absence of assessment guidelines. These are identified and discussed in the Sections below.

Onsite storage inventory quantities of the hazardous materials used in the Project and the corresponding Inventory Threshold Level are shown in Table 4-6.

Table 4-5: Level 1 and Level 2 Threshold Inventory for Project Hazardous Materials

Hazardous Material	Hazardous Material Category	Storage Inventory	Threshold Level Designation
Sodium Cyanide	Highly Toxic Substance	600 Metric Tons	Level 2
Diesel Fuel	Flammable Substance	80,000 Liters (67 Metric Tons)	Risk Screening Level
ANFO and Dynamite	Explosives (Mine Blasting)	2 Metric Tons	Risk Screening Level
Lead Nitrate	Oxidizing Agent/ Toxic	19 Metric Tons	Risk Screening Level
Hydrochloric Acid	Type A: Reacts Violently with Water	1,000 Liters	Risk Screening Level

Source: Annex 2-7e of Revised Procedural Manual of DAO 2003-30.

Quantitative risk assessments resulting from possible accident event scenarios were performed using software models recognized by the US Environmental Protection Agency (USEPA) and other scientific research models. The predominant model used for worst case scenarios was the Area Locations of Hazardous Atmospheres (ALOHA) software developed by the United States National Oceanic and Atmospheric Administration (NOAA) and the USEPA.

4.2.1 Hazards from Toxic Chemical Substances

The complete list of chemicals and chemical substance that will be used in the operation of the Project is provided in **Table 4-6** based on the proposed 2,500 tons per day throughput of the plant as being applied for this EPRMP. This is the same list and amount provided in the original EIS of TVIRD for their processing plant since this was already among these chemicals, only lead nitrate and sodium cyanide are classified priority chemicals under DAO 2005-07: Revised Priority Chemical List.

Table 4-6: Chemical Reagents and Estimated Consumption for 2,500 Metric tons per Day Throughput

Item No.	Reagent	Classification and Purpose	Dosage (grams/metric ton)	Daily Consumption (kg)
1	Lime	pH regulator (Leaching, CN Detoxification)	3,250	6,500

2	Sodium Cyanide	Leaching agent, anion source for stripping (Leaching)	1,494	2,989
3	Magnafloc	Flocculant (Thickening)	30	60
4	Nasfroth HEL	Frother	40	80
5	Aerophine 3418A	Collector	48	96
6	Potassium Amyl Xanthate	Collector	12	24
7	Diatomaceous Earth	Filter aid (Merrill Crowe/EMEW)	4	8
8	Zinc Dust	Gold cementation (Merrill Crowe)	423	846
9	Lead Nitrate	For Zn-Pb couple (Merrill Crowe)	350	700
10	Carbon	Leached gold collector (CIP)	4,000	8,000
11	Hydrochloric Acid	Carbon inorganic washing (Carbon Regeneration)	0.032	0.064
12	Sodium Hydroxide	Anion source (Stripping)	2.5	5.0
13	Sodium Metabisulfite	Oxidant (Cyanide Detoxification)	3,000	6,000
14	Copper Sulfate	Catalyst (Cyanide Detoxification)	730	1,460
15	Borax	Flux (Smelting)	20	40
16	Soda Ash	Flux (Smelting)	42	84
17	Silica	Flux (Smelting)	22	44
18	Niter	Flux (Smelting)	22	44

Sodium cyanide is also covered by a Chemical Control Order (CCO) under DAO 97-39: Chemical Control Order for Cyanide and Cyanide Compounds. This order establishes importation, handling, and management protocols to reduce hazards to health and the environment from its use. Chemicals under the Priority Chemical List and Chemical Control Order are regulated by the government due to their known toxicity to human health and the environment.

Chemicals such as acid and bases are non-toxic but are considered hazardous due to their corrosive properties. These include hydrochloric acid and sodium hydroxide and are included in the chemical reagent list.

The other chemicals listed in the table are considered non-hazardous and non-toxic. However, proper handling and disposal will need to be implemented for both hazardous and non-hazardous chemicals, in compliance with the Implementing Rules and Regulations of RA 6969: Toxic Substances and Hazardous and Nuclear Waste Management Act of 1990.

4.2.1.1 Sodium Cyanide

Approximately 1.5 kilograms of Sodium Cyanide (NaCN) for every metric ton of ore will be used during the ore processing. During the initial stages of operation at a throughput rate of 500 metric tons per day, the monthly volume requirement for sodium cyanide is 22.5 metric tons. The volume requirement will increase linearly with the maximum use of 90 metric tons per month at a throughput of 2,500 metric tons per day. A three-month inventory will be stored on site resulting in a maximum on site stored amount of 600 metric tons. Based on its toxic nature and the quantity of material stored onsite, it is assigned a Level 2 designation requiring a Quantitative Risk Assessment and an Emergency/Contingency Response Plan.

The physical and chemical properties as well as hazards of sodium cyanide are shown in Table 4-7.

Table 4-7: Physical and Chemical Properties of Sodium Cyanide

Property	Value
CAS No:	143-33-9
Appearance	White Granular Solid, Odorless
Solubility	Soluble in water
Boiling pt.	1,496°C
Melting point	563°C
Fire hazard	Flammable in the presence of moisture and acids. Emits toxic fumes of hydrogen cyanide when heated to decomposition.
Potential Acute Effects	
Exposure	Corrosive to skin and eyes. Causes varying degree of tissue damage. Inflammation of the skin is characterized by itching, scaling, reddening, or blistering. Inflammation of the eyes characterized by redness, watering, and itching. Severe exposure can result in corneal damage or blistering.
Inhalation	Irritation to respiratory tract, characterized by burning, sneezing, and coughing. Severe overexposure may cause headache, weakness, dizziness, labored breathing, nausea, and vomiting followed by cardiovascular effects, unconsciousness, convulsions, coma and death.
Ingestion	Causes gastrointestinal tract irritation with nausea and vomiting. It may affect nervous system, respiratory and cardiovascular system. Massive doses may lead to sudden loss of consciousness and prompt death from respiratory arrest.
Potential Chronic Effects	
Exposure	Repeated or prolonged exposure can produce target organ damage. Repeated eye exposure can cause eye irritation. Chronic exposure of the skin can cause dermatitis.
Inhalation	Respiratory tract irritation or lung damage may occur.

Source: MSDS of chemicals (www.sciencelab.com)

4.2.1.2 Lead Nitrate

Lead Nitrate [$Pb(NO_3)_2$)] is one of the few reagents that will be used during the silver recovery leaching process. Approximately 100 grams of Lead Nitrate will be used for every metric ton of ore throughput. The monthly volume requirement for a daily mill production of 500 metric tons per day is 1.6 metric tons. This increases to a monthly volume of 6.4 metric tons at the maximum throughput of 2,500 metric tons per day. A three-month inventory will be stored on site which is equivalent to approximately 19 metric tons at the maximum throughput. The toxicity and inventory quantity characteristics indicate this reagent is designated as requiring a Risk Screening Analysis as part of the ERA.

The physical and chemical properties as well as hazards of lead nitrate are shown in

.

Table 4-8: Physical and Chemical Properties of Lead Nitrate

Property	Value
CAS No:	10099-74-8
Appearance	White, Translucent Crystals
Solubility	Soluble in water

Property	Value
Decomposition temp	470°C
Fire hazard	Nonflammable. When heated it can decompose and emit toxic fumes of lead and nitrogen oxides. It is slightly explosive in the presence of heat, combustible materials, and organic materials.
Potential Acute Effects	
Exposure	Causes skin and eye irritation.
Inhalation	Causes nose and throat irritation. Irritation of the bronchi and lungs may also occur. It may cause methemoglobinemia, cyanosis, convulsions, tachycardia, chest pain due to labored breathing and death.
Ingestion	May result in lead colic, abdominal discomfort or cramps, lead line on the gums, anorexia, constipation, and metallic taste. It may also affect central nervous system and cause headache, exhaustion, insomnia, muscle weakness, irritability, dizziness, reduced memory and disturbed sleep.
Potential Chronic Effects	
Exposure	Categorized by the American Conference of Industrial Hygienists (ACGIH) as an A3 chemical wherein it is proven to have carcinogenic effects on animals with unknown relevance to humans. The International Agency for Research on Cancer (IARC) further classifies lead nitrate, under inorganic lead compounds, as a 2A category chemical. It is also mutagenic for mammalian cells and a toxin for female reproductive system.

Source: MSDS of chemicals (www.sciencelab.com)

4.2.1.3 Other Chemicals

Some reagents, although not listed as priority chemicals, pose hazards in cases of human contact. Strong acids and bases are very corrosive and may cause tissue damage upon contact with mucous membranes of the eyes, mouth, and the respiratory tract. If swallowed, they may cause ulceration, or perforation of the gastrointestinal tract and resultant gastric hemorrhage. They may also cause death of swallowed.

Hydrochloric acid, a strong acid, will be used in the carbon washing during the electro winning process. This reagent is in form of colorless to light yellow solution, characterized by pungent, strongly irritating odor. Strong base Sodium Hydroxide, which will be used in the stripping process, will be acquired in odorless, white pellet form. Physical properties of these substances are tabulated in Table 4-9 and 4-10.

Table 4-9: Physical Properties of Hydrochloric acid

Property	Value
CAS No:	7647-01-0
Appearance	Colorless to light yellow liquid
Solubility	Soluble in cold water, hot water, diethyl ether
Boiling pt.	108.58°C
Melting point	-62.25°C
Fire hazard	Nonflammable
Potential Acute Effects	

Property	Value
Exposure	May cause irreversible eye injury. Vapor or mist may cause irritation and severe burns. Contact with liquid is corrosive to the eyes and causes severe burns. Contact with liquid is corrosive and causes severe burns and ulceration. The severity of injury depends on the concentration of the solution and the duration of exposure
Inhalation	May be fatal if inhaled. May cause severe irritation of the respiratory tract with sore throat, coughing, shortness of breath and delayed lung edema. Causes chemical burns to the respiratory tract. Causes corrosive action on the mucous membranes.
Ingestion	Causes severe digestive tract burns with abdominal pain, vomiting, and possible death. May cause corrosion and permanent tissue destruction of the esophagus and digestive tract.
Potential Chronic Effects	
Exposure	Prolonged or repeated skin contact may cause dermatitis. Repeated exposure may cause erosion of teeth. Repeated exposure to low concentrations of HCl vapor or mist may cause bleeding of nose and gums. Chronic bronchitis and gastritis have also been reported

Source: MSDS of chemicals (www.Fischer Scientific)

Table 4-10: Physical Properties of Sodium Hydroxide

Property	Value
CAS No:	1310-73-2
Appearance	Odorless, white pellets
Solubility	soluble in cold water
Boiling pt.	1388°C
Melting point	323°C
Potential Acute Effects	
Exposure	Causes eye burns. May cause blindness. May cause chemical conjunctivitis and corneal damage. Causes skin burns. May cause deep, penetrating ulcers of the skin.
Inhalation	Irritation may lead to chemical pneumonitis and pulmonary edema. Causes severe irritation of upper respiratory tract with coughing, burns, breathing difficulty, and possible coma. Causes chemical burns to the respiratory tract.
Ingestion	May cause severe and permanent damage to the digestive tract. Causes gastrointestinal tract burns. May cause perforation of the digestive tract. Causes severe pain, nausea, vomiting, diarrhea, and shock.
Potential Chronic Effects	
Exposure	Prolonged or repeated skin contact may cause dermatitis. Effects may be delayed.

Source: MSDS of chemicals (www. Fischer Scientific)

4.2.2 Flammable and Explosive Materials

Flammable materials to be used during the Project include fuel oil and lubricants for power generators and motor vehicles. Fuel oils consist of diesel fuel and gasoline fuel. Diesel will be used primarily by the generator sets for electricity generation for milling, processing, and supplementary operations. Operation of heavy equipment and transport vehicles will require diesel fuel for mobilization.

Explosive materials may be used for blasting activities. Their use will depend on the hardness of the rock materials as mining goes deeper into the ore body. This will be determined once the Project operation and surface mine overburden and ore excavation begin.

4.2.2.1 Flammable Materials

At the maximum throughput of 2,500 metric tons per day, approximately 24,000 liters of diesel fuel will be consumed daily for power generation and 2,800 liters per day for mobile equipment. Other service transport vehicles such as motorcycles will use gasoline fuel. Approximately 82 liters of unleaded gasoline per day will be consumed by these and other mobile transport vehicles.

Diesel fuel predominantly consists of aliphatic, alicyclic, and aromatic hydrocarbons. It is generally combustible with flashpoint of 75˚C for industrial diesel (for generator sets) and 72˚C for the automotive diesel (for mobile vehicles). Both may contain carcinogenic material. The substance is a skin and eye irritant upon direct contact. Inhalation of high vapor concentrations can lead to nausea and headache. Data in the literature recommend a maximum exposure limit for aromatic and aliphatic compounds of 100 parts per million in an 8-hour average time.

Unleaded gasoline will be used for some of the motor vehicles. The substance is composed of petroleum hydrocarbons combined with non-lead additives. It is stable at ambient temperature but may decompose upon exposure to heat. It is highly flammable with a flashpoint of 56˚C. Upon combustion, it may release carbon monoxide and other toxic fumes. It may also contain carcinogenic materials. Data in the literature recommend a 300-part per million exposure limits for all natural gasoline products.

A fuel storage area will be constructed on site which will consist of storage tanks and bund walls for secondary containment. Multiple storage tanks will likely be used with a total storage capacity equal to a minimum of three days inventory for the generator sets and 15 days for equipment and vehicles. This amounts to approximately 114,000 liters of diesel fuel storage and 6,000 liters of gasoline storage.

Based on the high flashpoint, the diesel fuel is not considered flammable. None of the flammable substances are categorized as hazardous material under the threshold inventory provided in DAO 2003-30. Based on this, an ERA is not required. Nonetheless, a Risk Screening Analysis was performed to accommodate Occupational Health and Safety concerns.

4.2.2.2 Explosive Materials

Explosives that will be used for blasting activities include ammonium nitrate- fuel oil (ANFO) and emulsion explosives. They are blasting agents that consist of mixtures of fuels and oxidizers. During mining operations, dry blast holes will be charged by ANFO and primed with emulsion explosives. Wet holes will be loaded entirely with packaged emulsions. Approximately 0.3 kilograms of blasting materials will be used to blast 1 cubic meter of ore or overburden material. The frequency of blasting will depend on the ore materials and operations throughput as mining progresses.

ANFO consists of 94% ammonium nitrate (NH_4NO_3) and 6% fuel oil, acting as the oxidizing agent and the fuel, respectively. It is cap-insensitive, and thus requires a primer to ensure detonation. Ammonium nitrates are highly hygroscopic, readily absorbing water in air. As such, they should not be stored in a humid environment. Absorbed water can interfere with the explosive function.

Emulsion explosives are water in oil emulsions, with an internal phase of oxidizer salt (ammonium nitrate) solution and surrounded by a continuous fuel phase (generally oil or wax or a combination of the two). An emulsifying agent stabilizes the emulsion formed against the liquid separation. The non-polar nature of its exterior makes it water resistant. ANFO added to emulsions can increase the energy by about 5% for every 10% increment added. Technical properties of the two blasting agents are shown in Table 4-11.

Table 4-11: Technical Properties of Blasting Agents

Parameters	Emulsion Explosives	ANFO
Density (kg/m^3)	1,225	960
Detonation Velocity (m/s)	5,000-5,500	2,500-4,800
Gas Production (L/kg)	900	970
Explosion Heat (MJ/kg)	2-7	3.8
Strength/Unit Weight (%)	100	100
Strength/Unit Volume	1.0-1.4	0.7-0.8

Source: "Surface Drilling and Blasting" "Tamrock, 1988" Mine Planning and Equipment Selection" 2004

Hazards associated with explosive materials are fly rock generation, premature blasting, exposure to toxic blasting fumes, overpressure from air blast, and blasting misfires.

Since blasting results in the fragmentation of rocks, fragments can be thrown as projectiles beyond the expected limits. Generation of fly rock and failure to secure the blasting area dominate the blasting-related accidents in surface mining. Generally, fly rock is caused by a mismatch of the explosive energy with the geo-mechanical strength of the rock mass surrounding the explosive charge. Geological anomalies and lack of proper confinement are considered contributory factors for the creation of fly rock. Although these factors are not completely controllable, security within the blast area and appropriate training of the employees involved can prevent injuries related to fly rock.

The required permits for the transport and storage of explosives, including the design of structures, are applied for from the Philippine National Police (PNP), which have very strict standards for the same. The approved plans and separation distances for the existing magazines (which are based on a 2,500 tons per day throughput) are in the following figures. The approved storage capacity is 54 tons of ANFO and 36 tons of dynamite plus a separate containment for blasting caps. This is so designed that any explosion in the main magazines will not impact the mining area (716-meter distance) or the plant (about 1.5 kilometers distance). With receptor populations about 6.5 kilometers away and separated by hills/mountains, there is little to no danger to any residential neighborhoods from this magazine.

Figure 4-1: Approved Existing Magazine Layout

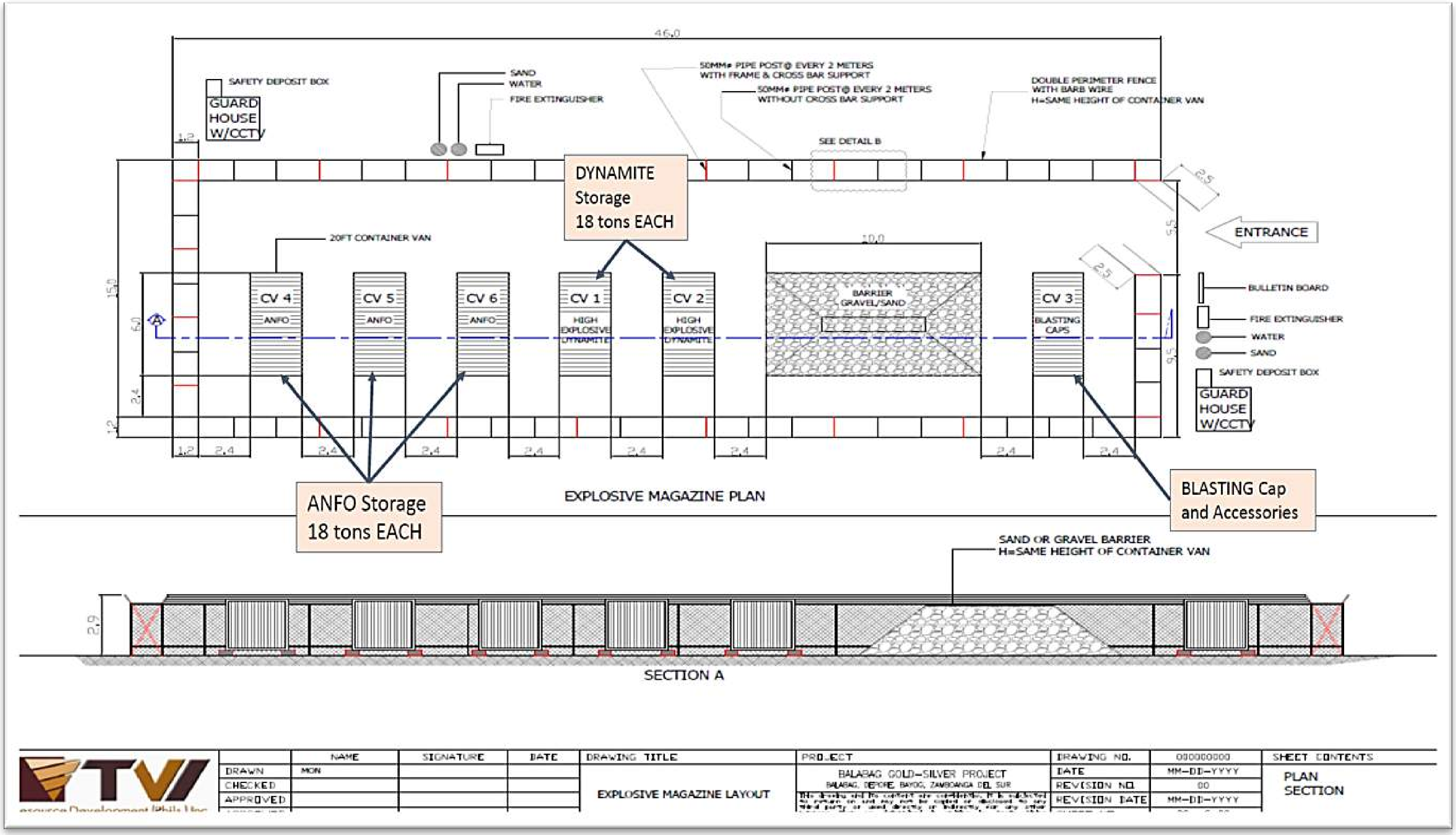


Figure 4-2: Individual Magazine Layout Fence and Pad Detail

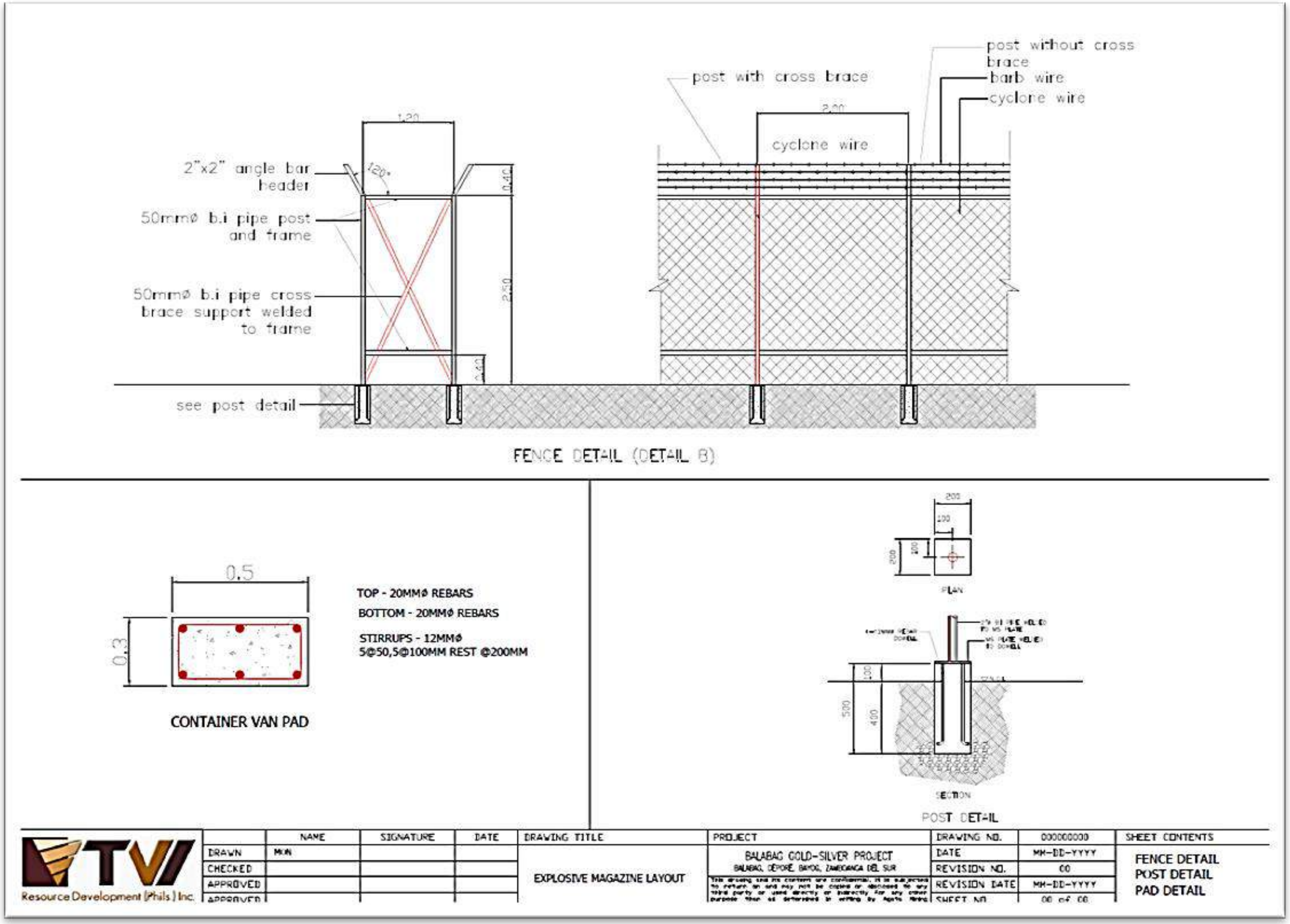
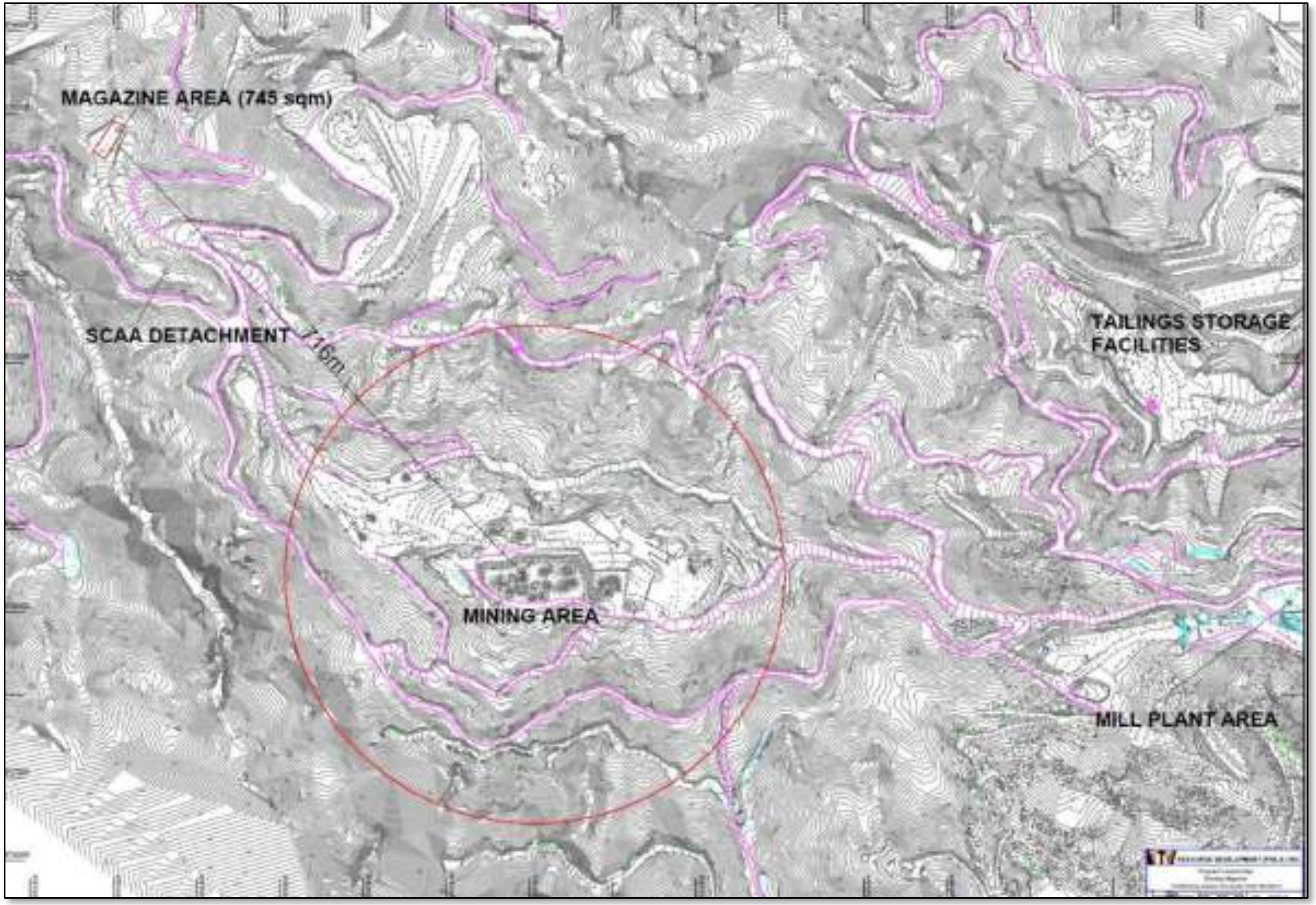


Figure 4-3: Approved Distance to the Mining area



4.2.3 Mechanical Failures

Mechanical failure of any of the mill and processing facilities may result in the release of hazardous, toxic or flammable materials. These could consist of chemicals or reagents, fuel oil, explosives components, and tailings. The mechanical failures could be associated with valves, pumps, pipelines, storage tanks and mobile equipment. The potential exists for any of the materials released to come into contact with the environment and/or humans present in the area. Accidents related to malfunctioning equipment also pose an occupational safety and health hazard. Additional risk may also be potentially attributed to the inability of the persons involved to respond to emergency situations accordingly.

4.2.4 Structural Failure

Structural failure of any of the Project facilities may also result in the release of hazardous, toxic or flammable materials. The principal structures associated with this include the Tailings Storage Facility (dam and spillway), Process Plant (reagent and operations reaction tanks), Cyanide Detoxification Facility (tanks), Waste Rock Disposal Area (slope failure) and Warehouse and Reagent Storage (tanks and secondary containment).

Release of water and tailings from the Tailings Storage Facility may occur due to a dam breach or overtopping. Both tailings and watershed sediment materials from the impoundment may reach the nearby water bodies causing water contamination and siltation. This may result in water quality degradation, and destruction of the aquatic habitat. A sudden release of water from the impoundment may also result in flooding of Unao-Unao Creek and possibly the Dipili River. A filter drain malfunction could lead to excessive pore pressures within the dam embankment and result in an embankment stability failure.

Failure of reagents and operation process tanks may result in a release of hazardous or flammable materials. Spills and leaks from the chemical and fuel storage may result in explosion and fires. Appropriate secondary containment will mitigate or eliminate this potential provided there are no failures of the containment system.

Leaks due to pipeline connections, valves and rupture of pipelines can pose a hazard to human health and the environment. Release of water or tailings from a failure of the piping system(s) may lead to flooding and/or the transport of contaminated materials to the natural environment.

Erosion and stability failures of the waste rock and stored overburden materials may result in the transport of excessive sediment and soils to the area creeks and rivers. The resulting siltation may result in water quality issues, aquatic habitat impacts and the conveyance capacity of the creeks and rivers.

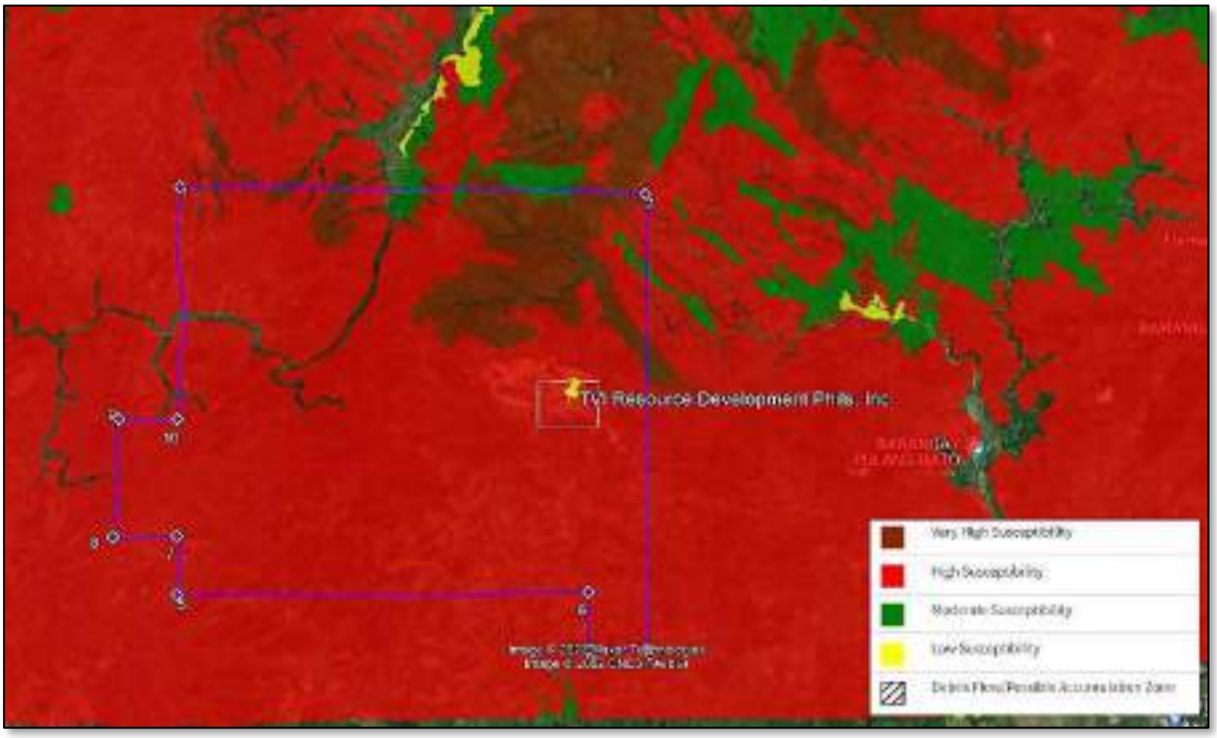
4.2.5 Other or Natural Disaster Risks

A natural disaster is a negative impact when a natural hazard occurred, it can be significantly harmful to the community and people that can be resulted in property damage and even loss of life. It is characterized by the normal intensity of natural agents such as heavy rains which create flooding which can eventually trigger mudslides, landslides, earthquakes that create ground shaking, ground rupture, liquefaction, and even collapsing of structure. TVIRD Balabag Gold-Silver Project established a response preparedness plan to handle and manage if such events will happen. Other risks include hazards from geologic as well as meteorological hazards, since the site is in a particularly hilly area which is prone to landslides These are as follows:

4.2.5.1 Rain Induced Landslide

Based on the Mines and Geosciences Bureau (MGB) maps on rain-induced landslides, the MPSA is in a high to very high susceptibility area for rain-induced landslides. (See Figure 4-4).

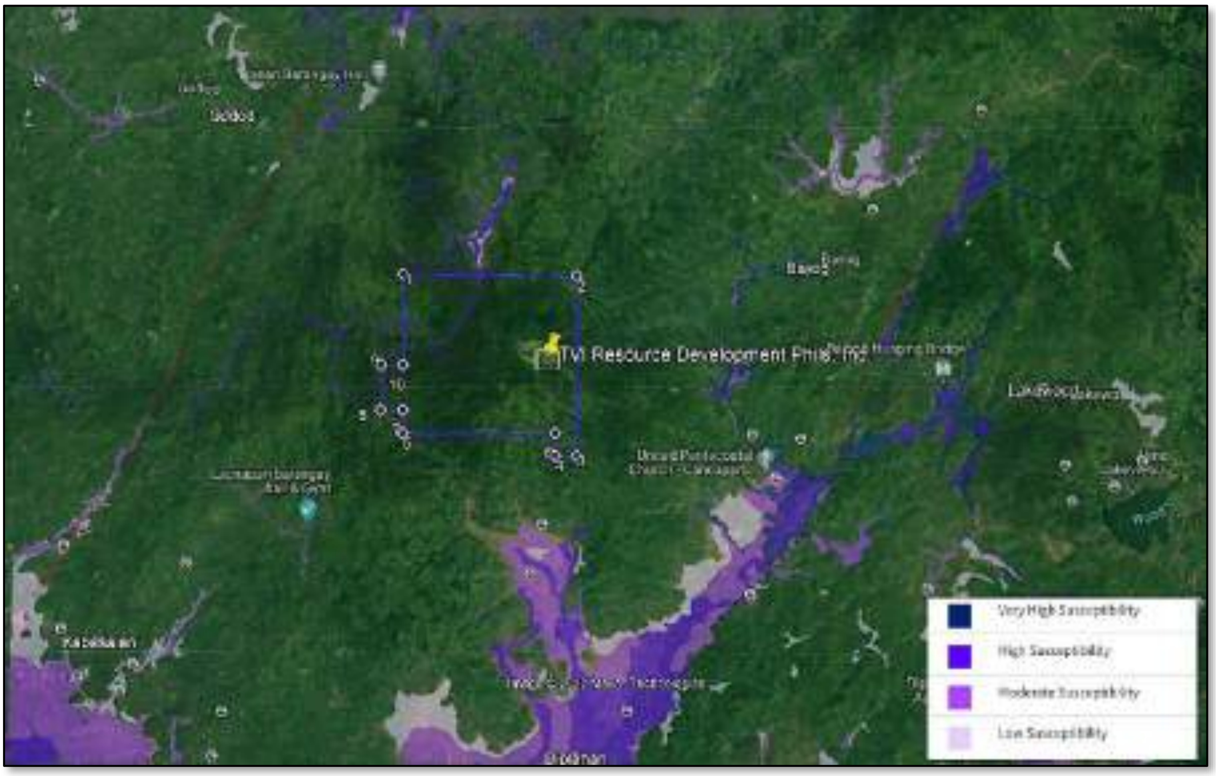
Figure 4-4: Rain-Induced Landslide susceptibility (source: HazardHunter.ph from MGB)



4.2.5.2 Flooding

While flooding in the hilly portions of the site will most likely be temporary at best, there are major implications on the dammed portions of the project (including the FSF) during high rainfall events. The flooding susceptibility map from MGB shows flood prone areas are outside of the MPSA boundaries (see Figure 4-5).

Figure 4-5: Flood Risk (Source HazardHunter.ph from MGB)



4.2.5.3 Earthquakes

Earthquake related hazards include the following: ground shaking, liquefaction, landslide, surface rupturing, and tsunami. Ground shaking, liquefaction and surface rupture are hazards that are directly related to actual ground movements while landslides and tsunami are mainly due to the indirect effects of the earthquake shocks.

Earthquakes result from the sudden shifting of the earth's crust below or at the surface, causing ground vibrations and shocks. There are two main kinds of earthquakes experienced in the Philippines, tectonic and volcanic. A tectonic earthquake is a sudden shift of the earth's crust along active faults, A volcanic earthquake on the other hand happens near volcanoes when hot rocks or magma moves from deep within the earth.

The nearest active fault to the Plant site is the Bayog Fault which is 11.3 kilometers to the southeast (Figure 4-6). However there have been very few earthquakes of magnitude 4.5 and above in the region, with only three exceeding 4.5 in the past twenty-two years as shown in Figure 4-7.

Figure 4-6: Nearest Active Fault (source Phivolcs)

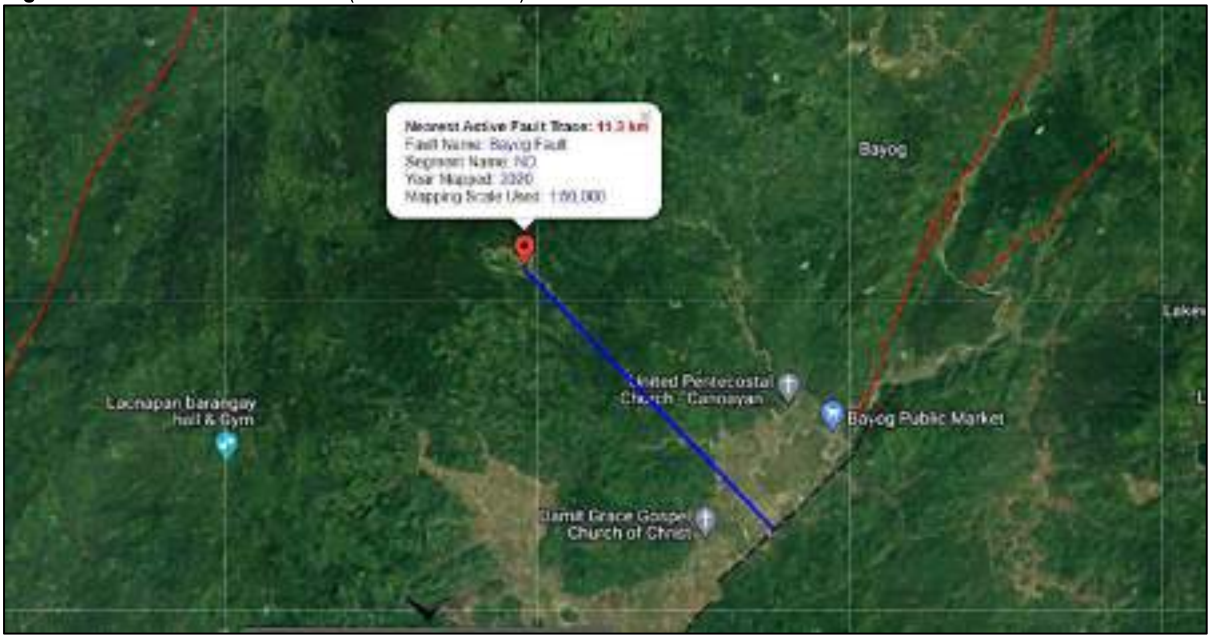


Figure 4-7: USGS Map of Earthquakes Above 4.5 in Magnitude Since 2000.

4.2.5.4 Ground Shaking

Most of the damages incurred during earthquakes mainly result from strong ground vibrations that are caused by the passage of seismic waves from the earthquake source to the ground surface. The intensity of ground shaking depends on the magnitude of the earthquake, distance of the site from the earthquake generator, and the modifying effects of subsoil conditions (i.e., loose unconsolidated sediment is subject to more intense shaking than solid bedrock).

In case of a major earthquake, the peak ground acceleration (PGA) that an area may experience may be estimated given the magnitude of the earthquake and the distance of the area to the epicenter. PGA may be determined using an attenuation relationship such as that presented by Fukushima and Tanaka[1] (1990) as follows:

$$\mathrm{Log10A} = 0.41M - \log10(R + 0.032X10^{(0.41M)}) - 0.0034R + 1.3$$

The peak ground acceleration for a 500-year return period for a rock surface is 0.3g according to maps from Phivolcs as provided in Figure 4-8. PGA is an important parameter (also known as an intensity measure) for earthquake engineering, The design basis earthquake ground motion (DBEGM) is often defined in terms of PGA.

Figure 4-8: Peak Ground Acceleration (500-year Return Period) (source Hazard Hunter from Phivolcs)

4.2.5.5 Ground Rupture

Ground rupturing occurs along the fault zone that moves during the earthquake. Damage can be severe for structures directly straddling and located within a narrow zone of the active fault traces. Since there are no active faults within the project area, there is a minimal risk that this will occur.

4.2.5.6 Liquefaction

Liquefaction is a phenomenon wherein the strength and stiffness of a soil is reduced by earthquake shaking or other rapid loading. Essentially, liquefaction occurs in saturated soils or soils which the space between individual particles is filled with water. Such water exerts a pressure on the soil particles that influences how tightly the particles themselves are pressed together. Without movement such an earthquake, the water pressure is relatively low but when shaking or earthquake occurs, the water pressure may increase to the point where the soil particles can readily move with respect to each other.

Since the project is within a mountainous area with little to no liquefaction hazard, there is a minimal risk that this will occur.

4.3 NEAREST RECEPTORS

The nearest residential areas to the TVIRD plant to the east is the community of Barangay Pulangbato while to the south, the nearest residential areas is the community of Brgy. Guinoman. Straight-line distance determination shows that the distance of the process plant to the residential areas of Pulangbato to be about 6.5 kilometers while the distance to Brgy. Guinoman is about 6.4 kilometers. However, this straight-line determination is an oversimplification as there are hills between Brgy. Pulangbato and Brgy. Guinoman and the project site as shown in Figure 4-9 and Figure 10.

Figure 4-9: Distance of the Process Plant to Brgy. Pulangbato

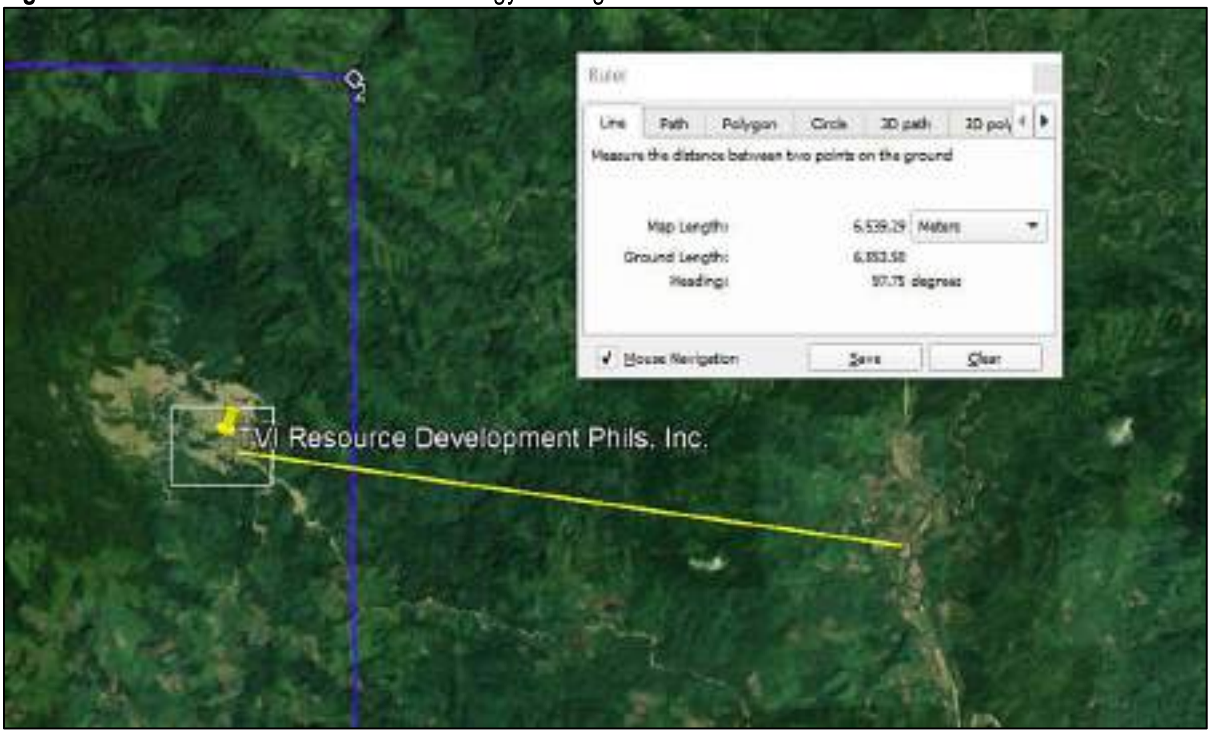


Figure 4-10: Distance of the Process Plant to Brgy. Guinoman

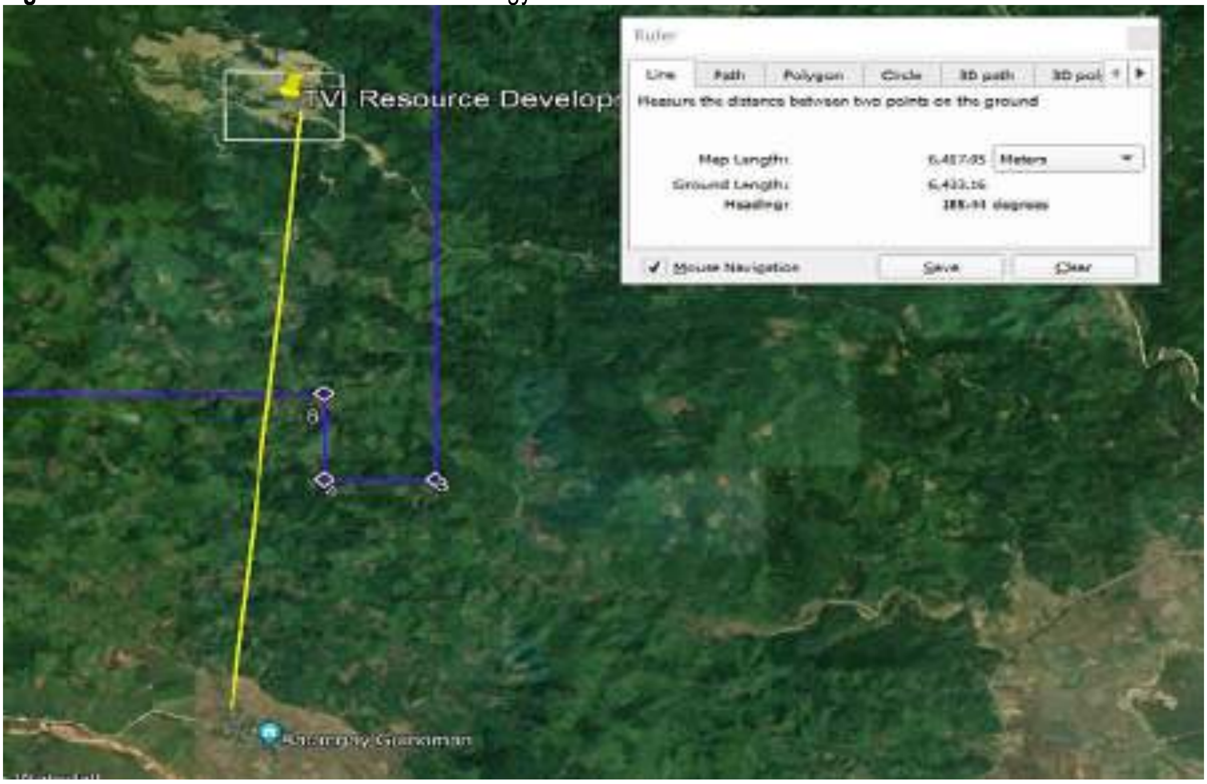


Figure 4-11: Hilly area Between Brgy. Pulangbato and the Project Site

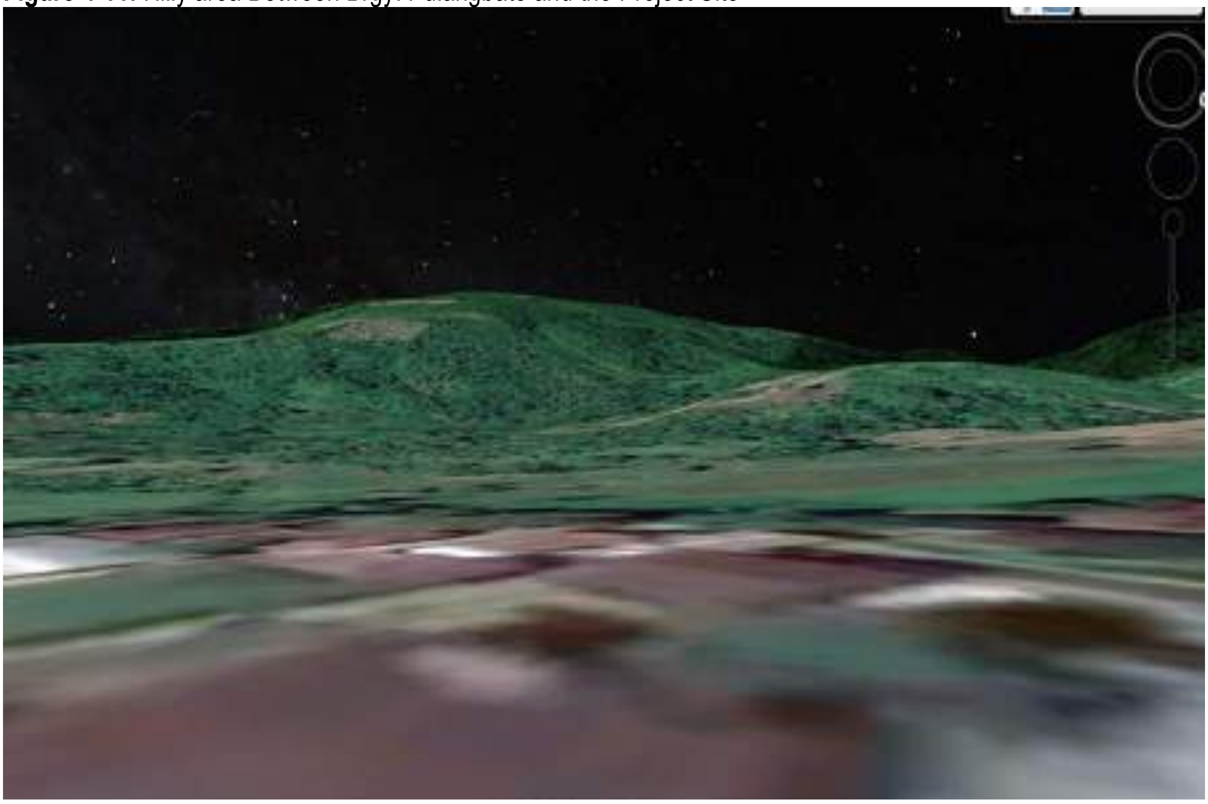
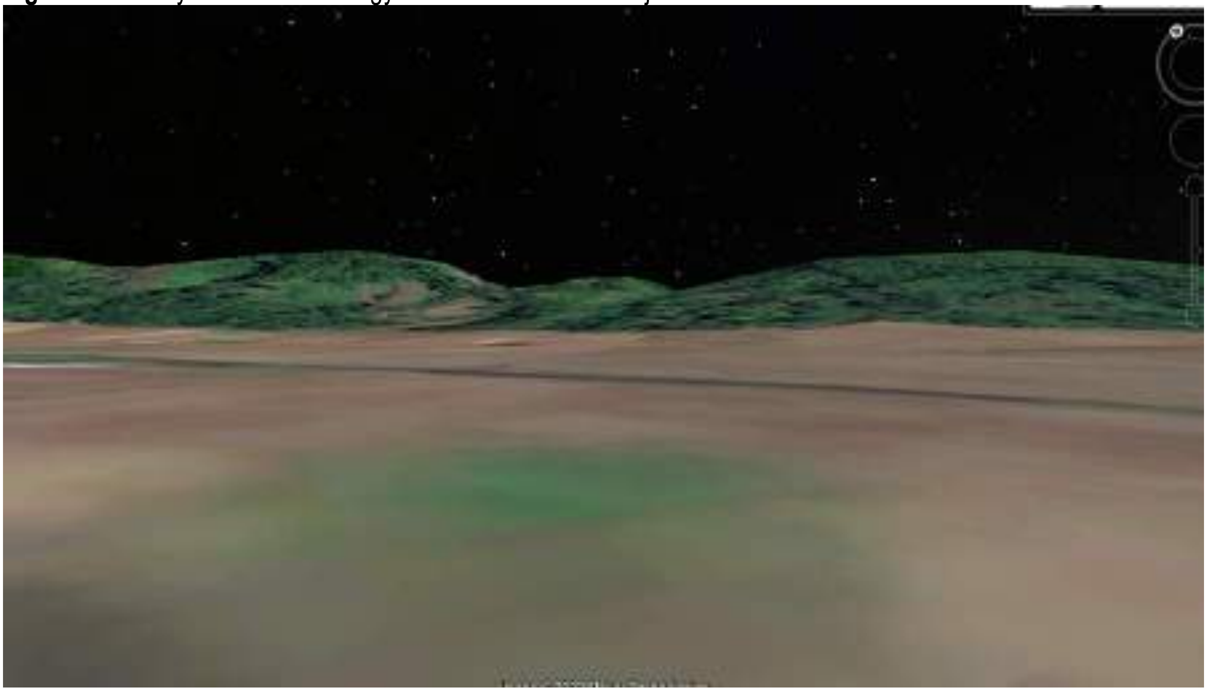


Figure 4-12: Hilly area Between Brgy. Guinoman and the Project Site



4.4 RISK EVENT SCENARIO ASSESSMENT

Accident event scenarios related to the identified hazards were constructed and are evaluated individually. The analysis of each event scenario was demonstrated through Event Tree Analysis, wherein the consequences of the event are followed through a series of possible outcomes. Pathways are defined, sources of contaminant release identified, transport mechanisms established, and endpoints/receptors identified. Seven event scenarios have been identified for assessment. These consist of the following:

- Uncontrolled Release of Sodium Cyanide and Toxic Cyanide Gas Vapor Cloud Formation
- Uncontrolled Release of Hydrochloric Acid
- Sodium Cyanide Storage Fire with Cyanide Gas Vapor Cloud and Thermal Radiation Impact
- Fuel Oil from Storage Fire with Fireball Formation and Thermal Radiation Impact
- Ignition of the Explosives Magazine with Thermal Radiation Impact and Toxic Vapor Cloud Formation
- Failure of the Tailings Storage Facility and Flood Impact.
- Failure of the Waste Rock Disposal Storage Area.
- Disaster Risk

Some of these events have multiple risk scenarios depending on the type of accident. These are evaluated and discussed as well.

Frequency and Risk Analysis have been omitted in the Environmental Risk Assessment process due to the absence of available historical data in the Philippines for the above risk scenarios to estimate probabilities.

4.4.1 Sodium Cyanide Spill

Sodium cyanide will be handled as a dry powder during transport and storage prior to mixing and use in the Process Plant. Within the ore recovery process, it will be used in solution form. Several different accident situations may arise during the handling and use that have the potential to impact the environment and/or human health. Worst case scenarios relative to uncontrolled sodium cyanide release are assumed during transport of the reagent to the Project area, rupture of the mixing tank containing the sodium cyanide solution in the Plant and a cyanide gas or vapor release.

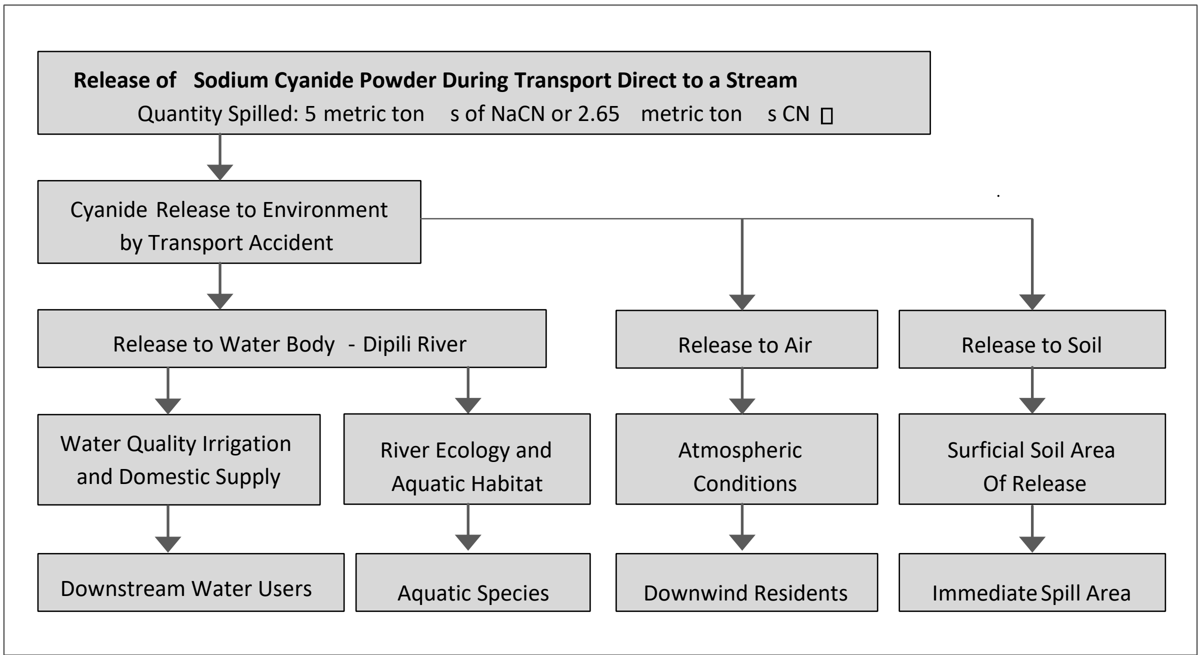
4.4.1.1 Scenario 1 – S pill During Reagent Transport

The Sodium Cyanide will be transported by land from the nearest port facility to the mine site passing along major highways, bridges, and residential/commercial areas. The reagent will be supplied in 1-metric tonner bags and further contained by a wooden crate. The spill scenario assumes the truck carrying the sodium cyanide is open with plastic or tarps covering the wooden crates. The truck experiences an accident forcing the crates to break and exposing the contents to the environment.

The truck is assumed to be carrying 11 crates of sodium cyanide. Five crates are assumed to be broken with the material released to the environment. Each crate is assumed to contain 1 metric ton of powdered sodium cyanide. The event tree for this scenario is shown in Figure 4-13.

The pathways would be air transport, release to the soil and release to a water body. Air transport would be dependent on the atmospheric conditions while soil contamination would be limited to the area of the spill only. The Dipili River in Bayog is the potential water body to be affected due to its proximity to the Project area and location along the transport corridor to the Project area. A spill at this river would also represent a worst-case scenario given the downstream uses of water for domestic and irrigation supply.

Figure 4-13: Sodium Cyanide Transport Spill Event Tree



Information needed for the analysis of the impact of the scenario consist of atmospheric conditions, surficial area of the spill and estimates of the stream flow of the Dipili River at the point of spillage.

Air Contamination Scenario

The spilled material, since in powder form, may pose a risk to be dispersed by air through the atmosphere. Risks arising from sodium cyanide spill relative to its pathway through the air will include risk from direct exposure of the sodium cyanide powder and risk from exposure to HCN from the conversion of sodium cyanide with its reaction to moisture. Due to lack of modeling software available for cyanide dispersion, extent of the plume the cyanide powder may reach is not identified. However, using the baseline information relative to the wind speed and direction of Dipolog City, the cyanide powder may be transported at an estimated distance of 2.8 kilometers from the spill site within 30 minutes from the incident. This estimate does not include volatilization rate of sodium cyanide, pH, temperature, and cyanide concentration (EPA 1979).

Population present in the immediate area of spill can be directly exposed to the sodium cyanide powder transported by the wind. Route of exposure can be through inhalation, accidental ingestion, or absorption through the eyes and skin. The rate of skin absorption is enhanced when the sin is cut, abraded, or moist. Inhaled sodium cyanide is readily dissolved and absorbed upon contact with moist mucous membrane.

Biochemical action of cyanide is the same, upon entering the body. Once in the bloodstream, cyanide will form a stable complex with a form of cytochrome oxidase, inhibiting the cell's oxygen utilization in the blood and will lead to cellular asphyxiation and lactate acidosis. The combined effect of the hypoxia and lactate acidosis is depression of the central nervous system that can result in respiratory arrest and death. At higher lethal concentrations, cyanide poisoning also affects other organs and systems in the body, including the heart.

Initial symptoms of cyanide poisoning include headache, drowsiness, vertigo, weak and rapid pulse, deep and rapid breathing, a bright-red color in the face, nausea, and vomiting. Convulsions, dilated pupils, clammy skin, a weaker and more rapid pulse, and slower, shallower breathing can follow these symptoms. Finally, the heartbeat becomes slow and irregular, body temperature falls, the lips, face, and extremities take on a blue color, the individual falls into a coma, and death occurs. These symptoms can occur from sublethal exposure to cyanide but will diminish as the body detoxifies the poison and excretes it primarily as thiocyanate and other minor metabolites through urine. (International Cyanide Management Code for the Gold Mining Industry accessed at www.cyanidecode.org)

Sodium cyanide fraction transported in the atmosphere will absorb moisture from the air and release hydrogen cyanide which is estimated to be retained in the atmosphere up to a few months. Atmospheric HCN is well mixed in the troposphere and decreases concentration in the stratosphere with increasing altitude. HCN in troposphere may degrade via reactions with hydroxyl and oxygen radicals, producing nitric oxide in the process. In the stratosphere, UV photolysis and subsequent oxidation of the cyanide free radical is the degradation process. While these two atmospheric degradation pathways are possible, ocean uptake is still considered to be the main sink for atmospheric HCN. HCN taken up by ocean waters is expected to be degraded by biological processes. (Priority Existing Chemical Assessment Report No. 31: Sodium Cyanide, Department of Health and Ageing, Australia, 2010)

Soil Contamination Scenario

The sodium cyanide during a spill may contaminate the soil. Cyanide attenuation in soils occurs due to adsorption and precipitation. However, soil adsorption is probably insignificant when compared to volatilization in air and biodegradation in water (EPA 1979, 1992f). Tests on bio attenuation of cyanides indicated they move only short distances through the soil before being biologically converted to nitrates then to ammonia.

Extent of the contamination of sodium cyanide in soil depends on its mobility in soil. Cyanides are fairly mobile in soil. Mobility is lowest in soils with low pH and high concentrations of free iron oxides, positively charged particles, and clays (e.g., chlorite, kaolin, gibbsite), and highest in soils with high pH, high concentrations of free CaCO3 and negatively charged particles, and low clay content (EPA 1979). Although cyanide has a low soil sorption capability, it is usually not detected in groundwater, probably because of fixation by trace metals through complexation or transformation by soil microorganisms (EPA 1978c).

Fate of cyanides in soil would be dependent on cyanide concentrations, pH, temperature, metal content, concentration of microbes, availability of nutrients, and acclimation of microbes. Cyanide may occur as hydrogen cyanide, alkali metal salts, or as immobile metallo-cyanide complexes. In soil, cyanide present at low concentrations would biodegrade under aerobic conditions with the initial formation of ammonia, which would be converted to nitrite and nitrate in the presence of nitrifying bacteria. Under anaerobic conditions, the cyanides ion will denitrify to gaseous nitrogen (Richards and Shieh 1989).

No numerical models are available that will predict extent of contamination from the cyanide spill scenario. The depth of contamination will be better determined by extracting samples at various depths to determine individual cyanide concentration in each layer. Further, due to low mobility of cyanide in soil and its partitioning coefficient, cyanide is not very available to plants. In the event that a tiny amount of sodium cyanide has been taken up by the plant roots, it will be rapidly converted to hydrogen cyanide by the buffered pH maintained by plant tissues. Being highly volatile, hydrogen cyanide can easily escape into the atmosphere through leaf stomatal openings. Any residual amount of hydrogen cyanide is not expected to cause problems. Also, higher plants are endowed with the cyanide resistant pathway in its system. The insensitivity explains why native vegetation is relatively immune to soil cyanide. (Hsu F.C, Factors affecting plant uptake of sodium cyanide from soil, 1994).

Water Body Contamination Scenario

The point of spill is assumed to be the Dipili River Spillway crossing near the Brgy. Poblacion. The area of concern is assumed to be downstream of the confluence of Dipili River with the Sibuguey River (6.4 kilometers from the spill location). This particular reach of the Sibuguey River is the source of water for several farm irrigation systems.

Numerical models can be used to estimate the travel time of a pollutant and the pollutant dispersion. To be an effective model and provide a predictive analysis, these models require some level of calibration using data from the river being modeled. In lieu of extended field studies, several times of travel and dispersion studies have been used to develop empirical equations that appear to provide general applicability (Jobson, 1996). Use of these equations and methods requires some base assumptions. These include the following:

- No loss of pollutant between the spill area and the point of confluence.
- No losses from chemical reactions, volatilization, absorption of the streambed or other processes.
- No dilution from rainfall. Magnitude of streamflow remains constant for the duration of the spill.
- Steady flow condition of the river during the time of spill with no oxidation of the cyanide.

Both low stream flow and high stream flow conditions were used in the analyses in order to bracket the cyanide concentration values and provide a perspective on impacts relative to the season. Similarly, minimum and maximum flow velocities were used to provide a time bracket of the pollutant travel period. Model input assumptions are summarized in Table 4-25.

Results of the contaminant spill model are summarized in Table 4-26 and Table 4-27 and are based on the empirical equations and hydrology data available for the Sibuguey River. Key results of the model are the most probable peak concentration of the pollutant and travel time within the Dipili and Sibuguey Rivers.

The results of the contaminant modeling indicate cyanide concentrations within the Dipili River reach and the Sibuguey River reach downstream of the spill will exceed the stream standards for several hours. Water quality (cyanide concentration) at the Sibuguey station is predicted to stabilize at a maximum of 41 hours after the spill. The result would likely be some loss of aquatic life based on the lethal concentration values (LC50) for aquatic species.

Based on the model, this scenario will mostly affect the aquatic habitat along the Dipili to Sibuguey River junction reach. Downstream of this point, rapid degradation of free cyanide is anticipated. This is due to the short half-life of cyanide, the turbulent flow conditions, and the higher stream flow of the Sibuguey River. The free cyanide concentration is predicted to be reduced to the DAO 34 standards within 11 to 41 hours after the spill. The model prediction, however, does not consider the kinetics of volatilization of cyanide which will likely increase the degradation. Given this, the predicted degradation time represents a worst-case condition for the spill conditions.

Table 4-25: Contaminant Modeling Input Data Dipili River and Sibuguey River Spill Event

Parameter/Model Condition	Input Data and Model Assumptions	
Drainage Area at the Point of Spill at Dipili River Spillway Crossing	116 square kilometers	
Mean Annual Discharge of Dipili River at Dipili River Spillway Crossing	9.7 cubic meters per second	
Drainage Area at the Confluence of Dipili River and Sibuguey River (Dipili River + Sibuguey River)	121.4 square kilometers	
Mean Annual Discharge of Sibuguey River and Dipili River at Confluence	10.6 cubic meters per second	
Drainage Area Sibuguey River at Downstream Gauging Station	759 square kilometers	
Mean Annual Discharge of Sibuguey River at Downstream Gauging Station	66 cubic meters per second	
Bracketed Low and High Flow Seasonal Stream Flow Conditions	Low Stream Flow Conditions - Dry Season (February)	High Stream Flow Conditions - Wet Season (July)
Streamflow of Dipili River at the Spill Location	5.0 cubic meters per second	13.5 cubic meters per second
Streamflow of Sibuguey River and Dipili River at the Confluence	5.5 cubic meters per second	14.8 cubic meters per second
Streamflow of Sibuguey River at Downstream Gauging Station	34.2 cubic meters per second	92.4 cubic meters per second

Source: TVIRD, 2011.

Table 4-13: Contaminant Modeling Results Dipili River and Sibuguey River Spill Event

Dipili River Reach from Spill Location Down Streams to Confluence with the Sibuguey River (6.4 Kilometers)				
Parameter	**Model Results**			
	Low Stream Flow Conditions		**High Stream Flow Conditions**	
	Minimum Velocity	**Maximum Velocity**	**Minimum Velocity**	**Maximum Velocity**
Velocity of the Peak Concentration (m/s)	0.24	0.61	0.4	0.89
Unit Peak Concentration (per second)	174.6	363	284.6	515.5
Most Probable Peak Concentration (mg/l)	92.7	192.6	55.9	101.2
Time when the first trace of pollutant will be observed at the confluence after the spill (hrs.)	6.5	2.6	4	1.8
Time when the peak Concentration will reach the Confluence after the spill (hrs.)	7.3	2.9	4.4	2
Time when the trailing edge (10% of the peak concentration) passes the Confluence after the spill (hrs.)	9.6	4.1	6	2.8
Eco toxicity of Fish (24-hr LC50) (ug/l)	40	40	40	40

Range of Non-lethal but Negative Fish Impact Concentration (ug/l)	5-7.2	5-7.3	5-7.4	5-7.5

Reference: Prediction of Travel Time and Longitudinal Dispersion in Rivers and Streams, Jobson 1996.

Table 4-14: Contaminant Modeling Results Dipili River and Sibuguey River Spill Event

Sibuguey River Reach from Confluence with Dipili River to Down Stream Gauging Station (36.7 Kilometers)				
Parameter	**Model Results**			
	Low Stream Flow Conditions		**High Stream Flow Conditions**	
	Minimum Velocity	**Maximum Velocity**	**Minimum Velocity**	**Maximum Velocity**
Velocity of the Peak Concentration (m/s)	0.3	0.72	0.5	1.1
Unit Peak Concentration (per second)	49.9	100	90.2	159.9
Most Probable Peak Concentration (mg/l)	0.01	0.02	0.007	0.01
Time when the peak Concentration will reach the Confluence after the spill (hrs.)	41	17.2	24.7	11.4
Eco toxicity of Fish (24-hr LC50) (ug/l)	40	40	40	40
Range of Non-lethal but Negative Fish Impact Concentration (ug/l)	5-7.2	5-7.3	5-7.4	5-7.5

Reference: Prediction of Travel Time and Longitudinal Dispersion in Rivers and Streams, Jobson 1996.

The use of cyanide contaminated water for irrigation may impact plant growth depending on the cyanide concentration levels in the water and plants exposed to the contaminated water. In the Sibuguey River basin, common crop planted is rice and other root crops. However, limited data is available on the uptake of plants, specifically rice, which may be affected by the contaminated river used for irrigation. The US EPA (1997) stopped testing of plants because results obtained up to that time indicated no meaningful and measurable uptake of cyanide had taken place. According to Dupont (1994), cyanide tightly binds to soil rendering it quite immobile and is thus not available to plants. Any damage to plant life would not be expected. This is also identified by Hsu (1994), wherein his studies identified that tiny amount of cyanide taken in plant roots will be rapidly converted to hydrogen cyanide by the buffered pH maintained by plant tissues. Also, higher plants are endowed with the cyanide resistant pathway in its system.

Limited studies done are for plants not available in the Philippines, for example willow trees. Willow trees, in low doses of cyanide are unaffected. However, in high doses (concentration greater than 19 mg/L), fatal effects will be experienced by the plant within 216 hours (Phytotoxicity of cyanide in weeping willow trees, 2005).

4.4.1.2 Scenario 2 - Tank Rupture or Valve/Piping Malfunction Containing the Sodium Cyanide Solution

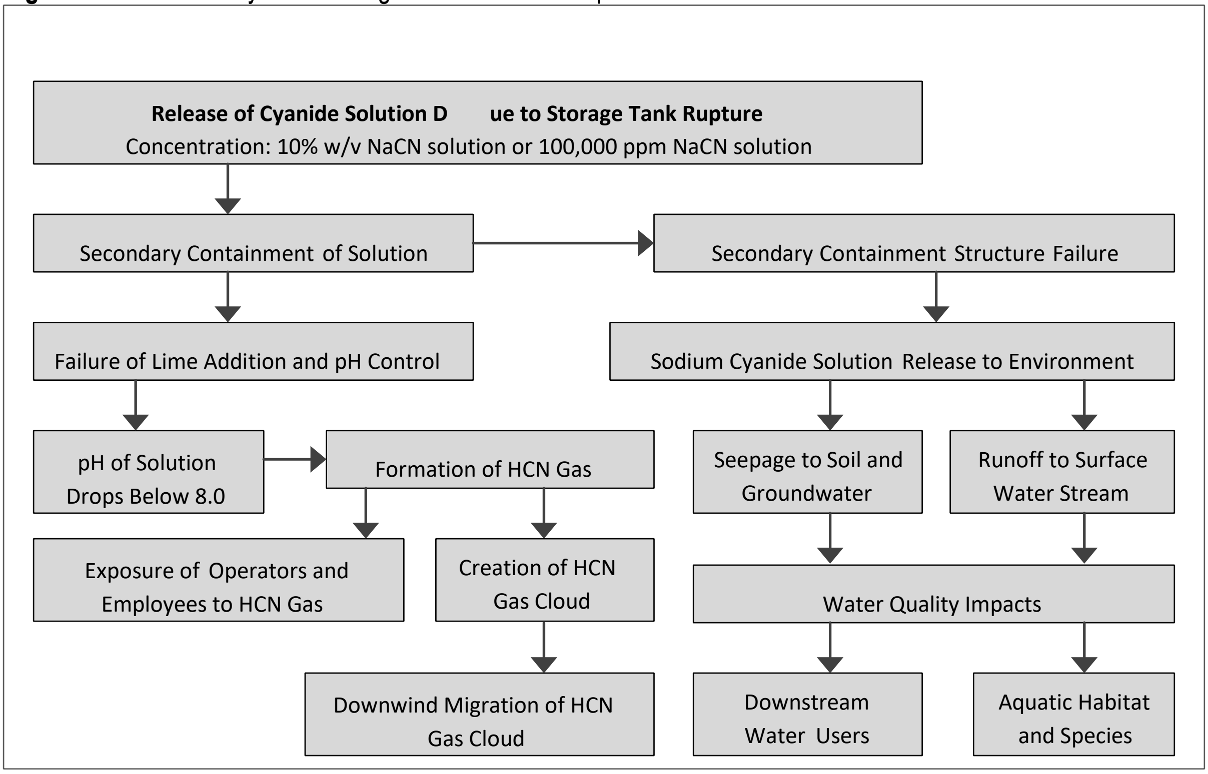
The sodium cyanide mixing, and storage activities are located within the process plant and consist of mixing the powdered sodium cyanide with freshwater from the Project area water sources. The mixture has a 10% weight to volume ratio of sodium cyanide solution or a concentration of 100,000 ppm NaCN. Lime is added to the solution to maintain a high pH and prevent the formation of HCN gas. The mixing and storage tank has a 2-meter diameter and a height of 4 meters. A bag breaker is located at the top of the tank with a small opening to allow the sodium cyanide powder to drop inside the tank with minimal exposure. Flow from the tank is regulated by a valve located at the bottom of the tank.

The accident scenario assumes the solution is released due to a tank rupture or a valve malfunction. The solution is assumed to be contained within the secondary containment structure however the lime addition ceases, and the pH is reduced. This is further assumed to result in the formation of HCN gas and creation of a human health hazard.

An alternative accident scenario is a failure of the secondary containment structure and there is a release of the sodium cyanide solution to the environment. The pathway would be either surface water or groundwater and the impacts and risks would be similar to the reagent spill during transport scenario.

For either scenario, the tank is assumed to be filled 75% of its capacity (9.420 liters) and all warning/control systems fail. It was also assumed there were no operators or personnel onsite to manage the initial accident event. The event tree for this scenario is shown on Figure 4-14.

Figure 4-14: Sodium Cyanide Mixing Tank Failure and Spill Event Tree



Given the strongly basic nature of the solution due to lime addition, cyanide species exist primarily as cyanide ions in the solution. With the assumption that lime addition was stopped upon the control system failure and valve malfunction, formation of HCN gas will occur. Concentration calculations of cyanide species were estimated using a steady state mass balance and are summarized in Table 4-15.

Table 4-15: Concentration of Cyanide in the Spilled Solution (as CN- ion)

Parameter	Result
Cyanide Release Concentration	
As cyanide ions (CN^-) :	52,821 mg/liter CN^-
As hydrogen cyanide (HCN) gas:	155 mg/liter HCN
Eco Toxicity for CN^- (US EPA and Philippine Standards)	$[CN^-]<0.052$ mg/liter

Source: TVIRD 2012, USEPA

HCN Gas Release Scenario

To evaluate the hazards from the HCN gas release, worst case release scenario analysis provided in the US EPA Risk Management Program (US EPA RMP) Guidance for Offsite Consequence Analysis was used.

The toxic gas release under US EPA RMP's worst case scenario assumes that the entire amount of HCN gas present in the tank was released in 10 minutes. It was also assumed that the release occurred in an environment with atmospheric stability class F, wind speed of 1.5 meters per second and ambient air temperature of 25˚C. Chosen topography for the area was under rural, with minimal obstructions and flat terrain. A summary of the assumptions and conditions used as are shown in Table 4-16.

Table 4-16: Worst Case Scenario Conditions for HCN Gas Release

Parameters	Assumptions
Wind Speed	1.5 meters per second
Topography	Urban
Ambient Air Temperature	25 deg C
Atmospheric Stability Class	F (stable)
Tank Dimensions	Diameter= 2 meters Height= 4 meters
Tank Operation Volume	75% of Total Capacity Volume= 9.42 cubic meters (9,420 liters) of NaCN Solution
Density Classification of HCN	Buoyant gas
Amount of HCN in tank	154.65 ppm
Toxic Gas Release	Continuous gas leak from ruptured tank. Storage tank is inside an enclosed area (plant)
Release Duration	10 minutes
Toxic Endpoint of HCN	0.011 mg/mL (11 mg/m^3)

Source: TVIRD 2012, USEPA RMP and Exhibit B-1 Data for Toxic Gases of the RMP

The HCN gas was released to the outside air of the building at 0.177 lbs/min as determined using the release rate equation provided in USEPA RMP. The toxic endpoint for HCN defined by RMP is 0.011 mg/mL (based on Emergency Response Planning Guideline (ERPG) for HCN). This is the maximum concentration in air below which it is believed nearly all individuals could be exposed for up to one hour without experiencing or developing irreversible or other serious health effects or symptoms that could impair their abilities to take protective action. Using the generic reference tables in the document, the worst-case consequence distance from the point of release to the toxic endpoint is 161 meters. Area inside this radius is considered to be a threat zone to possible adverse effects of HCN exposure. In the case of a spill and generation of HCN gas, evacuation of the affected population to an area outside the 161-meter radius is recommended. This is to allow for better control and manage any adverse health effects. Hydrogen cyanide vapor is absorbed rapidly through the lungs (Gettler and St. George, 1934). Human inhalation of 270 ppm of HCN vapor brings death immediately, while 135 ppm is fatal after 30 minutes (Dudley, et al. 1942). Hydrogen cyanide vapor is also absorbed through the skin (Drinker, 1932; Potter, 1950; Tovo, 1955; Walton and Witherspoon, 1926). Absorption is probably increased if the skin is cut, abraded, or moist.

Sodium Cyanide Solution Release Due to Tank Rupture or Valve Malfunction

This scenario considers the tank rupture or equipment malfunction resulting in the release of the liquid solution to the secondary containment area. This situation is further compounded by a failure of the secondary containment structure and release of the sodium cyanide solution to the environment.

The risk analysis for this scenario, however, will be limited to the immediate area where the spill occurred. The location of the tank is within the Processing Plant area with the drainage system directed to the detoxification facility. The potential risk to nearby surface water bodies is remote and the impact is limited to soil surface within the immediate vicinity of the incident.

The impact of the sodium cyanide solution release to the soil surface will be minimal. As indicated in the previous section, soil adsorption is considered insignificant when compared to volatilization in air and biodegradation in water (EPA 1979, 1992f). Tests on bio attenuation of cyanides indicated they move only short distances through the soil before being biologically converted to nitrates then to ammonia. The degree of impact may be measured on the depth of contamination. The need for a remediation measure will be best determined by extracting soil samples at various depths to determine individual cyanide concentration in each layer.

4.4.2 Hydrochloric Acid Release

The scenario involves the uncontrolled release of Hydrochloric acid due to collapsed chemical storage rack. The storage area stores 4,400 bottles of 2.5-liter bottles of 37.7% w/v Hydrochloric acid solution. Worst case atmospheric condition of stability class F, wind speed of 1.5 m/s, and ambient temperature were considered in this risk assessment. The acid instantaneously spread on a flat, non-absorbing surface forming a pool of 1-cm depth.

The rate equations for unmitigated release defined by the USEPA RMP were used to determine a release rate of 5.72 lbs /min for the spilled solution. The toxic endpoint considered for the hydrochloric acid release is 0.03 mg/L based on the ERPG-2 value. Calculated distance from the point of release to the toxic endpoint is 804.65 meters. Exposure at distances closer to the point of release can cause irreversible or other serious health effects of HCl exposure.

4.4.3 Sodium Cyanide Storage Building Fire

Approximately 750 kilograms of sodium cyanide will be consumed daily during the first stage of operation at a throughput of 500 metric tons per day. This will increase to a maximum of 3 metric tons per day at a throughput of 2,500 metric tons per day. A 3-month inventory will be maintained in the cyanide storage area resulting in a maximum storage quantity of 600 metric tons.

A risk scenario was developed that assumes the 130 square meter cyanide storage warehouse is set on fire. Water from the firefighting encountered all the NaCN stored, creating a pool of NaCN solution and a subsequent generation of HCN gas. The resulting quantities of cyanide decomposition products were estimated using a steady state mass balance and are summarized in Table 17.

The HCN vapors are lighter than air and can travel considerable distances creating exposure, fire and explosion hazard. In this scenario, a vapor cloud was formed and eventually detonates. Another risk is the uncontrolled release of the NaCN solution pool to the environment. The event tree for this scenario is shown on Figure 4-15.

Table 4-17: Cyanide Species in the NaCN Solution Pool

CN Species	Quantity
As cyanide ions (CN^-) :	1.43 x 10^8 g CN- (5.5 x 10^6 mol)
As hydrogen cyanide (HCN) gas:	2.53 x 10^2 g HCN- (9.38 mol)

Source: TVIRD 2012

Atmospheric conditions and other assumptions used in the consequence analysis for the fire event are listed in Table 4-19.

Figure 4-15: Sodium Cyanide Storage Fire Event Tree

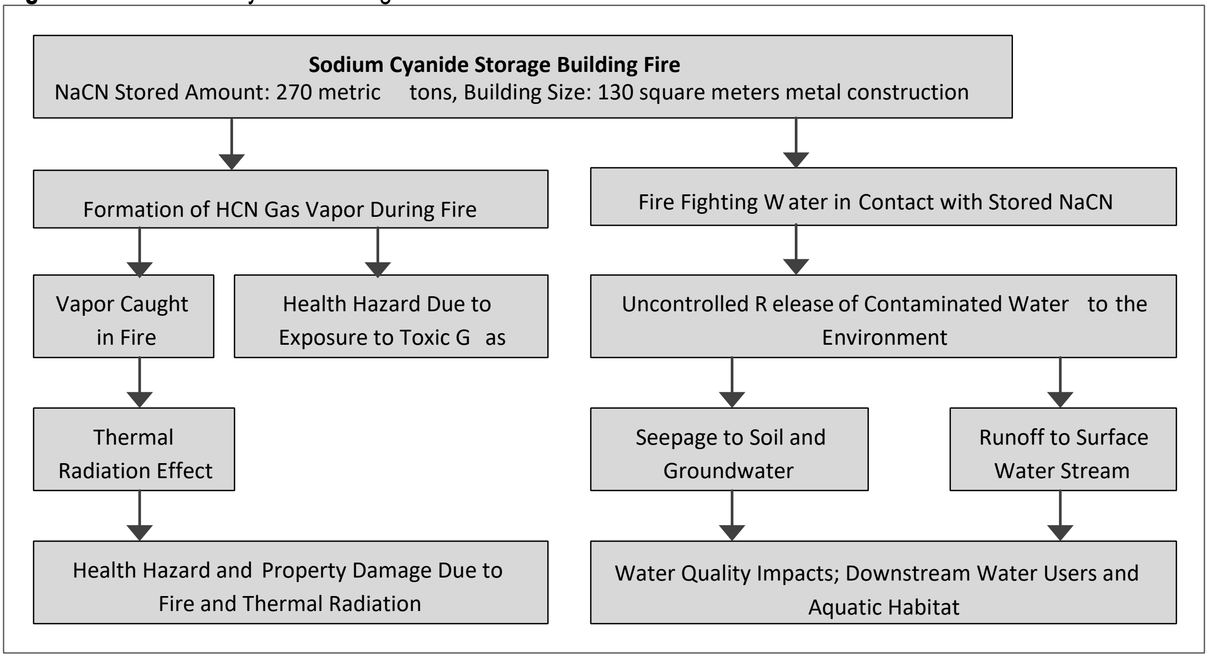


Table 4-18 : Worst Case Scenario Conditions for the NaCN Storage Fire

Parameter	Assumptions
Wind Speed	1.5 meters per second
Topography	Urban
Ambient Air Temperature	25 deg C
Atmospheric Stability Class	F (stable)
Building Floor Area	130 square meters
Type	Single story, enclosed, concrete flooring
Quantity of NaCN stored	270 metric tons of NaCN powder
Toxic Gas Release	Continuous HCN release from the NaCN solution pool

Source: TVIRD 2012

4.4.3.1 Scenario 1- Release of HCN Gas from Chemical Storage Fire

The same method used in the release rate calculation and toxic endpoint distance evaluation for HCN release from the ruptured tank was used in this analysis. Calculated release rate of HCN based on the USEPA RMP to the outside air of the storage building is at 0.031 lbs/min. The distance to toxic endpoint for the HCN release is estimated to be at 161 meters. The nearest population center from the storage warehouse is the mill plant. To manage adverse health effects, evacuation of people to outside the identified toxic threat zone should be done.

4.4.3.2 Scenario 2 - Development of Flammable Vapor Cloud from Chemical Storage Fire

In this scenario, it was assumed that a vapor cloud containing the entire HCN gas generated from the pool was formed. The entire content of the cloud is also assumed to be within the flammability limits, leading to a vapor cloud explosion. Consequence distances to an overpressure level of 1 pound per square inch was determined based on a TNT- equivalency method as presented in Appendix A of the US EPA RMP document. The explosion threat endpoint of 1 psi was used as the threshold for potential injuries to people as a result of property damage caused by an explosion.

A distance of 8.68 meters was calculated to be the consequence distance for the occurrence of a vapor cloud explosion overpressure of 1 psi. Table 4-19 summarizes the effects of explosion overpressure that may be experienced inside the identified explosion threat endpoint.

Table 4-19: Effects of Explosion Overpressure

Explosion Overpressure	Effect
7 kPa (1 psi)	Damage to internal partitions and joinery but can be repaired; Probability of injury is 10%. No fatality.
14 kPa (2 psi)	House uninhabitable and badly cracked.
21 kPa (3 psi)	Reinforced structures distort; Storage tanks fail; 20% chance of fatality to a person in a building.
35 kPa (5 psi)	House uninhabitable; Wagons and plant items overturned; Threshold of eardrum damage; 50% chance of fatality for a person in a building and 15% chance of fatality for a person in the open.
70 kPa (10 psi)	Threshold of lung damage; 100% chance of fatality for a person in a building or in the open; Complete demolition of houses.

Source: Hazardous Industry Planning Advisory: Paper No.2

4.4.3.3 Scenario 3 - Thermal Radiation Effect from Burning Vapor Cloud

With reference to the previous accident scenario, this scenario assumes the HCN vapor cloud above the pool of spilled cyanide solution was caught by the flames of the burning storage area creating a pool fire. Based on the USEPA RMP, the heat radiation endpoint is 5 kilowatts per square meter (kW/m^2). This level is reported to cause second degree burns from a 40-second exposure. It is assumed that people would be able to escape from the heat in 40 seconds.

Using the equation provided in the USEPA RMP, the distance where exposed people could potentially suffer second degree burns can be estimated using the Pool Fire Factor (PFF) of HCN and maximum pool area of the spilled chemical. In this scenario, the pool diameter is estimated at 12 meters spreading to a depth of 1 centimeter.

A distance of 20.51 meters was calculated to be the distance from the source to the radiation heat endpoint. Immediate evacuation will be necessary within this range. Table 4-20 summarizes the effects of thermal radiation that may be experienced at distances shorter than the identified heat radiation threat endpoint.

Table 4-20: Effects of Exposure to Thermal Radiation

Incident Influx, Qt (kW/m^2)	Type of Damaged Caused	
	Damage to Equipment	Damage to Human/Public Health
37.5	Damage to process equipment	100% fatality in 1 minute. 1% fatality in 10 sec.
25.0	Minimum energy to ignite wood at indefinitely long exposure w/out flame	100% fatality in 1 minute. Significant injury in 10 seconds.
12.5	Minimum energy to ignite wood with a flame; melts plastic tubing.	30% fatality in 1 min. 1st degree burns in 10 sec.

Source: World Bank Technical Paper No. 55

The Project facility with a potential population that could be affected is the Processing Plant. Employees working during the time of accident may be exposed to any of the identified threats.

4.4.3.4 Scenario 4 – Sodium Cyanide Contaminated Water from Firefighting Activities

This accident scenario is associated with water used during the firefighting activities coming in contact with the sodium cyanide. This may result in some level of contamination. In the event the secondary containment structure is destroyed or breached, there may be a release of the sodium cyanide solution to the environment.

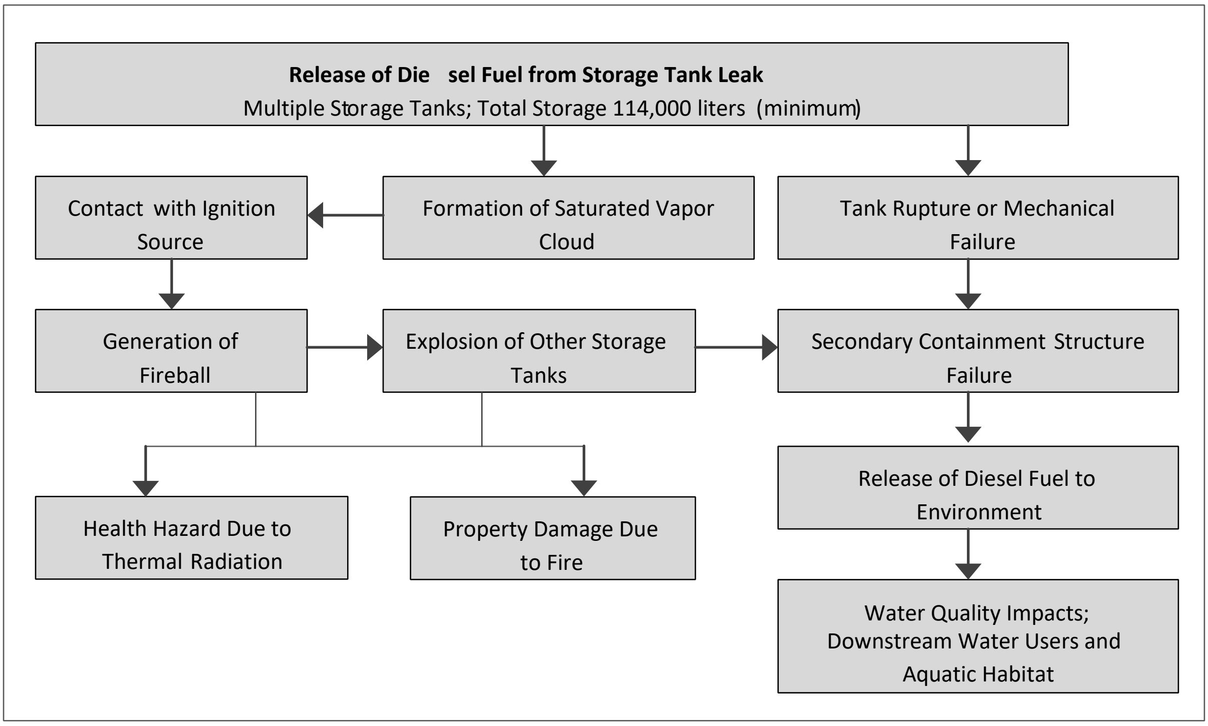
The pathway would be either surface water or groundwater and the impacts and risks would be similar to the reagent spill during transport scenario or the release of sodium cyanide solution due to a tank rupture or valve malfunction.

4.4.4 Fire from Fuel Storage Leak

Diesel fuel will be stored in standard steel above ground fuel tanks. Multiple tanks will be used to store the industrial and automotive diesel for the generator sets, equipment and vehicles. A minimum of 3-day use volume inventory of the industrial fuel (72,000 liters) and 15-day use volume inventory of the automotive diesel (42,000 liters) will be stored on site. Unleaded gasoline used for vehicles and equipment, will be stored in a smaller tank (6,000 liters). The storage tanks design and installation will follow the design and safety protocols with reference to the fire protection standards. A 5-meter spacing between tanks will be maintained and the facility will be provided with secondary containment for control of spills or leaks.

For risk analysis, an accident scenario was generated by assuming the occurrence of a fire due to ignition of fuel from a storage tank leak. The release of petroleum product creates a pool, which is then ignited causing a pool fire. Vapor cloud was formed, and ignition of the cloud leads to a vapor cloud explosion. This then results in the explosion of other storage tanks. An associated risk is the release of diesel fuel to the environment resulting from a failure of the secondary containment facility due to the explosion. The event tree for this accident is shown on Figure 4-16.

Figure 4-16: Fuel Storage Tank Fuel Release and Fire Event Tree.



Worst case conditions defined in the US EPA RMP document were used to evaluate the identified risks. Atmospheric conditions and other assumptions used in the consequence analysis for the fuel storage fire event are listed Table 4-21.

Table 4-21: Worst Case Scenario Conditions for the Fuel Storage Fire

Parameter	Assumptions
Wind Speed	1.5 meters per second
Topography	Rural
Ambient Air Temperature	25 deg C
Atmospheric Stability Class	F (stable)
Total Quantity of Fuel Stored	114,000 L of Diesel and 6,000L Unleaded Gasoline stored in separate tanks
Cylindrical Tank Dimensions	Diameter= 10 ft Height= 17 ft Tank capacity= 10,000 gal (3/4 filled= 7,500 gal)
Release mechanism	Ground level release through a 2-inch diameter puncture at tank bottom
Release Rate	1,595 lbs/min
Evaporation Rate from Pool	0.15 lbs/min
Release Duration	33 minutes (tank empty)

Source: TVIRD 2012, US EPA RMP

4.4.4.1 Scenario 1 - Flammable Liquid Pool Fire from Fuel Tank Leakage

Hazard related to the pool fire is the thermal radiation (heat) emitted. If the level of thermal radiation is sufficiently high, other objects which are flammable can be ignited and human health may be at risk. The damage caused by thermal radiation can be calculated from the dose of radiation received. A measure of the received dose is the energy per unit area of the surface exposed to the radiation over the duration of the exposure.

The heat radiation endpoint considered in this assessment is a fire that could cause second degree burn from a 40-sec exposure or a heat radiation equivalent to 5 kW/m^2. It was calculated using equations presented in US EPA RMP document that this heat radiation endpoint is at 393 meters away from the source. No population center is located within this identified threat zone. The nearest populated area is the employee housing area, approximately 500 meters away from the fuel storage area. People involved in the firefighting must be equipped with personal protective equipment to avoid health hazard related to thermal exposure. Table 4-20 lists the potential thermal radiation effects that may be experienced at distances shorter than the identified heat radiation endpoint.

4.4.4.2 Scenario 2 – Flammable Vapor Cloud Explosion from Fuel Storage Fire

In this scenario, it was assumed that a vapor cloud from the released diesel fuel was formed within its flammability limits, and then the cloud detonates. This then result in the explosion of other storage tanks containing gasoline and diesel fuel. Endpoint for the explosion of this vapor cloud mixture was determined as the overpressure level of 1 pound per square inch which can cause property damage and potential injuries to people. Distance to this endpoint was determined using a TNT- equivalency method as presented in Appendix A of the US EPA RMP document.

A distance of 1,018 meters was calculated to be the distance to overpressure of 1 psi. Greater overpressure risks are expected at distances closer to the source of explosion. Table 4-19 summarizes the effects of explosion overpressure greater than the 1 psi threshold.

4.4.4.3 Scenario 3 – Release of Diesel Fuel to the Environment

This accident scenario is associated with a failure of the secondary containment structure as a result of the fire event and a subsequent release of diesel fuel to the environment. The pathway would be either surface water or groundwater. This event scenario could also occur in the event of a tank rupture or mechanical failure and a failure of the secondary containment structure.

Under this scenario, it is assumed that 50% of the diesel fuel (57,000 liters) is released from the secondary containment while the remaining 50% is subject to a fire event. The diesel flow release rate is assumed to be 5 cubic meters per second. At this rate, the secondary containment will be emptied within 23 seconds with the fuel oil plume reaching a maximum distance of 500 meters from the spill site. The slope gradient of the area and volatility rate of diesel is not considered in this estimate.

Given the location of the storage facility, the risk will be the most significant at the soil surface layer with minimal risk to the surface water given potential obstructions, seepage and soil absorption rates.

Diesel fuel and oil spills or leaks from the fuel tanks or other handling activities can result in elevated levels of contaminants such as benzene, toluene and xylene in the soil. Some of these chemicals are unlikely to remain in the surface soil due to their volatility. Other compounds in diesel which will tend to be more persistent and more bound to solid particles will include the polycyclic aromatic hydrocarbons (PAHs), alkyl PAHs and alkyl benzenes. Higher concentrations of heavier PAHs will tend to remain within the soil matrix rather than migrate to the groundwater. Benzo (a) pyrene (BaP), which is present as a trace component in diesel, is largely immobile in soil and unlikely to migrate from a spill site into either adjacent soils or groundwater (Irwin, 1997).

Diesel within the surface soils may have an impact on humans, animals or plants. However, diesel in surface and near-surface soils will biologically degrade using soil oxygen that would normally be available to plant roots. This may result in vegetation distress in the immediate vicinity of the spill or release.

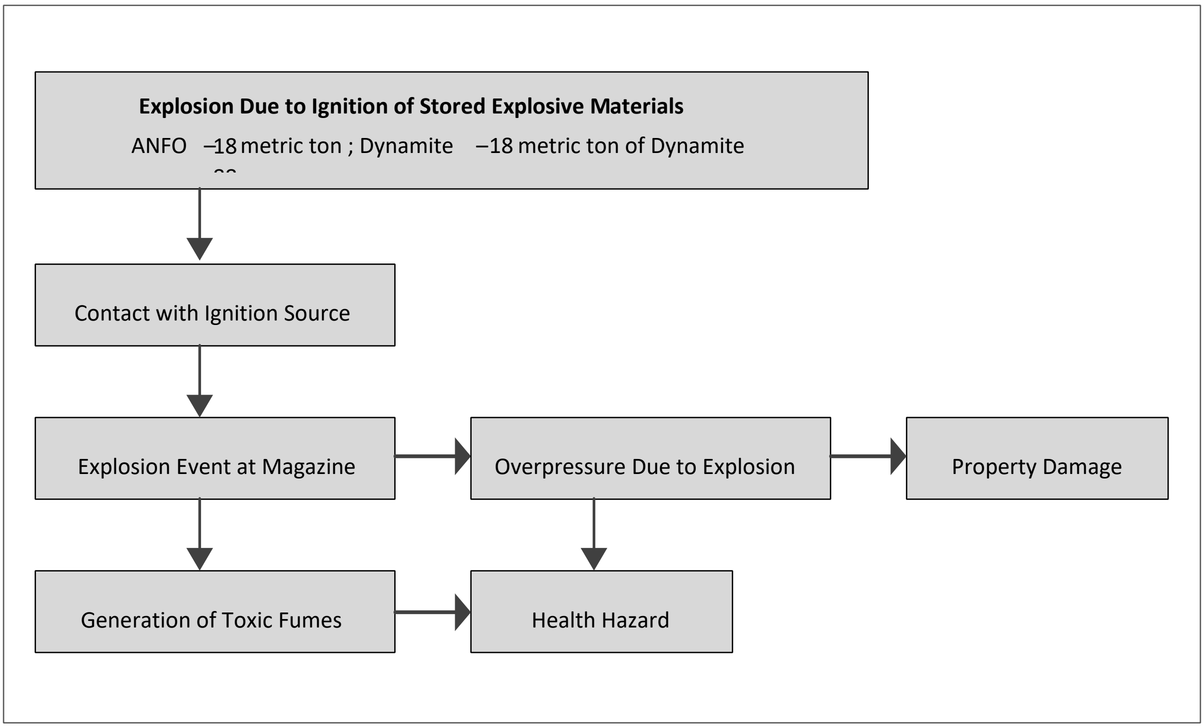
Diesel fuel spilled within natural waterbodies may contaminate plankton and algae which are food sources for larger aquatic organisms. It also prevents light from penetrating into the water, interfering with the photosynthesis within the aquatic ecosystem. This may result in some negative impact on the aquatic resources.

The potential for the spilled material to catch fire is not included in this scenario since the worst-case scenario of the whole storage area catching fire is already described in the preceding section.

4.4.5 Ignition of Explosives Magazine Area

Another potential explosion scenario involves the Explosives Magazine area for storage of blasting materials. An explosion could occur if an ignition source is present, and the conditions are complimentary. Based on calculations approved by the DND, the storage capacity of 54 tons of ANFO and 36 tons of TNT has a safety distance of 700 meters as provided in Table 4-22. The event tree for this scenario is shown on Figure 4-17.

Figure 4-17: Ignition of Explosive Magazine Event Tree

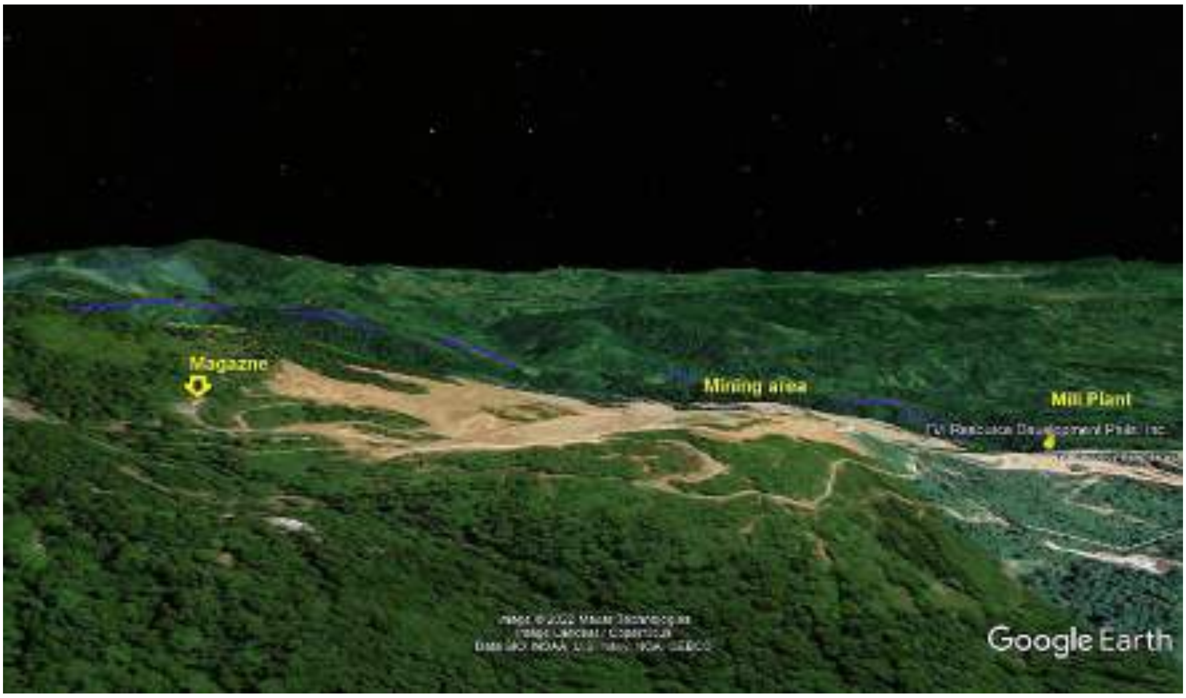


4.4.5.1 Overpressure Effects Due to Explosion

One effect of explosion accidents can be measured in terms of exposure to overpressure. Blasting releases an atmospheric pressure wave consisting of both high and low frequency sound which can cause damage when the sound pressure is high enough. The effect of overpressure on both humans and structures is shown in Table 4-23.

The effect of overpressure due to an explosion of the explosive storage warehouse was determined using the TNT Equivalent Model. This model is the principal method for calculating effects of explosions caused by detonation of either explosives, pyrotechnics or unstable substances (Lees. 1996). The model calculates the TNT equivalent mass, which represents the mass of TNT that would produce the same effects as the amount involved in the explosion. In this case, the distance of 716 meters to the plant site was sufficient not only because of the distance but because it is located on the other side of a hill above the plant site. At any case, any explosion will be away from the plant site since this will also be obstructed by the hill.

Figure 4-18: Hills Between the Mill Plant and the Magazine and the Mining Area



4.4.5.2 Toxic Gases and Fumes Due to Explosion

Another risk associated with the explosion event is the health effects of toxic gases and fumes generated by the detonation. Ideally, a detonation produces only steam (H_2O), carbon dioxide (CO_2), and nitrogen. However, poor performance of an explosive in a blast can produce toxic fumes of nitrogen dioxide (NO_2), nitric oxide (NO), and carbon monoxide (CO).

Table 4-22: Explosion Overpressure Effects at Distance

	ANFO		Dynamite		
Estimated Distance from Source (meters)	Equivalent Distance for 1 kg – TNT (meters)	Explosion Overpressure of 1,000 kg Explosives (psi)	Equivalent Distance for 1 kg –TNT (meters)	Explosion Overpressure of 1,000 kg Explosives (psi)	Effect
10	1.08	2900	0.87	4,350	Threshold of lung damage; 100% chance of fatality for a person in a building or in the open; Complete demolition of houses.
50	5.4	58.0	4.3	101.5	
100	10.8	15.2	8.7	29.0	
500	54.0	1.56	43.3	30.0	
1,000	108.0	1.0	86.2	1.5	Damage to internal partitions and joinery but can be repaired; Probability of injury is 10%. No fatality.
1500	162.0	0.65	129.9	0.8	Glass breakage; no fatality and very low probability of injury.

Source: Explosion overpressure referenced from Fig. 1 Side-on overpressure vs. scaled distance for the TNT equivalent model (I. Chem.E,1994) of the "Characteristic overpressure-impulse-distance curves for the detonation of explosives, pyrotechnics, or unstable substances.
Note: Equivalency factor determined as relative effectiveness factor of ANFO = 0.8 and Dynamite as nitroglycerine = 1.54

Exposure to these gases within the workplace is regulated using the Permissible Exposure Limit (PEL) values. These are defined as the time weighted average concentration that must not be exceeded during an 8-hour workday. Another measure of toxicity is the Immediately Dangerous to Life and Health (IDLH) criteria. These criteria represent the maximum concentration of the gas that a person may be exposed to without specialized respiratory protection. The effects of exposure to the toxic gases as well as respective PEL and IDLH criteria are summarized in Table 4-24.

The explosive magazine area will be situated in an open area with separation distances from buildings and roads as prescribed by the Mine Safety and Health standards. As such it is unlikely the toxic gas criteria will be exceeded. Manmade barricades will also be provided to prevent airborne debris from creating a human health hazard and damage to nearby structures.

Table 4-23: Toxicity Criteria and Effects of Fumes from Explosives Events

Toxic Gas	Color/Odor	PEL	IDLH	Effect of Exposure
Carbon Monoxide (CO)	Colorless/ odorless gas	50 ppm	1,200 ppm	Initial symptoms include headache, higher exposure can cause rapid heart rate and low blood pressure. Overexposure leads to nausea, impaired coordination, fainting, coma, convulsions, and death.
Nitrogen Dioxide (NO_2)	Brown gas/ pungent odor	5 ppm	20 ppm	Corrosive gas that may cause burns to skin, eyes, and lungs. NO_2 poisoning has delayed effects, with minor lung damage manifestations at first. Several hours later, lungs will be congested with fluid, characterized by labored breathing.
Nitric Oxide (NO)	Colorless gas	25 ppm	100 ppm	Acute exposure causes eye redness, abdominal pain, coughing, headache, blue skin and lips, and convulsions. NO_2 poisoning will follow as NO is simultaneously converted to NO_2.

Source: ISEE Blasters' Handbook, IDLH and PEL values from NIOSH, 1994
Note: PEL- Permissible Exposure Limits   IDLH – Immediately Dangerous to Life and Health

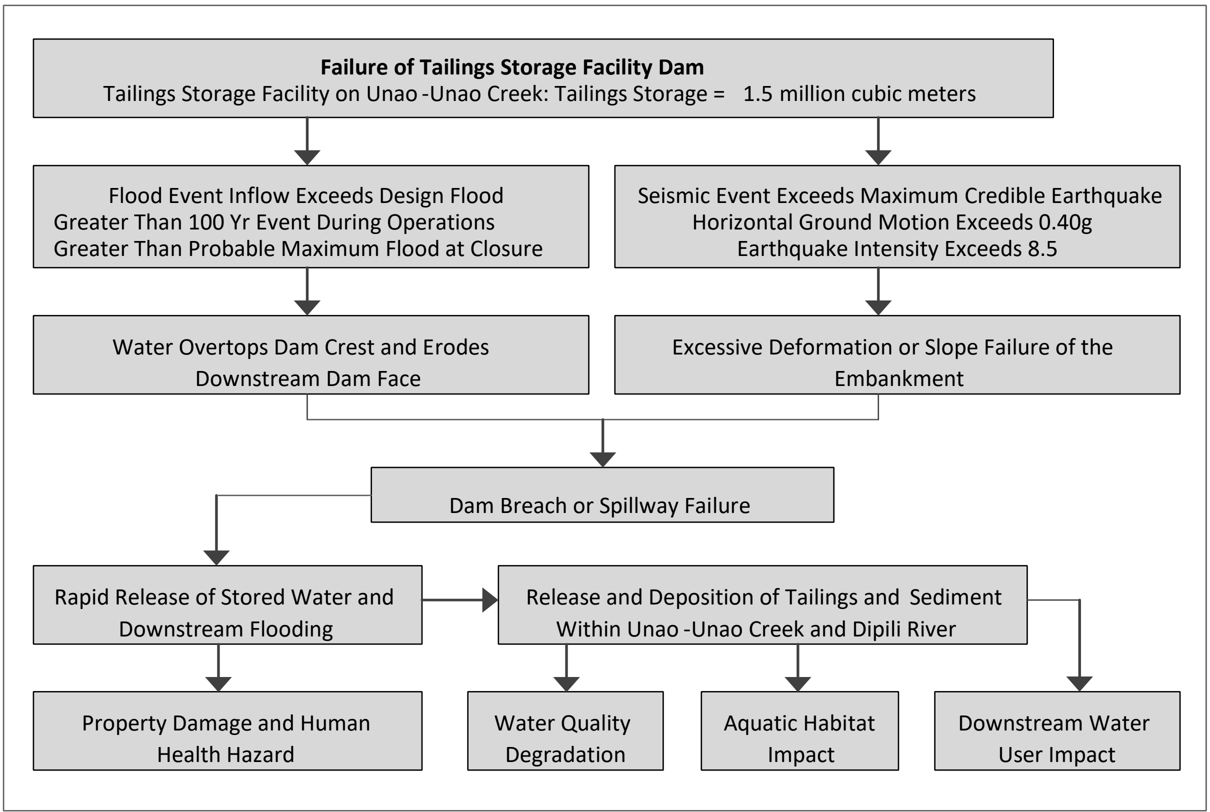
4.4.6 Tailings Storage Facility Dam Failure

Embankment dams are subject to several different methods of failure. These include foundation failure, slope failure, erosion, deformation, overtopping, piping, and liquefaction. Each failure mode may result in a partial or complete embankment failure. In nearly all cases a failure will result in some form of dam breach and the potential release of water or material stored behind the dam. For the most part these types of failures can be eliminated through proper geotechnical design and construction. Assigning a probability of failure due to these events is difficult and nearly impossible in most cases.

Natural events that could lead to a dam breach include overtopping due to a flood event greater than the design flood or a seismic event that exceeds the design earthquake. The event tree for these two scenarios is shown on
.

Hydrologic analyses performed as part of the design of the Tailings Storage Facility considered both the 100-year Flood Event and the Probable Maximum Flood (PMF) Event. Philippine regulations require the Tailings Storage Facility to be designed for the 100-year event during operations and the PMF for post mining. Since the PMF represents the extreme event, the likelihood of a dam breach due to extreme hydrologic conditions will be the highest during the operations period. Similarly, the dam is also designed to withstand the Maximum Credible Earthquake (MCE) which represents the extreme seismic event.

Figure 4-19: Failure of Tailings Storage Dam Event Tree



In the event the dam breach is caused by overtopping of the embankment, the impounded water would be released first followed by the tailings. The volume of water released would be a function of the breach size and amount of water and tailings stored at the time.

From the standpoint of a water release, the worst-case scenario would be shortly after the completion of the dam and spillway construction when the water level is at the spillway elevation and the tailings deposition is at a minimum. This would likely occur at the end of the first year of operations. The maximum volume of water stored would be approximately 1.0 to 1.3 million cubic meters. The amount of water released, and the flooding characteristics would be dependent on the size and configuration of the breach. The worst-case situation would be a full depth breach and all the water is released. The most likely scenario is a depth less than the full depth with a portion of the water remaining within the impoundment. Assuming a breach depth equal to 50% of the water depth, approximately 900,000 cubic meters of water would be released, and the peak discharge would be in the range of 40 to 50 cubic meters per second. The peak discharge would be equivalent to a 50-to-60-year flood event under current conditions without the Tailings Storage Facility.

The worst-case scenario for a tailings release would occur immediately at the end of operations when the impoundment is full of tailings and sediment. The maximum volume of tailings and sediment stored at this time would be approximately 1.54 million cubic meters. Based on historical data and studies on past tailings dam failures, an average, approximately 600,000 cubic meters of tailings, water and sediment could be released from the impoundment (Rico, et al. 2007).

Given the high percentage of solids, the flow characteristics of the release cannot be accurately determined. However, the majority of the tailings materials would be expected to be deposited within Unao-Unao Creek and probably the Dipili River. Deposition will not be uniform given the topography of the area. Reduced peak flow for both water and tailings are expected at greater distances due to attenuation and energy losses. It can be assumed that the thickness of deposited materials would be greater within Unao-Unao Creek and the upstream portion of the Dipili River.

High solids concentrations during the event and the sediment deposition can adversely affect the aquatic biota and habitat in four ways:

- Impairment of filter feeding by clogging or reduction of food quality
- Reduction of light penetration
- Physical abrasion (algae and exposed fish organs) by sediment
- Increased heat absorption and increased water temperatures

Another environmental hazard is from water quality degradation. The tailings will contain metal complexes, heavy metals and other dissolved constituents which may be toxic to aquatic species at various concentrations.

Field examination of Unao-Unao Creek and the Dipili River did not indicate structures or inhabitants along the two waterways immediately downstream of the Tailings Storage Facility. As such, the most significant impact consequences of a dam breach will likely be limited to changes in the physical characteristics of the creek and river and impacts to the aquatic species and habitat.

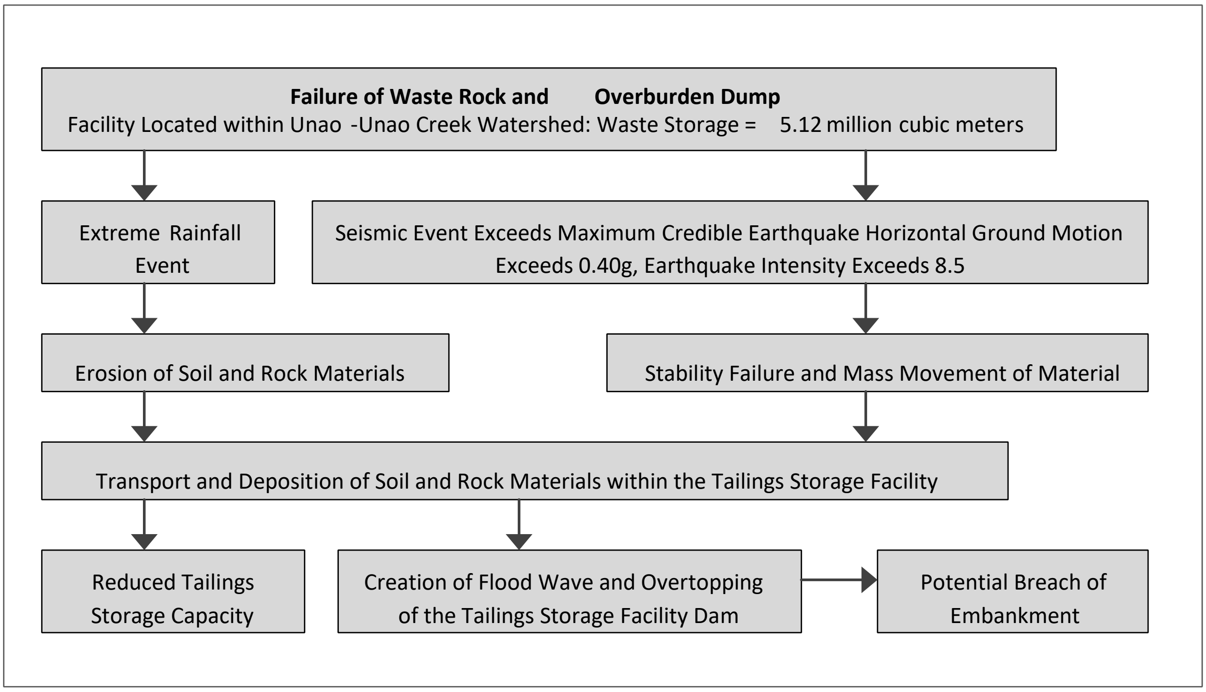
4.4.7 Waste Rock and Overburden Dump Failure

Approximately 5.12 million metric tons of overburden materials are anticipated to be generated from the surface mining operations. These materials will be placed in the identified waste dump area, located north of the surface mine and upstream of the Tailings Storage Facility. This accident scenario assumes a failure of the waste dump as a result of an extreme seismic event or an extreme hydrologic event. The failure would consist of a mass material movement downstream due to slope stability failure or extensive erosion. The event tree for this accident scenario is shown on Figure 4-20.

In the event of a waste dump failure the primary impact area will be the impoundment of the Unao-Unao Creek Tailings Storage Facility. The downstream of the toe of the waste dump is immediately upstream of the tailings impoundment. There is no other Project infrastructure located downstream of the waste dump.

The volume of waste material that could be deposited within the impoundment under a failure scenario is unknown. This could occur from a landslide event or a debris flow event. The impoundment has some additional storage capacity in excess of that required for the tailings deposition which would act as a surcharge volume. Should this occur, operations would end until other tailings management facilities could be constructed.

Figure 4-20: Failure of Waste Dump Event Tree



The most significant environmental risk associated with this event would be the displacement of existing tailings and/or creation of a wave that may overtop the dam. The greatest impact of tailings displacement would occur at the end of operations with the maximum tailings storage and the minimum water cover over the tailings. The greatest impact from a wave overtopping event would be at the completion of the dam construction with the tailings deposition at a minimum and the water depth at the crest of the overflow spillway. The available volume and freeboard for each event is shown in Table 4-24.

Table 4-24: Available Storage within the Tailings Storage Facility to Mitigate a Waste Dump Failure

Scenario	Tailings Elevation (m)	Available Storage Volume (m^3)	Event Description
Maximum Tailings Storage and Minimum Water Storage (end of operations)	Elev. 377 meters 3 meters below Spillway Crest	230,000 cubic meters for sediment storage and 230,000 cubic meters of water released.	230,000 cubic meters of material from a landslide or debris flow could be accommodated within the impoundment before the material entered the overflow spillway. The water depth is 60 % of the available freeboard resulting in a small water displacement.
Minimum Tailings Storage and Maximum Water Storage (end of Year 1 operations)	Elev. 353 meters 27 meters below Spillway Crest	1.3 million cubic meters for sediment storage and 2.3 million cubic meters of water released.	1.3 million cubic meters of material from a landslide or debris flow could be accommodated within the impoundment before the material entered the overflow spillway. The water depth is 540 % of the available freeboard resulting in a larger water displacement.

The impacts and consequences would be similar to a Tailings Dam Failure scenario. The potential for a dam breach under the maximum tailings scenario would be low. The greatest impact would be the potential for sediment and tailings to be discharged downstream through the spillway. The dam breach would be more likely under the minimum tailings storage scenario due to a large water wave created by the displacement from the sediment inflow.

4.4.8 Geologic/Meteorological Risks

The hazards, outcomes, probabilities and mitigation measures for geologic risks and meteorological risks are provided in the following table.

Table 4-25: Hazards and Mitigation Measures for Geologic Hazards

Hazard / Threat	Cause / Fault / Failure	Consequence Event(s)	Outcomes	Potential Probability (Unmitigated)	Safety Measure and Mitigation	Potential Probability (Mitigated)
Ground shaking	Earthquake	Shaking of foundation, structures	Injury or death	Moderate Risk	Avoid building on ground with high seismic attenuation potential	Low Risk
			Dam breach or collapse	High Risk	Design and construct dam, tunnels, and other facilities according to acceptable standards based on realistic earthquake scenarios and based on peak ground acceleration values	Low Risk
		Ground rupture	Tunnel collapse	High Risk	Use strong containment materials/methods for storage of chemicals and explosives	Low Risk
		Slope failure	Damage / destruction of other facilities	High Risk	Establish an Earthquake Emergency Response Plan	Low Risk
			Loss / reduction of access	High Risk		Low Risk
			Explosion or fire	Moderate Risk		Low Risk
Ground rupture	Earthquake	Formation of ground cracks	Injury or death	Low Risk / no nearby active faults	Avoid building on active or inactive fault lines	Low Risk
		Uplifting/ subsidence of ground	Dam breach or collapse	Low Risk / no nearby active faults	Design and construct dam, tunnels and other facilities according to acceptable standards based on realistic earthquake scenarios	Low Risk
			Tunnel collapse	Low Risk / no nearby active faults	Use strong containment materials/methods for storage of chemicals and flammable/explosive substances	Low Risk

			Damage / destruction of pipelines	Low Risk / no nearby active faults	Establish an Earthquake Emergency Response Plan	Low Risk
			Damage / destruction of other facilities	Low Risk / no nearby active faults	Use strong containment materials/methods for storage of chemicals and flammable/explosive substances	Low Risk
			Loss / reduction of access	Low Risk / no nearby active faults	Establish an Earthquake Emergency Response Plan	Low Risk
			Explosion or fire	Low Risk / no nearby active faults		Low Risk
Earthquake-induced landslide	Earthquake	Slope failure	Injury or death	Moderate Risk	Avoid building on highly fractured steep slopes	Minimal Risk
			Dam breach or collapse	Moderate Risk	Design and construct dam, tunnels and other facilities according to acceptable standards based on realistic earthquake scenarios	Minimal Risk
			Damage / destruction of pipelines	Moderate Risk	Use strong containment materials/methods for storage of chemicals and flammable/explosive substances	
			Damage / destruction of other facilities	Moderate Risk	Establish an Earthquake Emergency Response Plan	Minimal Risk
			Loss / reduction of access	Moderate Risk		Minimal Risk
			Explosion or fire	Moderate Risk	Use strong containment materials/methods for storage of chemicals and flammable/explosive substances	Minimal Risk

Table 26: Meteorological Hazards and Mitigation Measures

Hazard / Threat	Cause / Fault / Failure	Consequence Event(s)	Outcomes	Potential Probability (Unmitigated)	Safety Measure and Mitigation	Potential Probability (Mitigated)
Rain-induced slope failure	High water pressure Saturation of Sols	Slope failure	Injury or death	Moderate Risk	Avoid building in areas with previously recorded rain-triggered landslides	Moderate Risk
			Dam breach or collapse	Low Risk	Avoid building in areas with steep slopes	Moderate Risk
			Tunnel collapse	Low Risk	Provide appropriate drainage systems to reduce water saturation in ground	Moderate Risk
			Damage / destruction of pipelines	Low Risk	Engineer stable slopes	Moderate Risk
			Damage / destruction of other facilities	Moderate Risk	Set up piezometers and other groundwater / seepage monitoring systems	Moderate Risk
			Loss / reduction of access	Moderate Risk	Access stability/maintenance and signages	Moderate Risk
Flooding	Intense rainfall	Inundation of facilities	Injury or death	Low Risk	Avoid building in low-lying areas and natural drain ways of floods	Minimal Risk
			Dam breach or collapse	Low Risk		Minimal Risk
Tropical cyclones	Weather systems	Intense rainfall	Injury or death	Moderate Risk	Keep updated with the latest weather bulletin	Minimal Risk
		Flooding	Dam breach or collapse	Low Risk	Design and maintain sufficient freeboard	Minimal Risk
		Strong winds	Tunnel collapse	Low Risk	Monitor ground pore water pressure	Minimal Risk

		Slope failure	Damage / destruction of pipelines	Low Risk	Design spillway that can accommodate extreme weather discharges	Minimal Risk
			Damage / destruction of other facilities	Moderate Risk	Limit exposure to the elements during extreme weather	Minimal Risk
			Loss / reduction of access	Moderate Risk	Access stability/maintenance and signages	Minimal Risk
Heavy rainfall	Tropical cyclones Monsoon rains	Flooding Slope failure	Injury or death	Low Risk	Keep updated with the latest weather bulletin	Minimal Risk
			Dam breach or collapse	Low Risk	Design and maintain sufficient freeboard	Minimal Risk
			Tunnel collapse	Low Risk	Monitor ground pore water pressure	Minimal Risk
			Damage / destruction of pipelines	Low Risk	Design spillway that can accommodate extreme weather discharges	Minimal Risk
			Loss / reduction of access	Moderate Risk	Provide sufficient drainage system Limit exposure to the elements during extreme weather	Minimal Risk

4.5 SAFETY PERFORMANCE

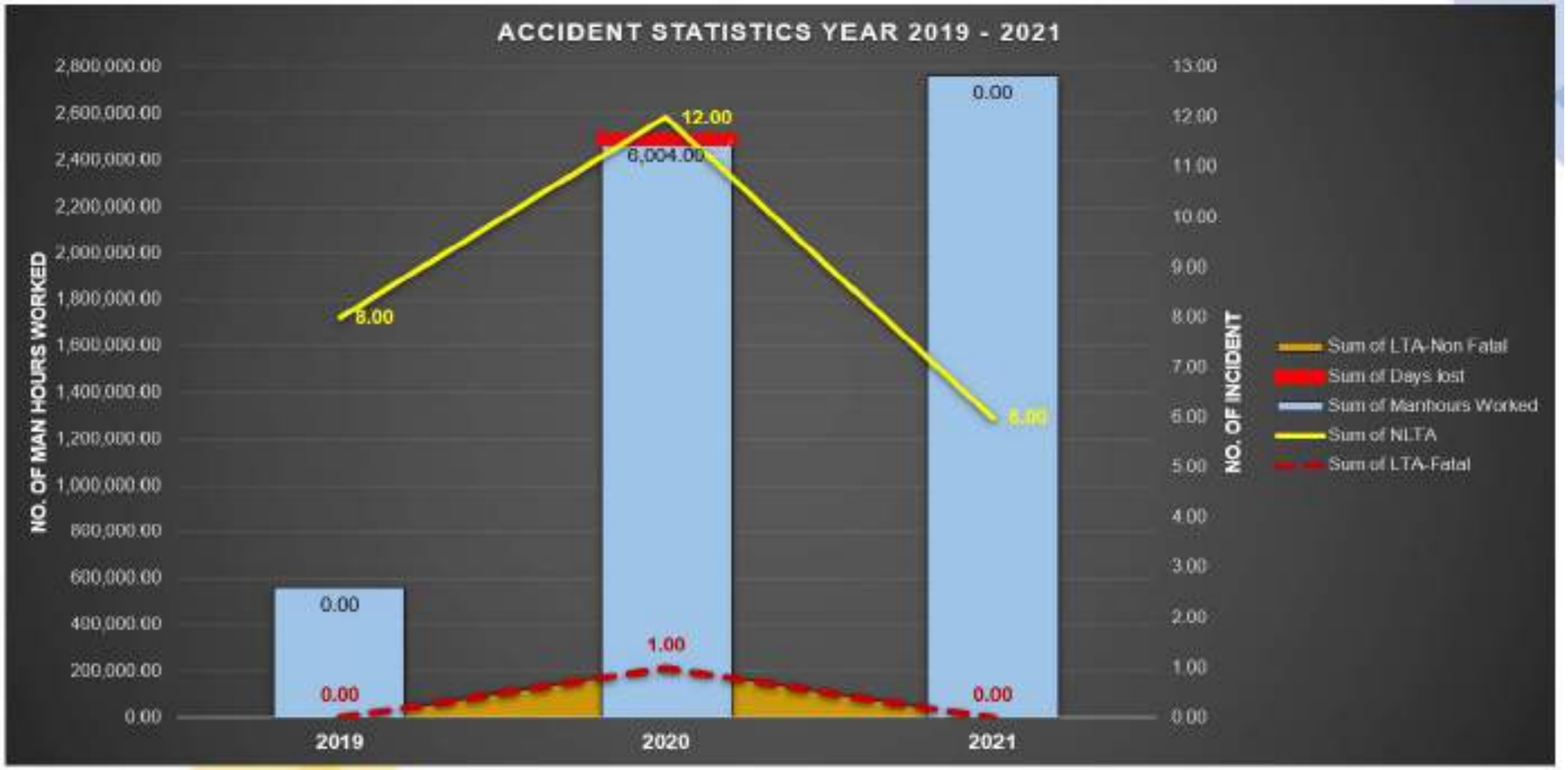
A total of 4,229,655.83 million man-hours of work with no lost time accident as May 2022 was achieved by the Company operations since it started its commercial operation in 2021. Some cases of Non-Loss Time Accidents (NLTA) were noted in Year 2021. Most of these accidents are first aid cases. Stricter implementation of the safety protocols has been put into place to minimize occurrence of these incidents, shown in last the quarter of 2021.

The annual safety key performance indicator statistics through the Project's first year commercial operation, are summarized in Table 4-27. All the safety parameters are complied, based on the requirements set by DAO 2000-98: Mine Safety and Health Standards, DOLE DO 198-18: Implementing Rules and Regulations of RA 11058 Entitled "An Act Strengthening Compliance with Occupational Safety and Health Standards and Providing Penalties for Violations Thereof", MGB Safety and Health, Environment, and Social Development and Management (SHES) Manual 2021.

Table 4-27: Annual Safety Key Performance Indicator Statistics

Safety Performance Indicator		Year 2021 - 2022																	
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Total
First Aid Accident Case		1	2	0	1	0	0	0	1	1	0	0	0	1	2	2	2	0	13
Equipment/Vehicle Accident Case		0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Near Miss Case		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lost Time Accidents (Non-Fatal)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lost Time Accidents (Fatal)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Days Lost		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Manhours Worked		181,984	174,602	209,916	162,443	172,697	198,257	239,727	259,435	272,874	301,695	290,189	301,067	279,021	274,067.50	314,029.22	296,813.61	298,838.50	4,229,655.83
Manpower Headcount	Male	615	652	716	728	795	722	768	865	897	927	1,006	993	941	1,023	1,071	1,066	1,107	962
	Female	75	74	78	83	87	86	86	86	85	86	91	91	90	86	91	89	90	
	Total	690	726	794	811	882	808	854	951	982	1,013	1,097	1,084	1,031	1,109	1,162	1,155	1197	
	IR	5.49	11.45	0.00	6.16	0.00	0.00	0.00	3.85	3.66	0.00	0.00	0.00	3.58	7.30	9.55	6.69	0.00	3.31

Figure 4-21: Accident Statistics from 2019-2021



The 2019-2021 accident distribution shows that out of the total of 26 recorded incidents, 24 are associated to TVIRD-BGSP (including the 1LTA-Fatal and 1 LTA-Non-Fatal) and 2 are from its Contractor. Most of the incident happened during the early period of development/construction phase.

4.5.1 2019-2021 Accident Distribution by Cause

The submitted safety and health reports further show that of the 26 recorded accidents 16 are due to unsafe action and only 4 are due to unsafe condition and 6 are poor planning or can also be considered as unsafe action.

Since the Company is already an ISO Certified Company (ISO 14001:2015), the following control measures are being implemented to reduce and further prevent incidents/accidents:

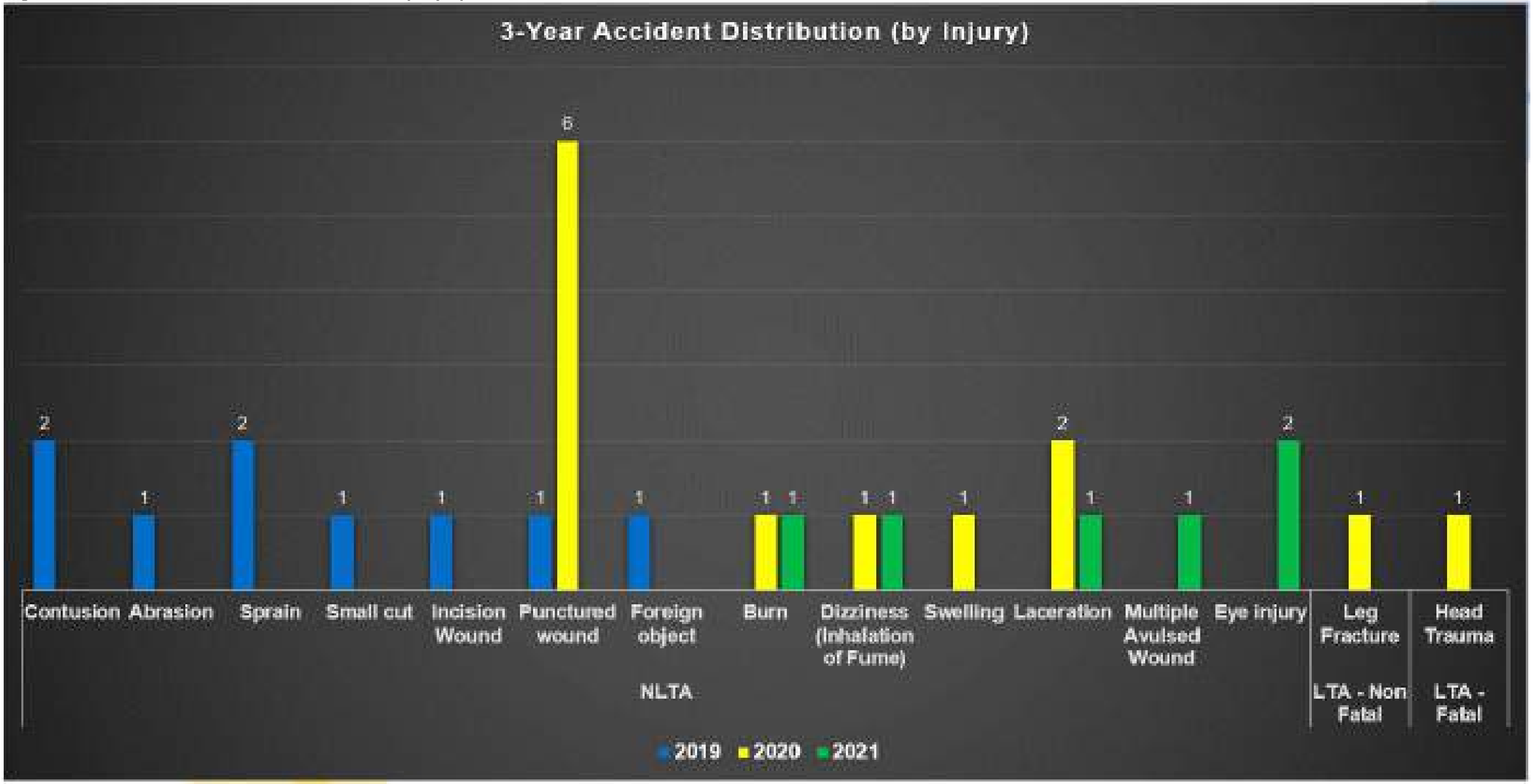
- Conduct of regular toolbox, coordination meetings, and Central Safety and Health Committee meetings.
- Trainings and Development, and regular conduct of Emergency Drills
- Regular information dissemination of working procedures to every Department and workers/ IEC Campaign.
- Conduct of daily site inspections in all working areas.
- Availability of 24-hours Clinic with Doctor, Nurses, and Emergency Response Team
- Availability of well-stocked first aid kit in all areas
- Implementation of Emergency Preparedness and Response Plan
- Risk Management Approach

Table 4-28: 2019-2021 Accident Distribution by Cause

Factor	2019												2020												2021											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Non-compliance w/ standards	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	1	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Unfit to work	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Unsafe Working Condition	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	1	0	0	0
Lack of Training/ Instruction	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	1	0	0	0	0
Use of Defective Tools	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Inadequate Tools/Equipment	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Poor Planning/ Coordination	0	0	0	0	0	2	0	0	0	0	1	1	0	0	1	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Others	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Legend:
NLTA (green)
LTA-Non Fatal (yellow)
LTA-Fatal (red)

Figure 4-22: 2019-2021 Accident Distribution by Injury



4.5.2 Emergency Drills for YEARS (2019-2022)

TVIRD-BGSP regularly conducts an emergency preparedness and response related drill as part of the Annual Safety and Health Program under the element of Emergency Response and Preparedness Program. In the last three (3) years of implementation, period 2019-2021, TVIRD-BGSP's Emergency Response Reports data shows a focused-on preparedness and awareness trainings, emergency simulations and exercises, routine activities, and actual emergency responses to both onsite and community medical related emergencies.

Training is conducted mostly monthly to quarterly from basic to advance first aid, earthquake drills, hazmat and oil spill response, firefighting, confined space rescue, and high angle rescue among other general and specialized training needed for a specific type of activity. Routine activities are conducted daily and monthly that involves monitoring, inspection, and maintenance of fire alarm system, lightning tracker monitoring, emergency mobile equipment, fire hydrant and hoses maintenance, fire extinguisher, explosive storage, emergency lights, oil, and chemical spill kits, first aid kit, emergency shower, an eyewash station, fire pump, and piping system inspection/test, water pumps, mechanical and electrical source of energy, and other Emergency Response Team (ERT) equipment inventory at ERT storage box. In 2019, during the ongoing pre-development and construction stage the readiness of the team in any site emergencies particularly the fire-related incident, significant to minor personal injury, equipment or vehicular emergencies, and other related emergencies were timely responded to and managed, up to this time 2022 wherein more completed and trained ERT was established.

The ERT continued to upgrade their skills in Firefighting by facilitating the conduct of the Fire Competency Training Course attended by all ERT Members and a group of contractors conducted by the Provincial Fire Station (BFP). Safety and Health-related training continued throughout the year 2020 up to the 1st quarter of 2022. As of now an average of 200 participants attended the different pieces of training conducted by the TVIRD-BGSP Safety and Health Department.

As part of the company's social commitment, the community was also catered through medical outreach, consultation, and even assistance in the event of an emergency. Also, they were included in the emergency preparedness through training and provision of emergency vehicles and equipment.

To further improve and strengthen the team skills in responding to medical, traumatic incidents, and mass casualty incidents, well-equipped trainings was provided thru a partnership with PDRRMC Agusan Del Norte Training Team and Philippine Red Cross Pagadian Chapter during the conduct of Standard First Aid, Basic Life Support and Mass Casualty Incident Training and ICS. Relevant to challenging rescue and recovery, the Bureau of Fire Protection-Special Rescue Force were also tapped to conduct special training on rescue particularly if the incident involves high-angle rescue, cliff rescue, and other critical rescue and recovery activity.

As stipulated in the Annual Safety and Health Program from 2019 to 2022, the Safety and Health Department proactively conducted several Simulation Drills to avert or minimize the effects of any on-site/off-site emergencies which are stated herein:

1. Trauma Response and Rescue Exercises
   a. Mass Casualty Incident
   b. Car Crush Accident
   c. Hauling Accident
   d. Truck Fall-off Cliff Accident
2. Fire Drills
   a. Mill Plant Fire Incident
   b. Helicopter Fire Incident
   c. Fire after the earthquake

3. Earthquake Drill
4. Chemical Spill Incident Drill
5. Oil Spill Incident Drill
6. COVID-19 Response Drill

The stated drills were to strengthen not just the ERT but also the Employee's competency in order to continually improve the Company's Safety Performance and provide a quality standard of Safety and Health Management System.

As training in First Aid, Basic Life Support and Fire Extinguisher training course are continuously scheduled in all personnel, specialized skills training among ERT responders, weekly and daily risk assessments are also employed.

Working areas especially those with high-risk category were familiarized by the Safety and ERT team. During the conduct of any drills, issues or observations were discussed to identify areas for improvement and to identify the gaps and requirements in doing emergency response. The simulations and exercises continued with the objective of generating actions for the improvement in emergency preparedness and response. With this, the Safety and Health team in cooperation of the concern department or process owner conducted several simulations involving potential risk within their operation such as electrical fire incidents, flammable liquid, or gases fires, contact with energy (mechanical/electrical/pneumatic) incident, chemical spill or leak, oil spills, traffic related incident among others and even the natural event like earthquake. These simulation drills identified various steps that improved the emergency responses, equipment to be provided and maintained, equipment to be purchased, capability and skills of the ERT, and the awareness or consciousness of all employees which are part of the operation or activity.

For the period 2019 to 1st quarter of year 2022, only very minimal incident of oil spill was monitored (from repair of mobile vehicle) and promptly addressed by contractors and turn-over to MEPEO the contaminated earth materials and only 1 incident were recorded at mill plant (burst of diesel supply line) and was appropriately responded and controlled by the Fixed Plant, MEPEO, and ERT. The burst was recorded on April 14, 2021, after the diesel oil spilled from ground when the pipeline accidentally hit by the arm of the excavator unit. This single oil spill incident in the past five (3) years can be considered minimal as compared to the scale of the project's operation. Another incident of gas leak was recorded on December 22, 2021, wherein the hydrochloric pipe accidentally burst inside the containment area, the leaked created foggy vapor, the incident was immediately responded by Fixed Plant and ERT to contain and control. Also, it further shows that this single incident can be attributed to the effective implementation of in-place procedures and management system.

Photographs of the training and programs are shown below together with the emergency preparedness drills and simulations.

Photo 4-1: 1st First Aid, Basic Life Support, and Mass Casualty Training under PDRRMC

Photo 4-2: Basic Occupational Safety and Health Training (40-Hours BOSH)

Photo 4-3: Basic Rescue and Rope Technique Training by Bureau of Fire Protection (BFP) – Special Rescue Forces (SRF)

Photo 4-4: 2nd First Aid and BLS Training

Photo 4-5: Refresher Training on BLS (Basic Life Support)

Photo 4-6: Basic Firefighting (Fire Extinguisher)

Photo 4-7: Safety Leadership, JHA and Accident Incident Investigation Training

Photo 4-8: Lecture on Chemical Spill Emergency Preparedness and Response to Met Lab and Process Plan Operation Personnel

Photo 4-9: LOTOTO Training for Fixed Plant Personnel

Photo 4-10: Annual General Workplace Safety and Health Orientation and Onboarding Orientation

Photo 4-11: Contractors Basic Safety Rules and Regulations, Smoking Policy, Safety Procedures and Policies

Photo 4-12: Emergency Drill on Mass Casualty Incident

Photo 4-13: Emergency Drill on Covid-19 Response Inclusing the Use of PPE

Photo 4-14: Oil Spill Emergency Response Drill ath the Hazardous Waste Storage Facility

Photo 4-15: Emergency Drill with Situation: The Helicopter was on Fire and the Pilot was Rescued by the ERT

Photo 4:16: Chemical Spill Drill at Assay Laboratory

Photo 4-17: Mass Casualty Incident Drill

Photo 4-18: Fire Response Drill

Photo 4-19: Car Crush and Truck Fall-Off Cliff Accident Drill

Photo 4-20: Emergency Response Equipment

5. SOCIAL DEVELOPMENT PLAN AND IEC FRAMEWORK

5.1. COVERAGE OF IMPACT AREAS

The Social Development and Management Plan (SDMP) for the Balabag Gold-Silver Project was based on the stipulated provisions of DAO 2010-21 which aims to promote the general welfare of the community and sustain improvement in the living standards of the host and neighboring communities by creating responsible, self-reliant and resource-based communities capable of developing, implementing and managing community development programs, projects, and activities in a manner consistent with the principle of people empowerment.

Further, Condition No. 10.e of the Project's original ECC (ECC-CO-1301-0004) requires…" *Implementation of a Social Development and Management Program (SDMP) in coordination with complementing the development plans of the affected barangays. The SDMP shall be submitted to MGB Regional Office No. 9 for approval prior to project implementation. Likewise, the EMB Central Office and Regional Office (EMB Region IX) shall be furnished with the approved EPEP and SDMP within thirty (30) days from its approval*…"

Hence, the design and implementation of the social component of the Balabag Gold-Silver Project and the overall intent of these section consist of the following:

- The Contractor/ Permit Holder/ Lessee shall assist in the development of the host and neighboring communities in accordance with its Social Development Management Plan (SDMP) to promote the general welfare of the inhabitants living therein.

- The Contractor/ Permit Holder/ Lessee shall develop a program for the advancement of mining technology and geosciences to build up resources and mineral discoveries, improve operational efficiency and resource recovery, and enhance environmental protection and mine safety.

- The Contractor/ Permit Holder/ Lessee shall develop and institutionalize an Information, Education and Communication (IEC) Program for greater public awareness and understanding of responsible mining and geosciences.

The programs/ projects/ activities (P/P/As) summarized under the SDMP to develop the host and neighboring communities include the following activities:

- Human Resource Development and Institutional Building.
- Enterprise Development and Networking.
- Assistance to Infrastructure Development and Support Services.
- Access to Education and Educational Support Programs.
- Access to Health Services, Health Facilities and Health Professionals.
- Protection and Respect of Socio-Cultural Values.
- Use of facilities/ services within the mine camp or plant site, such as hospitals, among others, by members of the host and neighboring communities.

For the development of mining technology and geosciences, the P/P/As are:

- Basic and applied research on mining technology, geosciences, and related subjects.
- Advanced studies, related to mining which are conducted by qualified researchers, who are not employees of the mine.
- Expenditures for scholars, fellows, and trainees, including grants for dissertations, on mining technology and geosciences and related subjects.
- Expenditures on equipment and capital outlay as assistance for research and/ or educational institutions which serve as a venue for developing mining technology and geosciences.

Lastly, the P/P/As for the promotion of public awareness and education on mining technology and geosciences consist of the following:

- Establishment/ enhancement/ maintenance of information and publicity centers where stakeholders can access information on the performance of a mining project.
- Publication of IEC materials on social, environmental, and other issues/ concerns relative to mineral resources development and responsible mining operations.
- Expenditures for continuing public awareness and education campaigns such as radio and web-based broadcasts, publications, and other forms of mass communication, on mining-related information, issues and concerns.
- Expenditure on equipment and capital outlay as assistance to the institutionalization of public awareness and education on mining technology and geosciences.

5.2. COVERAGE OF IMPACT AREAS

The mine impact communities are defined as those areas directly or indirectly affected by mining operations in terms of social, economic, political, and environmental aspects. In terms of the social aspect of the Project, there are three levels of impact communities. These are defined and identified below and in Table 5-1. The locations of the impact areas are shown on Figure 5-1.

- Host Communities – These represent the areas directly affected by the mining operations. During the pre-development, development, and commercial operation phase, the host community is Sitio Balabag in Barangay Depore. Considering the expansion of project components, Brgy. Dimalinao will now be identified also as host community.

- Neighboring Communities – These are the barangays that are within proximity of coverage of the MPSA and primary impact areas of mine operations. Now that Brgy. Dimalinao is a host community, only Brgy. Pulangbato and Brgy. Dipili will be identified as neighboring communities. All these communities are in the Municipality of Bayog.

- Secondary Communities – These are the barangays that are along the route of transport to and from Bayog and other key areas of the Balabag Project. These areas do not necessarily benefit from major SDMP but may have access to community assistance on a case-to-case basis. The secondary communities include Brgy. Guinoman in the Municipality of Diplahan; Brgy. Bantal, Brgy. Poblacion, Brgy. Depase, Brgy. San Isidro, Brgy. Lamare, Brgy. Damit and Brgy. Salawagan in the Municipality of Bayog.

Figure 5-1: SDMP Designated Host, Neighboring and Secondary Impact Communities

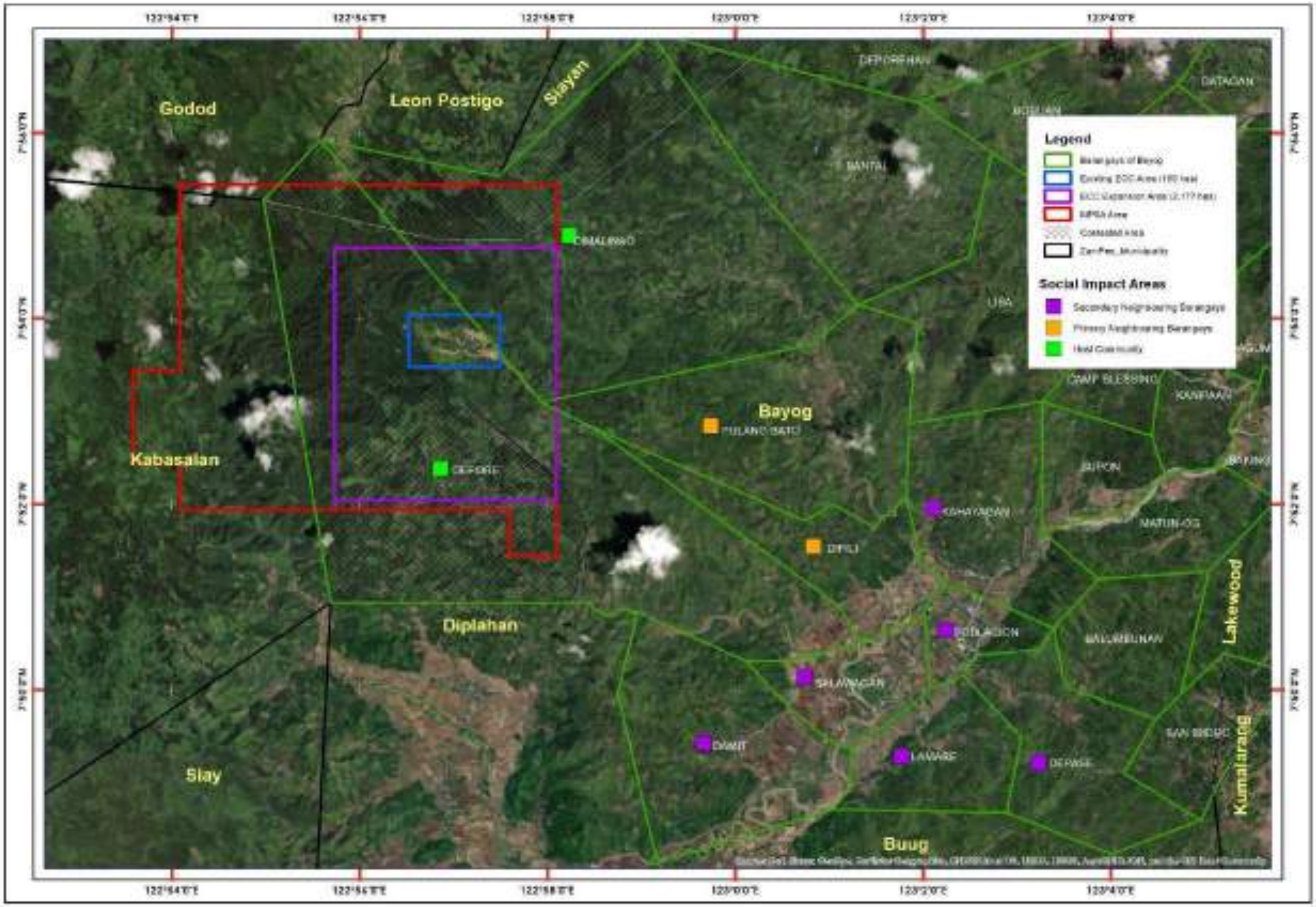


Table 5-1: Host, Neighboring and Secondary Communities of the Project

Impact Barangay	Municipality	Impact Category
Host Community		
Depore	Bayog	Location of Key Facilities (Mine Area, Waste Dump Area, and other Ancillary Facilities)
Dimalinao	Bayog	Location of Key Facilities (TSF)
Neighboring Communities		
Pulangbato	Bayog	Route of Transport
Dipili	Bayog	Route of Transport
Secondary Communities		
Guinoman	Diplahan	Road for Exploration Activities
Bantal	Bayog	Highest IP (Subanon) concentration in Bayog
Poblacion	Bayog	Location of Satellite Office/ Main Access Road
Lamare	Bayog	Potential Environmental Concerns
Damit	Bayog	Potential Environmental Concerns
Salawagan	Bayog	Potential Environmental Concerns
Depase	Bayog	Route of Transport
San Isidro	Bayog	Route of Transport

5.3. SOCIAL DEVELOPMENT FRAMEWORK

The SDMP for the Balabag Gold-Silver Project was based on the most Project appropriate P/P/As identified under DAO 2010-21. Detailed program was developed prior to commercial operation by the Company's Community Relations Office (CRO).

On November 26, 2019, MGB Regional Office IX has approved the 1st 5-Year SDMP of the Company for CY 2019-2023. The total committed SDMP fund is Php 153,592,000.00. As of 2021, the Company have already implemented a total amount of Php 36,672,150.28 which is 24 % of the total committed budget. This holds an impression that TVIRD is progressively implementing its social program for its host, neighboring, and secondary community.

Based on the approved SDMP and for effective implementation of the same, Annual SDMP is submitted annually to MGB Regional Office IX for approval and implementation. These programs are funded on an annual basis by allocation of a minimum of one and a half percent (1.50%) of the operating cost. This amount is further apportioned to 1.125% (75% of 1.50%) to implement the SDMP, 0.15% (10% of 1.50%) for the implementation of program for Development of Mining Technology and Geosciences, and 0.225% (15% of 1.50%) for the implementation of Information, Education and Communication programs.

The approved financial plan for the 5-year SDMP of TVIRD from 2019 to 2023 is presented in Table 5-2, While the details of the P/P/As for each SDMP component are presented in Table 5-3 to Table 5-5.

Table 5-2: Financial Plan of the 5-Year Social Development and Management Plan

Year	Annual Budget	IEC Component (15%)	DMTG (10%)	DHNC (75%)
2019	1,800,000	867,000	100,000	833,000
2020	11,070,000	1,660,500	1,107,000	8,302,500
2021	23,628,000	3,544,200	2,362,800	17,721,000
2022	8,514,000	1,277,100	851,400	6,385,500
2023	8,580,000	1,287,000	858,000	6,435,000
Total	53,592,000	8,635,000	5,279,200	39,677,000

Table 5-3: 5-Year SDMP Plan for IEC (2019-2023)

Project/Program/Activity (PPA)	5-Year SDMP Budget	Yearly Budget				
		2019	2020	2021	2022	2023
Stakeholders' Meeting	3,753,330.00	867,000.00	881,000.00	1,308,240.00	342,090.00	355,000.00
Brgy. Depore						
Capacity Development on Environmental Management and Protection	100,000.00	-	50,000.00	50,000.00		
Capacity Development on Abaca and Rubber Farming	100,000.00	-	50,000.00	50,000.00		
Capacity Development for Elementary and Highschool Teachers	150,000.00	-	50,000.00	50,000.00	50,000.00	
Capacity Development for Barangay Health Workers & Midwives	150,000.00	-	50,000.00	50,000.00	50,000.00	
Capacity Development for Operators of Rice and Corn Mill	100,000.00	-		50,000.00	50,000.00	
Capacity Development for MRF usage and maintenance	100,000.00	-	50,000.00	50,000.00		
Capacity Development for Peoples Organization on Values, Procedures, Financial Management	50,000.00	-		50,000.00		
Total	**750,000.00**	**-**	**250,000.00**	**350,000.00**	**150,000.00**	**-**
Brgy. Dipili						
Capacity Development on Hollow Block Making	50,000.00	-		50,000.00		
Capacity Development on Dress Making	50,000.00	-		50,000.00		
Capacity Development on the Usage and Maintenance of Post-Harvest Facilities and Equipment	50,000.00	-		50,000.00		
Capacity Development of BDRRMC	100,000.00	-	50,000.00	50,000.00		
Capacity Development on Tuberculosis Prevention	100,000.00	-	50,000.00	50,000.00		

Capacity Development for Peoples Organization on Values, Procedures, Financial Management	100,000.00	-	50,000.00	50,000.00		
Capacity Development for Elementary and Highschool Teachers	-	-	-	-	-	-
Capacity Development for Barangay Health Workers & Midwives	-	-	-	-	-	-
Capacity Development on Proper Waste Disposal	100,000.00		50,000.00		50,000.00	
Total	**550,000.00**	**-**	**200,000.00**	**300,000.00**	**50,000.00**	**-**
Brgy. Pulangbato						
Capacity Development for Peoples Organization on Values, Procedures, Financial Management	100,000.00	-	50,000.00	50,000.00		
Capacity Development on Cardava Banana Production	100,000.00	-	50,000.00	50,000.00		
Capacity Development on Food Processing Projects for Women	100,000.00	-		50,000.00	50,000.00	
Capacity Development on the Usage and Maintenance of Post-Harvest Facilities and Equipment	100,000.00	-	50,000.00	50,000.00		
Capacity Development for Elementary and Highschool Teachers	100,000.00	-		50,000.00	50,000.00	
Capacity Development for BHW & Midwives	100,000.00	-		50,000.00	50,000.00	
Capacity Development on Proper Waste Disposal	50,000.00	-	50,000.00			
Total	**650,000.00**	**-**	**200,000.00**	**300,000.00**	**150,000.00**	**-**
Brgy. Dimalinao						
Capacity Development for Peoples Organization on Values, Procedures, Financial Management	100,000.00	-	50,000.00	50,000.00		

Capacity Development on Abaca and Rubber Farming	100,000.00	-	50,000.00	50,000.00		
Capacity Development on Abaca and Rattan Furniture and Handicraft	100,000.00	-	50,000.00	50,000.00		
Capacity Development on the Usage and Maintenance of Post-Harvest Facilities and Equipment	100,000.00	-	50,000.00	50,000.00		
Capacity Development for Elementary and Highschool Teachers	100,000.00	-		50,000.00	50,000.00	
Capacity Development for BHW & Midwives	100,000.00	-		50,000.00	50,000.00	
Capacity Development on Proper Waste Disposal	50,000.00	-		50,000.00		
Total	**650,000.00**	**-**	**200,000.00**	**350,000.00**	**100,000.00**	**-**

Table 5-4: 5-YR SDMP on Development of Mining Technology and Geosciences (DMTG)

Project/Program/Activity (PPA)	Barangay/Location	5Year SDMP Budget	2019	2020	2021	2022	2023
Scholarship Program & Skills Development (mining, environment & geosciences)	Brgy. Depore	1,197,040.00		157,400		250,480	190,000
Scholarship Program & Skills Development (mining, environment & geosciences)	Brgy. Dipili	862,320		193,050		112,860	156,410
Scholarship Program & Skills Development (mining, environment & geosciences)	Brgy. Pulang Bato	862,320		193,050		112,860	156,410
Scholarship Program & Skills Development (mining, environment & geosciences)	Brgy. Dimalinao	862,320		193,050		112,860	156,410
DMTG to Secondary Barangays and/or Mining Related Trainings, Seminars, and Events		1,495,200	100,000	370,450	568,640	262,340	198,770
Total		**5,279,200.00**	**100,000.00**	**1,107,000.00**	**2,362,800.00**	**851,400.00**	**838,000.00**

Table 5-5: 5-YR SDMP on Development of Host and Neighboring Communities (DHNC)

A.	Health Services, Health Facilities and Health Professionals	Barangay/ Location	5-Year SDMP Budget	Yearly Budget				
				2019	2020	2021	2022	2023
1	Medical/Hospitalization Support in 4 host barangays)	4 Host & Neighboring Barangays	40,000.00	40,000.00				
Brgy. Depore								
1	Provision of medical equipment, medical/ financial assistance, and supplies to Barangay Health Center	Brgy. Depore	500,000.00		100,000.00	200,000.00	100,000.00	100,000.00
2	Assistance/ Support to Barangay Health Worker	Brgy. Depore	244,000.00		36,000.00	36,000.00	100,000.00	72,000.00
3	Assistance/Support to Barangay Midwife & CVO	Brgy. Depore	538,000.00		96,000.00	150,000.00	100,000.00	192,000.00
4	Provision of PhilHealth Benefits	Brgy. Depore	300,000.00		60,000.00	60,000.00	60,000.00	120,000.00
5	Feeding Program for school children	Brgy. Depore	150,000.00		50,000.00	100,000.00		
6	Provision of Medicines	Brgy. Depore	250,800.00		50,000.00	50,000.00	50,000.00	100,800.00
7	Level 2 expanded Water system	Brgy. Depore	450,000.00		200,000.00	150,000.00	100,000.00	
8	Establishment of Material Recovery Facility	Brgy. Depore	50,000.00		50,000.00			
9	Construction of Public Toilet at Purok 7	Brgy. Depore	50,000.00		50,000.00			
10	Purchase of Emergency vehicle	Brgy. Depore	600,000.00			600,000.00		
	Total		**3,172,800.00**	**40,000.00**	**692,000.00**	**1,246,000.00**	**510,000.00**	**584,800.00**
Brgy. Dipili								
1	Expansion of the existing Level 2 water system	Brgy. Dipili	990,050.00		190,050.00	300,000.00	500,000.00	
2	Feeding Program	Brgy. Dipili	175,000.00		25,000.00	50,000.00	100,000.00	
3	Provision of medical equipment, medical/ financial assistance, and supplies to Barangay Health Center	Brgy. Dipili	1,175,000.00		275,000.00	400,000.00	500,000.00	

4	Tuberculosis Directly Observed Treatment Short-course medicine package	Brgy. Dipili	165,950.00		20,000.00	50,000.00	95,950.00	
5	Assistance/Support to Brgy Midwife	Brgy. Dipili	350,000.00		20,000.00	60,000.00	150,000.00	120,000.00
6	Provision of PhilHealth Benefits	Brgy. Dipili	120,000.00		20,000.00	50,000.00	50,000.00	
7	Honoraria for Barangay Health Worker/CVO	Brgy. Dipili	294,000.00		36,000.00	150,000.00	36,000.00	72,000.00
	Total		**3,270,000.00**	**-**	**586,050.00**	**1,060,000.00**	**1,431,950.00**	**192,000.00**
Brgy. Pulangbato								
1	Expansion of the existing Level 2 water system for Purok's 2 to 4	Brgy. Pulang Bato	600,000.00		200,000.00	300,000.00	100,000.00	
2	Provision of medical equipment, medical/ financial assistance, and supplies to Barangay Health Center	Brgy. Pulang Bato	500,000.00		50,000.00	400,000.00	50,000.00	
3	Enrollment to Philhealth	Brgy. Pulang Bato	300,000.00		60,000.00	60,000.00	60,000.00	120,000.00
4	Support/Assistance to Barangay Worker & CVO	Brgy. Pulang Bato	358,000.00		36,000.00	150,000.00	100,000.00	72,000.00
5	Support & Assistance to Barangay Midwife	Brgy. Pulang Bato	300,000.00		60,000.00	60,000.00	60,000.00	120,000.00
6	Feeding Program for school children	Brgy. Pulang Bato	300,000.00		50,000.00	150,000.00	50,000.00	50,000.00
	Total		**2,358,000.00**		**456,000.00**	**1,120,000.00**	**420,000.00**	**362,000.00**
Brgy. Dimalinao								
1	Provision of medical equipment, emergency vehicle, medical/ financial assistance, and supplies to Barangay Health Center	Brgy. Dimalinao	800,000.00		150,000.00	650,000.00		
2	Feeding Program for school children	Brgy. Dimalinao	150,000.00		50,000.00	100,000.00		
3	Expansion of the existing Level 2 water system	Brgy. Dimalinao	450,000.00		150,000.00	100,000.00	50,000.00	150,000.00
4	Support to Barangay Health Worker & CVO	Brgy. Dimalinao	408,000.00		36,000.00	150,000.00	150,000.00	72,000.00
5	Support to Barangay Midwife	Brgy. Dimalinao	300,000.00		60,000.00	60,000.00	60,000.00	120,000.00

6	Enrollment to PhilHealth	Brgy. Dimalinao	300,000.00		60,000.00	60,000.00	60,000.00	120,000.00
7	Provisions of Medicine for Health Center	Brgy. Dimalinao	73,450.00		23,450.00	25,000.00	25,000.00	
	Total		**2,481,450.00**	**-**	**529,450.00**	**1,145,000.00**	**345,000.00**	**462,000.00**

B.	Education and Educational Programs	Barangay/ Location	5-Year SDMP Budget	Yearly Budget				
				2019	2020	2021	2022	2023
1	Honorarium Day Care Worker	4 Host Barangays	144,000.00	144,000.00				
Brgy. Depore								
1	School Improvement of Day Care Center	Brgy. Depore	400,000.00		100,000.00	200,000.00	100,000.00	
2	Support/assistance for Day Care Worker/CVO	Brgy. Depore	274,000.00		36,000.00	130,000.00	36,000.00	72,000.00
3	Support/assistance for Elementary Teacher	Brgy. Depore	480,000.00		96,000.00	96,000.00	96,000.00	192,000.00
4	Provision of School Supplies for complete elementary pupils 1-6 and Pre-school	Brgy. Depore	590,000.00		160,000.00	250,000.00	120,000.00	60,000.00
5	Feeding Program for school children	Brgy. Depore	150,000.00		50,000.00	100,000.00		
6	Repair & Improvement of Elementary School	Brgy. Depore	300,000.00			200,000.00	50,000.00	50,000.00
7	Support to school facilities & Supplies	Brgy. Depore	450,000.00		50,000.00	200,000.00		200,000.00
8	Establishment of Material Recovery Facility in school	Brgy. Depore	100,000.00			100,000.00		
9	Construction of Dental Lounge	Brgy. Depore						
	Total		**2,888,000.00**	**144,000.00**	**492,000.00**	**1,276,000.00**	**402,000.00**	**574,000.00**
Brgy. Dipili								
1	Provision of audio-visual equipment and supplies and instructional materials	Brgy. Dipili	160,000.00		150,000.00	10,000.00		
2	Support/assistance for Daycare Worker/CVO	Brgy. Dipili	150,000.00		30,000.00	30,000.00	30,000.00	60,000.00

3	Provision of School Supplies for elementary supplies and preschool	Brgy. Dipili	500,000.00		250,000.00	250,000.00		
4	Construction of Mini Library with books and references	Brgy. Dipili	500,000.00			500,000.00		
5	Provision of Day Care Instructional Materials and complete facilities	Brgy. Dipili	250,000.00		100,000.00	150,000.00		
6	Provision of Science Laboratory facilities/materials	Brgy. Dipili	200,000.00		100,000.00	100,000.00		
	Total		**1,760,000.00**	**-**	**630,000.00**	**1,040,000.00**	**30,000.00**	**60,000.00**
Brgy. Pulangbato								
1	School Improvement of Pulang Bato Elem. School	Brgy. Pulang Bato	375,000.00			350,000.00		25,000.00
2	School Improvement of Day Care Center of Pulang Bato Proper	Brgy. Pulang Bato	700,000.00		200,000.00	500,000.00		
3	Rehabilitation of one classroom in Pulang Bato Elementary School	Brgy. Pulang Bato	400,000.00		100,000.00	300,000.00		
4	Provision of school supplies for elementary and preschool students	Brgy. Pulang Bato	250,000.00		250,000.00			
5	Honoraria for Daycare Worker	Brgy. Pulang Bato	828,000.00		36,000.00	36,000.00	36,000.00	720,000.00
6	Support/Assistance for Elementary Teacher	Brgy. Pulang Bato	290,000.00		50,000.00	60,000.00	60,000.00	120,000.00
7	Support to school facilities & supplies	Brgy. Pulang Bato	100,000.00		100,000.00			
	Total		**2,943,000.00**	**-**	**736,000.00**	**1,246,000.00**	**96,000.00**	**865,000.00**
Brgy. Dimalinao								
1	Support/Assistance for Daycare Worker/CVO	Brgy. Dimalinao	180,000.00		36,000.00	36,000.00	36,000.00	72,000.00
2	Honoraria for Elementary Teacher	Brgy. Dimalinao	300,000.00		60,000.00	60,000.00	60,000.00	120,000.00
3	Provision of school supplies for elementary and preschool students	Brgy. Dimalinao	550,000.00		350,000.00	200,000.00		
4	Repair & Improvement of Elementary School	Brgy. Dimalinao	450,000.00		125,000.00	200,000.00	125,000.00	

5	Construction of Daycare Center	Brgy. Dimalinao	400,000.00		200,000.00	200,000.00		
6	Support to school facilities & Supplies	Brgy. Dimalinao	300,000.00		100,000.00	200,000.00		
	Total		**2,180,000.00**	**-**	**871,000.00**	**896,000.00**	**221,000.00**	**192,000.00**

C.	Livelihood Project and Enterprise Development and Networking	Barangay/ Location	5-Year SDMP Budget	Yearly Budget				
				2019	2020	2021	2022	2023
1	Skills Development Training (TESDA Programs)	All Communities	500,000.00		100,000.00	100,000.00	100,000.00	200,000.00
2	Establishment of Demo Farm		2,011,000.00		1,500,000.00	511,000.00		
	Total		**2,511,000.00**	**-**	**1,600,000.00**	**611,000.00**	**100,000.00**	**200,000.00**
Brgy. Depore								
1	Abaca Plantation	Brgy. Depore	300,000.00		100,000.00	200,000.00		
2	Rubber Seeding Production	Brgy. Depore	400,000.00		100,000.00	200,000.00	100,000.00	
3	Rehabilitation of existing and construction of additional solar dryer	Brgy. Depore	300,000.00		100,000.00	200,000.00		
4	Corn and Rice Mill Machine/Facility (lot is community counterpart)	Brgy. Depore	200,000.00			200,000.00		
5	Vegetable Production (Gulay sa Kabahayan	Brgy. Depore	140,000.00		40,000.00	50,000.00	25,000.00	25,000.00
	Total		**1,340,000.00**	**-**	**340,000.00**	**850,000.00**	**125,000.00**	**25,000.00**
Brgy. Dipili								
1	Hollow block making livelihood project	Brgy. Dipili	100,000.00		100,000.00			
2	Dressmaking livelihood project for women's organization	Brgy. Dipili	200,000.00		100,000.00	100,000.00		
3	Post-Harvest Equipment (cassava peeler, chipper, tractor, thresher, sheller)	Brgy. Dipili	100,000.00			100,000.00		
4	Construction of Creek Protection	Brgy. Dipili	150,000.00		100,000.00		50,000.00	
5	Construction of Storage Warehouse (Rice & Corn)	Brgy. Dipili	400,000.00			200,000.00	200,000.00	

6	Free range chicken propagation	Brgy. Dipili	350,000.00		50,000.00	300,000.00		
	Total		**1,300,000.00**	**-**	**350,000.00**	**700,000.00**	**250,000.00**	
Brgy. Pulangbato								
1	Abaca Plantation/Production	Pulang Bato	517,250.00		200,000.00	200,000.00	117,250.00	
2	Post-Harvest Equipment (peeler, chipper, tractor, thresher, sheller)	Pulang Bato	250,000.00		50,000.00	200,000.00		
3	Cardava Banana Production	Pulang Bato	100,000.00			100,000.00		
4	Startup capital for Food Processing Project for Women	Pulang Bato	100,000.00			100,000.00		
5	Rehabilitation of the existing community solar dryer	Pulang Bato	200,000.00		100,000.00	100,000.00		
	Total		**1,167,250.00**	**-**	**350,000.00**	**700,000.00**	**117,250.00**	
Brgy. Dimalinao								
1	Abaca Production	Dimalinao	530,000.00		200,000.00	200,000.00	50,000.00	80,000.00
2	Rubber Seeding Production	Dimalinao	400,000.00		100,000.00	200,000.00	50,000.00	50,000.00
3	Post-Harvest Equipment (cassava: peeler, chipper, tractor, thresher, sheller) (abaca: mobile stripper)	Dimalinao	200,000.00			200,000.00		
4	Abaca and Rattan Furniture and Handicraft Livelihood Project	Dimalinao	325,000.00		100,000.00	100,000.00	50,000.00	75,000.00
5	Vegetable Production (Gulayan sa Kabahayan)	Dimalinao	103,500.00		50,000.00	53,500.00		
	Total		**1,558,500.00**	**-**	**450,000.00**	**753,500.00**	**150,000.00**	**205,000.00**

E.	Socio Cultural	Barangay/ Location	5-Year SDMP Budget	Yearly Budget				
				2019	2020	2021	2022	2023
1	Fiesta Celebration	4 host barangays	460,000.00	10,000.00	50,000.00	100,000.00	100,000.00	200,000.00
2	Araw Celebration	4 host barangays	460,000.00	10,000.00	50,000.00	100,000.00	100,000.00	200,000.00
3	Support to Religious Sector	4 host barangays	175,000.00		5,000.00	100,000.00	20,000.00	50,000.00
4	Support to Women	4 host barangays	175,000.00		5,000.00	100,000.00	20,000.00	50,000.00
5	Support to Youth Sector	4 host barangays	175,000.00		5,000.00	100,000.00	20,000.00	50,000.00
6	Support to Senior Citizen	4 host barangays	175,000.00		5,000.00	100,000.00	20,000.00	50,000.00
7	IP Leaders' Allowance (10)		584,000.00	534,000.00				50,000.00
8	Zambo Sur Anniversary		150,000.00	50,000.00		100,000.00		
9	Miscellaneous Expense – CRO Comm Devt.		345,000.00	45,000.00		100,000.00		100,000.00
	Total		**2,699,000.00**	**649,000.00**	**120,000.00**	**900,000.00**	**280,000.00**	**750,000.00**

5.3.1 Implemented Projects in 2019

In 2019, TVIRD implemented Php 1,463,242.78 worth of projects. Rundown of projects implemented were the following:

Information, Education and Communication Campaign (IEC)

Public Awareness through a continuous IEC Campaign was carried out to ensure that TVIRD's host and neighboring communities are updated on the project development and that relevant concerns of the barangays are immediately addressed. Close coordination with barangay folks was done by attending regular Sangguniang Barangay sessions and through informal discussions in the barangay. Relevant IEC materials and proof of implementation are as follows:

- Community meetings with the host and neighboring barangays regarding the identified P/P/As under 5-Year SDMP
- Planning with the host and neighboring communities for the preparation of 2020 ASDMP
- Regular attendance to Barangay Council Meeting in Brgy. Pulangbato, Bayog, Zamboanga del Sur
- Regular attendance to Brgy. Council Meeting in Brgy. Dipili, Bayog, Zamboanga del Sur
- Regular attendance to Brgy. Council Meeting in Brgy. Depore, Bayog, Zamboanga del Sur

Development of Host and Neighboring Communities (DHNC)

- Disbursement of financial assistance for medical assistance
- Assistance to Brigada Eskwela Program of Bayog Technical School
- Provision of Brgy. Depore's Water System

Socio-cultural Representation

- Extending financial assistance to host and neighboring communities i.e, projects, facility improvements, etc.
- Conducted of Pakano Ritual at Waste Dump Area
- Other Activities (Brgy. Fiesta and Workshops, Cultural Presentation, etc.)
- Public consultation with regards to the amendment of the 5-Year SDMP
- Skills mapping for employment of the host and neighboring communities
- Collected Barangay Development Plans for the host and neighboring barangays

5.3.2 Implemented Projects in 2020

In 2020, TVIRD implemented Php 13,217,309.01 worth of projects. However, when the surge of COVID-19 hit the Philippines on the 1st Quarter of the year, lockdowns and strict protocols were imposed. Despite the attempt to make deliverables on time, as an inevitable result of the foregoing circumstances which were beyond the Company's control, the expected output of the program was deferred/hindered.

Nonetheless, by virtue of MGB's authorization, funds of the ASDMP were mostly realigned to COVID-19 crisis management. The Company have supported the local government units and the community with a total amount of Php

6.6 million for COVID RESPONSE. The project was one of the first responders in the Zamboanga Region. The Company's related operations reached not just the Municipality of Bayog or the province of Zamboanga del Sur where it belongs but throughout the whole Zamboanga Peninsula, providing support to hundreds of frontliners and reaching thousands of families affected by the lockdowns.

Assorted Protected Personal Equipment (PPE) was provided to frontliners, and food packs were distributed to the communities. Items for the food packs were sourced locally to stimulate the local economies. The project also realigned Php 1.6 million to respond to the call of the MGB Central Office to help affected Impact and Non-Impact communities by the recent typhoon and low pressure that caused sizable damage due to flooding. More than 3,500 families in CARAGA Region benefited from this effort.

5.3.3 Implemented Projects in 2021

In 2021, TVIRD implemented a total of Php 21,991,598.49 million worth of projects. Earlier that year, the ASDMP 2021 is set to be implemented but the surge of COVID-19 became more serious which resulted to heightened lockdowns of Provinces and Municipalities. Delays were still encountered but despite that, the following P/P/As were still implemented:

Access to Education and Educational Support

Educational support for the host and neighboring barangays: Brgy. Depore, Brgy. Dipili, Brgy. Pulangbato, and Brgy. Dimalinao.

- Improvement of Elementary Building
- Day Care Center Module Reproduction and Provision of Printers and Bond Paper Supplies
- Support to the Day Care Centers
- Elementary School Module Reproduction and Provision of Printers and Bond Paper Supplies
- Provision of Playground in the Day Center
- Assistance to CVO in Ensuring Safety of School Children

Access to Health and Services, Health Facilities and Professionals

- COVID 19 Response: Provision of supplies, thermal gun, face mask, face shield, PPE Suit, alcohol, handwash liquid soap and sanitizers
- Assistance to Barangay Health Workers
- Establishment of Material Recovery Facility (MRF)
- Construction of Purok Toilets
- Rehabilitation of Health Centers with Complete Tables and Chairs
- Provision of Medicines for Health Centers
- Provision of Medical Refrigerators for Vaccines and Provision of Tank Regulators to Health Centers
- Medical Outreach Program and Provision of Medicines
- Provision of Vitamins to Malnourished Childrens

Enterprise development and Networking

- Workshop on Good Agricultural Practices for Abaca Fiber Plantation of Barangays Depore and Pulang Bato
- Capacity Development Training for Rubber Farmers Association
- Construction of Water Refilling Stations at Brgy. Dipili

Assistance to Infrastructure Development and Support Services

- Expansion of Water System (Level 2) at Brgy. Depore
- Improvement of Multi-purpose Hall at Brgy. Dimalinao

Other Activities

- RHNC (Representatives of the Host and Neighboring Communities) Meeting
- Community Day of TVIRD Balabag Gold and Silver Project
- Super Typhoon Odette Relief Operations in Surigao and CARAGA Region

5.3.4 Photo Documentations

Photo 5-1: "Tabang Caraga" and "Tabang Dinagat", TS Odette Relief Operations

Photo 5-2: Community Meetings

Photo 5-3: RHNC Meetings

Photo 5-4: Turnover of Cash Assistance

Photo 5-5: Turnover of Medicines

5.4 EMPLOYMENT

This Section evaluated the TVIRD's employment data to ascertain compliance with Condition No. 7 of Annex B of the original ECC which quotes … "*Proponent needs to give priority employment to qualified local residents. Adequate public information for jobs available to local residents in the affected areas shall be provided…*"

5.4.1 TVIRD's Employment

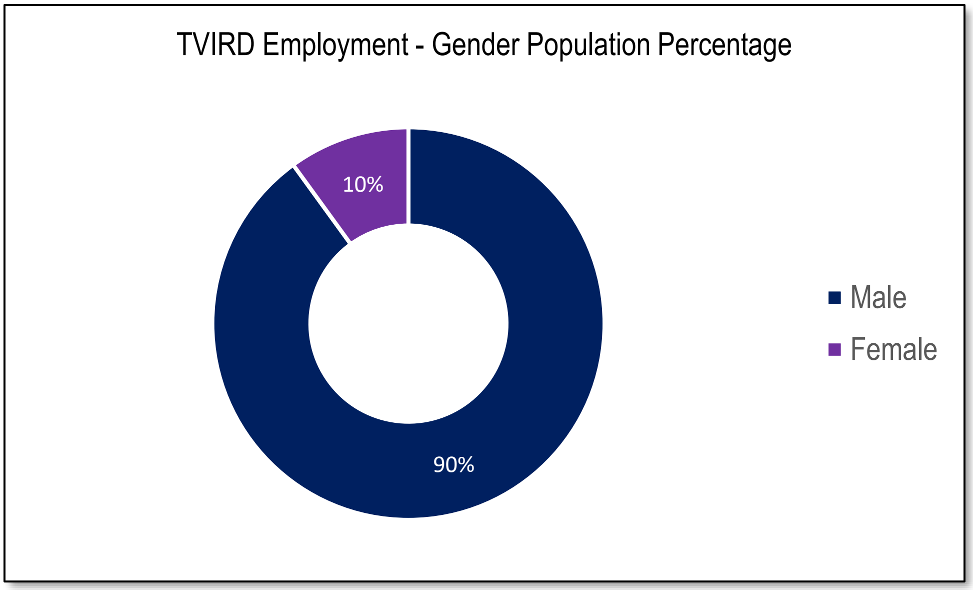
As of May 2022, TVIRD employed a total of 955 employees. These are regular and/or permanent employment: probationary, casual or temporary, and others which include On-the-Job and Contractual employees. Out of the overall employment, 54.5 % or 507 employees are local residents (from Depore, Dipili, Dimalinao, Pulang Bato and from the other barangays in the Municipality of Bayog). Seventeen percent (17%) or 156 composed of Indigenous People (Subanen Tribe) and 18% or 171 employees are technical.

Figure 5-2 shows that on average, the ratio of male to female employees is 9.5:1. The mining industry is still male dominated because of the nature of operations. Some women with collegiate education perform technical positions but mostly have administrative and staff functions.

Table 5-6: Employment Status of TVIRD as of May 2022

Location of Origin	Employment	Percentage
Brgy. Depore	45	4.8%
Brgy. Dipili	70	7.5%
Brgy. Dimalinao	21	2.3%
Brgy. Pulangbato	45	4.8%
Within Bayog	326	35.1%
Within Zamboanga Del Sur	52	5.6%
Within Zamboanga Sibugay	193	20.8%
Within Zamboanga Del Norte	83	8.9%
Outside Zamboanga Peninsula	95	10.2%
Total	**930**	**100%**

Figure 5-2: TVIRD Employment – Gender Population Percentage



5.4.2 Contractors Employment

In May 2022, TVIRD's contractors employed 246 employees. Two-fifths (2/5) of total employees came from the Municipality of Bayog. Nearly a fifth or 22% resides in the host and neighboring barangays. The rest are from Zamboanga Del Sur and outside Zamboanga Peninsula.

Table 5-7: TVIRD's Contractors Employment as of May 2022

Contractors	Manpower	Male	Female
ABC	15	15	0
AFS	55	55	0
BLAFF	20	20	0
CONEX	24	24	0
EDCO	72	72	0
MSKS	20	19	1
PICHEL	18	14	4
RMGY	14	14	0
VBC	8	8	0
Total	**246**	**241**	**5**

5.4.3 Hiring Policies and Procedures

Recruitment usually starts through coordination with the Barangay Officials of host and neighboring communities to prioritize employment of legitimate residents. The barangay officials also assist in the scheduling of workers to ensure that all unskilled laborers could take turns in working. The rotational system is applied to spread the benefits to as many locals as possible. Announcements and postings of job vacancies are coursed through different channels like the Official Facebook Page of TVIRD-BGSP, Barangay Hall, Purok Centers and other public places. Company representatives meet with residents in the Purok Centers to explain the hiring procedures and distribute Application Forms. Those interested in applying are instructed to visit the Human Resources Department for the prescribed screening.

5.5 INFORMATION AND EDUCATION CAMPAIGN ACTIVITIES

Condition No. 1 of the original ECC reads… "*Implementation of Information, Education and Communication (IEC) Program to explain to all stakeholders, especially to its local residents, the mitigating measures embodied in the EIS, the conditions stipulated in this Certificate and measures in surface mining for greater awareness and understanding of the project. An annual detailed IEC program shall be prepared in coordination with the Mines and Geosciences Bureau (MGB) Central Office and Regional Office (EMB Region IX) and submitted to EMB Central Office copy furnished the Regional Office within sixty (60) days from receipt of this Certificate*…"

TVIRD"s 5-year IEC or ICE (Information, Consultation, and Education) Program as preferred by the MGB Region IX Office is integrated in the 5-Year SDMP. For the 2019– 2023 SDMP, the ICE budget is Php 8,083,800. This is to ensure the holistic approach of ICE program implementation. Pursuant to Section 134.d of DAO 2010-21, 15% of the 1.50% of operating costs is allocated of ICE programs. The annual ICE program forms part of the Annual Social Development and Management Program or ASDMP. Both reports are submitted to the MGB Regional IX Office for evaluation and approval.

The approved activities of the ICE program include the following:

- Community Meetings and Consultations
- People's Organization formation, seminars, and livelihood project appraisal
- SDMP monitoring and validation
- RHNC trainings and seminars and,
- Posting of information billboards and streamer

Photo 5-6: Community Meetings at Brgy. Depore

Photo 5-7: Community Meetings at Brgy. Pulangbato

Photo 5-8: Community Meetings at Brgy. Dipili

Photo 5-9: Community Meetings at Brgy. Depore

Photo 5-10: CADT Bayog IP Leader Meetings and Consultations

Table 5-8 presents the list of EIC activities conducted by the proponent for the proposed expansion project. The issues and concerns raised by the stakeholders were also included in the table.

Table 5-8: Stakeholder Consultations Conducted for the Proposed Expansion Project

Type of Engagement	Date	Issues Raised
Community Consultation with Dipili Brgy. Council on the Company Expansion of ECC.	February 23, 2022	Rice Fields near the quarry has no water supply. Need assistance from the company to supply water for irrigation system.
		One of the current concerns is the air pollution caused by Mining in our barangay.
Community Consultation with Brgy. Dipili Women's Organization on the Company Expansion of ECC.	February 23, 2022	TVI vehicles including heavy equipment passing the barangay road were over speeding.
		TVIRD must present their programs/control in preventing pollution to the environment.
Community Consultation with Brgy. Dipili Senior Citizen on the Company Expansion of ECC.	February 23, 2022	Query on the benefits that the company will be provided to the residents if the company will expand its ECC.
Community Consultation with Pulangbato Brgy Council on the Company Expansion of ECC.	February 27, 2022	Update on the road maintenance near the ISAG project. The current condition of the road near Purok 1 is very dangerous and could lead to accident.
		Rice Fields near the quarry has no water supply. Need assistance from the company to supply water for drainage system.
Community Consultation with Pulangbato Women's Organization on the Company Expansion of ECC.	February 27, 2022	One of the current concerns is the discoloration of our river even though there is no rain.
		TVIRD vehicles including heavy equipment passing the barangay road were over speeding.
		Concern regarding the discontinuance of salary for Daycare Workers being paid by the Company.
Community Consultation with Pulangbato Senior Citizen on the Company Expansion of ECC.	February 27, 2022	Request of 2 water tanks for thew water system of Purok 5.
		Over speeding dump truck passing through the barangay road. There were some instances that residents riding on their motorcycle almost got into accidents.
		Request for water system near "Batman" or security gate.
Community Consultation with Bayog, Buug, Diplahan, Siay, Imelda Irrigators (BABUDISI) Association.	February 4, 2022	TVIRD must present the map showing the entire coverage of proposed amendment of ECC.
		TVIRD operation is the source of water discoloration and siltation of Dipili and Depore river which is the source of water supply for rice fields.
		Dust along the road, may affect the health of the community.
		TVIRD must present their programs/control in preventing air, water, and land pollution to the environment.

Type of Engagement	Date	Issues Raised
		TVIRD must conduct inspection of the river, drainage canals together with Irrigators, NIA and DA.
		Water Supply of the farmers' rice fields is affected since the Dipili Dam must be closed whenever the presence of rain to ensure that silted water will not go to their rice fields which can cause low production.
		TVIRD must conduct a Feasibility Study for Agro-Economic Survey. Also added why the Company did not include the Irrigators Association during the conduct of Community Consultation prior to the operation to obtain Social Acceptance from NIA Regional Legal Officer.
		Since there is already silt deposited in the irrigation, TVIRD must aid in desilting of irrigations.
		TVIRD must include the BABUDISI Association as MMT and MRFC member for regular monitoring and for recommendations from their side.
		Also presented some request to help the federation. 1. Assistance to affected farmers / farmlands. 2. Irrigator's Association to be beneficiaries of SDMP.
Community Consultation on ECC Amendment at Barangay Depore.	February 23, 2022	With the expansion of the ECC of TVRD-BGSP, is there any changes in the mine operations and its mine life?
		The community wanted the Company to provide status update on the environmental measures being conducted to keep them posted on the company activities that concerns their area.
		Would there be an increase to the demand of workers needed for the mine operations?
		Would there be an increase in the SDMP allocation with the ECC Expansion?
		Will there be more cutting of trees with the expansion of the ECC?
		How will TVIRD resolve the issue of siltation if it will continue to expand its operations?
		Will TVIRD provide sustainable livelihood program to the community? Then, what is the plan of the Company regarding educational support.
Community Consultation on ECC Amendment at Barangay Dimalinao.	February 15, 2022	What is the reason for expansion of the Company's ECC? What is the possible immediate effect to the community?
		Given its expansion, will the Company provide more environmental controls on the impacts of Company's operation?
		What additional benefits will be provided to the residents if the company will expand its ECC?

Type of Engagement	Date	Issues Raised
		Will there be more employment opportunities to the residents? Will the company commit on prioritization of the local hires?
		Does the Company plan to give its host community medical assistance especially in times of Emergency?
		Given the existing issues on siltation, how can the company assure that ECC expansion will not aid in the aggravation of the existing issue.

6 ENVIRONMENTAL COMPLIANCE MONITORING

6.1 ECC COMPLIANCE MONITORING

The Company commits to comply with the ECC conditions in all stages of Project development. Since the company started operating in 2019, the MMT has not noted any violation with the ECC conditions, nor non-compliance with regulatory requirements. A summary of the ECC conditions and the Environmental Management Plan, along with the Project's status of compliance is summarized in Table 6-1.

Table 6-1: Summary Status of ECC Compliance (BGSP)

<table>
<tr><th>ECC/EMP Condition/ Requirement Categorization</th><th>#s</th><th>Requirement Description</th><th>Compliance Status</th><th>Objective Evidence</th></tr>
<tr><td rowspan="3">1) Project coverage/ limits</td><td rowspan="3"></td><td>Shall cover mining and processing of ore for gold and silver production.</td><td>Complied</td><td>Same mining and processing method is indicated in the approved Declaration of Mining Project Feasibility (DMPF) and Three-Year Development/ Utilization Work Program (3YD/UWP).

See attached Three-Year Development/ Utilization Work Program "Annex 6-01"</td></tr>
<tr><td>The mining activities shall be within the 180-hectares project area out of the total area covered by MPSA No. 086-97-IX.</td><td>Complied</td><td>Site Development Plan of the Project is within the 180-hectares as stated in the approved 3YD/UWP.

See attached Progressive Land Use Map showing the disturbed areas as of June 2022"Annex 6-02"</td></tr>
<tr><td>It has an estimated maximum annual extraction rate of 2 million metric tons of ore and waste materials using open pit mining while the mill and processing plant shall have a maximum daily</td><td>Complied</td><td>The annual production is within the extraction limit in this ECC. Presented in the table below is the production rate of the Company since start of operations:
<table>
<tr><th>Covered Reporting Period</th><th>Ore Production (tons)</th><th>Waste Volume (tons)</th><th>Total</th></tr>
<tr><td>2021</td><td>220,139</td><td>1,775,837</td><td>1,995,976</td></tr>
<tr><td>2022 (as of May)</td><td>157,746</td><td></td><td></td></tr>
</table></td></tr>
</table>

ECC/EMP Condition/ Requirement Categorization	#s	Requirement Description	Compliance Status	Objective Evidence
		production capacity of 2,000 metric tons per day.		The average Mill throughput from 2021 up this period is only 600 to 800 tons per day., as the Company is still improving the production efficiency of the process plant.
2) Components	1	Components of the project include: waste and overburden stockpile area cyanide detoxification facility tailings and storage facility and spillway camp and housing facility chemical storage facility administration facility, warehouses and materials management facility power and water supply facility solid and hazardous waste storage facility access roads other supporting infrastructure	Complied	Some components of the ECC are already 100% completed and some are progressively constructed as described below: a. waste and overburden stockpile are 68.16% b. Cyanide detoxification facility 100% completed. TSF Phase 1 is already 100% completed. Expansion of this Phase 1 project is in-progress, currently increasing the height of embankment to accommodate calculated wastes. d. The administration building is already 100% completed. Staff houses are already occupied. e. The chemical storage is being expanded to accommodate 600 tons to 800 tons of chemicals. This facility is within the approved ECC. f. The Administration Facility is 100% completed. g. Warehouses and materials management facility is 100% completed however a new area

ECC/EMP Condition/ Requirement Categorization	#s	Requirement Description	Compliance Status	Objective Evidence
				is being developed within the approved ECC to increase the capacity. h. Power and Water Supply Facility is 100% completed. i. Solid and Hazardous waste storage facility is also 100% completed occupying a total area of 120 sq.meter within the approved ECC. j. A total of 11.47 access road is being developed . This is progressively improved as the mining operation progresses. See attach Photo Documentation of Infrastructure "Annex 6-03"
3) Other sectoral requirements mandated by other agencies to be complied with	5	In line with the DENR's thrust to promote biodiversity conservation and greenhouse gas (GHG) emissions reduction, the proponent in coordination with the Regional Office (DENR Region IX) shall identify a site, establish, adopt a maintain a mini-forest and/or implement a reforestation program integrating Climate Change Adaptation measures.	Complied	Biodiversity conservation and GHG reduction is part of the approved Environmental Protection and Enhancement Plan submitted to MGB RIX. Specific activities include Reforestation, Rehabilitation, Temporary Revegetation, Nursery Operation and Biodiversity Assessment. Up to date, a total of 162,177 pcs seedlings were planted consisting of Phil. Oak tree, Balobo, Gibo, Pilit, Kalayaan, Tulanmanok, Magabuyo, Dipterocarps (White lauan, Bagtikan, Apitong, Mayapis, Magasusu, kalunti, Tanguile and Miscellaneous trees) and

ECC/EMP Condition/ Requirement Categorization	#s	Requirement Description	Compliance Status	Objective Evidence
				Lesser-Used Species such as Hagimit, Basyang, Pasirit, Katog, Tibig. Generated planting stocks are also being maintained and taken cared of at the nursery. See attach Greenhouse Gas (GHG) Calculation as "Annex 6-04"
	12	The project implementation shall only proceed after securing the necessary permits/ clearances from other government agencies which shall include among others, a Free and Prior Informed Consent from all the concerned indigenous peoples of affected areas consistent with the provisions of RA 8371 or "The Indigenous Peoples Rights Act of 1997".	Complied	Free Prior and Informed Consent (FPIC) process was conducted by TVIRD, in coordination with the NCIP, in the Year 2014. Consequently, the Certificate of Precondition was awarded by NCIP on May 25, 2016, and the MOA with the Subanen IP Tribe was signed in July 2016. See attach Certification Precondition from NCIP "Annex 6-05"
	13	Project implementation shall proceed only upon final approval of the proponent's declaration of mining project feasibility over the proposed project areas.	Complied	The DMPF was approved by MGB on April 29, 2016. Subsequently a Notice to proceed was awarded to the Company on July 12, 2018, by MGB Central Office. See attached Approved DMPF and Notice To Proceed "Annex 6-06"
4) EMP and updates as deemed required				See Assessment of EMP in Section 5.2 on page 6-23.

ECC/EMP Condition/ Requirement Categorization	#s	Requirement Description	Compliance Status	Objective Evidence
5) Conduct of baseline, compliance, and impact self-monitoring	6	Conduct air dispersion modeling following the EMB Air Dispersion Modeling Guidelines to validate initial results in the EIS prior and during project implementation. The first report shall be submitted to EMB Central Office within 60 days before the start of operation/ commissioning	Complied	Prior to the Project Implementation, Air Dispersion Modelling was done through a third-party group, Green Development Solutions. Last November 10-13, 2018. Modelling results suggest pristine air quality at the mine site. See attached Air and Noise Modelling Report "Annex 6-07".
	7	Conduct noise modelling prior and during implementation, and the first report shall be submitted to EMB Central Office 60 days before the start of operation/ commissioning.	Complied	The noise dispersion modelling was done through a third-party group, Green Development Solutions. A baseline ambient noise monitoring was done on site last Nov 10-13, 2018. There was no significant source of noise observed at the time of monitoring. Results of the noise dispersion modelling using Sound Plan Essential Noise Model showed that higher noise level will be expected to be derived from the operating equipment and blasting operation, hence the use of personal protective equipment is prescribed for the workers. However, simultaneous operation of the mine facilities and equipment will not significantly contribute to the increase of the background noise levels, beyond the 1.6-km radius from the mine site.

ECC/EMP Condition/ Requirement Categorization	#s	Requirement Description	Compliance Status	Objective Evidence
				See attach Noise Modelling Report in "Annex 6-07"
	8	The proponent shall appoint a third-party reviewer to undertake during the operation phase an annual inspection and geotechnical review of the tailings dam, freshwater dam, silt traps, waste dumps, and critical slopes, a report of which shall be submitted to EMB Central Office within 30 days from the conduct thereof.	Complied	Knight Piesold Consulting was engaged during the conceptualization and final design of the Tailings Storage Facility (TSf). During the development phase, GHD Group Pty Ltd was tapped by TVIRD in the TSF's construction management and supervision as our consultant. This is to ascertain the effective, safe, and reliable project outcome of the structure. Further, Mr. Tumbokon, associated to Engineering and Development Corporation of the Philippines (EDCOP) was contracted as third-party reviewer/ technical expert to undertake geotechnical review of TSF, Waste Rock Dump and other facilities. Reports are being finalized for submission to EMB. See Contract of Mr. Tumbokon Engagement as "Annex 6-08"
6) Multi-sectoral Monitoring (as may be required)	10.b	Establishment of Multipartite Monitoring Team (MMT) and Mine Rehabilitation Fund Committee (MRFC).	Complied	TVIRD's Contingent Liability Rehabilitation Fund Resolution was signed on July 22, 2020 establishing the MMT and MRFC; Resolution No. 20-03 and 20-02 deputizing the TVIRD-MMT.

ECC/EMP Condition/ Requirement Categorization	#s	Requirement Description	Compliance Status	Objective Evidence
				2nd Quarter 2021 MMT monitoring was conducted last July 29-30, 2021, and 2nd Quarter 2021 MRFC meeting conducted last August 26, 2021, while the 3rd Quarter 2021 MMT monitoring conducted last November 4-5, 2021. While the 3rd Quarter 2021 MRFC meeting was conducted last November 25, 2021. See attached CLRF MOA and MRFC Resolution in the creation of TVIRD MMT as "Annex 6-09" See attached MMT and MRFC photo documentation "Annex 6-10"
	10.c	Setting up of a Contingent Liability and Rehabilitation Fund (CLRF) and Environmental Trust Fund (ETF).	Complied	FMRDF: Deposited in Land Bank of the Philippines – Pagadian Branch with Account Number 0521-2905-01. Out of P 271,300.00 commitment, already deposited 149,255,551.00 as of March 31, 2022. RCF: An amount of Php 5,000,000.00 was deposited at Land Bank of the Philippines – Trust Banking Group under the Company's Trust Account Number 47691-21909-31-01. MTF: An amount of Php 150,000.00 was deposited at Land Bank of the Philippines – Trust Banking Group under the

ECC/EMP Condition/ Requirement Categorization	#s	Requirement Description	Compliance Status	Objective Evidence
				Company's Trust Account Number 47691-21908-31-01. ETF: An amount of Php 150,000.00 was deposited at Land Bank of the Philippines – Trust Banking Group under the Company's Trust Account Number 47691-21910-31-01. See attach Bank Certification as proof for FMRDP, RCF, MTF and ETF Deposition "Annex 6-11"
7) Regular reporting			Complied	All Reportorial Obligations (CMR & SMR) were submitted to EMB R-IX. See attached Online Submission of SMR "Annex 6-12".
8) Institutional arrangements necessary for implementation of environmental management measures	10.d	Establishment of Mine Environmental Protection and Enhancement Office (MEPEO) to competently handle the environment related aspects of the project in addition to the monitoring requirements as specified in the EMP/EMoP. The MEPEO shall monitor actual project impacts vis-à-vis the predicted impacts and management measure in the EIS.	Complied	Mine Environmental Protection and Enhancement Office (MEPEO) is established and incorporated in the overall Table of Organization of the Company. It is led by a MEPE Officer together with a Registered Forester, Pollution Control Officers, Civil Engineer, with a total of 100 personnel. EnP Jjam S. Cutillas MEPEO – Sr. Superintendent Engr. Crissee Joie Maagad - Envi Supervisor/Pollution Control Officer

ECC/EMP Condition/ Requirement Categorization	#s	Requirement Description	Compliance Status	Objective Evidence
				Engr. Rusbey O. Buyser - Envi Supervisor/ Water Resource Management For. Gwendelvic Billy S. Taneo - Forester Specialist See attach Table of Organization “Annex 6-13” Secured Certificate of Accreditation for Pollution Control Officer of Crissee Joie Maagad with certificate no. COA No. 2019-IX-070 B which was issued on August 6, 2019. See attached Certificate of Accreditation “Annex 6-14”.
9) Standard DENR requirement on transfer of ownership			Complied	No transfer of ownership has been made.
10) Standard DENR requirement on abandonment			Complied	The Project is still in its Operation Stage with an approved EPEP-FMRDP dated March 11, 2016. See attached Approved EPEP-FMRDP “Annex 6-15”
11) Impact Mitigation Plan or Construction/ Contractor’s Environmental Program	2.a	Proper stockpiling and disposal of waste materials generated from the mining site. Silt materials removed from the settling ponds shall be placed in permanent, stabilized areas away from any water body and drainage systems and	Complied	Pre-stripped materials were hauled and stored in the Waste Dump Area. The Dumping Area was filled from the bottom upwards to ensure the materials are properly compacted. Waste Rock Dump is raised in 10-meter-thick lifts in a 50-degree face angle to maintain the integrity of the structure.

ECC/EMP Condition/ Requirement Categorization	#s	Requirement Description	Compliance Status	Objective Evidence
		shall be maintained in safe and non-polluting conditions.		Recovered materials will be impounded for future rehabilitation and reforestation initiatives of the Company. See attached photo documentation of Waste Dump Area "Annex 6-16"
	2.b	Stabilization and erosion control of affected side slopes of the roads within the project site and nearby creeks, rehabilitation area, as well as in siltation ponds shall be immediately undertaken.	Complied	All slope stabilization and erosion control measures are continually implemented and maintained. A total of 1.05 hectares was rehabilitated as of to date. Provision of environmental structures and mitigating measures such as Silt Ponds, Silt Fences, Gabion Cages and Gabion Check Dam are undertaken to prevent and minimize the impacts. Strategic locations of the structures are situated primarily where there is great volume of runoff water loaded with suspended solids. Additional medium for erosion control, drainage and filtration applications like Geotextile filter fabric, Coco-matting and Gabion are integrated with the environmental structures to augment prevention of sedimentation into the hydrological system. Repair and maintenance are also conducted to prolong their functionality.

ECC/EMP Condition/ Requirement Categorization	#s	Requirement Description	Compliance Status	Objective Evidence
				See attached photo documentation of Environmental Structure Activity "Annex 6-17"
	2.c	Stockpiling of waste materials in designated suitable areas with stockpile slopes based on angle of response and stabilized by vegetation and/or engineering interventions to protect it from erosion.	Complied	Pre-stripped materials were hauled and stored in the Waste Dump Area. The Dumping Area was filled from the bottom upwards to ensure the materials are properly compacted. Waste Dump is raised in 10-meter-thick lifts in a 50-degree face angle to maintain integrity of the structure. See attached photo documentation of Waste Dump Area "Annex 6-16"
	2.d	Use of suitable recovered topsoil and overburden materials for re-soiling, rehabilitation or as covering of waste dumps, and other disturbed areas.	Complied	Recovered materials will be impounded for rehabilitation and reforestation initiatives of the Company. See attached photo documentation of Environmental Structure Activity "Annex 6-17"
	9	The mining and milling/ processing operations shall conform with the provisions of RA 6969, RA 8749, RA 9003, RA 9275.	Complied	Sound environmental measures to conform with the provisions of applicable environmental laws are integrated in the environmental management program implemented through all phases of development. Designated Pollution Control Officers under the Mine Environmental Protection and Enhancement Office (TMEPEO) of the Company oversees its implementation. R.A. 6969

ECC/EMP Condition/ Requirement Categorization	#s	Requirement Description	Compliance Status	Objective Evidence
				a. Secure Online hazardous waste Generator registration Certificate with Registration no. OL-GR-R9-73-015201 issued on April 1, 2021. b. Constructed clinical septic vault for M501 Pathological or Infectious Waste Temporary storage. c. Secured CCO registration Certificate with registration certificate number CCOr-R09-CN-2020-00155 issued last September 4, 2020, and CCOr-Pb-2020-00224 issued on October 31, 2020. d. Secured HW Generator Registration Certificate with manual registration number M-GR-R9-73-00019 issued last September 21, 2019 and Re-registration of Manual Hazardous Waste ID to Online Hazardous Waste Registration Certificate with registration no. OL-GR-R9-73-01520 issued on April 01, 2021. e. Established Temporary Hazardous Waste Storage Facility. f. Implementation of Hazardous Waste Management Procedure. g. Conduct of IEC/ Orientation regarding Hazardous Waste Management to Employees, Contractors, and Sub-contractors of the Company. R.A. 9003

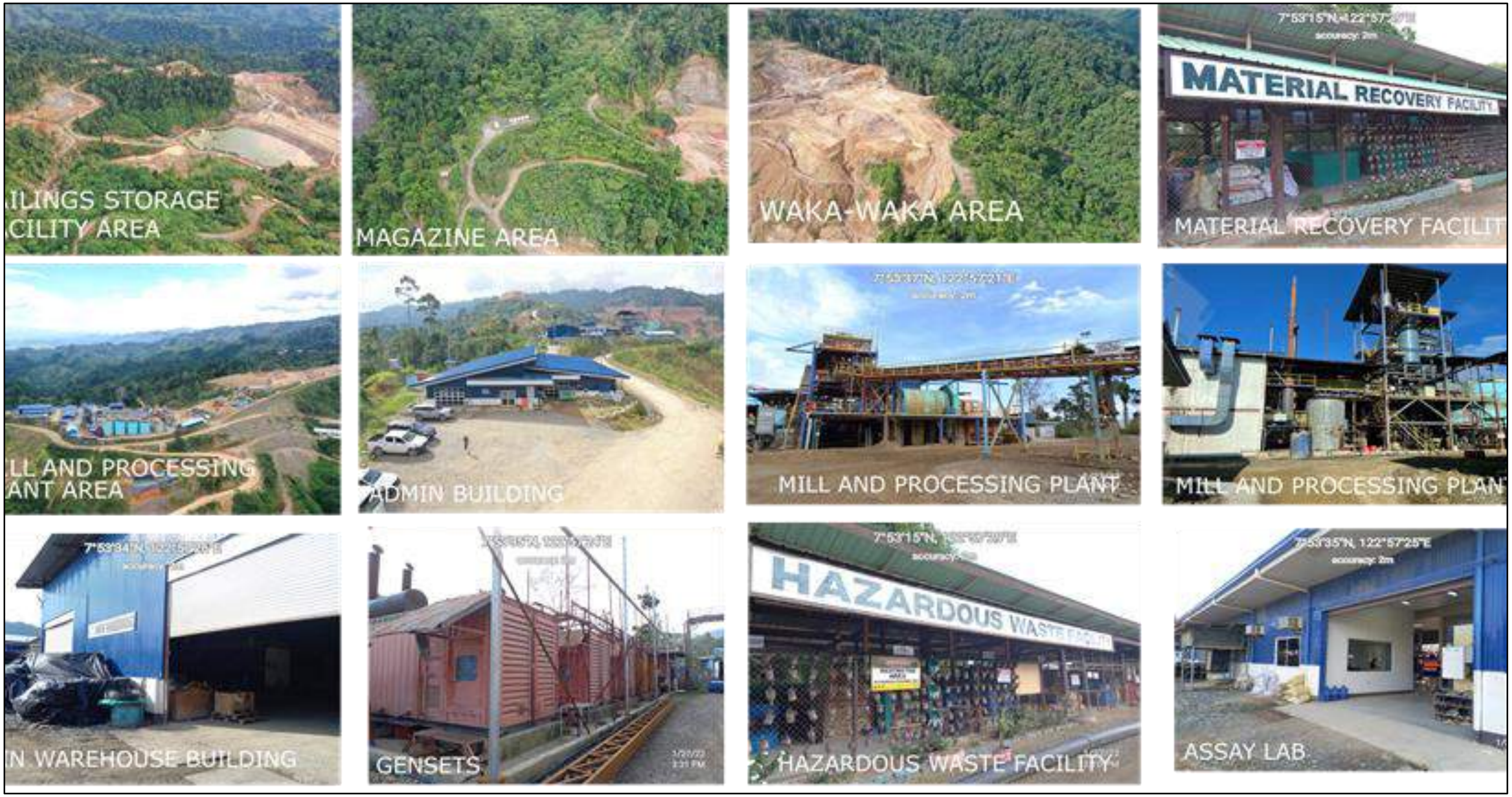
ECC/EMP Condition/ Requirement Categorization	#s	Requirement Description	Compliance Status	Objective Evidence
				a. Established Materials Recovery Facility (MRF) b. Provision of waste receptacles on strategic areas in the Mine Site c. Conduct daily waste collection of generated solid waste within the mine premises d. Implementation of Solid Waste Management Procedure e. Conduct of IEC/ Orientation regarding Solid Waste Management to Employees, Contractors, and Sub-contractors of the Company <u>R.A. 8749</u> a. Secured Permit to Operate for Two (2) units 62.5 kVa, One (1) unit 15 kVa, one (1) unit 43 kVa, and one (1) unit 37.5 kVa with permit no. 2019-POA-C-0973-0052 issued on August 6, 2019 b. Secured Permit to Operate for Two (2) units 6 kVA, 60 kVA, 117 kVA, 150 kVA, 375 kVA, 400 kVA, Two (2) units 1 MW, Three (3) unit 2 MW, Sag Mill, two (2) unit Ball Mill, Crushing, Flotation, Carbon-In-Leach, Merril Crowe, Gold Room, Acid Scrubber, Lead Scrubber and Dust Collector. c. Quarterly air and noise sampling and monitoring conduced by a third-party service provider. <u>R.A. 9275</u>

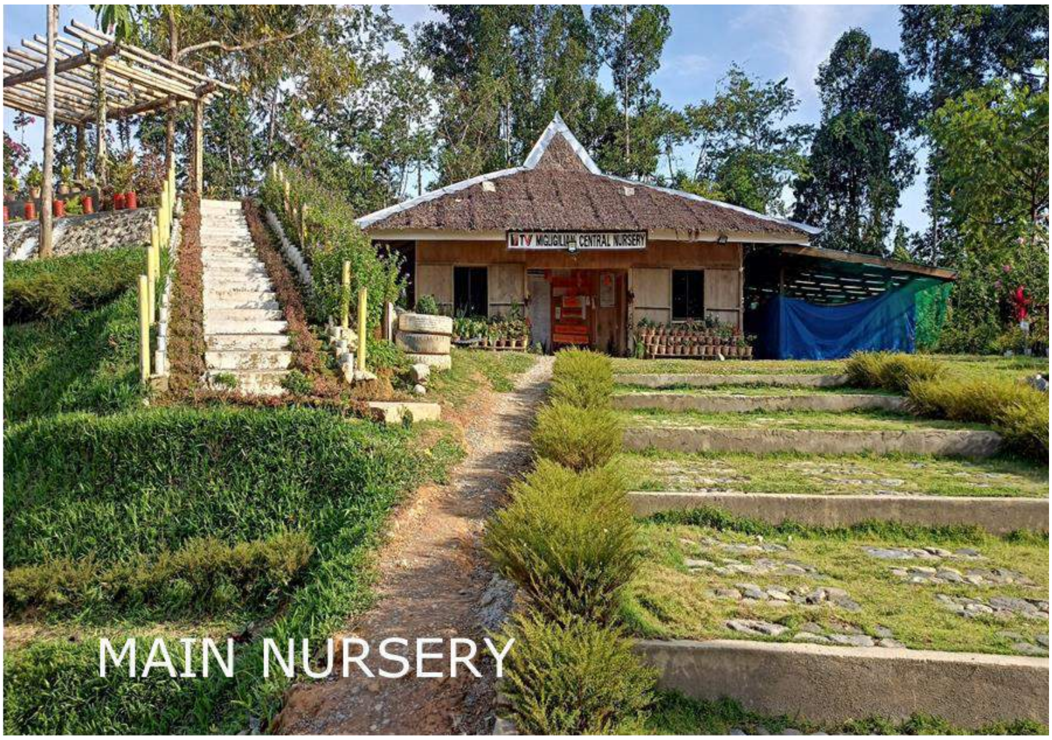
ECC/EMP Condition/ Requirement Categorization	#s	Requirement Description	Compliance Status	Objective Evidence
				a. Prior to operational stage of the project, aspects are determined so to come up with the realistic picture of the impacts of mining activities. Provision of environmental structures and mitigating measures such as Silt Ponds, Silt Fences, Gabion Cages and Gabion Check Dam are undertaken to prevent and minimize the impacts. Strategic locations of the structures are situated primarily where there is great volume of runoff water loaded with suspended solids. Additional medium for erosion control, drainage and filtration applications like Geotextile filter fabric, Coco-matting and Gabion are integrated with the environmental structures to augment prevention of sedimentation into the hydrological system. Repair and maintenance are also conducted to prolong their functionality. b. Secured Wastewater Discharge Permit. c. Continuous implementation of Water Resource Management under approved AEPEP. d. Internal weekly water sampling and monitoring, and quarterly water sampling in the 21 identified sampling stations covering impact areas and nearby municipalities.

ECC/EMP Condition/ Requirement Categorization	#s	Requirement Description	Compliance Status	Objective Evidence
				See attach Copy of Permits "Annex 6-18".
	11	The proponent shall ensure that its contractors, sub-contractors, and operators shall strictly comply with the relevant conditions of this Certificate.	Complied	Project Orientation is being conducted to every employee, contractor, subcontractor, and operator prior to undertake first day of work. Likewise, hazards and risks associated to the daily basis activities are being discussed during Toolbox (Pre-start) Meeting. Moreover, Monthly Information, Education and Communication (IEC) to contractors and other departments for solid waste management is being conducted. See attached NOV Policy as "Annex 6-19" See attached IEC photo documentation "Annex 6-20"
12) Social Development Plan (SDP)	10.e	Implementation of a SDMP in coordination with complementing the development plans of the affected barangays. The SDMP shall be submitted to MGB R-IX for approval prior to project implementation.	Complied	SDMP for CY 2019-2023 with Certificate of Approval SDMP # 042-2019-09IX was issued to TVIRD on November 26, 2019. The Company allotted an estimated budget of Php 53,592,000.00 to implement the Programs/Projects/Activities (P/P/As) stipulated in the Five-Year SDMP. See attached Certificate of Approval of Five-Year Social Development and Management Program "Annex 6-21"
13) IEC Plan	1	Implementation of IEC Program to explain to	Complied	Project Orientation is being conducted to every employee,

ECC/EMP Condition/ Requirement Categorization	#s	Requirement Description	Compliance Status	Objective Evidence
		all stakeholders, especially to its local resident, the mitigating measures embodied in the EIS, the conditions stipulated in this Certificate and measures in surface mining for greater awareness and understanding of the project.		contractor, subcontractor, and operator prior to undertake first day of work. Likewise, hazards and risks associated to the daily basis activities are being discussed during Toolbox (Pre-start) Meeting. Further IEC activities are also incorporated in the Company's AEPEP and ASDMP. See attach IEC photo documentation "Annex 6-20"
14) Contingency/ Emergency Response Plan or equivalent Risk Management Plan	Annex B.8	The proponent shall submit a Risk Management Plan/ Program that will include contingency measures to address environmental risks in case of accidents, equipment malfunctions, machine failures, and other emergencies.	Complied	The overall Risk Management Plan is integrated in the submitted and approved Environmental Impact Statement.
15) Abandonment Plan (when applicable)			Complied	FMRDP was approved on March 11, 2016. See attached Certificate of Approval as "Annex 6-15".
16) Environmental Monitoring Plan (EMoP)			Complied	Implemented and reported in the Semestral Compliance Monitoring Report. See attach 2nd Semester 2021 report as "Annex 6-22"

Photo 6-1: Photo Documentation of Project's Development




MAIN NURSERY

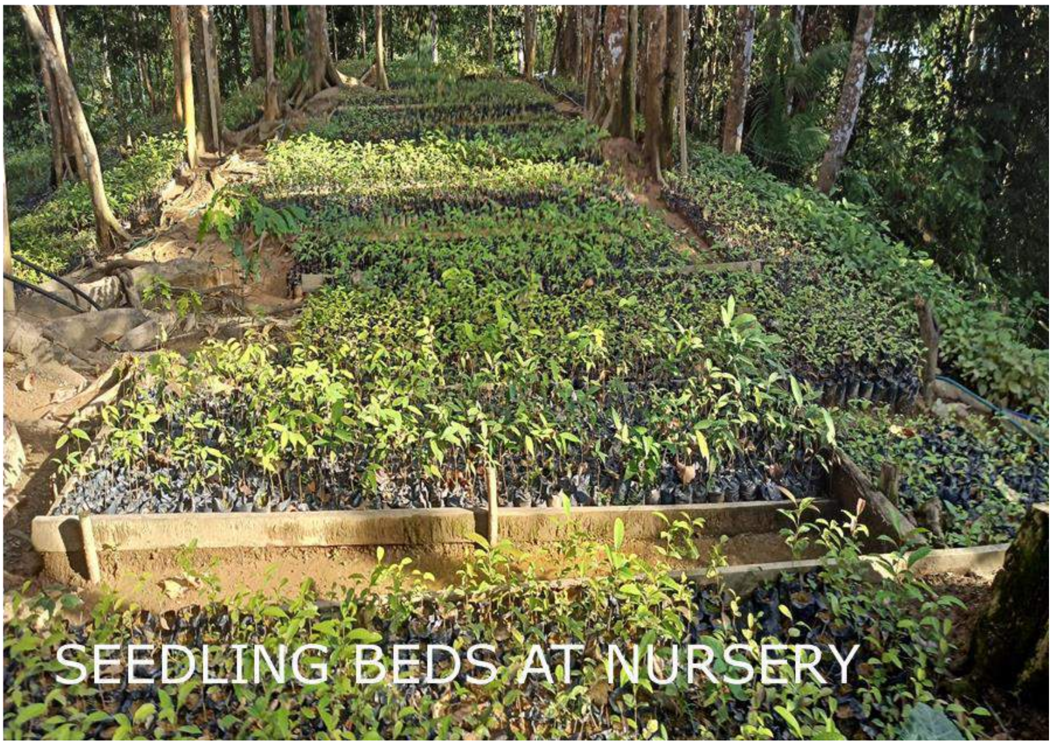
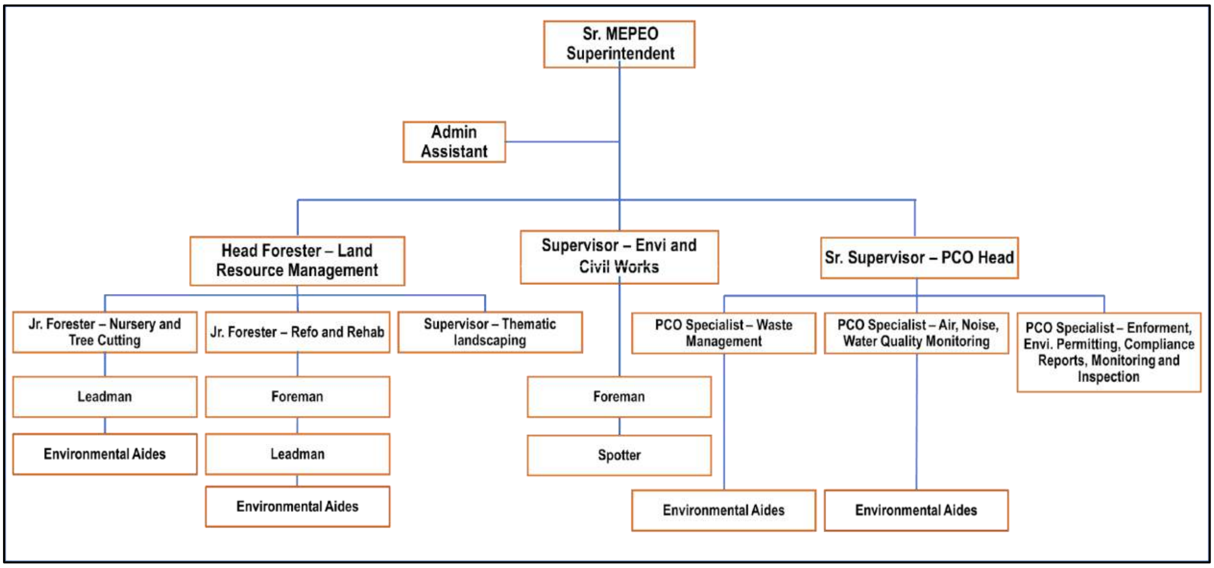

SEEDLING BEDS AT NURSERY

Figure 6-1: Existing MEPEO Table of Organization



6.2 2012 EIS IMPACT MANAGEMENT PLAN COMPLIANCE

6.2.1 Impact(s) Mitigation Plan (IMP) Management Plan

Table 6-2 presents the Impacts Management Plan which the 2012 EIS formulated for each major impact of the Balabag Project. Opposite each Plan component is a recital of what was implemented by TVRID, including costs, as per the EPEP Accomplishment Reports and Self-Monitoring Reports (SMRs). Any comments or findings of the MMT during its quarterly monitoring of the Project as contained in the MMT Compliance Monitoring and Validation Report (CMVR) which are relevant to the Plan component are re-stated.

The analysis is then enriched and updated by the recent findings of the EPRMP. Finally, the efficacy of the Plan component is evaluated using the scores of "No mitigation", "Slight mitigation", "Moderate mitigation", and "Full mitigation". Any subsequent action required of the Project proponent is indicated.

All cited Reports are part of the set of documents made available by TVIRD. Annex 6-23 reproduces the MMT CMVRs covering the year 2021. Table 6-3 extracts the findings and recommendations of the MMT from 2019 to 2021. The findings and recommendations may be classified into broad groups such as silt, waste management, etc. Based on the classification, nine each of the MMT findings pertain to silt and waste management. Five of the findings pertain to safety; 3 to the use of personal protective equipment (PPE) by the workers; 2 to steep slopes and landslides; and 1 each to air quality, buffer zone at the port area, hygiene, and water quality. A comparison of the MMT findings and recommendations listed in Table 6-3 with the overall assessment of the efficacy of the Impacts Management Plan shown in Table 6-2 shows the output of the MMT's works. The crucial items in the Management Plan which should be given adequate attention are:

1. Generation of cyanide contaminated tailings.
2. Release of Tailings to the ambient environment.

3. Establishment of a 20-m buffer zone along the entire periphery of the mining site and between the nearest water body and the mine and ore stockpile areas
4. Recovery and use of topsoil.
5. Progressive rehabilitation in the mining area.
6. Implementation of the stormwater/runoff management program.
7. Reduction or Depletion of Local Water Resource Supply.
8. Minimization or delay of ground disturbance.
9. Use of endemic species in the revegetation program.
10. Slope and soil stabilization using endemic species.

Table 6-2: Assessment of the 2012 IMP Compliance

Impacts	Impact Management Plan		Comments of MMT as Per CMVR	Findings of this EPRMP	Mitigation of Impacts
	Programmed	Implemented as per EPEP Accomplishment Report and SMR			
Erosion and Sedimentation	Planning Construction and operation good practices				
	Access and Haul Roads shall be Designed to Minimize the Gradients. Hard-wearing Course Provided to Minimize Soil Erosion.	Reported		Earthworks during the dry season especially in the upland are very difficult. Obviously, this guided the construction schedule of TVIRD	Moderate mitigation
	Provision of Road Drainage Canals to Control Runoff and Reduce Roadside Erosion.	Reported		All roads were provided with drainage canals draining towards the constructed settling ponds	Moderate mitigation
	Enhancement of Vegetative Cover Along the Sides of the Constructed Roadways.	Reported		Natural trees retained along the road and other roadsides will be disturbed in the future	Moderate mitigation
	Grade disturbed soil to a stable slope	Reported		No unsafe slopes were observed. TVIRD will improve the road-to-mine	Moderate mitigation – Corrective measure being implemented

Impacts	Impact Management Plan		Comments of MMT as Per CMVR	Findings of this EPRMP	Mitigation of Impacts
	Programmed	Implemented as per EPEP Accomplishment Report and SMR			
				gradient by constructing another road.	
	Stormwater and Run-Off Management				
	Diversion of runoff away from disturbed soil	Construction of drainage channels were reported.	The Silt ponds and siltation's abatement and control strategies must be intensified because of the increase in the size of the disturbed areas as the company pursue its development and construction works, which can affect receiving surface water bodies.	Observed drainage channels were inadequate. Water flows through disturbed slopes.	Slight mitigation – Corrective measures required
	Keeping runoff velocities low	Maintenance of drainage structures		There are gabion check dams and silt traps installed along drainage channels.	Slight mitigation – Corrective measures required
	Buffer Zone Management				
	Provision of Buffer Zones Between the Area of	Nursery Operation	The company must prohibit the cutting of trees within the	Based on the reforestation map provided, a total	Slight mitigation – TVIRD has programmed the

Impacts	Impact Management Plan		Comments of MMT as Per CMVR	Findings of this EPRMP	Mitigation of Impacts
	Programmed	Implemented as per EPEP Accomplishment Report and SMR			
	Disturbance and Rivers and Creeks		MPSA area and strictly secure the property against illegal activities.	of 192.5 ha were planted. However, the areas are widely distributed, without priority to the margins of Project features and roadsides	accelerated buffer zone works in 2021. The works should be focused on the margins and sides of Project structures
	Mitigating Measures				
	Settling ponds/sumps establishment	Implemented	Siltation/ water discoloration concern in the waterways of Brgy. Dimalinao, Brgy. Pulangbato, Brgy. Dipili, and Brgy. Depore.	Constructed 13 and 4 Settling Pond at Unao-unao and Genaro Area Catchment, respectively. A review of the areas, dimensions, and location of sediment traps and ponds is needed. The structures need to be designed to handle sediment down to the 0.016 mm size if possible. Baffles, passive dewatering system, and	Moderate mitigation – Corrective measures required

Impacts	Impact Management Plan		Comments of MMT as Per CMVR	Findings of this EPRMP	Mitigation of Impacts
	Programmed	Implemented as per EPEP Accomplishment Report and SMR			
				trash guards should be provided. In addition, the use of geotextile tubes immediately downslope of settling ponds should be tested and if found suitable, it may be adopted by TVIRD.	
	Gabion Check Dams	Constructed		Constructed 4 check dams and 11 check dams at Unao-unao and Genaro Area Catchment, respectively.	Moderate mitigation – Corrective measures required
	Silt Fence	Constructed		Silt fences are meant to shorten long slopes and thereby reduce erosion. Silt Fences were constructed in a specific where they can be strategically installed.	Slight mitigation – Corrective measures required
Generation of cyanide	Establishment of detoxification facility to	Constructed		A cyanide detoxification facility was included in the	Moderate Mitigation

Impacts	Impact Management Plan		Comments of MMT as Per CMVR	Findings of this EPRMP	Mitigation of Impacts
	Programmed	Implemented as per EPEP Accomplishment Report and SMR			
contaminated tailings	degrade cyanide in tailings to acceptable levels prior to discharge to tailings facility.			ore processing and all tailings subject to cyanide contamination were subjected to detoxification prior to discharge to the TSF.	
Release of Tailings to the ambient environment	Proper Design and Construction of the Tailings Storage Facility to contain tailings waste.	Implemented	Final Land Use of the TSF Stability of TSF and the water quality of wastewater being discharged at the facility and the waterways Presentation of the TSF design to the members of MMT and MRFC	On-going development of Tailings storage facility (TSF). The development of TSF is divided into 3 Phases. To date, Phase 2 of it has almost reached is completion.	Slight mitigation – Corrective measures required
Industrial, office, and domestic wastes	Management of industrial and office wastes including hazardous wastes.	The hazardous wastes being generated are waste oil, sulphuric acid, hydrochloric acid, nitric acid, phosphoric acid, hydrofluoric acid, ammonium hydroxide, toxic containers, Lead Compounds, Waste Electrical		Industrial wastes including hazardous ones are properly being managed by TVIRD and contractors. TVIRD has an adequate Hazardous Waste Storage	Moderate mitigation – corrective measures required

Impacts	Impact Management Plan		Comments of MMT as Per CMVR	Findings of this EPRMP	Mitigation of Impacts
	Programmed	Implemented as per EPEP Accomplishment Report and SMR			
		and Electronic Equipment, and Waste with cyanide. TVIRD regularly reports to the EMB on the disposition of these wastes.		Facility (HWSF). However, disposal of Haz Waste must be done twice a year.	
	Management of domestic waste	Installation of Segregation Bins and Material Recovery Facility (MRF)		Aside from Hazardous waste, domestic wastes are properly being managed by TVIRD and contractors. TVIRD has an adequate MRF in which all generated were stored. Some of the generated wastes were turned over to the Municipal Eco-Park Sanitary Landfill. However, TVIRD has no permanent disposal area	Moderate mitigation – Corrective measures required

Impacts	Impact Management Plan		Comments of MMT as Per CMVR	Findings of this EPRMP	Mitigation of Impacts
	Programmed	Implemented as per EPEP Accomplishment Report and SMR			
				for its biodegradable waste.	
Reduction or Depletion of Local Water Resource Supply	Implement Water Recycling and Conservation Programs	Not Reported		TVIRD has an established procedure for resource conservation procedures.	Slight mitigation – Corrective measures required
Dust	Use of Dust Suppression Techniques such as Watering of Exposed Surfaces	Implemented Three (3) Water trucks available		The number of water trucks deployed for water sprinkling cannot solely mitigate the dust problem. To further mitigate dust generation, the following measures are employed: Road ballasting; Speed limits of 20 kph for loaded trucks and 35 kph for unloaded trucks; Use of chemical dust suppressant or soil binder.	Slight mitigation – Corrective measures required
	Reduction of Vehicle Travel Speeds and Limit Exposed Areas	Not reported		TVIRD has signages along the road on speed limits. However, there is a need	Slight mitigation – Corrective measures required

Impacts	Impact Management Plan		Comments of MMT as Per CMVR	Findings of this EPRMP	Mitigation of Impacts
	Programmed	Implemented as per EPEP Accomplishment Report and SMR			
				to strengthen the enforcement. Positive reinforcement on drivers' safety is being done to encourage the drivers to strictly follow speed limits.	
	Provision of Fume Scrubber and Dust Collector at the Assay Laboratory to Control Emissions During Sample Preparation and Laboratory Analysis.	Implemented		A fume scrubber was installed in the Assay Laboratory to remove hazardous gases, fumes, and other air pollutants within the workplace environment and prior to release to the natural environment.	Moderate mitigation –
	Enclosures within and around the stockyard area	Not reported		The main source of dust is the haulage road. During dry and windy days, vegetated buffer zones have been established and it will also be reinforced by road ballasting, This mitigation	Slight mitigation – Corrective measures required

Impacts	Impact Management Plan		Comments of MMT as Per CMVR	Findings of this EPRMP	Mitigation of Impacts
	Programmed	Implemented as per EPEP Accomplishment Report and SMR			
				is included by TVIRD in its proposed Expansion Project.	
Noise	Use of silencers, mufflers, or enclosures	Reported		Individual units of equipment is monitored using noise meters. Further, contractors are required to submit SMR on their equipment status to ensure that the equipment is in a sound condition.	Slight mitigation – Corrective measures required
Terrestrial flora impacts	Slope and soil stabilization using forest species and Vetiver grass	Implemented		The slopes where soil was edge-dumped are potential sources of sediment, if not mitigated. Progressive revegetation is done for soil and slopes stabilization.	Slight mitigation – Corrective measures required
	Use of endemic species for planting	Endemic species were reportedly planted mixed with fruit trees and bamboos		The endemic species survive because it was planted under the mother trees. Endemic seedlings grow well in shady area.	Slight mitigation – Corrective measures required

Impacts	Impact Management Plan		Comments of MMT as Per CMVR	Findings of this EPRMP	Mitigation of Impacts
	Programmed	Implemented as per EPEP Accomplishment Report and SMR			
Visual Aesthetics	Revegetation of vicinity of main dam and impoundment	Not implement yet		On-going development Tailings storage facility (TSF). The development of TSF is divided into 3 Phases. To date, Phase 2 of it has almost reached is completion.	Slight mitigation – Corrective measures required
	Rehabilitation/ Reforestation of mined-out areas	Implemented	Department Regional Office Representative of the MMT, CENR Officer Jose Mario E. Reyes informed the MMT that he cannot attend the monitoring activity, however, he expressed his concern regarding an alleged complaint of illegal logging at the area of Balabag Dos and that a new structure was built. The MMT members present conduct an ocular inspection of the subject area and learned that the	Progressively rehabilitated 5.47 ha in other disturbed areas such as side slopes	Moderate mitigation – More Corrective measures required

Impacts	Impact Management Plan		Comments of MMT as Per CMVR	Findings of this EPRMP	Mitigation of Impacts
	Programmed	Implemented as per EPEP Accomplishment Report and SMR			
			existing Exploration Office and Staff House was not recently built. The Team went around the area and no traces of logging was observed. Bamboo Plantation - TVI Balabag has committed 20 hectares for bamboo plantation (as of September 2020) - As of February 2021, the company has purchased 50,000 seedlings (giant and "tikling" species)		

Table 6-3: MMT Findings and Recommendations, 2019 – 2021.

Date of Inspection	Findings	Recommendations
August 18-19, 2020	1. The Silt ponds and siltation's abatement and control strategies must be intensified because of the increase in the size of the disturbed areas as the company pursue its development and construction works, which can affect receiving surface water bodies.	
	2. The company must prohibit the cutting of trees within the MPSA area and strictly secure the property against illegal activities.	
	3. Water quality monitoring to be conducted in the next monitoring shall be in accordance with the procedures described in the Memorandum of Agreement (MOA) entered between the TVI and the MRCF. Duplicate samples shall be collected from each sampling station and sent to each EMB-accredited laboratory for analyses of pertinent parameters. This procedure shall serve as confirmatory sampling to ensure the integrity of the water samples.	
October 14-15, 2020	1. Department Regional Office Representative of the MMT, CENR Officer Jose Mario E. Reyes informed the MMT that he cannot attend the monitoring activity, however, he expressed his concern regarding an alleged complaint of illegal logging at the area of Balabag Dos and that a new structure was built. The MMT members present conduct an ocular inspection of the subject area and learned that the existing Exploration Office and Staff House was not recently built. The Team went around the area and no traces of logging was observed. Additionally, the Core House located within the Balabag Dos area was found to be previously built but it can be observed that it has undergone expansion. The personnel-in-charge of the area claimed that the wood/lumber used in the expansion of the	

Date of Inspection	Findings	Recommendations
	Core house was from the previous Special Tree Cutting Permit (STCP).	
	2. The team also saw a "Core Sample Cutting Machine" and initially thought that it was used for wood cutting. The company representative told the team that it was cutting the core samples in half, one half to be sent to assay laboratory and the other half to be kept for "logging".	
February 10-11, 2021	1. Total expenditure for CY 2020 is at Php 14,577,594.68 against the budget of Php 7,866,011.20. Some of the components were not 100% attained but most had exceeded the planned programs.	Carry over the remaining activities (not yet 100% accomplished) to CY- 2021 AEPEP
	2. Bamboo Plantation • TVI Balabag has committed 20 hectares for bamboo. . plantation (as of September 2020) • As of February 2021, the company has purchased 50,000 seedlings (giant and "tikling" species)	Attend the Online Learning Event for Establishment of Bamboo Plantation in Mining Area on March 11, 2021
May 20-21, 2021	Letter from RDC IX/NEDA IX relative to the concerns raised by a certain Engr. Soliva, RDC IX Private Sector Representative, addressed to MGB RIX regarding the measures for the Environmental Protection and Preservation being implemented by TVIRD.	MGB RIX, MSESDD Chief Ramon Alforte will present the Envi programs and initiatives of TVIRD to NEDA RIX on Monday. Data and other docs to be forwarded to MGB RIX to supplement their presentation.
	Bamboo Plantation Update – Timuay Manda suggested if the Company could involve the LGU, POs, IPs, so they could help in the determination of possible areas for plantation.	Establish plantation of Giant Bamboos within its disturbed areas.
	Inform LGUs and IPs if the Project will commence commercial operations already	The company to submit the Final Report to MGB RO IX within 6 months from the completion of the development and constructions of activities.
	Final Land Use of the TSF.	Letter dated March 30, 2021, the company

Date of Inspection	Findings	Recommendations
		ensured that they will consider review and revision of FMRDP once the project hits operational status.
November 4-5, 2021	Stability of TSF and the water quality of wastewater being discharged at the facility and the waterways.	To present TSF Design and treatment of wastewater from Detox Plant to TSF until discharge to waterbodies. Result to be presented also if necessary.
	Siltation/ water discoloration concern in the waterways of Brgy. Dimalinao, Brgy. Pulangbato, Brgy. Dipili, and Brgy. Depore.	Action Plan to be presented.
	Extensive IEC including programs being undertaken by TVIRD.	To include concerned LGUs.
	Transparency of product refinery.	Members requested to visit/ observe the Gold Room.
	Company promotions i.e., partnership activities with Government Agencies and Non-Government Agencies.	To include promotion of IECs and other Company programs and should not focus only on livelihood/ job opportunities.
	Progress Map on STCEP Compliance.	To include updates of compliance with the previous STCEP.
	Realignment of AEPEP	Shall focus on Water Resource and Quality Management to serve the purpose of the program especially that major concerns are related to it.
January 27-28, 2022	Quarterly replenishment of Monitoring Trust Fund (MTF) to correspond to the expenses incurred by the monitoring team was not conducted regularly (Update and Status/movement of funds)	TVIRD to replenish the MTF regularly in compliance with DAO 2010-21 Section 181.a
	The company had identified a potential local NGO as a member of the MMT and MRFC	To provide updates in the MRFC Meeting
	Water classification issue on the directly affected water bodies	For discussion in the upcoming MRFC Meeting

Date of Inspection	Findings	Recommendations
	Transparency in the computation of IP Royalty	CRO to devise a system of transparency in the computation of Royalty in coordination with the IP Leaders
	Presentation of the TSF design	To be presented this 1st Quarter MRFC TVIRD BGSP
	The final land use of the TSF will be a reclaimed area.	TVIRD BGSP should submit to MGB RO the revised FMRDP for pre-evaluation and endorsement to MRFC for evaluation and approval.

6.3 IMPLEMENTATION OF ENVIRONMENTAL PROTECTION AND ENHANCEMENT PROGRAM

6.3.1 Land Resource Management

Control strategies associated with the Land Resource impacts represent commitments to environmental management of the Land Resources during development and mining operations and in preparation for closure and decommissioning.

Strategies and mitigation measures have been identified and developed with the intent that they will be implemented throughout and following the mining operations. With respect to the Land Resources component, control strategies focus primarily on progressive rehabilitation, reforestation of denuded areas, thematic landscaping, erosion control/slope stabilization, maintenance of previous and new plantations, nursery operations, establishment of clonal facility, and establishment of vermicomposting facility.

6.3.1.1 Rehabilitation of Other Disturbed Area (MFP)

The total disturbed area resulting from the mining project is approximately 112.28 hectares, by the end of March 2022. This area includes the environmental management structures, haul road network, waste dump, stockyards, and other mine facilities. The distribution of actively disturbed areas is presented in Table 6-4. A map showing the disturbed areas is shown in Figure 6-2.

Table 6-4: Project Disturbed Areas and Progressive Rehab as of June 2022

Location	Area disturbed 2022 (ha)	Area Applied For in EPRMP	Status
Road Network	11.47	30	Active
Mill Plant	2.39	15	Active
Tailings Dam	37.34	76	Active
Infrastructure Camp Area	8.23	20	Active
Drainages	1.84	3	Active

Location	Area disturbed 2022 (ha)	Area Applied For in EPRMP	Status
Waste Dump	24.82	50	Active
Nursery	0.70	1	Active
Silt Ponds	0.88	5	Active
Ore Stockyard	3.83	6	Active
Mine Area	15.31	35	Active
Rehabilitation	5.47		Active
Total	**112.28**	**241**	

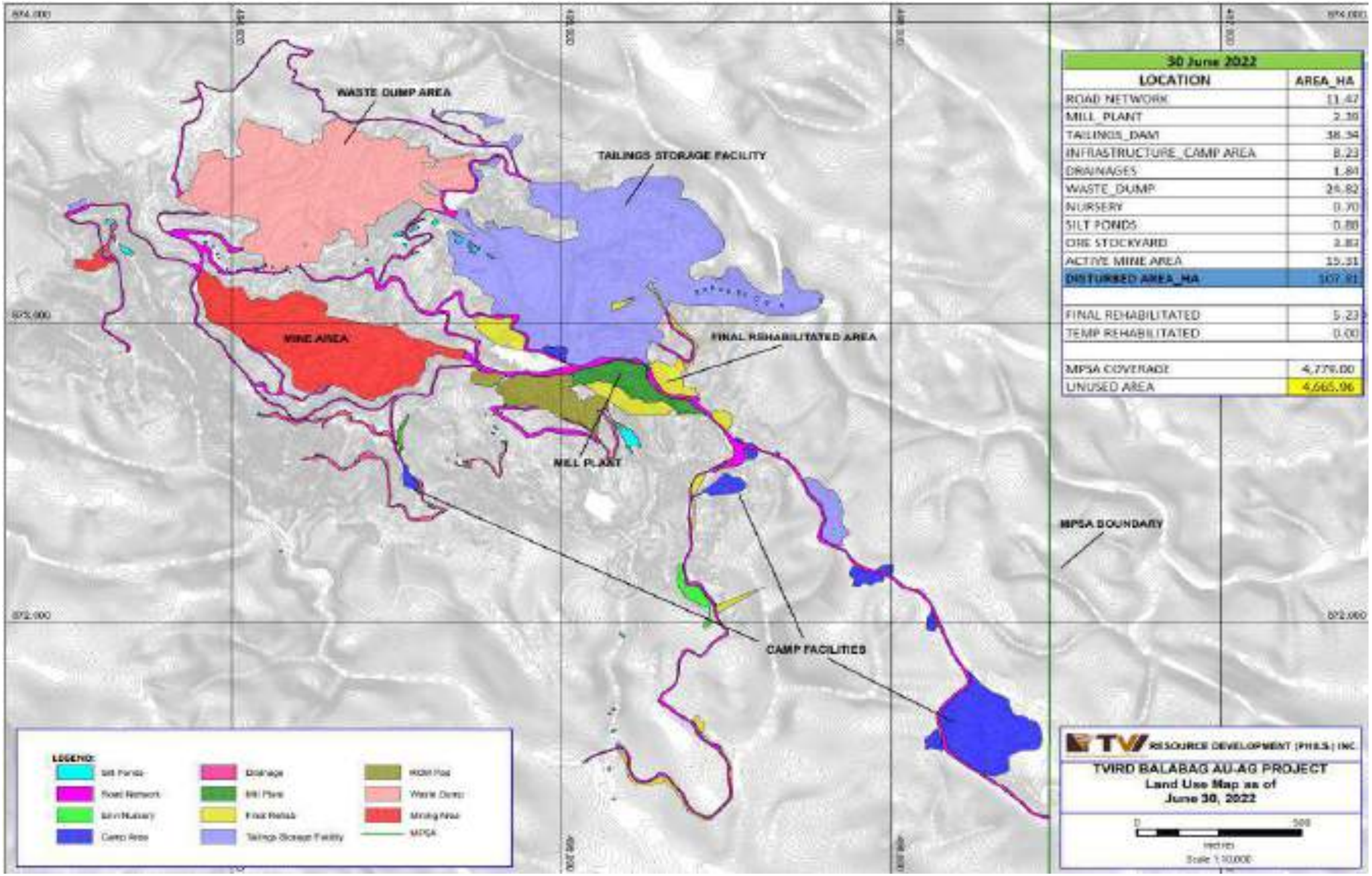
Progressive rehabilitation program is initiated in mining areas that are considered inactive. This entails earthwork and establishment of drainage control structures to improve structural and slope stability prior to revegetation. Progressive rehabilitation activities are implemented on a programmed schedule depending on the progress of mining activities.

Implementation of progressive rehabilitation activities have started 1 year after mining operations commenced which encompasses an accumulated area of 5.47 has as of June 2022.

Other rehabilitation activities continuously being done on site include soil erosion and sedimentation control, slope stabilization, the establishment of drainage systems, and storage of topsoil/spoil materials. Brief discussion of each activity is provided in the following sub-sections.

Photo 6-2: Before and After Rehabilitation of the North Side of Mill Plant

Figure 6-2: Land Use Map as of June 2022



6.3.1.2 Reforestation and Plantation Maintenance (Mining Forest Program)

Under the progressive rehabilitation program, mined-out areas are prepared immediately for re-vegetation. Land preparation, which includes backfilling, re-contouring, and benching are done prior to revegetation activities. Replanting, soil amelioration, mulching, fertilizer application and watering, if necessary are continuous as part of care and maintenance operations

Under the Land Resource Management, the implementation of Mining Forest Program has been constantly conducted as to establishment of bamboo plantation within and outside the MPSA.

Photo 6-3: Planting of Indigenous Species of Seedlings at Northside of Mill Plant as Part of Reforestation Program

Photo 6-4: Bamboo Planting Activities as part of MFP

6.3.1.3 NGP Plantation Establishment and Maintenance

The Project has been compliant with the National Greening Program (NGP) Mandated by the DENR since the mineral exploration phase in Year 2011. As of the first quarter of Year 2022, the NGP reforestation commitment of TVIRD was 100% accomplished with a cumulative total 165,697 seedlings planted covering 258.18 hectares of reforestation area. The maintenance activities include brushing, weeding and replanting.

Maintenance of established plantations is ultimately significant to ensure survival and success in attaining the projected purpose and outcome of rehabilitation and reforestation programs. The activity will be implemented to various plantations established during the time of exploration until Year 2022. The reforestation accomplishment is shown in Table 6-5. A map showing the reforestation areas maintained is shown on Figure 6-3.

Table 6-5: Annual Reforestation Accomplishment

Reforestation	Plantation Category			Cumulative as of March 2022
	Old	Recent	Latest	
No. of Seedlings Planted	12,000	150,177	3,520	165, 697
Re-planted seedlings	0	250	0	250
No. of Surviving Plants	8,749	134,429	3,278	146,456
Survival Rate	70.16%	89.51%	93.14%	88.38%

Figure 6-3: Map Showing the Reforestation Sites Planted with Indigenous Species within the MPSA

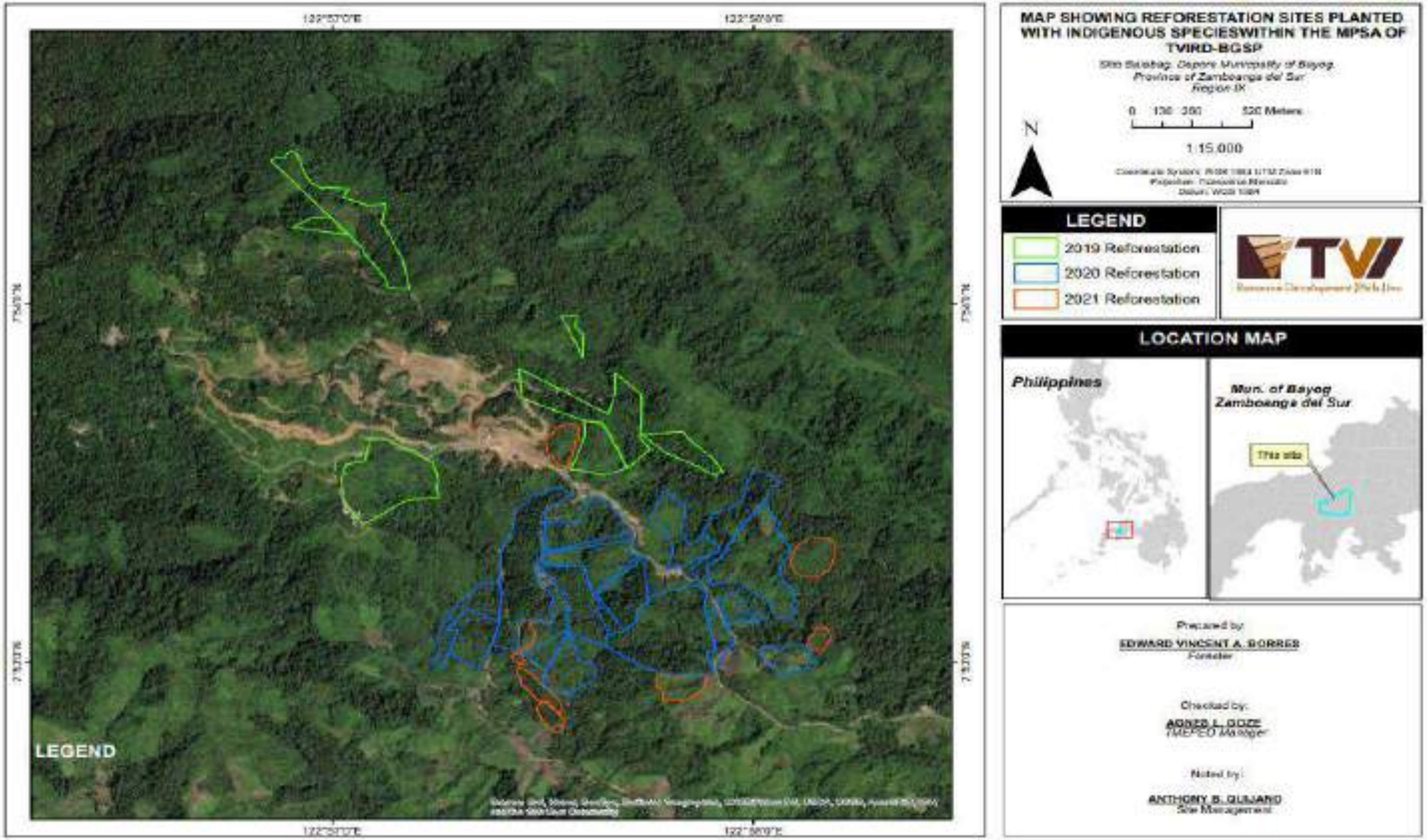


Photo 6-5: Turn-over of Seedlings (left) to the NGP beneficiaries Outside the MPSA; Planted Coconut Seedlings of Alos Edal (right) One of the Beneficiaries of NGP Program Outside the MPSA

Photo 6-6: From left, CENRO Pacifico Cabrido Inspecting the Planting Site of Timuay Manda, Marlo Andus; (right) Conduct of Care and Maintenance of Planted Coconut Seedlings

6.3.1.4 Slope Stabilization

Slope stabilization measures in place include the installation of coconet, biologs, gabion baskets, and establishment of ground covering along unstable slopes to minimize erosion and landslide incidents. Proper slope drainage system is also established to facilitate continuous water flow along slopes, without eroding the soil materials. These measures have minimized soil transport and sedimentation within the local streams. Within the past year, approximately 1.045 hectares of slopes were stabilized.

Photo 6-7: Installation of Coconets and Planting of Cover Crops (Mani-mani and Vetiver) Along Berms and Slopes

Photo 6-8: Bamboo Seedlings and Napier Grass Planted Along Slopes

Photo 6-9: Re-planting of Indigenous Seedlings Along Slopes

6.3.1.5 Nursery Operation and Maintenance

The project has an established central nursery onsite with a total area of 0.70 hectares. It can house up to 100, 000 seedlings for the implementation of reforestation, rehabilitation and revegetation as entailed within the MFP and NGP areas. Seedling variations are forest trees, fruit trees, fruit bearing crops as well as ornamental plants. Soil ameliorants are employed as organic fertilizers for the substrate of the collected wildling and sapling. The potted plants are observed closely with care and maintenance within the hardening shed. After the hardening phase, the seedlings are ready for reforestation and rehabilitation activities.

Photo 6-10: MMT Participants Visit to the Migligilian Central Nursery (top left), Collection of Wildlings and Transfer to Polybags (top right), Weeding of Potted Seedlings (bottom left) and Potting of Polybags (bottom right)

Photo 6-11: Inventory of Seedlings at Hardening Area and Sorting out of Seedlings per Species (left to right)

Photo 6-12: Planting of Strawberries at Migligilian Central Nursery

6.3.1.6 Access Road Maintenance

The Project has 21.37 hectares of road networks. The roads are maintained by grading and re-surfacing uneven area using uniform ballasting materials. Grading and compacting of these roads are regularly done during the operations period to increase road safety and minimize dust emission. Likewise, clearing and keeping the roads passable during the rainy season are also conducted to prevent major road damages such as landslides and road surface scouring.

Photo 6-13: Graveling and Repair of Major Access Road as part of Road Maintenance Activity

6.3.1.7 Topsoil and Subsoil Management

Topsoil materials removed from the stripping and clearing activities are stored within designated topsoil storage areas to preserve for future use on rehabilitation and patching of mined out and disturbed areas. These materials are blended with soil ameliorants, fertilizers, and other soil conditioners to improve the quality of soil used in the revegetation program.

Photo 6-14: Topsoil Utilization as Landscaping Materials at Admin Building, Central Nursery and Simbol Area

Photo 6-15: Topsoil Utilization as Landscaping Materials at Admin Building, Simbol Area and as Potting Mix Media

6.3.1.8 Buffer Zone Management

TVIRD conducted a survey prior to the establishment of buffer zone wherein a 20-meter buffer marked surrounding the MPSA. These zones will be re-stabilized by improving its surrounding vegetation.

Photo 6-16: Installation of Signages and Brushing Along the Buffer Zone Area

6.3.1.9 Stockyard Management (ROM Pad)

The existing stockyard of the Project has an area of 3.09 hectares which was utilized for ore stockpiling of varying grades and size reduction through crushing. To manage those above impacts on stockpiling, the project will only observe the following within the 3.09 ha of the stockyard this calendar 2022:

- Perimeter planting to serve as buffer for dust and noise dispersion
- Regular water spraying in stockyard access roads
- Ballasting/surfacing of uniformly based-course rock materials on its access road to minimize dust emissions
- Establishment of sufficient drainage system to avoid clogging road to minimize dust emissions
- Regular daylighting of stockyard waste

Photo 6-17: 3.83 has ROM Pad Constructed Adjacent to the Crusher Area

6.3.1.10 Thematic Landscaping

This activity aims to improve the aesthetic of the project site that is value adding to its surroundings. Buildings will be provided with landscaping style using recyclables and will be provided with ornamental plants that provides calmness and appealing to the employees and visitors. Utilization of recyclable materials such as used tires, plastic, and glass bottles to sustain landscaping as to lessen the waste generation.

Photo 6-18: Landscaping of Central Nursery Area

Photo 6-19: Landscaping of Helipad Located at Mine Area

Photo 6-20: Landscaping of Admin Building Area


6.3.2 Water Resource and Quality Management

Control strategies relative to water management are focused on the changes in drainage patterns and the potential water quality and habitat degradation from siltation. Particular interest are the impacts on the small watersheds draining the Project area. The mining operation is affecting a total of 4 watersheds. Control strategies will focus on the four (12) watersheds including Unao-Unao watershed, Dimalinaw watershed, Dipili watershed, Lalab watershed, Malagak 1 watershed, Malagak 2 watershed, Malagak 3 watershed, Malagak 4, watershed, Genaro watershed, Upper Depore watershed, Bayan creek watershed and Depore watershed which will be draining the Project disturbed areas. A watershed map covering the Project area is shown on Figure 6-4.

Figure 6-4: Watershed Map

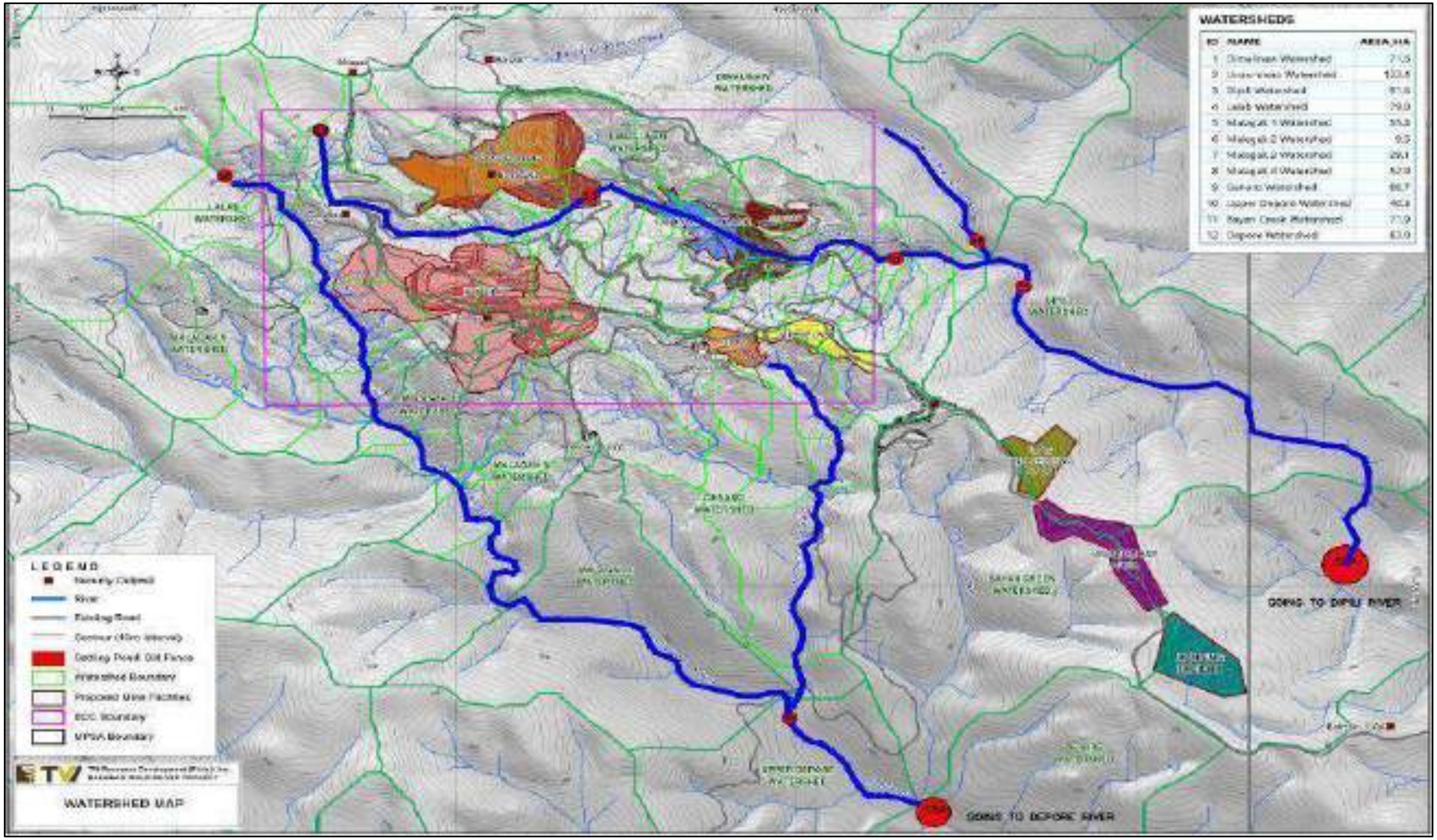
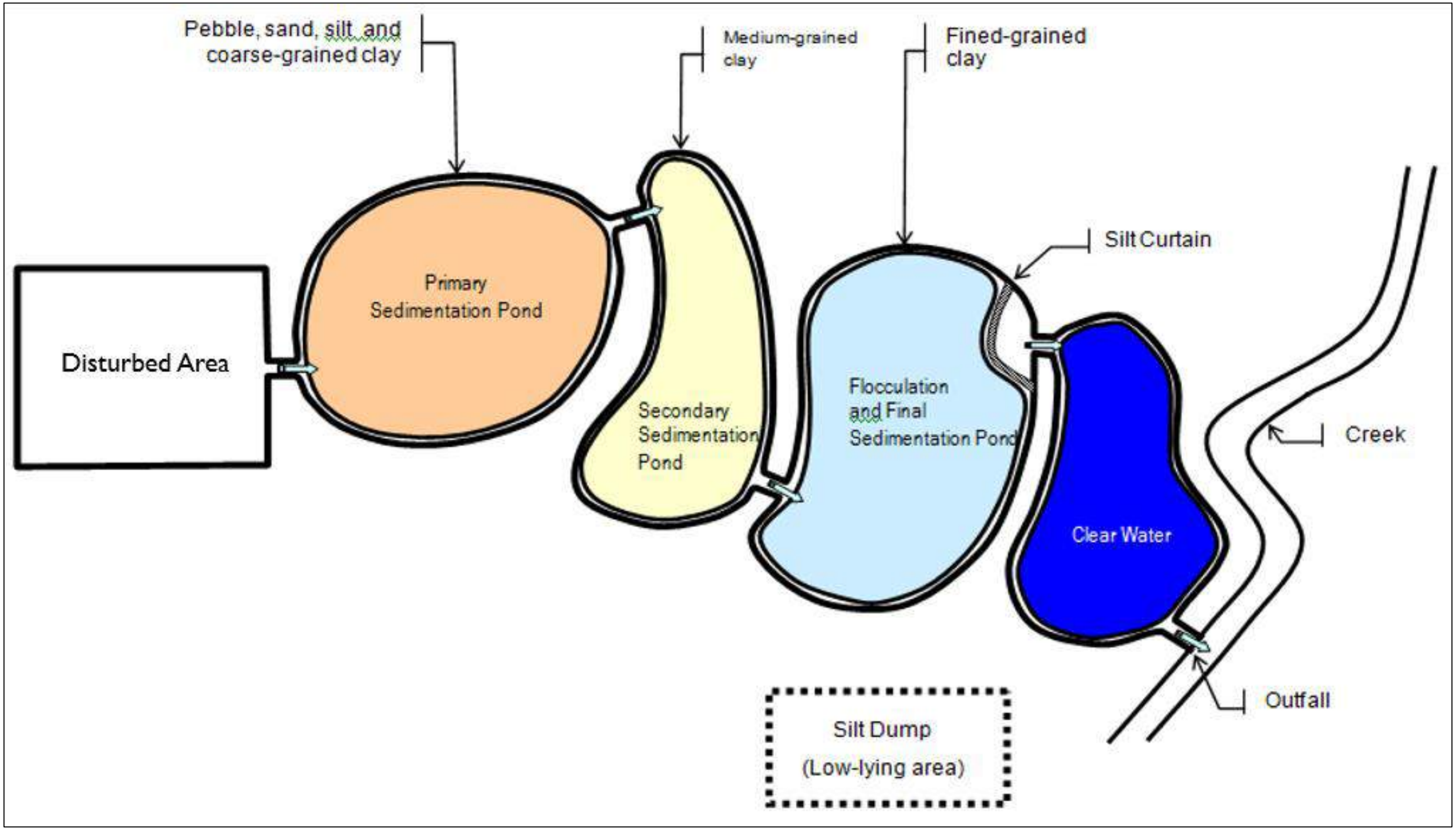


Figure 6-5: Schematic Diagram of Series of Settling Ponds



6.3.2.1 Desilting or Maintenance of Settling Ponds/Check Dams/Collector Sumps

Measures for sediment control have included construction and maintenance of settling ponds, silt collector sumps, in-pit ponds, and ditch canals at identified drainage catchment areas. To date, there are about 1,107 installed silt fences, 21 settling ponds, 3 in-pit ponds, 24 silt collector sumps, 6 gabion check dams constructed to manage the surface water runoff from the project area. One (1) discharge permit have been secured for these series of water management facilities. As of May 2022, an accumulated 40, 000 m3 has been desilted from the said environmental structures. The schematic diagram of the constructed silt and sediment ponds within the Project area is shown on Figure 6-5.

Photo 6-21: Desilting of Settling Ponds

Photo 6-22: Construction and Maintenance of Collector Sump

Photo 6-23: Construction of Gabion Dams

Photo 6-24: Installation of Silt Fences along Unao-Unao Waterway

Photo 6-25: Construction and Maintenance of Gabion Check Dams along Unao-Unao Waterway

6.4 COMPLIANCE MONITORING UNDER SMR AND ENVIRONMENTAL LAWS

6.4.1 Surface Water Quality Monitoring

Water sampling for in-house analysis is conducted on a daily basis for parameters; TSS, TDS and Free cyanide within the nine (9) stations namely, DM-4, U-6, U-7, G-3, G-5, U-3, DM-1, DM-2 and DM-3. Regular water quality monitoring activities done both internally every month and quarterly in compliance with the MMT events. Multiple sampling locations within the Project area will be established to ensure compliance with DENR surface and effluent standards. Water samples will be collected according to the provisions of the Water Quality Monitoring Manual of the Environmental Management Bureau. Water quality will be measured in terms of physical and chemical characteristics. Other parameters such as heavy metals, BOD5 and Bacteriological analysis will be performed by accredited DENR-EMB laboratories for the MMT/quarterly sampling.

Frequency and monitoring parameters will be determined depending on the location and the operations activities. General parameters are in line with DAO 2016:08 Water Quality Guidelines and General Effluent Standards of 2016. Monitoring stations are summarized in Table 6-6 and a map showing the water quality monitoring stations are shown on Figure 2-46: Surface Water Quality Sampling Locations and reproduced for purposes of presentation in Figure 6-32.

Shown in Tables 6-7 to 6-21 are the water quality monitoring results since the commercial operations of TVIRD in 2019 up to 2021. Water quality parameters such as pH, TSS, BOD5, Fecal Coliform, Free Cyanide, Copper, Lead, Mercury, Arsenic, Cadmium, Zinc, Oil and Grease, Chloride, Phosphates, and Nitrates are being monitored regularly.

Based on the data presented, it can be perceived that among the said parameters, the TSS, Fecal Coliform, Oil and Grease, and Phosphates, have the number of incidents of exceedances.

For TSS, it can be noted that there are exceedances in sampling stations within the project site, was well as in other sampling stations. These exceedances mostly occurred during construction and development phase of the Project since bulk of the earthworks are concentrated on these stations. Also, the topographic position of the slope at our Project Site is one of the considerable factors affecting these results and the great amount of rainfall rate leading to the development of erosion and consequently sediment transport from the active areas.

However, these are holistically being addressed by making sure that the last discharge points, Station U-6 DS Unao Unao Creek before Batman and Station G-3 DS Genero Creek, for the two (2) main drainage systems namely, Sotheast Drainage System-Dipili River and Southwest Drainage System – Depore River conforms within DENR Standard.

Environmental Structures put forth by the Company to reduce/prevent TSS and sedimentation in creeks and rivers that receives mine-derived sediments are: Settling Ponds, Collector Sumps, Drainage Canals, Gabion Check Dam, and Silt Fences. Additional medium for erosion control, drainage and filtration applications like Geotextile Filter Fabric, Geotextile Tubes, Coco-matting, and Gabions are integrated to stabilized soil structure and to augment prevention of sedimentation into the hydrological system. Further, all mitigating structures are being repaired and improved to maintain their capacity and integrity. Geotextiles are also replaced if necessary.

Oil and grease concentration at U-5 US Dipili River with 2 mg/L and G-3 DS Genaro Creek 2mg/L has exceeded the standard threshold limit due to ongoing construction of TSF Dam, fuel depot and heavy equipment where repairment usually could take place within construction site. While fecal coliform and phosphate parameters exceeded in some stations within and outside the MPSA, this is due to man-made factors such as human and animal waste, detergents, and agricultural run-off during rain events. To note, during the exploration phase, baseline results of phosphate from all stations already had an exceedance and that the Project site was once a small-scale mining area.

Further, based on the Conduct of Resource and Geological Assessment of Sibugay River and its Tributaries by DENR RO IX's Assessment Team in July 05, 2020, led by the ARD for Technical Services, there overall finding states that…" Based on the Laboratory Result, it showed that all parameters were below the threshold limit with respect to the standards established on Dao 2016-008 for a Class C Waterbody. With the data, it is deduced that there was no abrupt change, alteration, and alarming constituents with regards to the chemical qualities…"

Photo 6-26: Daily Water Quality Monitoring Sampling at U-6 (right) and U-3 Sampling Station (left)

Table 6-6: Water Quality Monitoring Stations

Stations	Latitude	Longitude	Description
U-1 (S1)	7°54'0.456" N	122°56'36.852" E	Upstream Unao-Unao Creek
U-2 (S3)	7°53'52.932" N	122°57'3.486" E	Midstream Unao-Unao Creek before TSF
U-3 (S2)	7°53'44.676" N	122°57'34.686" E	Downstream Unao-Unao Creek after TSF
U-4 (S4)	7°53'46.764" N	122°57'39.216" E	Downstream Dimalinao Creek
U-5 (S5)	7°53'43.62" N	122°57'44.322" E	Upstream Dipili River
U-6 (S2A)	7°53'17.532" N	122°58'16.344" E	Downstream Unao-Unao Creek before Batman
U-7 (S7)	7°51'28.77" N	123°1'56.364" E	Dipili River (Dam Section)

Stations	Latitude	Longitude	Description
(G-1) S6	7°53'55.518" N	122°56'31.224" E	Upstream Lalab before Surface Mine
G-2 (S8)	7°52'52.116" N	122°57'21.342" E	Lalab-Genaro Confluence
G-3 (S8A)	7°52'58.206" N	122°57'22.596" E	Downstream Genaro Creek
G-4 (S9)	7°52'12.012" N	122°57'14.106" E	Malagak River
G-5 (S11)	7°50'28.35" N	123°0'36.204" E	Depore River (Bridge Section)
SEB-1 (S19)	7°52'26.976" N	123°6'28.908" E	Sibugay River (Pobalcion)
SEB-2 (S18)	7°52'37.296" N	123°2'41.616" E	Sibugay River (Bulawan Lakewood)
SEB-3 (S10)	7°48'45.51" N	123°0'18.126" E	Sibugay River (Bayog-Diplahan)
SEB-4 (S12)	7°47'33.99" N	122°57'48.354" E	Sampoli River (Bridge Section)
SEB-5 (S13)	7°49'27.786" N	123°1'7.95" E	Sibugay River (Salawagan-Bayog)
SEB-6 (S14)	7°45'55.158" N	122°58'30.378" E	Buug Muyo Creek (Paradise, Diplahan)
SEB-7 (S15)	7°45'52.182" N	122°58'28.242" E	Sibugay River (Paradise, Diplahan)
SEB-8 (S16)	7°43'52.896" N	122°57'6.294" E	Balagon River (Brgy. Minsulao)
SEB-9 (S17)	7°40'28.068" N	122°54'24.69" E	Sibugay River (Diplahan-Siay)

Figure 6-6: Water Quality Monitoring and Sampling Stations

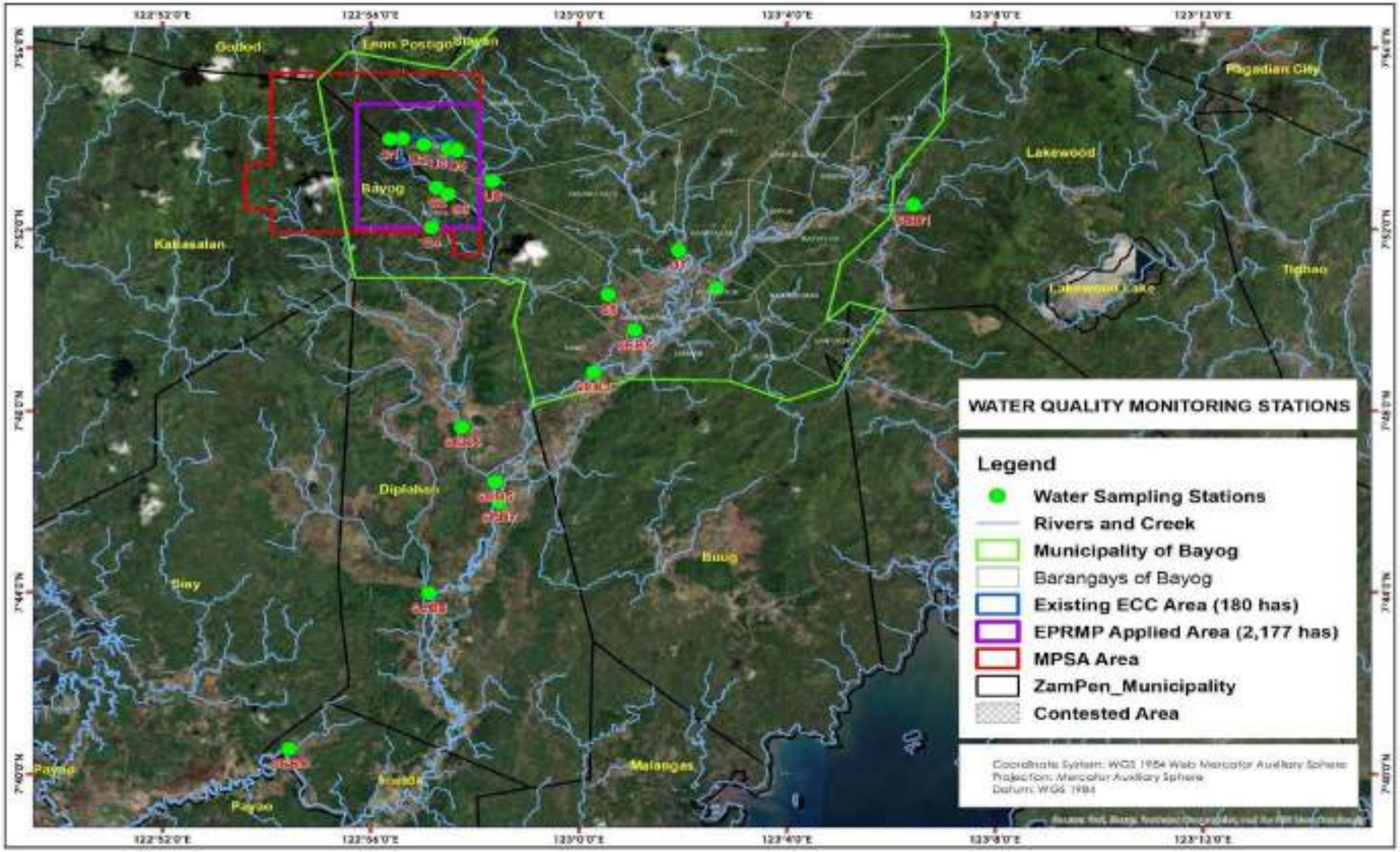


Table 6-7: Water Quality Results for pH

Monitoring Objective	Environmental Aspect	Environmental Impact	Parameter	Station No.	Sampling and Measurement													DENR Standard	Remarks
					Q1 2019	Q2 2019	Q3 2019	Q4 2019	Q1 2020	Q2 2020	Q3 2020	Q4 2020	Q1 2021	Q2 2021	Q3 2021	Q4 2021	Q1 2022		
Compliance to RA 9275 (Water Quality)	Discharge of waste and effluent to freshwater (FW) and Drinking water (DW) sources	Water pollution, land contamination, health hazards	pH	U-1 (S1)		6.50		7.01			6.34		6.43	6.43	6.61	6.94	6.18	6.5-9.0	PASSED
				U-2 (S3)		6.80		6.99			7.02		6.53	6.73	7.06	7.16	6.75		
				U-3 (S2)		6.60		7.73			6.93		7.36	6.54	6.62	7.19	7.56		
				U-4 (S4)							7.11		6.83	6.58	7.06	6.90	7.86		
				U-5 (S5)							7.21		7.39	6.60	7.08	6.88	7.76		
				U-6 (S2A)				7.68			7.04		7.41	6.72	6.96	7.00	7.21		
				U-7 (S7)		7.40		7.85			7.44		7.21	7.18	7.20	6.92	7.96		
				(G-1) S6		7.00			8.08		7.30		7.66	6.70	7.10	7.01	7.97		
				G-2 (S8)		6.90		7.76			7.44		7.35	7.15	7.34	6.92	7.98		
				G-3 (S8A)				7.64			7.48		7.72	7.27	7.33	6.91	7.59		
				G-4 (S9)							7.43		7.73	7.24	7.30	6.99	7.52		
				G-5 (S11)		7.50		7.85			7.40		7.64	7.44	0.32	7.04	7.58		
				SEB-2 (S18)							7.50		7.55	7.17	7.64	0.31	7.88		
				SEB-1 (S19)							7.83		7.56	7.16	0.31	7.05	7.84		
				SEB-3 (S10)							7.40		7.70	7.23	7.27	6.96	7.72		
				SEB-4 (S12)							7.40		7.54	7.12	7.33	6.90	7.66		
				SEB-5 (S13)		8.00		8.35			7.37		7.50	7.11	0.32	6.86	7.76		
				SEB-6 (S14)		4.60					7.27		7.42	7.00	7.34	6.82	7.64		
				SEB-7 (S15)		4.60		7.88	7.99		7.06		7.37	6.96	7.27	6.79	7.60		
				SEB-8 (S16)							7.05		7.38	6.97	7.28	7.12	7.63		
				SEB-9 (S17)							7.24		7.48	6.81	7.27	7.02	7.62		

Table 6-8: Water Quality Results for BOD5

Monitoring Objective	Environmental Aspect	Environmental Impact	Parameter	Station No.	Sampling and Measurement													DENR Standard	Remarks
					Q1 2019	Q2 2019	Q3 2019	Q4 2019	Q1 2020	Q2 2020	Q3 2020	Q4 2020	Q1 2021	Q2 2021	Q3 2021	Q4 2021	Q1 2022		
Compliance to RA 9275 (Water Quality)	Discharge of waste and effluent to freshwater (FW) and Drinking water (DW) sources	Water pollution, land contamination, health hazards	BOD5	U-1 (S1)				1.0			<1.0		<1.0	3.0	<1.0	2.0	3.0	7.0 mg/L	PASSED
				U-2 (S3)				8.0			1.0		1.0	2.0	<1.0	<1.0	2.0		
				U-3 (S2)				3.0			<1.0		1.0	2.0	<1.0	<1.0	4.0		
				U-4 (S4)							1.0		<1.0	<1.0	<1.0	2.0	2.0		
				U-5 (S5)							<1.0		<1.0	2.0	2.0	1.0	<1.0		
				U-6 (S2A)				2.0			<1.0		<1.0	4.0	<1.0	2.0	2.0		
				U-7 (S7)							<1.0		<1.0	<1.0	1.0	3.0	3.0		
				(G-1) S6					<0.1		<1.0		<1.0	3.0	2.0	2.0	<1.0		
				G-2 (S8)				<1.0			<1.0		<1.0	2.0	1.0	2.0	2.0		
				G-3 (S8A)							1.0		<1.0	<1.0	<1.0	2.0	<1.0		
				G-4 (S9)							1.0		<1.0	2.0	2.0	3.0	2.0		
				G-5 (S11)							<1.0		<1.0	2.0	2.0	2.0	3.0		
				SEB-2 (S18)							<1.0		<1.0	4.0	<1.0	2.0	<1.0		
				SEB-1 (S19)							2.0		<1.0	3.0	<1.0	2.0	3.0		
				SEB-3 (S10)							3.0		2.0	<1.0	2.0	1.0	2.0		
				SEB-4 (S12)							<1.0		2.0	3.0	2.0	2.0	3.0		
				SEB-5 (S13)							3.0		<1.0	2.0	<1.0	<1.0	2.0		
				SEB-6 (S14)							1.0		<1.0	3.0	<1.0	2.0	3.0		
				SEB-7 (S15)					<0.01		3.0		3.0	2.0	1.0	2.0	5.0		
				SEB-8 (S16)							2.0		2.0	3.0	<1.0	3.0	4.0		
				SEB-9 (S17)							3.0		2.0	5.0	1.0	2.0	2.0		

Table 6-9: Water Quality Results for TSS

Monitoring Objective	Environmental Aspect	Environmental Impact	Parameter	Station No.	Sampling and Measurement													DENR Standard	Remarks
					Q1 2019	Q2 2019	Q3 2019	Q4 2019	Q1 2020	Q2 2020	Q3 2020	Q4 2020	Q1 2021	Q2 2021	Q3 2021	Q4 2021	Q1 2022		
Compliance to RA 9275 (Water Quality)	Discharge of waste and effluent to freshwater (FW) and Drinking water (DW) sources	Water pollution, land contamination, health hazards	TSS	U-1 (S1)		11		82			2		5	21	7	5	21	80 mg/L	With Exceedances
				U-2 (S3)		28		1332			592		688	72	800	72	72		
				U-3 (S2)		15		8620			55		159	49	313	38	49		
				U-4 (S4)							14		78	325	487	253	325		
				U-5 (S5)							10		144	15	55	9	15		
				U-6 (S2A)				2			12		220	8	33	35	8		
				U-7 (S7)		9		24			3		6	4	68	<2	4		
				(G-1) S6		10			15		3		20	32	201	39	32		
				G-2 (S8)		5		13			17		17	13	40	8	13		
				G-3 (S8A)				12			14		22	39	44	8	39		
				G-4 (S9)							<2		<2	<2	<2	2	<2		
				G-5 (S11)		12		10			6		92	165	194	58	165		
				SEB-2 (S18)							3		13	13	75	14	13		
				SEB-1 (S19)							2		16	21	18	19	21		
				SEB-3 (S10)							53		95	106	87	128	106		
				SEB-4 (S12)							32		20	80	50	44	80		
				SEB-5 (S13)		7		46			33		42	79	85	94	79		
				SEB-6 (S14)				64			17		87	109	42	46	109		
				SEB-7 (S15)		30			69		22		183	164	214	147	164		
				SEB-8 (S16)							82		20	53	12	27	53		
				SEB-9 (S17)							57		4	<1	<2	<2	<1		

Table 6-10: Water Quality Results for Fecal Coliform

Monitoring Objective	Environmental Aspect	Environmental Impact	Parameter	Station No.	Sampling and Measurement													DENR Standard	Remarks
					Q1 2019	Q2 2019	Q3 2019	Q4 2019	Q1 2020	Q2 2020	Q3 2020	Q4 2020	Q1 2021	Q2 2021	Q3 2021	Q4 2021	Q1 2022		
Compliance to RA 9275 (Water Quality)	Discharge of waste and effluent to freshwater (FW) and Drinking water (DW) sources	Water pollution, land contamination, health hazards	Fecal Coliform	U-1 (S1)		170						7,000	78	450	28,000	78	170	**200 MPN/100 mL**	**With Exceedances**
				U-2 (S3)		48						2,700	200	170	1,300	24,000	48		
				U-3 (S2)		17						35,000	24,000	230	3,300	1,300	17		
				U-4 (S4)								17,000	780	200	1,100	200			
				U-5 (S5)								22,000	260	200	200	780			
				U-6 (S2A)								7,900	1,300	1,300	2,200	260			
				U-7 (S7)		2,200						9,400	3,300	13,000	22,000	82	2,200		
				(G-1) S6		7.8		20				450	82	68	140	3,300	7.8		
				G-2 (S8)		430						3,300	1,100	450	2,300	1,100	430		
				G-3 (S8A)								3,300	400	200	2,300	400			
				G-4 (S9)								13,000	450	780	170	450			
				G-5 (S11)		350						35,000	2,600	4,900	35,000	1,700	350		
				SEB-2 (S18)								7,000	2,200	4,900	1.4	7,000			
				SEB-1 (S19)								4,900	1,700	13,000	4,900	3,300			
				SEB-3 (S10)								17	7,000	1,100	7,000	2,100			
				SEB-4 (S12)								17,000	3,300	7,900	11,000	4,900			
				SEB-5 (S13)		3,500						35,000	2,100	4,900	24,000	4,600	3,500		
				SEB-6 (S14)		9,200						4.9	4,900	4,900	3,300	3,300	9,200		
				SEB-7 (S15)		9,200		13,000				7,900	4,600	7,900	7,000	7,900	9,200		
				SEB-8 (S16)								160,000	3,300	24,000	17,000	2,200			
				SEB-9 (S17)								110,000	7,900	17,000	35,000	2,600			

Table 6-11: Quality Results for Free Cyanide

Monitoring Objective	Environmental Aspect	Environmental Impact	Parameter	Station No.	Sampling and Measurement													DENR Standard	Remarks
					Q1 2019	Q2 2019	Q3 2019	Q4 2019	Q1 2020	Q2 2020	Q3 2020	Q4 2020	Q1 2021	Q2 2021	Q3 2021	Q4 2021	Q1 2022		
Compliance to RA 9275 (Water Quality)	Discharge of waste and effluent to freshwater (FW) and Drinking water (DW) sources	Water pollution, land contamination, health hazards	Free Cyanide	U-1 (S1)		<0.01				<0.001		0.002	<0.02	<0.02	<0.02	<0.02	<0.01	0.1 mg/L	PASSED
				U-2 (S3)		<0.01				<0.001		0.0044	<0.02	<0.02	<0.02	<0.02	<0.01		
				U-3 (S2)		<0.01				<0.001		0.002	<0.02	<0.02	<0.02	<0.02	<0.01		
				U-4 (S4)						<0.001		<0.002	<0.02	<0.02	<0.02	<0.02			
				U-5 (S5)						<0.001		<0.002	<0.02	<0.02	<0.02	<0.02			
				U-6 (S2A)						<0.001		<0.002	<0.02	<0.002	<0.02	<0.02			
				U-7 (S7)		<0.01				<0.001		<0.002	<0.02	<0.02	<0.02	<0.02	<0.01		
				(G-1) S6		<0.01		0.008		<0.001		<0.002	<0.02	<0.02	<0.02	<0.02	<0.01		
				G-2 (S8)		<0.01				<0.001		<0.002	<0.02	<0.02	<0.02	<0.02	<0.01		
				G-3 (S8A)						<0.001		<0.002	<0.02	<0.02	<0.02	<0.02			
				G-4 (S9)						<0.001		<0.002	<0.02	<0.02	<0.02	<0.02			
				G-5 (S11)		<0.01				<0.001		<0.002	<0.02	<0.02	<0.02	<0.02	<0.01		
				SEB-2 (S18)						<0.001		<0.002	<0.02	<0.02	<0.02	<0.02			
				SEB-1 (S19)						<0.001		<0.002	<0.02	<0.02	<0.02	<0.02			
				SEB-3 (S10)						<0.001		<0.002	<0.02	<0.02	<0.02	<0.02			
				SEB-4 (S12)						<0.001		<0.002	<0.02	<0.02	<0.02	<0.02			
				SEB-5 (S13)		<0.01				<0.001		<0.002	<0.02	<0.02	<0.02	<0.02	<0.01		
				SEB-6 (S14)		<0.01				<0.001		<0.002	<0.02	<0.02	<0.02	<0.02	<0.01		
				SEB-7 (S15)				0.009		<0.001		<0.002	<0.02	<0.02	<0.02	<0.02			
				SEB-8 (S16)						<0.001		<0.002	<0.02	<0.02	<0.02	<0.02			
				SEB-9 (S17)						<0.001		<0.002	<0.02	<0.02	<0.02	<0.02			

Table 6-12: Water Quality Results for Copper

Monitoring Objective	Environmental Aspect	Environmental Impact	Parameter	Station No.	Sampling and Measurement													DENR Standard	Remarks
					Q1 2019	Q2 2019	Q3 2019	Q4 2019	Q1 2020	Q2 2020	Q3 2020	Q4 2020	Q1 2021	Q2 2021	Q3 2021	Q4 2021	Q1 2022		
Compliance to RA 9275 (Water Quality)	Discharge of waste and effluent to freshwater (FW) and Drinking water (DW) sources	Water pollution, land contamination, health hazards	Copper	U-1 (S1)		<0.05					<0.01		<0.01	<0.01	<0.005	<0.003	<0.01	0.2 mg/L	PASSED
				U-2 (S3)		0.06					<0.01		<0.01	<0.01	<0.005	0.003	<0.01		
				U-3 (S2)		<0.05					<0.01		0.06	<0.01	0.046	0.006	<0.01		
				U-4 (S4)							<0.01		<0.01	<0.01	<0.005	<0.003	<0.01		
				U-5 (S5)							<0.01		<0.01	<0.01	0.005	<0.003	<0.01		
				U-6 (S2A)							<0.01		<0.01	<0.01	<0.005	0.004	<0.01		
				U-7 (S7)		<0.05					<0.01		<0.01	<0.01	<0.005	<0.003	<0.01		
				(G-1) S6		0.05			<0.02		<0.01		<0.01	<0.01	0.005	<0.003	<0.01		
				G-2 (S8)		<0.05					<0.01		<0.01	<0.01	<0.005	<0.003	<0.01		
				G-3 (S8A)							<0.01		<0.01	<0.01	<0.005	<0.003	<0.01		
				G-4 (S9)							<0.01		<0.01	<0.01	<0.005	<0.003	<0.01		
				G-5 (S11)		<0.05					<0.01		0.01	<0.01	<0.005	<0.003	<0.01		
				SEB-2 (S18)							<0.01		<0.01	<0.01	<0.005	<0.003	<0.01		
				SEB-1 (S19)							<0.01		<0.01	<0.01	<0.005	<0.003	<0.01		
				SEB-3 (S10)							<0.01		<0.01	<0.01	<0.005	<0.003	<0.01		
				SEB-4 (S12)							<0.01		<0.01	<0.01	<0.005	<0.003	<0.01		
				SEB-5 (S13)		<0.05					<0.01		<0.01	<0.01	<0.005	<0.003	<0.01		
				SEB-6 (S14)		<0.05					<0.01		<0.01	<0.01	<0.005	<0.003	<0.01		
				SEB-7 (S15)		<0.05			<0.02		<0.01		<0.01	<0.01	<0.005	<0.003	<0.01		
				SEB-8 (S16)							<0.01		0.01	<0.01	<0.005	0.019	<0.01		
				SEB-9 (S17)							<0.01		<0.01	<0.01	<0.005	0.0003	<0.01		

Table 6-13: Water Quality Results for Lead

Monitoring Objective	Environmental Aspect	Environmental Impact	Parameter	Station No.	Sampling and Measurement													DENR Standard	Remarks
					Q1 2019	Q2 2019	Q3 2019	Q4 2019	Q1 2020	Q2 2020	Q3 2020	Q4 2020	Q1 2021	Q2 2021	Q3 2021	Q4 2021	Q1 2022		
Compliance to RA 9275 (Water Quality)	Discharge of waste and effluent to freshwater (FW) and Drinking water (DW) sources	Water pollution, land contamination, health hazards	Lead	U-1 (S1)		<0.05					<0.01		<0.01	<0.01	<0.006	0.006	<0.01	0.05 mg/L	PASSED
				U-2 (S3)		<0.05					<0.01		<0.01	<0.01	<0.006	0.007	<0.01		
				U-3 (S2)		<0.05					<0.01		<0.01	<0.01	0.013	0.007	<0.01		
				U-4 (S4)							<0.01		<0.01	<0.01	<0.006	<0.006	<0.01		
				U-5 (S5)							<0.01		<0.01	<0.01	<0.006	<0.006	<0.01		
				U-6 (S2A)							<0.01		<0.01	<0.01	<0.006	0.009	<0.01		
				U-7 (S7)		<0.05					<0.01		<0.01	<0.01	<0.006	<0.006	<0.01		
				(G-1) S6		<0.05			<0.01		<0.01		<0.01	<0.01	<0.006	<0.006	<0.01		
				G-2 (S8)		<0.05					<0.01		<0.01	<0.01	<0.006	<0.006	<0.01		
				G-3 (S8A)							<0.01		<0.01	<0.01	<0.006	<0.006	<0.01		
				G-4 (S9)							<0.01		<0.01	<0.01	<0.006	<0.006	<0.01		
				G-5 (S11)		<0.05					<0.01		<0.01	<0.01	<0.006	<0.006	<0.01		
				SEB-2 (S18)							<0.01		<0.01	<0.01	<0.006	0.006	<0.01		
				SEB-1 (S19)							<0.01		<0.01	<0.01	<0.006	<0.006	<0.01		
				SEB-3 (S10)							<0.01		<0.01	<0.01	<0.006	<0.006	<0.01		
				SEB-4 (S12)							<0.01		<0.01	<0.01	<0.006	<0.006	<0.01		
				SEB-5 (S13)		0.06					<0.01		<0.01	<0.01	<0.006	<0.006	<0.01		
				SEB-6 (S14)							<0.01		<0.01	<0.01	<0.006	<0.006	<0.01		
				SEB-7 (S15)		0.07			<0.01		<0.01		<0.01	<0.01	<0.006	<0.006	<0.01		
				SEB-8 (S16)							<0.01		<0.01	<0.01	<0.006	<0.006	<0.01		
				SEB-9 (S17)							<0.01		<0.01	<0.01	<0.006	<0.006	<0.01		

Table 6-14: Water Quality Results for Mercury

Monitoring Objective	Environmental Aspect	Environmental Impact	Parameter	Station No.	Sampling and Measurement													DENR Standard	Remarks
					Q1 2019	Q2 2019	Q3 2019	Q4 2019	Q1 2020	Q2 2020	Q3 2020	Q4 2020	Q1 2021	Q2 2021	Q3 2021	Q4 2021	Q1 2022		
Compliance to RA 9275 (Water Quality)	Discharge of waste and effluent to freshwater (FW) and Drinking water (DW) sources	Water pollution, land contamination, health hazards	Mercury	U-1 (S1)		<0.001					<0.001		<0.001	<0.001	0.0009	<0.0000	<0.001	**0.002 mg/L**	**PASSED**
				U-2 (S3)		<0.001					<0.006		<0.001	<0.001	0.008	0.00056	<0.001		
				U-3 (S2)		<0.001					<0.001		0.001	<0.001	0.0018	0.0007	<0.001		
				U-4 (S4)							<0.001		<0.001	<0.001	0.0006	0.00029	<0.001		
				U-5 (S5)							<0.001		<0.001	<0.001	0.0008	0.00033	<0.001		
				U-6 (S2A)							<0.001		<0.001	<0.001	0.0008	0.00036	<0.001		
				U-7 (S7)		<0.001					<0.001		<0.001	<0.001	0.0007	0.00035	<0.001		
				(G-1) S6		<0.001			<0.001		<0.001		<0.001	<0.001	0.001	0.0003	<0.001		
				G-2 (S8)		<0.001					<0.001		<0.001	<0.001	0.0008	0.00038	<0.001		
				G-3 (S8A)							<0.001		<0.001	<0.001	0.0009	0.00042	<0.001		
				G-4 (S9)							<0.001		<0.001	<0.001	0.0009	0.0003	<0.001		
				G-5 (S11)		<0.001					<0.001		<0.001	<0.001	0.0004	0.00036	<0.001		
				SEB-2 (S18)							<0.001		<0.001	<0.001	0.0003	<0.0000	<0.001		
				SEB-1 (S19)							<0.001		<0.001	<0.001	0.0009	<0.0000	<0.001		
				SEB-3 (S10)							<0.001		<0.001	<0.001	0.0008	0.00039	<0.001		
				SEB-4 (S12)							<0.001		<0.001	<0.001	0.0005	0.00013	<0.001		
				SEB-5 (S13)		<0.001					<0.001		<0.001	<0.001	0.0004	<0.0000	<0.001		
				SEB-6 (S14)							<0.001		<0.001	<0.001	0.0006	<0.0000	<0.001		
				SEB-7 (S15)		<0.001			<0.01		<0.001		<0.001	<0.001	0.0005	<0.0000	<0.001		
				SEB-8 (S16)							<0.001		<0.001	<0.001	0.0004	<0.0000	<0.001		
				SEB-9 (S17)							<0.001		<0.001	<0.001	0.0008	<0.0000	<0.001		

Table 6-15: Water Quality Results for Arsenic

Monitoring Objective	Environmental Aspect	Environmental Impact	Parameter	Station No.	Sampling and Measurement													DENR Standard	Remarks
					Q1 2019	Q2 2019	Q3 2019	Q4 2019	Q1 2020	Q2 2020	Q3 2020	Q4 2020	Q1 2021	Q2 2021	Q3 2021	Q4 2021	Q1 2022		
Compliance to RA 9275 (Water Quality)	Discharge of waste and effluent to freshwater (FW) and Drinking water (DW) sources	Water pollution, land contamination, health hazards	Arsenic	U-1 (S1)		<0.05					<0.01		<0.01			<0.008	<0.01		
				U-2 (S3)		<0.05					<0.01		<0.01			<0.008	<0.01		
				U-3 (S2)		<0.05					<0.01		<0.01			<0.008	<0.01		
				U-4 (S4)							<0.01		<0.01			<0.008	<0.01		
				U-5 (S5)							<0.01		<0.01			<0.008	<0.01		
				U-6 (S2A)							<0.01		<0.01			<0.008	<0.01		
				U-7 (S7)		<0.05					<0.01		<0.01			<0.008	<0.01		
				(G-1) S6		<0.05			<0.01		<0.01		<0.01			<0.008	<0.01		
				G-2 (S8)		<0.05					<0.01		<0.01			<0.008	<0.01		
				G-3 (S8A)							<0.01		<0.01			<0.008	<0.01		
				G-4 (S9)							<0.01		<0.01			0.01	<0.01	**0.02 mg/L**	**PASSED**
				G-5 (S11)		<0.05					<0.01		<0.01			<0.008	<0.01		
				SEB-2 (S18)							<0.01		<0.01			<0.008	<0.01		
				SEB-1 (S19)							<0.01		<0.01			<0.008	<0.01		
				SEB-3 (S10)							<0.01		<0.01			<0.008	<0.01		
				SEB-4 (S12)							<0.01		<0.01			<0.008	<0.01		
				SEB-5 (S13)		<0.05					<0.01		<0.01			<0.008	<0.01		
				SEB-6 (S14)							<0.01		<0.01			<0.008	<0.01		
				SEB-7 (S15)		<0.05			<0.01		<0.01		<0.01			<0.008	<0.01		
				SEB-8 (S16)							<0.01		<0.01			<0.008	<0.01		
				SEB-9 (S17)							<0.01		<0.01			<0.008	<0.01		

Table 6-16: Water Quality Results for Cadmium

Monitoring Objective	Environmental Aspect	Environmental Impact	Parameter	Station No.	Sampling and Measurement													DENR Standard	Remarks
					Q1 2019	Q2 2019	Q3 2019	Q4 2019	Q1 2020	Q2 2020	Q3 2020	Q4 2020	Q1 2021	Q2 2021	Q3 2021	Q4 2021	Q1 2022		
Compliance to RA 9275 (Water Quality)	Discharge of waste and effluent to freshwater (FW) and Drinking water (DW) sources	Water pollution, land contamination, health hazards	Cadmium	U-1 (S1)							<0.002		<0.002	<0.002	0.003	<0.001	<0.002	0.005 mg/L	PASSED
				U-2 (S3)		<0.01					<0.002		<0.002	<0.002	0.002	<0.001	<0.002		
				U-3 (S2)		<0.01					<0.002		<0.002	<0.002	0.003	<0.001	<0.002		
				U-4 (S4)		<0.01					<0.002		<0.002	<0.002	<0.002	<0.001	<0.002		
				U-5 (S5)							<0.002		<0.002	<0.002	0.002	<0.001	<0.002		
				U-6 (S2A)							<0.002		<0.002	<0.002	0.004	<0.001	<0.002		
				U-7 (S7)							<0.002		<0.002	<0.002	<0.002	<0.001	<0.002		
				(G-1) S6		<0.01					<0.002		<0.002	<0.002	0.002	<0.001	<0.002		
				G-2 (S8)		<0.01	<0.002				<0.002		<0.002	<0.002	<0.002	<0.001	<0.002		
				G-3 (S8A)		<0.01					<0.002		<0.002	<0.002	<0.002	<0.001	<0.002		
				G-4 (S9)							<0.002		<0.002	<0.002	<0.002	<0.001	<0.002		
				G-5 (S11)							<0.002		<0.002	<0.002	<0.002	<0.001	<0.002		
				SEB-2 (S18)		<0.01					<0.002		<0.002	<0.002	0.002	<0.001	<0.002		
				SEB-1 (S19)							<0.002		<0.002	<0.002	0.005	<0.001	<0.002		
				SEB-3 (S10)							<0.002		<0.002	<0.002	<0.002	<0.001	<0.002		
				SEB-4 (S12)							<0.002		<0.002	<0.002	<0.002	<0.001	<0.002		
				SEB-5 (S13)							<0.002		<0.002	<0.002	<0.002	<0.001	<0.002		
				SEB-6 (S14)		<0.01					<0.002		<0.002	<0.002	<0.002	<0.001	<0.002		
				SEB-7 (S15)							<0.002		<0.002	<0.002	<0.002	<0.001	<0.002		
				SEB-8 (S16)		<0.01	<0.002				<0.002		<0.002	<0.002	<0.002	<0.001	<0.002		
				SEB-9 (S17)							<0.002		<0.002	<0.002	0.003	<0.001	<0.002		

Table 6-17: Water Quality Results for Zinc

Monitoring Objective	Environmental Aspect	Environmental Impact	Parameter	Station No.	Sampling and Measurement													DENR Standard	Remarks
					Q1 2019	Q2 2019	Q3 2019	Q4 2019	Q1 2020	Q2 2020	Q3 2020	Q4 2020	Q1 2021	Q2 2021	Q3 2021	Q4 2021	Q1 2022		
Compliance to RA 9275 (Water Quality)	Discharge of waste and effluent to freshwater (FW) and Drinking water (DW) sources	Water pollution, land contamination, health hazards	Zinc	U-1 (S1)		0.07					<0.005		<0.005	<0.005	<0.009	0.014	<0.005	2.0 mg/L	PASSED
				U-2 (S3)		0.09					0.1		<0.005	<0.005	0.034	0.027	<0.005		
				U-3 (S2)		<0.05					0.02		0.16	<0.005	0.081	<0.002	<0.005		
				U-4 (S4)							<0.005		<0.005	<0.005	0.015	<0.002	<0.005		
				U-5 (S5)							<0.005		<0.005	<0.005	0.022	0.004	<0.005		
				U-6 (S2A)							<0.005		<0.005	<0.005	0.042	<0.002	<0.005		
				U-7 (S7)		0.07					<0.005		<0.005	<0.005	0.021	<0.002	<0.005		
				(G-1) S6		0.14			<0.02		<0.005		<0.005	<0.005	0.012	0.003	<0.005		
				G-2 (S8)		0.09					<0.005		<0.005	<0.005	0.017	<0.002	<0.005		
				G-3 (S8A)							<0.005		<0.005	<0.005	0.029	<0.002	<0.005		
				G-4 (S9)							<0.005		<0.005	<0.005	0.016	<0.002	<0.005		
				G-5 (S11)		0.12					<0.005		0.02	<0.005	0.017	<0.002	<0.005		
				SEB-2 (S18)							<0.005		<0.005	<0.005	0.017	0.025	<0.005		
				SEB-1 (S19)							<0.005		<0.005	<0.005	0.017	<0.002	<0.005		
				SEB-3 (S10)							<0.005		<0.005	<0.005	0.038	0.008	<0.005		
				SEB-4 (S12)							<0.005		0.01	<0.005	0.014	0.017	<0.005		
				SEB-5 (S13)		<0.05					<0.005		0.02	<0.005	0.022	0.019	<0.005		
				SEB-6 (S14)							<0.005		<0.005	<0.005	0.014	<0.002	<0.005		
				SEB-7 (S15)		<0.05			0.03		<0.005		<0.005	<0.005	0.027	0.004	0.006		
				SEB-8 (S16)							<0.005		<0.005	<0.005	0.014	0.025	<0.005		
				SEB-9 (S17)							<0.005		0.01	0.006	0.034	0.018	<0.005		

Table 6-18: Water Quality Results for Oil and Grease

Monitoring Objective	Environmental Aspect	Environmental Impact	Parameter	Station No.	Sampling and Measurement													DENR Standard	Remarks
					Q1 2019	Q2 2019	Q3 2019	Q4 2019	Q1 2020	Q2 2020	Q3 2020	Q4 2020	Q1 2021	Q2 2021	Q3 2021	Q4 2021	Q1 2022		
Compliance to RA 9275 (Water Quality)	Discharge of waste and effluent to freshwater (FW) and Drinking water (DW) sources	Water pollution, land contamination, health hazards	Oil and Grease	U-1 (S1)		1							<1	<1	<1	1	<1	2 mg/L	**With Exceedances**
				U-2 (S3)		<1							103	2	1	<1	2		
				U-3 (S2)		<1							<1	2	<1	<1	<1		
				U-4 (S4)									<1	2	<1	1	2		
				U-5 (S5)									<1	<1	<1	2	2		
				U-6 (S2A)									135	<1	<1	1	<1		
				U-7 (S7)		1							<1	<1	1	<1	<1		
				(G-1) S6		<1							<1	<1	<1	<1	<1		
				G-2 (S8)		<1							<1	1	2	<1	1		
				G-3 (S8A)									<1	2	<1	2	2		
				G-4 (S9)									2	2	1	1	2		
				G-5 (S11)		<1							1	<1	<1	<1	2		
				SEB-2 (S18)									<1	<1	<1	1	<1		
				SEB-1 (S19)									3	2	<1	2	<1		
				SEB-3 (S10)									3	<1	1	1	1		
				SEB-4 (S12)									2	<1	1	<1	1		
				SEB-5 (S13)		<1							3	1	2	<1	<1		
				SEB-6 (S14)		<1							13	1	1	1	6		
				SEB-7 (S15)		<1							5	<1	1	<1	<1		
				SEB-8 (S16)									3	6	1	<1	<1		
				SEB-9 (S17)									6	<1	<1	2	<1		

Table 6-19: Water Quality Results for Chloride

Monitoring Objective	Environmental Aspect	Environmental Impact	Parameter	Station No.	Sampling and Measurement													DENR Standard	Remarks
					Q1 2019	Q2 2019	Q3 2019	Q4 2019	Q1 2020	Q2 2020	Q3 2020	Q4 2020	Q1 2021	Q2 2021	Q3 2021	Q4 2021	Q1 2022		
Compliance to RA 9275 (Water Quality)	Discharge of waste and effluent to freshwater (FW) and Drinking water (DW) sources	Water pollution, land contamination, health hazards	Chloride	U-1 (S1)		2.53							2.3	0.07	1.7	1.9	0.07	350 mg/L	With exceedances
				U-2 (S3)		6.97							5.8	1	5.3	3	<0.4		
				U-3 (S2)		13.85							12.2	<0.4	8	0.6	1.6		
				U-4 (S4)									1.9	<0.4	1.4	2.4	1		
				U-5 (S5)									0.6	0.7	1.5	3.4	<0.4		
				U-6 (S2A)									1.5	1.6	5.2	1.4	0.7		
				U-7 (S7)		4.07							1	0.5	0.6	2.6	2.2		
				(G-1) S6		5.16							1.9	2.2	0.9	0.8	0.5		
				G-2 (S8)		3.71							2.2	<0.04	2.2	0.5	<0.04		
				G-3 (S8A)									0.6	0.6	1.2	0.5	0.6		
				G-4 (S9)									0.8	20.4	1.4	1	20.4		
				G-5 (S11)		1.63							0.9	<0.4	2.2	<0.4	<0.4		
				SEB-2 (S18)									1.1	<0.4	0.7	0.8	<0.04		
				SEB-1 (S19)									0.5	<0.4	1.8	1	<0.4		
				SEB-3 (S10)									1	<0.04	0.9	<0.4	<0.4		
				SEB-4 (S12)									0.5	<0.4	0.7	0.5	<0.4		
				SEB-5 (S13)		3.98							0.5	<0.4	1.7	0.6	<0.4		
				SEB-6 (S14)									0.5	<0.4	0.7	<0.4	0.4		
				SEB-7 (S15)		3.8							<0.4	<0.4	0.7	0.5	<0.4		
				SEB-8 (S16)									0.9	0.4	0.6	0.5	<0.4		
				SEB-9 (S17)									1.6	<0.4	1.5	<0.4	<0.4		

Table 6-20: Water Quality Results for Phosphates

Monitoring Objective	Environmental Aspect	Environmental Impact	Parameter	Station No.	Sampling and Measurement													DENR Standard	Remarks
					Q1 2019	Q2 2019	Q3 2019	Q4 2019	Q1 2020	Q2 2020	Q3 2020	Q4 2020	Q1 2021	Q2 2021	Q3 2021	Q4 2021	Q1 2022		
Compliance to RA 9275 (Water Quality)	Discharge of waste and effluent to freshwater (FW) and Drinking water (DW) sources	Water pollution, land contamination, health hazards	Phosphates	U-1 (S1)		1.311							0.07	0.08	0.1	0.17	0.08	0.025 mg/L	With exceedances
				U-2 (S3)		0.419							<0.02	0.04	0.09	0.08	0.08		
				U-3 (S2)		0.25							0.07	0.08	0.03	0.02	0.04		
				U-4 (S4)									0.05	0.04	0.03	0.12	0.04		
				U-5 (S5)									0.05	0.06	0.04	<0.01	0.04		
				U-6 (S2A)									0.06	0.04	0.1	0.1	0.06		
				U-7 (S7)		0.513							0.06	0.08	0.09	0.09	0.11		
				(G-1) S6		0.394							0.12	0.11	0.14	0.12	0.08		
				G-2 (S8)		0.388							0.04	0.08	0.08	0.05	0.08		
				G-3 (S8A)									0.02	0.04	0.08	0.06	0.04		
				G-4 (S9)									0.14	0.13	0.11	0.11	0.13		
				G-5 (S11)		0.463							0.07	0.02	0.09	0.06	0.08		
				SEB-2 (S18)									0.04	0.04	<0.02	<0.01	0.06		
				SEB-1 (S19)									<0.02	0.08	0.04	<0.01	0.06		
				SEB-3 (S10)									0.06	0.06	0.13	0.05	0.07		
				SEB-4 (S12)									0.06	0.06	0.09	0.05	0.04		
				SEB-5 (S13)		0.218							0.09	0.07	0.06	0.09	0.03		
				SEB-6 (S14)									0.05	0.04	0.11	0.03	0.09		
				SEB-7 (S15)		2.73							0.07	0.03	0.06	0.1	0.08		
				SEB-8 (S16)									0.04	0.09	0.08	0.06	0.04		
				SEB-9 (S17)									0.1	0.08	0.06	0.08	0.02		

Table 6-21: Water Quality Results for Nitrates

Monitoring Objective	Environmental Aspect	Environmental Impact	Parameter	Station No.	Sampling and Measurement													DENR Standard	Remarks
					Q1 2019	Q2 2019	Q3 2019	Q4 2019	Q1 2020	Q2 2020	Q3 2020	Q4 2020	Q1 2021	Q2 2021	Q3 2021	Q4 2021	Q1 2022		
Compliance to RA 9275 (Water Quality)	Discharge of waste and effluent to freshwater (FW) and Drinking water (DW) sources	Water pollution, land contamination, health hazards	Nitrates	U-1 (S1)							<0.05		0.1	0.2	0.2	0.5	0.2	7 mg/L	**With exceedances**
				U-2 (S3)							0.2		0.1	0.3	0.2	0.3	<0.05		
				U-3 (S2)							<0.05		<0.05	<0.05	0.2	0.04	<0.05		
				U-4 (S4)							<0.05		<0.05	0.1	0.1	<0.02	0.3		
				U-5 (S5)							<0.05		<0.05	0.1	0.1	0.04	0.1		
				U-6 (S2A)							<0.05		<0.05	<0.05	0.1	<0.02	0.1		
				U-7 (S7)							<0.05		0.1	0.1	0.1	0.03	0.2		
				(G-1) S6					0.1		<0.05		0.1	0.2	0.1	0.06	0.1		
				G-2 (S8)							<0.05		0.7	0.1	<0.05	<0.02	0.1		
				G-3 (S8A)							<0.05		<0.05	0.1	0.1	0.1	0.1		
				G-4 (S9)							<0.05		<2	0.1	<0.05	0.04	0.1		
				G-5 (S11)							<0.05		0.1	0.2	<0.05	<0.02	0.3		
				SEB-2 (S18)							<0.05		<0.05	0.1	<0.05	0.2	0.1		
				SEB-1 (S19)							<0.05		0.1	0.3	0.06	0.1	0.2		
				SEB-3 (S10)							<0.05		0.1	0.1	<0.05	0.03	0.2		
				SEB-4 (S12)							0.1		0.2	0.2	0.06	0.1	0.4		
				SEB-5 (S13)							<0.05		0.1	0.2	0.06	0.04	0.5		
				SEB-6 (S14)							0.5		0.5	0.4	0.3	0.4	0.62		
				SEB-7 (S15)					0.2		0.3		0.2	0.5	0.2	0.3	0.3		
				SEB-8 (S16)							0.7		0.4	0.62	0.4	0.6	0.1		
				SEB-9 (S17)							0.4		0.3	0.3	0.2	0.2	0.2		

6.5 ENVIRONMENTAL MONITORING PLAN

Table 6-22: Environmental Monitoring Plan

Key Environmental Aspects per Project Phase	Potential Impacts Per Environmental Sector	Parameter for Monitoring	Sampling and Measurement Plan			Lead Person	Annual Estimated Cost	EQPL Management Scheme					
			Method	Frequency	Location			EQPL Range			Management Measure		
								Alert	Action	Limit	Alert	Action	Limit
All Project Phases	Land												
	Visual aesthetics Solid waste	Daily volume of solid waste dumped in the landfill; weekly volume of compost generated	Volume measurement	Daily and weekly	Project area	MEPEO							
	Terrestrial Biology	Species composition density cover, diversity, regeneration	Transect Quadrat Method	Annually	Open space/ Grassland, secondary growth forest	MEPEO	450,000						
		Areas cleared or disturbed	Area measurement	weekly	Project area	MEPEO							
	Freshwater Biology	Species Composition, diversity	Transect Quadrat Method	Annually			350,000						
	Tailings Seepage	Underdrain Water Pressure	Digital Piezometer	Daily	TSF Embankment	TSF							
		Seepage Color	V-Notch Weir	Daily	TSF Toe-Line	TSF							
	Ambient Air Quality												
		TSP (µg/NCM)	Gravimetric	Monthly	Station 1, Station 2, Station 3, Station 4, Station 5, Station 6	MEPEO	25,000	260	275	300	240	260	280
			Gravimetric	Quarterly		Third Party laboratory	200,000	260	275	300	240	260	280
		PM10	Gravimetric	Monthly	Station 1, Station 2, Station 3, Station 4, Station 5, Station 6	MEPEO	25,000	160	180	200	140	160	180
			Gravimetric	Quarterly		Third-Party Laboratory	200,000	160	180	200	140	160	180

Key Environmental Aspects per Project Phase	Potential Impacts Per Environmental Sector	Parameter for Monitoring	Sampling and Measurement Plan			Lead Person	Annual Estimated Cost	EQPL Management Scheme					
			Method	Frequency	Location			EQPL Range			Management Measure		
								Alert	Action	Limit	Alert	Action	Limit
		NO_2 (µg/ NCM)	Gries Saltzman	Monthly	Station 1, Station 2, Station 3, Station 4, Station 5, Station 6	MEPEO	25,000	220	240	260	200	220	240
			Gries Saltzman	Quarterly	Station 1, Station 2, Station 3, Station 4, Station 5, Station 6	Third Party laboratory	200,000						
		As	Hydride Generation AAS	Monthly	Station 1, Station 2, Station 3, Station 4, Station 5, Station 6		25,000						
			Hydride Generation AAS	Quarterly	Station 1, Station 2, Station 3, Station 4, Station 5, Station 6	Third Party laboratory	200,000						
		So_2 (µg/ NCM)	Pararosalinine	Monthly	Station 1, Station 2, Station 3, Station 4, Station 5, Station 6		25,000	280	300	340	260	280	300
			Pararosalinine	Quarterly	Station 1, Station 2, Station 3, Station 4, Station 5, Station 6	Third-Party Laboratory	200,000						
		Cadmium (Cd) (µg/ NCM)	Flame (AAS)	Monthly	Station 1, Station 2, Station 3, Station 4, Station 5, Station 6		25,000	8	9	10	7	8	9
			Flame (AAS)	Quarterly	Station 1, Station 2, Station 3, Station 4, Station 5, Station 6	Third-Party Laboratory	200,000						
		Lead (Pb) (µg/ NCM)	Flame (AAS)	Monthly	Station 1, Station 2, Station 3, Station 4, Station 5, Station 6		25,000	16	18	20	14	16	18
			Flame (AAS)	Quarterly	Station 1, Station 2, Station 3, Station 4, Station 5, Station 6	Third Party Laboratory	200,000						

Key Environmental Aspects per Project Phase	Potential Impacts Per Environmental Sector	Parameter for Monitoring	Sampling and Measurement Plan				Annual Estimated Cost	EQPL Management Scheme					
								EQPL Range			Management Measure		
			Method	Frequency	Location	Lead Person		Alert	Action	Limit	Alert	Action	Limit
		Hg	Cold Vapor AAS	Monthly		Third Party Laboratory	25,000						
			Cold Vapor AAS	Quarterly		Third Party Laboratory	200,000						
	Noise Pollution												
		Noise (dBA)	Digital Sound Level Meter	Weekly, Quarterly	Station 1, Station 2, Station 3, Station 4, Station 5, Station 6	MEPEO	15,000			Morning – 70 Daytime – 75 Evening – 70 Nighttime – 65			
	Water Quality												
	Turbidity	TSS (mg/L)	Gravimetric Method	Daily	DM-4, U-3, U-6, U-7, G-2, G-3, G-5	In-house Assay Laboratory	200,000	60	70	80	55	60	65
			Gravimetric Method	Quarterly	U-1, U-2, U-3, U-4, U-5, U-6, U-7, G-1, G-2, G-3, G-4, G-5, SEB-1, SEB-2, SEB-3, SEB-4, SEB-5, SEB-6, SEB-7, SEB-8, SEB-9	Third Party Laboratory	120,000						
	Cyanide	Total Cyanide	Titration	Daily	DM-1, DM-2, DM-3, DM-4, U-3	In-house Assay Laboratory	400,000	0.06	0.08	0.1	0.6	0.07	0.08
			Distillation-ISE	Monthly		Third Party Laboratory	300,000						
			Distillation-ISE	Quarterly	U-1, U-2, U-3, U-4, U-5, U-6, U-7, G-1,G-2,G-3, G-4, G-5, SEB-1, SEB-2, SEB-3, SEB-4, SEB-5, SEB-6 , SEB-7, SEB-8, SEB-9	Third Party Laboratory	150,000						

Key Environmental Aspects per Project Phase	Potential Impacts Per Environmental Sector	Parameter for Monitoring	Sampling and Measurement Plan			Lead Person	Annual Estimated Cost	EQPL Management Scheme					
			Method	Frequency	Location			EQPL Range			Management Measure		
								Alert	Action	Limit	Alert	Action	Limit
	Oil and Grease	Oil and Grease (mg/L)	Gravimetric Method	Monthly, Quarterly	U-1, U-2, U-3, U-4, U-5, U-6, U-7, G-1,G-2 G-3, G-4, G-5, SEB-1, SEB-2, SEB-3, SEB-4, SEB-5, SEB-6 , SEB-7, SEB-8, SEB-9	Third-Party Laboratory	20,000	1	1.5	2	0.5	1	1.5
		pH (Power of Hydrogen)	Electrochemical Method	Daily	DM-4, U-3, U-6, U-7, G-2, G-3, G-5		5,000	6.5	6	6.5-9.0	6.5	6	7
			Electrometric Method	Quarterly	U-1, U-2, U-3, U-4, U-5, U-6, U-7, G-1,G-2,G-3, G-4, G-5, SEB-1, SEB-2, SEB-3, SEB-4, SEB-5, SEB-6 , SEB-7, SEB-8, SEB-9	Third-Party Laboratory	5,000						
		Dissolved Oxygen	Water Quality Checker (Horiba U-50)	Daily	DM-4, U-3, U-6, U-7, G-2, G-3, G-5		5,000	8	6	=>5 mg/L	7	6	5
			Iodometric Method	Quarterly	U-1, U-2, U-3, U-4, U-5, U-6, U-7, G-1, G-2, G-3, G-4, G-5, SEB-1, SEB-2, SEB-3, SEB-4, SEB-5, SEB-6, SEB-7, SEB-8, SEB-9	Third-Party Laboratory	5,000						
		5-Day 20°C BOD	5-day BOD Test	Quarterly	U-1, U-2, U-3, U-4, U-5, U-6, U-7, G-1, G-2, G-3, G-4, G-5, SEB-1, SEB-2, SEB-3, SEB-4, SEB-5, SEB-6, SEB-7, SEB-8, SEB-9	Third-Party Laboratory	5,000			7(10)			
		Phosphate	Stannous Chloride Method	Quarterly	U-1, U-2, U-3, U-4, U-5, U-6, U-7, G-1, G-2, G-3, G-4, G-5, SEB-1, SEB-2, SEB-3, SEB-4, SEB-5, SEB-6 , SEB-7, SEB-8, SEB-9	Third-Party Laboratory	5,000	0.2	0.4	0.5	2.5	3	3.5
		Chloride	Argentometry	Quarterly	U-1, U-2, U-3, U-4, U-5, U-6, U-7, G-1, G-2, G-3, G-4, G-5, SEB-1, SEB-2, SEB-3, SEB-4, SEB-5, SEB-6, SEB-7, SEB-8, SEB-9	Third-Party Laboratory	5,000	310	330	350	310	320	330

Key Environmental Aspects per Project Phase	Potential Impacts Per Environmental Sector	Parameter for Monitoring	Sampling and Measurement Plan				Annual Estimated Cost	EQPL Management Scheme					
			Method	Frequency	Location	Lead Person		EQPL Range			Management Measure		
								Alert	Action	Limit	Alert	Action	Limit
		Nitrate	Colorimetric, Brucine	Quarterly	U-1, U-2, U-3, U-4, U-5, U-6, U-7, G-1, G-2, G-3, G-4, G-5, SEB-1, SEB-2, SEB-3, SEB-4, SEB-5, SEB-6, SEB-7, SEB-8, SEB-9	Third-Party Laboratory	5,000	5	6	7	4	5	6
	Heavy Metals	Mercury	Inductively Coupled Plasma Method	Quarterly	U-1, U-2, U-3, U-4, U-5, U-6, U-7, G-1, G-2, G-3, G-4, G-5, SEB-1, SEB-2, SEB-3, SEB-4, SEB-5, SEB-6, SEB-7, SEB-8, SEB-9	Third-Party Laboratory	25,000			0.002			
		Lead (Pb) (mg/L)	Tri-acid Digestion – AAS Finish	Monthly	U-1, U-2, U-3, U-4, U-5, U-6, G-1, G-2, G-3	In-house	25,000			0.05			
			Cold Vapor AAS	Quarterly	U-1, U-2, U-3, U-4, U-5, U-6, U-7, G-1, G-2, G-3, G-4, G-5, SEB-1, SEB-2, SEB-3, SEB-4, SEB-5, SEB-6, SEB-7, SEB-8, SEB-9	Third-Party Laboratory	25,000						
		Copper	Tri-acid Digestion – AAS Finish	Monthly	U-1, U-2, U-3, U-4, U-5, U-6, G-1, G-2,G-3	In-house	25,000						
			Inductively Coupled Plasma Method	Quarterly	U-1, U-2, U-3, U-4, U-5, U-6, U-7, G-1, G-2, G-3, G-4, G-5, SEB-1, SEB-2, SEB-3, SEB-4, SEB-5, SEB-6, SEB-7, SEB-8, SEB-9	Third-Party Laboratory	25,000			0.02			
		Zinc	Tri-acid Digestion – AAS Finish	Monthly	U-1, U-2, U-3, U-4, U-5, U-6, G-1, G-2, G-3	In-house	25,000			2			
			Inductively Coupled Plasma Method	Quarterly	U-1, U-2, U-3, U-4, U-5, U-6, U-7, G-1, G-2, G-3, G-4, G-5, SEB-1, SEB-2, SEB-3, SEB-4, SEB-5, SEB-6, SEB-7, SEB-8, SEB-9	Third-Party Laboratory	25,000						
		Cadmium (Cd) (mg/L)	Inductively Coupled Plasma Method	Quarterly	U-1, U-2, U-3, U-4, U-5, U-6, U-7, G-1, G-2, G-3, G-4, G-5, SEB-1, SEB-2, SEB-3, SEB-4, SEB-5, SEB-6, SEB-7, SEB-8, SEB-9	Third-Party Laboratory	25,000			0.095			

Key Environmental Aspects per Project Phase	Potential Impacts Per Environmental Sector	Parameter for Monitoring	Sampling and Measurement Plan			Lead Person	Annual Estimated Cost	EQPL Management Scheme					
			Method	Frequency	Location			EQPL Range			Management Measure		
								Alert	Action	Limit	Alert	Action	Limit
	Drinking Water												
		Fecal Coliform (MPN/100mL)	Microbial Analysis	Monthly	RO, DW1, DW2	Third-Party Laboratory	25,000	150	180	200	150	180	180
		Total Coliform (MPN/100mL)	Microbial Analysis	Monthly	RO, DW1, DW2	Third-Party Laboratory	25,000			5,000			
	People												
	Socio- economics, employment taxes, community program	a. Income comparison for relocated households before and after relocation	Household survey	Annual	Direct and indirect impact barangays	MEPEO	P 40,000						
		b. Number of immigrants attracted by the project	Assessment			TVRD and contractor's HR Officers	Part of HR"s operating budget						
		c. Proportion of direct employment to residents of impact barangays to total direct employment provided by the project and distribution of employed residents per impact barangay	Assessment			TVRD and contractor's HR Officers	Part of HR"s operating budget						
		d. Number of training programs and number of trainees against proportion of trainees actually employed	Assessment			TVRD and contractor's HR Officers	Part of HR"s operating budget						
		e. Number of alternative means of livelihood created and number of people actually benefitted	Household survey			MEPEO	Part of HH survey						
		f. Amount of royalty tax share collected by LGU	LGU data			MEPEO	Part of HR"s operating budget						

Key Environmental Aspects per Project Phase	Potential Impacts Per Environmental Sector	Parameter for Monitoring	Sampling and Measurement Plan			Lead Person	Annual Estimated Cost	EQPL Management Scheme					
								EQPL Range			Management Measure		
			Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
		g. Income comparison for barangays and municipalities before, during, and after the project	LGU data			MEPEO	Part of EMO's Operating budget						
		h. Ratio of income gained and income lost because of the project	LGU data			MEPEO							
		i. Community program implemented and number of beneficiaries				CRO							
	Occupational health and safety- excessive exposure to elements, musculo- skeletal stress, physical injuries, loss of hearing, respiratory diseases,	Safety and health program; monthly safety reports; safety meetings, trainings, and inspections; PPEs; accident statistics and reports; medical records		Semestral	PGMC and contractors	Safety and Health Manager							
	Public health – vector and water-borne diseases, traffic hazards, respiratory diseases, spread of diseases by migrant workers, heavy metals	Metals and general health conditions	Blood chemistry, hepatitis test, basic blood chemistry, CBC and blood analysis, urinalysis, fecalysis of selected samples	Annual	Direct and indirect impact barangays	MEPEO							

7. EMERGENCY RESPONSE POLICY AND GENERIC GUIDELINES

The mandate and protocols for preparation of an Emergency Response Policy and Emergency Preparedness Plan are found in Chapter X, Section 49 of DAO 2000-98: the Mine Safety and Health Standards. The Policy and Plans shall contain, at a minimum, the following items:

- Identification of hazards that might disrupt or cause an emergency within the operations area or an operations event outside the immediate operations area.
- Identification of perceivable risks associated with hazards or accident events that may constitute an emergency and require some level of emergency response.
- Identification and description of control measures and emergency response protocols that are required to be performed to prevent or deal with the emergency and mitigate the consequences and impacts of the emergency.

Policy objectives of the Emergency Preparedness and Response Plan (EPRP) and generic guidelines for emergency situation management are discussed in the following sections. A separate and more detailed document was prepared specific to the Project operations, facilities and equipment.

7.1. EMERGENCY PREPAREDNESS AND RESPONSE PROGRAM OBJECTIVES

The Emergency Preparedness and Response Program (EPRP) was developed to provide guidelines on how to react positively and effectively to emergency situations affecting the health, safety and security of personnel, assets, operations and the environment. The Guidelines stated in this program provide a coordinated means and direction to employees for appropriate management of emergency situations that may occur at the Project site. In such circumstances, the EPRP should be able to address the following objectives:

- Manage the emergency effectively and professionally.
- Ensure the safety and support of our people and neighbors.
- Minimize the impact of the emergency event on our operations and business.
- Provide appropriate support to people who may have been adversely affected by the event.
- Demonstrate that TVIRD is a professional, responsible, and trained organization.
- Assist the media to focus on known facts and positive actions.
- Maintain public and shareholder confidence in our ability to effectively manage the crisis.
- Continue to run the business safely and efficiently during the emergency management activities.

7.2. SCOPE OF THE EMERGENCY PREPAREDNESS AND RESPONSE PLAN

The Emergency Preparedness and Response Plan (EPRP) serves as the emergency action guide for employees, community members, and visitors in the event of an emergency. Emergencies pertinent to the Project include the following:

- Fire
- Fatality or Serious Injury
- Chemical Spill or Contact
- Landslide
- Power Outage
- Dam Failure
- Earthquake
- Security Breach

7.3. EMERGENCY RESPONSE TEAM

The Emergency Response Team (ERT) was established, trained and convened to respond in case of any emergency situation. The team is composed of people that were trained to specific assigned to them.

Aside from the response team during activation of ICS, an elite ERT was formed and trained to ensure the company's readiness in the event of incidents and other emergency situations affecting the environment and the health and safety of all personnel. The members of the ERT come from employees of different departments. They are not just trained to respond to internal emergency, they are also ready to help and respond to community emergencies. The team also represents the company in different safety competitions.

7.3.1. Emergency Response Team Composition

The ERT is composed of personnel identified in Table 7-1. These personnel have assigned roles and responsibilities to carry out the objectives of the EPRP. Trainings are provided on procedures and emergency techniques such as evacuation, first aid, use of fire extinguishers, and other areas as determined by their duties and responsibilities.

Table 7-1: Emergency Response Team Composition

Role	Responsible Person
Chairman and Spokesperson	General Manager
Incident Coordinator/ Deputy Chairman/ Security Commander	Security Manager
Emergency Services Coordinator/ Fire Safety Commander	Safety Manager
Media Coordinator/ Incident Reporter	Public Affairs Manager
Medical Commander	Site Physician
Transportation Commander	Mobile Supervisor
Search and Rescue Commander	Human Resources Manager
Logistics Commander	Purchasing Manager
Environment Commander	Environment Manager
Community Coordinator	Community Relations Manager
Commercial Services/ Recovery Coordinator	Finance Manager
Damage and Restoration Commander	Civil Engineering Services Manager
Control Center Coordinator	Administrative Officer

Source: TVIRD Crisis Manual, 2009

7.3.2. Response Team Training Program

Training programs appropriate to the expected level of involvement for each ERT member are provided on a regular basis. The objectives of the training programs focus on three items, to wit:

a. Ensure personnel are knowledgeable of their roles and responsibilities within the Plan structure;
b. Ensure that personnel are knowledgeable of the Plan procedures to affect a safe response to emergencysituations; and
c. Ensure personnel are knowledgeable of evacuation procedures to affect a safe and efficient evacuation program.

The training program is developed relative to frequency, training level, supervisory training and specific ERT member training. A drill program is also established to familiarize with procedures, response times and applicability of the different procedures. Drill frequency and documentation procedures of the drills are also established.

7.3.3. Responsibilities of the Emergency Response Team Members

Certain responsibilities are defined to ensure that the emergency response management procedures are carried out as planned, beginning from the emergency notification up to the termination of the emergency. Included are the evacuation procedures and post emergency evaluation and monitoring. Positions and members of the ERT are identified below as well as primary individual responsibilities.

a. Chairman or Spokesperson

- Has over-all control of all evacuation plan orders.
- Directly reports and coordinates situations to the Head Office Crisis Management Team (CMT).
- Notifies Relevant Statutory Authorities (MGB, EMB, LGU, among others) either personally or through designated representatives.
- Submits formal incident report to the Crisis Management Team in the Head Office.

b. Incident Coordinator or Deputy Chairman or Security Commander

- Alerts every one of the emergencies.
- Exercises overall supervision and control of the evacuation operations.
- Ensure that all personnel are evacuated in a timely and safe manner from the site and that all personnel are accounted for following evacuation.
- Reports status of evacuation to the Fire Safety Commander and Fire Department during fire events.
- Maintains communication with the Chairman and the other ERT members.

c. Emergency Services Coordinator or Fire Safety Commander

- Serves as the primary contact person responsible for coordination of all emergency actions.

- Exercises overall supervision of the response team.
- Attends to the scene as appropriate.
- Provides leadership to assure the EPRP is reviewed and updated annually and copies of the revised EPRP are distributed to all employees.
- Maintains the master copy of the EPRP and facilitates the implementation of changes to the program.
- Submits formal report to the Chairman or Spokesperson.
- Ensures that ERT members and employees are trained in proper rescue and evacuation methods through facility safety training and evacuation drills.
- Responds to all reported fires and direct the actions of the Fire Brigade and site employees.
- In case of fire emergency, advises the Fire Officer in charge as to present conditions in the area (location of fire, missing personnel, chemicals involved, etc.).
- Consolidates all records and forms used during the incident. These are used for several purposes, such as incident investigation, insurance claims, and potential legal actions.
- Conducts damage assessment to site properties and equipment to determine the extent of damage to facilities and the safety hazards resulting from the incident.
- Conducts debriefing to affected employees and community members to inform them of any hazards that may remain in the Project area following the incident and to identify unsafe conditions that may still exist.

d. Environment Commander

- Acts as the Emergency Services Coordinator in case of any environmental emergency. A major environmental emergency includes a situation wherein there is widespread, actual or potential destruction or contamination of the environment.
- Determines the emergency level as soon as an emergency event is observed or reported, as follows:

  Level 1: Unusual event leading to minimal environmental hazard
  Level 2: Unusual event leading to intermediate environmental hazard
  Level 3: Unusual event leading to severe environmental hazard

- Immediately notifies the Incident Commander for the appropriate emergency level.
- Provides updates of the situation to the Incident Commander to assist him in making timely and accurate decisions regarding warnings, evacuations, etc.
- Decides when to terminate the emergency.
- The Environment Commander records all of the information, observations, and actions taken.
- Notes the time of changing conditions. Documents the situation with photographs and video if possible.
- Submits formal incident report, together with the recommendations and corrective actions, to the chairman and to MGB.

e. Medical Commander

- Overall person in charge of attending to medical needs of people affected by the emergency incident.
- Initiates first aid training for fellow ERT members, employees, and community members within the Project area.

f. Transportation Commander

- In charge of the transportation requirements for rescue and evacuation operations during any emergency.

g. Search and Rescue Commander

- In charge of the search and rescue operations during any emergency.
- Initiates rescue training for fellow ERT members, employees, and community members within the Project area.

h. Logistics Commander

- In charge of the supply management during and up to the termination of any emergency incident.

i. Control Center Coordinator

- Maintains open communication lines between the ERT members and the Crisis Management Team.

j. Media Coordinator or Incident Reporter

- Designates spokesperson for media communication.
- Primarily responsible for statement released to the media and the public.
- Corrects false or misleading information released to the public.

k. Community Coordinator

- Initiates applicable programs that will facilitate community recovery after an emergency. This may include assistance for livelihood, housing, and counseling services in case of stress related to injuries or loss of life.

l. Commercial Services or Recovery Coordinator

- In charge of the business recovery plan that will be implemented following the emergency phase of the incident.

m. Damage and Restoration Commander

- Assists the Emergency Services Coordinator or Fire Safety Commander in assessing damage that has occurred to site properties and equipment to determine the extent of damage to facilities.
- Initiates the remedial repair of damaged structures and facilities to minimize further damage, maintain safe conditions and restore the facility to operational use.

7.4. EMERGENCY COMMUNICATION PROTOCOL

Emergency response will start upon notification of an emergency incident. Depending on the emergency, evacuation may be required of all or part of the Project site. It is critical that an early warning of the emergency be communicated to all employees and timely evacuation of concerned personnel from the hazard area. The Project area uses an alarm system to signal the occurrence of a Project area-wide emergency (such as fire, explosion, earthquakes, etc). When an incident is reported by means of a fire alarm pull station, a verbal report is transmitted over the site hand-held portable radio.

A secondary means of notification is by telephone from an area not involved in the emergency or by hand-held portable radio if available.

In case of small, area-specific incidents such as individual medical emergencies that generally do not require the notification of the entire Project area, the telephone will be the preferred means of reporting, via an emergency hotline directed to the office of the Incident Coordinator. When available, the hand-held portable radio may also be used to make notification of an emergency. As a last resort, verbal notification of the situation can be made at the office of the Incident Coordinator.

Upon signal of an emergency, initial management and response will be handled by the most senior personnel available at or near the location of the incident, until there are further instructions from the ERT, or in a worst-case scenario, the Crisis Management Team (CMT) in Makati.

Emergency situations that will be handled at an ERT level will be managed according to the specific Action Plan provided in the EPRP and will be assessed whether immediate information to the CMT needs to be provided. If the severity of the situation requires that the CMT be informed, the ERT Chairman will notify the Chief Operating Officer and the rest of the CMT members through a phone call and an email message. Instructions, recommendations, and feedback from the CMT will be sent back directly to the Chairman.

If the situation merits the knowledge of the media, the Incident Reporter will report directly to the Public Affairs Director so that an official statement can be prepared immediately. Any statement release will be cleared with the CMT.

7.5. EMERGENCY IDENTIFICATION AND MANAGEMENT

Different emergency situations and overall action plans are discussed below. Preparatory, immediate, and follow up actions that will guide the commander on the emergency management are outlined. Communication protocol diagrams are also provided for each emergency.

7.5.1. Fire

Fires will be classified as small fires and large fires. Small fires can easily be extinguished without evacuating the building or calling the fire department. However, even small fires can quickly become a serious problem and may turn into a larger fire if not contained within the first few minutes of occurrence.

Table 7-2: Employee Action in Response to a Small Fire

Objective	Control and isolate the fire to reduce the risk of a bigger fire.
Immediate Actions	▪ Alert other people in the area and inform supervisor if readily around or ask someone to inform supervisor. ▪ Put out the fire, but never attempt to fight a fire alone. Extinguish small fires by using a portable fire extinguisher. ▪ Use the proper extinguisher, directing the nozzle at the base of the flame. Remove other materials that may catch fire and cause an explosive reaction.
Follow up Action	▪ Await advise or clearance from the Incident Coordinator before going back to work in the area.

Source: Emergency Response Preparedness Program, TVIRD Canatuan Mining Project

Table 7-3: Emergency Response Team Action and Fire Brigade Activity in Response to a Large Fire

Objective	Control and isolate the fire to reduce the risk to employees and property
Immediate Actions	▪ Upon receipt of the call or upon hearing the fire alarm, immediately respond by proceeding to where the fire is located. ▪ The first arriving Fire Brigade member/ ERT will report by radio status of the scene and provide an initial assessment of the situation. ▪ Assists in evacuation of employees and visitors.
Follow up Action	▪ Assessment of the damage that the fire may have caused. Clean up operation. ▪ Documents the incident.

Source: Emergency Response Preparedness Program, TVIRD Canatuan Mining Project

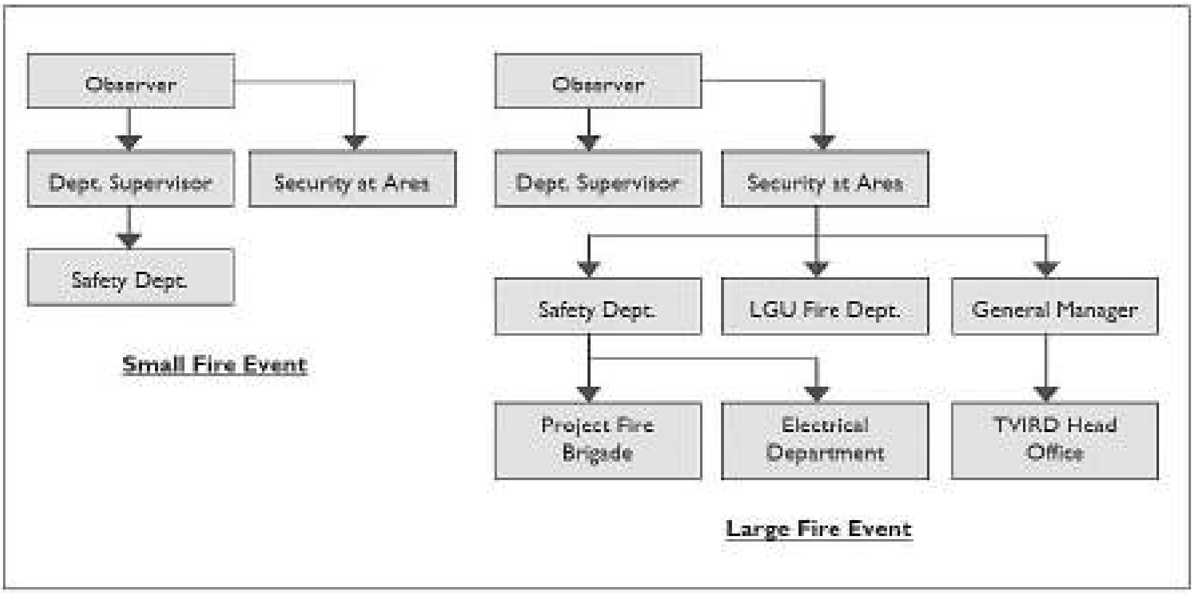
Table 7-4: Action of the Incident Coordinator in Response to a Large Fire

Objective	Control and isolate the fire to reduce risk to employees and property.
Immediate Actions	▪ Respond to all reported fires and direct the actions of the Fire Brigade and site employees. ▪ Ensure that necessary actions, such as evacuation, accountability of personnel, fire suppression of incipient fires, etc., are initiated. ▪ Advise the fire officer in charge as to present conditions in the area. ▪ Assess damage impact and determine which areas that cannot be reoccupied.
Follow up Action	▪ Assess whether temporary repair work can feasible be performed by employees to minimize further damage. Such work might include covering ventilation openings made by the firefighters, securing doors that were opened during rescue operations, and shutting down any unnecessary utilities to prevent further incident.

Source: Emergency Response Preparedness Program, TVIRD Canatuan Mining Project

The communication protocol for both small and large fire emergencies is shown on Figure 7-1.

Figure 7-1: Emergency Communication Flow Fire Event Emergencies



7.5.2. Fatality or Injury Resulting from Other Emergencies

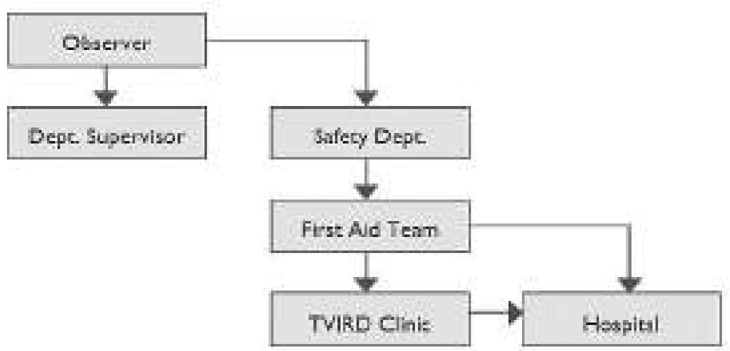
Specific actions and responses are required for incidents where there is a serious injury or fatality associated with company facilities, operations, staff, contractors, or community members. This situation will have resulted from general emergencies such as fire, explosion, sabotage, earthquake, flood, and security risks.

Table 7-5: Fatality or Serious Injury Action of the Emergency Response Team

Objective	Minimize further injury and loss of life. Render immediate medical assistance. Inform CMT if necessary
Immediate Actions	▪ Ascertain and confirm the following information: Time of incident and Location, Nature of incident, Personnel missing, Nature of injuries, On site response undertaken, and Immediate requirements. ▪ Ensure that immediate treatment is available for the injured in the vicinity of the incident. ▪ Determine the nature of injury to establish the required specialist treatment. ▪ Consider and identify the need for protective clothing for the rescuers and the victims. ▪ Arrange deployment of medical staff for onsite treatment. ▪ Make arrangements for evacuation and transport of personnel; ambulance for the injured and vehicle for all others.
Follow up Action	▪ Determine the need for partial or complete shutdown. Determine the need for additional security from the local government. Commence investigation. ▪ Assess the extent of damage and loss to determine requirements for the resumption of operations. ▪ Inform CMT if necessary. Maintain an Incident Logbook.

Source: Emergency Response Preparedness Program, TVIRD Canatuan Mining Project

Figure 7-2: Emergency Communication Flow Personal Injury Event



7.5.3. Chemical Spill or Contact

Due to the storage and use of various reagents within the Project operations, the potential for chemical spills and human contact with chemicals presents a potential accident scenario that may require an emergency response action. An emergency response action is required if the spill or chemical contact event results in the following:

- Causes personal injury or exposure that requires medical attention.
- Results in a fire hazard or uncontrolled volatility.
- Involves or contaminates a public area.
- Results in airborne contamination that requires evacuation.

- Results in a spill that cannot be easily controlled or contained.
- Results in property damage.
- Requires a prolonged or overnight cleanup period.
- Involves an unknown substance.

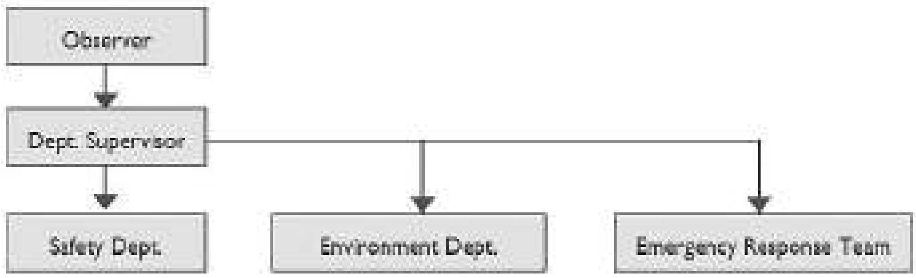
If the spilled substance is classified as a hazardous material, any cleanup supplies and materials used are marked as hazardous chemicals and disposed of properly.

Table 7-6: Action of the Emergency Response Team for a Chemical Spill or Contact

Objective	Control and isolate the spill area to reduce risk to employees and property.
Immediate Actions	▪ Alert personnel in adjacent areas. ▪ Review Material Safety Data Sheets for the chemical Confine the spill and evacuate non-essential personnel. Attend to contaminated personnel. ▪ If spilled material is flammable, extinguish any flames and other sources of ignition. Do not assume gases or odors are harmless due to lack of odor. Treat all gases as dangerous. ▪ Secure appropriate clean-up supplies. ▪ Use protective gear and equipment during the clean-up activities. ▪ Identify any pathways that may have transported the spilled material to the environment.
Follow up Action	▪ Determine the need for partial or complete shutdown. Commence investigation. ▪ Assess the extent of damage and loss to determine requirements for the resumption of operations. ▪ Inform CMT if necessary. Maintain an Incident Logbook.

Source: Emergency Response Preparedness Program, TVIRD Canatuan Mining Project

Figure 7-3: Emergency Communication Flow Chemical Spill Event



7.5.4. Power Outage

Power outages are expected to occur from time to time. These are generally not considered an Emergency Response Team event unless the outage results in one of the other emergency or accident events. Employee actions associated with a power outage include the following:

- Unless there is another related problem such as a fire or other reason for evacuation, employees should remain within their designated work area until notified by the Supervisor.
- Shut off tools, equipment, computers, and other items that could be damaged once the power is restored.
- Use flashlights or other portable lights instead of candles or other ignition sources.
- Notify the Electrical and Safety Departments.

7.5.5. Dam Failure

Failure of the Tailings Storage Facility can occur because of spillway failure or embankment failure. These may be a result or design or construction deficiencies, extreme weather events or natural disasters, operating conditions that exceed the design criteria, terrorism, or sabotage.

Table 7-7: Action Items Relative to a Potential Dam Failure Incident

Step 1 – Event Detection	▪ Observations at or near the dam of unusual occurrences by safety inspectors, people working at or near the dam or the public. ▪ Evaluation of instrumentation data. Seismic events within the area. ▪ Forewarning of weather or other events that could have a significant safety impact on the dam and operations.
Step 2 – Expected Actions	▪ Anyone who observes an unusual or emergency event at the dam should immediately contact the Environment or Safety Office. The Environment Manager determines the emergency level. ▪ The Environment Manager shall inspect the dam. This shall include the full length of the upstream and downstream slopes, dam crest length, downstream toe, filter drain outlets, abutments, spillway crest and outlet channel.
Step 3 – Emergency Level Determination	▪ Level 1 – A non-emergency event but unusual in occurrence and is slowly developing. The situation is not normal but has not threatened the operational or structural integrity of the dam. ▪ Level 2 – A potential dam failure situation which is rapidly changing but there is no immediate threat of dam failure. This situation may eventually lead to a dam failure and may result in flooding downstream of the dam. ▪ Level 3 – An urgent condition with dam failure imminent. This level requires immediate implementation of notification and possibly evacuation protocols.
Step 4 – Notification and Communication	▪ Level 1 – Environmental Manager shall contact the General Manager and the MGB to describe the situation and request technical assistance on the next steps to be implemented. ▪ Level 2 – Immediately contact the Safety Manager and describe the situation. The General Manager and the MGB are then contacted, and remedial actions identified.

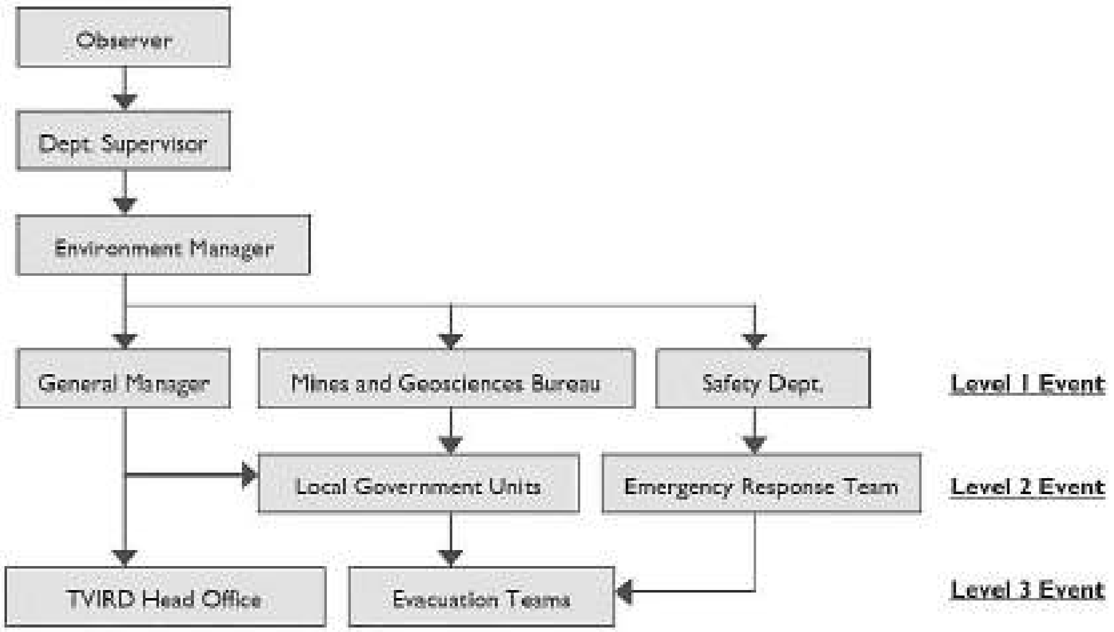
	▪ Level 3 – Safety Manager contacted immediately, and the potentially flooded area evacuated.

Source: Emergency Response Preparedness Program, TVIRD Canatuan Mining Project

Table 7-8: Emergency Remedial Actions for Potential Dam Failure

Emergency	Possible Remedial Action
Dam Embankment Overtopping	▪ Check if the dam spillway is blocked. Assign heavy equipment to remove debris materials from the spillway. ▪ Cover the weak areas of the crest of the dam and downstream slope with sandbag, plastics or other materials for erosion protection.
Earthquake	▪ Immediately conduct a general overall visual inspection of tailings storage facilities, overburden stockpile areas and other facilities. ▪ Perform field survey at the tailings storage facility if there has been any movement of the dam embankment and spillway. ▪ Check for obstruction of the spillway and filter drain.
Embankment Movement/Failure	▪ Stabilize movement or slope failure areas by placing soil or rock fill buttress against the toe of the area.

Figure 7-4: Emergency Communication Flow Dam Emergency Event



Given the critical nature and risk level associated with the Tailings Storage Facility, a detailed Emergency Preparedness Plan will be developed for the different features of the facility based on the design criteria and operations plans as well as the risk assessment evaluations. Included in this document will be specific items to be watched including settlement of the dam crest, increased filter drain discharge, crack development within the embankment section, cloudy seepage water discharge, and development of sinkholes or localized landslides.

7.5.6 Earthquakes

The area is not prone to earthquakes of large magnitude, but small intensity earthquakes have been experienced. One or more other accidents or events requiring implementation of the EPRP may be expected to occur as a result of a significant earthquake. The actions of the Emergency Response Team will follow the protocols associated with that particular emergency. General precautions, outside the ERT activities, to be taken include the following:

- Do check for fires and fire hazards.
- Do not walk-through standing water.
- Do not smoke, light matches, use any open flames or turn on electrical switches or electrical equipment if gas leaks are suspected.
- Evacuate building and structures.
- Stay away from moving equipment and machinery.
- Stay away from steep or unstable land slope areas.

7.5.7 Environmental Crisis Events

These are incidents involving widespread, actual or potential destruction or contamination of the environment. These may be due to extreme weather events (i.e rainfall, earthquake) that exceed the original designed conditions of the Project facilities, causing them to fail and release hazardous substances to the environment. Examples of incidents that may cause environmental crises are dam breaches or overtopping, and chemical spill from tank or pipeline rupture and fuel storage tank leakage or failure. Each of these events has specific action items and protocols.

Table 7-9: General Actions of the Emergency Response Team Relevant to Environmental Crisis Events

Objective	▪ Initiate an immediate and effective response. Inform the CMT if necessary. ▪ Exercise control at the incident site. Minimize operation disruption. ▪ Secure access to the site. ▪ Deploy security to protect assets.
Immediate Actions	▪ Maintain an Incident logbook and take note the following information: Location ▪ Time of incident, Nature of environmental impact/damage, Immediate remediation needs. ▪ Decide for any evacuation needs and transport requirements. Obtain maps or plans of the area prior to the incident. ▪ Employ temporary engineering solutions or other procedures to contain the damage. Identify the need of trained staff/specialists. ▪ Document the incident, at various stages, through video or photos if possible. Deploy security personnel to secure the contaminated area from unauthorized Persons. ▪ Inform the MGB or EMB of the incident, impact and measures taken, if necessary. Inform CMT if necessary.

Source: Emergency Response Preparedness Program, TVIRD Canatuan Mining Project

Table 7-10: General Actions of the Environment Commander Relevant to Environmental Crisis Events

Objective	▪ Take over the management of crisis. Minimize environmental impacts. ▪ Prevent recurrence.
Preparatory Actions	▪ Update Environmental Risk Assessment, preventive measures, and mitigation programs. ▪ Establish Standard Operating Procedures for environmental crises. ▪ Maintain a register of specialist equipment that can be hired within the immediate region for environmental hazard management. ▪ Identify specialist/ consultants to be hired in the event of designated environmental incidents. ▪ Prepare emergency kits to be used in case of emergency. ▪ Conduct regular comprehensive training in environmental crisis management among environmental staff and employees.
Immediate Actions	▪ Identify the emergency level of the environmental emergency situation (level 1, level 2 or level 3). Specific Action Plan will depend on the level of emergency. ▪ Discuss and assess the extent of contamination and required response with ERT members. ▪ Ensure photo/video documentation of various stages of the incident. Provide formal notification to DENR representative to the region. Prepare initial statement for CMT members. ▪ Prepare an initial statement, cleared with CMT, for issue to employees, contractors, and community members. ▪ Coordinate with the Public Affairs Department regarding the media watch and media releases.

7.5.8 Security Breach

The Project may be subjected to different security breaches. These may involve breach due to illegal entry of people such as rebel groups/ individuals known to be inhabitants within the vicinity, small scale miners; or breach of confidential information that may be passed on to different individuals posing threat to the Project operation.

Table 7-11: Emergency Remedial Actions for Security Breach

Emergency	**Response or Action**
Unauthorized access in off limit areas or disclosure of confidential information by Company personnel.	▪ Conduct Investigation to determine the extent of the offense committed. ▪ Based on the information obtained, assess collateral damage to Company operation and adopt damage control measures. ▪ Deny the person further access to confidential files and limit his/her access to other areas in camp until investigation is over. ▪ If non-Company employee, arrest and turn-over to the nearest Police Station and file appropriate charges.

Emergency	Response or Action
Illegal entry of unauthorized person (s) in Company facility/premises.	▪ Effect the immediate apprehension of the suspect. ▪ Conduct investigation and turn over to the police for filing appropriate charges. Implement security inspection of the whole area after the suspect was arrested to monitor for any damage or abnormalities caused by the entry.
Illegal Possession of Firearms/explosives/weapons inside Company Premises.	▪ Report the person to the Security Department upon notice. ▪ With appropriate back-up personnel, disarm the person and conduct an initial Investigation. ▪ Turn-over subject to the nearest Police Station and file appropriate charges.
Ambush against Company personnel/visiting guests or expatriates.	▪ Determine the exact location of the incident and seek assistance from the nearest Police Station or military unit. ▪ Cause immediate extrication of the wounded and evacuation to nearest hospital while providing first aid assistance to the victim. ▪ Seek military assistance if air evacuation is necessary.
Armed clash between Security Personnel and NPAs and lawless elements in camp and along main access road.	▪ Perform immediate action drill as regularly rehearsed during attack to seek cover and remain in a prone position while exchange of fire is ensuing. ▪ Deter attack by counterfire and maneuver as rehearsed and report to the nearest military detachment for assistance/reinforcement. ▪ Perform quick reaction to return fire and move outside the area of concern in case of vehicular ambush. ▪ Evacuate/treat wounded to the nearest hospital.
Threat letter or text received by a Company employee/staf.	▪ Report the matter to the security department and inform the Police or NBI for record purposes and basis for further investigation. ▪ Advise the person concerned to be extra careful in his/her movement and be conscious of his surroundings for any suspicious incident and or persons and report the same to security personnel. ▪ Limit his/her travel outside of Company premises.

7.6. RESCUE AND RECOVERY

Immediate transportation of a victim from a dangerous place to a safe place using the knowledge, skills, techniques, and equipment appropriate for the situation without further endangering the life of the victim and the responder and preserving the scene as far as possible. The responder ERT shall ensure that skills and equipment are ready well prepared, and the following should be in consideration.

- Keep equipments clean and ready for use
- Inspect equipment always
- Acquire supplementary knowledge (3 basics requirement for emergency)
- Individual responsibility is well defined.
- Ways of communication are open and clear.
- Upgrade and update skills through trainings, seminars, and education.

- Ropes, rope anchor and accessories, Ladders, Jacks and lever, Spine-board / Long and short backboards, First Aid Kit and neck-support, Rescue boat, lifebuoy, and float-jacket, SCBA and fire suit.
- Reconnaissance and dealing with surface casualty, coordinate with other emergency responders and, in cases of massive emergency situations or tragedies, inform the local disaster and risk reduction management council.
- Location and removal of lightly trapped casualties and exploration of likely survival points
- Systematic debris removal and secure the location/scene, better to establish isolation.
- Never engage without Personal Protective Equipment (PPE).

- Normal Protective Equipment: Such clothing can be worn within an area that is not contaminated with gases, chemicals, flammable liquids, or any radioactive materials; includes goggles or face shields, coveralls, gloves, knee guards, boots, and an appropriate mask.
- Full Protective Clothing/Equipment: Clothing designed to prevent gases/vapors, liquids, and solids from coming into direct contact with the skin; may include a helmet, face mask, coat and pants (customarily worn by firefighters), gloves, rubber boots, bands (light-reflecting material) around the waist, arms and legs as well as coverings for other parts of the head not protected by the face mask or helmet.
- Special Protective Equipment/Clothing: Clothing specially designed to protect against a specific product hazard (for example, strong acids, radioactive materials, cryogenic gases, or poisonous substances).

7.7. EMERGENCY EVACUATION PROCEDURES

Some emergency and crisis response situations may require evacuation of all or some employees and visitors to the Project area. A safe, efficient and orderly evacuation program is of the utmost objective of TVIRD. It is critical that an early warning of a crisis and evacuation being communicated to personnel and visitors.

TVIRD management has the responsibility to provide a safe workplace environment for staff, contractors, and visitors to the Project area. As part of this responsibility, each employee, supervisor, and manager have a responsibility to ensure all are evacuated in a safe manner and are accounted for during and following the evacuation.

Table 7-12: Procedures and Responsibilities During an Evacuation Event

Personnel	Action Items
Safety Manager	▪ Responsible for training of personnel in proper evacuation procedures and implementation of regular evacuation drills.
Security Manager	▪ Responsible for timely sounding of emergency alarms and accounts for all personnel following the evacuation. ▪ Reports on the status of the evacuation program to the Fire Department upon their arrival.
Department Managers and Supervisors	▪ Responsible for the training and familiarity of personnel within their department of the evacuation rules and procedures. ▪ Identify any special evacuation needs or assistance required by personnel within their department. ▪ Account for all personnel within their department during and after an evacuation event.

Employees	Responsible for being aware and understanding the evacuation procedures and protocols.

7.7.1. Emergency Evacuation Centers

Primary and secondary evacuation areas have been identified throughout the Project area relative to the Project features and operations. During an evacuation event, employees, staff, personnel and visitors are required to proceed to the primary evacuation area by way of the designated evacuation route. Should the primary evacuation area be considered hazardous, the secondary evacuation area will be used. Upon arrival at the evacuation area, everyone is required to report to the Supervisor who will then provide an attendance report to the Security Manager.

7.7.2. Evacuation

All evacuations can be either of the following:

- Pre-arned Evacuation – a foreseeable event which enables adequate warning and does not unduly limit preparation/evacuation time. Examples of this type of event may include flood and storm surge.
- Immediate Evacuation – evacuation resulting from a hazard impact, which triggers an immediate action, allowing little or no warning and limited preparation time prior to initiating the evacuation. Examples of this type of event may include electrical fire, security event such as a bomb threat and or blasting activity wherein the escape route during blast is identified.

7.7.2.1. Muster Point

Muster points are areas where personnel are to gather once evacuated from the mine site. It is an area that has been predetermined, is removed from the danger but close enough that control can be maintained.

The following are the muster points location.

- The explo camp's Muster Point is at the parking area.
- Mill plant's muster point is located at the south portion of the mill plant.
- Permanent Accommodation's muster point is located at the basketball court.

In some instances, it may be considered appropriate to evacuate to another approved safe area as nominated by the Incident Commander or the attending Emergency Services.

7.8. EMERGENCY EQUIPMENT

The TVIRD emergency equipment is available and in good working condition, readily available in the event of an incident.

Emergency equipment of TVIRD includes:

- Emergency Signage and Lighting
- Evacuation diagrams
- Personal Protective Equipment
- Fire Alarms
- Firefighting Equipment
- Fire Truck
- Ambulance
- Spill Kit

7.9. TERMINATING THE EMERGENCY EVENT

Proper termination of the emergency is critical to ensure all employees, staff, personnel, and visitors are accounted for and the impact areas have been restored to a safe condition. Immediately following the containment and resolution of the crisis the TVIRD management team will prepare a business recovery plan. Activities to be performed during the post emergency period are focused on five sectors.

- Recovery of Operations – The recovery of site operations and services will depend on the extent of the damage suffered. The General Manager will prioritize activities that can be accomplished with available staff and resources.
- Documentation of the Emergency – Documentation of the emergency activities performed is of critical importance in determining the cause of the crisis, impacts and changes to be made to avoid the crisis in the future.
- Emergency Incident Investigation – The emergency crisis event must be investigated as soon as possible following the event. The initial investigations will be done by the supervisor or manager of the department in which the event occurred.
- Damage Assessment – Following the emergency crisis event and assessment of the damage to property and equipment and remediation measures required to mitigate the impacts of the event.
- Post Emergency Activities – These activities focus on evaluating the post incident welfare of the personnel and staff and provide for a review of the actions and results of the Emergency Response Team programs. This includes a thorough debriefing of all actions and critiques of what worked well and what did not work well.

7.10. EMERGENCY RESPONSE PREPAREDNESS PROGRAM TRAINING

All employees are introduced to the Emergency Response Program of the company, including general plan procedures and specific departmental procedures, during initial employment. Refresher trainings are also conducted, at least quarterly, during Safety meetings. When employees have changes in their area of assignment, they will receive from their department heads an appropriate training in their responsibilities and actions as required by the program for their new area.

Training programs are initiated by the Incident Coordinator and are facilitated by professionals who are competent in their respective fields. Site personnel receive training as appropriate to the level of their expected involvement. Aside from the EPRP guidelines, employees are also educated in some generic emergency courses such as evacuation procedures, search and rescue operations, incident discovery, emergency notifications, firefighting, and first aid training. Other special topics on emergency management will also be initiated.

Emergency drills are conducted on a quarterly basis, during varied work shifts to ensure that the EPRP fits the current conditions and that all involved individuals will respond properly. Specific areas to be evaluated during the quarterly drill include the following:

- Evacuation and accountability of personnel.
- Proper functioning of the alarm system.
- Response time of emergency response personnel to emergency situations.
- Adherence to plan procedures.

Incident management training for the ERT members, employees, contractors, and the local community are provided on a regular basis. This is done either through the Safety Department or in partnership with local agencies. Emergency simulation and drills are conducted on-site to practice the incident response procedures for improved retention and response times.

8. DECOMMISSIONING/ABANDONMENT/REHABILITATION POLICY

The Mine Closure Plan provides the decommissioning, rehabilitation, reclamation, monitoring, and other environmental management procedures that will need to be implemented during the mine closure phase. Examples of mine closure scenarios include the planned closure due to ore resource depletion, early closure should the Project end due to financial or economic constraints or forced closure by regulatory agencies due to non-compliance of environmental regulations. Financial or regulatory based closure may also occur as a temporary closure scenario until economic conditions improve or regulatory compliance issues are resolved. Under this scenario, the Project may be placed into a care and maintenance mode.

The requirements for preparation and approval of a mine closure plan are identified in Section 187 of DAO 2010-21: Providing for a Consolidated DAO for the Implementing Rules and Regulations of RA 7942. This plan is identified as the Final Mine Rehabilitation and/or Decommissioning Plan (FMR/DP). The FMRDP shall be a separate document but will be integrated within the EPEP. The document is subject to the approval of the MRF Committee through the Regional Office and the CLRF Committee at the National level.

Preparation and submittal of the FMRDP is required within 60 days of the issuance of the project Environmental Compliance Certificate. Included within the FMRDP is a risk and opportunity assessment of the Plan, Plan information and management protocols, target closure outcome and goals, monitoring and progress evaluation methods, criteria to measure rehabilitation performance and success, reclamation time schedule and estimated cost for decommissioning and reclamation. The FMRDP will be subject to review and revision every two years after the approval of the original FMRDP.

8.1. MINE CLOSURE PLANNING

The International Council on Mining and Metals (ICMM) provides three basic steps in developing an effective closure plan. The first step is the development of a target closure outcome and goals which are used to develop the conceptual closure plan. The formulation of target outcomes and goals will involve effective community and stakeholder engagement.

The second step involves the ongoing development and implementation of a detailed closure plan which increases the understanding and details of specific goals and milestones. This plan should be regularly updated due to the potential for expectations of the community and the Company to change over time.

The third and final step is the effective transition to closure and decommissioning. Successful implementation of the closure plan hinges on meeting the closure goals set by the Company and the stakeholders. Following completion of the closure plan and programs, there should be little residual risk to the Company and the community should be the recipient of post operations benefits without further involvement of the Company.

Within these three steps are several intermediate requirements and objectives that are integral to the closure process. Development of the Conceptual Closure Plan provides the framework and starting point. This is represented by the FMRDP.

Six organizational items have been developed by the ICMM that provide the framework for developing an effective Conceptual Closure Plan or FMRDP. These consist of the following:

- Risk/Opportunity Assessment and Management –This assessment is used to maximize the positive benefits of closure and minimize the negative consequences.
- Contextual Information Development – Enough information relative to social, environmental, health and human rights sectors should be developed to provide a basis for planning and plan development.
- Target Closure Outcomes and Goals – This step should set out as many goals and objectives of the Closure Plan as practical to allow both the community and the Company to effectively engage the stakeholders and identify the key closure needs.
- Monitoring and Evaluation – The Closure Plan shall identify the types of monitoring programs to be implemented during the closure activities and the methods of monitoring to evaluate the achievement of goals and objectives.
- Closure Costs – Costs are expected to be broad estimates at the Conceptual Closure Plan stage with the recognition that the costs may vary significantly.
- Updating The Concept Closure Plan – The Plan should be updated regularly and when significant changes in community and stakeholder objectives change and when Company objectives or Project conditions change.

8.2. CONCEPTUAL CLOSURE PLAN OUTLINE

8.2.1. General Reclamation and Closure Plan Objectives

General reclamation and closure objectives to be addressed within the FMRDP are shown in Table 8-1.

Table 8-1: General Reclamation and Closure Objectives

Aspect	Objective
Land Use	Maximize the beneficial use of the site after closure.
Safety	Leave the site in a condition where the risk of adverse effects to people, flora, fauna and the environment, has been reduced to levels acceptable to TVIRD and the stakeholders.
Stability	Achieve a condition where the processes affecting landform stabilization are at a rate that meets acceptable conditions.
Landform	Develop final landforms that are compatible with the surrounding area and proposed land uses.
Vegetation	Revegetate the site to conform to the proposed land use plan.
Pollution	Achieve a final condition for the area that is acceptable to the requirements of environmental legislation requirements.
Socioeconomic	Enable all appropriate stakeholders to express their interests during the mine closure process. Ensure that the cost of closure is adequately planned and allocated.

Source: 2009 FMRDP, Canatuan Mining Project

Each of these objectives should also be evaluated with respect to risks and opportunities. Six specific risks are identified by the ICMM and include the following:

- Health and Safety Risk
- Natural Environment Risk
- Social Risk
- Reputational Risk
- Legal Risk
- Financial Risk

Risks and opportunities can be evaluated based on two methods:

- Evaluation based on a specific issue the risk or opportunity based associated with that issue and management of that particular risk or opportunity.
- Evaluation based on a specific closure goal and the risk that goal will not be attained and management of that risk.

Also, critical to understanding and meeting the overall objectives, is capturing, and communicating the issues affecting the closure plans. Contextual information is important in communicating these issues. This information and these data identify the various constraints as well as opportunities that can be expected during implementation of the Closure Plan. Baseline data and risk assessment analyses presented in the Environmental Impact Statement provide a key source of contextual information as do local perception surveys and conversations within the community.

8.2.2. Specific Closure Plan Objectives

Specific Closure Plan objectives and activities will build upon the general reclamation and rehabilitation programs identified in Table 8-1. Objectives specific to the Closure Plan are identified in Table 8-2 below.

Table 8-2: Specific Closure Process Objectives and Targets

Aspect	Objective
Post Mining Land Use	Returning as much of the flora and fauna communities as possible to a condition where pre-mining usage can resume. Removing structures, machinery and equipment that will no longer be used or considered useful to the stakeholders.
Safety and Stability of Structures and Project Facilities	Ensure tailings are safely and securely stored for the long term. Ensure long term stability of overburden stockpiles and mine area.
Landform Modification	To safely route and convey surface water runoff and stream flows through or around the tailings impoundments and overburden stockpiles. To ensure the mined areas are stabilized and re-vegetated.
Pollution Control	To store all potentially acid generating materials in a manner to prevent or minimize the potential for oxidation. To ensure water quality around the disturbed area to be of good quality.
Land Stability	Rapidly stabilize the disturbed land and prepare it for natural re-vegetation.

Aspect	Objective
Vegetation	Re-establish self-sustaining native vegetation which will ultimately be similar in structure and diversity to that which existed prior to mining. Where appropriate, to favor the reestablishment of particular plant species that are rare or that have particular importance in restoration of wildlife habitats or development of livelihood programs. Establishment of an onsite nursery to sustain production of seedlings and re-vegetation stock sources.
Socioeconomics and Community Programs	Integrate sustainable development programs identified in the Ancestral Domain Sustainable Development Protection Plan (ADSDPP). Assist the local community in the development of livelihood programs and economic opportunities for the post mining period.

Source: 2009 FMRDP, Canatuan Mining Project

The goals identified in Table 8-2 will be further expanded to be even more specific as the Closure Plan development process continues. This will be done by developing internal terms of reference involving baseline studies and relevant local information, using different stakeholder engagement activities, and enhancing the environmental and social impact assessments.

From the standpoint of identifying field programs and people/equipment allocation needs, four basic rehabilitation and closure programs were identified. These consist of Structure Demolition/Decommissioning, Structural Improvements, Soil Treatment and Re-vegetation/Reforestation. These programs will also form the basis of defining and implementing a progressive Rehabilitation Program to be initiated once the mining operations begin. The intent is to promote rehabilitation activities throughout the operation period.

a. Structure Demolition and Decommissioning

This activity involves removal of the existing structures or facilities that are no longer needed. These will primarily be the Mill and Plant Process Facilities and material warehouses. Staff housing structures may in part be demolished and removed depending on their final condition and the desires of the stakeholders.

b. Structural Improvements

This activity is generally associated with items and activities needed for erosion control, soil stabilization, re-vegetation, and infrastructure support. Included are drainage structures, earth retaining structures, stream channel improvements, irrigation and water supply systems, water quality treatment systems, trails and access roads and erosion control structures such as sediment ponds and diversion canals. Earthwork activities such as road rehabilitation, re-grading, benching and topographic contouring are also included.

c. Soil Treatment and Conditioning

This activity is identified as placement of topsoil for revegetation activity, short term erosion control treatments such as slope matting, wattling, gabions and placement of clay cover material over soils that may be subject to acid mine drainage. Critical to this activity is the storage and maintenance of topsoil materials removed during stripping operations for Project facility construction. These will be subsequently used for revegetation and reforestation programs. Also key to this activity is the establishment of soil fertilizer sources from the local community. This will be used to enhance the soil characteristics and provide for more efficient growth of the revegetation species.

d. Revegetation and Reforestation

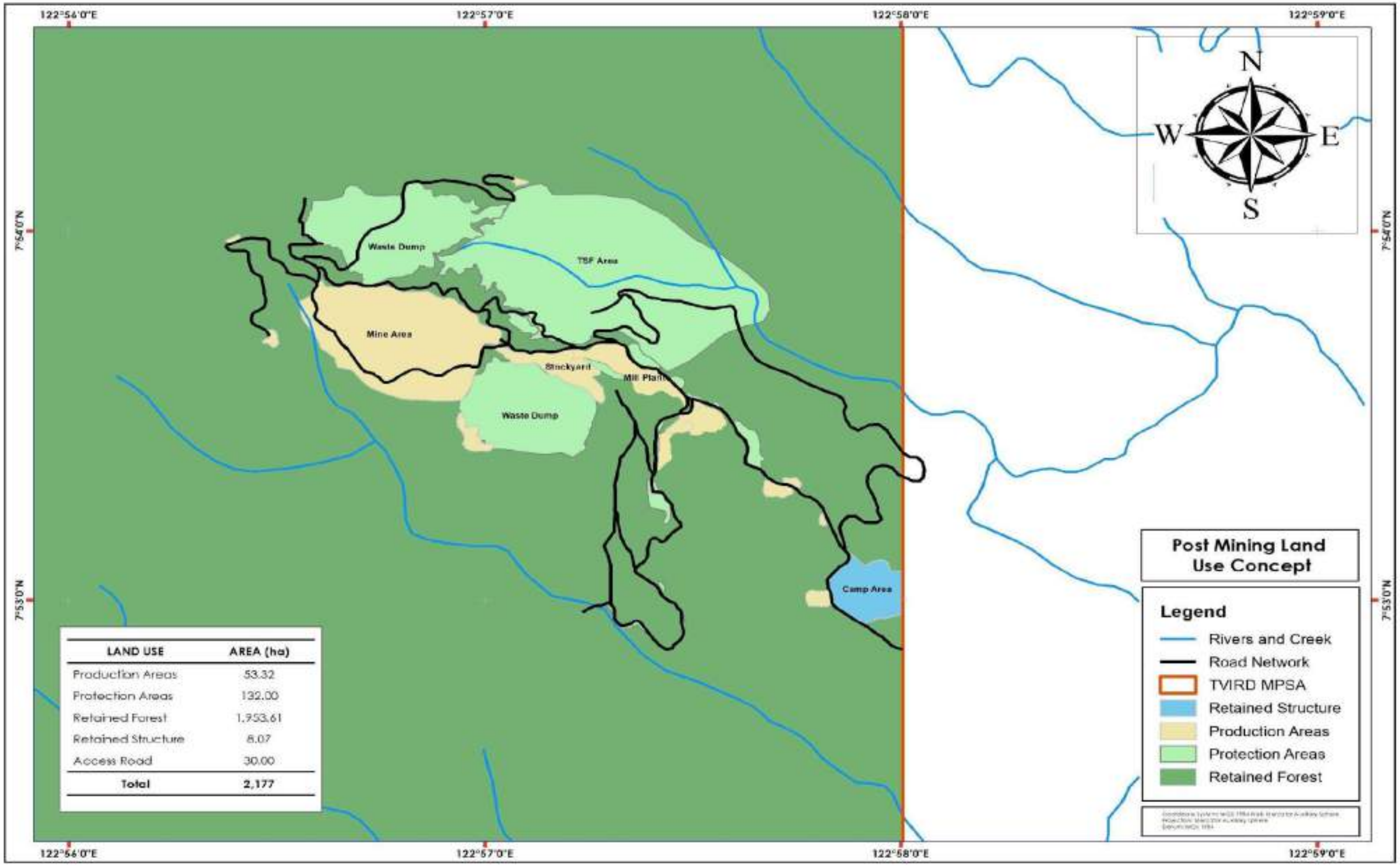
This activity consists of replanting the disturbed areas using grasses, shrubs, low canopy trees and higher canopy trees. One objective is to introduce fast growing species to stabilize the soils and land slopes. This would then be followed by intercropping with slower growing hardwood species with an emphasis on threatened and endangered species. This activity could also include planting of cash crops and plantation development for future community use after the end of mining operations.

8.2.3. Final Land Use Plan

To assist in the preparation of the Concept Mine Closure Plan, it is beneficial to have a basic post-mining land use plan to guide the programs and develop initial manpower and equipment needs and develop basic costs. The plan also serves as a key element for initiating post-mining reclamation dialogue and planning with the stakeholders.

A general land use plan for the Balabag Expansion Project area is shown on Figure 1-8. The said is still subject for revision and modification throughout the operations period as a result of community input and participation in the closure process.

Figure 8-1: Post Mining Land Use Concept



CLOSURE COSTS AND SCHEDULE

8.3.1. CLOSURE COST

In accordance with Section 71 of RA 7942 and Item f, Section 1 of Executive Order No. 270-A, a Final Mine Rehabilitation and Decommissioning Fund (FMRDF) shall be established by the Proponent. This is to ensure that the full cost of the approved FMRDP is accrued before the end of the operating life of the mine. The cost estimates shall be based on the closure methodology and concepts, taking in consideration expected inflation and technology advances among other items. The estimates shall also cover full extent of work necessary to achieve the objectives of mine closure, such as but not limited to, decommissioning, rehabilitation, maintenance and monitoring, and employee and other social costs, including residual care, if necessary, over a ten-year period.

The Annual cash provisions shall be made based on the following formula:

Annual Provision = (Cost of Implementing the FMRDP) x (Percentage Required)

The “Percentage Required” factor is based on the life of the mine and the applicable year of mining. These factors are included in a tabular format within the regulations.

The Balabag Gold-Silver Project is estimated to be in the range of Php 36 million to Php 40 million. A detailed cost evaluation and expenditure schedule will be included as part of the FMRDP. Annual cash provision will be deposited in a government bank within one year after approval of the FMRDP.

8.3.2. CLOSURE SCHEDULE

The closure activities identified in the FMRDP are scheduled to commence after the cessation of mining operations. Progressive Rehabilitation activities will however commence shortly after the start of operations. These will be identified in the AEPEP and will be developed to complement the FMRDP programs.

An active decommissioning and rehabilitation program is anticipated to cover the first two years of the post-mining program. This will be followed by a three-year passive program with a focus on monitoring and evaluation activities. Additional years may be added to the program as needed up to five more years. The closure schedule will be updated on a regular basis depending on the changes in the mining plans and community requests.

9. INSTITUTIONAL PLAN FOR EMP IMPLEMENTATION

BGSP is an ISO 14001:2015 certified company that has an Environmental Policy that upholds the highest operational standards in the exploration, development, and utilization of the mineral deposits in its tenement areas. It is committed to achieving the protection and restoration of the environment through the proactive establishment, implementation, maintenance, and continuous improvement of the Environment Management System.

The table of organization of the Balabag Gold-Silver Expansion Project is shown in Figure 9-1. At the helm of the operation is the General Manager assisted by the respective Assistant GMs for the management of different Departments consisting of the following:

A. Technical Group

a. Mines
b. Assay Laboratory
c. Process Plant
d. Fixed Plant
e. General Engineering Services
f. Fleet Maintenance
g. Tailings Storage Facilities

B. Support Group

a. Materials Management
b. Security
c. Health and Safety
d. Finance
e. Human Resources / Administration
f. MEPEO
g. Community Relations
h. Site Management (IT, ISO, TMC)

The Company goals and objectives will continue to be attained through close coordination between the different Project Departments at Balabag. Specific environmental goals will be implemented directly by the Mine Environmental Protection and Enhancement Office (MEPEO). See Figure 9-2 for its organizational structure. The MEPEO reports directly to the AGM – Support.

The Contractor and sub-contractors are also covered by the EMS Policy to ensure compliance with the relevant ECC conditions, and environmental laws such as the Clean Water Act, Clean Air Act, Ecological Solid Waste Management Act, and Toxic Substances and Hazardous and Nuclear Wastes Control Act. These compliances are regularly taken up in the weekly PCO Contractors' Meeting initiated by the MEPEO.

Part of the EMS is the policies and procedures which lays down the administrative procedures to be adopted by the MEPEO in handling environmental monitoring, assessment, clearance and notice, violations, or complaints.

Figure 9-1: TVIRD-BGSP Table of Organization

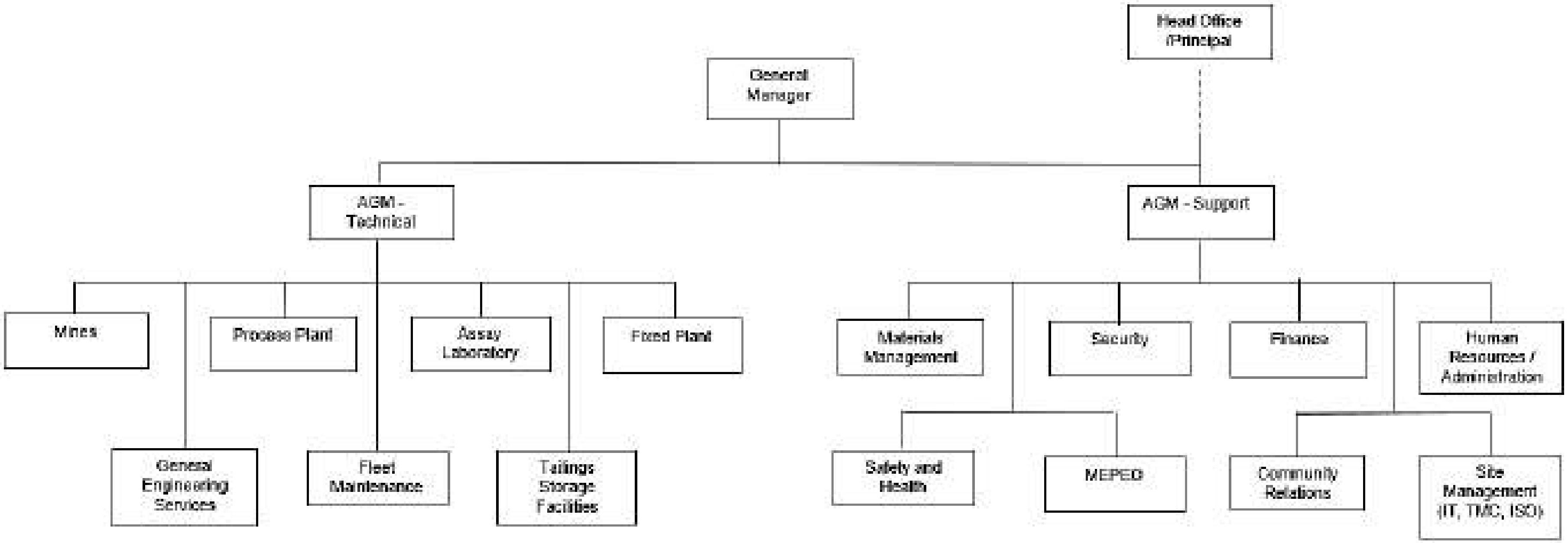
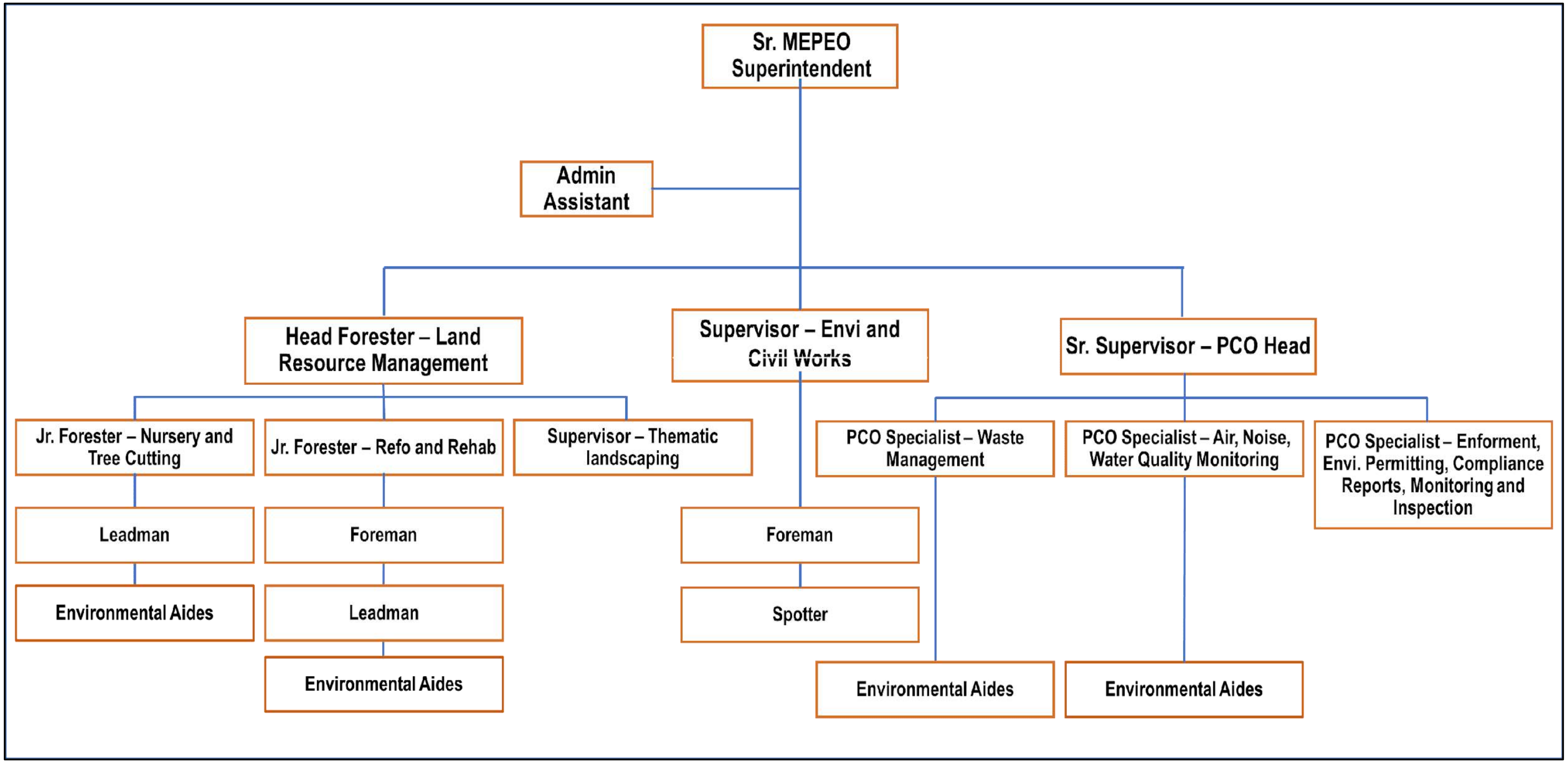


Figure 9-2: MEPEO Table of Organization



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