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List of Acronyms

ADCP	Acoustic Doppler Current Profiler
AEGL	Acute Exposure Guideline Levels
ARI	Acute Respiratory Inspection
AURI	Acute Upper Respiratory Infections
BHS	Barangay Health Station
BOD_5	Biochemical Oxygen Demand
BMCR	Boiler Maximum Continuous Rating
BSWM	Bureau of Soils and Water Management
CEMS	Continuous Emission Monitoring Equipment
CENRO	Community Environment and Natural Resources Office
CFB	Circulating Fluidized Bed
CLUP	Comprehensive Land Use Plan
COD	Chemical Oxygen Demand
CORMIX	Cornell Mixing Zone Expert System

CRO	Community Relations Officer
CSR	Corporate Social Responsibility
CTD	Conductivity Temperature and Depth
DAO	DENR Administrative Order
DCS	Distribution Control System
DENR	Department of Environment and Natural Resources
DepEd	Department of Education
DIA	Direct Impact Area
DILG	Department of Interior and Local Government
DIV	Dutch Intervention Values
DO	Dissolved Oxygen
DOE	Department of Energy
DOH	Department of Health
DPWH	Department of Public Works and Highway
DWT	Dead Weight Ton
ECA	Environmentally Critical Areas
ECC	Environmental Compliance Certificate
ECP	Environmental Critical Project
EGF	Environmental Guarantee Fund
EIA	Environmental Impact Assessment
EIARC	Environmental Impact Assessment Review Committee
EIS	Environmental Impact Statement
EMB	Environmental Management Bureau
EMF	Environmental Monitoring Fund
EMoP	Environmental Monitoring Plan
EMP	Environmental Management Plan
EP	Electrostatic Precipitator
EPIRA	Electric Power Industry Reform Act
ERA	Environmental Risk Assessment
ERT	Energy Recovery Turbine
ES	Executive Summary
FLA	Foreshore Lease Agreement
FMU	Fuel Management Unit
GHG	Greenhouse Gas
GIS	Gas Insulated Switchyard
GLC	Ground Level Concentration
GEOSPHERE	Geosphere Technologies, Inc.
HAZOP	Hazard Operability Study
HH	Household
IEC	Information Education Communication
IMO	International Maritime Organization
IMP	Impacts Management Plan
IPCC	Intergovernmental Panel on Climate Change
IRA	Internal Revenue Allocation
IRR	Implementing Rules and Regulations
ISDP	Indicative Social Development Plan
IWTS	Wastewater Treatment System
LGU	Local Government Unit
LPA	Low Pressure Areas
LWUA	Local Water Utilities Administration
MAR	Mean Annual Rainfall
MCR	Maximum Continuous Rating
MFT	Master Fuel Trip
MGB	Mines And Geosciences Bureau
MMT	Multipartite Monitoring Team
MOA	Memorandum of Agreement
MPSA	Mineral Production Sharing Agreement
NAAQGV	National Ambient Air Quality Guidance Values
NAMRIA	National Mapping and Information Resource Authority
NAPOCOR	National Power Corporation

NAAQGV	National Ambient Air Quality Guideline Values
ND	Not Detected
NFR	Near Field Region
NGCP	National Grid Corporation of the Philippines
NGO	Non-Government Organization
NIOSH	National Institute of Occupational Safety and Health
NSO	National Statistics Office
NSR	Nearest Sensitive Receptor
NWRB	National Water Resource Board
OHS	Occupational Health and Safety
OIS	Operator Interface System
OMSC	Operation and Maintenance Services Contract
OWTS	Oily Water Treatment System
OSCT	Oil Spill Control Team
PAF	Philippine Air Force
PAGASA	Philippine Atmospheric Geophysical and Astronomical Services Administration
PAR	Philippine Area of Responsibility
PBS	Proposed Boiler Stack
PCG	Philippine Coast Guard
PEMAPS	Project Environmental Monitoring and Audit Prioritization Scheme
PEISS	Philippine Environmental Impact Statement System
PEZA	Philippine Economic Zone Authority
PFZ	Philippine Fault Zone
PGA	Peak Ground Acceleration
PHIVOLCS	Philippine Institute of Seismology and Volcanology
PLC	Programmable Logic Controller
PM	Particulate Matter
PNP	Philippine National Police
PNSDW	Philippine National Standard for Drinking Water
PPA	Philippine Ports Authority
PRM	Plant Resource Manager
PRO	Police Regional Office
PWL	Sound Power Level
QRA	Quantitative Risk Assessment
RA	Republic Act
RDC	Regional Dispatch Center
RES	Retail Electricity Supplier
RHU	Rural Health Unit
RO	Reverse Osmosis
SDMP	Social Development Management Plan
SDP	Social Development Plan
SEC	Securities and Exchange Commission
SPL	Sound Pressure Level
SST	Sea Surface Temperature
STG	Steam Turbine-Generator
STP	Sewage Treatment Plant
TCT	Transfer Certificate of Title
TD	Tropical Depressions
TDS	Total Dissolved Solids
TESDA	Technical Education and Skills Development Authority
TS	Tropical Storm
TSP	Total Suspended Particulate
TSS	Total Suspended Solids
TY	Tropical Typhoon
UNFCCC	United Nations Framework Convention on Climate Change
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
UTI	Urinary Tract Infection
VM	Volatile Matter

VOC	Volatile Organic Compound
VTB	Vertical Board
VWO	Valve Wide Open
WWTS	Wastewater Treatment System

EXECUTIVE SUMMARY

A. PROJECT FACT SHEET

Project Name	Mariveles Coal Power Plant (MCPP) Project
Project Location	Mariveles Economic Zone (**MEZ**), Brgy. Biaan, Mariveles, Bataan
Project Type	Thermal Power Plant (Coal Fired)
Project Area	130.08 hectares of land area; 25.4 hectares of foreshore and miscellaneous lease areas
Project Capacity	Phase I: 4x150 MW (Plant 1); Phase II: 4x150 MW (Plant 2)
Project Technology	Circulating Fluidized Bed Technology
Project/Investment Cost	PhP99.080 Billion
Project Components	Major Components • Boiler • Steam Turbine Generator Support Facilities • Pier, Jetty and Jetty Trestle (Common or shared facility) • Coal Yard (covered roofing) • Coal Handling System • Ignition Light Diesel Oil System • Water Supply System • Feedwater System • Water Treatment System • Closed Cycle Cooling Water System • Feedwater System • Condensate System • Chemical Feed System • Seawater Intake and Outfall Structures • Circulating Cooling Water System • Compressed Air and Dryer System • Combustion Air and Flue Gas System • Instrumentation and Control • Power Transmission System Pollution Control System • Electrostatic Precipitator • Exhaust Stack • Continuous Emissions Monitoring System • Wastewater Treatment System • Ash Handling System • Ash Disposal System
Profile of the Proponent	
Name of Proponent	Mariveles Power Generation Corporation
Proponent's Address	19th Floor, San Miguel Properties Centre, No. 7 St. Francis, Mandaluyong City, Metro Manila
Authorized Signatory/ Representative	Mr. Rene R. Mendoza Project Director
Contact Details	Telephone No: (02) 667-5203; Mobile No.: 0917-8342078 Email Address: rrmendoza@smcgph.sanmiguel.com.ph
Profile of the Preparer	
EIA Preparer	GEOSPHERE Technologies, Inc.
Consultant's Address	19D Eisenhower Tower, Eisenhower St., Greenhills, San Juan, Metro Manila
Contact Person	Engr. Ledicia T. Dela Cruz Managing Director
Contact Details	Landline: (+632) 724-5665; 724-5667; (+632) 723-4250 (Fax) Email Address: gti0722@geospheretech.com

B. PROCESS DOCUMENTATION

EIA Team

The EIA Study was conducted by a multidisciplinary team of specialist and consultants of the GEOSPHERE Technologies, Inc., who have strong background in environmental assessments, in close coordination with the project management of the MPGC. The composition the EIA Team is presented in **Table ES-1**.

Table ES-1 EIA Team Composition

Module/Section	Team Member	EMB Registry No.
Project Management	Ledicia T. dela Cruz	IPCO-287
Geology and Geohazard	Emmanuel G. Ramos	IPCO-117
Water Quality and Aquatic Biology	Ma. Vivian D. Camacho	IPCO-213
Marine Biology	Vincent V. Hilomen	-
Coral Fish and Fishery	Victor Ticzon	-
Oceanography and Thermal Plume Modeling	Cesar Villanoy	-
Meteorology & Air Quality	Reynaldo S. Tejada	IPCO-036
Socio-cultural	Felixberto H. Roquia, Jr.	IPCO-028
Public Health	Daphne D. Bate	IPCO-243

From the side of MPGC, the project management was spearheaded by Engr. Lauro Andrade, the Project Manager for the proposed MCPP Project. **Annex ES-2** presents the Accountability Statements of the Preparer and the Proponent.

EIA Schedule

The EIA Study was conducted for a period of 12 months commencing from the conduct of project briefing for the EIA concerned personnel of the EMB to Information, Education and Communication (**IEC**) activities. Technical Scoping was conducted with the EMB and EIARC members and based on the agreed scope of work, the collection of primary data was conducted. Data collected were processed, analyzed and evaluated for impact assessment and formulation of impact management plan. The data and information were written into an EISR and the final version of the EISR will then be submitted to the EMB-CO for ECC application. The major activities undertaken to complete the EIA were listed in **Table ES-2**.

Table ES-2 EIA Study Schedule

Activity	Date
IEC Activities	June 24, 2016 and July 11, 2016
Public Scoping	July 11, 2016
Technical Scoping	July 14, 2017
Public Consultation/Public Hearing	November 20, 2018
Data Collection	
Land Use	August 2-4, 2016
Geology and Geological Hazards	July 22, 2016
Pedology	August 2-4, 2016
Marine Water Quality & Aquatic Ecology	July 16-17, 2016 and December 8, 2017
Air Quality and Noise	August 2-4, 2016
Socio-economic, Health and Perception Survey	July 12 to August 10, 2016
Social Development Planning Workshop	September 15, 2016

EIA Methodologies

The EIA for the proposed MCPP Project conforms to the Department Administrative Order (DAO) No. 30 Series of 2003 of the Revised Procedural Manual of the Philippine EIS System (PEISS) and EMB

Memorandum Circular 005 dated July 7, 2014. The data collected and the outline of the this EISR are in accordance with the EIA Scoping and Screening Form for Thermal Power Plant Projects (Annex ES-1), which was finalized during Technical Scoping at the Environmental Management Bureau of the Department of Environmental and Natural Resources (EMB-DENR) Central Office, DENR Compound, Visayas Avenue, Diliman, Quezon City on March 9, 2016. **Table ES-3** shows the pertinent data, sources and methodology used for the proposed Project.

Table ES-3 The EIA Methodology

Environmental Component	Methodology
LAND	
Land Use and Classification	• Review of Comprehensive Land Use Plan (**CLUP**) of Mariveles.
Geology	• Conduct of field surveys • Review of available reports, geologic literature and information from Mines and Geosciences Bureau (**MGB**), Philippine Institute of Volcanology and Seismology (**PHIVOLCS**), Philippine Atmospheric, Geophysical and Astronomical Services (**PAGASA**), National Mapping and Resource Information Authority (**NAMRIA**) and Proponent
Pedology	• Review of existing literature and maps of the project area. • Field survey and collection of soil samples
Terrestrial Ecology	• From the EISR of EFIHI for MEZ
WATER	
Hydrology	• From the EISR of EFIHI for MEZ
Oceanography	• Review of secondary data from existing reports and maps of the project area from MPGC. • Conduct of field work to collect primary data/ambient conditions onsite. • Use Castaway Conductivity-Temperature-Depth (**CTD**) Profiler Data in measuring the vertical temperature profiles. • Use of a 600kHz RDI Teledyne Acoustic Doppler Current Profiler (**ADCP**) programmed to measure current on 30 second intervals at 2m bins from the surface to bottom. • Use of the Mike 3 Hydrodynamic Model (DHI Water and Environment) in modeling the thermal discharge of the proposed Project.
Water Quality	• Groundwater and freshwater quality from the EISR of EFIHI for MEZ. • Collection of marine water samples for analysis of physical, chemical, microbiological, micro-nutrient and heavy metal analyses at Mach Union Laboratory, Inc. in Las Piñas City. Levels of DO, salinity, conductivity, TDS and Temperature were measured on-site. • Assessment of marine water quality based on DAO 2016-08 (Water Quality Guidelines and General Effluent Standards of 2016).
Freshwater Ecology	• From the EISR of EFIHI for MEZ
Marine Ecology	• Collection of primary and secondary data. • Assessment of coral communities using modified photo transect method. Identification of life form using the standard 28 benthic life form categories of English et al. (1997). • The samples of zooplankton and phytoplankton were collected from seven (7) sampling stations at the marine environment. Plankton organisms were identified to lowest possible taxa (Goswami, 2004; Nishikawa and Toda, 2004; Sekiguchi et al., 2004; Verlencar, 2004) and their numbers counted. Phytoplankton and zooplankton densities were expressed as no. of cells/ m^3 and no. of inds./ m^3, respectively.
AIR	
Meteorology and Climatology	• Collection and review of existing literature and maps of the project area from PAGASA Sangley Point Synoptic Station in Cavite

Environmental Component	Methodology
Air Quality and Noise Level	• Conduct of ambient air quality monitoring at the four (4) established sampling stations to measure the NO_2, SO_2, TSP, PM_{10} and Heavy metals concentration in the project area and its vicinity. • Conduct of Noise level measurement during morning, daytime, evening, and nighttime using Extech Noise Data Logger at the five (5) established sampling stations. • Use of AERMOD version 15181 software to assess and determine air quality impact due to the emissions of TSP, PM_{10}, SO_x, NO_x, and CO in the operation of the proposed Project. • Noise prediction for construction and operation activities of the proposed Project using CUSTIC 2.0 modeling software.
PEOPLE	
Socioeconomic and Public Health	• Conduct of IEC for the Barangay and Municipal LGUs • Conduct of Public Scoping • Conduct of Socio-economic, Public Health and Perception Survey at Barangay Biaan • Review of the CLUP and Socio-economic Profile of Mariveles Municipality and Barangay Profile of Biaan • Review of available secondary data, relevant studies and other information from Philippine Statistics Authority (**PSA**). • Gathering and review of relevant primary data critical to the study; • Collected and evaluated recent trends of secondary data on health and injury profile from the Municipal Health Office (**MHO**) for possible relationship to health impacts associated with coal power plant operations. • Literature review on the potential impacts and risks of coal-fired thermal power plant on health of people living in surrounding communities, to confirm established relationships between hazards of coal power operations and health risks and effect to people. • Conducted SDP workshop with the Municipal LGU, Barangay Council and residents of Barangay Biaan in the preparation of the Indicative SDP, and IEC Framework.

<u>Public Participation Activities</u>

An extensive and comprehensive IEC campaign about the Project and the EIS System was conducted to ensure a meaningful and active participation of well-informed stakeholders – host communities, LGUs, relevant agencies, the EMB and the local DENR in the EIA process.

Information, Education and Communication. The IEC sessions, as presented **Table ES-4**, were conducted to provide updated information about the proposed Project and encourage the concerned stakeholders to participate in the EIA process. The IEC activities started with a prayer followed by the explanation of the EIA process, and the presentation of the project description and its potential impacts to the environment. An open forum was then held after the presentations in order to solicit the response of the stakeholders regarding the Project and to incorporate the issues that were raised into the EIA Study. IEC documents such as attendance sheets, issues raised, and photos taken during the IEC are presented in **Annex ES-3.**

Table ES-4 IEC Conducted for the EIA Study of the Proposed Project

Session	Date/Time	Venue
Barangay Officials and Sectoral Leaders	June 24, 2016, 11:00AM	Hall, Barangay Biaan, Mariveles, Bataan
Municipal Officials	July 11, 2016, 2:00 PM	Office of the Sangguniang Bayan, Municipal Hall, Brgy. Poblacion, Mariveles, Bataan

Public Scoping. The Public Scoping was conducted at Basketball Court of Barangay Biaan, Mariveles, Bataan on July 12, 2016 at 10:00 o'clock in the morning to present the EIA Process and the proposed Project to the public and also to collect site-specific concerns/inputs and suggestions to be incorporated in the EISR of the proposed Project. The issues/concerns raised, copy of the received invitation letters, attendance sheets and photos taken during Public Scoping are presented in **Annex ES-4**.

Social Development Planning Workshop. Social Development Planning Workshop, particularly the formulation of the Indicative Social Development Plan (**ISDP**) for the Local Government Units was conducted at Barangay Hall of Barangay Biaan, Mariveles, Bataan on September 15, 2016 at 2:00 o'clock in the afternoon. The workshop was attended by the department heads of Mariveles and the council members of Barangay Biaan. SDP documents such as attendance sheets, issues raised and photo documentation are given in **Annex ES-5**.

Public Hearing. The Public Hearing was conducted at the Multi-purpose Court of Barangay Biaan, Mariveles, Bataan on November 20, 2018 at 10:00 o'clock in the morning. The public hearing was conducted to give opportunity to stakeholders and other interested parties to freely express their concerns, support, opposition and questions about the project. All relevant comment/inputs from the public was incorporated into the Final EISR for submission to EMB for issuance of ECC. The issues/concerns raised during Public Hearing, copy of the received invitation letters, attendance sheets and photos taken during Public Hearing are presented in **Annex ES-6**.

C. EIA SUMMARY

Summary of Alternatives

Siting. There is no other alternative site considered for the proposed MCPP Project of MPGC, except for the 125 hectares lot within the MEZ that has already been developed by EFIHI.

Technology. Two (2) types of technology which use coal as primary fuel were initially considered for the project, the Pulverized Combustion (**PC**) and the Circulating Fluidized Bed (**CFB**). Considering the project area and capacity of the proposed MCPP Project, CFB has been recommended. CFB is also considered as a better alternative to conventional pulverized coal boiler due to its better efficiency in regulating gas emissions, particularly SO_x and NO_x even without the need for expensive pollution control system.

Summary of Key Environmental Impacts and Management Plan

Table ES-5 presents the summary the probable significant impacts per critical process of the project and the corresponding mitigation measures to reduce the identified significant impacts.

Table ES-5 Environmental Management Plan for the Proposed MCPP Project

Environmental Component	Potential Impact	Prevention/Mitigation/ Enhancement Measures
CONSTRUCTION PHASE		
LAND		
Land use and Classification	• Change/ Inconsistency in Land Use	• The Project site is an industrial land and consistent with the general land use of Mariveles and therefore there is no issue with the change in land use.
	• Encroachment to ECA	• The Project site has not encroached in an ECA.
	• Impairment of visual aesthetic	• Establishment of buffer zones • Coordination with Camaya Coast Resort owner
	• Devaluation of land value as a result of improper solid waste management	• Implementation of the Solid Waste Management Plan • Utilization of the ash storage facility within MCPP

Environmental Component	Potential Impact	Prevention/Mitigation/ Enhancement Measures
Geology/ Geomorphology	• Change in surface landform/terrain/ slope	• Backfill materials shall be compacted to the required density. • Soft materials will be excavated and replaced by engineered backfill
	• Change in sub-surface underground geomorphology	• The excavations that will be done at the site shall cause permanent but low level of disturbance. • Strict conformance to the recommendations of the geotechnical study
	• Inducement of subsidence, liquefaction, landslides, mud/debris flow	• Since the area is already developed, the possibility of experiencing landslides and/or mud/debris flow is nil.
Pedology	• Soil erosion	• Construction of soil erosion control measures either by engineering structure or planting of grasses/trees. • Placement of excavated soil materials in appropriate stockpile areas with avoidance of stockpiling along drainage ways/creeks. • The soil stockpiles will be covered with plastic sheets/geotextile, or planted with grasses/ small shrubs for erosion control. • Scheduling of excavation work/earth movement during dry months.
	Soil Contamination	• Development and implementation of a solid waste management program that shall include proper waste segregation and good housekeeping • Proper handling of oil products and equipment maintenance. • Oil sludges shall be properly contained in leak proof containers prior disposal. Oil contaminated materials should be collected, stored and disposed by DENR-accredited waste treater. • Fuel storage should be contained with an impervious bund which is designed to handle 110% of the tank capacity.
Terrestrial Ecology	• Revegetation of areas identified as buffer zone	• Project site within Mariveles Economic Zone (MEZ) is already developed and cleared of vegetation cover. However, MPGC shall establish a 24.53 ha buffer zone and native species shall be used for vegetation, as these would be expected to have good survival rate.
WATER		
Water Quality	• Degradation of surface and groundwater quality	• Provision of containment structures and canals in the storage areas for oil and the motor pool area • Return of contaminated cans/containers of hazardous materials such as paints, thinners, wood preservatives and others to the supplier/producer for treatment and safe disposal • Putting in place erosion control measures along drainage ways prior to construction such as silt traps and sedimentation basins • Scheduling of construction activities during the

Environmental Component	Potential Impact	Prevention/Mitigation/ Enhancement Measures
		dry season, when necessary • Immediate stabilization of exposed soil/s/barren areas with indigenous drought resistant plants • Work to minimize destruction to seabed through the use of geotextile curtains to control the spread of sediment • Prohibit the discharge of bilge water from attending vessels and other delivery vessels • Ensure compliance with the following: MARPOL, PCG-MC 01-94, DAO No. 08 S. 2016 to be stipulated in the Contract of Contractors • Regular monitoring of surface and groundwater quality
Marine Ecology	• Threat to existence and/or loss of corals • Threat to abundance, frequency and distribution of corals, reef fishes, plankton and marine benthic organisms	• Construction of siltation ponds to prevent sediment from being washed into the bay area. • Stockpiles shall have appropriate drainage to prevent erosion of silt to the bay. • Adequate and proper drainage system • Careful planning for the layout of offshore facilities to avoid significant adverse impacts on the marine habitat in the area • To control the spread of sediment, silt curtains will be utilized so that sediments disturbed are contained in the vicinity. In swift moving waters, it may be necessary to have more than one wall of silt curtains. • Regular monitoring of plankton and marine benthic invertebrates shall be conducted to evaluate effects of siltation on the composition and abundances of these biota. • Support the establishment of marine sanctuary of EFIHI in cooperation with LGU. • Over the long time, the pier piles of the jetty can serve as artificial refuge for a wide variety of marine animals in the area and can enhance the diversity of marine organisms.
AIR		
Meteorology/ climatology	• Change in local micro-climate and local temperature	• MPGC shall establish a 24.53 ha buffer zone and native species shall be used for vegetation, as these would be expected to have good survival rate. • MPGC will also participate in reforestation program of the government
Air Quality and Noise	• Degradation of Air Quality	• Every main haul road shall be paved with concrete, bituminous materials, hardcores or metal plates; keep the road clear of dusty materials; spray the road with water or a dust suppression chemical so as to maintain the entire road surface wet; and immediately before leaving a construction site, every vehicle shall be washed to remove any dusty materials from its body and wheels; • Where a vehicle leaving a construction site is carrying a load of dusty materials, the load shall be covered entirely by clean impervious sheeting to ensure that the dusty materials do not leak

Environmental Component	Potential Impact	Prevention/Mitigation/ Enhancement Measures
		from the vehicle; • The working area of any excavation or earth moving operation shall be sprayed with water or a dusty suppression chemical immediately before, during and immediately after the operation so as to maintain the entire surface wet; • Exposed earth shall be properly treated by compaction, turfing, hydroseeding, vegetation planting or or other suitable surface stabilizer within six (6) months after the last construction activity on the construction site or part of the construction site where the exposed earth lies; • Any stockpile of dusty material shall be either covered entirely by impervious sheeting; placed in an area sheltered on the top and the three (3) sides; or sprayed with water or a dust suppression chemical so as to maintain the entire surface wet. • Periodic watering of aggregates storage piles or covering or enclosure if material is especially dusty. • Provision of water sprays and chemical dust suppressants or oil on roadways • Ambient air (TSP) monitoring
	• Increase in ambient noise level	• Scheduling certain high noise emitting works to more acceptable times of day • Use of the most environmentally acceptable equipment which is properly maintained and silenced • Use of the least intrusive method of work • Proper instruction and supervision of staff • It is advisable that electrically powered plant shall be preferred, where practicable, to mechanically powered alternatives. If mechanical powered plant will be used, it shall be fitted with suitable silencers and mufflers • Defective equipment/parts with abnormal noise and/or vibration will be either repaired replaced • Schedule use of equipment/machines emitting high noise like pile driver during day time operation while, minimize use during night time operation • All employees working on site will be provided with proper ear protectors • Conduct noise level monitoring
PEOPLE		
Local residents	• Increase income for residents	• Positive Impact
Local residents	• Increase in local employment	• Priority employment for qualified local residents without discrimination to women
Local community	• Improvement in infrastructures and social services	• Diligent payment of taxes/revenues
Local residents	• Construction-related hazards	• Environment, health and safety training prior to construction

Environmental Component	Potential Impact	Prevention/Mitigation/ Enhancement Measures
OPERATION PHASE		
LAND		
Geology	• Subsidence and Liquefaction	• Structural monitoring of buildings/facilities especially after each earthquake • Formulation of detailed Emergency Preparedness and Response Plan
Pedology	• Soil contamination with heavy metals	• Regular monitoring of heavy metals in soil (Pb, Hg, Cd, Cr^{+6}, etc.) through sampling and analysis
	• Soil erosion	• Planting of trees within the vicinity of the project site to serve as buffer for soil erosion • Sedimentation ponds will be established within the power plant vicinity
Terrestrial Ecology	• Possible off-site impacts • Generation of power plant emissions	• MPGC shall establish a buffer zone and native species shall be used for vegetation, as these would be expected to have good survival rate.
WATER		
Oceanography	• Change in coastal processes	• Implementation of shoreline protection measures such as sand bypass/relocation operation and engineering and vegetation measures, in the event of shoreline erosion and accretion
Water Quality	• Degradation of water quality	• Installation of WWTS that will treat operation wastewater prior to discharge into Lusong Bay • Installation of STP to treat the domestic wastewater generated prior to discharge into sea • MPGC shall install thermistors to monitor the seawater temperature on a monthly basis
Marine Ecology	• Threat to abundance, frequency and distribution of species of corals, reef fishes, plankton and marine benthic organisms • Loss of important species • Loss of habitat	• Installation of screens at the intake structure • Frequent cleaning and maintenance of intake structure • Using the lowest possible hypochlorite concentration and proper and regular maintenance of the underwater structures • Installation of sensor mechanism to control dosage of the sodium hypochlorite level at the outlet to 2 ppm • Develop and maintain a marine protected sanctuary (in cooperation with EFIHI, other locators and LGU) to relocate and/or replace affected corals
	• Increase productivity of benthic fauna due to colonization of jetty piles by reef-dwelling biota • Re-colonization of benthic communities in the jetty area	• Positive Impact • Implement exclusion zone and place visible markers to protect the area from intrusion and disturbance • Design jetty piles (e.g., rough surface) to hasten colonization by sessile organisms
Groundwater Quantity	• Groundwater contamination	• Daily supervision of possible leaks or spillages in the fuel storage tanks • Regular maintenance to minimize pipe tank leaks or ruptures • Use of coal ash by cement plants
AIR		
Air Quality	• Degradation of Air Quality	• The CFB Technology allows the fuel to be burned at a relatively lower temperature, which reduces the NOx formation by approximately

Environmental Component	Potential Impact	Prevention/Mitigation/ Enhancement Measures
		60% due to a low combustion temperature of 800-900ºC. • Limestone injection shall capture up to 98% of sulfur impurities from the fuel by reacting with it to form calcium sulfate, an inert material that is removed with the combustion and, thereby reducing SO_x formation. • EP shall be installed to remove 99.5% of particulates, particularly fly ash from the flue gas prior to its release through the stacks. • CEMS shall be installed to have real time monitoring of emissions at the stack • Stack will be constructed at 100m to have proper air dispersion • Conduct ambient air quality monitoring and stack emissions testing
	• Dust Generation from Material Handling in ADF	• Implement wet handling of ash • Loading directly into trucks to be transported to cement plants to minimize storage volume
Noise Quality	• Increase in ambient noise level	• Air compressors and emergency generators will be equipped with noise attenuation enclosures; • Steam turbine and boiler equipment will be enclosed and provided with silencers at the exhaust; and • The steam drum, super heater and re-heater safety valves will be provided with an absorptive silencer. • Conduct noise level monitoring • Presence of buffer zones around the plant
PEOPLE		
Waste Management	• Generation of sewage/solid waste	• Provision of STP, portable toilets and latrines, no litter signs, waste can • Applying the hierarchy of measures: Reduce, Segregate, Re-use, Recycle and Dispose • Proper disposal of non-recyclable wastes through an accredited contractor
Population	• Change in population (size, distribution) • In-migration	• Priority hiring of qualified local residents in coordination with the Municipal Gov't and host barangay • Training program and skill transfer for local residents
Social services	• Overburdening of public social services	• Priority hiring of qualified local residents • On-site medical clinic staffed by at least a doctor and a nurse • Provision of an ambulance
Health	• Introduction of disease between migrant and local workers	• Clean bill-of-health as a condition for employment based on work description • Medical check-up shall be included in CSR program to monitor the occurrence of unusual health problems that can be associated with the proposed Project. • Provision of potable water, sanitary facilities and garbage bins for workers • Provision of Medical clinic and a safety officer to monitor safe working conditions • Provision of Medical/First Aid kits in all work

Environmental Component	Potential Impact	Prevention/Mitigation/ Enhancement Measures
		places • Provision of an ambulance
Local residents	• Increased social and economic financial activity	• Positive impact, no mitigation required
Local properties	• Fire hazard	• Regular compaction and watering of coal pile once the temperature exceeds 90°C • Installation of temperature monitoring system, water sprinkler system and fire hydrants in the coal yard • Provision of fire suppression systems, fire detections systems, fire host stations and portable fire extinguishers • Full enclosure of the coal yard • A "first-in-first out policy of handling of coal • Transferring, cooling and immediate use of affected portions of the stock • Provision of a fire truck
ABANDONMENT PHASE		
LAND		
Pedology	• Soil contamination with heavy metals	• The Abandonment Rehabilitation Plan shall be followed strictly with emphasis on the strategy of sustaining erosion/ sedimentation control within and adjacent vicinity of the power plant and rendering the Project area free of soil contamination for heavy metals (Pb, Hg, Cd and Cr^{+6})
Terrestrial Ecology	• Increase biodiversity due to retention of buffer zone	• Positive impact, no mitigation needed • Regular monitoring and tree-planting activities to maintain and develop buffer zone
WATER		
Water Quality	• Degradation of water quality	• Collection of spills • Removal and/or neutralization of chemicals • Continuous water quality monitoring
AIR		
Air Quality and Noise	• Degradation of air quality • Increase in noise levels	• Watering during dismantling to minimize dusts • Proper maintenance of vehicles • Use of noise suppressors/mufflers • Limiting noisy activities during daytime • Conduct noise level monitoring
PEOPLE		
Local residents	• Increase of temporary employment • New skills developed for decommissioning may be marketable elsewhere	• Priority for qualified local residents
	• Reduction in employment opportunities to include the staff of local contractors with long-standing service contracts with the project	• Six (6)-month notice prior to termination of contract to give ample time to look for next employment • Effective management via consultation, planning and communications with affected workers • Financial support within a human resources plan
Demographic	• Out migration of affected project personnel to seek work elsewhere	

Environmental Component	Potential Impact	Prevention/Mitigation/ Enhancement Measures
Local Community	• Nuisance due to increased road traffic, noise, etc.	• Formulation and implementation of decommissioning impact management plan

In summary, the proposed MCPP has no significant adverse impact on land component, as it will be located within MEZ. For the water component, the main impact would be during the operation phase due to thermal discharges. Corals will be affected when the jetty, outfall and intake structures are built. The mitigation measures to prevent the dispersal of disturbed sediment will thus be crucial in ensuring that the impacts are temporary enough to allow the corals to recover after the construction phase. Support for the establishment of a marine sanctuary will offset the impacts of the project to the marine ecology.

For the air component, the air emissions are the main impact of the proposed MCPP Project. However, with the CFB Technology, the fuel to be burned will be at a relatively lower temperature, thus, reduces the NO_x formation by approximately 60% due to a low combustion temperature of 800-900ºC. Limestone injection also captures up to 98% of sulfur impurities from the fuel by reacting with it to form calcium sulfate, an inert material that is removed with the combustion and, thereby reducing SO_x formation. Moreover, installation of 100m stack, EP and CEMS ensures that emissions will meet DENR air quality standards. No residual air impacts are projected based on the air dispersion modeling done.

The residents in the host barangay and municipality will benefit from employment opportunities, CSR, and SDP during construction and operation phases of the proposed MCPP Project. The LGU will also be positively affected mainly with the payment of taxes and fees. No major risks and uncertainties were identified based on the findings of the EIA.

1.0 PROJECT DESCRIPTION

SMC Global Power Holding Corporation and Meralco PowerGen Corporation (**MGen**) had formed a partnership in a greenfield thermal power plant project in Mariveles, Bataan thus forming the Mariveles Power Generation Corporation **(MPGC**).

The MPGC proposed to construct and operate a thermal coal-fired power plant with a total capacity of 1,200MW which employs Circulating Fluidized Bed (**CFB**) Technology, named as Mariveles Coal Power Plant (**MCPP**) Project. The proposed MCPP Project will be constructed in two (2) phases, each phase will have 4x150MW capacity.

The proposed MCPP Project will be located within an Authority of the Freeport Area of Bataan (**AFAB**)-registered Mariveles Economic Zone (**MEZ**) in Barangay Biaan, Mariveles Bataan which will be leased from E-Fare Investment Holdings, Inc. (**EFIHI**), the developer of MEZ. The total lot area of the proposed MCPP Project to be leased would be about 130.08 hectares. **Annex 1-1** presents zoning certificate issued by AFAB for MEZ while **Annex 1-2** presents the Memorandum of Agreement of MPGC with EFIHI for the 130.08-ha lot.

The proposed MCPP project of MPGC is classified under A-1 Category of Environmentally Critical Projects (**ECPs**) pursuant to Administrative Order (**DAO**) No. 30 Series of 2003, the Revised Procedural Manual of the Philippine EIS System (**PEISS**) of the Department of Environment and Natural Resources (**DENR**) which requires an Environmental Impact Statement Report (**EISR**) for application of an Environmental Compliance Certificate (**ECC**).

Brief Information about the MPGC

MPGC is formed from the partnership of SMC Global Power Holdings Corporation and MGen with principal place of business at the 19th Floor of San Miguel Properties Centre, No. 7 St. Francis, Mandaluyong City. The MPGC was incorporated on January 23, 2015 with the Securities and Exchange Commission (**SEC**) with Registration No. CS201500966 which Certificate as presented in **Annex 1-3**.

SMC Global Power Holdings Corporation is a subsidiary of San Miguel Corporation (**SMC**). SMC Global Power Holdings Corporation has been in the power business since 2008 and has current greenfield power project in Limay, Bataan and Barangay Culaman, Malita with capacity of 600MW and 300MW, respectively. The projects will be on stream within the 4th quarter of 2016 and 2nd quarter of 2017.

MGen is a subsidiary of MERALCO and has been in the power business since 2010. It has current green field power in Subic, Bataan; Mauban, Quezon; and Atimonan, Quezon with capacities of 600 MW, 460 MW and 2x600 MW, respectively.

1.1 PROJECT LOCATION AND AREA

1.1.1 Description and Accessibility of the Project Area

Description of the Project Area

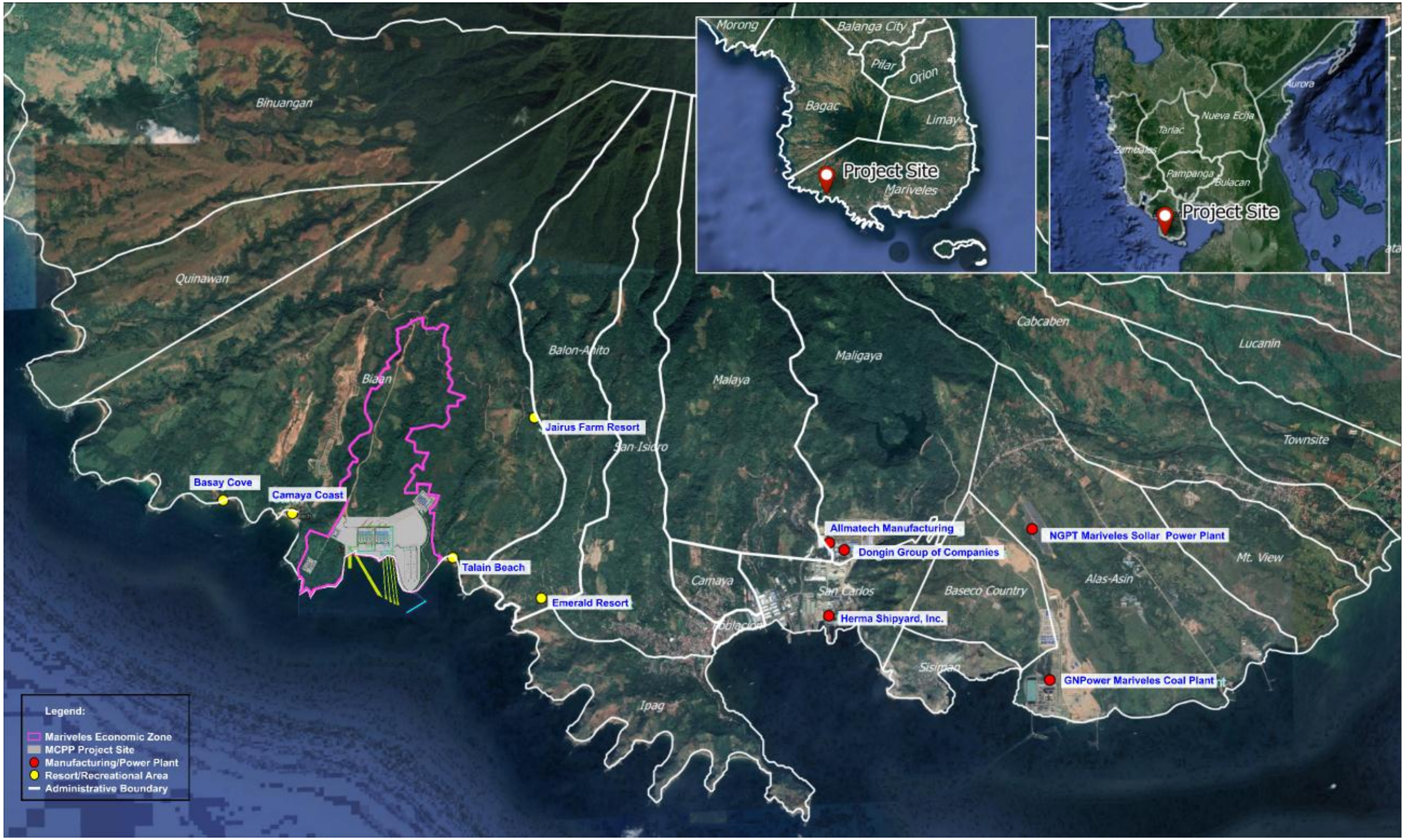
The proposed MCPP Project of MPGC will be located within the AFAB registered MEZ in Barangay Biaan, Mariveles, Bataan as shown in **Figure 1-1.** The host municipality, Mariveles, is a first class municipality in the Province of Bataan. It is where the Freeport Area of Bataan where is located. There are several manufacturing industries and power plants located within Mariveles. These include NGPT Mariveles Solar Power Plant, GNPower Mariveles Coal Power Plant and the proposed GNPower Dinginin Coal Power Plant which are approximately more than nine (9) km east of the proposed project site.

Within the vicinity of the project site, there are beach resorts. The nearest is the Camaya Coast which is approximately 0.5 km from the project site. At present, there are no existing industries located within the MEZ. The proposed MCPP power plant site will cover an area of about 130.08 hectares at the southern portion of the MEZ. At the north, east and west of the project site are vacant lots with shrubs and orchards, and at the south is the Lusong Beach and the West Philippine Sea. At present, portions of the proposed project site was already clear of vegetation.

The vicinity map of the proposed project site is presented in **Figure 1-2**. **Figure 1-3** presents the technical description and the geographical boundary of the proposed MCPP Project.

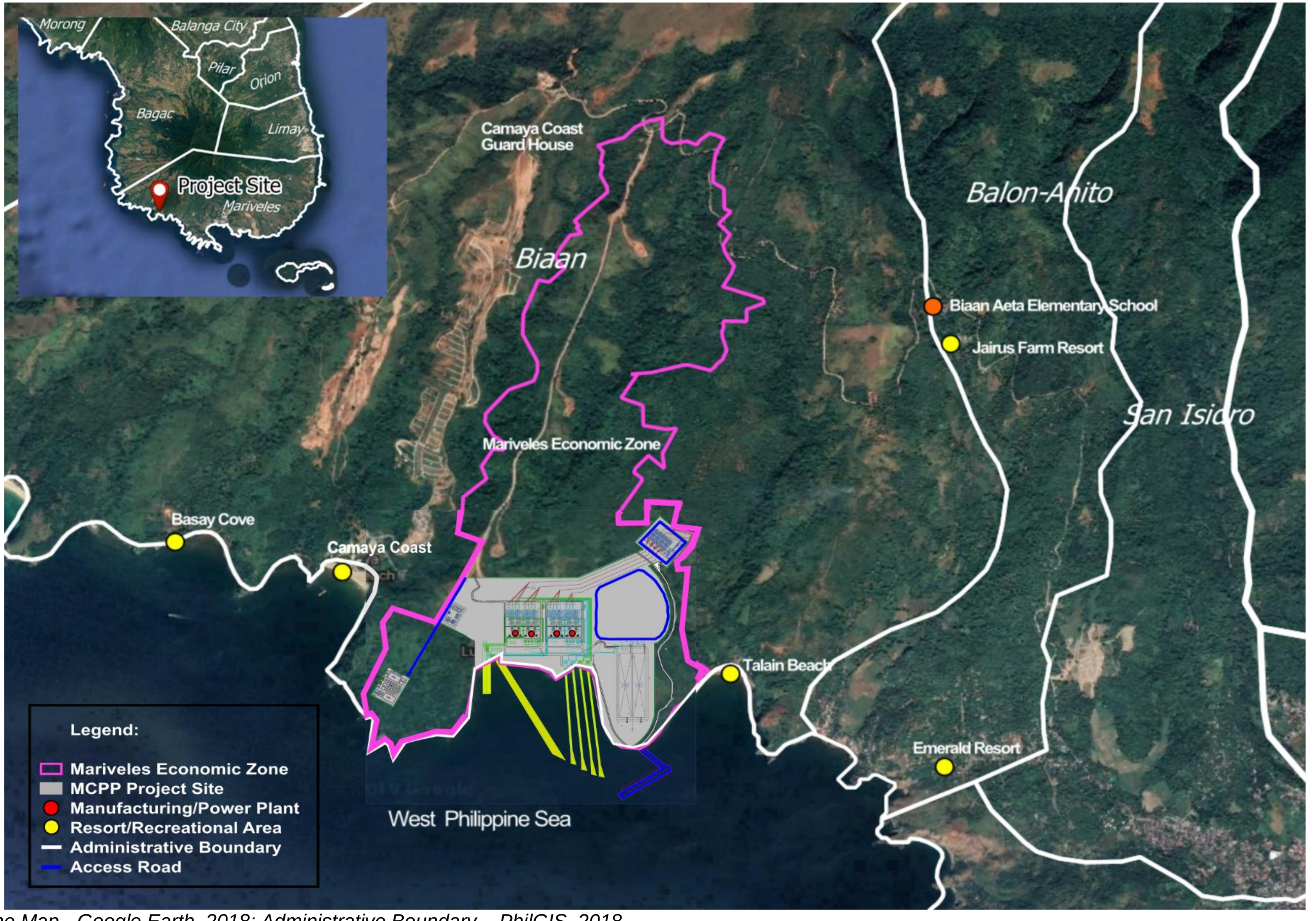
Accessibility of the Project Site

The proposed MCPP Project site is accessible from Manila by both land and sea routes. The land route will be via North Luzon Expressway (**NLEX**) through Pampanga-Bataan route or through the Subic-Clark-Tarlac Expressway (**SCTEX**) at a total distance of about 170 km. The route by sea is through ferry transport cruising Manila Bay from the Cultural Center of the Philippines in Manila to the Port of AFAB with an approximate travel time of 1hr and 15 minutes. Numerous public utility vehicles plying the Manila–Mariveles route and Balanga–Mariveles route enhance the accessibility of the Project site. Other means of transportation from Balanga to Mariveles are the jeepneys, and air conditioned PUVs. The proposed MCPP Project site is about 20-minute boat ride from Barangay Hall of Barangay Biaan, Mariveles, Bataan.



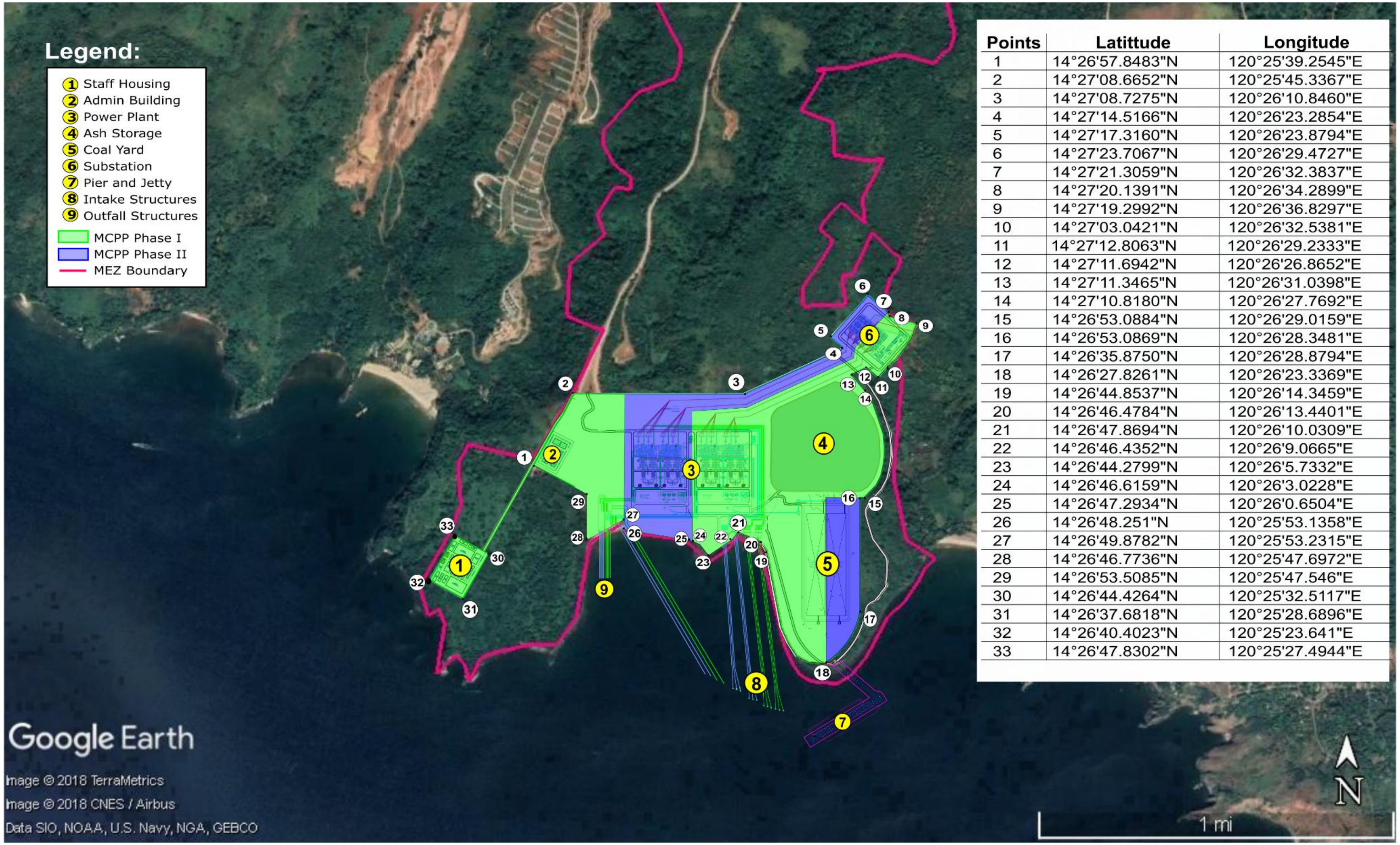
Source: Baseline Map - Google Earth, 2018; Administrative Boundary – PhilGIS, 2018

Figure 1-1 Location Map of of the Proposed MCPP Project



Source: Baseline Map - Google Earth, 2018; Administrative Boundary – PhilGIS, 2018

Figure 1-2 Vicinity Map of the Proposed Project



Points	Latittude	Longitude
1	14°26'57.8483"N	120°25'39.2545"E
2	14°27'08.6652"N	120°25'45.3367"E
3	14°27'08.7275"N	120°26'10.8460"E
4	14°27'14.5166"N	120°26'23.2854"E
5	14°27'17.3160"N	120°26'23.8794"E
6	14°27'23.7067"N	120°26'29.4727"E
7	14°27'21.3059"N	120°26'32.3837"E
8	14°27'20.1391"N	120°26'34.2899"E
9	14°27'19.2992"N	120°26'36.8297"E
10	14°27'03.0421"N	120°26'32.5381"E
11	14°27'12.8063"N	120°26'29.2333"E
12	14°27'11.6942"N	120°26'26.8652"E
13	14°27'11.3465"N	120°26'31.0398"E
14	14°27'10.8180"N	120°26'27.7692"E
15	14°26'53.0884"N	120°26'29.0159"E
16	14°26'53.0869"N	120°26'28.3481"E
17	14°26'35.8750"N	120°26'28.8794"E
18	14°26'27.8261"N	120°26'23.3369"E
19	14°26'44.8537"N	120°26'14.3459"E
20	14°26'46.4784"N	120°26'13.4401"E
21	14°26'47.8694"N	120°26'10.0309"E
22	14°26'46.4352"N	120°26'9.0665"E
23	14°26'44.2799"N	120°26'5.7332"E
24	14°26'46.6159"N	120°26'3.0228"E
25	14°26'47.2934"N	120°26'0.6504"E
26	14°26'48.251"N	120°25'53.1358"E
27	14°26'49.8782"N	120°25'53.2315"E
28	14°26'46.7736"N	120°25'47.6972"E
29	14°26'53.5085"N	120°25'47.546"E
30	14°26'44.4264"N	120°25'32.5117"E
31	14°26'37.6818"N	120°25'28.6896"E
32	14°26'40.4023"N	120°25'23.641"E
33	14°26'47.8302"N	120°25'27.4944"E

Source: MPGC 2018

Figure 1-3 Geographical Location of the Proposed Project

1.1.2 Impact Areas

1.1.2.1 Direct Impact Areas

The direct impact areas (**DIA**) includes the 130.09 ha. lot within MEZ in Brgy. Biaan where the proposed power plant facilities will be located.

In addition, the DIA also include the foreshore lease area and miscellaneous lease areas for seawater intake and treated cooling water outfall; the area designated as the temperature compliance monitoring point of thermal effluents, Lusong Bay which will receive the treated cooling water and effluent discharges. For the offshore facilities, a 500-meter radius from the berthing platform of the jetty is proposed to serve as exclusion zone. In terms of socio-economic benefits, the DIA areas include the host local government units (**LGUs**): Barangay Biaan, Mariveles Municipality, Province of Bataan and Region 3 which are project beneficiaries for employment, business opportunities, taxes and benefits from DOE ER 1-94 of the EPIRA Law as well as reliable power supply that contributes to the economic stability of the Region.

Foreshore Lease Area and Miscellaneous Lease Area

MPGC will be utilizing the Foreshore Lease Area (FLA) and Miscellaneous Lease Area (MLA) of Mariveles Economic Zone (MEZ) of EFIHI. The Authority of the Freeport Area of Bataan (AFAB) has awarded the FLA application of MEZ with total area of 14,495 square meters (1.4 ha) in Sept 2018. Contract signing between EFIHI and AFAB for the FLA is expected to be executed by the end of October 2018. For the MLA, EFIHI is currently securing the Certificate of No Objection from the Sangguniang Bayan (SB) prior to the submission of the MLA application to CENRO. The MLA will have a total area of 239,687 square meters (24 ha).

1.1.2.2 Indirect Impact Areas

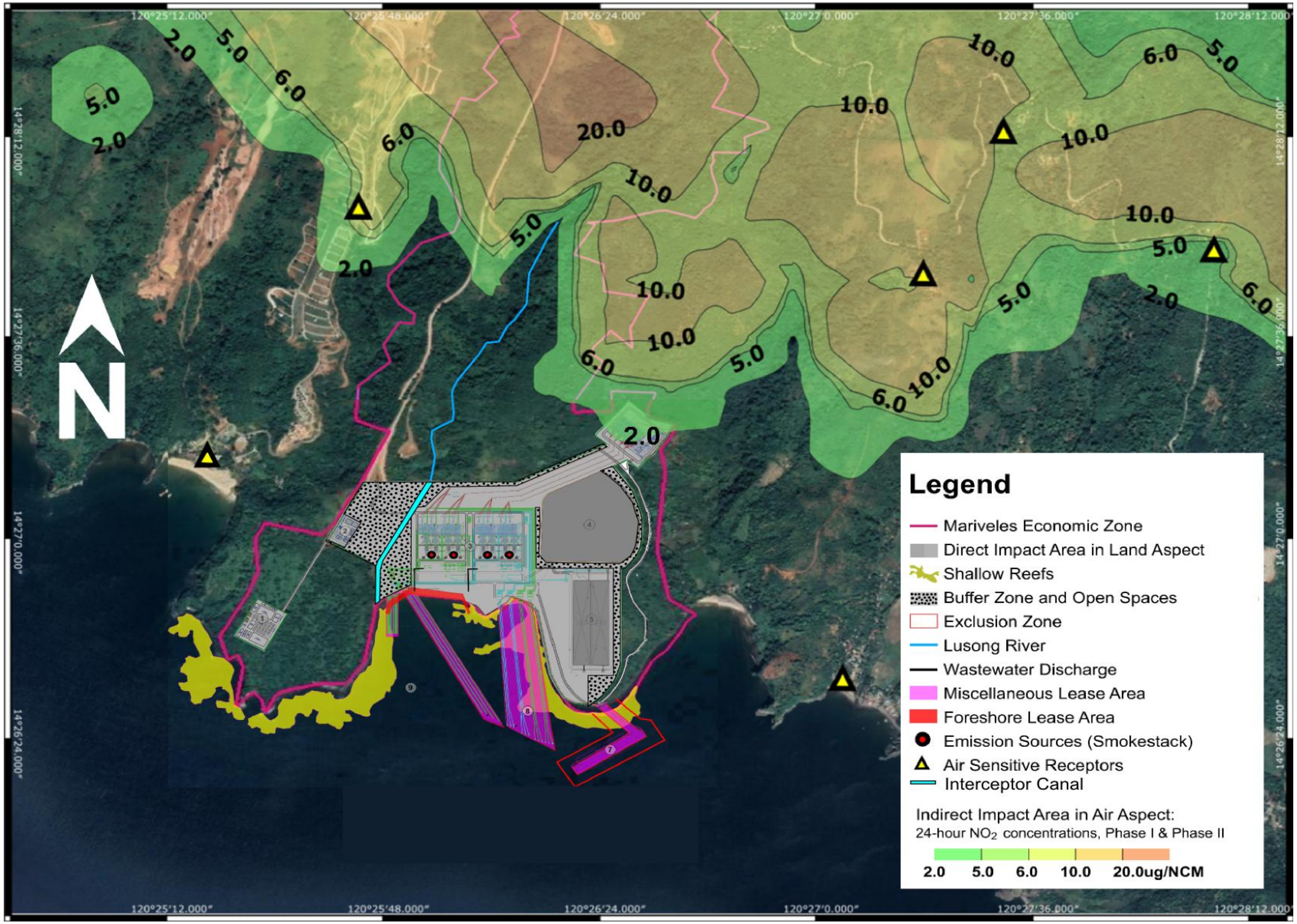
The indirect impact areas (**IIA**) include the Lusong River and other water sources for MEZ, and the receptors of the plant's air emissions that comply with the standards based on the air quality modeling. The IIA in terms of socio economic benefits, will cover the entire Country, which will benefit from the competitively priced, stable and reliable power supply which can contribute further to the economic stability of the country.

The DIA and IIA of the proposed MCPP Project are presented in**Table 1-1**. The direct and indirect impact areas are shown in **Figure 1-4**.

Table 1-1 Impact Areas of the Proposed MCPP Project

DIRECT IMPACT AREAS:
Land
• 130.08 ha. of land covered by the project footprint
Water
• Portion of the West Philippine Sea occupied by seawater intake and outfall structures, pier, jetty and jetty trestle • Foreshore lease and miscellaneous lease areas - 25.4 ha. • Area designated as the temperature compliance monitoring point of thermal effluents • Lusong Bay - receiving body of water of the treated cooling and effluent discharges • Exclusion zone – 500-meter radius from the berthing platform
Socio-Economic
• Host Barangay, Municipality, Province and Region - Barangay Biaan, Municipality of Mariveles, Province of Bataan, Region 3 Central Luzon
INDIRECT AREAS:
Air
• Receptors of plant's air emissions with concentrations less than the criteria set by the DENR - Barangay Biaan, Barangay Camaya and Barangay Malaya • Other locators in the MEZ

Water
• Lusong River and other water sources from where MEZ will source its water supply for distribution to its locators



Base map: Google Earth, modified by GTI, 2018

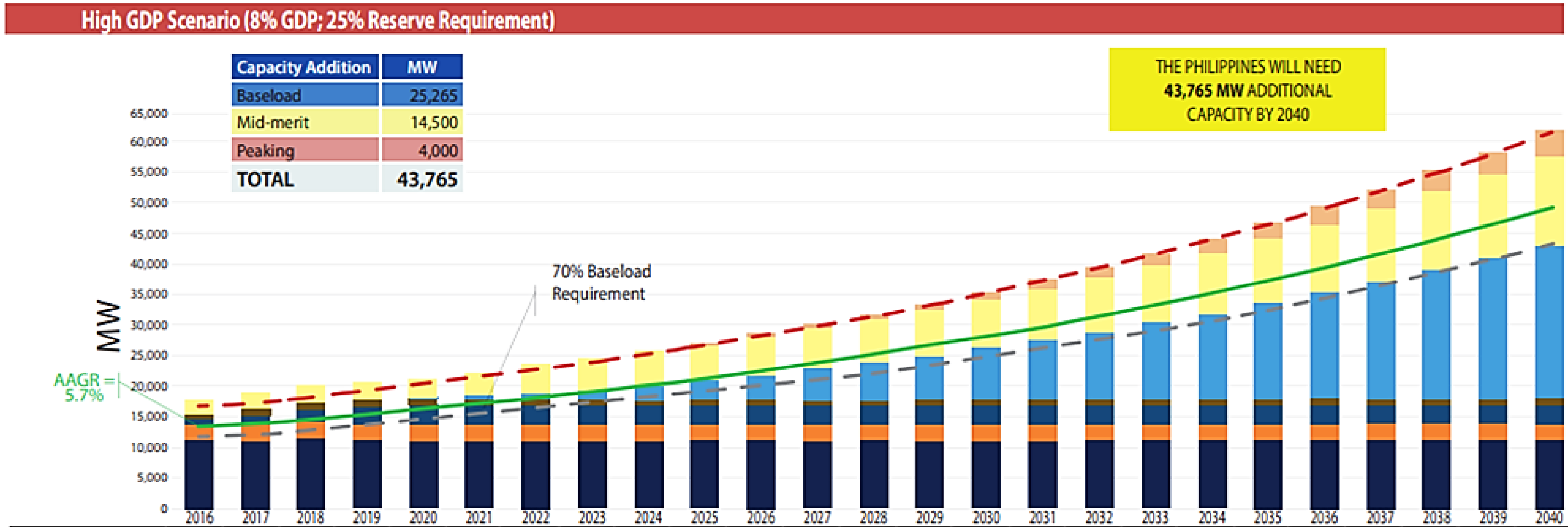
Figure 1-4 Impact Areas of the Proposed MCPP Project

1.2 PROJECT RATIONALE

1.2.1 Project Need at the National Level

Strong economic growth and a rise in energy demand have exerted pressure on the Philippines' energy sector in recent years. The Philippines' energy usage is increasing because of growth in our industries and the growing demand from households. Daily activities in large and small businesses, hospitals, schools, offices, government agencies and households are heavily dependent on electricity. However, the power supply from existing power plants is not enough to meet the continually increasing demand. The Philippines demand-supply outlook for 2016-2040 is presented in **Figure 1-5**.

Given the country's rapidly growing economy, demand for power will outpace supply in the Philippines in the next years. The proposed power project will help augment the demand for reliable and affordable baseload power supply. The proposed power plant will not only supply enough electricity to Filipino households and businesses but will also contribute to national development.



	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Capacity Addition - Peaking	0	0	0	0	0	0	150	250	300	450	450	550	650	950	1,150	1,250	1,550	1,900	2,100	2,400	2,650	2,950	3250	3600	4,000
Capacity Addition - Midmerit	2,500	2,600	2,700	2,700	2,900	3,600	4,400	5,000	5,400	5,700	6,200	6,600	7,000	7,300	7,800	8,300	8,800	9,300	10,000	10,500	11,200	12,000	12,700	13,500	14,500
Capacity Addition - Baseload	105	105	105	187	269	538	807	1,234	2,043	2,957	3,953	5,002	6,021	7,152	8,388	9,759	11,130	12,583	14,059	15,752	17,445	19,220	21,235	23,250	25,265
Committed Peaking	37	66	77	110	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111
Committed Midmerit	402	876	876	876	876	876	876	876	876	876	876	876	876	876	876	876	876	876	876	876	876	876	876	876	876
Committed Baseload	850	1,383	2,343	2,683	3,091	3,091	3,091	3,091	3,091	3,091	3,091	3,091	3,091	3,091	3,091	3,091	3,091	3,091	3,091	3,091	3,091	3,091	3,091	3,091	3,091
Existing Peaking	2,600	2,600	2,600	2,600	2,600	2,600	2,600	2,600	2,600	2,600	2,600	2,600	2,600	2,600	2,600	2,600	2,600	2,600	2,600	2,600	2,600	2,600	2,600	2,600	2,600
Existing Midmerit	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
Existing Baseload	11,277	11,277	11,277	11,277	11,277	11,277	11,277	11,277	11,277	11,277	11,277	11,277	11,277	11,277	11,277	11,277	11,277	11,277	11,277	11,277	11,277	11,277	11,277	11,277	11,277
Reserve Requirement	3,347	3,445	3,644	3,855	4,081	4,305	4,543	4,795	5,063	5,346	5,646	5,965	6,302	6,660	7,039	7,441	7,867	8,318	8,795	9,301	9,837	10,405	11,007	11,645	12,322
System Peak Demand	13,390	13,778	14,575	15,422	16,323	17,221	18,173	19,182	20,251	21,384	22,585	23,859	25,209	26,640	28,158	29,765	31,467	33,270	35,180	37,204	39,348	41,620	44,028	46,581	49,287
70% baseload Reqt	11,716	12,056	12,753	13,494	14,282	15,069	15,901	16,784	17,720	18,711	19,762	20,876	22,057	23,310	24,638	26,044	27,534	29,111	30,783	32,553	34,429	36,418	38,525	40,758	43,126

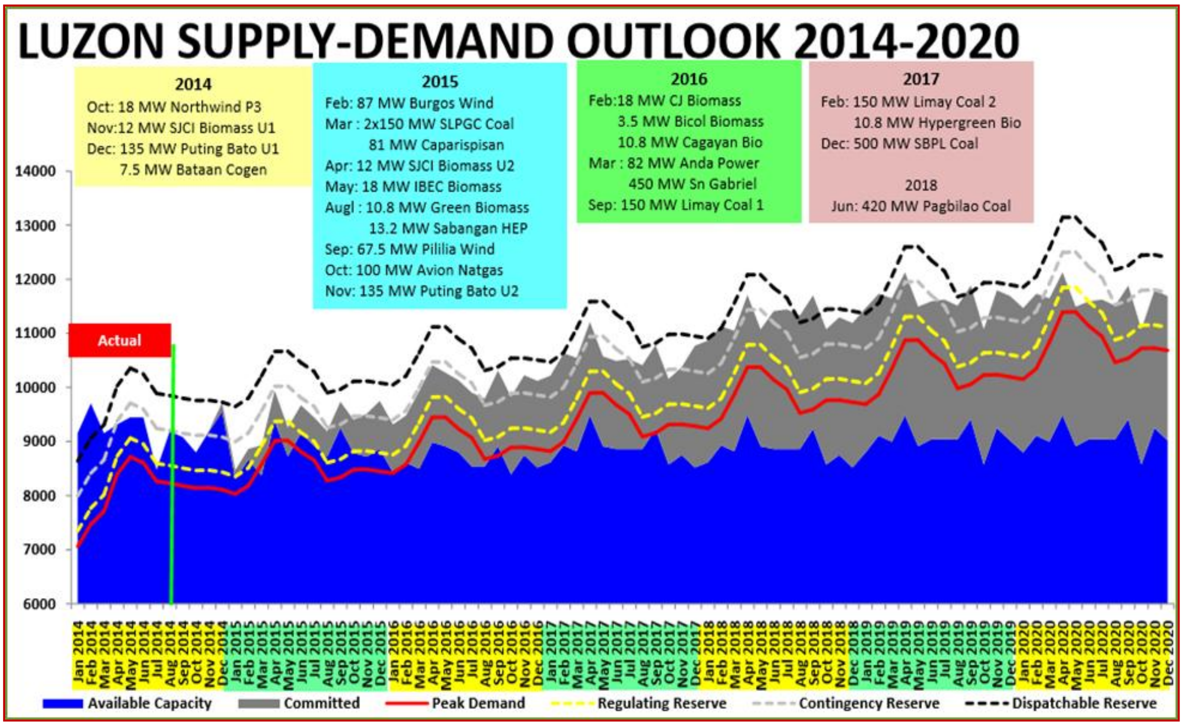
Source: DOE PDP, 2016-2040

Figure 1-5 Philippines Demand-Supply Outlook, 2016-2040

1.2.2 Project Need at the Regional and Local Level

Shortage of the Luzon Grid in Electric Power Capacity

The Department of Energy (**DOE**) Power and Supply-Demand Outlook for 2014-2020 as presented in **Figure 1-6**, shows an increasing power demand in Luzon Grid at an average annual growth rate (**AAGR**) of 4-5%. With this projection, an additional capacity is needed on top of the already committed power projects. In order to address the gap, the MPGC has proposed to install its MCPP Project at Barangay Biaan, Mariveles, Bataan. Upon expected commercial operations in 2022, the proposed power plant's net capacity of 600MW and its annual associated energy of 4,608,000 MWh shall be made available and provided to the Luzon Grid.



Source: DOE PDP, 2014-2020

Figure 1-6 DOE Supply-Demand Outlook in Luzon, 2014-2020

The MPGC has also secured an Endorsement from the DOE for the installation of its proposed MCPP Project as presented in **Annex 1-4**.

Power Supply for the Mariveles Economic Zone

The 500 hectares MEZ in Barangay Biaan, Mariveles, Bataan which is being developed by EFIHI, also a subsidiary of SMC, will require about 50~75 MW of power for its locators. The power requirement for the EFIHI and its locators will also be provided by MPGC though the MCPP.

1.3 PROJECT ALTERNATIVES

1.3.1 Site Selection

There is no other alternative site considered for the proposed MCPP Project of MPGC, except for the 130.09-hectare lot within the MEZ that has already been developed by EFIHI, since MCPP will provide the power requirements of the locators within MEZ. Moreover, in terms of land use, the area is already classified as industrial under the AFAB and within the already developed economic zone (**Annex 1-1**).

1.3.2 Technology Selection

Two (2) types of technology which use coal as primary fuel were initially considered for the project, the Pulverized Combustion (**PC**) and the Circulating Fluidized Bed (**CFB**). Considering the project area and capacity of the proposed MCPP Project, CFB has been recommended. CFB is also considered as a better alternative to conventional pulverized coal boiler due to its better efficiency in regulating gas emissions, particularly SO_x and NO_x even without the need for expensive pollution control system. The comparative analysis on PC and CFB technologies is presented in **Table 1-2**, which aided MPGC in choosing CFB technology for its proposed MCPP Project.

Table 1-2 Technology Selection

Item	CFB Technology	PC Technology
1. Fuel Flexibility	Developed for the combustion of a wide range of combustion fuels including low grade coal, minimization of industry waste and environmental pollution. The relatively low furnace temperatures are below the ash softening temperature for nearly all fuels. As a result, the furnace design is independent of ash characteristics which allow a given furnace to handle a wide range of fuels.	Developed for maximization of coal combustion efficiency.
2. Combustion Condition • Temperature	• 750-950ºC	• 1,200-1,500ºC
• Efficiency	• Above 98% with re-circulation system	• Above 98% with combustion of pulverized coal
3. Operation Condition • Operating time	• Approximately 4 hours during cold start-up • Quick response time	• Faster than CFB during cold start-up. • Response speed is slower than CFB
• Load sensibility and response speed	• 7-10%/min • Load control ratio of 3:1	• 7-10%/min • Load control ratio of 3:1
• Auxiliary Fuel	• Very low consumption	• Very high consumption (Auxiliary fuel needed for combustion with low volatile coal for stabilization of flame)
4. Maintenance • Coal Crushing	• No Pulverizer	• Crusher and pulverizer are needed • Abrasion problem, spontaneous fire and explosion of pulverizer is expected • Costly high maintenance and lengthy shutdown
• Ash	• No slagging and fouling due to low combustion temperature (750-950ºC)	• Slagging and fouling due to high combustion temperature (1,200-1,500ºC)
• Abrasion	• Possible due to bed material at projection point	• None, because there is no bed material

Item	CFB Technology	PC Technology
5. Pollution • SO_x	• Does not require special FGD (desulfurized above 90%) • Limestone is an effective sulfur sorbent in the temperature range of (815-925°C). Limestone injection removes sulfur impurities from the coal by reacting to form calcium sulfate, which is an inert material used in the manufacture of cement	• Requires special FGD for combustion of high sulfur coal because it does not suppress SO_x on its own.
• NO_x	• Coal combustion at low temperatures effectively reduces the nitrogen oxides or NO_x emissions.	• Requires special low NO_x Burner
6. Economy	• Simple and economical • Low construction costs • Does not require FGD	• Simple and economical • Low construction costs • Requires FGD

1.3.3 Alternatives to Coal

Other sources of power like renewables and liquid fuels are too expensive while others like hydro and geothermal are site-dependent with limited available resources. Although renewable energy sources are attractive for their being environmentally-friendly, they are not without disadvantages.

Solar power plants, for example, have high initial cost for relatively lower power capacity output. Also, solar panels contain cadmium and lead which pose environmental issues in disposal, and manufacturing them also involves use of toxic and hazardous chemicals. They are also dependent on availability of sunlight, and require larger land areas to generate energy comparable to conventional energy sources.

Wind farms, on the other hand, depend on wind patterns which have high variability, so siting wind farms in windy areas and locations is one limiting factor for its use. The high variability of winds also means high cost of investment for relatively fluctuating power output. Other impacts of wind farms include deaths of local bird and bat species due to collision with wind turbines and generation of noise during operation.

The selection of coal as fuel is still preferred due to the following reasons:

Availability. Coal reserves are significantly more abundant and much more widely and evenly dispersed worldwide than other fossil fuels. Oil and gas reserves are concentrated in the Middle East and the former Soviet Union. Various forecasts for oil and gas indicate a depletion of supplies as early as the middle of this century.

Cost. Coal is an affordable source of energy for the Philippines. WCI (2006) cited that there is a competitive international market for coal while the market for oil is dominated by a cartel, and for natural gas, the markets are of a unique situation, which might be described as regional oligopolies forming functional cartels in which prices are effectively determined by the oil market. Therefore, coal prices are relatively stable compared to other oil fuels.

Safe Transportable Fuel. The International Maritime Organization (**IMO**) has removed coal from the list of dangerous products. Accordingly, imports of coal by sea do not pose the same environmental and safety threats as those created by imports of oil and gas.

With a comparative analysis of the various possible energy sources, it shows that coal is still the best option in terms of environmental safety, availability, and cost. MPGC will use imported coal from Indonesia and locally available Daguma and Semirara coal. The Daguma coal is supplied by Daguma Agro Minerals, Inc. which is a subsidiary of San Miguel Corporation. In order to maintain the quality of the coal to be used as fuel in MCPP, MPGC will require its coal supplier to include mercury content in the analysis of coal.

1.3.4 Alternative Uses of Fly Ash and Bottom Ash

MPGC will utilize the reusable components of the ash to reduce the amount of ash disposed at the Ash Disposal Facility. The fly ash waste from the power plant can be used in a variety of structural and low strength fill applications. It can be used as mineral filler for paints, shingles, carpet backing and other products. It can also be used in manufacturing bricks, blocks, mortars and stuccos. Other possible uses of fly ash are in the neutralization and processing of human sludge waste into fertilizer and in the stabilization of sewage and toxic sludge.

The largest application of fly ash, however, is in the production of concrete. Concrete is the most common building material and is primarily a mixture of gravel, sand, cement and water. Compounds in the cement react with water to form glue that binds the sand and rock into a hardened mass. When fly ash is added to the concrete mix, some of the cement can be eliminated. Mechanically, fly ash particles are small and spherical – allowing them to fill voids and provide a "ball-bearing" effect that allows less water to be used. Chemically, fly ash reacts with excess lime that is created when cement is mixed with water, creating more of the durable binder that holds concrete together. The result is concrete that is more durable and stronger over time, than concrete made with cement alone.

Other benefits of using fly ash in concrete include: 1) decreased permeability, 2) reduced damage from heat of hydration, and 3) increased resistance to sulfate and other chemical attack. Thus, using fly ash in concrete and other building products eliminates the need to dispose them in landfills. These are mainly the reasons why MPGC will sell all the fly ash generated to affiliate Northern Cement and Eagle Cement plants similar to what they are currently doing in their existing SMC Consolidated Power Plant in Limay, Bataan. Should there be excess fly ash generated, they will just sell to other interested cement plants.

The bottom ash normally has limited reuse potential and is usually used as grading material and filling material. It is thus mainly bottom ash that will be stored at the ash disposal facility since the fly ash component will be sold to cement plants. However, in our SMC Consolidated Limay Bataan Power plant some of the bottom ash generated are being used by Petron Refinery in Bataan as sand bedding replacement for their boiler requirements. While in San Miguel Consolidated Power plant in Malita, Davao Occidental, the bottom ash is currently being used for making lightweight construction material such as concrete hollow blocks (CHB) for their perimeter fencing.

1.3.5 No Project Alternatives

Due to growing demand and increasing new consumers, DOE forecasted that there will still be a shortfall of power supply by 2018. Therefore, the No Project Alternative is not an option and MPGC felt the need to develop the proposed MCPP Project. Without the proposed MCPP Project, it could result to a worst-case scenario comprising of rotating brownouts and total blackouts, loss of new investments and expansion of industries, work stoppages, increased pollution resulting from the use of small generators with no appropriate pollution controls, reduced economic growth, increased poverty and social inconvenience by 2018. Without the project, opportunity for additional 2,500-3,000 jobs for three (3) years of construction, about 200-250 permanent jobs during operation and indirect jobs and business opportunities that would be created by the proposed MCPP Project would be lost. The substantial increase in local taxes and revenues including the direct and indirect local benefits that are expected to receive would also be foregone.

1.4 PROJECT COMPONENTS

Table 1-3 presents the major components, support facilities, pollution control devices and temporary facilities for the proposed MCPP Project of MPGC. Detailed discussion of the components follows.

Table 1-3 Proposed MCPP Project Components and Specification

Component	Unit		Description/Specification
	Phase 1	Phase 2	
Main Components			
Boiler	4	4	150 MW Drum Type, CFBC Boiler
Steam Turbine Generator	4	4	One or Two Casing, Multi-stage, Impulse or Reaction, Reheat Condensing Type Turbine, Heat Rate at Maximum Continuous Rate of 1,989 kcal/kW-hr (Gross); Total Enclosure Air Cooled Generator Capacity: 150MW (gross) Power Factor: 0.85 lagging Voltage: 13.8 kV Frequency: 60 Hz
Support Facilities			
Pier, Jetty and Jetty Trestle (Common or shared facility)	1		Concrete structure: • Jetty: about 10-12-m wide, 260-m long • Pier : about 24-m wide and 380-m long
Coal Yard (covered roofing)	1	1	180,000 tons (equivalent to 20-days storage capacity)
Coal Handling System			
• Coal Unloading System: Pier to TT-1 (common/shared)	2		1,400 tons per hour
• Coal Conveyor System (TT-1 to Coal Yard)	2	2	1,400 tons per hour
• Coal Supply Conveyor System (reclaimer to crusher)	2	2	700 tons per hour
• Coal Crusher	1 + 1	1 + 1	700 tons per hour
• Coal Supply Conveyor System (from Crusher to Boiler Silo)	2	2	700 tons per hour
Ignition Light Diesel Oil System	1 (shared)		500 m^3 capacity storage tank, to store Grade 2 Oil for start-up
Feedwater System			
• Deaerator & Storage Tank	4	4	Spray and Tray type, 460 tph
• Feed Water Pump, BFP	1 + 1 x 4	1 + 1 x 4	Multi-stage ring section, Centrifugal type
• HP Feed Water Heater	1 + 1 x 4	1 + 1 x 4	Horizontal Type, Tube/Shell
• LP Feed Water Heater	2 + 1 x 4	2 + 1 x 4	Horizontal Type, Tube/Shell
Condensing System	4	4	Surface Condensing, Divided Water Box Type, Transversely mounted to TBN, One (1) Pass Condensate Pump, LP Feed Water Heater.
Water Treatment System			
• Demineralization System	1	1	Capacity: 1,500 tons per day Storage Tanks : 2 x 2,000 m^3
• Raw Water Treatment System (Industrial Water)	1	1	Capacity: 1,500 tons per day Storage Tanks: 2 x 2,000 m^3
Circulating Cooling Seawater System	4	4	Once through type cooling for condenser. With: Circulating Water Pump, Travelling Screen, Screen Wash Pump, Ball Cleaning devices system per condenser unit.
Closed Cycle Cooling Water System	1 + 1 x 4	1 + 1 x 4	Paten or tube-shell type Capacity: 500 tons per hour Integrated with circulating cooling system
Seawater Intake and Outfall Structures			

Component	Unit		Description/Specification
• Seawater Intake Structure	3 x 2	3 x 2	Submerged HDPE pipe, approximately 764m & 816m long for Phase 1 & Phase 2 respectively, from the shoreline to West Philippine Sea
• Seawater Outfall Structure	2 x 2	2 x 2	Submerged HPDE pipe, approximately 749m & 704m long for Phase 1 & Phase 2 respectively, from the shoreline to West Philippine Sea.
Compressed Air and Dryer System	1	1	Centrifugal Type Compressor with Air Dryer Unit and Air receiver Capacity: 7 kg/cm^2 (g) pressure Instrument Air: 2 +1 for 4 boilers Plant Air: 2 +1 for 4 boilers.
Combustion Air and Flue Gas System	4	4	Centrifugal primary and secondary fans with inlet silencers, Induced draft fans for handling combustion gases
Chemical Feed System	4	4	Storage capacity: 200 L tank each for neutral amine and sodium phosphate; 100 L for carbon hydrazine
Instrumentation and Control System	1	1	Digital control system, turbine control monitoring system and PLC Relays
Power Transmission System	1	1	500 kV switchyard
• Step-down transformer	4	4	500/13.8 kVA, 180 MVA
• Circuit breaker	4	4	13.8 kVA 10,000 A
Pollution Control System			
Electrostatic Precipitator	4	4	Dry Bottom, Horizontal Gas Flow Type Inlet Flue Gas Load: 731 tons per hour Inlet Dust Load: 26 g/Nm^3 Capacity Margin: 120% of MCR
Exhaust Stack	2	2	Concrete Wind Shield with Steel Liners One Stack per Two boilers Height: 100-m from Ground Level. Inside Diameter: 3.9m
Continuous Emissions Monitoring System	4	4	Every unit equipped with individual CEMS.
Wastewater Treatment System	2	2	Chemical wastewater treatment Capacity: 100 tons per hour per set
Ash Handling System	4	4	96-h continuous operation storage capacity Silos each unit
Ash Storage Facility (common/shared)	1		Ash Storage with an estimated initial volume capacity of 500,000 m^3 and expandable

1.4.1 Main Components

1.4.1.1 Boiler and Auxiliary Systems

The primary function of the boiler and auxiliary system is to supply sub-critical steam with constant pressure to the turbine generator for the generation of electric power. The system also supply steam to the auxiliary steam system for plant usage. The boiler and auxiliary system consist of furnace, solid separator, convection pass, coal crusher, coal silo, bed material bin and feeder for the coal combustion system, limestone supply system, soot blower, boiler start-up system, structural steel, piping and instrumentation and control system.

The boiler is of sub-critical steam pressure design, drum type, balance draft and CFB combustion. The boiler and auxiliary systems will be designed according to Boiler Maximum Continuous Rating (**BMCR**) condition and it will be capable of having full automation operation at more than 60% nominal rating without auxiliary fuel (**Table 1-4**).

Table 1-4 Boiler Specifications

Parameters	Specifications
Maximum Continuous Rating **(MCR)**	150MW (gross)
Steam Parameter Temperature Pressure	 541 ± 5.0°C 129kg/cm^{2}g
Firing System Start-Up Operation	 Light Diesel Oil Burners Coal Burners
Draft System	Balance draft
Main Fuel	Coal

Note: Subject to change during detailed design stage

1.4.1.2 Steam Turbine Generator and Auxiliary Systems

The function of the steam turbine is to transform the thermal energy of the steam generated from the boiler into kinetic energy, which in turn is transformed to generate electric power. Some of the thermal energy is extracted from several points during the turbine cycle and is used for heating feedwater, and the remainder is discharged to the circulating water system through the condenser.

The steam turbine generator for the proposed MCPP Project will be a tandem compound, single flow turbine, reheat, regenerating and condensing type. The turbine will be designed to meet the characteristics of boiler load variation, the ramping rate and instantaneous step load change rate between the maximum guaranteed load and the minimum load, capable of continuous operation at all ranges between the maximum guaranteed load and the minimum load and capable of operation on partial arc admission and on full arc admission. The turbines and control valves are designed to be capable of operation on constant pressure with the control valves operating sequentially. All piping and equipment have sufficient drain facilities in accordance with ANSI/ASME TDP-1 or equivalent codes for the prevention of water induction into the turbine during all modes of operation and will be designed to maintain constant flow rate of inlet and outlet steam during all modes of operation.

The turbine and auxiliary systems are designed to accommodate variations in steam pressure and to cope with the transient phenomenon of steam pressure and temperature occurring at instant load loss. The relevant specifications of the steam turbine and the generator are presented in **Table 1-5.**

Table 1-5 Steam Turbine and Generator Specifications

Parameters	Specifications
Steam Turbine	
Type	Multi-Stage, Impulse or Reaction Reheat Condensing Type
Rated Output	460 tons per hour
Steam Condition Temperature Pressure	 538 ± 5°C 125 kg/cm^2 (g)
Net Heat Rate, LHV	1,989 kcal/kw-hr
Generator	
Rating	150MW (gross)
Power Factor	0.85 lagging
Rated Voltage	13.8 kV
Rated Speed	3,600 rpm

Parameters	Specifications
Frequency	60Hz
Cooling System	Air cooled

Note: Subject to change during detailed design stage

1.4.2 Support Facilities

1.4.2.1 Pier, Jetty and Jetty Trestle

The jetty and pier are raised structures in a body of water supported by well-spaced (open design) piles or pillars to minimize its impact to coral communities and water circulation.

Table 1-6 Pier and Jetty Specifications

Item	Specifications	
	Phase 1	Phase 2
Barge Vessel	Barge Vessel / Panamax Vessel	
Design	Open design	
Dimensions	Pier: 24m wide, 380m long; Jetty: 10-12m wide, 260m long	
Pier Draft (Maximum)	15.0 meters	

The jetty will receive coal deliverd through Panamax vessels. Coal will be unloaded from the vessel into conveyors to the coal yard. **Figure 1-7** shows the typical open jetty design which will be utilized by MCPP.

Source: MPGC, 2018

Figure 1-7 Typical Open Design Jetty and Pier Structures

1.4.2.2 Coal Yard

A fully covered coal yard will receive the coal conveyed from the jetty (**Figure 1-8**). The coal yard will have a storage capacity of 180,000 tons per project phase, or equivalent to twenty (20) days of operation. The yard will be designed to prevent spontaneous combustion by spraying or other suppression systems.

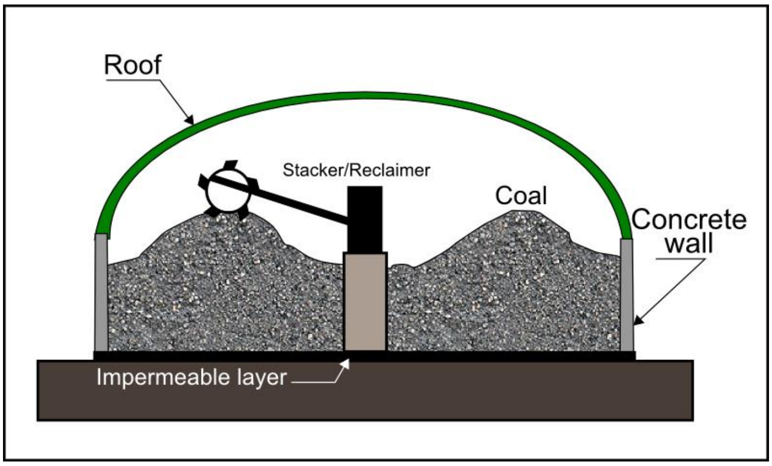


Figure 1-8 Typical Coal Yard Design

1.4.2.3 Coal Handling System

The primary function of the coal handling system is to provide coal to the coal silo of the boiler (both units) for the firing of the crushed coal of required sized. Coal will be delivered to the site and then unloaded, weighed, sampled and transported to storage piles or directly to the coal silo. The coal handling system includes the following sub-systems:

- Coal unloading and staking system
- Coal reclaiming system
- Plant distribution and silo feeding system
- Dust collection and dedusting system
- Fire protection system

The chute and hopper shall be inclined properly and line with stainless steel or other rust-resistant high strength material. The transfer tower, crusher building, and coal silo shall be enclosed. The coal conveyor shall be enclosed by a hood cover with underground hoppers. The dust collection system will utilize bag filter and the dust suppression system will utilize water spray.

The anti-explosion area designated by NEC Article 500 is equipped with electrical facilities consisting of explosion-proof designs.

The coal unloading system specifications are summarized in **Table 1-7**.

Table 1-7 Coal Unloading and Storage System Specifications

Item	Specifications	
	Phase 1	Phase 2
Ship Unloader	Grab type or Continuous Ship Unloader type	
Nominal Coal Unloading Capacity	1,500 ~ 2,000 tons per hour	
Ship size	20,000 DWT ~ 70,000 DWT	
Conveyor Capacity • Unloading conveyor (Pier to TT-1)	2 units x 1,400 tons/hour	
• Supply conveyors	2 units x 700 tons/hour	2 units x 700 tons/hour
Coal Stacking	1,400 TPH	1,400 TPH
Coal Reclaiming	2 units 700 tons/hour	2 units 700 tons/hour
Coal Crusher	2 units x 700 tons/hour	2 units x 700 tons/hour

1.4.2.4 Ignition Light Diesel Oil System

The function of the ignition light diesel oil system is to unload from the tank lorry, store, transfer and supply ignition oil to the boiler, emergency diesel generator, etc. This system consists of an ignition light oil storage tank, ignition light oil pump, related piping and fittings, and instrumentation. The ignition light oil system will supply light diesel oil to the warm-up burners of the main boiler, auxiliary boiler and emergency diesel generator. The combustion rate used to design the ignition light diesel oil system will be capable of supplying fuel at less than 35% heat input of the BMCR load. Ignition light oil is of ASTM D975 Grade No. 2 light diesel oil and its analysis is shown in **Table 1-8**.

Table 1-8 Analysis of ASTM D975 Light Oil

Properties	Unit	Specification
Specific Gravity, API at 15.5°C	32	40
Density at 15.5ºC	0.82~0.880	0.82 ~ 0.86
Kinetic Viscosity at 37.8°C , cSt	1.60	2.68
Sulfur, % wt	0.3%	0.5%
Calorific Value (HHV)	19,600 Btu/lb (10,889 kcal/kg)	
Calorific Value (LHV)	18,400 Btu/lb (10,221 kcal/kg)	

1.4.2.5 Water Supply System

Plant Raw water system will treat the raw water from the MEZ water supply system. The industrial water produced will be delivered to industrial tanks. The industrial water will be provided to supply plant service water and demineralized water for the CFB boiler cycle.

1.4.2.6 Water Treatment System

The Water Treatment System removes ion type constituents, organic substances and COD constituents using Reverse Osmosis (**RO**) equipment and a mixed bed ion exchanger to produce demineralized water. Demineralized water will be stored in the demineralized water storage tank and supplied to the condenser by the demineralized water transfer pumps.

The Water Treatment System is made up of a micro filter, high pressure pump, RO module and cleaning equipment and MBE. The water will be stored in the RO reservoir and transferred to mixed bed ion exchanger. The water treatment system consists of two series of RO equipment and a mixed bed ion exchanger. Chemical feed equipment will be fabricated from a chemical resistant material, considering the operation situation of the injection point. Chemical storage tanks will be designed to have a capacity of 30 days storage. The chemical feed and transfer system will have two (2) 100% or three (3) 50% or four (4) 33.3% capacity pumps. The demineralized water storage tank will be sized so that it will have a capacity of two and half days storage for daily usage of demineralized water. All equipment, piping and accessories will be designed based on a pressure of 10 kg/sq.cm.g a temperature of 66°C, excluding the steam water heater.

Regeneration of make-up demineralizer system is designed as a co-current regeneration type. Compressed air for all regeneration systems will be provided by the compressed air system. Piping and fittings connected to the demineralizer system will be made of stainless steel or equivalent for environmental limitation and corrosion resistance. The design water quality range at downstream of demineralized water system is presented in **Table 1-9**.

Table 1-9 Design Water Quality Range at Downstream of Demineralized Water System

Item	Water Quality
Conductivity (μS/cm) at 25°C	< 0.2
Total SiO_2 (mg/L as SiO2)	< 0.015
Na (ppm as Na+), mg/L	< 0.01
Fe^{2+} , mg/L	<0.01
Cu^{2+} , mg/L	<0.005
pH at 25°	6.5 ~ 7.0

The system shall be three (3) trains arrangement, each train consists of mixed bed exchanger with automatic valve control and complete with in-line acid and caustic regeneration of resins in the exchangers. The system is designed to function fully automatic operation including start/stop of the regeneration process.

Reverse Osmosis System

The reverse osmosis system shall be three (3) trains arrangement, each train consists of carbon filter, RO unit, RO HP pump with inverter control. RO water tank on each train are equipped with automatic valve control, thus the entire RO system operation are fully automatic.

One (1) raw water storage per two (2) units will be installed so that it will have a capacity of one (1) day storage equivalent to 2,100m^3 for daily usage of water. The capacity of pretreatment system is over 2,500m^3/day considering recovery rate of RO. The equipment and piping related with water transfer and pretreatment are designed to maximum pressure and temperature. The backwash water of U/F is used to U/F filtered water pond and wastewater after backwash is treated by wastewater treatment facility. The backwash pump shall fabricate the ability for lifting media (particle size: 0.5-1.0mm) sufficiently. The pressure vessel shall be designed for minimum of 5mm thick rubber lined carbon steel or polypropylene or suitable for water service. The SWRO will reduce the water total dissolved solid (**TDS**) content of greater than 40,000 ppm to freshwater containing less than 300 ppm of TDS.
RO is created when sufficient pressure is applied to the concentrated solution to overcome the osmotic pressure. This pressure is provided by the high pressure feed pumps. Concentrated waste (brine) is removed from the high pressure side of the RO membranes and pure water (permeate) is removed from the low pressure side. The residual Chlorine present in the feedwater, to prevent biological fouling of upstream equipment, must be removed prior to introduction to the RO membranes. An excess Sodium Bisulfite is injected in the suction side of the RO high pressure pump for removal of residual chlorine that can cause hydrolysis and deterioration of RO membranes. Acid and Anti-scalent are also added in order to control the salt precipitation and scale formation and prevent fouling of membranes. The high pressure reject brine is passed to the energy recovery turbine (**ERT**) to reduce the energy consumption of the high pressure pump. Pump material shall be duplex stainless steel or equivalent material compatible with seawater being handled. The pump TDH will be calculated based on 5 year-old membranes at the coldest water temperature and with a 10% additional allowance for dirt.

Demineralized Water Storage and Transfer System

The function of the demineralized water storage and transfer system is to receive, store and supply demineralized water to the condenser and to other miscellaneous users within the plant. Demineralized water system is designed at 500 m^3/day x 3 trains per phase with common piping for four (4) boiler unit and two (2) demineralized storage tank of 2,000 m3 capacity equivalent to 2.5 days. The condenser hotwell will be provided with an emergency condensate make-up line and a reject line. The condensate storage tank will be filled with make-up water from the demineralized system by the demi train feed pumps. The condensate transfer pump supplies condensate from the condensate tank to the deaerator, condenser hotwell, closed cooling water head tank make-up and boiler economizer inlet.

1.4.2.7 Closed Cycle Cooling Water System

The closed cycle cooling water system removes the heat generated from the components of the various plant equipment and dissipates the heat to the circulating water system. The closed cooling water pump circulates closed cooling water through the closed system, composed of various plant equipment, and the closed cooling water heat exchangers provide the means for dissipating heat to the circulating water system. The closed cooling water system will provide cooling water to the following plant equipment.

- Turbine lube oil coolers
- Generator air coolers
- Feedwater pump shaft seal water coolers and lube oil coolers
- Main control building chiller condensers

- Service and instrument air compressor intercoolers and aftercoolers
- Water analysis sample cooler
- Boiler facility
- Emergency diesel generator cooling water tank make-up
- Boiler pump seal water coolers, etc.

The closed cooling water system will be designed to remove the maximum heat load rejected from various equipment. The closed cooling water system will be designed such that the failure of any component in the system will not affect the normal operation of the system. Inhibited condensate water will be used for the closed cooling water system make-up to inhibit corrosion of pipes and equipment in the system. The system will be supplied with a high density hydrazine solution to protect against iron oxide in the system. 1+1 (standby) closed cooling water pumps are provided for each boiler unit to continuously circulate cooling water through various coolers. Closed cooling water pumps with 1+1 capacity continuously circulate closed system cooling water heat exchangers reject heat from the closed cooling water to the circulating water. The closed cooling water head tank will be installed on the deaerator floor, which is higher than other equipment in the system and has the capacity to accommodate thermal expansion and surge volume. The make-up water for the closed cooling water head tank will be supplied from the demi-water system through the level control valve. Inhibited condensate water will be used for the closed cooling water system make-up to inhibit corrosion of pipes and equipment in the system. A high density hydrazine feed pump will supply carbon hydrazine to the system to protect against iron oxide in the system.

Table 1-10 Closed Cooling Water System Specifications

Type	Specifications
Cooling Medium	Demineralized Water
Pump Configuration	Quantity: 1+1 per boiler unit Capacity: 1,000 tons/hr (preliminary) Head: 50 m

1.4.2.8 Feedwater System

The feedwater system delivers the water from the storage tank to the boiler economizer inlet through high pressure feedwater heater by the motor driven boiler feedwater pump. A secondary function of the feedwater system is to deliver desuperheating water to the desuperheater of boiler.

The system design is based on the heat balance for the maximum continuous load with turbine valve wide open (**VWO**). Carbon hydrazine and ammonia are injected into the common suction line of the make-up feedwater pump and deaerator respectively. Pumps of the feedwater system will have durability on excessive stress and fatigue caused by frequent load changes over 25 years or more. Minimum flow recirculation line to the feedwater storage tank will be provided at the feedwater pump discharge line to avoid overheating and unstable condition of pumps. Bypass line and isolation valves will be provided for high pressure feedwater. Sampling water for feedwater analysis will be extracted from the feedwater line and the economizer inlet.

1.4.2.9 Condensate System

The condensate system condenses the exhausted steam from the turbine within the condenser, collects condensate in the hotwell, and delivers it to the deaerator feedwater storage tank though the gland steam condenser, the low pressure feedwater heaters and the deaerator. The system design will be based on the heat balance for the maximum continuous load. The minimum flow recirculation line for the condensate pumps and the gland steam condenser will be provided at the downstream of the gland steam condenser.

The condenser will be designed to prevent tube or baffle failures caused by steam impingement from the turbine exhaust. The tubes will be expanded and seal welded at the cooling water side of the tube sheets to prevent leakage from tubes to tube sheet joints. Individual bypass lines will be provided for the five (5) feedwater heaters as well as the gland steam condenser. Bypass lines including bypass valves will be sized for the same pressure drop as the total pressure drop in the heater.

1.4.2.10 Chemical Feed System

The chemical feed system injects neutral amine and carbon hydrazine to maintain an adequate pH level and to create a protective coating against iron oxide in the boiler, feedwater system and condensate system. It also injects sodium phosphate to protect plant component materials from corrosion and to maintain the required feedwater quality. The tank feed pump will consist of single-acting, positive-displacement diaphragm type and have stroke and revolution-control devices for phosphate pumps. The tanks and their accessories will be made of stainless steel with a thickness of more than 3.2mm. The feed water quality will be maintained to the condition presented in **Table 1-11**.

Table 1-11 Feedwater Condition

Item	Unit	Design Value
pH at 25°C	-	8.5 ~ 9.3
Hardness(CaCO3)	mg/ℓ(ppm)	0
Dissolved O2	ppm	0.007
Total Iron (Fe)	ppm	Max. 0.02
Total Copper (Cu)	ppm	Max. 0.005
Hydrazine (N2H4)	ppm	Min. 0.01
Silica (SiO2)	ppm	Max. 0.02
Conductivity at 25°C	micromhos/cm	Max. 0.5

1.4.2.11 Seawater Intake and Outfall Structures

MPGC will take seawater through the intake structure located at southern part of the plant and will have an elevation of 10 m and 5 m for Phase 1 and Phase 2 respectively, from the shoreline. The seawater intake structure will include the trash rack, static screen, electric hoist, stop gate, trash sluice and others.

The discharge outfall structures will be designed where the circulating water outfall will be a submerged culvert (concrete) having about 2m in diameter with a discharge rate of 10.28 m^3/sec to achieve the maximum mixing with the ambient water as rapidly as possible. The discharge pipe will be 749 m for Phase 1 and 709 m for Phase 2 from the shoreline extending into West Philippine Sea.

1.4.2.12 Circulating Cooling Water System

The circulating cooling water system supplies the cooling water (seawater) to the condenser, condensates the turbine exhaust steam. The system also supplies the cooling water to the closed cooling water heat exchangers in order to eliminate the heat load from various plant equipment.

The seawater cooling system is composited with sub-sea intake system pipeline and pumping station with pump system. The sub-sea intake head system which has screen and is located at designed seabed depth (about 15-m depth) to allow low intake seawater temperature and avoid floating debris. Each intake pump system has three (3) pump units with 50% maximum flow rate capacity with two (2) trash screens in front to protect from floating debris.

The design flow rate of the circulating water pumps shall be based on the cooling water demand of the condenser and related closed cooling water heat exchanger at maximum continuous load. A common line shall be installed between the circulating water pump discharge so that the circulating water can be supplied to two (2) water boxes during a single circulating water pump trip. The pump control system shall be designed to protect itself against the water hammering pressure resulting from unit start, stop and trip. The circulating water system will be designed such that any repair work of the condenser tubes in case of tube leakage will not affect the normal operation of the system. Debris filter and condenser tube cleaning system will be installed to increase heat transfer efficiency of the condenser by removing microorganisms, sediments, and corrosion formations formed in the condenser tubes. The circulating water intake structure shall be designed so that the circulating water pumps located in individual suction bays are able to supply cooling water to the condenser. Trash racks and stop gates per unit will be installed to minimize the entrainment of debris. A waterbox priming system shall be provided to remove noncondensible gases in the waterbox, and consists of two (2) complete sets of air ejectors for each power unit for priming the condenser inlet and outlet water boxes.

Chlorination

Chlorination system will be provided to treat the circulating water to control biological build up. The system will add a sodium hypochlorite solution in circulating sea water.

1.4.2.13 Compressed Air and Dryer System

The function of the compressed air and dryer system is to produce and supply air of suitable quantity and pressure for the plant operation. It is divided into the service air system and the instrument air system. The service air system supplies compressed air for boiler light oil burner atomizing air, general station use, etc. The instrument air system supplies compressed air after being filtered and dried to various instrumentation and control equipment. The compressed air system consists of air compressors, compressed air receivers for service and instrument air, air driers, pre-filters, after-filters, load and non-load operation controllers, etc.

There are three (3) 50% duty common service and three (3) 50% instrument air compressors per project phase and the total capacity of two (2) compressors are designed to supply the combined maximum potential plant equipment demand for service and instrument air. Both service and instrument air receiver tanks are tied together to a common header. The service and instrument air are separately conditioned by filters and air dyer units before it enters the service header. The third compressor will be operated as stand-by.

The compressed air system will be designed for a maximum ambient temperature of 39°C and a discharge pressure of 7.0 kg/cm^2 g. Air supply will come from the area surrounding the compressor intakes located in the building. The compressed air will leave the after-coolers saturated at 43°C and at 7.0 kg/cm^2g. The compressed air will be dried to the dew-point corresponding to 2°C at 7.0 kg/cm^2g. The exit air dew point will be less than 2°C at 7.0 kg/cm^2g.

1.4.2.14 Combustion Air and Flue Gas System

The combustion air and flue gas system supplies properly preheated combustion primary and secondary air to the burners and discharges the flue gas through the stack. The fans will be designed for continuous stable operation in single over full operation range.

The sound levels generated by draft equipment during normal operation will not exceed 85 dB(A) at a horizontal distance of one (1) meter from all surfaces of the equipment and at a height of 1.5 meters above or below the platform or 1.5 meters above the floor on which the equipment is mounted.

1.4.2.15 Instrumentation and Control System

The Instrumentation and Control system are designed, manufactured and installed to ensure safe, reliable and efficient operation of the plant. It will be designed to enable automatic and manual operation through the main control room. Centralized operation and monitoring of the plant will be possible by a minimum number of operators.

The control system will consist of a microprocessor based distributed digital control system (**DCS**), other DCS and programmable logic controller (**PLC**) (or hardwired relay). The application of control system will configure the following system:

- DCS: Boiler & balance of plant (**BOP**) system controls and interface of package system
- Turbine Control Monitoring System (**TCMS**): Turbine-generator controls
- PLC (or hardwired relay): Mechanical package system controls

Digital Control System (DCS)

The DCS will be a microprocessor based control system and the control system will be hierarchically and effectively structured. It will perform modulating control, sequence control, and monitoring and data acquisition of boiler, turbine and BOP under all operating conditions (normal or abnormal). The major process variables will be displayed on the large screen display unit be mounted on the vertical board (**VTB**).

For the plant-wide supervision and control in the Main Control Room (**MCR**), turbine control system and each PLC based mechanical packaged control system will be interfaced with the DCS via dual redundant data communication links and/or hardwired as necessary.

Operator Interface System (**OIS**) of the DCS will consist of monitors, keyboard/mouse, printer, etc. The following controls at the DCS will be hierarchically and functionally structured for operating convenience:

- Hierarchical architecture: Unit, Group, Drive level
- Functional architecture: Boiler, Turbine, BOP and trip including Master Fuel Trip (MFT) as well as protective interlock control
- Turbine governor control will be a Digital Electro-Hydraulic Control (DEHC) system.

The DEHC will be capable of continuous control of turbine operation from zero speed to synchronization speed and from zero load to maximum load.

Main Control Room and Electronic Room

The main control room and electronic room will be located within the control building. The main control room will contain the operator interface system and peripheral devices of DCS, TCMS, Electrical Control and Monitoring System Fire Alarm Panel, CCTV Monitor, Monitoring Equipment and others. The arrangement will allow the operator to control operations safely and reliably under any operating condition (normal or abnormal conditions). The electronic room will contain control cabinets for the boiler, turbine, and BOP systems, vibration monitoring cabinets for major equipment, protection relay cabinets, input/output cabinets, and monitoring equipment cabinets.

Operator Console and Vertical Board

The operator console and vertical board will be designed in accordance with the recommended human factors engineering concept. This will allow the operator to start-up/shutdown and react to unfavorable conditions with ease and safety.

Local Control Panel for Packaged Control System

Certain plant control equipment requires automatic local regulations that are not integral to the DCS. These controller systems will be provided with PLC-based control system respectively, and mounted in a local control room or near the package system. The local control panel will have an annunciator system, and alarms associated with the local controller will be transmitted to the plant annunciator system.

1.4.2.16 Power Transmission System

Transmission assets will be installed to accommodate the power produced by the proposed MCPP Project. A 500 kV Switchyard will be constructed within the MCPP project area and will be connected to the proposed 500 kV Switchyard of National Grid Corporation of the Philippines (**NGCP**) in Barangay Alasasin, Mariveles, Bataan. NGCP will then take charge of the transmission of electricity to different areas and end-users. The total permanent connection point to point from

MCPP Project Switchyard to NGCP's Switchyard will have an approximate distance of thirteen (13) km.

The 500kV Switchyard substation will be a component of the proposed MCPP. However, the 13 km transmission line that will permanently connect the MCPP Substation to NGCP Substation will not be a component of this Project. A separate ECC will be acquired for the 13 km transmission line.

Prior to the connection of the MPGC Power Plant to the grid, various tests shall be conducted by the NGCP which upon the completion, NGCP will issue the certification on the approval to connect to the grid. Once connected to the Grid, another set of tests will be conducted such as the Minimum Stable Load, Ram Rate, Maximum Stable Load, among others to determine the actual reaction of the power plant to the grid. The minimum stable load achieved for SMC's existing power plant is 60 MW. This minimum stable load also be used for the MCPP.

1.4.3 Pollution Control Devices

1.4.3.1 Air Pollution Control Devices

1.4.3.1.1 Electrostatic Precipitator

The function of the electrostatic precipitator (**ESP**) is to remove suspended particulate matter from the flue gas of the coal firing boiler so that the effluent particulate loading does not exceed specified limits. The ESP collects fly ash using electrical forces to protect atmospheric pollution. The ESP will consist of one chamber (one casing per unit) suitable for 100% duty gas flow at BMCR. It will be a cold side flue gas ESP, and will be located between the air preheater outlet and the ID fan inlet.

Each boiler will have a dedicated ESP unit, which will consist of a collection section, hoppers and steel structures such as stairways, platforms, etc. The ESP will be designed to perform as specified without fail during normal operation of the fired boiler. All hoppers will be provided with individually controlled heaters to maintain the entire inside face of the hopper at a temperature above 120°C during all operating conditions.

1.4.3.1.2 Exhaust Stack

Each project phase will have two (2) concrete windshield having two (2) individual steel flue liners for two (2) boiler units. Each concrete exhaust stack will be provided with access platforms and grilages, ladders, elevator, breechings, drain system, aviation obstruction warning lighting, interior lighting system and lighting protection system. Each exhaust stack has a height of 100m from finished ground level.

1.4.3.1.3 Continuous Emissions Monitoring Systems (CEMS)

Continuous Emissions Monitoring System (**CEMS**) will be installed on each boiler units with real time display monitoring system. The CEMS consists of a stand-alone electronic analyzer designed to measure CO_2, CO, NO_x, SO_2, O_2 and VOC. CEMS will be mounted on flue duct between ID fan and the stack or on the stack for emission monitoring. An alarm devise is integrated in the system in case standards are exceeded. This data will be integrated in the plant DCS by input-output (I/O) interface. The CEMS shall compose of O_2, NO_x, CO analyzer, opacity meter, analyzer cabinet and sampling line.

The CEMS system will be equipped with communication port which will provide output data for connection to EMB Server. This will enable the CEMS data from MCPP to be continuously retrieved and monitored by EMB.

The diagram of the connection between CEMS System of MCPP and EMB Server is presented in **Figure 1-9**.

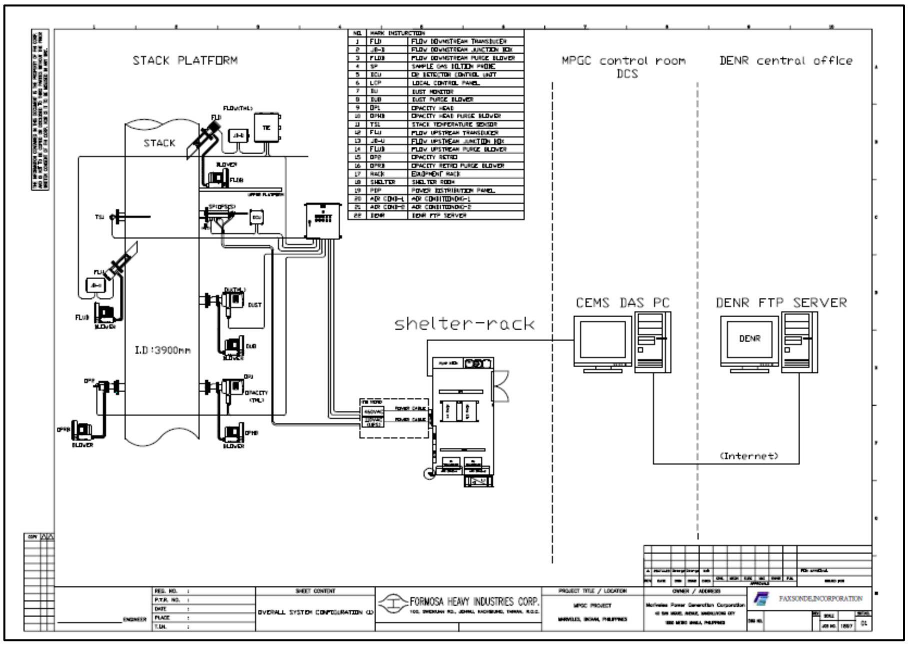


Figure 1-9. CEMS System Configuration for MCPP

1.4.3.2 Water Pollution Control System

1.4.3.2.1 Wastewater Treatment System

The Wastewater Treatment System (**WWTS**) of the proposed MCPP Project will be composed of two separate systems for treating industrial wastewater and for treating sanitary or domestic wastewater prior to discharge into the sea.

Industrial Wastewater

An Industrial Wastewater Treatment Plant will be constructed inside the Mariveles Coal Power Plant to treat approximately 2,400 tons/day (100 m^3/hr) wastewater generated by the plant.

The Wastewater Treatment System, will consists of the following sub-systems:

- Low TDS wastewater treatment sub-system – This collects low TDS wastewater from the whole water treatment system and the boiler blowdown water from the boiler system by the ditch or pipeline;
- High TDS wastewater treatment sub-system – This collects high TDS waste water from the Mixed-bed polisher in the regeneration;
- Sludge treatment sub-system – This consists of Sludge buffer tank, sludge pumps, sludge thickener with scraper and a filter press.

The Sanitary and Domestic Wastewater from the offices, toilets and lavatory have separate treatment facility from that of industrial wastewater. The treatment shall include primary digester tank, secondary digester tank, aeration and oxidation tank, settling tank and disinfection chamber. A pre-fabricated Fiber-Reinforced Plastic (**FRP**) Package Sanitary Waste Water Treatment facility with a capacity to process 12 m^3/h of sanitary and domestic wastewater will be installed. After treatment, water will be discharged in the storm drainage system.

Sanitary wastewater treatment and industrial wastewater treatment flow processes of MCPP are presented in **Figure 1-10** and **Figure 1-11**, respectively.

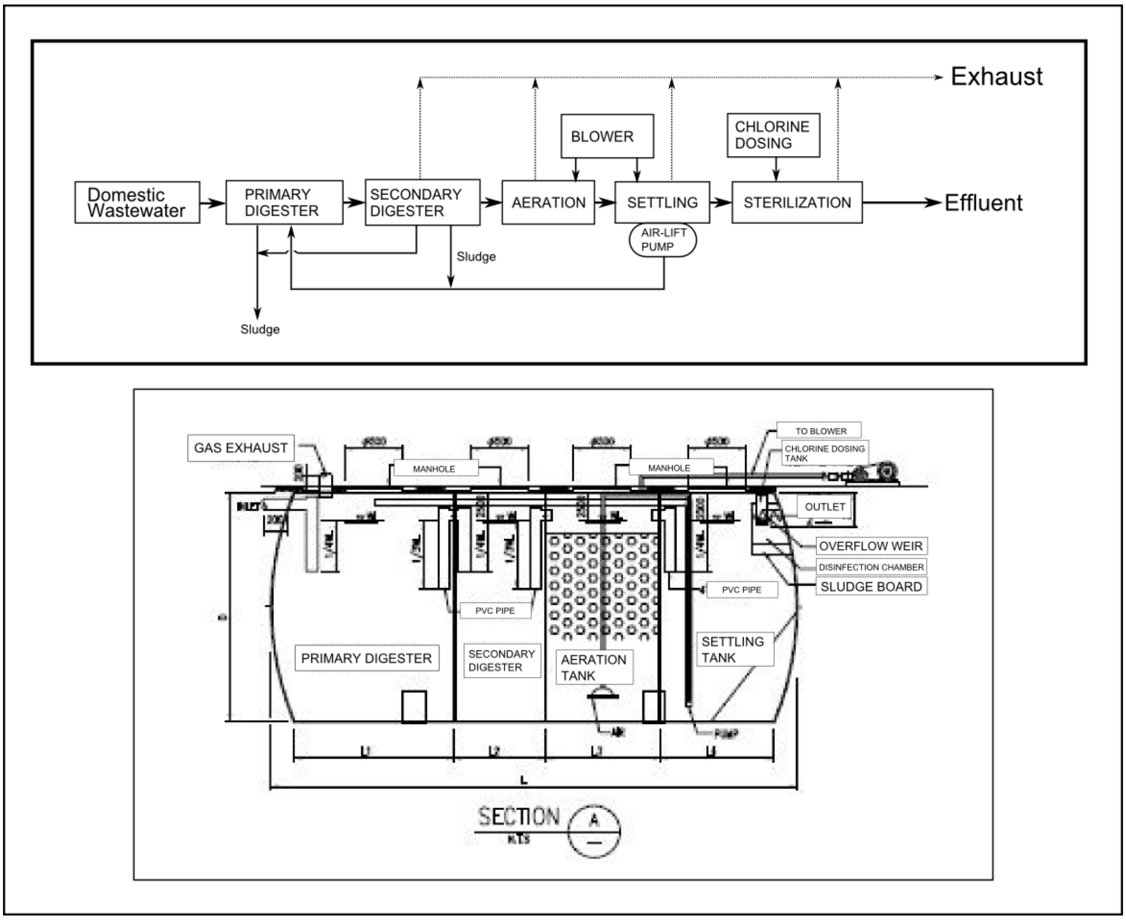


Figure 1-10 Sanitary and Domestic Wastewater Treatment Process and Equipment Diagram (Package Sanitary Wastewater Treatment)

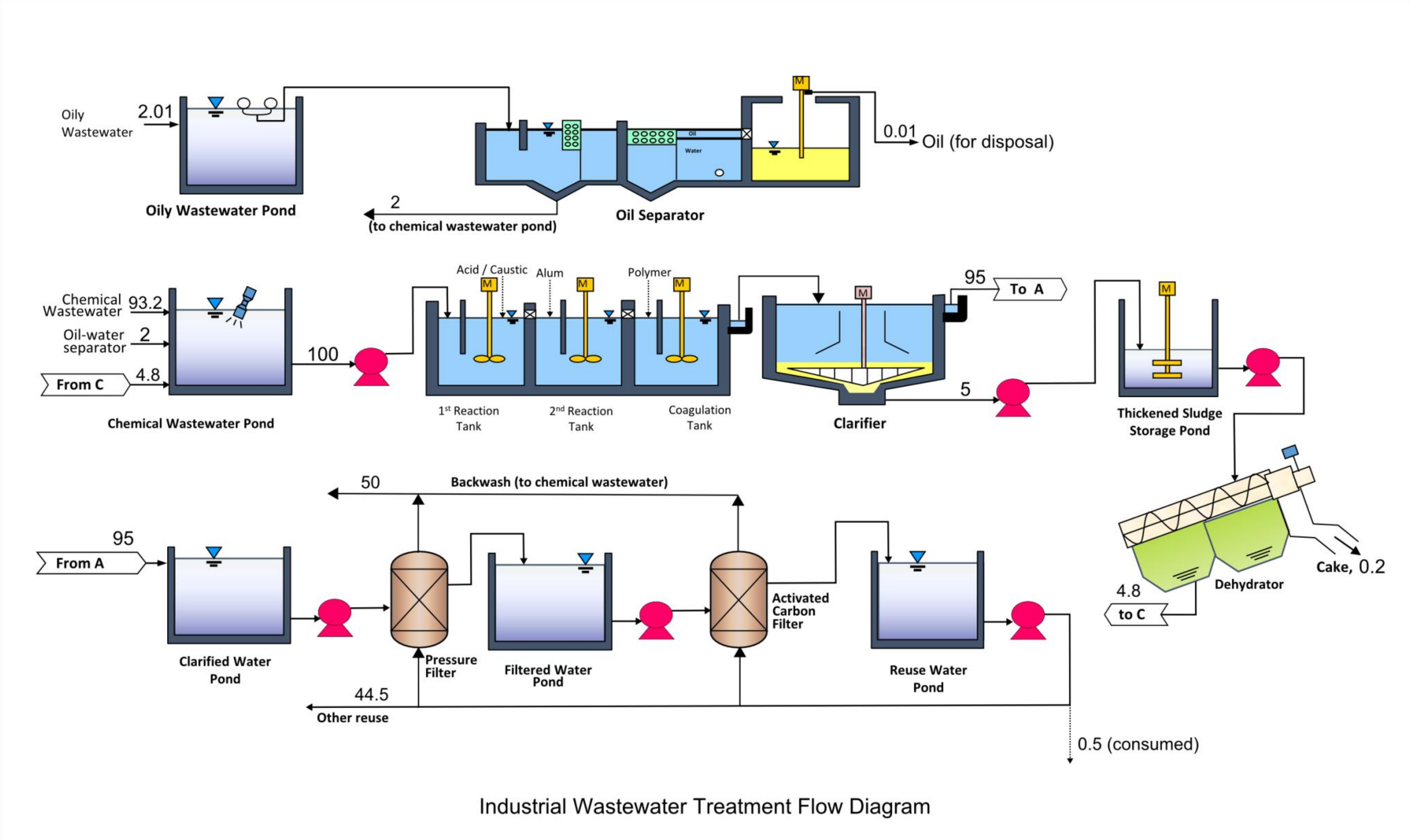


Figure 1-11 Industrial Wastewater Treatment Flow Diagram

Sewage Treatment Plant

The sewage will be sent to a sewage treatment unit (biological treatment) where suspended organic matter in the effluent is greatly reduced, most of which is transformed into stable sediment. Influent shall undergo biological treatment and then sent to the sedimentation pond to allow separation of water from the sludge. The sludge will be transferred to a holding tank. The sewage treatment plant (**STP**) shall be designed to meet the required effluent quality before discharged to the sea.

Oily Wastewater Treatment System (OWTS)

The oily wastewater accumulated from the plant area sump such as the turbine building, transformer area, and oil storage area will be collected into a storage pond. An oil removal system will be employed for the removal of oil from the wastewater effluent. The treated wastewater will be transferred into the chemical wastewater pond and will be treated using the same process as that for chemical wastewater. The sludge from the oil separator will be discharged periodically and sent to a DENR accredited sludge treatment and disposal facility.

Chemical Wastewater Treatment System

Chemical Wastewater Pond. The chemical wastewater will be collected in the chemical wastewater pond and will be aerated to achieve uniform characteristics. The aerated and uniform wastewater will be transferred to the pH adjustment and reaction tank.

pH Adjustment Tank and Reaction Tank. Caustic or acid will be injected to the pH adjustment tank and mixed with wastewater by agitator to maintain the optimum pH condition for neutralization. Then the wastewater flows into the reaction tank by gravity. The coagulant such as Alum or PAC will be injected into the reaction tank and mixed by agitator to form fine floc by the reaction with suspended solids and colloids in the wastewater.

Coagulation Tank. Since the fine floc transferred from the reaction tank has low sedimentation property, the coagulant aid such as polymer will be injected into the coagulation tank and stirred slowly to enlarge the fine floc so as to increase its sedimentation property. However, a Jar Test must still be performed in advance to determine the optimum condition because coagulation depends on the wastewater quality, pH, coagulant injection rate, water temperature and operation methods.

Clarifier. The floc in the wastewater will settle at the bottom of the clarifier during the retention time and the overflow wastewater will flow into the clarified water pond. The settled sludge will be pumped to the dehydration system.

Clarified Water Pond. Clarified water will be stored in the clarified water pond and will be pumped to the final pH adjust pond through pressure filter and activated carbon filter to remove remaining suspended solids, dissolved organics and heavy metals.

Pressure Filter. The suspended solids in the clarified water will be removed by the filter media such as anthracite, gravel and sand in the pressure filter. The operation method of the pressure filter consists of filtration and backwash as the fluid flows from top to bottom during filtration.

Filtration

The clarified water transferred by the clarified water pump flows into the top of the pressure filter and the filtered water is then discharged from the bottom of the pressure filter after removal of suspended solids by the filter media.

Backwash

Filtration performed over a long period of time results in the accumulation of SS on the surface of the filter media, and it makes bad flow pattern, loss of filtering capability and increase in pressure drop.

Backwash will be carried out to prevent the above-mentioned problem from occurring when the flow rate reaches a certain amount or when the differential pressure between inlet and outlet is above 0.5kg/cm^{2}g.

It is also possible to backwash everyday when daily operation is completed for better management of the wastewater treatment system.

The backwashed wastewater will be returned to the chemical wastewater pond through the floor drainage system. The pressure filter backwashing will be conducted with the reused water.

Activated Carbon Filter. The main function of the activated carbon filter filled with the activated carbon is 2nd filtration to remove dissolved organics and heavy metals. Therefore, the activated carbon filter will be in operation in case of high dissolved organic concentration and heavy metal. The same procedures as the pressure filter applies to filtration and backwash of the activated carbon filter.

pH Adjustment Pond and Reuse Water Pond. The treated wastewater by the process of neutralization, coagulation, sedimentation, filtration and adsorption will be collected in the reuse water pond after passing through the pH adjustment pond. Acid or caustic will be injected finally to control the pH value of the treated wastewater within the range of [6.0~9.0] in the pH adjustment pond.

The treated wastewater at the reuse water pond will be reused as washing water for the dehydrator, cleaning water for the wastewater treatment building, backwashing water for the pressure filter & activated carbon filter, flushing water for the pumps or piping of the wastewater treatment system. The balance of the treated water will be discharged to the storm drainage via the final disposal channel.

Dehydration of Sludge. The settled sludge originated from the clarifier is transferred to settled sludge pond. The settled sludge will be transferred to the dehydrator system. The dehydrator system consists of thickener, dehydrator, chemical (coagulation aids) injection system and cake container.

The sludge in the settling sludge pond is transferred by sludge pump to thickener. The sludge in thickener is generated as floc by chemicals and the size of floc became larger. The sludge in the thickener will be injected into the dehydrator after forming packed floc by adding polymer and mixing it to improve the dewatering efficiency.

The moisture content of the dewatered cake should be 80% or less. The dewatered cake from the dehydrator will be stored in the cake hopper and collected in the container to be treated by commissioning. The drained water from the dehydrator will be returned to the chemical wastewater pond through the floor drain.

Chemical Injection System. The chemical injection system consists of chemical tanks, power dissolution equipment, injection tank, agitators, and injection pumps. Injection tanks and agitators are used for the purpose of dilution of the chemicals.

Wastewater Reuse System. The reuse pump will be installed for the internal usage of WWTS and power plant.

Leachate Treatment Facility

The leachate treatment facility will be designed to treat the leachate generated in the proposed ash storage facility. The leachate will be initially collected in the leachate holding pond prior to treatment. The leachate holding pond will have a nominal storage capacity of 3.5 ML, design maximum flood level of 4.3 ML and dam crest flood level of 5.9 L. An emergency spillway will be constructed on the middle of abutment of the leachate holding pond. A silt trap will be constructed at the toe of the inlet structure to capture any ash or silts from the drainage network.

Sedimentation Pond

The coal storage area is fully covered with roofing, thus no run-off during rainy season. In the event that there will be wastewater from coal storage, sedimentation pond will be installed to treat wastewater and meet the effluent regulation. The treated water will be reuse at the coal storage stock pile or ash disposal area as spray water, with excess for discharge.

1.4.3.3 Solid Waste Management System

1.4.3.3.1 Ash Handling System

The Ash Handling System collects, removes and transport ash employing dry handling system. Ash collected from the furnace bottom is transported in a dry state to the bottom ash silo. Likewise, the fly ash system pneumatically removes the ash collected in the air preheater and the Electrostatic Precipitator hopper and transports it in the dry state to the fly ash silo. The ash handling system will be designed for continuous satisfactory operation at Boiler Maximum Continuous Rating (**BMCR**).

Table 1-12 Design Ash Density

Item	For Volumetric Calculation (kg/m^3)	For Structural Calculation (kg/m^3)
Bottom ash	720	1,120
Fly ash	800	1,445
Bulk Ash	1500	-

Table 1-13 Ash Production Quantity per Unit and Ash Handling Time (8 Hours for 1 Shift)

Item	Production Quantity	Handling Time
Bottom ash	Up to 30% of total ash formed	4 hours / shift
Fly ash	Up to 70% of total ash formed	4 hours / shift
Total ash	Maximum of 6 tons per hour based on current coal specification used in existing CFB boilers (Limay and Malita Power Plants)	

Each phase has four (4) sets of bottom ash and fly ash silos, one (1) set of bottom ash and fly ash silo per boiler that has a storage capacity of 96 hours of continuous operation. The ash handling system will be composed of suitable abrasion-resistant materials, piping and fittings of high hardness. In particular, elbows will be made of carbon steel or cast iron having an abrasion-resistant liner.

Bottom ash and fly ash from the storage silos are discharged on the bottom silo via a telescoping chute system.

The stored ash will be removed from the ash silo by the following methods:

a) Fly ash will be transferred directly from storage silos through telescoping chutes to sealed pozzolanic tankers and will be transported to cement factories for recycling as cement raw material. The chute system ensures that minimal or no fugitive dust is generated during transfer from silo to the tankers. The pozzolanic tankers are designed to handle the transport of dry ash and other bulk materials in a sealed manner to avoid dust dispersion. Cement plants will be required to provide their pozzolanic tankers in good service conditions every time it transports ash from MCPP to their respective plants.

- Bottom ash and residual fly ash will be disposed in the ash disposal facility of MCPP. Bottom ash will be discharged from the furnace through the furnace bottom and enters into water-cooled ash screw cooler (ASC). The ASC reduces the furnace bottom ash temperature to approximately 200°C. The residual fly ash will be loaded to sealed vehicles through a wet dustless unloader. The disposed ash will be wetted by a fully mobile mechanical dust suppression system and compacted to stabilize the ash and prevent it from dispersing as dust.

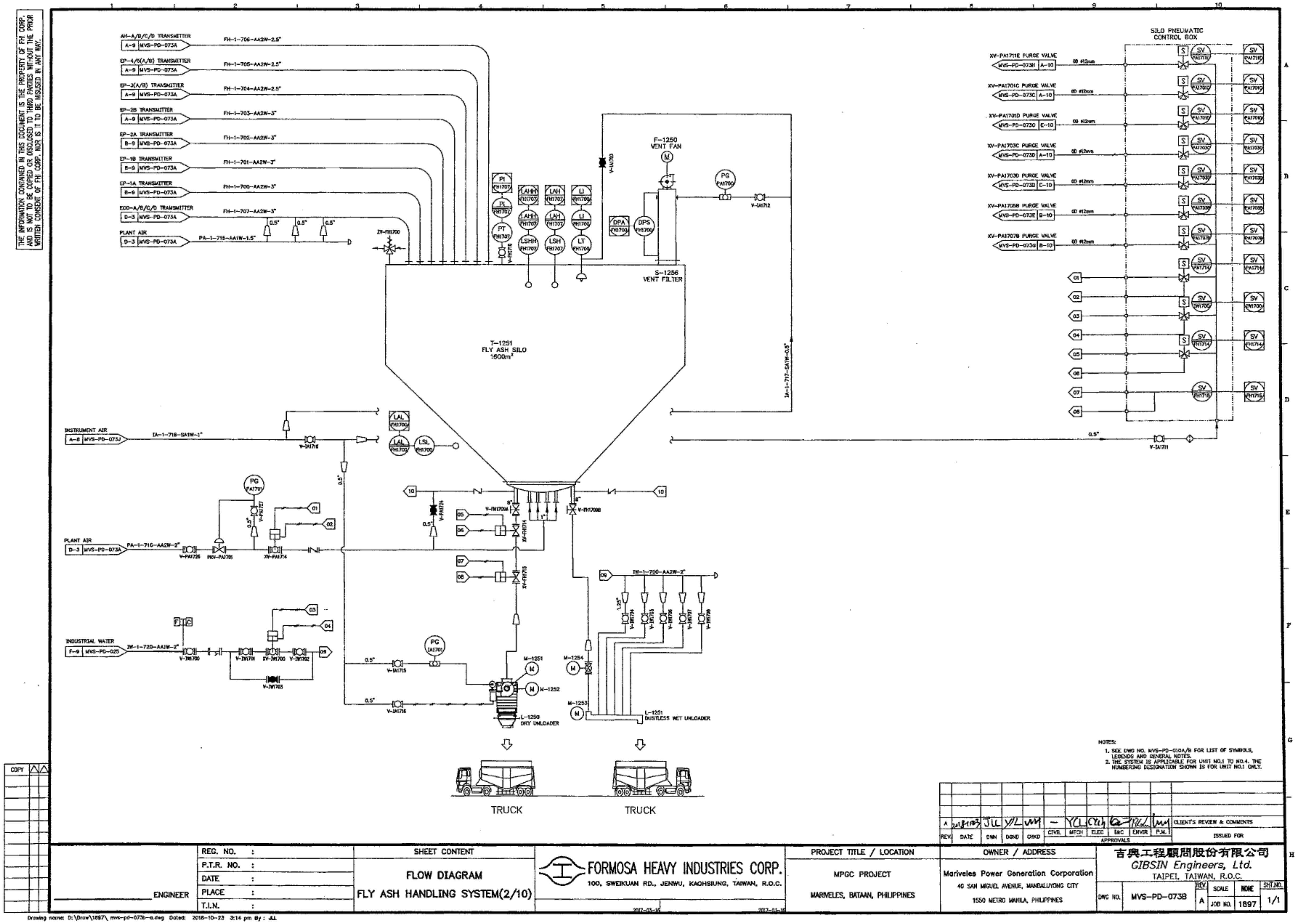


Figure 1-12 Flow Diagram of Fly Ash Handling System for MCPP

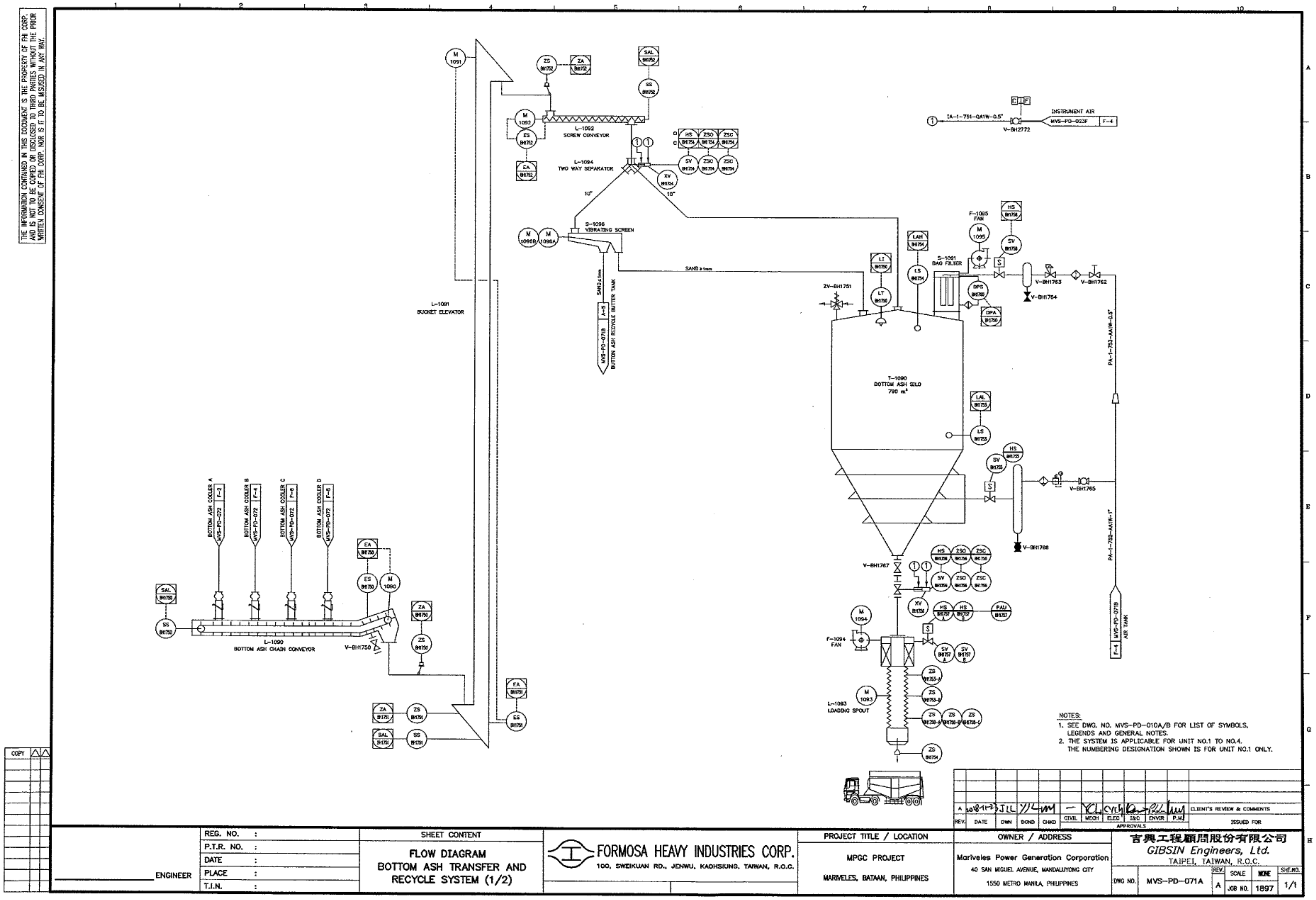


Figure 1-13 Flow Diagram of Bottom Ash Handling System for MCPP

1.4.3.3.2 Ash Disposal System

Ash is a major waste product from the combustion of coal and necessitates the establishment of a designated disposal area and method. The expected total ash generated for each boiler is about 5.7 tons per hour consisting of fly ash at 4 tons per hour and bottom ash at 1.7 tons per hour. Once the final configuration (8x150MW) is made operational, the combined amount of ash generated will be at 91.2 m^3/day (at 1.5 tons per m^3).

The construction of the Ash Disposal Facility (ADF) will be done in two (2) phases. Phase 1 will be constructed simultaneously with the Phase 1 of the Power Plant (4x 150 MW) and will have an ash storage capacity of 878,000 m^3. The ADF is planned to start construction by first quarter of 2020 and commence operation by first quarter of 2021 in time for the commercial operation of the first 150 MW boiler of MCPP Phase 1, in June 2021.

The projected life span of the Phase 1 - Ash Disposal Facility (ADF) is about 24 years and 12 years based on the projected Power Plant Phase 1 (600 MW) and Phase 2 (1,200 MW) bottom ash production, respectively, if all the fly ash generated will be sold to cement plants as projected.

There is a 35.36 hectare property located north-east of the MPGC Power plant inside the E-Fare Mariveles Economic Zone reserved for the Phase 2 Expansion of the ADF. **Annex 1-7** presents the Letter of Confirmation of MPGC to E-Fare Reserving the Property for the Phase 2 ADF Expansion, while **Annex 1-8** presents the tecnhical description of the ash disposal facility.

The construction of Phase 2 – ADF with an additional ash storage capacity of 1,826,000 m^3 will bring the combined ash storage capacity to 2,704,000 m^3 and corresponding ADF life span to 75 years and 37 years for Power Plant Phase 1 (600 MW) and Phase 2 (1,200 MW) bottom ash production, respectively. This is more than sufficient for the 25-year life span of the power plant. The Phase 2 of the ADF will be constructed 2 years before the 100% utilization of the Phase 1 ADF since the ADF construction will only take about 1 year to complete. The volume of ash disposed will be regularly monitored and will form part of the report MPGC will submit to the MMT.

Table 1-14 and **Table 1-15** summarizes the ash production per unit boiler, and disposal life span for Phase 1 ADF and Phase 2 ADF, respectively, while **Figure 1-15** shows the standard Coal Ash Treatment design.

Table 1-14 Summary of Ash Production and Disposal Lifespan for Phase 1 ADF

Particulars	Fly Ash	Bottom Ash	Total
Ash Production Per Unit			
Ash production, tons/hr	4.0	1.7	5.7
Daily production (24-hr operation), tons/day	96.0	40.8	136.8
Ash volume, m^3/hr (bulk density = 1.5 tons/m^3)	2.67	1.13	3.8
Daily Ash volume, m^3/day	64.0	27.2	91.2
Monthly Ash Production, m^3/month	1,920	816	2,736
Annual Ash Production, m^3/year (annual operation = 330 days)	21,120	8,976	30,096
Ash Disposal Facility Lifespan			
Maximum volume	878,000 m^3		
		Bottom ash only	Fly ash and Bottom ash
MCPP Phase 1 (4 units)		24 years	7 years
MCPP Phase 2 (8 units)		12 years	4 years

Table 1-15 Summary of Ash Production and Disposal Lifespan for Phase 2 ADF

Particulars	Fly Ash	Bottom Ash	Total
Ash Production Per Unit			
Ash production, tons/hr	4.0	1.7	5.7
Daily production (24-hr operation), tons/day	96.0	40.8	136.8
Ash volume, m^3/hr (bulk density = 1.5 tons/m^3)	2.67	1.13	3.8
Daily Ash volume, m^3/day	64.0	27.2	91.2
Monthly Ash Production, m^3/month	1,920	816	2,736
Annual Ash Production, m^3/year (annual operation = 330 days)	21,120	8,976	30,096
Ash Disposal Facility Lifespan			
Additional ADF Volume	1,826,000 m^3		
Total ADF Volume	1,704,000 m^3		
		Bottom ash only	Fly ash and Bottom ash
MCPP Phase 1 (4 units)		75 years	22 years
MCPP Phase 2 (8 units)		37 years	11 years

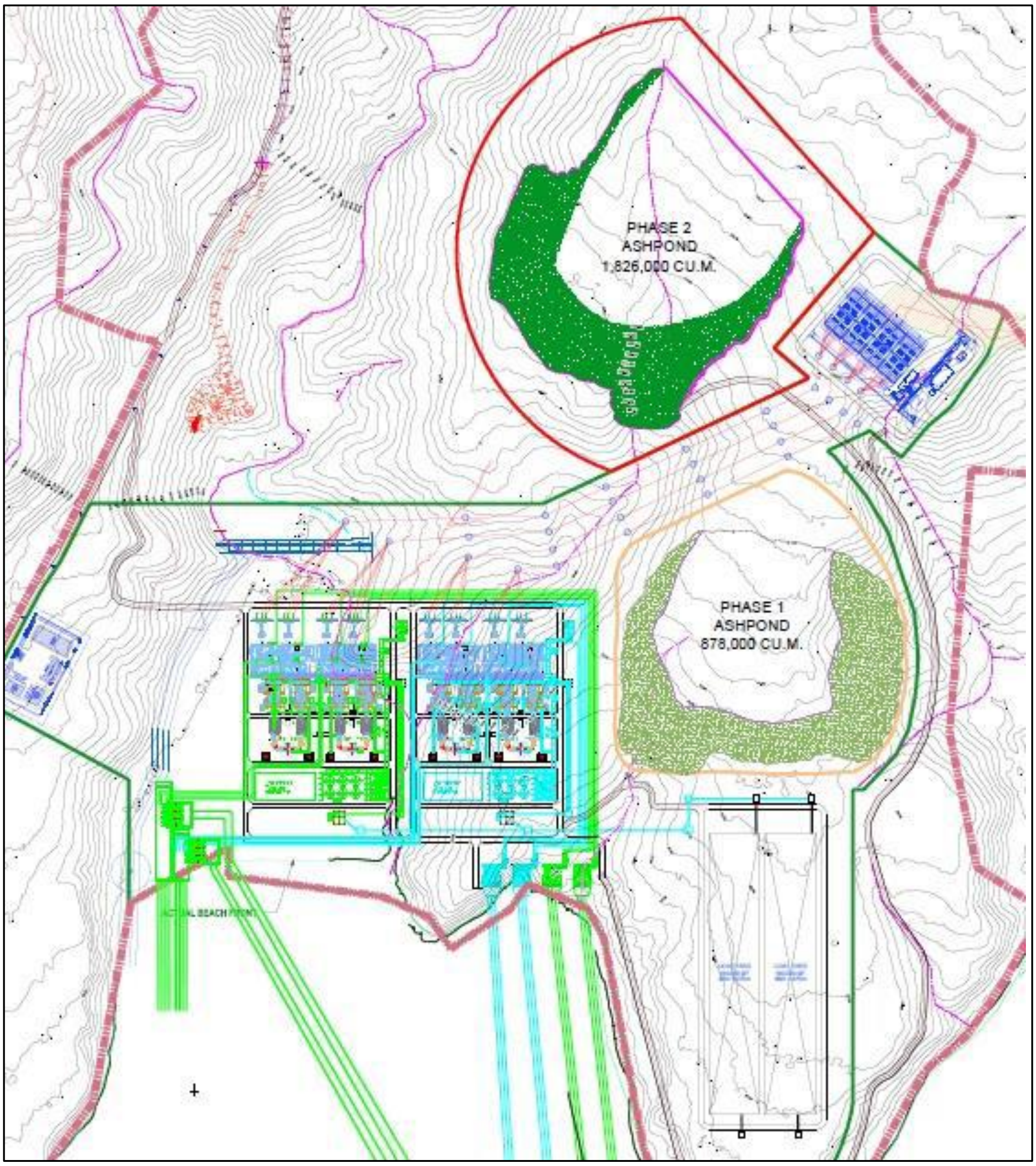


Figure 1-14 Layout of the Ash Disposal Facility (Phase 1 and Phase 2)

Ash Handling System

The combustion process will generate two types of ash: fly ash and bottom ash. Fly ash can range from 60 to 80 percent of the total ash and comprise the fine particulates that rise with the flue gases. Bottom ash makes up the balance of the total ash and is taken from the furnace bottom and cooled in an ash cooler, before being sent to the bottom ash silo, which has a 5-day storage capacity. Bottom ash may be re-used in the furnace. From the ash silo, ash shall be delivered by truck to the ash disposal facility.

Ash Pond Liner System

The plant's ash pond will have a double lining system consisting of a compacted layer of silty sand topped with a geo-membrane (HDPE liner). It is almost comparable to the USEPA standard for ash treatment (**Figure 1-15**) but compacted silty sand will be applied instead of compacted clay due to its abundance supply in the area. Two (2) groundwater monitoring wells representing the upstream and downstream section will be installed to detect if leaks are present in the ash pond area.

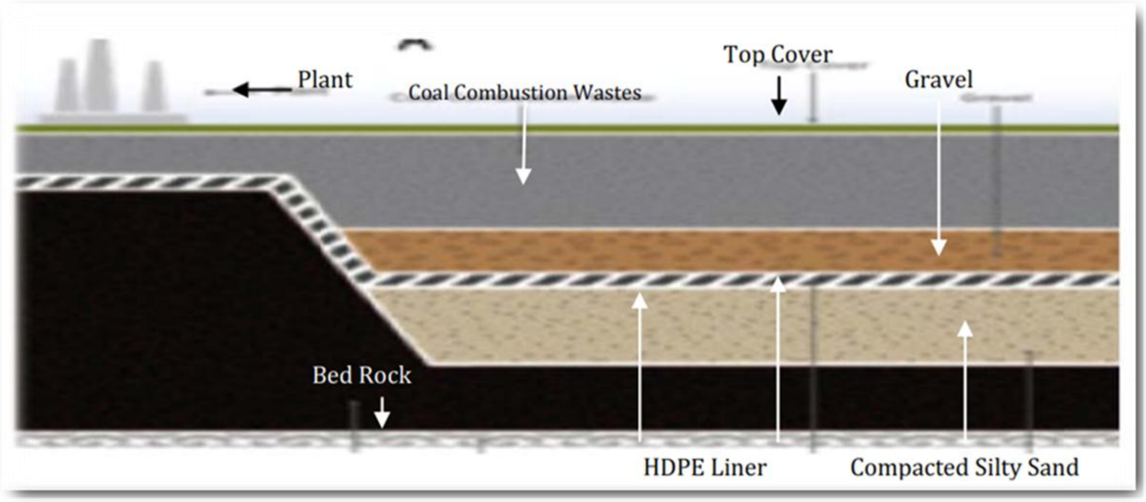


Figure 1-15 Coal Ash Treatment Diagram

Leachate Collection and Treatment

The ash pond will be equipped with perforated pipes for leachate collection and to prevent overflow. The collected leachate shall be pumped to the leachate treatment facility for neutralization and treatment.

Ash Disposal Facility Maintenance

Regular maintenance of the Ash Disposal Facility is largely aimed at minimizing potential problems by dealing with them before they cause major problems. Some aspects of the maintenance program can be integrated with the monitoring program. Where minor problems are detected, they may be corrected as generally described within this manual or is to be noted within a maintenance register to be addressed at a later date as part of a dedicated work program.

Major or complex problems should be immediately notified to the Ash dump facility designer. The Designer may address directly or escalate appropriately based upon an assessment of the conditions and situations involved.

The urgency of all maintenance at the facility should be based on the potential for the problem to affect the operation or integrity of the facility or damage to the environment

There is no fixed period for maintenance of the ash disposal facility. General maintenance of the facility will be undertaken in conjunction with construction operations and as required following events such as typhoons or earthquakes. The Ash Disposal maintenance will include the following:

- Locally trimming eroded batters;
- Re-grading surfaces to provide drainage;
- Trimming of vegetation growth of the downstream face;
- Filling of low points to avoid water ponding;
- Locally excavating and re-compacted areas of extensive erosion.

Leachate Pond

Similar to the ash disposal facility, there is no fixed period for maintenance of the leachate pond. General maintenance of the pond will be on an as required basis. Maintenance will include the following:

- Locally trimming eroded batters
- Replacing slumped rip-rap;
- Trimming of vegetation growth of the downstream face;
- Clearing the spillway of any blockages;
- De-silting by vacuum truck, dredge, or excavator.

Drains

The perimeter drains shall be routinely inspected and de-silted on no more than a monthly basis. Should low points develop within a drain due to settlement that results in significant water ponding or impairment of flows, then the low point shall be filled with either thick cement grout or mass concrete to a level such that water flows away. Major cracking or other damage to drains should be treated as directed by the designer.

Access Roads

Access and perimeter road maintenance shall generally be on an ‘as required’ basis. Maintenance shall generally compromise of treating of ruts, pot holes, or any damage that may be created by extreme rainfall events, and maintaining appropriate grades and surfaces to facilitate drainage.

Small ruts and potholes may be treated by locally filling with select granular base course materials and compacting using a tamping plate. Larger ruts or pot holes may require locally excavating, shaping, and removal of unsatisfactory materials prior to the placement of base course materials.

The access and perimeter road should be re-graded initially every 6 months; however, the frequency may be varied to suit the pavement condition as required.

Routine Surveillance

The operation of the ash dump facility may pose a significant hazard to personnel on the site, members of the public, the environment, and the operation and credibility of MPGC. To assist in the management of the hazards, regular and routine surveillance of the dump is to be undertaken to monitor and assess the performance of the dsiposal facility. This shall assist in identifying potential problems, addressing them early, and developing future plans to improve efficiency.

Routine Surveillance should be undertaken of the ash dump and appurtenant structures to assess their condition, to identify items that require maintenance, and to provide information on the long term performance.

Generally routine visual inspections should be undertaken between on a daily to a tri-weekly basis. Additional inspections may be required after large or extreme weather or geo-hazard events, such as typhoons or earthquakes.

The following enumerates some of the items that may be inspected during routine surveillance of the ash disposal facility:

- General dumping operations and ash zoning;
- Erosion or riling of the ash dump;
- Low points in the dump;
- Ponding water and or wet/soft areas;
- Seepage from the dump;
- Slumping or movement of the downstream face;
- Condition of vegetation on the downstream face;
- General effectiveness of dust suppression activities;
- Checking for presence of foreign material within the dump (i.e. organic matter).

The condition of the ash disposal should be noted in a log book, and as a minimum it should include the date of the inspection, the name of the person undertaking the inspection, the general condition of the dump, and list any action items that may be required.

Construction and Dust Suppression
All construction and dust suppression equipment should be regularly serviced in accordance with the manufacturer's recommendations.

1.4.4 Temporary Facilities

Construction Offices

Temporary facilities shall be constructed to house the offices of MPGC, contractor and its subcontractor. The offices shall be equipped with appropriate utilities such as power supply, water supply, sanitary facilities, communication/internet connection and road network.

Accommodation Facilities during Construction

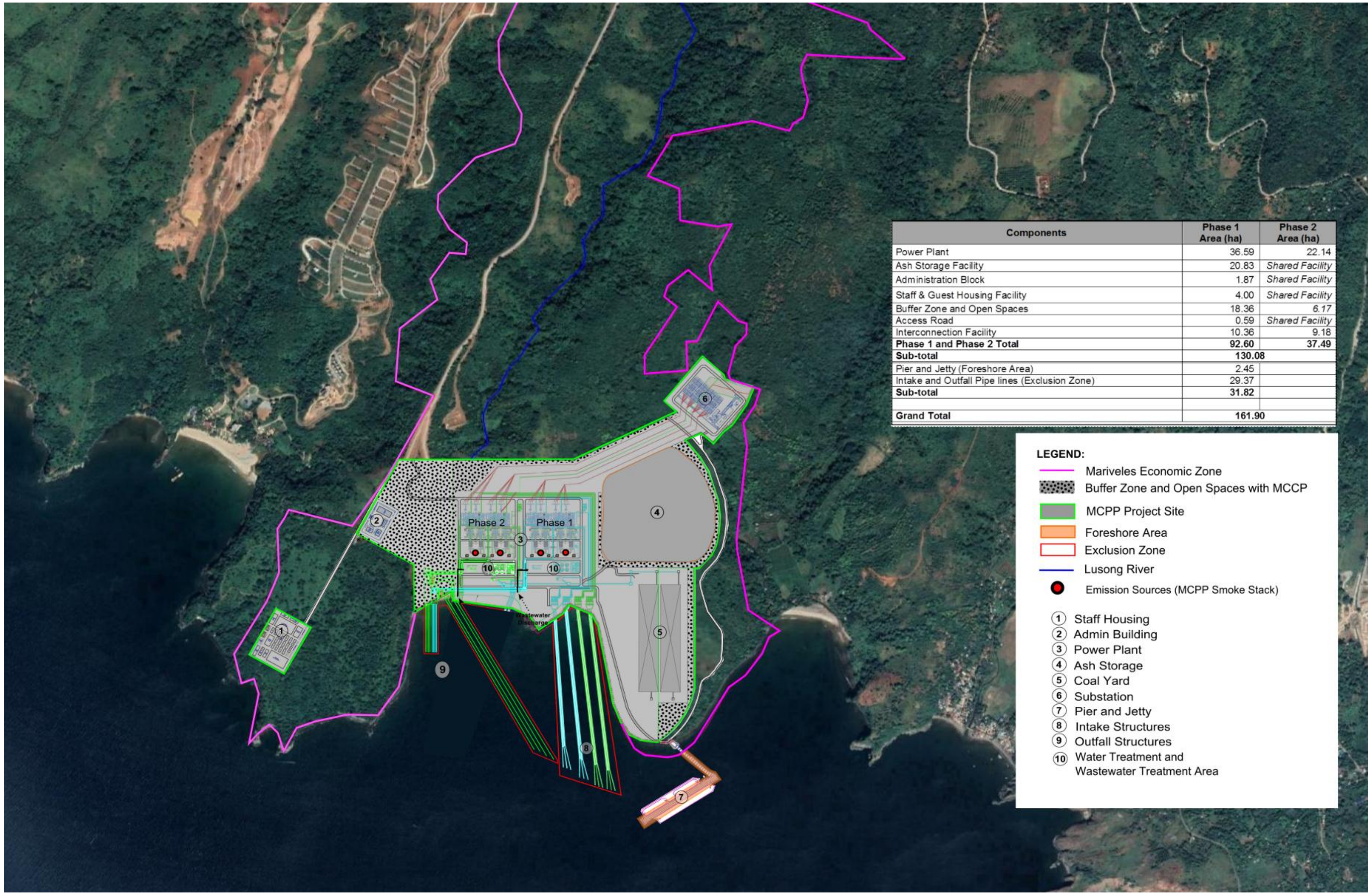
During construction phase, there will be influx of workers at the project site. A temporary housing facility shall be built which will house a number of staff during construction phase. The housing shall be equipped with appropriate amenities such as power supply, water supply, sanitary facilities, road network and recreational facilities.

1.4.5 General Layout Facilities

Table 1-16 shows the major components and the corresponding estimated footprints of the proposed MCPP Project. The Site Development Map of the MCPP Project is shown in **Figure 1-16**.

Table 1-16 Estimated Footprint of the Proposed MCPP Project

Components	Phase 1 Area (ha)	Phase 2 Area (ha)
Power Plant	36.59	22.14
Ash Storage Facility	20.83	*Shared Facility*
Administration Block	1.87	*Shared Facility*
Staff & Guest Housing Facility	4.00	*Shared Facility*
Buffer Zone and Open Spaces	18.36	*6.17*
Access Road	0.59	*Shared Facility*
Interconnection Facility	10.36	9.18
Phase 1 and Phase 2 Total	**92.60**	**37.49**
Sub-total	**130.08**	
Pier and Jetty (Foreshore Area)	2.45	
Intake and Outfall Pipe lines (Exclusion Zone)	29.37	
Sub-total	**31.82**	
Grand Total	**161.90**	



Components	Phase 1 Area (ha)	Phase 2 Area (ha)
Power Plant	36.59	22.14
Ash Storage Facility	20.83	*Shared Facility*
Administration Block	1.87	*Shared Facility*
Staff & Guest Housing Facility	4.00	*Shared Facility*
Buffer Zone and Open Spaces	18.36	6.17
Access Road	0.59	*Shared Facility*
Interconnection Facility	10.36	9.18
Phase 1 and Phase 2 Total	**92.60**	**37.49**
Sub-total	**130.08**	
Pier and Jetty (Foreshore Area)	2.45	
Intake and Outfall Pipe lines (Exclusion Zone)	29.37	
Sub-total	**31.82**	
Grand Total	**161.90**	

Note: Map showing in particular, the location and boundaries of project area, location and footprint of main facilities, storage and support facilities

Figure 1-16 Layout and Site Development Plan of the Proposed MCPP Project

1.5 PROCESS/TECHNOLOGY

The MPGC will utilize the latest clean coal technology – the CFB Technology, which has emerged as an environmentally acceptable technology for burning a wide range of solid fuels to generate steam and electric power.

The combustion of fuel in a CFB Boiler takes place in the furnace. The furnace is a vertical chamber composed of fin welded waterwall tubes in which the CFB process occurs. This includes fluidization of the furnace bed material which is composed of the following materials: ash, fuel, sorbent and sand, if required. Properly sized fuel is fed into the furnace and burned at a relatively low combustion temperature. Fine grain sorbent that is introduced into the furnace is calcined and oxidized enabling the product to react with the sulfur dioxide formed during the combustion of sulfur-contained fuels. The product of tis reaction is calcium sulfate (gypsum), a solid which adds to the bed inventory and is easily removed with the ash which formed the combustion process.

The bed material is fluidized with a combustion of primary air, secondary air, and combustion gases. The primary air is introduced to the furnace through fluidizing air nozzles which are located at the grate of the furnace. The introduction of this primary air initiates fluidization of the bed material. The subsequent formation of combustion gases along with the introduction of secondary air in the furnace produces sufficient upward velocity of gas to cause the bed material to form a gradient of suspended solids throughout the height of the furnace. This column of suspended solids is in constant motion in which particles either exit the furnace with the combustion gases or reflux back down the column towards the furnace grate.

The solids which is conveyed out of the furnace are separated from the combustion gas in a particle separator (cyclone) and are continuously returned to the lower portion of the furnace by a recycle loop. The very high internal and external circulating rates of the solids, characteristic of the circulating fluid bed results in consistently uniform combustion temperatures throughout the furnace.

Solid residence time in the furnace can be on the order of minutes for each cycle of the solids circulation. This is due to the high slip velocity between the combustion gases and solids, which causes the solids to proceed through the furnace at a much lower velocity than the combustion gases. The long residence time of the solids and the constant solid circulation produces high combustion efficiency and high heat transfer rates to the furnace waterwall tubes.

The combustion of the fuel occurs in two (2) zones: a primary reducing zone in the lower section of the furnace and the final combustion zone located above the upper level of secondary air inlets to the furnace. The primary combustion zone is located between the primary fluidizing air nozzles and the upper secondary air inlets. One level of secondary air inlets is located between the primary air nozzles and the upper secondary air inlets where the combustion process is staged at substoichiometric air requirements. Final combustion using excess air takes place in the upper region of the furnace, above the upper secondary air inlets. This staged combustion process and low temperature combustion effectively suppresses NO_X formation.

The combustion of the fuel produces two (2) material streams: combustion gases and ash. All of the combustion gases exits the furnace via outlets located in the upper region of the furnace. Carried along with this gas are any solids that may have been entrained in the gas stream. This stream of material enters the particles separator which removes a majority of the solids from the combustion gases. The gases exit the top of the cyclone particle separator and are then ducted to the convection section of the boiler. Ina typical CFB arrangement the gas travels the following path after exiting the particles separator:

First, the combustion gas enters a steam cooled backpass enclosure which contains superheater and economizer surface. Second, the gas is cooled by the air preheater. Third, the remaining particulate matter entrained in the combustion gas is removed in an ESP unit. And lastly, the cleaned combustion gas is exhausted to the atmosphere via the induced draft fan to a stack or chimney.

The solids separated from the gas stream in the cyclone particle separator are returned to the furnace via the seal pot located at the end of each stand pipe of each particle separator.

The inventory of solids in the CFB is controlled by the discharge of ash from the circulating loop (Primary Loop) of solids. As leaves this loop through two (2) streams: solids entrained in the combustion gas at the particle separator outlet and solids discharged from the furnace through the bed drains. Ash which passes over the convective pass with the gas stream is collected and removed from the system at two (2) locations:

- From the backpass pass and air preheater ash hoppers, and
- From the ESP.

The ash discharged from the furnace is cooled in water cooled ash screw coolers which also control the rate of discharge of the ash from the system. A low pressure and temperature water source is required for proper operation.

Combustion system. For circulating fluidized bed combustion, the coal stored in the coal silo is fed to the furnace by the coal feeder. The coal fed to the combustion furnace comes in contact with bed material at approximately 900°C. Bed material and coal are combusted on a circulating fluidized bed, unburned coal is collected in solid separators, and then reinjected to the combustion furnace.

Coal silo. Coal silos are used to store the coal transferred by conveyor in the coal handling system. Silos are installed in the front of the boiler. Each boiler has three (3) coal silo with a total storage capacity for 14 hours continuous operation at BMCR. The load cell determines the weight of the stored coal.

Coal feeder. Coal feeders are used to continuously feed the coal stored in the coal silo to the combustion furnace according to boiler load. Each feeder is located under the coal silo, and the feeding flow will be controlled. A feeding monitor installed in the silo outlet measures the coal flow between the coal silo and the coal feeder.

A feeder control for adjusting the RPM of the feeder motor is continuously used to feed the proper quantity of coal to the combustion furnace.

Limestone storage silo. The limestone silo is a facility used to store the limestone powder transported from the tank lorry. Each boiler unit will have individual limestone silo with a storage capacity to hold enough limestone for two (2) days at BMCR with a Ca/S mole ratio of 2.56:1 considering limestone transportation and equipment maintenance.

Limestone feeder. A limestone feeder is used to continuously feed the limestone stored in the limestone silo to the combustion furnace according to boiler load and SO_x criteria. One limestone feeder is located under the limestone silo, and the feeding flow will be controlled.

Bed material bin. A bed material bin is used to feed bed material when bed material is not in the combustion furnace during boiler start-up operation. Bed material consists of sand or bed ash. To create a bed material bin, the bed can be filled up from a bed media regeneration system or truck unloading.

Start-up burner. A start-up burner is used to preheat bed material in the combustion furnace during boiler start-up operation. The start-up burner is installed near the bed under the combustion furnace and connected to a secondary air duct.

The coal fed to the combustion furnace is combusted while in contact with bed material. Unburned coal included in the flue gas is collected in the solid separator and then reinjected to the combustion furnace. Ash return facilities are installed between the solid separator and combustion furnace protects combustion gas from reverse flow and eases the reinjection of bed material to the combustion furnace.

Sootblower. To remove the soot piled up on the heat surface of the superheater, economizer and air preheater, an appropriate sootblower will be installed and operated by the steam fed from the primary superheater outlet.

A long retractable blower connected to the lance tube operates forward and backward automatically in the flue gas passage. The lance tube is operated using a blower carriage moving along a track beam rail.

The CFB Technology process diagram and material balance are described in **Figure 1-17**.

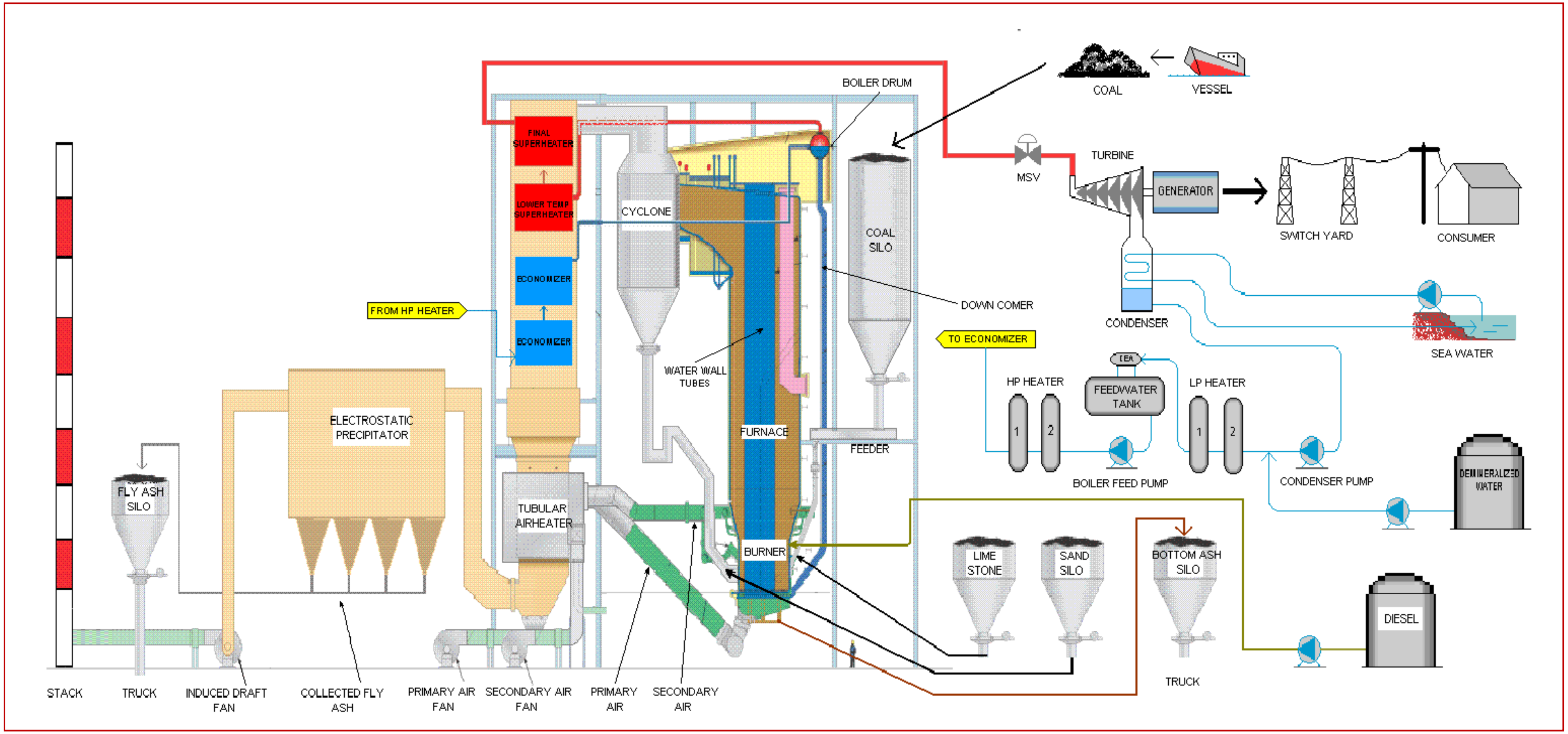


Figure 1-17 Process and Material Balance of One Unit Boiler of the Proposed MCPP Project

1.5.1 Utility Requirements

1.5.1.1 Fuel Coal

The proposed MCPP Project will require about 2,819,520 tons/year of Sub-bituminous Coal per Phase to generate 4X150 MW power at 100% Plant Factor and 330 operating days. MPGC initially plans to have a ten-year supply contract (extendable to another 10 years) with a reputable coal supplier; the additional coal requirement shall be from the spot market. At 80% Plant Factor, the coal consumption will be 2,255,616 tons/year per project Phase, thus the total coal consumption for the Phase 1 & Phase 2 will be about 4,511,232 tons/year.

The coal will be delivered using panamax vessel of 60,000-70,000 DWT capacity and unloaded in the pier and jetty using a 1,500-2,000 TPH coal ship unloader. The coal will be conveyed and stored at a fully covered coal yard with a storage capacity of 180,000 tons per project phase. The boiler will be designed according to the Design Coal Specification as presented in **Table 1-17.**

Table 1-17 Coal Specifications to be Supplied for the Proposed MCPP Project

Description	Unit	Range	Design
Total Moisture(As Received basis)	%Wt	< 34.00	33.96
Proximate Analysis (AR basis)			
- Moisture	%Wt	< 14.0	14.0
- Volatile matter	%Wt	28.5 < V.M. < 33.5	30.56
- Fixed Carbon	%Wt	25.0 < F.C. < 35.5	28.67
- Ash	%Wt	1.0-12	6.82
Sulfur (AR basis)	%	0.5 < S < 1.5	1.49
Fuel Ratio (AR basis)	FC/VM	Min. 0.70	0.94
Size (AR basis)	Mm	Max. 50	≤ 50
Ultimate Analysis (AR basis)			
- Carbon	%Wt	37.0 < C < 54.0	42.97
- Hydrogen	%Wt	2.2 < H < 3.75	3.00
- Nitrogen	%Wt	< 1.0	0.59
- Oxygen	%Wt	< 13.0	11.42
- Sulfur	%Wt	0.5 < S < 1.5	1.49
- Ash	%Wt	6.0 < Ash < 15.0	6.82
Higher Heating Valve (AR basis)	kcal/kg	Min. 4,000	4,008
Ash Fusion Temperature (IDT)	ºC	>1,150	1,155°C
Ash Analysis			
- SiO_2	%Wt	30-60	26.89
- Al_2O_3	%Wt	10-30	17.12
- Fe_2O_3	%Wt	Max. 20	9.06
- CaO	%Wt	Max. 13	17.24
- MgO	%Wt	Max. 10	1.99
- Na_2O	%Wt	$Na_2O + K_2O < 3.5$	1.68
- K_2O	%Wt		0.34
- Others, Chlorine	%Wt	-	<0.12

1.5.1.2 Limestone

The limestone will be sourced locally from Cement Industry with the following specifications:

Table 1-18 Limestone Specifications

Description	Unit	Design
$CaCO_3$	% Wt	93.7
$MgCO_3$	% Wt	0.61
H_2O	% Wt	0.72
Inert	% Wt	5.01

Note: Limestone water content must be less than 1.0% for pneumatic conveying.

1.5.1.3 Light Diesel Oil

For start-up, the boiler will use the light diesel oil. It will be stored in a 500m^3 light diesel oil storage tank. **Table 1-19** presents the specifications of the light oil to be used for the proposed MCPP Project.

Table 1-19 Oil Specifications (ASTM D975 Grade No. 2 Oil)

Properties	Unit	Specification
Specific Gravity, API at 15.5°C	32	40
Density at 15.5ºC	0.82~0.880	0.82 ~ 0.86
Kinetic Viscosity at 37.8°C , cSt	1.60	2.68
Sulfur, % wt	0.3%	0.5%
Calorific Value (HHV)	19,600 Btu/lb (10,889 kcal/kg)	
Calorific Value (LHV)	18,400 Btu/lb (10,221 kcal/kg)	

1.5.1.4 Water Use

The proposed MCPP project will be using about 128 m^3/hour of freshwater and 144,000 m^3/hour of seawater per project phase. The total water requirement per project phase is broken down as follows:

- Cooling water requirements (Seawater) – 144,000 m^3/hour
- Freshwater requirement – 128 m^3/hour
    - Industrial Water – 30 m^3/hour
    - Potable and Domestic Water – 12 m^3/hour
    - Demineralized Water – 46 m^3/hour
    - Water Treatment Plant Requirement – 40 m^3/hour

MPGC will be extracting seawater for condenser cooling requirement and will likewise discharging it back to the sea. About 144,000 m^3/hour of seawater per Phase will be extracted and discharge back to the sea. The seawater discharge will be about 1.7°C warmer (at discharge point) than the intake seawater temperature of about 29 ºC.

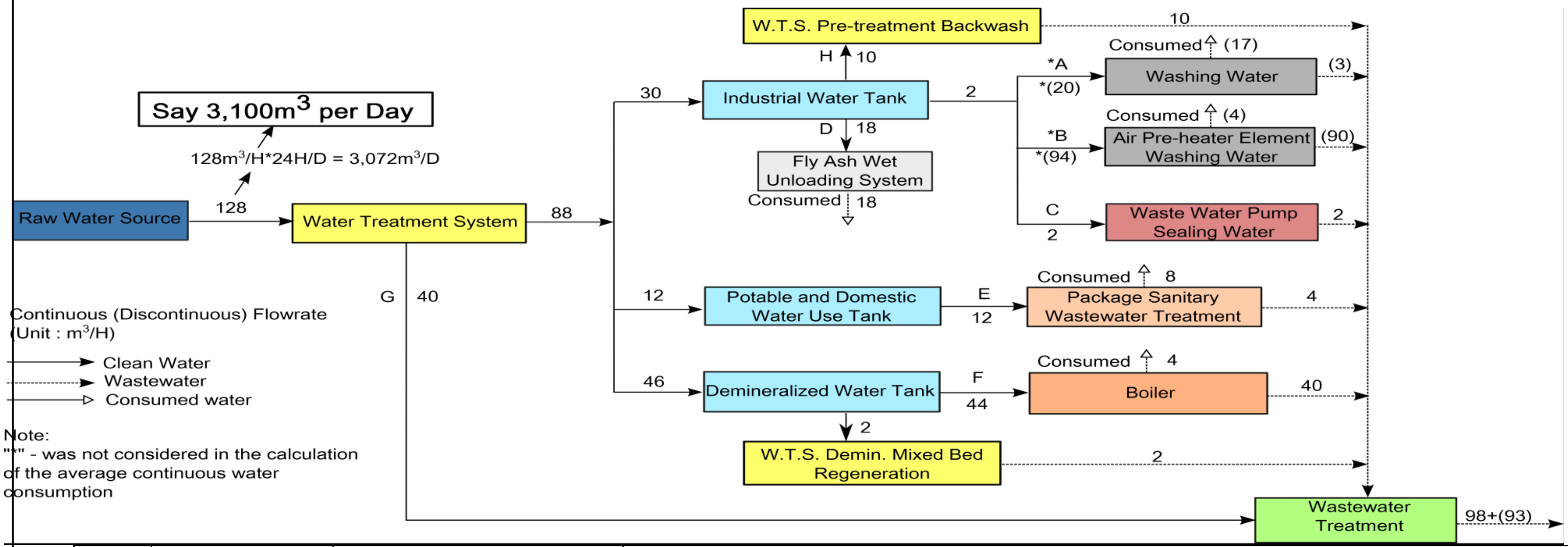
The freshwater requirement of MPGC will be primarily used as process water, make-up water, service water, potable water and other necessary water consumptions. The total requirement per project phase is 128 m^3/hour (3,100 m^3/day) or a total of 256 m^3/hour (6,200 m^3/day) for Phase 1 and Phase 2. This will be sourced from Lusong River through the water supply system of MEZ, as part of its Centralized Support Facilities. It will have an initial capacity of 10,000 m^3/day and final water supply capacity of 30,000 m^3/day. **Annex 1-5** presents the amended ECC of MEZ for its water supply.

The freshwater from Lusong River will be subjected to pre-treatment in the water treatment plant of MEZ in order to meet industrial water quality prior to supplying raw water to MCPP Project Water Treatment Facility for final treatment and plant usage. **Figure 1-18** presents the summary of water balance per project phase.

Table 1-20 Summary of Water Balance per Project Phase

Water Requirement		Input (m3/hr)	Output (m3/hr)	Remarks
Seawater Intake (Cooling Water)	Seawater	144,000	144,000	Will be discharged back to the sea
Water Treatment System	Freshwater[1]	128	30	Industrial Water Use
			12	Potable and Domestic Water Use
			46	Demineralized Water Use
			40	Water Treatment Reject

[1] Freshwater requirement of MCPP will be supplied by the MEZ water supply system. Source of water supply of MEZ is the Lusong River.



Items	Flow Rate (m3/H)	Frequency	Description
*A	(20)	Discontinuous	Assume 10m^3/H per unit, considering maximum 2 uniits at the same time, assumed 3m^3/H can be gathered by ditch. **Do not consider for AVG. Daily water consumption calculation.**
*B	(94)	Discontinuous at PMS	Only use when unit overhaul. Assume 94 m^3/H per unit, assumed 4 m^3/H water can't be gathered by ditch. **Do not consider for AVG. Daily water consumption calculation.**
C	2	Continuous	Assumed 0.5 m^3/H per unit, total 4 units.
D	18	Discontinuous & convert to continuous for calculation	Assume 20 m^3/H per unit, considering wet unloading fly ash for 2 units at the same time. **For AVG. daily water consumption, use 18 m^3/H for 4 units AVG. Daily continuous consumption.**
E	12	Continuous	Assume 3m^3/H per unit, consumed 2 m^3/H per unit.
F	44	Continuous	Boiler make-up assuming 11 m^3/H per unit, consumed 1 m^3/H per unit. Continuous blowdown assumed 10 m^3/H per unit.
G	40	Continuous	W.T.S. continuous water consume is approximately 40 m^3/H (Included RO reject wastewater 29 m^3/H)
H	10	Discontinuous & convert to continuous for calculation	W.T.S. pre-treatment backwash needs I.W. 160 m^3/h once per day, one time 30 min. per train. **For AVG. Daily water consumption, use 10 m^3/H for 3 trains AVG.daily continuous consumption.**
I	2	Discontinuous & convert to continuous for calculation	W.T.S. Demin mixed bed regeneration needs Demin. Water 50 m^3 per one time, the period is roughly once per 1 day **For AVG. Daily water consumption, use 2m^3/H for 3 trains AVG. Daily continuous consumption.**

Source: MPGC, 2016

Figure 1-18 Water Balance Diagram

1.5.1.5 Electricity

During its operation, the plant's generator will produce 13,800 volts AC. A step-up transformer will increase the voltage to 500,000 volts or 500kV before it is supplied to the Luzon Grid via the 500kV substation. The parasitic load per unit of the proposed MCPP Project is 18MW. These will come from their generated power. **Table 1-21** presents the total parasitic load per Project Phase.

Table 1-21 Total Parasitic Load per Project Phase

Phase Project	Number of Units/Phase	Total Parasitic Load
Phase 1	4 x 150-MW	72-MW
Phase 2	4 x 150-MW	72-MW

1.5.2 Domestic Solid Wastes

The amount of domestic solid waste will not be significant. Waste per capita, calculated on an average income basis, in a developing country is 0.5 kg/day. With an estimated workforce of 2,500-3,000 during construction, the domestic waste will amount to 1,500 kg/day. With a workforce of 200-250 during operation, the domestic waste generated amounts to 125 kg/day. Domestic solid waste will include paper, cartons, plastic, bottles, tin cans, rubber, food left-over, etc. These will be temporarily collected and stored in waste bins properly sorted out into recyclables and non-recyclables before collection and disposal by the local government through the MRF Facility of MEZ. Some hazardous solid waste will include busted fluorescent lamps, spent industrial and car batteries, spent chemical cartridges and containers and expired chemicals. Within six (6) months from generation, these hazardous wastes will be removed, transported and disposed according to acceptable practices. MPGC will ensure that the hazardous waste will be properly treated and disposed of, by the DENR accredited transporter and treater.

1.5.3 Operations and Maintenance of Facilities

The proposed MCPP Project will operate 24 hours a day, 7 days a week and 52 weeks a year. However, scheduled shut down and plant maintenance will be conducted at the Power Plant for an aggregate of thirty (30) days per year per 150MW unit.

1.5.4 Summary of Input and Output Materials

Table 1-22 shows the summary of input and output materials for the proposed MCPP Project.

Table 1-22 Summary of Input and Output Materials

Requirement (Source/s)	Input	Output		Remarks
Water Balance per Project Phase				
Seawater (West Philippine Sea)	144,000 m^3/hr	Cooling water	144,000 m^3/hr	Discharged back to the sea
Freshwater (MEZ Water Supply System	128 m^3/hr	**Industrial Water Tank**	**30 m^3/hr**	
		➢ WTS Pre-treatment backwash	10 m^3/hr	To WWTP
		➢ Fly Ash Wet Unloading System	18 m^3/hr	Consumed
		➢ Wastewater Pump Sealing Water	2 m^3/hr	To WWTP
		Potable and Domestic Water Use Tank	**12 m^3/hr**	
		➢ Package Sanitary Wastewater Treatment	8 m^3/hr	Consumed
			4 m^3/hr	To WWTP
		Demineralized Water Tank	46 m^3/hr	
		➢ Boiler	4 m^3/hr	Consumed
			8 m^3/hr	To WWTP
		➢ WTS Demin Mixed Bed Regeneration	2 m^3/hr	To WWTP
		Water Treatment System requirement for operation (Including RO reject	40 m^3/hr	To WWTP

		wastewater)		
Solid Input and Output per Unit of Boiler				
Coal (Indonesia, Daguma and Semirara)	715,560 tons/yr	**Ash (6.82% of coal, based on AR analysis + 83% of limestone)**	**128,640 tons/yr**	Calculated based on design emission guarantee from boiler supplier at 335 days operation per year
Limestone (will be locally sourced from Cement Industry)	96,480 tons/yr	➢ Fly Ash[2] (70% of ash from coal and limestone) ➢ Bottom Ash[3] (30% of ash from coal and limestone)	90,048 tons/yr 38,592 tons/yr	
Gas Emissions per Unit of Boiler				
-	-	SOx	3,010 tons/yr	Calcualated based on design emission guarantee from boiler supplier at 335 days operation per year
		NOx	2,625 tons/yr	
		CO	4,400 tons/yr	
		PM	261 ton/yr	
Process Chemicals Used				
Neutral Amine[4]	104.3 MT/yr	-	-	Calculated based on the designed capacity provided by boilers supplier at 335 days operation per year
Hydrazine[5]	41.7 MT/yr	-	-	
Sodium Phosphate[6]	156.3 MT/yr	-	-	

1.6 PROJECT SIZE

The proposed MCPP Project will consist of two (2) project phases comprising of 4x150 MW CFB Boilers per project phase. The proposed MCPP Project has a gross capacity output of 1,200MW and net capacity output of 1,128MW. **Table 1-23** shows power plant components and corresponding capacities.

Table 1-23 Power Plant Components and Corresponding Capacities

Components	Phase 1	Phase 2	TOTAL
Total Project Area	92.60 hectares 2.54 ha. of foreshore area and miscellaneous lease area	37.49 hectares -	130.09 hectares 2.54 ha. of foreshore area and miscellaneous lease area
Gross output	150 MW x 4	150 MW x 4	1,200 MW
Net output	141 MW x 4	141 MW x 4	1,128 MW
Jetty and Pier	Jetty: 10-12 m wide, 260 m long Pier: 24 m wide and 380 m long	Shared with Phase 1	Jetty: 10-12 m wide, 260 m long Pier: 24 m wide and 380 m long
Coal			
Coal Storage	180,000 tons (20-day storage)	180,000 tons (20-day storage)	180,000 tons x 2
Ash Storage Facility	20.83 ha.	-	20.83 ha.
Wastewater Treatment Facility	100 tons/hr x 2	100 tons/hr x 2	100 tons/hr x 4
Demineralizer	1,500 tons/day	1,500 tons/day	1,500 tons/day x 2
Cooling Water	144,000 m^3/hr	144,000 m^3/hr	144,000 m^3/hr
Stack	100 m x 2	100 m x 2	100 m x 4

[2] Production Quantity: Bottom ash – up to 30% of total ash formed; Fly ash – up to 70% of the total ash formed
[3] Production Quantity: Bottom ash – up to 30% of total ash formed; Fly ash – up to 70% of the total ash formed
[4] Used as pH control
[5] Used to control dissolved oxygen levels in boiler feedwater
[6] Used to protect plant component materials from corrosion and to maintain the required feedwater quality

1.7 DEVELOPMENT PLAN, DESCRIPTION OF PROJECT PHASES AND CORRESPONDING TIMEFRAMES

1.7.1 Project Phases

1.7.1.1 Pre-Construction Phase

Permit Acquisition. During the Pre-Construction Phase, the design and detailed engineering of the project components will be prepared and finalized.

Preparatory works involves the procurement of the supplies and equipment planning for setting-up the physical characteristics, permit acquisition, and resource requirements provision and allocation. ECC is acquired during the pre-construction phase, prior to any site construction activities.

1.7.1.2 Construction Phase

The construction phase will include the following activities:

- Mobilization of construction equipment and materials;
- Establishment of workers' quarters; and
- Construction of power plant and facilities

Mobilization of Construction Equipment and Materials. Construction equipment and construction raw materials will be transported to the dedicated temporary laydown area. Machineries, equipment, and construction materials shall be transported by truck or by boat to the Project site. The temporary jetty will be used to transport large and heavy project components such as turbines. The following temporary facilities will be installed in the Project site:

- Batching plants – three (3) units with a capacity of 100m^3/hr
- Rock crushing plant – one (1) mobile rock crushing facility
- Construction Offices – temporary housing facility for the owner, contractors and sub-contractors of MPGC.

Establishment of Workers' Quarters. An estimate of 2,500 to 3,000 workers will be employed during the peak period of the construction stage. The majority of the workers will be coming from the host and nearby barangays of Mariveles while the highly skilled workers who will be coming from outside of the Mariveles will be billeted in the surrounding communities in order to enhance the economic activity of these areas.

Temporary facilities such as construction offices, welfare, medical clinic, and parking area will be provided during construction phase. The site temporary facilities are to be managed in line with Philippine statutory requirements as detailed by Department of Labor and Employment (**DOLE**).

Construction of Power Plant and Facilities. The construction activities will commence starting from the access and internal roads, installation of permanent drainage systems, construction of buildings and infrastructure and installation of components such as turbines, boilers and other ancillary equipment. The following structures will be constructed:

- Main Power Plant
  - 4 units steam turbine generators for each project phase
  - 4 x 150MW Boilers for each project phase

- Support Facilities per project phase
  - Seawater Cooling and Treatment System
  - Steam Condenser
  - Feedwater Heating System
  - Coal Handling System
  - Pollution Control System
  - Interconnection Facility (from power plant switchyard to NGCP substation)

During the construction, power requirements will be organized by the selected EPC contractor through the local distribution utility, Peninsula Electric Cooperative, Inc. (PENELCO). Temporary construction power line and transformer with switchgear will be furnished and installed to supply the power needs for construction machinery, office and staff barrack. Subcontractors shall also provide diesel generator set to facilitate work for individual work areas per their agreement with EPC contractor. The construction load requirement ranges from 1 MW to 5~10 MW depending on the stage of construction. The EPC contractor shall also furnish an environment management program in which water management and waste management are defined, this also has to be approved by MPGC and LGU. MPGC will also coordinate with EFIHI for water supply source arrangement. The construction period, from start of EPC NTP to start of commercial operation is approximately 42 months.

1.7.1.3 Post Construction Phase

During the Post-Construction phase, all temporary structures/facilities, whether onshore or offshore, will be demolished and construction debris will be removed. Construction machinery and equipment will be decommissioned and removed from the site. Clean-up activities will be undertaken.

Construction wastes will be segregated into recyclable and non-recyclable wastes. Where recyclable and reusable items are available and desired by the communities near the site, the MPGC will be willing to make these available to them.

The MPGC has allocated funds in the project budget to increase biodiversity at the site in terms of creating a habitat. The facility will be landscaped and planted with appropriate indigenous species. In all aspects, MPGC will endeavor to minimize the visual impact of the site consistent with its purpose as an industrial facility.

The MCPP will connect to the Grid via the National Grid Corporation of the Philippines (NGCP) Mariveles Substation. The power requirements needed during the commissioning stage for each 150 MW Power block modules is about 8MW. This will be sourced from other power plants of SMC Global Power business units or the through the Electricity Market. In the event that the transmission line will not yet be available during the commissioning stage a generator set will be installed to serve as an alternate source of power.

1.7.1.4 Operation Phase

The proposed MCPP Project will operate 24 hours a day, 7 days a week and 52 weeks a year. However, scheduled shut down and plant maintenance will be conducted at the Power Plant for an aggregate of thirty (30) days per year per 150MW unit.

The main activities during this stage consist of coal receiving, storage and handling, electricity generating, environmental pollution controls, solid wastes management, and wastewater treatment (as discussed in **Section 1.5**) are briefly discussed below:

Coal Receiving, Storage and Handling –From the coal unloading jetty, a covered conveyor belt will transport the coal to a fully covered coal storage area where the stacker/reclaimer will deposit the coal in piles that can store twenty (20) days' worth of fuel for the facility at full load operation. From the coal storage, coal is transferred to the boiler silos via a redundant coal conveying system.

Electricity Generation – The proposed MCPP Project will use the CFB Technology of producing electric power from coal by burning coal to heat water at high temperature in a large boiler. Exhaust gases from the combustion are then expelled through a flue after being cleaned of sulfur and particulates. The heated water within the tubes lining the boiler is converted to steam that spins a series of turbine blades on a common shaft and interconnected to a generator. The turbines utilize propeller-like blades that are rotated by the high-pressure steam as it flows through. The steam, after passing through the turbine, is condensed and returned to the boiler to be heated once again. The electricity generated at 13,800 volts will then be stepped-up to 500,000 volts.

Seawater Intake and Discharge. MPGC will utilize the existing seawater intake structure which Separate cooling water intake and discharge will also be constructed and operated for the proposed MCPP Project.

The cooling water intake will be designed as a "mid-depth" intake with fixed curtain walls to control the intake velocity and to protect the Seawater Screening Trains from being damaged by large floating debris. To inhibit biological growth in the seawater cooling system, a hypochlorite generation system will be installed. The system's main component is the electrolytic cell. The cooling water discharge will be designed as be a submerged HDPE pipe, oriented perpendicular to the shoreline and to the ambient flow in the West Philippine Sea. This design was chosen to achieve maximum mixing with the ambient water as rapidly as possible, to reduce the size of the mixing zone defined as the area with a 3°C rise in temperature.

Environmental Pollution Control and Monitoring. Part of the operations of the proposed MCPP Project is to ensure that all pollution control devices will be installed and properly working in order to assure compliance with the DENR standards.

For the Project's security and the local residents' safety, MPGC shall establish an offshore exclusion zone that would extend approximately 850 m from the shoreline to the sea and about 1,870m parallel along the shore wherein both intake of Phase 1 and Phase 2 are situated. The delineation of the exclusion zone will comply with the guidelines of the DENR. **Figure 1-4** shows the exclusion zone of proposed MCPP.

1.7.1.5 Abandonment Phase

The proposed MCPP Project's expected life is approximately 30 years. However, if the plant is still needed due to electricity demand, it may have to be refurbished and/or upgraded for further operations. In the unlikely event that the operation of the power plant is no longer deemed feasible to operate and maintain, a decommissioning or abandonment plan will be prepared by the proponent. The abandonment plan will specify the proposed studies to be conducted (e.g., site assessment) and what equipment can be recovered, relocated, or sold, and the area will be developed based on the next industrial use of the site. If soil contamination is present, the subject area will be decontaminated through the appropriate measures. The green buffer zone will have to be retained.

1.7.2 Project Schedule

The MCPP Phase 1 Project is targeted to begin construction within the third quarter of 2018 and completion of the first 1x150MW unit by first quarter of 2021. The succeeding three units completion will follow thereafter with 3-months interval. Thus MCPP Phase 1 expected project completion by 4th quarter of 2021.

The MCPP Phase 2 Project is targeted to begin construction within 3rd quarter of 2019 and completion of the first 150-MW unit by 1st quarter of 2022, then succeeding three units completion will follow thereafter with 3-months interval. Thus MCPP Phase 2 expected project completion by 4th quarter of 2022.

The schedule of MCPP Project for Phase 1 & 2 is presented in **Figure 1-16** and **Figure 1-17** respectively**.**

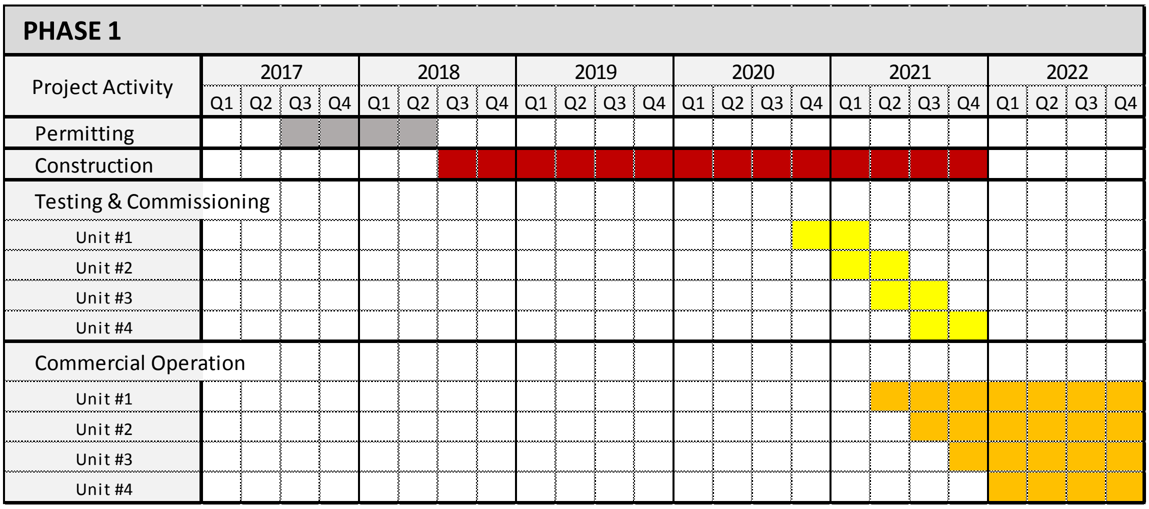


Figure 1-19 Proposed MCPP Phase 1 Project Schedule

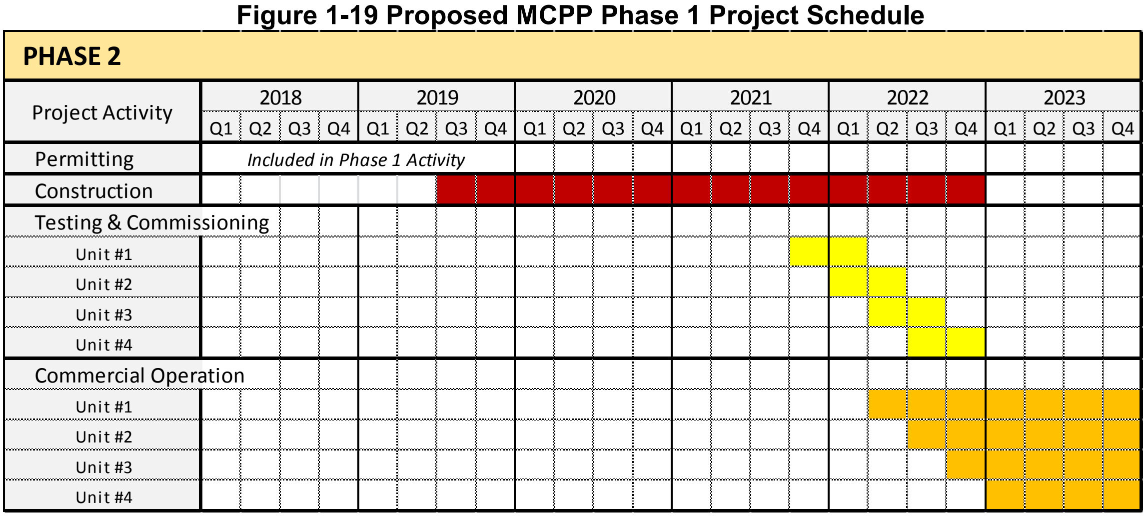


Figure 1-20 Proposed MCPP Phase 2 Project Schedule

1.8 MANPOWER

The manpower requirements of the proposed MCPP Project will be composed mostly of local skilled workers to be hired based on formal qualifications, experience and good moral character. Priority employment will be afforded to the local residents in the host barangay, surrounding barangays and Mariveles Municipality, provided they possess the necessary qualifications. Furthermore, MPGC will comply with the relevant provisions of the DOE Act (RA 7368) regarding local employment. The proposed MCPP Project is expected to employ approximately 2,500-3,000 workers during the peak construction period.

Since the project is under AFAB, employment of qualified local manpower will conform to AFAB requirements. **Annex 1-9** outlines the General Rules and Guidelines in the Recruitment of Workers by AFAB[7].

During the operation phase, it is estimated that 200-250 professional, technical and non-technical workers will operate and maintain the plant facility.

Temporary accommodation for some construction workers with required sanitary amenities will be installed. However, majority of the workers will be billeted in the surrounding communities in order to enhance the economic activity of these areas.

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[7] *As posted in AFAB Website, afab.gov.ph.*

1.9 INDICATIVE PROJECT INVESTMENT COST

The proposed MCPP Project and its components are estimated to cost PhP99.080 Billion or USD2.0642 Billion.

2.0 ANALYSIS OF KEY ENVIRONMENTAL IMPACTS

2.1 LAND

2.1.1 Land Use and Classification

2.1.1.1 General Land Use

The municipality of Mariveles is a first class municipality located at the southernmost tip of Bataan peninsula which is approximately 173 kilometers away from Manila in an overland trip. It is bounded by Manila Bay on the east, North Channel on the south, municipality of Limay on the northeast, municipality of Bagac on the northwest and West Philippine Sea on the west.

The municipality of Mariveles has a total land area of 15,930 ha. It represents 12% of the total land area of Bataan. Its land is classified into several land uses namely: built-in, industrial, parks or open space, forest lands and agricultural. Forest lands dominate the land use of the municipality, which covers 45% of the total land area. **Table 2-1** and **Figure 2-1** show the general land use of Mariveles.

Table 2-1 General Land Use of Mariveles

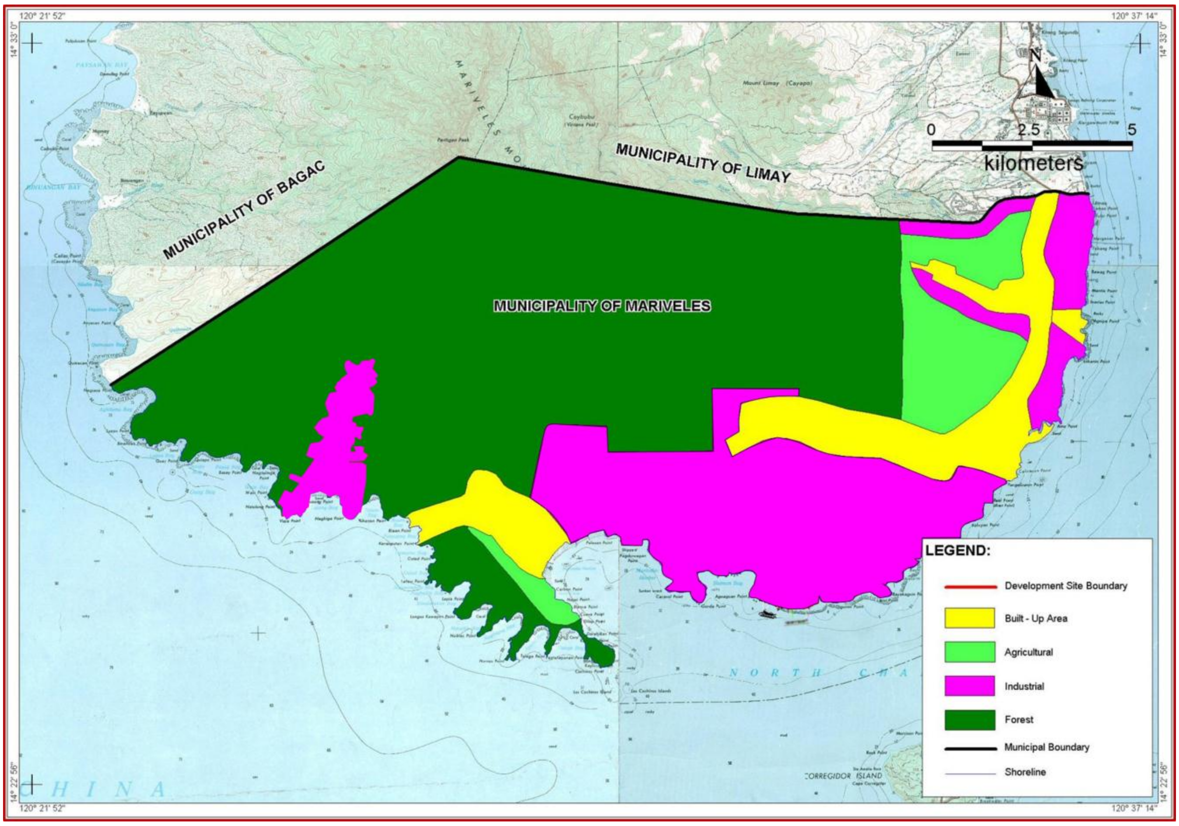
Land Use	Area (ha)	% Distribution
Built In	1,709.47	11%
Industrial	3,834.05	24%
Parks/open space	15.00	0.1%
Forest lands	7,231.61	45%
Agricultural	3,129.87	20%
Total	15,920.00	100%

The urban areas in the Municipality of Mariveles comprise of Barangays Poblacion, San Carlos, San Isidro and Balong Anito. The urban areas as classified herein have the following functional land uses: residential, commercial, institutional, parks or open space and industrial, as shown in **Table 2-2**.

Table 2-2 Urban Land Use of Mariveles

Land Use	Area (ha)	% Distribution
Residential	222.62	19%
Commercial	10.55	1%
Institutional	4.24	0%
Parks/Open Space	905.48	79%
Industrial	2.00	0%
Total	1,144.94	100%

Source: Socio-Economic Profile of Mariveles, Bataan



Source: 2002 CLUP of Mariveles, NAMRIA, modified by GTI 2018

Figure 2-1 General Land Use Map of Mariveles, Bataan

Mariveles Economic Zone

The proposed MCPP Project is located at the Mariveles Economic Zone within the Authority of Freeport Area of Bataan (AFAB). As shown in the allocation of area within the MEZ (**Figure 2-2**), the main plant of MCPP is sited in lots allocated for heavy industries, while the staff housing is located in a lot allocated for light industries.

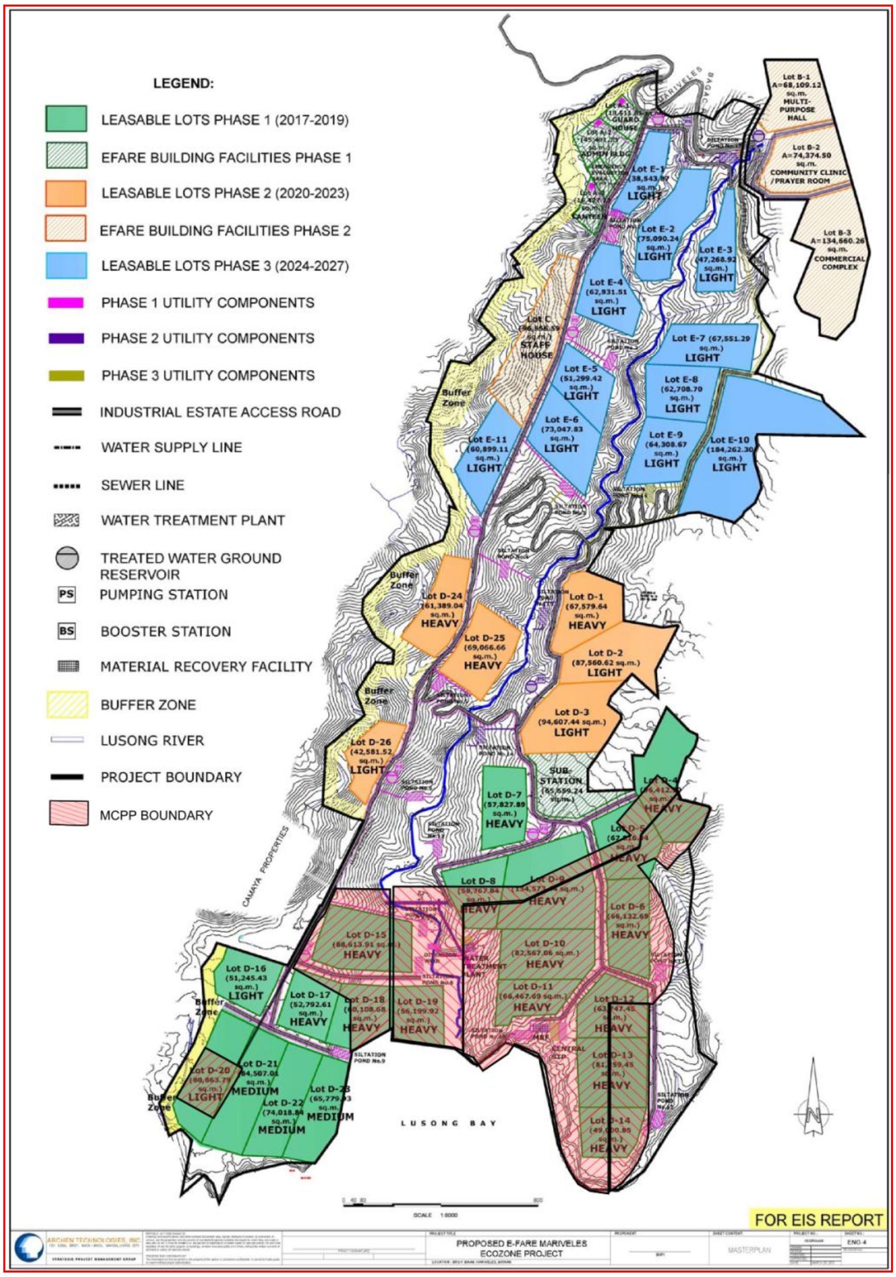


Figure 2-2 Allocation of Mariveles Economic Zone Showing MCPP Plant Boundary

2.1.1.2 Environmentally Critical Areas

Environmentally Critical Areas (ECAs) are environmentally sensitive areas declared under Presidential Proclamation No. 2146 of 1982 where significant environmental impacts are expected if certain types/thresholds of proposed project are located, developed or implemented.

Table 2-3 shows the assessment of the ECA in the proposed Project Site.

Table 2-3 Assessment of ECA at the Proposed MCPP Project Site

No.	Categories	The Project Falls within ECA Description			Basis: (a) State Specific Official Declaration of ECA; (b) List Specific ECA at the Project Site	Agency from which to Get Technical Information (if not available from EMB)
		Yes	No	Uncertain		
1	All areas declared by law as national parks, watershed reserves, wildlife preserves and sanctuaries		✓		The proposed MCPP Project is located within the Mariveles Economic Zone, which has been classified as an industrial area.	Authority of Freefort Area of Bataan and the Municipal Planning Development Office of Mariveles
2	Areas set aside as aesthetic, potential tourist spots		✓			
3	Areas which constitute the habitat for any endangered or threatened species of Indigenous Philippine wildlife (Flora and Fauna)		✓			
4	Areas of unique historic, archaeological, geological, or scientific interests		✓			
5	Areas which are traditionally occupied by cultural communities or tribes		✓		The NCIP has issued a Certificate of Non-Overlap for MEZ.	National Commission of Indigenous Peoples (NCIP)
6	Areas frequently visited and or hard hit by natural calamities (geologic hazard, floods, typhoons, volcanic activity, etc.)	✓			There has been no renewed volcanic activity expected from Mount Mariveles. No volcanic eruption has been recorded during historic period (for the past 500 years) for Mariveles Volcano. No volcanic deposit had yet been discovered with an age younger than 10,000 years. The youngest deposit described is about 190,000 years old. These features make Mariveles an inactive volcano. The proposed Project area is not flood prone. Project site is under medium typhoon risk, and is within an area experiencing 5 cyclones in three years.	PHIVOLCS, MGB, PAGASA

No.	Categories	The Project Falls within ECA Description			Basis: (a) State Specific Official Declaration of ECA; (b) List Specific ECA at the Project Site	Agency from which to Get Technical Information (if not available from EMB)
		Yes	No	Uncertain		
					The proposed MCPP Project site is potentially high to tsunami based on the Tsunami Prone Areas in the Philippines as published by PHIVOLCS. There is a record of tsunami events in near the MCPP Project in1677.	
7	Areas with critical slope: All lands with slope of 50% or more determined from the latest official topographic map from NAMRIA		✓		The slope of the Project Site within MEZ is at 0-30% which corresponds to areas with moderate slope to steep slope.	National Mapping and Resource Information Authority (NAMRIA)
8	Areas classified as prime agricultural lands		✓		The proposed Project site is classified as an industrial area.	AFAB and Municipal Planning Development Office of Mariveles
9	Recharge areas of aquifers		✓		The proposed MCPP Project site falls under the classification "Local and Less Productive Aquifers". This classification is attributed to the scarcity of productive wells in the area.	MGB
10	Water bodies characterized by one or any combination of the following conditions: tapped for domestic purposes; within the controlled and/or protected areas declared by appropriate authorities; which support wildlife and fishery activities.		✓		Lusong River located within the Project site is not included in the list of classified rivers of the EMB-DENR.	National Water Resources Board (NWRB)
11	Mangrove areas characterized by one or any combination of the following conditions: with primary pristine and dense young growth; adjoining mouth or major river systems; near or adjacent to traditional productive fry or fishing grounds; areas which act as natural buffers against shore erosion, strong		✓		There are no Mangrove Areas at the Project site.	Terrestrial Ecology Assessment conducted by GEOSPHERE

No.	Categories	The Project Falls within ECA Description			Basis: (a) State Specific Official Declaration of ECA; (b) List Specific ECA at the Project Site	Agency from which to Get Technical Information (if not available from EMB)
		Yes	No	Uncertain		
	winds and storm floods; areas on which people are dependent for their livelihood.					
12	Coral reefs characterized by one or any combination of the following conditions: With 50% and above live coralline cover; Spawning and nursery grounds for fish; Act as natural breakwater of coastlines.		✓		Marine ecology along the nearshore areas of MCPP indicates less than 50% mean hard coral cover [39.17% (±7.69%)], but described to be of generic diversity, good coral cover, and indicated good overall development of coral community.	Marine Ecology Assessment conducted by GEOSPHERE

2.1.1.3 Existing Solid Waste Management and Related Land Management Scheme in theArea

As presented in the EISR for MEZ, the SB Council of Mariveles has created the Environment Sanitation Management Office (ESMO) in 2005 which primary function was to manage the solid waste of the municipality and to maintain the cleanliness program of Mariveles. The EMSO conducted a clean-up of the old dumpsite (Figure 2-3) of Mariveles and used the area as garbage recovery facility (Figure 2-4).

Source: MEZ EISR

Figure 2-3 Open Dumpsite of Mariveles Before and After Compliance to RA 9003

Source: Socio-Economic Profile of Mariveles

Figure 2-4 Garbage Recovery Facility in Mariveles, Bataan

In 2009, the Municipality of Mariveles issued Kautusang Pambayan Blg. 71-2009 “Kodigo ng Sanidad sa Bayan ng Mariveles 2009”. Section 6 of the Sanitary Code of the Municipality of Mariveles requires all establishments, stall holders and similar establishments to have separate garbage can (biodegradable, non-biodegradable and recyclable) with cover and proper label in accordance to R.A. 9003 (Ecological Solid Waste Management Act) prior to the issuance of Sanitary Permit. (Seksiyon 4 Par. C-Mun. Ord. No.6-99) – all garbages, filths and other waste shall be placed in a proper receptacle for collection of garbage collectors.

2.1.1.4 Impact in Terms of Compatibility with Existing Land Use

The proposed MCPP Project is to be located at the Mariveles Economic Zone within the Authority of Freefort Area of Bataan, which was designated as industrial zone of Mariveles. The MEZ was issued a certification by FAB for its development of raw land property into an industrial center and economic zone. A copy of the certification is included as **Annex 1-1**.

Therefore, there is no issue with the change in land use.

2.1.1.5 Impact on Compatibility with Classification as an Environmental Critical Area

There is no identified ECA that will be encroached by the proposed MCPP Project, except for its medium typhoon risk and its being tsunami-prone area. Furthermore, the proposed MCPP Project site is classified as an industrial area by the Municipality of Mariveles. **Table 2-3** shows the assessment of the ECA in the proposed Project Site.

Camaya Coast

Camaya Coast is a beach resort approximately 1 km West of the project site, and is categorized as a tourist spot by the Department of Tourism.

Figure 2-5 Camaya Coast in Vicinity of Project Site

Coral Community Nearshore of MCPP

Although at present, the area covered by coral community nearshore of MCPP is below the threshold to be considered ECA, the assessment that it has potential for development may change its category in the future. MCPP shall address the condition of the coral cover as significant, and will provide mitigating measures to prevent and minimize its effects to development of the corals, while providing enhancement measures to help the coral community to further thrive. Specific measures will be discussed under the marine ecology section of this report.

2.1.1.6 Impact in Existing Land Tenure Issue/s

Since the proposed Project site is zoned as industrial, there will be no CARP related issues that will be discussed for the proposed Project. The project site does not overlap with CADT/CADC in the area.

The foreshore lease will be part of the lease agreement of MPGC with EFIHI. At present, EFIHI has already secured the approved foreshore lease plan from the DENR under FLA No. 030807-32 with an area of 14.95 has.

2.1.1.7 Impairment of Visual Aesthetics

There are no identified significant landforms or structures within the proposed MCPP Project site. However, the Camaya Coast, approximately 1 km from the MEZ site boundary, is a well-known resort and tourist attraction. The development of the proposed MCPP Project may cause adverse impact on the aesthetics of the said resort. Nonetheless, with its proposed mitigation measures and regular coordination with Camaya Coast Resort owner, the perceived adverse impacts would be accordingly addressed.

The MCPP will be designed with green and earth colors to blend with its natural surroundings.

With regards to the smoke being visible to the Camaya Coast, the MCPP will conform to the EMB guidelines of no more than 20% opacity or not darker than shade 1 in the Ringelmann Chart. A COMS will be installed in the smokestack for this purpose.

The smokestack of the MCPP will be visible from the resort, and visitors who approach the resort through ferry will see the power plant. Vessels delivering coal to the plant will also be visible from the resort visitors.

MPGC conducts regular coordination with Camaya Coast Resort owner to address the perceived adverse impacts of the MCPP.

2.1.1.8 Devaluation of Land Value as a Result of Improper Solid Waste Management and Other Related Impacts

Generation of waste and improper waste disposal may affect the soil quality in the area. The proposed MCPP Project will generate 1,500 kg/day of domestic solid wastes during construction phase and 125 kg/day of domestic solid waste during operation phase. Domestic solid waste will include paper, cartons, plastic, bottles, tin cans, rubber, food leftover, etc. Some hazardous solid waste that will be generated by the proposed MCPP Project include busted fluorescent lamps, spent industrial and car batteries, used oil, spent chemical cartridges and containers and expired chemicals.

A Solid Waste Management Plan will be implemented in the power plant facility, which includes minimization of waste generation and segregation. All domestic wastes will be temporarily collected and stored in waste bins properly sorted out into recyclables and non-recyclables before collection and disposal by the local government. Within six (6) months from generation, the hazardous wastes will be removed, transported and disposed according to acceptable practices. MPGC shall ensure that the hazardous waste will be properly treated and disposed of, by the DENR accredited transporter and treater. Regular soil quality monitoring will be conducted at the established sampling stations.

Burning of coal produces two types of solid wastes from the boiler; namely, bottom ash and fly ash. MPGC will sell to cement factories100% of its fly ash and dispose the bottom ash to its proposed ash disposal facility. The ash disposal facility for the proposed MCPP Project will be designed to accommodate both unused fly ash and bottom ash.

The ash disposal facility will be operated to comply with all applicable regulations and good environmental management practices.

2.1.2 Geology/Geomorphology

The geology of the project area as discussed in the EISR for MEZ is described below.

2.1.2.1 Topography and Geomorphology

The edifice of Mariveles Volcano represents a typical conical volcano with its radial symmetry capped by a large central crater. The mountain peaks at 1,388m on Pantigan Peak, found on the western rim of the 2km wide crater. The ridge that forms the crater rim shows a jagged outline with notches facing most of the major river systems that drain the volcano. To the north, the crater is breached to the crater floor where the Pantigan and Nabasag Rivers drain the summit depression into Manila Bay.

The symmetry of the slopes of Mariveles is broken by three satellite cones—Mounts Samat and Limay, and Sisiman Hill on the south. These smaller cones have small craters at their summits, with rivers draining their central portions. Mount Samat is found on the northern flank of the volcano, while Mount Limay is found on the east.

The relief of Mariveles' cone is zoned, being steep near the crater-rim and becoming more gentle with distance. Thus, the steepness of the slope forms concentric zones centered on the summit, having greater than 35% near the summit, bordered by a zone of 15 to 35 % at the middle slopes of the volcano, which in turn is surrounded by gentle slopes of 0 to 15% grade near the shore.

The project site is located on the southern flank of Mount Mariveles, in an area characterized by rolling hills with short steep cliffs near the streams and gentle slopes near the shore. East of the Mariveles are the Manila Bay and the extensive Central Luzon Valley, while south and north are continuations of the volcanic ridge that includes Mariveles and the other Bataan volcanoes. The project site is found on the southwest flank of the volcano, along the rising slopes that lead to the peaks of Mount Mariveles. The general trend of both the ridges and streams on this part of the volcano is northwest, following the radial drainage from the volcano's peak to the sea.

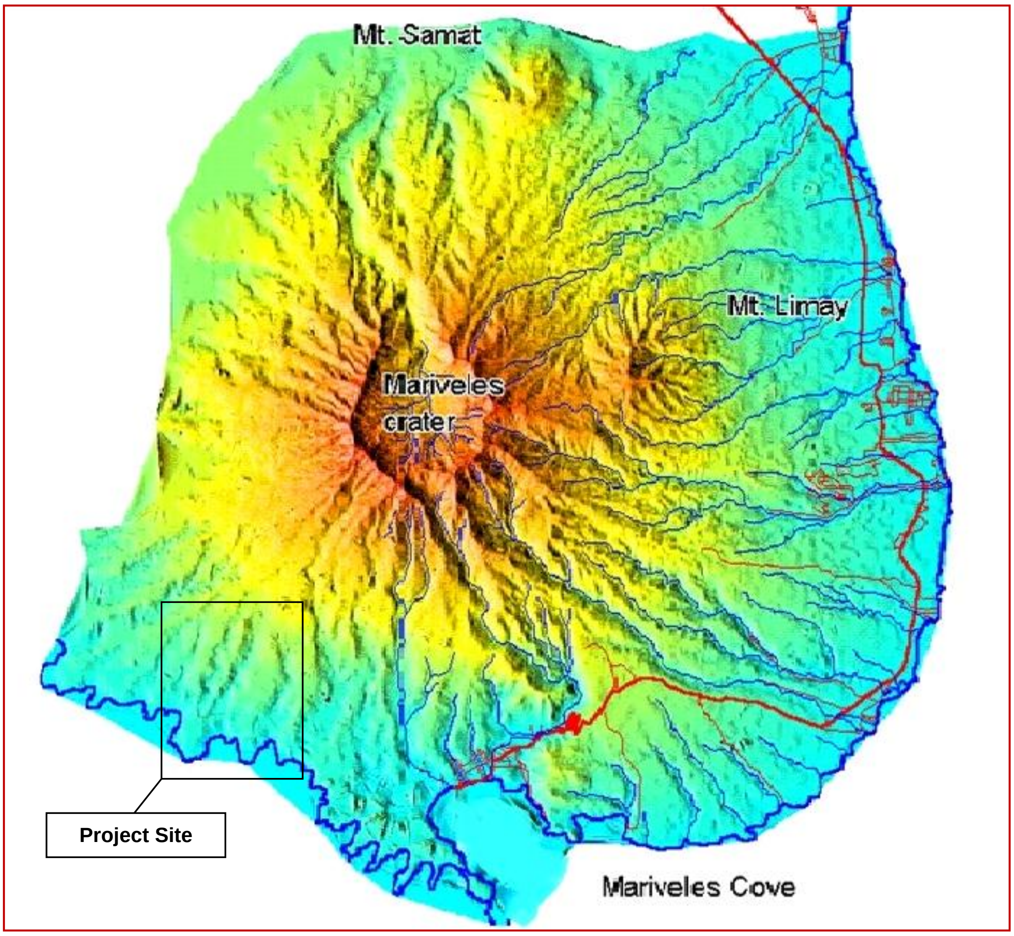
Figure 2-6 shows the general geomorphic features of the eastern part of Mariveles Volcano. This geomorphic map was derived from the digital topography to allow detailed analysis of the nature of the various landforms in the project site. Figure 2-6 indicates that several landforms are recognizable in the eastern slopes of the volcano, including the deeply dissected slopes found on the upper slopes and around Mount Limay and Sisiman Hill in Mariveles, the gentler slopes found mostly on the eastern slopes of the volcano, and the deeply dissected steep slopes found along rivers.

The outline and distribution of some of these features allow us to discern their probable source processes. The broad, steep and deeply dissected slopes are likely associated with the volcanic processes that formed the edifice of Mariveles Volcano, Mount Limay and the Sisiman Hill. Some lobate flow units are also discernible on the slopes of the volcano, their lower terminations ending with arcuate outlines that spread out laterally. In most instances, the upper slope terminations of these flows appear to merge probably due to the thinned upper edges of these deposits and to the effect of erosion. Some of the flow units appear to wrap around the edifice of Mounts Limay and Samat, indicating possible generation after these small volcanoes have formed.

Also discernible from the geomorphic maps are the existence of large fans on the eastern slopes of Mariveles Volcano. At least four separate fans are recognizable, each one with the distinctive narrow apex on their upper slope, and the broad, laterally spreading fan with semicircular contour lines. The lateral extent of these individual fans, and their juxtaposition to one another creates the apron of rolling slopes on the eastern part of Mount Mariveles. This continuity of the fans and their relatively less intense dissection indicate that these were likely created by the latest volcanic events of the volcano. The rivers on the eastern slopes of the volcano are now starting to cut into these fans, creating stretches of steep, crenulated slopes and river channels.

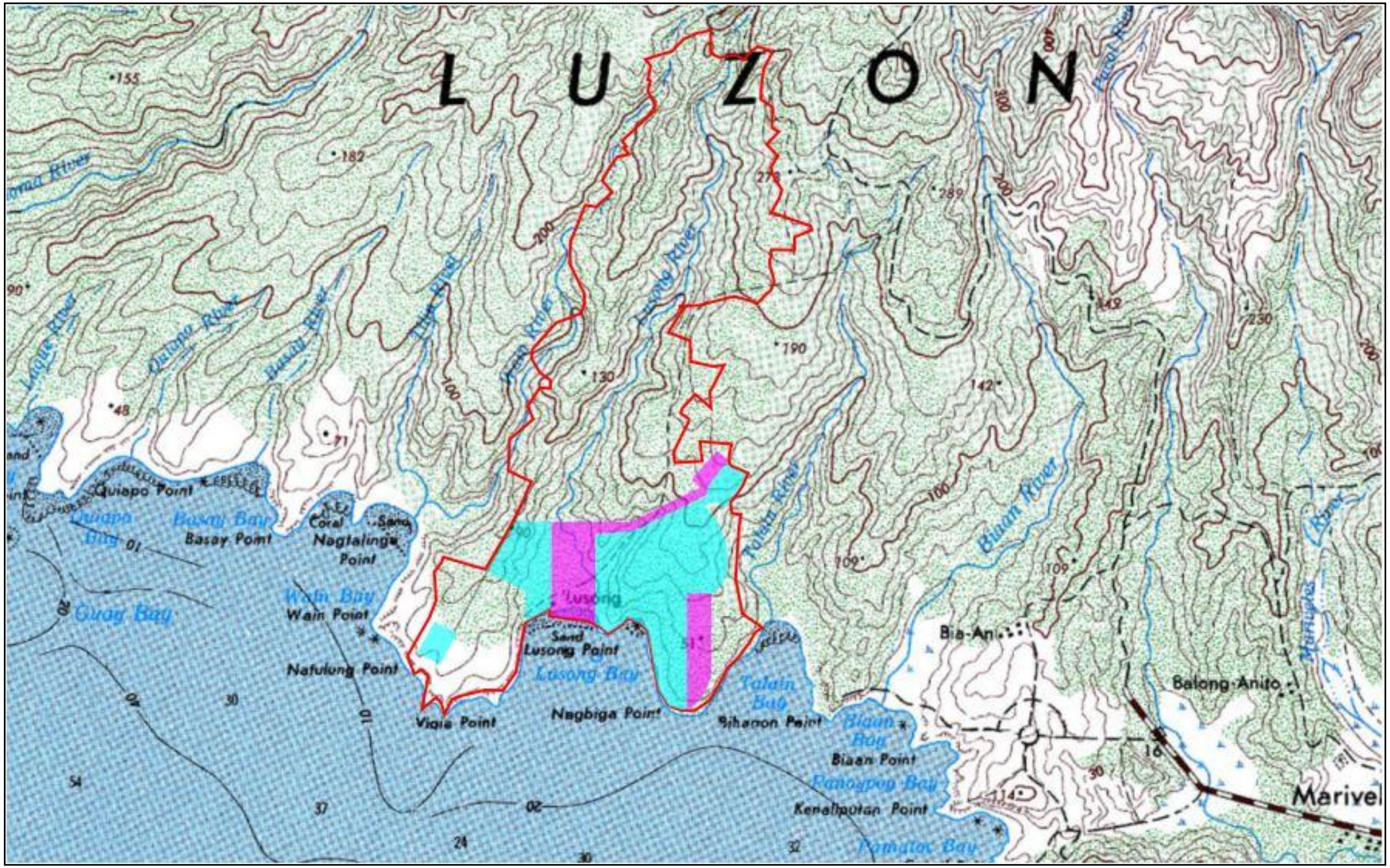
The geomorphic map indicates, therefore, that the proposed project site is located in the southwestern edge of Mount Mariveles, and underlain by its volcanic deposits. The site is generally rolling to hilly, with small patches of narrow flatlands are found along shore forming beach deposits.

The general topography of the project area is shown in **Figure 2-7.**



Source: MEZ EISR

Figure 2-6 Geomorphic Map of Mariveles Municipality



Source: MEZ EISR

Figure 2-7 Topographic Map of Mariveles

2.1.2.2 Regional Geology

Tectonic Setting

The project site is located in the southwestern flank of Mariveles Volcano, which is part of the chain of Quaternary volcanoes formed by subduction in the Manila Trench. The chain of volcanoes extends to Pinatubo, down to Natib and Mariveles, Corregidor, Taal and Palay-palay, and on to the volcanoes in northeastern Mindoro. This volcanic chain also serves as the border Lingayen Gulf—Central Luzon—Manila Bay—Laguna de Bay lowlands. Farther north, the volcanic chain blends with the Zambales Mountains while a series of smaller volcanic cones occur in the northern part of the Central Luzon plains as it merges with the Cordillera Mountains. The project area is part of the volcanic front adjacent to an active trench where ongoing subduction leads to faulting, volcanism and, in parts, rifting, are all taking place.

There are five (5) geotectonic features on this part of Luzon: (a) the Manila Trench and its related structures; (b) The volcanoes extending from Tarlac, Bataan, Batangas and Laguna; (c) the Philippine Fault and its branches, (d) the East Luzon Trough and (e) the local faults located in and near the project area.

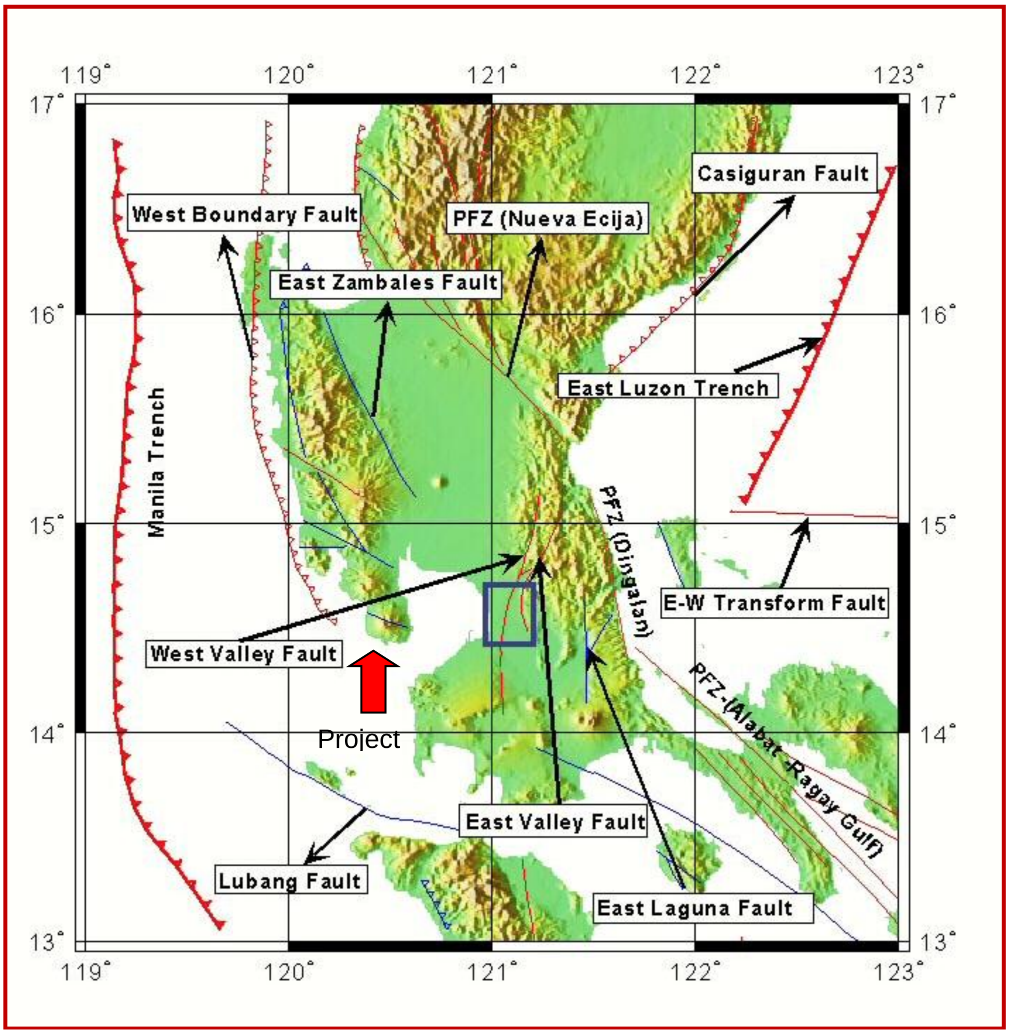
The Manila Trench marks the region where the ocean floor of the South China Sea dives under the Luzon landmass. This process, called subduction, is the main source of magmatism and seismic activity that generates the volcanoes and earthquakes in western Luzon. The Manila Trench is a deep ocean trough that represents the surface expression of the eastward-dipping subduction zone. The Manila Trench and subduction zone extend from north of Luzon to west of Mindoro (20° to 13° North latitude). The western Luzon volcanic arc is therefore part of the Luzon-Taiwan subduction system that follows the Manila Trench. The volcanic front results from partial melting of the crust due to the eastward subduction where parts of the South China Sea oceanic crust is melting after colliding with and diving down under the Luzon landmass. The volcanic arc is composed of a chain of volcanoes near the coastal area and several volcanoes behind the volcanic front. Volcanism in the coastal area, including Mount Pinatubo, Mount Natib, Mount Mariveles, and Corrigedor have very recent history of activity ranging from 2.26 million years to present. At present, the only active volcanoes on the western Luzon volcanic belt are Pinatubo and Taal Volcanoes. Mount Arayat is situated behind this active volcanic arc, and represents a line of extinct volcanoes in the Central Plains of Luzon including those on the northern end of the Central Plains in Pangasinan, where the three small cones of Amorong, Cuyapo and Balungao are found.

Tarlac, Bataan, Batangas and Laguna are known for their volcanoes. Pinatubo, Natib and Mariveles are prominent peaks with large craters formed by recent activities of the volcanoes. To the south and east, Corregidor provides the geographic link between the Bataan volcanoes to the Batangas-Laguna volcanic system. The volcanoes in Batangas and Laguna are characterized by large magmatic systems, with large calderas surrounded by lower volcanic cones and smaller craters. These peaks include Mounts Banahaw and Makiling, and the large volcanic lakes Laguna and Taal.

The Philippine Fault system is a northwest-trending fault zone whose branches have been mapped for 1,200 km from the eastern part of Mindanao to northern Luzon. Its trace passes through Ragay Gulf and Alabat Island, reaching about 80 km northeast of the project area. The Philippine Fault Zone is the biggest structural element in Philippine geology, cutting across many of the islands in the east of Mindanao and Visayas, and through a major part of Luzon. Seismic activity along this fault zone is also among most destructive in the country. Slip along the Philippine Fault Zone is left-lateral strike slip, accommodating the oblique convergence between the Philippine Sea and Eurasian/South China Sea plates. Several historic earthquakes in past have been clearly associated with this fault, the most recent of which are the 1973 Ragay Gulf earthquake whose epicenter is located east of the project site, and the 1990 Luzon earthquake whose epicenter is located northwest of the project site.

The East Luzon Trough is a deep oceanic trench that borders the eastern shores of Luzon, serving as a tectonic boundary between the Luzon arc and the Philippine Sea Plate which forms the western Pacific plate. The subduction along this trench is proposed by others (e.g., Hamburger, 1983) while its present seismotectonic activity is affected by the presence of the Benham Rise, the shallow oceanic platform due east of northern Luzon. The dominant tectonic process along the East Luzon trench is that of convergence, wherein the Philippine Sea Plate subducts under the Luzon arc along the East Luzon Trough. This subduction process is marked by the depression of the ocean floor along the East Luzon Trough, and by the intense and westward-deepening region of earthquakes. Both of these mark the site where portions of the western Philippine Sea oceanic crust is colliding with the landmass of Luzon and is being forced to dive into the earth's mantle.

The other major tectonic feature near the project site is the Philippine Fault. The Philippine Fault is a zone of predominantly northwest-trending faults whose branches have been mapped for 1,200 km along the eastern part of Mindanao to northern Luzon. Its trace passes through Ragay Gulf and Quezon which is about 100 km west of the study area. It is a broad complex zone of rifting composed of a number of faults of diverse directions. The segment of the fault in the Tayabas Isthmus shows an oblique left lateral structure with horizontal displacement larger than the vertical component. Several historic earthquakes have been clearly associated with this fault, the most recent of which are the 1973 Ragay Gulf earthquake whose epicenter is located east of the project site, and the 1990 Luzon earthquake whose epicenter is located in Nueva Ecija in Luzon. The Philippine Fault Zone is the biggest structural element in Philippine geology, cutting across many of the islands in the east of Mindanao and Visayas, and through a major part of Bicol. Seismic activity along this fault zone is also among most destructive in the country. Left-lateral slip along the Philippine Fault Zone accommodates the oblique convergence between the Philippine Sea and Eurasian/South China Sea plates. The location of the project site relative to the surrounding tectonic elements of the Philippines is shown in **Figure 2-8**.



Source: MEZ EISR by Bautista, 2001

Figure 2-8 Tectonic Map of Central Luzon

2.1.2.3 Bedrock Lithology

The MCPP Project site is located on the southwestern coast of Mount Mariveles, adjacent to small volcanic plugs and pyroclastic and lava flow deposits that appear geomorphologically older than the main edifice of Mariveles Volcano.

2.1.2.4 Stratigraphy

Mount Mariveles of a stratovolcano composed mainly of lava and pyroclastic flows, with debris flows and alluvial deposits forming in the lower slopes and river channels. Parasitic cones and necks are found on the sloped of the volcano, forming lower peaks on its north, east and south sides.

The geomorphic map (**Figure 2-6**) derived from the digital topography of the volcano allows us to identify major geologic features and relative ages of the deposits in the area. Six geologic units are recognized, from oldest to youngest, namely:

a) Proto-Mariveles deposits, including the Sisiman Plug
b) Main Mariveles Volcanics
c) Satellite Volcanics: (Mount Samat and Mount Limay)
d) Post-satellite Volcanics (Post-Samat flows, Post-Limay flows and Aleon Volcanics)
e) Late-stage pyroclastic fans (Pulong Bato, Lamao, Lucanin and Alasasin Pyroclastic fans)
f) Quaternary alluvium

Proto-Mariveles Volcanics

These are the rock units found on the southern slopes of Mariveles Volcano, particularly around the municipality of Mariveles. The rocks are composed of intercalating layers of pyroclastic flows, debris flows, volcanic breccia and minor lava flows. The cross-section of the unit is well exposed on the zigzag road leading down to the cove of Mariveles. The rocks are considered to be the oldest deposits of the volcano, and predate the main volcanic units of Mariveles based on the following features:

- Non-central position of the deposits, being concentric to and radiating from an eruption center located south of the present Mariveles crater.
- Higher degree of erosion of the slopes, and
- On-lap and over-lap covering of this deposit by the Main Mariveles units

The composition of the rocks appears similar to the other Mariveles rocks, the lava being andesitic, and the pyroclastic clasts containing abundant dacite materials. A large crater is also found on the slope, possibly resulting from a non-central explosion and creating the embayment now occupied by Mariveles Bay. These rocks may represent the older units determined to be around 2.8 to 4.1 million years (EBASCO-PNPP report) found around the Mariveles Harbor. The proposed project shall be located on the area underlain by these deposits.

Included in this Proto-Mariveles volcanics is the andesite volcanic plug located to the east of the Mariveles Municipality. The Sisiman Plug is a low hill composed of massive andesite lava that may have congealed in a volcanic neck and exposed by later explosions and erosion. The plug has been quarried for concrete aggregate, and appears to be the only place on this side of the mountain where such small volcanic necks can be found.

Main Mariveles Volcanics

This unit forms the main edifice of the volcano, and is composed of lava flows, pyroclastic flows, debris flows, volcanic breccia, airfall materials (ash, agglutinates and bombs), crater deposits and various intrusive that are collectively attributed to the main crater of the volcano. These deposits are found in many areas around Mount Mariveles, from the central crater to the coasts.

The geomorphic features of the volcano reveal the form of the flow units, characterized by a continuous down-sloping ridge, often flanked with prominent valleys, and showing bulbous toes on their lower terminations. These flows radiate down from the main crater, and their relative overlapping features can be used to indicate their age. These flow structures are shown as arrows in the geologic map (**Figure 2-9** Geologic Map of Mariveles Volcano).

The summit part of the volcano is occupied by a large crater which was probably formed by the coalescence of several large craters, as suggested by the discontinuous, non-alignment of some parts of the crater rim. The large crater of the volcano may have formed a lake in the past, but is now breached to the north and drained by a river. The geomorphic features also indicate that the western half of the volcano is more dissected than the other parts, suggesting that probably the western sections may host older deposits than the other part of the Main Mariveles Volcanics.

On the southern part of the volcano, the flow units are found to have interacted with the Proto-Mariveles deposits, indicating that many of the flow units from the Mariveles crater encountered some promontories that held back but overrun by later volcanic flow units. This feature supports the concept that the southern part of the volcano around Mariveles Harbor hosts the older volcanic deposits.

Based on the age dating done by EBASCO for the PNPP, the ages attributed to the rocks of Mariveles range from 1.1 to 0.19 million years. Due to the geomorphic features we have mapped, we assign the older ages, from 1.1 to 0.47 million years to the Main Mariveles Volcanics.

Table 2-4 shows representative chemical composition of the Mariveles rocks, as presented by BMG (1982).

Table 2-4 Representative Chemical Composition of the Mariveles Rocks (MGB, 1982)

Component	Specimen A	Specimen B	Specimen D	Specimen E
SiO2	58.63	50.03	57.23	58.65
TiO2	0.67	0.69	0.60	0.54
Al2O3	18.09	18.97	17.83	18.23
Fe2O3	8.13	10.40	8.68	8.08
MgO	3.42	4.84	3.81	3.29
CaO	7.32	9.98	8.18	7.73
Na2O	3.43	2.70	3.02	3.38
K20	1.15	0.96	1.22	1.12
Total	100.	84	98.57	100.57
Age Million Years	3.44 + 0.24	1.1 + 0.1	~3.9	0.19 + 0.04 years

Source: MEZ EISR

Satellite Volcanics

On the flanks of Mariveles Volcano are parasitic cones formed when magma followed conduits that stem from the main plumbing system of the volcano. Many such flank cones are smaller than their “parent” cones, and lived at a much shorter period than the main volcano. Mounts Samat and Limay, found on the north and eastern flanks of the volcano, are parasitic cones. Both these volcanoes are low, conical mountains and formed with their base overlapping with the main Mariveles cone. Both parasitic or satellite cones have formed craters of their own, which are now breached and drained by rivers that reach their central areas. Geomorphic features of the deposits around Mounts Samat and Limay indicate that some of the flows from the main Mariveles cone formed after the satellite cones were inactive. This is suggested by the flows that came down from Mariveles and encircled the satellite cones. Age dating of the rocks from Mounts Samat and Limay yielded 0.71 and 0.95 million years, supporting the notion that these parasitic cones were active during, but ceased earlier than the main Mariveles Volcano’s activity. Included in these deposits are the volcanic flows found in the middle sections of the Lamao River watershed. These younger flow units are collectively designated as the Post-Satellite Volcanics in the geologic map. Table 2-5 shows representative chemical composition of the Limay and Samat rocks, as presented by BMG (1982).

Table 2-5 Chemical Composition of Mounts Limay and Samat Rocks (MGB, 1982)

Component	Limay	Samat
SiO2	48.28	50.53
TiO2	0.73	0.84
Al2O3	18.42	18.56
Fe2O3	11.52	11.20
Mgo	6.05	5.16
CaO	11.32	9.69
Na2O	2.16	2.91
K20	0.63	0.90
Total	99.11	99.79
Age Million years	0.95 + 0.09	0.9 + ?

Late-stage Pyroclastic Fans

The geomorphic map of Mount Mariveles indicates that the youngest volcanic processes formed deposits that apron a large part of the eastern flank of the volcano. At least four of such fans exists on the eastern flank, forming a continuous apron that covers the middle slopes and extending down to the coastal area. The landform and outcrop features of the Late-stage Pyroclastic units suggest these to have been formed as pyroclastic flows coming from Mount Mariveles. These flows issued out from the central crater probably during large Plinian eruptions that overtopped the crater rim, causing pyroclastic materials to cascade down the slopes to fill the valleys and to form the large fans on the lower reaches of the volcano. The flows have distinctive pointed apex on their upper parts that was formed on a former river valley that channeled these flows. On the lower parts, the flows spread out into a fan when large volumes of materials covered the shallow valleys, causing the flows to radiate into overlapping flow units.

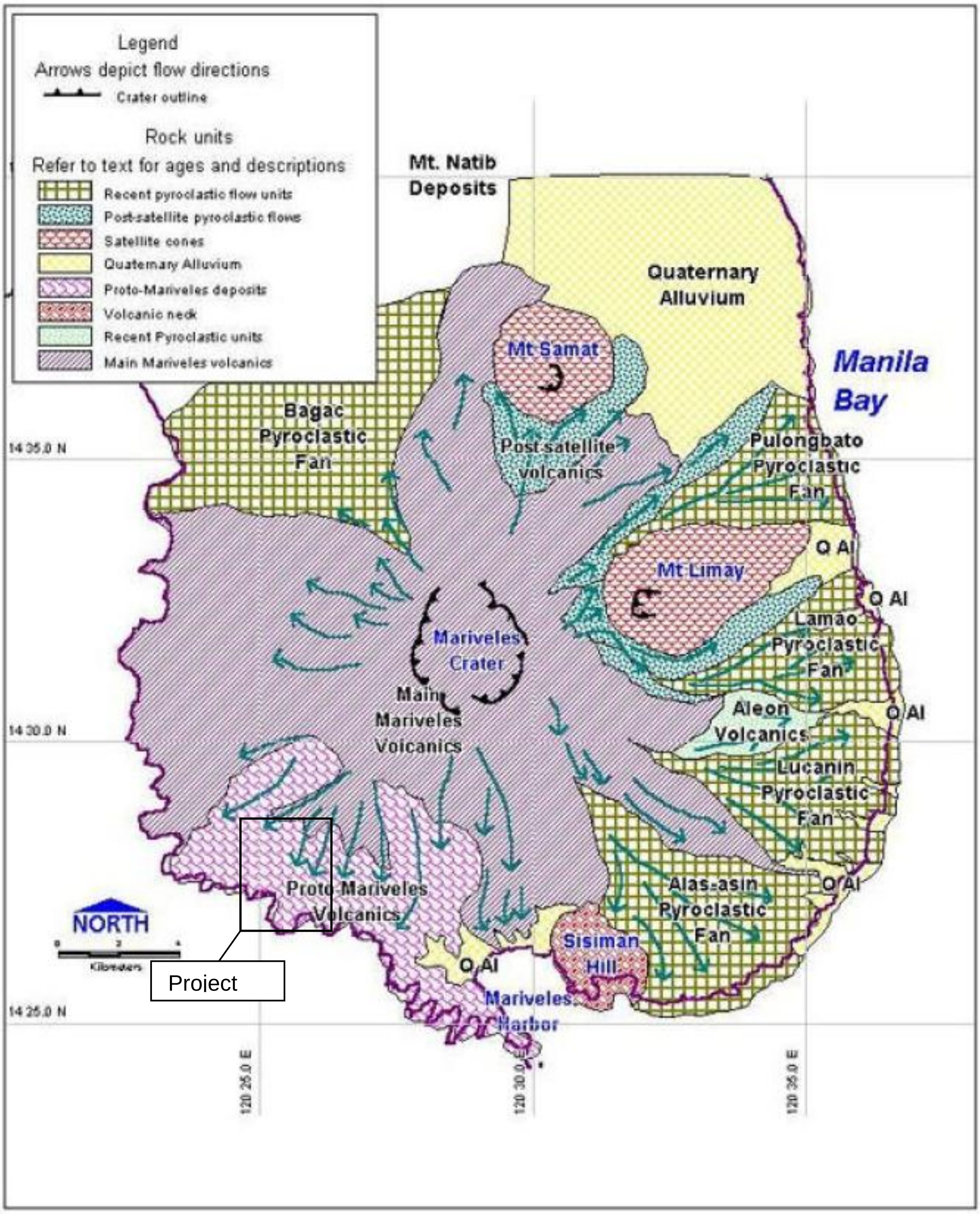
On the southern side of the volcano, the pyroclastic flows encountered the Sisiman Hill, ramped up on the low ridge and deflected to the easterly direction, forming the Alasasin Pyroclastic Fan. Around Mount Limay, these pyroclastic flows were directed around the satellite volcano by the rivers that encircled the cone, forming the Pulongbato and Lamao Pyroclastic Fans. Along the southern edge of the present Lamao River watershed, a pre-existing river channel directed the flow into a valley forming the Lucanin Pyroclastic Fan.

The Late-stage Pyroclastic Fans are the youngest volcanic processes recognizable in the geomorhic maps. Based on the geomorphic features of the fans, their surfaces are being disected by stream erosion, but their general fan form still retains the surface structures, indicating that the deposits are as old as the other slopes of Mariveles. It is therefore probable that these flows are several tens to a few hundred thousand years in age. These deposits may represent the youngest deposits in the analysis made by EBASCO, dated at 0.19 million years.

Quaternary Alluvium

The youngest geologic units in the project site are the unconsolidated sediments found in river valleys and in the coastal plains. These deposits were formed by the recent fluvial and coastal processes and are composed of detrital materials derived by weathering and erosion from the lavas and pycroclastics of Mariveles. The sediments are made up of varying sizes from boulders to sand, silt and clay. The coarse fragments are found strewn along river beds and in river terrace deposits. Finer deposits are found near the coast where the wave processes help in reducing the size of the fragments.

These alluvial deposits are found in the lower sections of volcano, near the coast and along the major rivers. Narrow beach deposits are also found along the shore. Also included in the Quaternary deposits are the patches of coral growths found along the shore and in deeper parts of the sea. The Alluvial deposits constitute the surficial deposits found at the stream channels and other shores.



Source: MEZ EISR by E. Ramos, PHILVOCS, 1998; Modified by GTI 2016

Figure 2-9 Geologic Map of Mariveles Volcano

2.1.2.5 Natural Hazards

2.1.2.5.1 Seismic Hazards

Intense ground shaking is the main hazard associated with earthquakes, with ground rupture/fissuring, tsunami and landslides as collateral hazards. The degree and extent by which the area is affected by these seismic hazards will depend on the magnitude of the earthquake, proximity to the earthquake source and the site's geologic conditions.

No local fault had been encountered in outcrops nor indicated in the geomorphic maps of the area. The available geological maps also do not contain any significant structure in the southern coast of Bataan Peninsula. Figure 2-9 shows the structures and faults identifies around the proposed Project site. Many of the faults belong to either the north-south trend that cuts across the Mariveles Crater, and to the east-west set of structures that appear to traverse the geologic units both in the north and southern flanks of the volcano.

On a regional scale, there are other structures that can generate earthquakes which can affect the project site (Figure 2-9). The Philippine Fault Zone is a northwest-trending fault zone whose branches have been mapped for 1,200 km along the eastern part of Mindanao to northern Luzon. Several historic earthquakes in past have been clearly associated with this fault, the most recent of which are the 1973 Ragay Gulf earthquake whose epicenter is located east of the project site, and the 1990 Luzon earthquake whose epicenter is located north of the project site. The East Luzon Trough is a deep oceanic trench that borders the eastern shores of Luzon, serving as a tectonic boundary between the Luzon arc and the Philippine Sea Plate which forms the western Pacific plate. The Manila Trench is a subduction zone on the western coast of Luzon, where melting is attributed to cause the volcanism from Pinatubo to Taal. Also associated with the activity of Manila Trench are the tectonic earthquakes which are the common source of seismic activity felt in the Bataan area.

The vulnerability of the middle portions of Luzon to earthquakes and other seismic activities is caused by the presence of the following geologic structures. These structures were discussed in the preceding sections and their location is shown on **Figure 2-9**.

a) Philippine Fault and its branches
b) Manila Trench and its related structures
c) East Luzon Trough
d) Lubang Fault
e) Casiguran Fault

The **Philippine Fault** is a major active geologic structure in the Philippines that is closest to Metro Manila. The fault traverses the Philippines in a northwest-southwest direction from Luzon to Mindanao. Movement along the Philippine Fault is left lateral causing land on its northeast to move to the northwest. The most recent large earthquake associated with movement along the Philippine Fault is the 1990 earthquake that affected most of northern Luzon.

The **Manila Trench** greatly influences the geology, volcanism and seismic activities in the central part of west Luzon. The trench marks the collision of the South China Sea Plate with the Luzon landmass causing the oceanic crust to dive under Luzon Island. The subduction process resulted in a deep trench and the melting of crustal materials produced the volcanoes found on the western part of Luzon (e.g. volcanoes of Bataan, Pinatubo in Zambales, and Taal in Batangas). Frequent earthquakes felt in the western side of Luzon manifest the continuing movement of the colliding plates. The Manila Trench subduction zone extends from the northern coast of Luzon near Taiwan until the western coast of Mindoro and Panay. A branch of the structure appears to merge into the northern shores of Mindoro along the Verde Island Passage. The western end of this structure is called the Lubang Fault and it appears to extend further east into the Verde Island Fault. The Manila Trench and its related structures are one of the seismically active zones in the Philippines.

The **East Luzon Trough** is a deep oceanic trench that borders the eastern shore of Luzon and serves as the tectonic boundary between the Luzon Arc and the Philippine Sea Plate. The presence of the shallow oceanic platform called Benham Rise on the east of Northern Luzon possibly affected the subduction along this trench. Convergence is identified as the dominant tectonic process along the East Luzon Trough and is manifested by faulting and crumpling of the crust along the Sierra Madre Mountain Range.

Lubang Fault has been assessed by PHIVOLCS to have lower potential for generating destructive earthquakes due to its periodic release of stress. It is a strike slip fault located between Mindoro and Batangas and extends to the southern edges of Manila Bay.

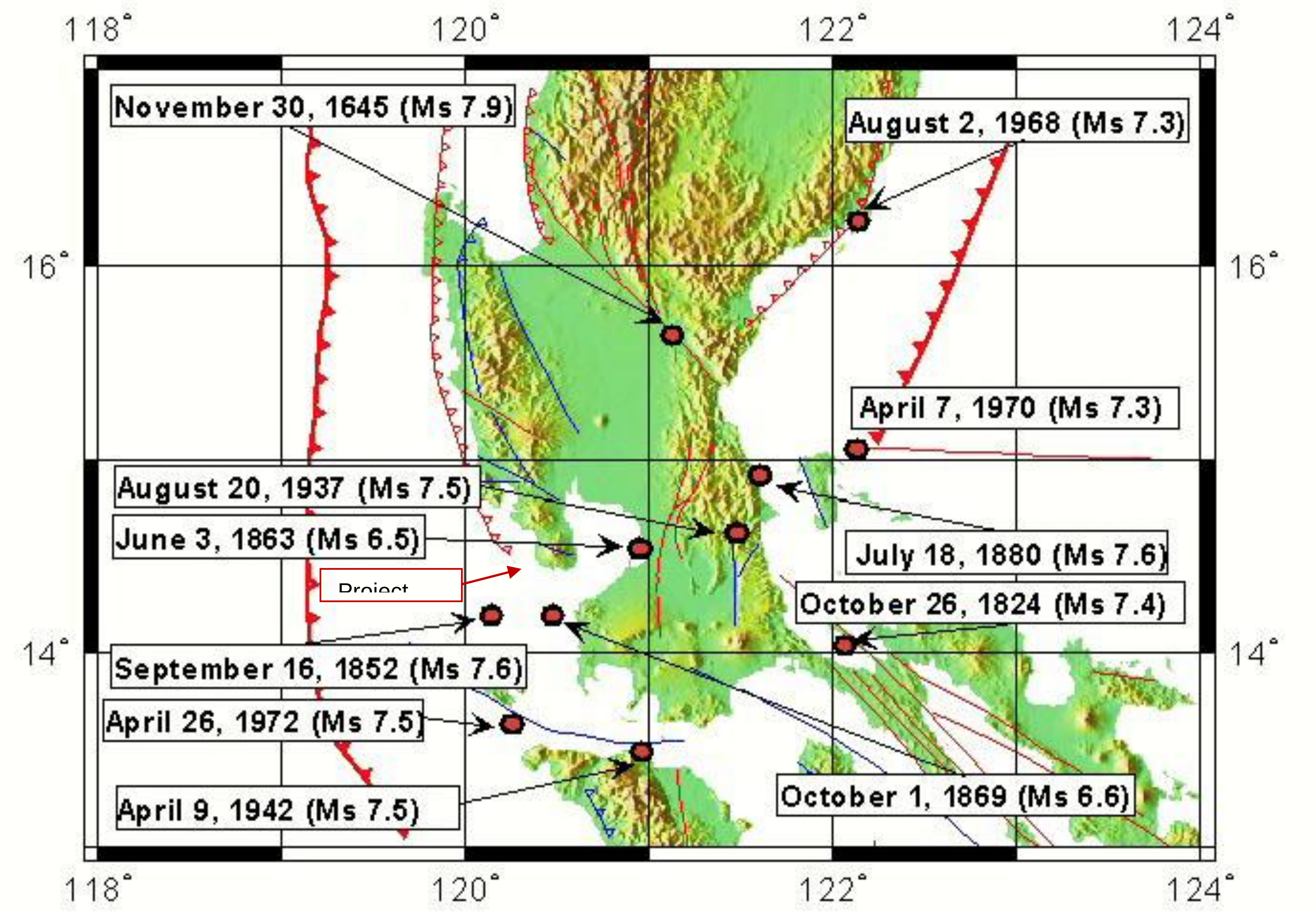
Casiguran Fault is estimated to have caused 30% of the earthquakes that affected Metro Manila. It is located on the eastern side of Luzon in the vicinity of Casiguran, Aurora.

Bautista (2001) states that at least 23 earthquakes during the past 400 years caused minimal damage to population areas in the region, particularly Manila while 13 earthquakes caused significant damage to the population. The most damaging earthquakes are listed below and their location is shown on **Figure 2-10**.

- 30 November 1645 (Ms 7.9)
- 26 October 1824 (Ms 7.4)
- 16 September 1852 (Ms 7.6)
- 03 June 1863 (Ms 6.5)
- 01 October 1869 (Ms 6.6)
- 18 July 1880 (Ms 7.6)
- 20 August 1937 (Ms 7.5)
- 09 April 1942 (Ms 7.5)
- 02 August 1968 (Ms 7.3)
- 07 April 1970 (Ms 7.3)
- 26 April 1972 (Ms 7.2)

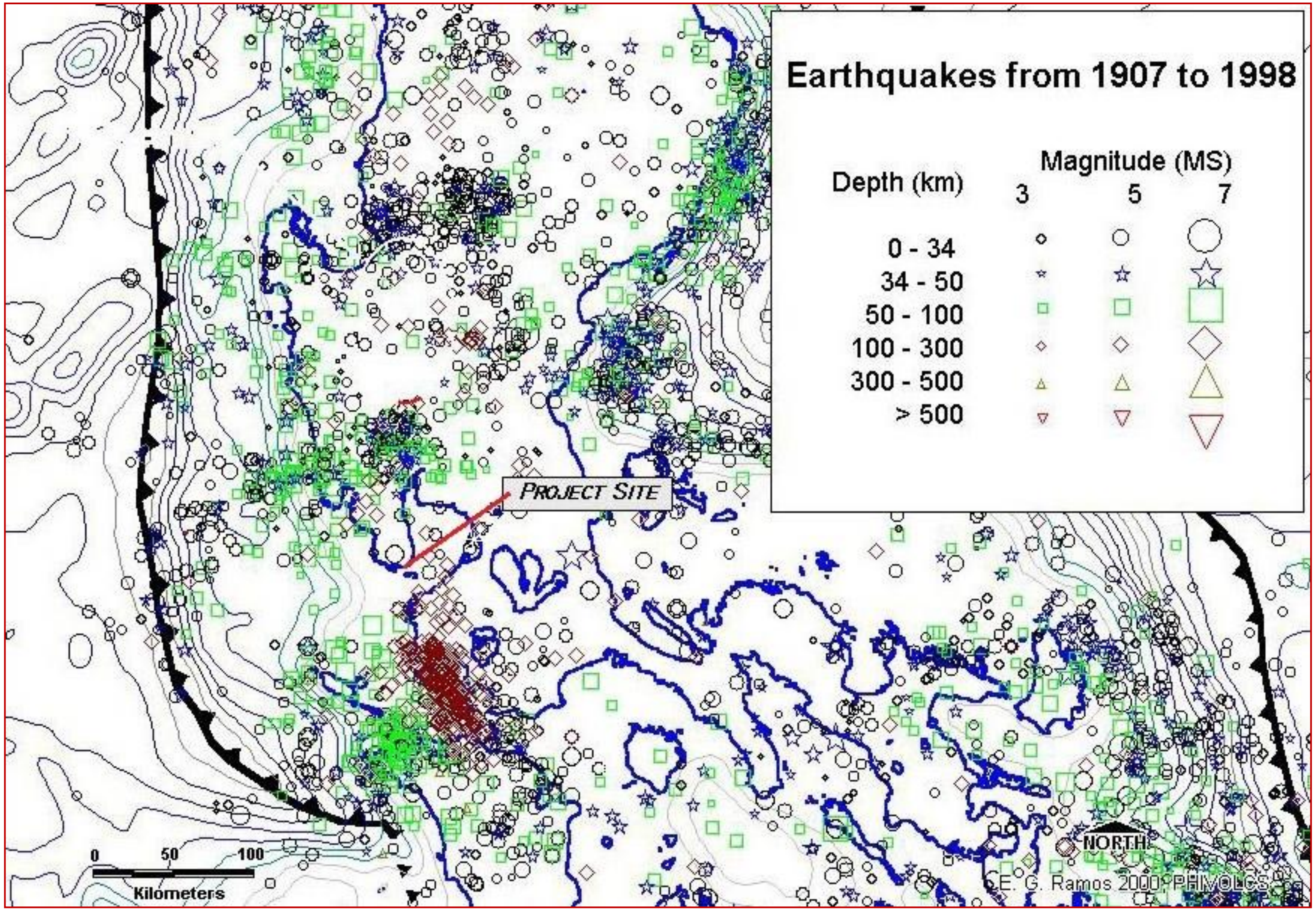
These earthquakes were caused by activities along the Philippine Fault zone, Manila Trench, East Zambales Fault, East Laguna Fault, and the Casiguran Fault-East Luzon Trench region. The damage incurred during these earthquakes was attributed to poor construction practices and unfavorable geologic conditions (i.e. soft soil and presence of thick sediments near riverbanks and reclaimed areas).

Figure 2-11 presents the seismicity map of surrounding Bataan. As shown on the map, relatively shallow and low-magnitude earthquakes have affected Bataan and nearby areas from 1907 to 1998.



Source: MEZ EISR

Figure 2-10 Epicenters of Historical Earthquakes that affected Metro Manila (Bautista, 2001)



Source: MEZ EISR by E.G. Ramos, PHIVOLCS 2000

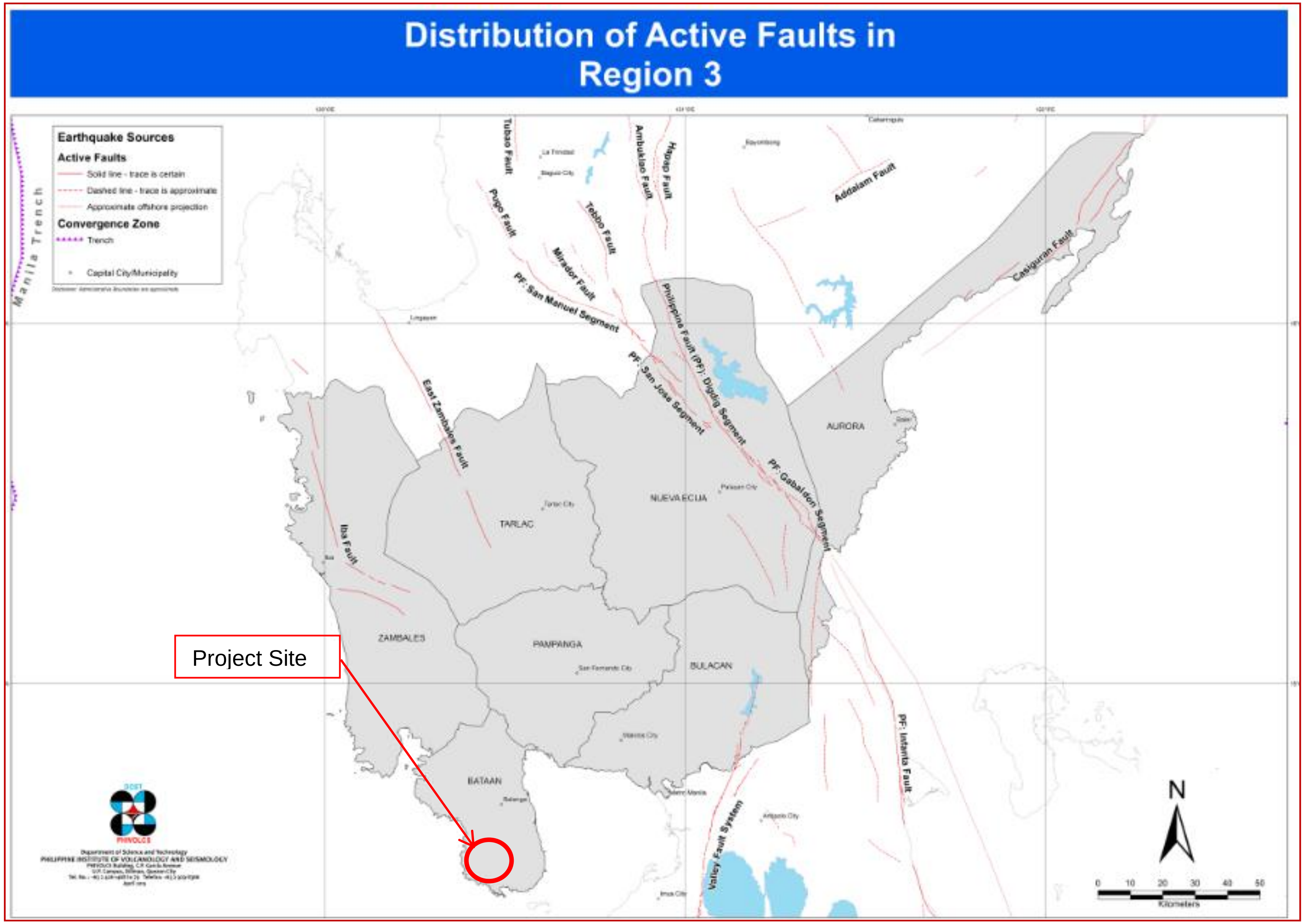
Figure 2-11 Seismicity Map of Project Area and Vicinity

Figure 2-11 shows the plot of the earthquakes that were recorded around the project area from 1907 to 1998. Most of the earthquakes plotted in the figure belong to three clusters, one along the eastern shores of Luzon, around Polilio Island, another cluster exists on the western coast of Luzon around Mount Pinatubo, and the third cluster is south of Taal Volcano, along the northern shore of Mindoro. Seismicity in these three clusters is influenced mostly by the subduction processes in these sites, as modified by the local volcanic and tectonic structures. Other earthquakes plotted in the map that are not related to the three clusters are generated by the major faults that cut the Philippine archipelago.

Seismicity along the East Luzon Trench is characterized by a sequence of destructive earthquakes that started from 1968 and ended in 1985. These earthquakes are caused mainly by the convergence between the Benham Plateau and Luzon, and may be genetically linked to the 1990 Luzon earthquake.

Seismicity along the Manila Trench is not uniformly distributed. More earthquakes occur on the region east of Baguio whose activity commenced after the 1990 earthquake, on the region around Mount Pinatubo, and on the southern end of the trench near Lubang Island.

Some of the events shown in **Figure 2-10** are caused by faults. These include the events along the Verde Island Passage, and the events along the Philippine Fault system. The earthquake in Mindoro in 1994 had a magnitude of 7.4 and caused a tsunami with severe damage to the communities in the northern coast of Mindoro. The waves from this tsunami reached about 8 meters in some parts, although most areas reported waves of around 3 to 5 meters high. The tsunami also caused scouring of the land, where debris and water rushing out caused significant erosion along old and newly-formed channels.



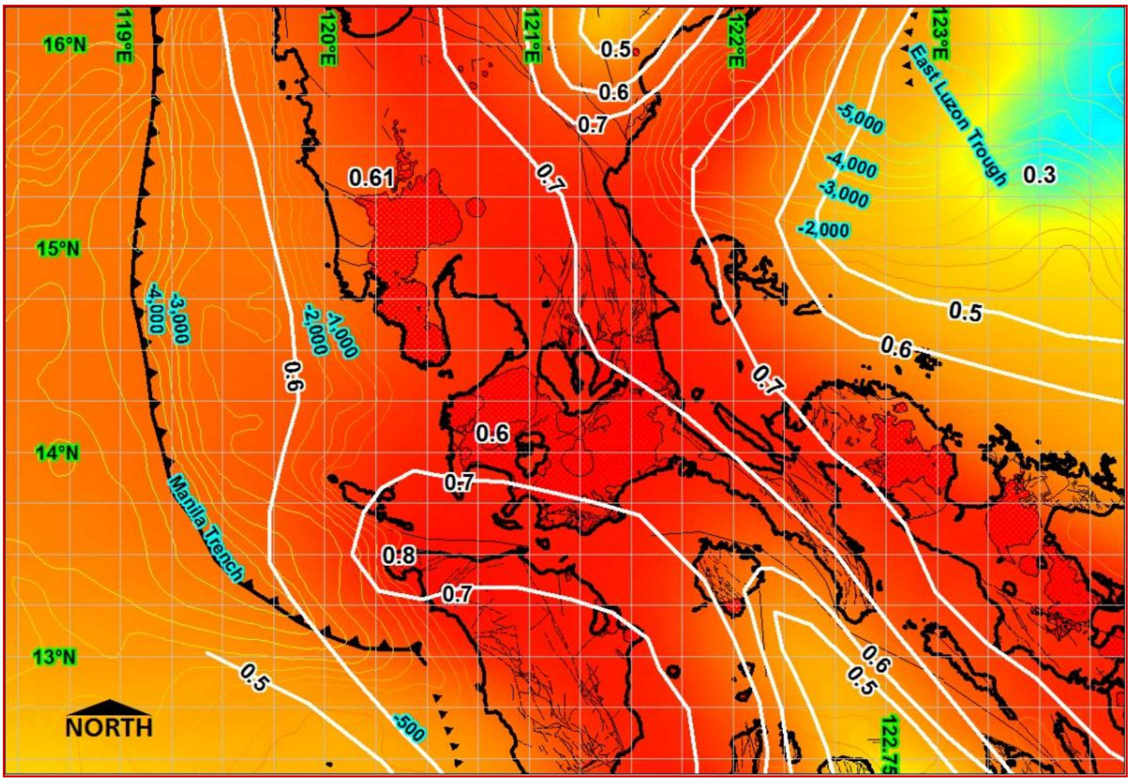
Source: MEZ EISR from PHIVOLCS

Figure 2-12 Distribution of Active Faults in Region 3

2.1.2.5.2 Ground Acceleration

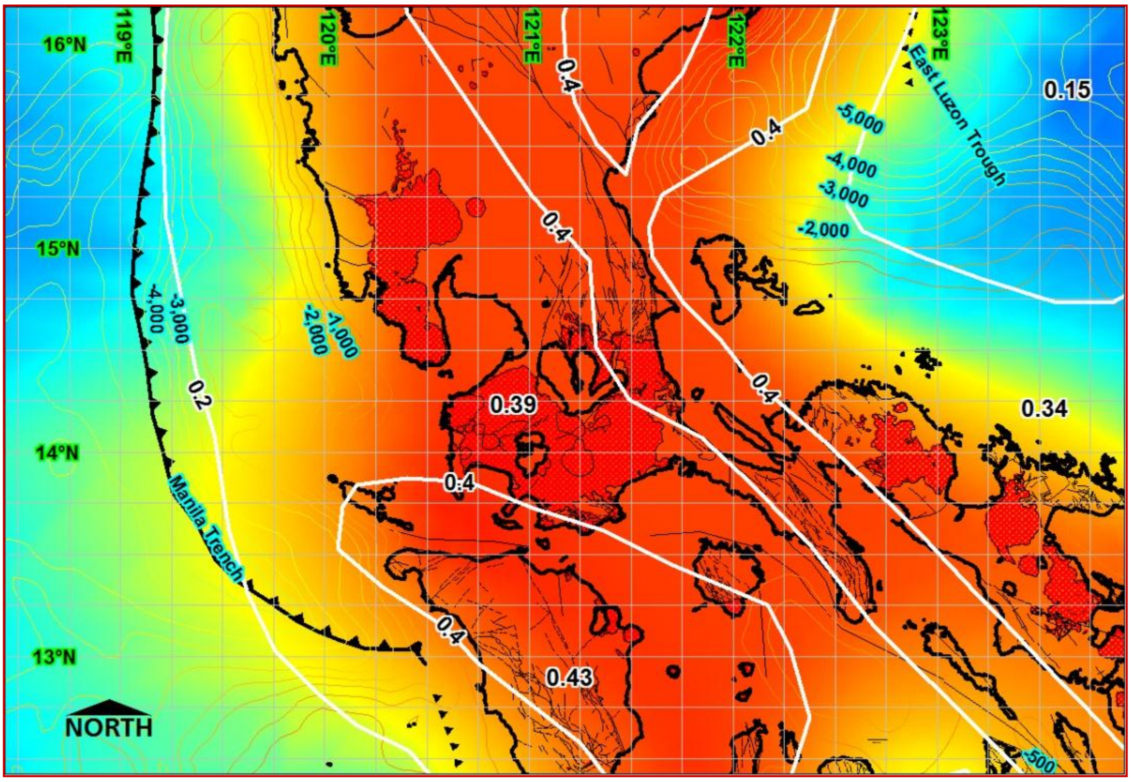
Ground shaking due to earthquake is one of the potential geologic hazards to the project site and vicinity. Ground shaking is a well-recognized geologic hazard in the Philippines considering that the country is located in a tectonically active region where seismic activities such as earthquakes normally occur. Numerous studies on ground shaking have been conducted, the most important of which is a study conducted by PHIVOLCS and USGS on the expected seismic acceleration in the country. Thenhaus, et al. (1994) used the analysis of time, space and size distribution of earthquakes to evaluate the distance-dependent distribution of seismic energy and presented the results in three soil conditions. The results of the calculations are shown in **Figures 2-13** to **2-15** for the soft soil, medium soil and rock conditions.

The maps show the influence of position of the faults and other geologic structures because the expected seismic acceleration values vary parallel to the tectonic features. The peak ground acceleration value for medium soil in Metro Manila was estimated at 0.4g while that for rock condition is estimated at 0.2g. These values have the probability of being exceeded in 50 years.



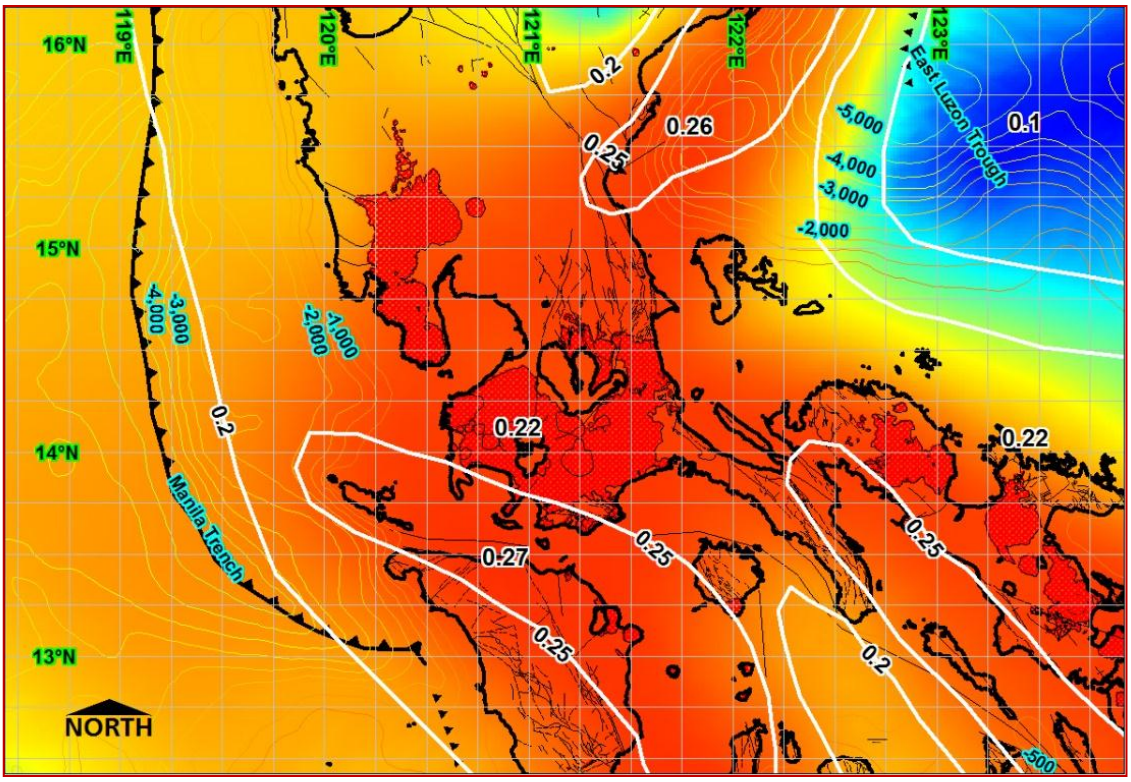
Source: MEZ EISR by Thenhaus et al., 1993

Figure 2-13 Peak Ground Acceleration Contour Map for Soft Soil



Source: MEZ EISR by Thenhaus et al., 1993

Figure 2-14 Peak Ground Acceleration Contour Map for Medium Soil



Source: MEZ EISR by Thenhaus et al., 1993

Figure 2-15 Peak Ground Acceleration Contour Map for Rock

Deterministic estimation of expected peak ground acceleration values resulting from earthquakes generated by the three major earthquake generators, the East Luzon Trench, Manila Trench and the Philippine Fault is presented in the table below. The estimates were derived using the Fukushima and Tanaka (1990) equation and the distances to nearest faults provided by PHIVOLCS and estimated in geologic maps.

Table 2-6 Deterministic Calculations of Peak Ground Acceleration Attributed to Various Earthquake Generators Around the Project Site

Seismic Generator	Distance from Site	Magnitude	Peak Ground Acceleration (PGA)	
			Medium Soil	Rock
East Luzon Trench	180 km	7.5	0.023	0.016
Manila Trench	205 km	7.0	0.031	0.021
Philippine Fault	37 km	8.0	0.078	0.054

Source: MEZ EISR

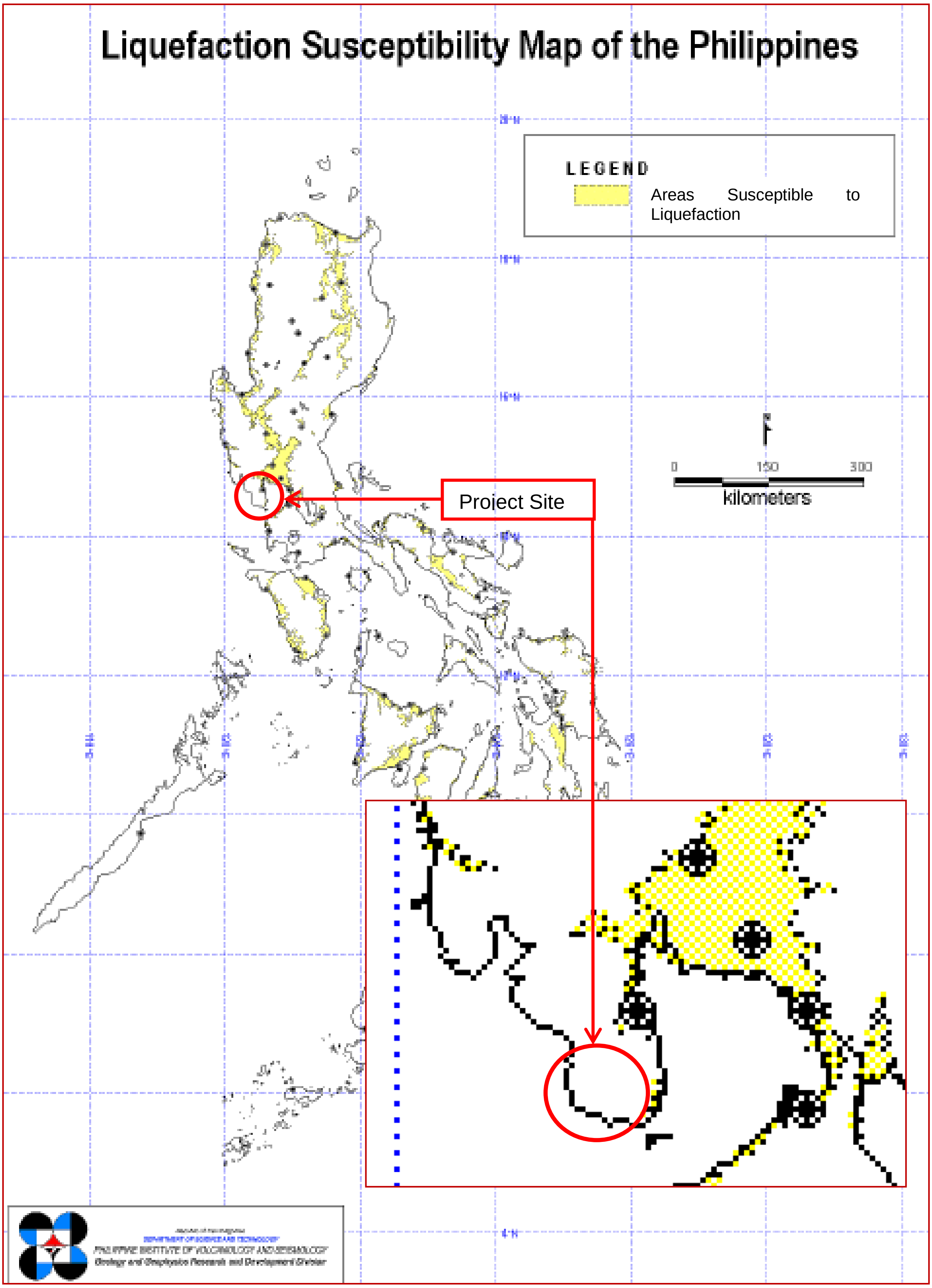
Mass Movements

The terrain of the project site is mostly hilly and rolling, thus there is a probability of occurrence of landslide. The hills are usually of very steep slopes near the river channels, while the roadcuts and coastal terraces are prone to rockfalls, rock slides and other forms of failure. The road cuts on the norhter slopes also left behind areas which are prone to downslope movement.

Monitoring for slope features should be done during the excavation for building foundation. Likewise, aggressive slope protection measures should be instituted in the areas where steep slopes are found.

2.1.2.5.3 Liquefaction

Liquefaction can occur in areas underlain by saturated sand-rich layer of soil, wherein fluids can be expelled from the sand layer resulting in subsidence of the underlying soil materials. **Figure 2-16** shows that Project area is not susceptible to liquefaction.



Source: MEZ EISR from PHIVOLCS, modified by GEOSPHERE

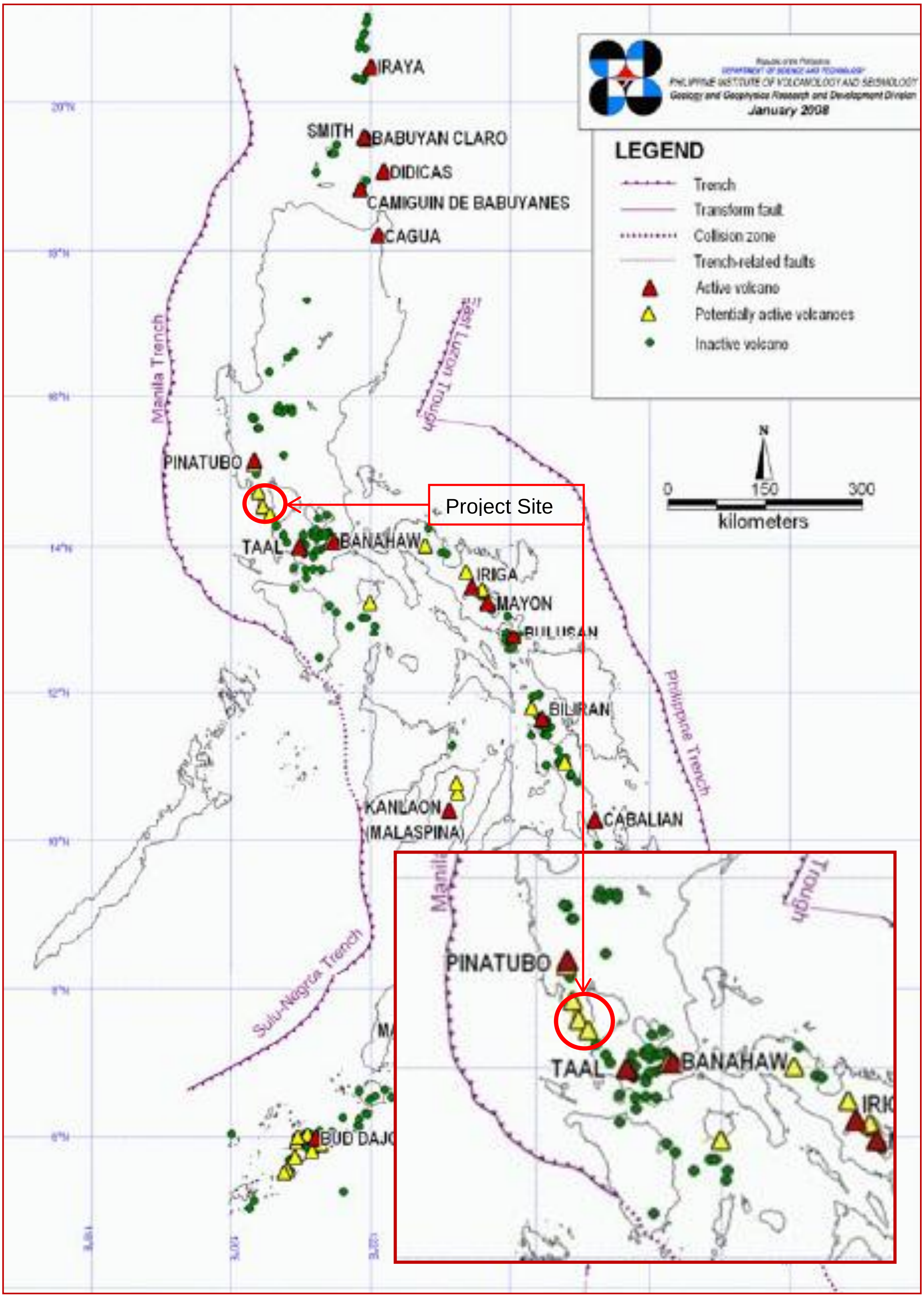
Figure 2-16 Liquefaction Susceptibility Map of the Philippines

2.1.2.5.4 Volcanic Hazards

The project site is far from active volcanoes such as Taal and Pinatubo to be directly affected by volcanic activities (**Figure 2-17**). Tephra or ashfall may reach the project site especially during large volcanic eruptions. The size of the materials expected at the site is not to exceed a few millimeters in diameter and may be similar to that experienced during the 1991 Pinatubo eruption. The thickness of that same event may also be used as a benchmark for which ash deposits from each eruption should be in the order of a few centimeters in thickness.

The worst threat for the site is the ashfall from any large volcanic eruptions from Pinatubo or Taal. In 1991, the Mariveles area received about 10 to 20cm of thickness of volcanic ash, which may have been readily mobilized by the subsequent rainfall.

In case of large eruptions of Pinatubo or Taal Volcanoes occur, volcanic ash may be blown into the site. Roofs with large areas shall be designed to have a steep pitch, and gutters and drainages shall be designed as suitable for clearing of ash deposits.



Source: MEZ EISR from PHIVOLCS

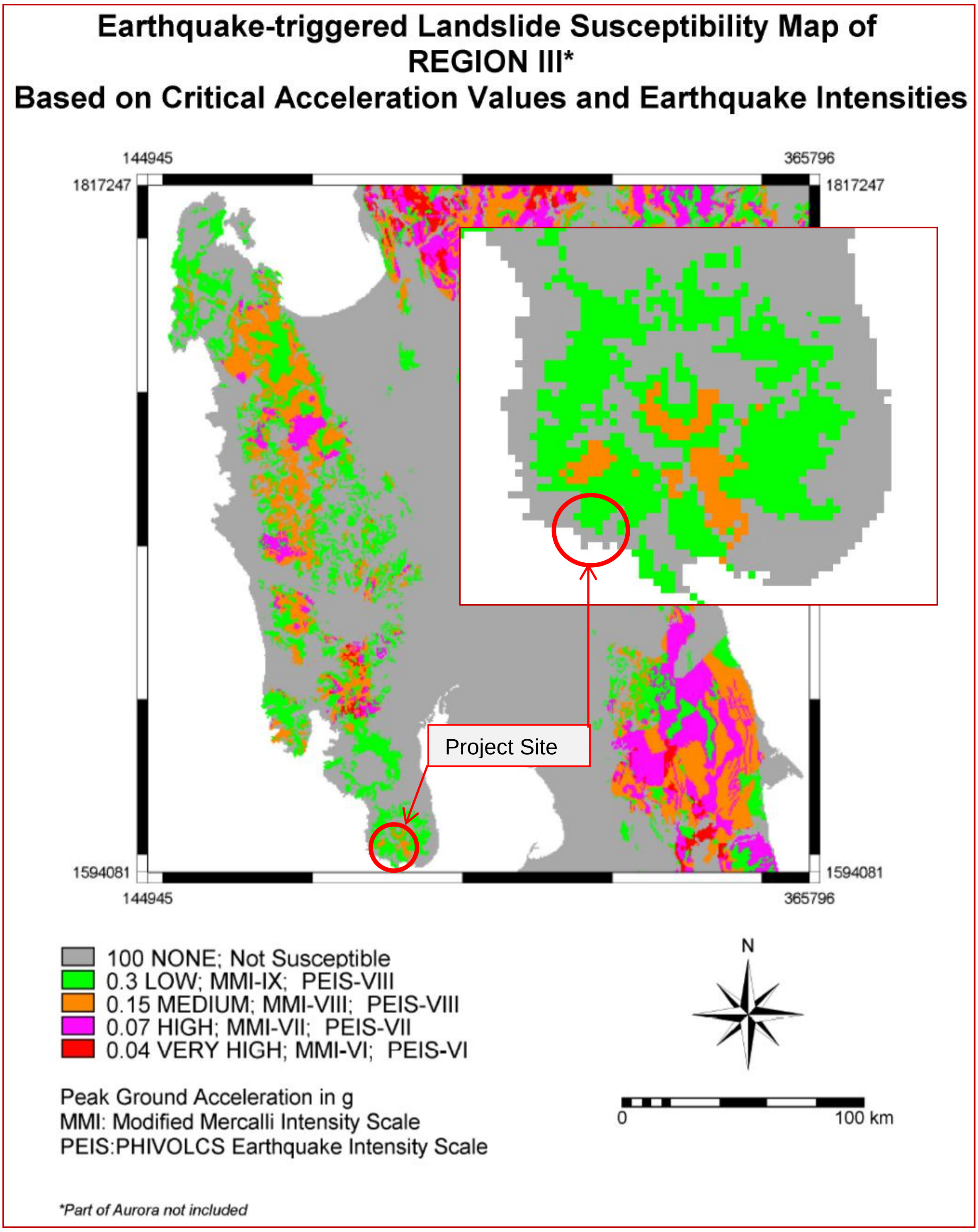
Figure 2-17 Distribution of Volcanoes in the Philippines

2.1.2.5.5 Ground Settlement/Subsidence

Because the site is to be located within MEZ, differential settlement is less expected as the site has undergone compaction during the site development stage.

2.1.2.5.6 Landslide Hazard

Slope failures triggered by past earthquakes in the Philippines consist of several discrete landslides that occurred on moderate to steep slopes, along drainage divides, valley heads and in road cuts. The occurrence of strong aftershocks and heavy rainfall could increase the number of landslide events. However, based on the Earthquake-triggered Landslide Susceptibility Map of Region 3 provided in **Figure 2-18**, which is based on Critical Acceleration Values and Intensities, the project area is not susceptible to landslide. Even during period of continuous heavy rainfalls, landslide within the limestone area is least expected.



Source: MEZ EISR from PHIVOLCS, modified by GEOSPHERE

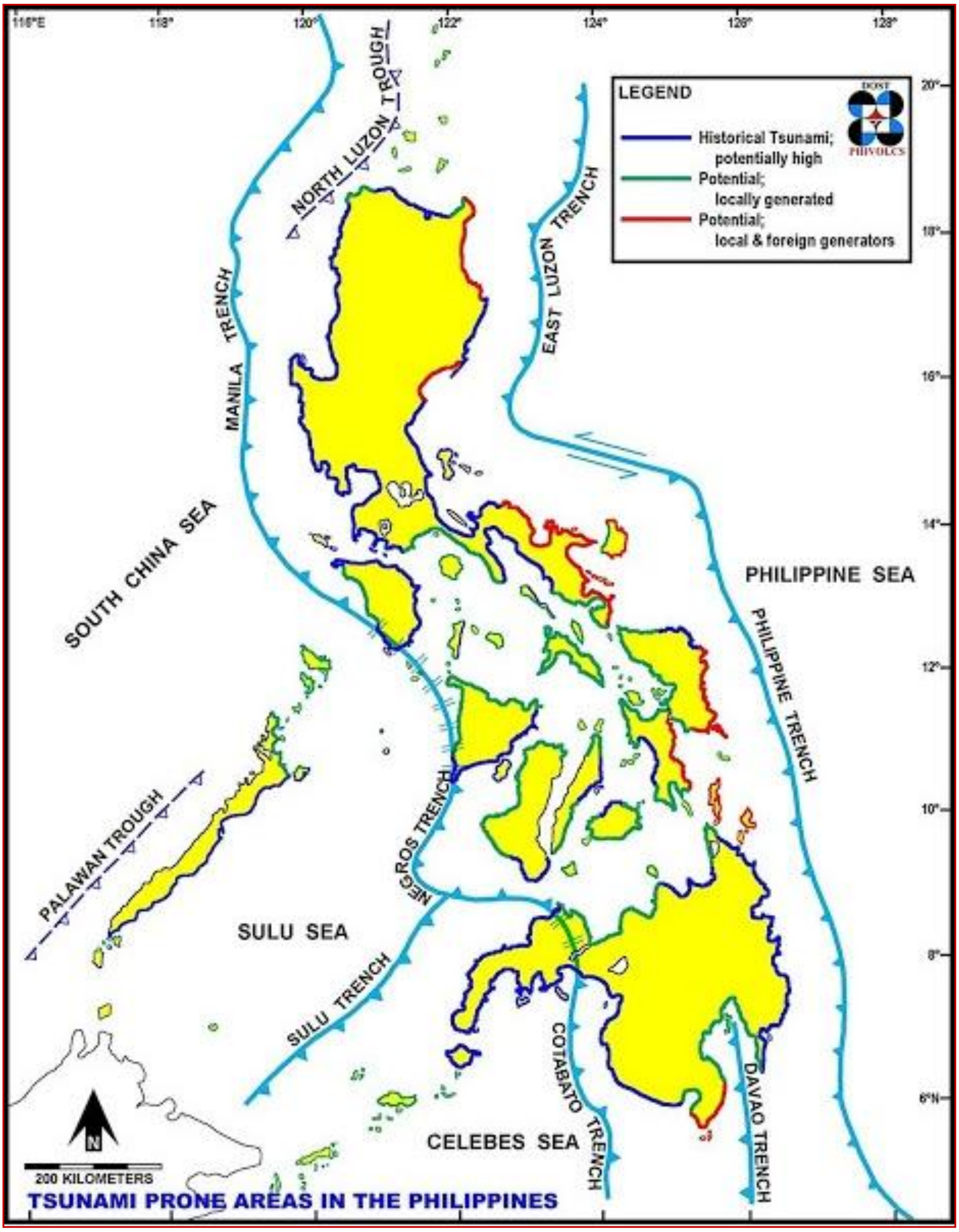
Figure 2-18 Earthquake-triggered Landslide Susceptibility Map of Region 3

2.1.2.5.7 Tsunami and Storm Surge

Tsunamis are high amplitude ocean waves generated by earthquakes, volcanic eruptions or other underwater explosions. Sudden displacements in the ocean floor caused by fault movements generate these large waves, which can travel over long distances.

Tsunami and storm surge are among the coastal hazards in the Philippines. Tsunamis are giant sea waves that are produced as a result of faulting under submarine conditions (Daligdig and Besana 1993). Coastal zones are particularly vulnerable to tsunami and storm surge and the edge of Manila Bay may be exposed to potential tsunamis and storm surges.

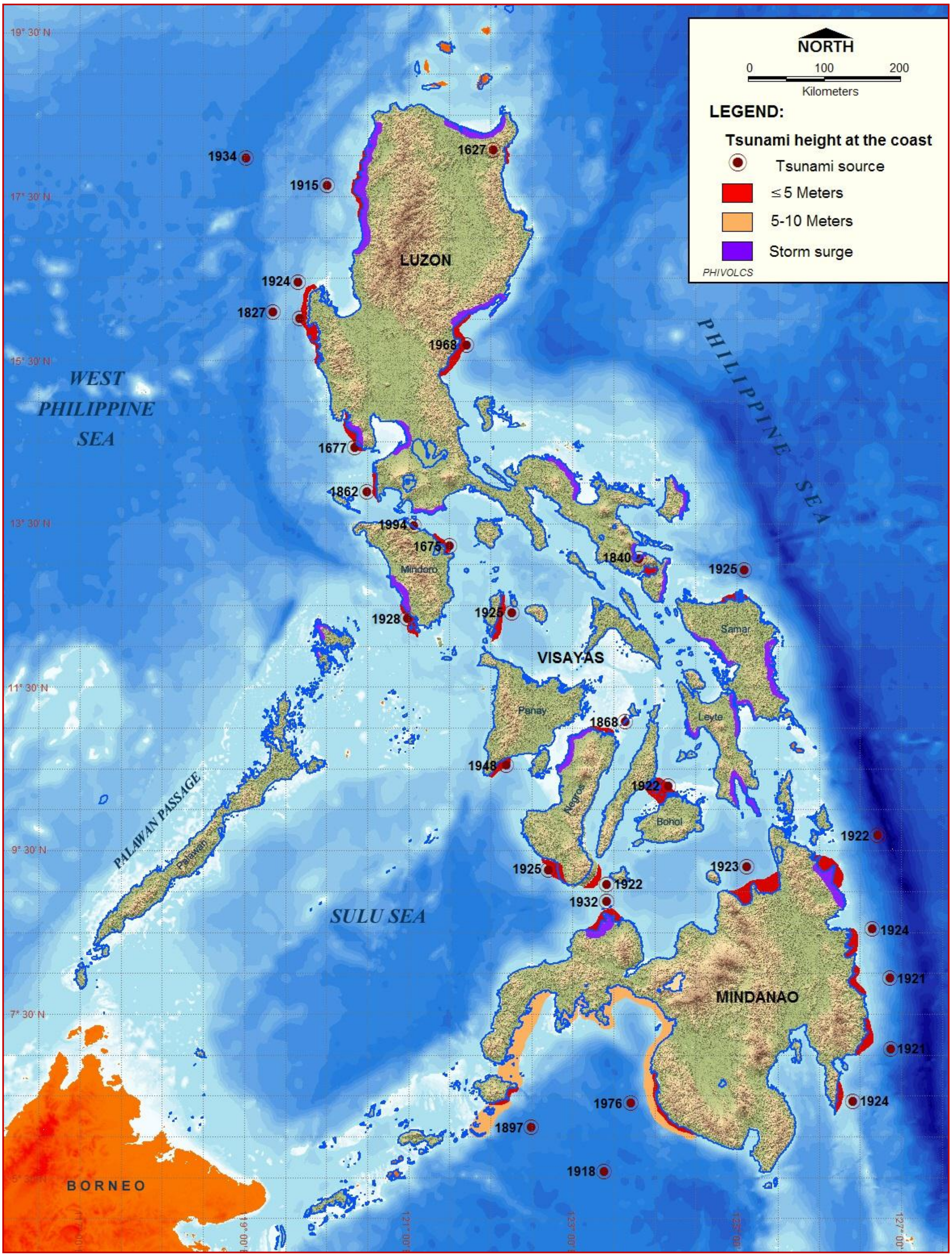
Figure 2-19 presents the tsunami prone areas in the Philippines. **Figure 2-20** shows the location of historical tsunami events in the Philippines while **Figure 2-21** is a map showing the location of areas vulnerable to storm surges.



Source: MEZ EISR from PHIVOLCS

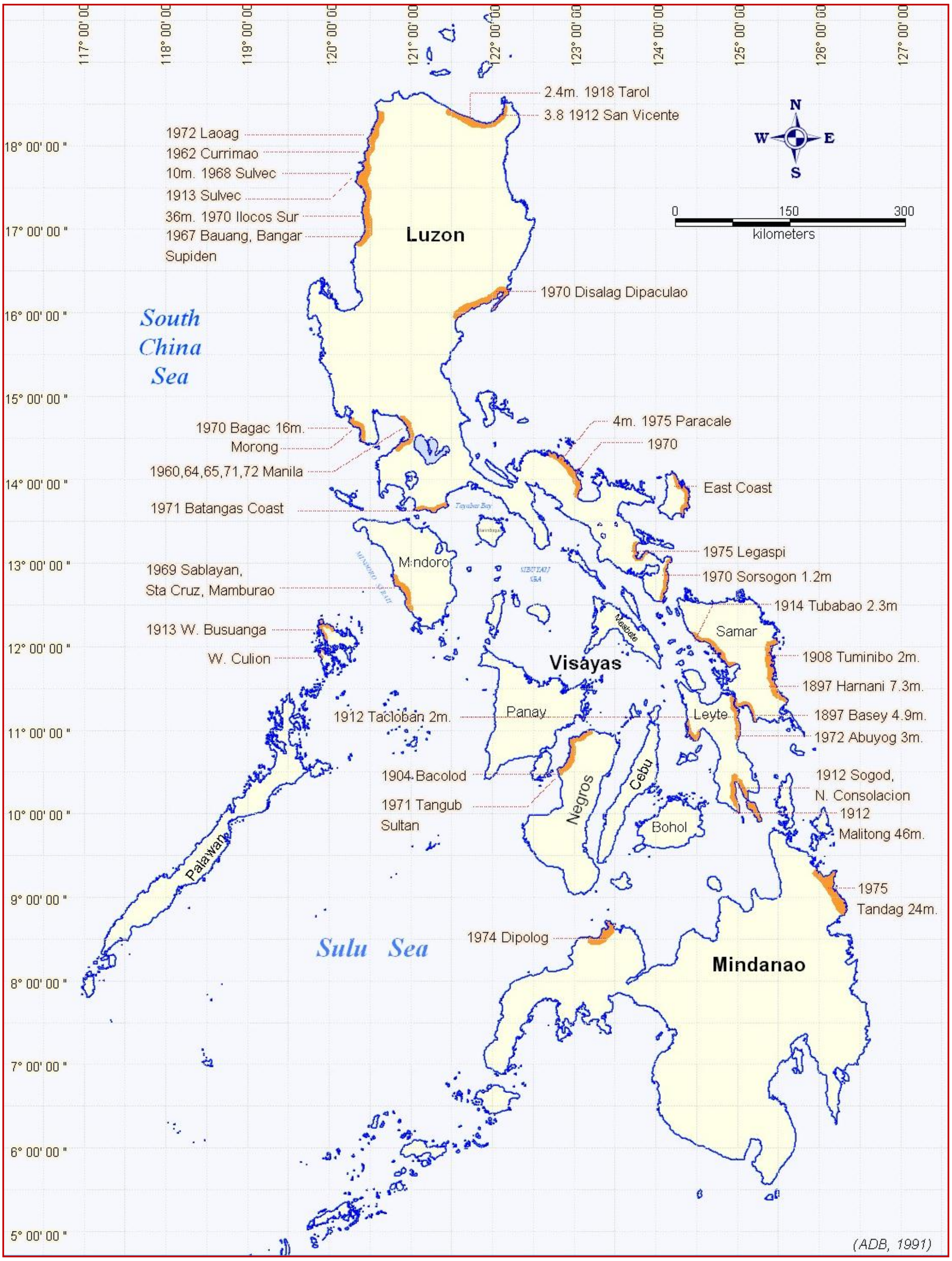
Figure 2-19 Tsunami Prone Areas in the Philippines

There were nine (9) tsunami events which occurred in Luzon with <5m high from year 1627 to 1968 as recorded in the Philippine Tsunamis and Seiches of PHIVOLCS (**Figure 2-21**).



Source: MEZ EISR from PHIVOLCS

Figure 2-20 Map of Historical Tsunami Events in the Philippines



Source: MEZ EISR by ADB,1991

Figure 2-21 Reported Storm Surge and/or Tsunami Ramp-up Levels for Various Events in the Philippines

The potential effects of a tsunami can be considered significant for this Project considering the proximity of the proposed site to the coast. It is therefore expected that if and when a tsunami occurs at the site, all ancillary facilities located along the shoreline, particularly those from sea level to 10m in elevation, are to experience the giant waves. This will include the jetty, water pumps and sea-water and sea-transport facilities at the power plant.

The main facilities of the power plant are to be located at elevations of more than 10m above sea level. This situation was specifically designed to enable the critical elements in the power generation to be safe from tsunami. Thus, in general, the power generation facility is safe and adopted to tsunami and other potential oceanic disturbances of less than 10m in amplitude. Among the items that are located in elevations less than 10m are only those related to sea water transport (coal jetty, pier and sea water pumps) and these are specially engineered to withstand storms and large waves.

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

It is expected that the surface landform or topography of the area will be disturbed and modified due to cut and fill activity during construction phase.

Backfill materials shall be compacted to the required density. If soft soil materials will be encountered in areas where heavy structures are to be constructed or where heavy equipment will be installed, the soft materials have to be excavated and replaced by engineered backfill.

2.1.2.7 Change in Sub-surface Geology/Underground Condition

There will be no significant disturbance of the subsurface/underground geomorphology of the Project site. Although, excavations shall cause permanent impact, the level of disturbance is considered to be low. The area of disturbance would include the footprint of the power plant, which includes its appurtenant facilities.

Monitoring of excavation is recommended in order to identify geologic structures that may be discovered on site. The site is founded on competent bedrock; engineering designs and construction should be in compliance with the national building code and complying with the recommended seismic design all aimed to minimize the impact of ground shaking to the proposed building.

2.1.2.8 Inducement of Subsidence, Liquefaction, Landslides, Mud/Debris Flow, etc.

There are no active faults and no significant liquefiable deposits at the site. However, the project site should expect moderate level of volcanic ash during eruptions of nearby volcanoes. Roofs should have steep grade, and open gutters suitable for ash cleaning. Drainages should have wide and broad-rimmed design, and accessible for ash declogging.

The project site is least prone to liquefaction, subsidence and ground rupture because of its bedrock foundation. Inducement of localized flooding may occur during the site preparation and construction stage of the project. While landslides are not expected, there may be areas wherein the cuts induce temporary unstable slopes.

Provision of adequate drainage system within the development area will minimize the threat of flooding in the project site. Covering up of any natural drainage channel is not recommended. In addition, the discharge point/outfall from the facility's storm drains should conform to the general drainage plan of the municipality.

To minimize unstable slopes that may cause landslides, cut and fill strategy should be prepared and monitored during execution. Slope should be managed along road-cuts and adjacent steep slopes and Proper drainages uphill/upstream of the slopes surrounding the project site should be constructed.

Attention shall be directed to designing the building to withstand repetitive shaking over long period of time. If soft soil materials will be encountered in areas where heavy structures are to be constructed or where heavy equipment will be installed, the soft materials have to be excavated and replaced by engineered fill. The founding level of all structures must be on hard clayey soil, dense to very dense sand or limestone of good rock quality designation.

MPGC shall prepare an Emergency Preparedness and Response Plan, which includes evacuation point, alternative transport routes and communication lines, which will be prepared for the occurrence of events such as typhoon, earthquake, tsunamis, etc.

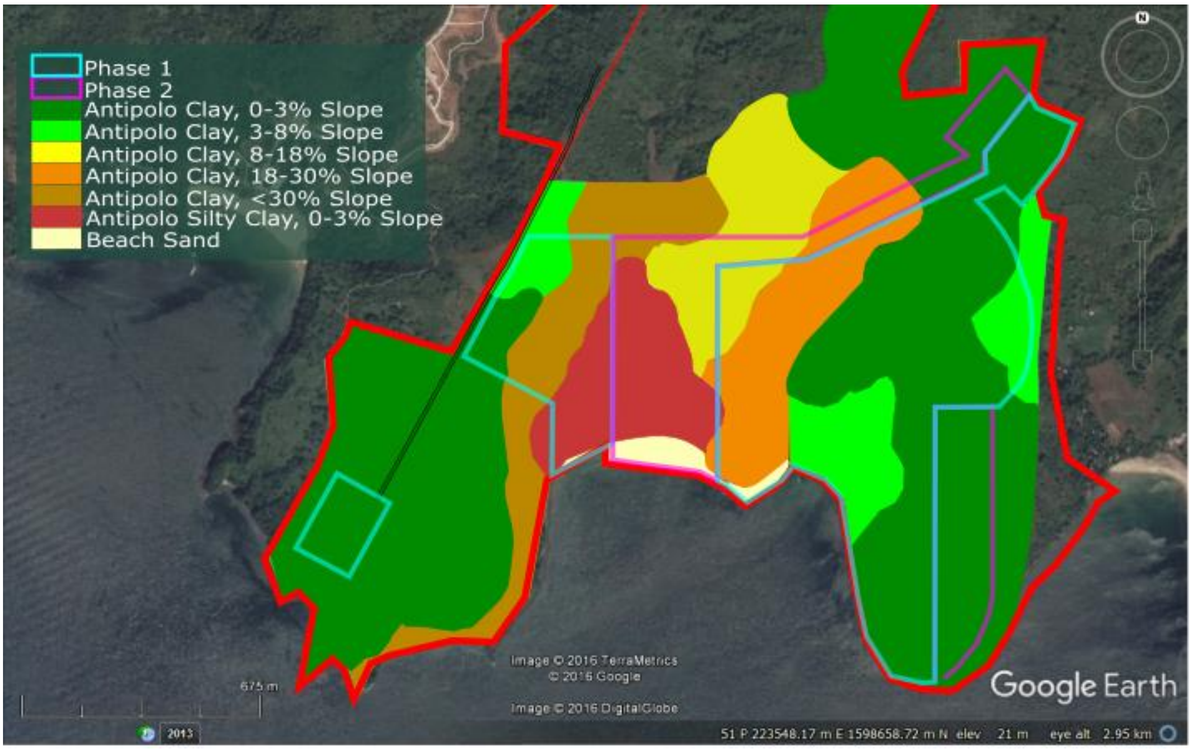
2.1.3 Pedology

2.1.3.1 Soil Types

Two (2) soil types and one (1) miscellaneous land type were identified, characterized and mapped within the project area namely, Antipolo Clay, Antipolo Silty Clay, and Beach Sand. Antipolo Clay as the main soil type is subdivided into five (5) soil mapping units based on differences in slope ranges. Antipolo Clay and Antipolo Silty Clay were developed from the weathering of volcanic pyroclastic deposits. Although Antipolo Silty clay was developed from the redeposited materials brought about by the Lusong River as it incised the volcanic foot slope with pyroclastic materials.

Antipolo Clay 0-3% slopes and Antipolo Clay 3-8% slopes occur on the western and eastern parts of project area which form like a plateau in the coastal area. Antipolo Clay, 8-18% slopes occur in the northern part of the project area. Antipolo Clay, 8-18% slopes occur from the northeastern part down to southern part of the project area. Antipolo Clay, 18-30% slopes occur from north down to the southern part of the project area, adjacent to Antipolo Clay 0-3% slopes and Antipolo Clay 3-8% slopes (western part). Beach Sand as miscellaneous land type occurs at the coastline between the Antipolo silty clay 0-3% slopes and the Lusong Bay.

The Soil Map at the proposed MCPP Project Site is presented **Figure 2-22**.



Source: Google Earth, modified by GEOSPHERE, 2016

Figure 2-22 Soil Map of the Proposed MCPP Project Site

2.1.3.2 Soil Erosion Susceptibility of the Project Area

The soil erosion susceptibility or erosion potential of the project area was mapped using the soil mapping units. For each soil unit, erosion susceptibility was assessed based on a contributing factor taken at a time. The individual susceptibility assessments were then aggregated to form a composite erosion susceptibility score for the soil unit. The contributing factors include rainfall, soil type, vegetation or land use and slope.

Rainfall

The rainfall data presented in Table 2-7, shows that the proposed MCPP Project site has five (5) wet months (with more than 200 mm./mo.) with August as the wettest month and seven (7) dry months with low to moderate rainfall. Using the Erosion Susceptibility Ratings in terms of the duration of rainfall season (**Table 2-7**), the proposed MCPP Project site is moderately susceptible to erosion.

Table 2-7 Erosion Susceptibility Ratings in Terms of the Duration of Rainfall Season

Degree of Susceptibility	Duration of Rainfall Season
Slightly	Areas with 5 to 6 dry months and 3 to 4 wet months
Moderately	Areas with 5 to 6 dry months and 5 to 6 wet months
	Areas with 2 to 4 dry months and 5 to 6 wet months
Highly	Areas with 5 to 6 dry months and 3 to 4 wet months with one or more months of 500mm or more rainfall per month
	Areas with 5 to 6 dry months and 5 to 6 wet months with one or more months of 500mm or more rainfall per month

Source: Bruce

Soil Type

Based on the Erosion Susceptibility Ratings in terms of soil type (**Table 2-8**), Antipolo Clay with more than 100 cm soil depth and >60% clay-silt fraction is moderately susceptible to erosion.

Table 2-8 Erosion Susceptibility Ratings in Terms of Soil Type

Degree of Susceptibility	Soil Depth and Texture
Slightly	Areas with 50 to 100cm solum and 60 to 100% clay-silt fraction
	Areas with greater than 100cm solum and 0 to 60% clay-silt fraction
	Unclassified soils of the mountain
Moderately	Areas with 50 to 100cm solum and 0 to 60% clay-silt fraction
	Areas with greater than 100cm solum and 60 to 100% clay-silt fraction
Highly	Areas with less than 50cm solum and 0 to 100% clay-silt fraction

Notes: Solum is made up of surface soil and subsoil. Clay-silt fraction is percent total of clay and silt particles determined through mechanical analysis of topsoil.
Source: Bruce

Slope

Based on the Erosion Susceptibility Ratings in terms of slope (**Table 2-9**), Antipolo Clay with 8-18% slope is moderately susceptible to erosion. Antipolo Clays with 18-30% and >30% slopes are highly susceptible to erosion. Antipolo Clay and Antipolo Silty Clay with 0-3 and 3-8% slopes are slightly susceptible to erosion.

Table 2-9 Erosion Susceptibility Ratings in Terms of Slope

Degree of Susceptibility	Slope Range
Slightly	Areas with slope between 0 and 8%
Moderately	Areas with slope between 8 and 18%
Highly	Areas with slope greater than 18%

Source: Bruce

Final Erosion Susceptibility Rating

The four (4) erosion susceptibility ratings of each soil unit are aggregated to form the final rating consistent with the decision rule on the composite or final erosion susceptibility index presented in **Table 2-10**.

Table 2-10 Composite Erosion Susceptibility Decision Rule

Individual Susceptibilities (Rainfall – landuse – slope – soil type)	Final Degree of Erosion Susceptibility
S – S – S – S	Slightly
M – M – M – M	Moderately
H – H – H – H	Highly
H – M – H – H	Highly
H – S – M – M	Moderately
H – M – M – H	Moderately

Note: S is slightly susceptible, M- moderately susceptible, and H- highly susceptible.
Source: Bruce

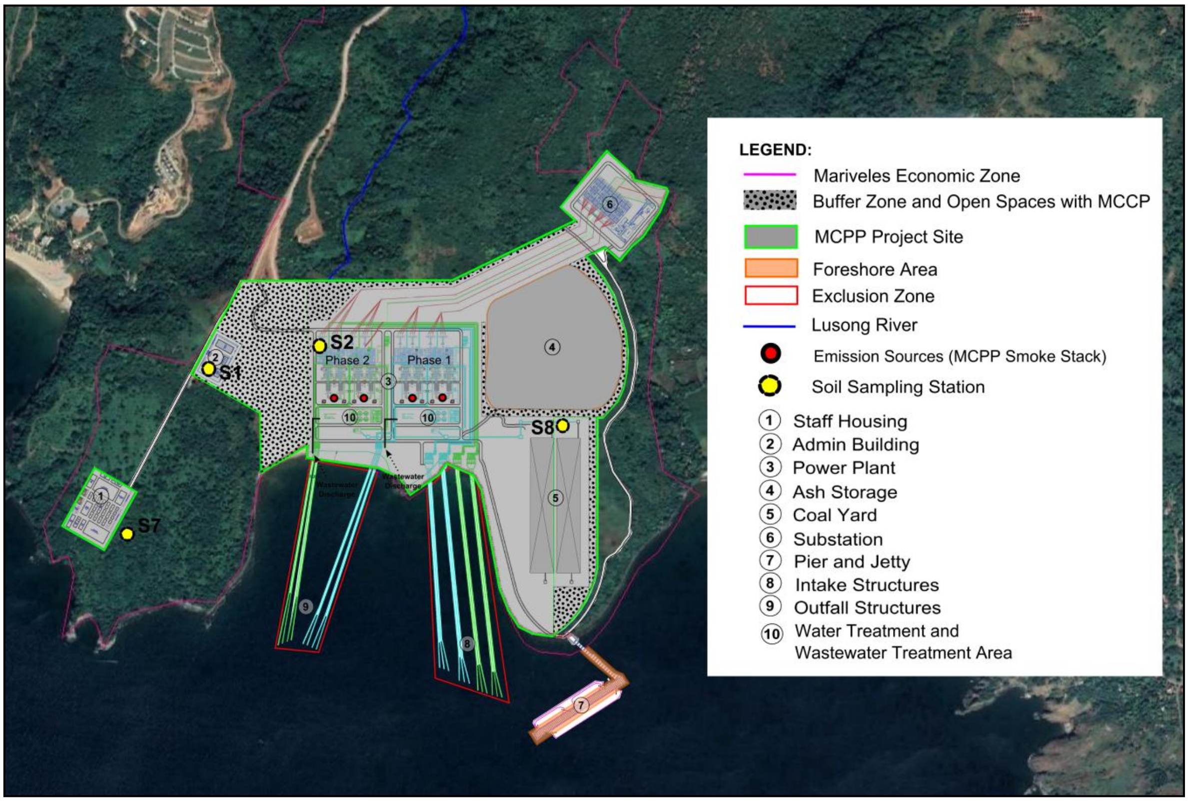
2.1.3.3 Soil Quality

Soil testing was conducted at four (4) established sampling stations on August 2-4, 2016 (**Table 2-11** and **Figure 2-23**).

The physico-chemical properties of the soil samples collected at the project site are presented in Table 2-12. Copy of the Laboratory Analysis Results from Bureau of Soils and Water Management, Mach Union Water Laboratory and Philippine Coconut Authority is given in **Annex 2-1**.

Table 2-11 Sampling Stations for Soil Quality Testing

Sampling Stations		Latitude	Longitude	Station Location in Reference to the Components of the Proposed MCPP Project
S1	Lusong, Brgy. Biaan, Mariveles, Bataan	120°25'42.85"E	120°25'42.85"E	Located at the proposed location of the admin building
S2	Lusong, Brgy. Biaan, Mariveles, Bataan	14°27'0.36"N	120°25'53.06"E	Located at the proposed location of power plant (Phase2)
S7	Lusong, Brgy. Biaan, Mariveles, Bataan	14°26'48.28"N	120°25'36.95"E	Located near the proposed staff house
S8	Lusong, Brgy. Biaan, Mariveles, Bataan	14°26'50.47"N	120°26'24.41"E	Located between the proposed location ash storage and coal yard



Source: Google Earth, modified by GEOSPHERE, 2016

Figure 2-23 Location Map of Soil Quality Sampling Stations

Antipolo clay, 0-3% slopes as represented by Station S1, S7 and S8 is a moderately well drained, deep clay soil. Soil reaction is slightly acidic (pH. 4.9-6.3). Nitrogen ranges from low (0.15%) to medium (0.23%). Organic matter is very low (1.4%) to low (3.3%). Phosphorous is very low (2.4 mg/kg) to low (10.4 mg/kg). Iron ranges from very low (30.02 mg/kg) to medium (106.9 mg/kg). Copper is low (4.5-5.1 mg/kg). Manganese ranges from low (69.5 mg/kg) to medium 125mg/kg. Zinc is high (4.8-6.1mg/kg). The natural fertility of this soil is low.

Antipolo silty clay 0-3% slopes as represented by Station S2 is a moderately well drained deep silty clay soil. Soil reaction is slightly acidic (pH 6.1). Nitrogen is low with 0.19%. Organic matter is very low with 1.5%. Phosphorous is medium with 13.5 mg/kg, while Potassium is high with 0.7 cmol/kg. Iron, Copper, and Manganese are low with 46.37, 4.7, and 17.1 mg/kg, respectively. Zinc is high with 2.05 mg//kg. The natural fertility of this soil is low.

Table 2-12 Results of Surface Soil Analysis Pertaining to Soil Fertility Rating, August 02-04, 2016

Parameters	Sampling Stations				Soil Fertility Rating Guidelinesa		
	S1	S2	S7	S8	Adequate (Favorable)	Moderate (Moderately Unfavorable)	Deficient (Unfavorable)
Soil Texture	Clay	Silty Clay	Clay	Clay	-	-	-
Slope (%)	0-3	0-3	0-3	0-3	-	-	-
Drainage	MWD	MWD	MWD	MWD	-	-	-
Soil depth (cm)	>100	>100	>100	>100	-	-	-
pH	5.7*	6.1*	6.3*	4.9*	5.5-8.5	5.0-5.5	<5.0/>8.5
Total Kjeldahl Nitrogen, %	0.23*	0.19*	0.15*	0.19*	-	-	-
Phosphorus, mg/kg	2.4*	13.5*	10.4*	4.9*	>10	6-10	<6
Potassium, cmol/kg	0.63**	0.7*	0.72*	0.84**	-	-	-
Organic Matter, %	3.3**	1.75*	1.4**	2.0*	>3	2-3	<2

Parameters	Sampling Stations				Soil Fertility Rating Guidelinesa		
	S1	S2	S7	S8	Adequate (Favorable)	Moderate (Moderately Unfavorable)	Deficient (Unfavorable)
Available Iron, mg/kg	106.9**	46.37**	30.02*	62.7**	-	-	-
Available Copper, mg/kg	5.1**	4.7*	4.5*	4.5*	-	-	-
Available Manganese, mg/kg	125**	17.1*	69.5*	69.5*	-	-	-
Available Zinc, mg/kg	6.1**	2.05*	5.6*	4.8**	-	-	-

Source: a Bureau of Soils and Water Management
** Weighted average of 40-50 cm depth*
***Topsoil sample, 0-18 cm depth*
Drainage: MWD = moderately well drained

The limits used for assessment of heavy metals are the Target and Intervention Values of Dutch Standards. USEPA 2010 Standard and Leeper, 1978 were used as reference for the assessment of parameters that are not found in the Dutch Standards. The Dutch Standards are environmental pollutant reference values used in environmental remediation, investigation and clean-up.

Table 2-13 shows that the levels of Pb, Hg and Cr+6 in Stations S1, S2, S7 and S8 are below the detectable limits of the analysis. The levels of Zn and As in Stations S1, S2, S7 and S8 are way below the Target Value of the Dutch Standard.

The level of Cd in Stations S1, S2, S7 and S8 exceeds the Target Value but way below the Intervention Value of the Dutch Standard. There are no existing facilities or activities that could be a potential source of cadmium in the area other than the natural background level. However, the elevated values of cadmium from baseline data need to be further monitored to establish trend for further evaluation. Monitoring of cadmium levels will be undertaken by MPGC for soil quality in the area.

The level of Fe in Stations S1, S2, S7 and S8 are within the standard range (3,000-10,000mg/kg) of Fe in soil.

Table 2-13 Results of Surface Soil Analysis for Heavy Metals, August 2-4, 2016

Parameters	Sampling Stations				Dutch Standard	
	S1	S2	S7	S8	Target Value	Intervention Value
Surface Samples**						
Lead, mg/kg	<3	<3	<3	< 3	85	530
Zinc, mg/kg	42.3	45.3	89.4	50.1	140	720
Mercury, mg/kg	<0.05	<0.05	<0.05	< 0.05	0.3	10
Iron, mg/kg	38,738	32,501	47,591	79,600	3,000 – 100,000 (Leeper)	
Cadmium, mg/kg	0.936	1.14	1.39	1.57	0.8	12
Arsenic, mg/kg	0.813	2.01	2.85	1.57	29	55
Chromium Hexavalent, mg/kg	<0.2	<0.2	<0.2	< 0.2	-	2 (USEPA)

Note: Target Values of Dutch Standard (2000) – indicates the level at which there is a sustainable soil quality; Intervention Values of Dutch Standard (2000) – representative of the level of contamination above which there is a serious case of soil contamination;
Range of Iron in Soil = 3,000 – 100,000 mg/kg (Leeper, 1978);
Chromium hexavalent = 2mg/kg (USEPA, 2010)
***Topsoil sample, 0-18 cm depth*

2.1.3.4 Soil Erosion/Loss of Topsoil/Overburden

Earthworks during construction phase will disturb the soil and may lead to soil erosion. The excavation for the plant facilities can generate significant volume of sediments that may be carried off by surface runoff. Soil erosion and sedimentation could be considerable during rainfall events, especially during the wet season but could be minimal during the dry season. However, erosion, downslope processes and siltation are expected to return to their natural rates as soon as excavation activities stop when construction phase ended. Operation-related impacts of the proposed MCPP Project on soil would be of minor magnitude, short-term duration, and small extent, and have a possible likelihood of occurring. Soils are anticipated to be completely stabilized upon commencement of plant operations.

To avoid considerable soil erosion during rainfall events, an erosion protection program will be implemented. This program shall contain specific engineering, protective construction and planting rules, as well as requirements in the terms of reference of construction companies.

Soil erosion/sedimentation control measures such as engineering structures/vegetative cover, silt traps, man-made ponds, sedimentation basins and drainage canals will be installed prior to grading of the site.

Earthworks during the construction phase shall be scheduled during dry season. Surface runoff will not be allowed to run along slopes in an uncontrolled manner to avoid sheet wash or riling. During earthwork construction, temporary collector drains and interceptors shall be provided to prevent accumulation of rainwater in low areas. Such discharges will not be allowed to drain downslope unless adequate measures are provided to prevent erosion of the slopes.

The collected runoff will be channeled away from exposed slopes into lined canals or ditches. Temporary drainage ditches will be provided along construction and earthwork sites to channel water into preferred drainage ways. Gullying will be avoided by providing necessary control of water discharge and the use of protective structures or vegetation as needed.

The ground surface on which fill is to be laid will be prepared by removing some non-complying fill, topsoil, and other unsuitable materials. The exposed material will be scarified to provide bond with the new fill. It is absolutely necessary that the fill slopes be keyed in into the natural sub-grade to prevent the formation of a weak interface which could trigger a block slide particularly when the interface is saturated with water. Detrimental amounts of organic materials will not be permitted on fills. All fills will be compacted to a minimum 95% of maximum dry density based on ASTM D-698 using an adequate size compactor. Irreducible material with a maximum dimension of greater than 300 mm will not be buried or placed on fills. The quality and adequacy of the compaction works will be verified using ASTM D-1556 Procedures. Vibratory rollers such as tamper foot of smooth drum are suited for granular materials. Such vibratory rollers will have a minimum static weight of ten (10) metric tons and vibrating frequency of 30 cps and will have a maximum travel speed of two (2) KPH when compacting granular materials. For soils exhibiting cohesiveness or plasticity, a smooth drum static roller or sheep foot roller will become necessary. Earthworks contractor will perform compaction trials to determine the most suitable compaction procedure.

Slopes around the project periphery will be stabilized by normal masonry work in which the gaps between the stones are filled with cement (or lime mortar) or by gabion masonry work in which the stones are held together in a metal mesh cage or by riprap or by re-vegetation of appropriate local species.

2.1.3.5 Change in Soil Quality and Fertility

Construction of the proposed MCPP Project involves the use of heavy equipment, which has risk of an accidental fuel or chemical spill and potential contamination of soils. The operation of the proposed MCPP Project could hypothetically result in localized contaminant loading into the soil due fuel leakage and spill and improper disposal of wastes. Accidental fuel, oil and chemical spill may occur in storage area, chemical storage area, tank truck unloading area and turbine building area.

The following procedures for the handling and storage of fuel and hazardous materials shall be implemented to reduce the potential soil contamination within the vicinity of the proposed MCPP Project:

a) Fueling and lubrication of equipment shall be in designated and approved locations.

b) Washing, servicing and fueling of mobile equipment shall not be allowed within thirty (30) meters of a waterway or drainage
c) Storage of waste oils and lubricants shall be in a tank or closed container
d) Storage of greasy or oily rags or materials shall be in an appropriate and approved designated area that are not prone to spontaneous combustion
e) Storage of all hazardous materials shall be provided with secondary containment for spill such that it contains 110% of the volume of the largest container/vessel stored in the storage area
f) Prohibition on dumping of any contaminating material product to the environment, including waste oils
g) Formulation of Spill Prevention Procedures and a Spill Contingency Plan, a detailed response system to deal with accidents such as the release of petroleum, oils, or lubricants or the hazardous liquids. Make available on-site all equipment and materials necessary to execute a clean-up
h) Collection and storage of all wastes recovered during clean-up operations in labeled and secured containers for subsequent disposal by an accredited treatment facility
i) Training and awareness programs shall be conducted for all personnel

The fuel storage area will be provided with a secondary containment in the form of a bund containment wall. The bund containment wall will surround the fuel storage tank and will be sized to accommodate the volume for a full capacity spillage of the tank. In a major spillage scenario, the drain valve leading to the WWTS will be shut down. This will ensure the spill will be confined in the secondary containment.

All chemical storage tanks including portable storage tanks and drums will be provided with spill containment area or stored in bermed areas. The design of the spill containment will be sized to contain 110% of the capacity of the largest tank. Where multiple tanks are stored in a common bermed area, the bermed areas will be sized for 110% of the largest tank, plus 10% of the aggregate capacity of all other tanks within the bermed area. Other tanks will be provided with an allowance for the volume of the containment area.

The tank truck unloading area shall be installed with a berm, sized with sufficient capacity to contain 110% of the largest tank truck capacity and the volume displaced by the truck in the unloading area. The fuel oil and ammonia unloading spill containment area will be provided with a level transmitter for level monitoring and alarm in the digital control system (DCS).

All routine handling or transfer of chemicals will take place within bermed areas to ensure that spills or leaks will be contained. Chemical feed skids, pot feeders, portable storage tanks, or drums will be installed or staged in bermed areas. Bermed areas for storing at least one spare portable tank or drum for each in service will be provided. All chemical containment areas will have protective coatings.

Due to minimal oil spill scenario, the whole turbine building will be provided with sufficient oily water drain that will direct the flow to the WWTS.

Possibility of soil contamination will be assessed through a soil-testing program, especially in the vicinity of storage areas. MCPP will adopt the Dutch standards to assess possible contamination and if this happens, then the area will be subjected to remediation or decontamination. Any toxic or hazardous materials remaining in the site will be collected along with the contaminated soil for appropriate disposal. An accredited treater/ transporter will be contracted to undertake the required treatment and proper disposal.

2.1.4 Terrestrial Ecology

2.1.4.1 Flora

The proposed MCPP project area will be located at the southern portion of MEZ. The project site is already cleared of vegetation with retained cover along the boundary lines as buffer zone.

Based on the EISR for MEZ, the three most important species with the highest Importance Value (IV) in the area were Ipil-ipil, Hagonoy, and Kasoy. The top ten species with the highest IV are mostly pioneers which indicate that the project area has been long-time subjected to human interference. The presence of hagonoy and coronitas in the top ten species with high IV indicates that the degraded state of the project site. These two species are considered oppotunistic invasive alien species (IAS) that are now on the top ten list of of invasives by Biodiversity Management Bureau-DENR because of their impacts to population of native plants and economy amongst agroforestry farmers nationwide.

Two (2) species recorded from the site were listed under either the Philippine Red List (DAO 2007-01) or the IUCN Red List of Threatened Species (2016.1). These were Bolong eta (Diospyros pilosanthera A.DC.) (DAO 2007-01) and Molave (Vitex parviflora A.Juss.) (IUCN 2016-1). and Liusin (Maranthes corymbosa) (DAO 2007-01).

2.1.4.2 Fauna/Wildlife

2.1.4.2.1 Birds

The most abundant species of birds in the MEZ area was Hypsipetes philippinus or the Philippine Bulbul.

All species of birds were classified under the category LEAST CONCERN by the IUCN. This means that the species of birds observed and recorded in the MEZ area were not in danger of becoming extinct and may have already adapted to the conditions in the area which for a long time has been devoid of human activities. There were no migratory birds observed and recorded in the area.

Insectivores were dominant among the species. Birds are known to prey on insect pests and are effective biological control. They roost and nest on trees present in the area and feed on insects which may infest fruit trees and other crops planted in the sites. Nectarivores and frugivores may also help in pollination and seed dispersal.

2.1.4.2.2 Mammals

The volant mammals recorded at the MEZ area were fruit bats, insectivores and nectarivore while there were also non-volant mammals recorded. One species of volant mammal, *Cynopterus brachyotis* and one non-volant, Rattus tanezumi were common in all the sites. These species were ubiquitous, Cynopterus brachyotis is a frugivore and is abundant where there is an abundance of fruiting trees and Rattus tanezumi is a house and farm pest which is an omnivore.

All species or 100% of the documented mammals were resident, found throughout Southeast Asia and for some species, the whole of Asia. All of the mammalian species are of LEAST CONCERN.

Bats are important pollinators and seed dispersers specially frugivores and nectarivores. The insectivores also contribute to pest control specially in agricultural and urban areas.

2.1.4.2.3 Herps

It was observed that the most abundant species was Limnonectes macrocephalus, Luzon Fanged Frog caught and the least was Polypedates leucomystax, Common Tree Frog. All diversity indices were very low.

There were two (2) introduced species, namely: Rhinella marina which at the same time is invasive, and Polypedates leucomystax. Two (2) species were endemic, Limnonectes macrocephalus and Fejervarya vittigera and only one (1) was a native species which was the lone reptile, Gecko gecko or Tokay Gecko.

Frogs and geckos are insectivores and in one way or another may help in the control of insect pests particularly mosquitoes. The endemic Luzon Fanged Frog was utilized as food and was collected from rivers and streams and rice fields and were sold locally. Amphibians are indicators of changes in the environment particularly climate change because they are the ones which are immediately affected by temperature change.

Of the five (5) species of herps, 3 of the amphibians are LEAST CONCERN, and one (1) is Near Threatened, Limnonectes macrocephalus. This species is threatened by habitat destruction by the pollution of rivers and streams, deforestation and by over consumption because it is a native delicacy and is being sold in the local markets. The Tokay Gecko has not been evaluated because it is common everywhere.

2.1.4.3 Possible off-site Impacts from Power Plant Emissions

The construction of the proposed MCPP Project will have minimal impact on terrestrial environment in the area as it is already developed by EFIHI.

However, unavoidable impacts on the surrounding flora and fauna due to dust generation will be expected during construction phase of the proposed MCPP Project. Dust will be generated as delivery vehicles transport the construction materials into the site. The dust will cover the leaves of nearby vegetation and may stress the plants thus, affecting the photosynthetic activity of the plants.

In order to minimize the generation of dust during construction phase, delivery trucks carrying loose materials such as sand and gravel as well as filling materials will be covered. The speed of vehicles shall be reduced and watering of road network during dry periods shall be undertaken.

MPGC is also committed to establish a 24.53 ha buffer zone to reduce air pollution that may be emitted within the Project site. Further, MPGC shall support the reforestation program initiatives of EFIHI.

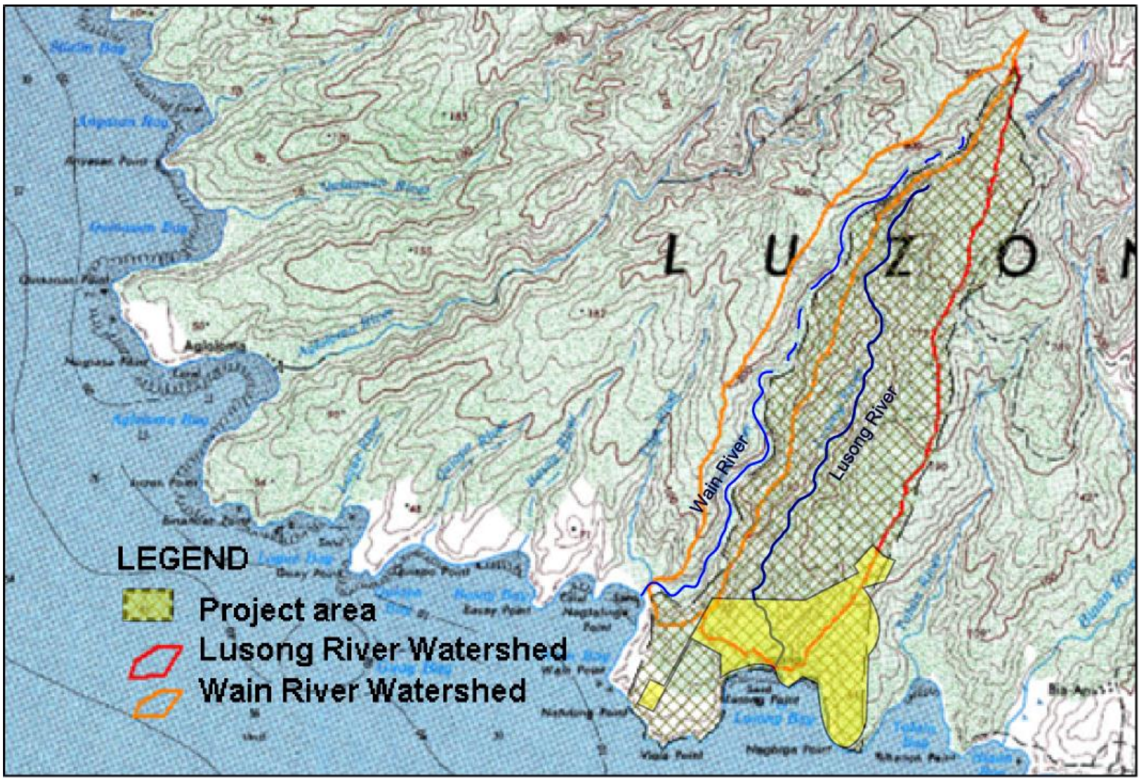
2.2 WATER

2.2.1 Hydrology/Hydrogeology

The existing hydrological condition including the groundwater (springs and wells) and surface water (rivers and tributaries) resources in the area are described based on the study conducted for the MEZ project.

2.2.1.1 Drainage Morphology

The proposed MCPP Project is to be located in Sitio Lusong and Sitio Talain in Barangay Biaan, Mariveles, Bataan. The Project site has two (2) river systems namely, Lusong River and Wain River. The entire Lusong River watershed is within the project area while almost half of the Wain River watershed covers the rest of the area, as presented in **Figure 2-24**.



Source: MEZ EISR modified by Geosphere

Figure 2-24 Project Site within the Drainage Areas of Lusong River and Wain River

Lusong River is a small perennial river that drains into Lusong Bay. It is composed of 4.323 km^2 of drainage area and a single identified tributary during the time of ocular inspection. The highest elevation of the watershed at the foot of Mt. Mariveles has an elevation of around 540 masl and the lowest elevation of around 4 masl at Lusong Bay. The main stretch of the river measures about 5.1 km with around 100 meters of the stretch upstream without water. The river has an average active width of 1.5 meters that varies in depth and velocity of flow along its stretch. There were five (5) identified waterfalls along the stretch of the river with varying height. The overbank areas were heavily wooded with majority of trees composed of mangoes, cashew and other fruit-bearing trees. The river bed was a combination of boulders, cobbles, native soil and roots of trees. The watershed was clearly well-managed. It was noted that Lusong River watershed is wider in extent compared to Wain River Watershed.

Draining into Wain Bay, Wain River is a stream composed of 2.557 km^2 of drainage area. The main stretch of the river measures about 5.5 km with half of its length considered ephemeral. The investigation was conducted on a wet season but half of the stretch has no flow. The stream has a steep overbank of about 80% slope with the eastern portion still heavily wooded and the western slope already developed. The watershed area is considerably long and narrow. The highest elevation of the watershed which is at the foot of Mt. Mariveles is at approximately 580 masl and the lowest elevation at the confluence with Tilin River is at elevation of approximately 10 masl. The average active flow downstream of the river was 1.0 m. The same combination of materials with Lusong River was noted.

Both watersheds received an average annual rainfall of approximately 2,310 mm and exhibits a Type I climate based on the Modified Coronas Climate Classification System. The area has a pronounced dry period in the first four months of the year and a wet period occurring from June to October. May, November and December are season transition months.

Table 2-14 Hydrologic Parameters of the Watersheds

River	Drainage Area, km^2	River Length, km	River Slope	Land use
Lusong	4.323	5.10	0.1057	Wooded/ Forest
Wain	2.557	5.54	0.1034	Partly developed

Source: MEZ EISR 2017

Water Availability and Dependability Analysis

The streamflows of Lusong River and Wain River were estimated by transposition of the streamflows at Pilar River gauging station located at Nagwaling, Pilar, Bataan. It was the nearest gauging station of the DPWH-BRS near the study area with hydrologic characteristics that do not significantly vary. The transposition method is based on the assumption that the specific yield (Q/A) and the rainfall depth and distribution is the same for the gauged and un-gauged basin. In general, to account for the difference in annual rainfall depth, the equation used for the streamflow transposition is:

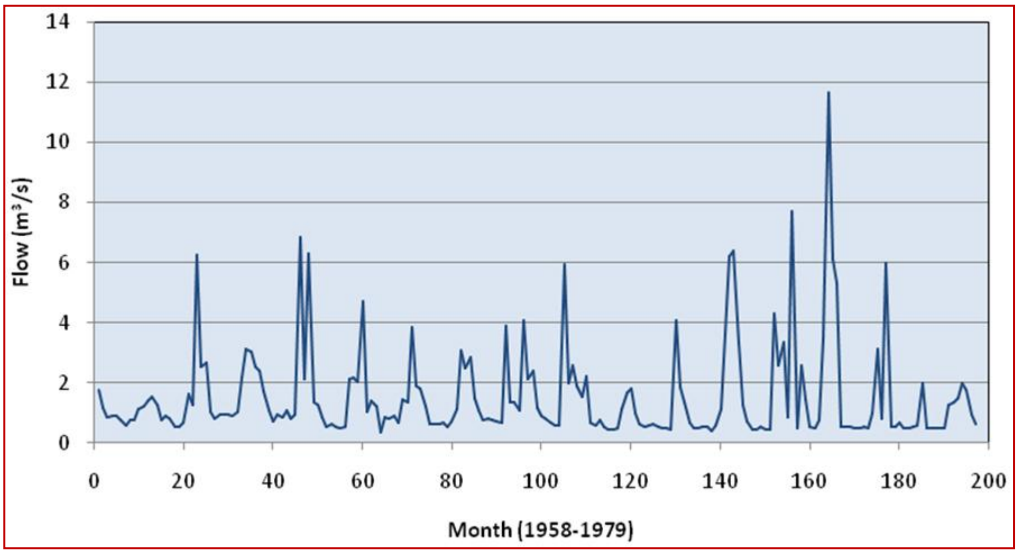
$$Q_{ij} = \frac{A_i \times P_i}{A_2 \times P_2} \times Q_2(j)$$

where:

$Q_{(i,j)}$ = estimated flow in m3/sec. of the sub-catchment i for the month j
A_i = area of the sub-catchment i in km^2
P_i = mean annual rainfall in millimeters of the sub-catchment i
$Q_2(j)$ = measured flow of the gauged basin in m^3/sec. for the month j
A_2 = gauged drainage area in km^2
P_2 = mean annual rainfall in millimeters of the reference station of the gauged basin

The water availability and dependability analysis is conducted in this study to determine the average flows, dependable flows, and required environmental flows for Lusong and Wain Watersheds.

The available data for Pilar River from 1958-1979 of the DPWH-BRS publication was used in the analysis because of its proximity to the study area. **Figure 2-25** shows the time-series plot of the flows in Pilar River. The daily streamflow data ranges from 0.37 m^3/s to 15.29 m^3/s with an average flow of approximately 0.95 m^3/s.



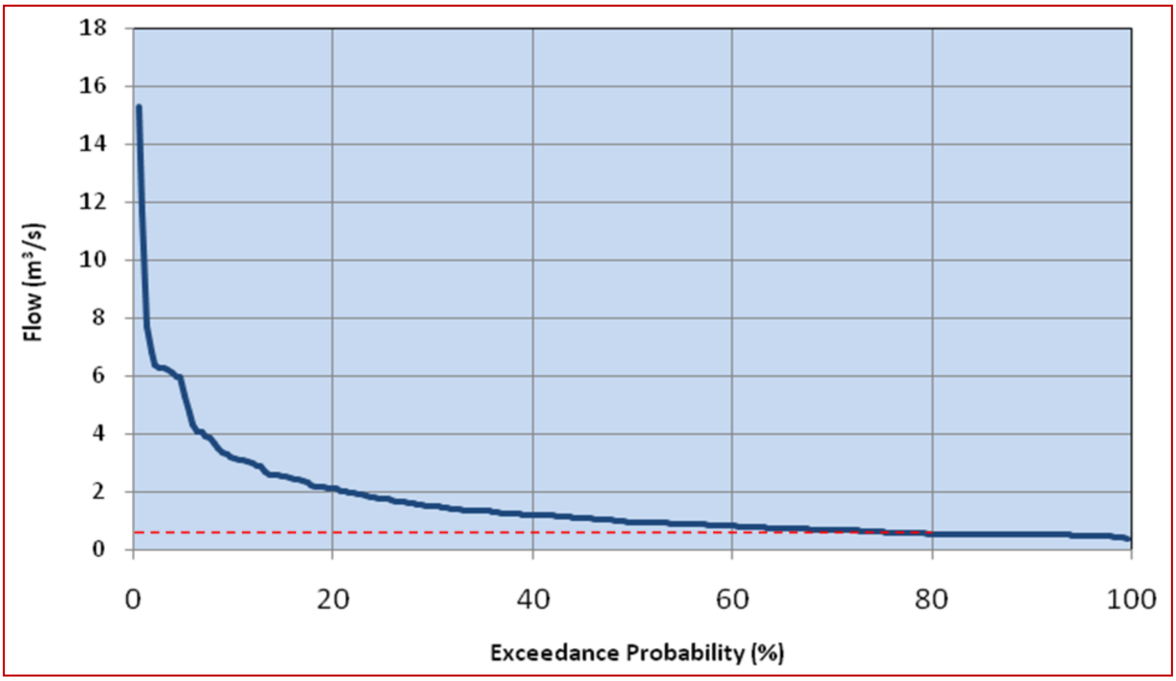
Source: MEZ EISR 2017

Figure 2-25 Time Series Plot of Average Daily Streamflows for Pilar River

From the monthly streamflows, flow duration curve for the entire year was generated to determine the dependable flow and the required environmental flow. The flow duration curve of a river indicates the exceedance probability or also called the dependability of a specific streamflow magnitude. For flow diversions, the 80% exceedance probability or the flow that is available 80% of the time throughout the year is regarded by the NWRB as the dependable flow at the point of diversion. Further, 10% of the dependable flow is considered as the minimum environmental flow. A flow at least equal to the minimum environmental flow has to be released all the time to the downstream reach of the diversion point for ecological sustainability. Figure 2-25 exhibits the flow duration curve for Pilar River. The values from the flow duration curve of Pilar River is transposed to derive the flow duration curves for Lusong River and Wain River and are presented in **Figure 2-26** and **Figure 2-27**, respectively.

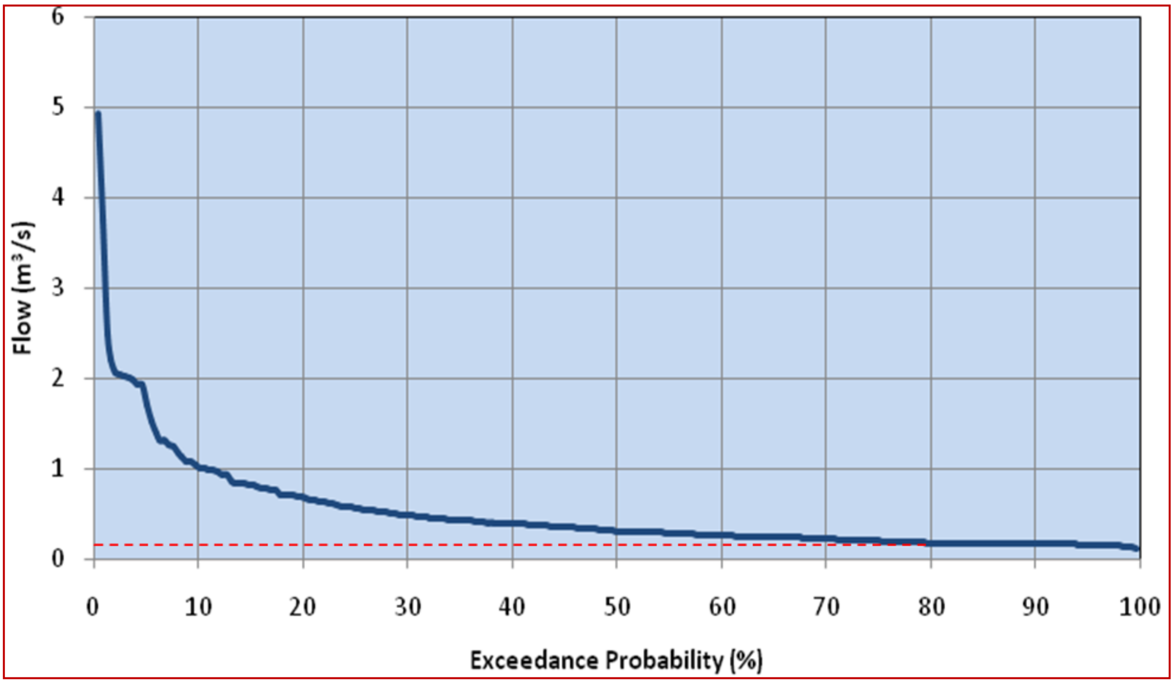
Based on the generated flow duration curve for the entire year, the 80% dependable flow of Lusong River is estimated at 0.18 m^3/s while the minimum environmental flow (10% of the dependable flow) is computed as 0.02 m^3/s.

On the other hand, the 80% dependable flow of Wain River is estimated at 0.11 m^3/s while the minimum environmental flow (10% of the dependable flow) is computed as 0.01 m^3/s. A summary of the average dependable and minimum environmental flows is given in **Table 2-15**.



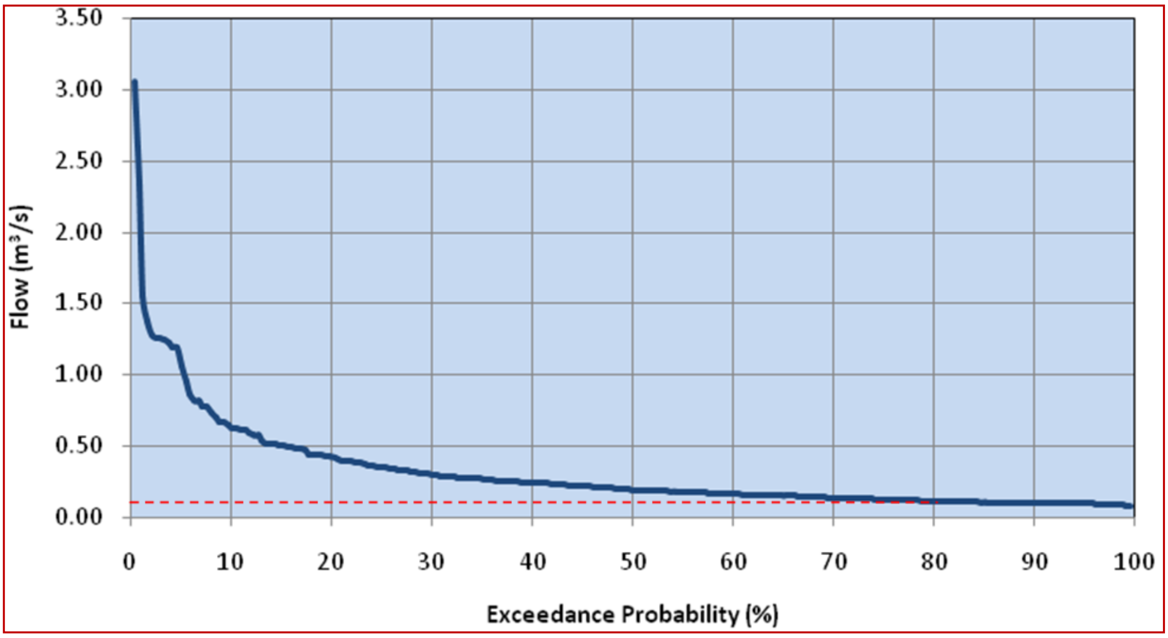
Source: MEZ EISR 2017

Figure 2-26 Generated Flow Duration Curve for Pilar River



Source: MEZ EISR 2017

Figure 2-27 Generated Flow Duration Curve for Lusong River



Source: MEZ EISR 2017

Figure 2-28 Generated Flow Duration Curve for Wain River

Table 2-15 Average, Dependable and Minimum Environmental Flows

Flow Type (from Flow Duration Curve)	Pilar River (m^3/s)	Lusong River (m^3/s)	Wain River (m^3/s)
Average Flow	1.60	0.52	0.32
10% Dependable	3.12	1.01	0.60
20% Dependable	2.10	0.68	0.40

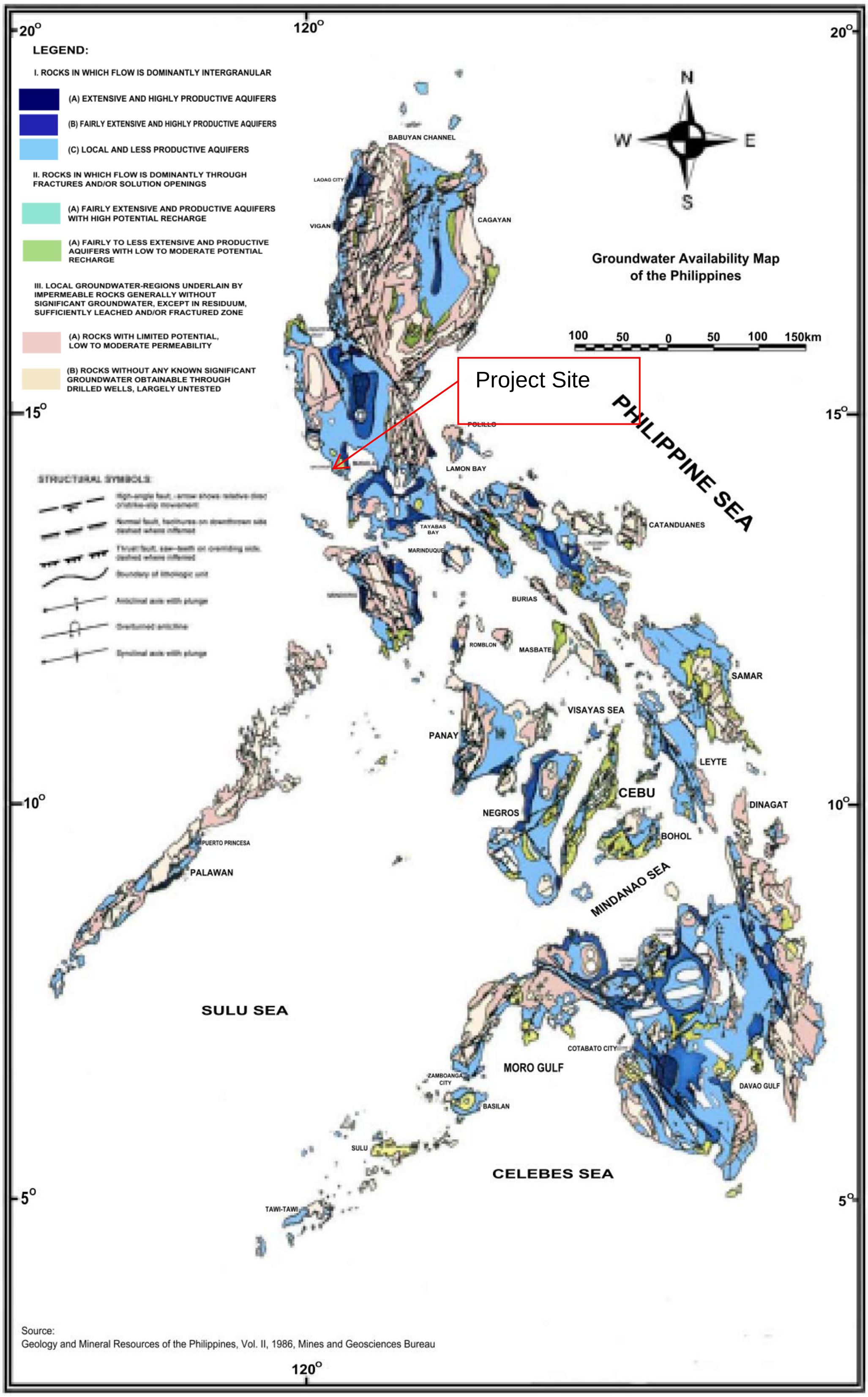
Flow Type (from Flow Duration Curve)	Pilar River (m^3/s)	Lusong River (m^3/s)	Wain River (m^3/s)
30% Dependable	1.49	0.48	0.28
40% Dependable	1.20	0.39	0.23
50% Dependable	0.95	0.31	0.18
60% Dependable	0.81	0.26	0.15
70% Dependable	0.68	0.22	0.13
80% Dependable	0.55	0.18	0.11
90% Dependable	0.50	0.16	0.10
Env Flow (0.1 x 80% DF)	0.06	0.02	0.01

Source: MEZ EISR 2017

2.2.1.2 Hydrogeological Setting and Identification of Aquifer

Based on the 1997 Groundwater Availability Map of the Philippines presented in Figure 2-28, the southwestern slope of Mt. Mariveles where the proposed MCPP Project is to be located fall under the classification “Local and Less Productive Aquifers”. This classification is consistent to the scarcity of productive wells in the area.

A total of 5 springs and 3 shallow wells were inventoried within the study area and actual discharge measurements were carried out in 9 surface water (SW) stations. All except one SW station (**SW#9**) was located in Wain River. All sources were tapped for domestic purposes. **Table 2-16** provides a summary listing of these surface water and groundwater inventory. **Figure 2-30** shows the groundwater inventory map.



Source: MEZ EISR by MGB-DENR

Figure 2-29 Groundwater Availability Map of the Philippines

Table 2-16 Surface Water and Groundwater Inventory

Station No.	Coordinates		Type	Estimated flow rate, Q	Remarks
	Latitude	Longitude			
SP #1	14-28-38.09 N	120-26-39.80 E	Spring	0.0045 lps	Located on the upstream portion of Lusong River near SW#2.
SP #2	14-28-30.36 N	120-26-34.08 E	Spring	0.0040 lps	Located near SW#4. The spring is not very distinct and was just filling up a pond near Lusong River.
SP #3	14-28-29.0 N	120-26-31.38 E	Spring	0.0046 lps	Not very noticeable spring on the bank of Lusong River near SW#4.
SP #4	14-27-15.69 N	120-26-13.36 E	Spring	0.11 lps	Located near SW#5, in the side of Lusong River. The spring provides water supply to few houses near the bay.
SP #5	14-27-0.02 N	120-25-44.0 E	Spring	0.23 lps	The discharge point is near the side of Wain River near SW#7.
GW#1	14-26-52.68 N	120-26-1.86 E	DW	0.42 lps	The deep well was shallow with a depth of 6m and is located near SW#5. The discharge was taken at normal manual pumping rate. The well needs priming before water is pumped.
GW#2	14-26-32.89 N	120-27-4.6 E	DW	0.47 lps	Located in Barangay Biaan proper.
GW#3	14-26-34.39 N	120-27-4.64 E	DW	0.46 lps	Located in Barangay Biaan proper.
SW #1	14-28-46.17 N	120-26-44.19 E	River	0.012 cms	Flow measured along Lusong River. It was difficult to find a longer stretch because of the presence of boulders and the water was shallow.
SW #2	14-28-40.05 N	120-26-40.85 E	River	0.013 cms	Located along Lusong River. The water was very shallow and the width of the stretch was minimum.
SW #3	14-28-32.19 N	120-26-32.08 E	River	0.027 cms	Located before the identified confluence between the tributary of Lusong River and Lusing River.
SW #4	14-28-29.01 N	120-26-25.81 E	River	0.083 cms	Located just after the confluence of Lusong River and its tributary.
SW #5	14-27-16.30 N	120-26-1.79 E	River	0.101 cms	Located on the downstream part of Lusong River. The river was greatly affected by tidal fluctuation.
SW #6	14-27-8.49 N	120-26-2.19 E	River	0.031 cms	Located on an ephemeral stream upstream of SW#5.
SW #7	14-29-0.78 N	120-26-30.45 E	River	0.045 cms	Located near the most upstream part of the tributary of Lusong River.
SW #8	14-28-41.07 N	120-26-21.89 E	River	0.056 cms	Downstream of SW#7 along the tributary of Lusong River
SW #9	14-27-24.03 N	120-25-21.89 E	River	0.021 cms	This was the only station along Wain River since we were not allowed to access the river through a private property. The stretch of the river with active flow is short. The upstream portion of the river was dry while the other portions were inaccessible because of the very steep overbank.

Source: EISR of MEZ

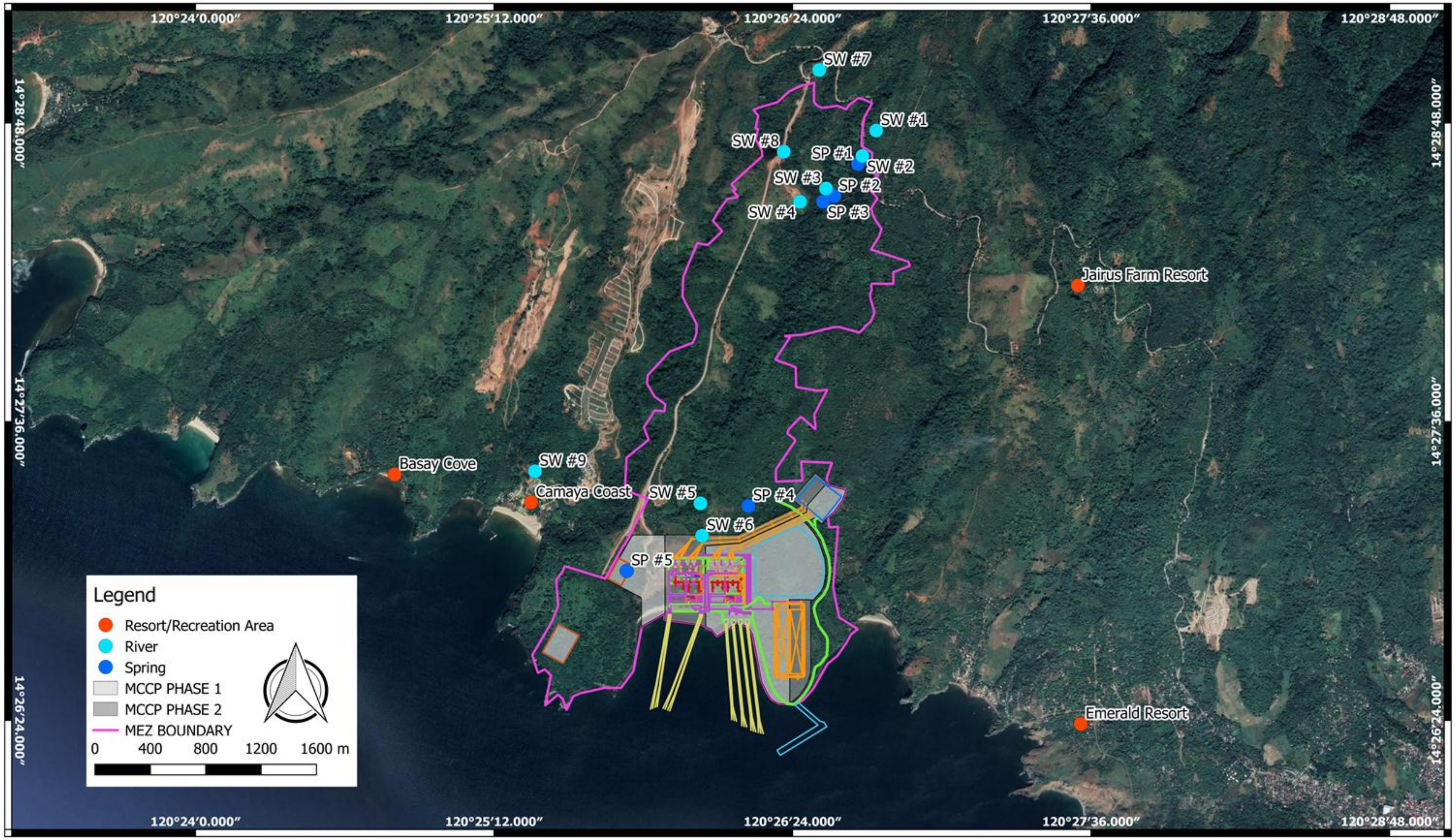
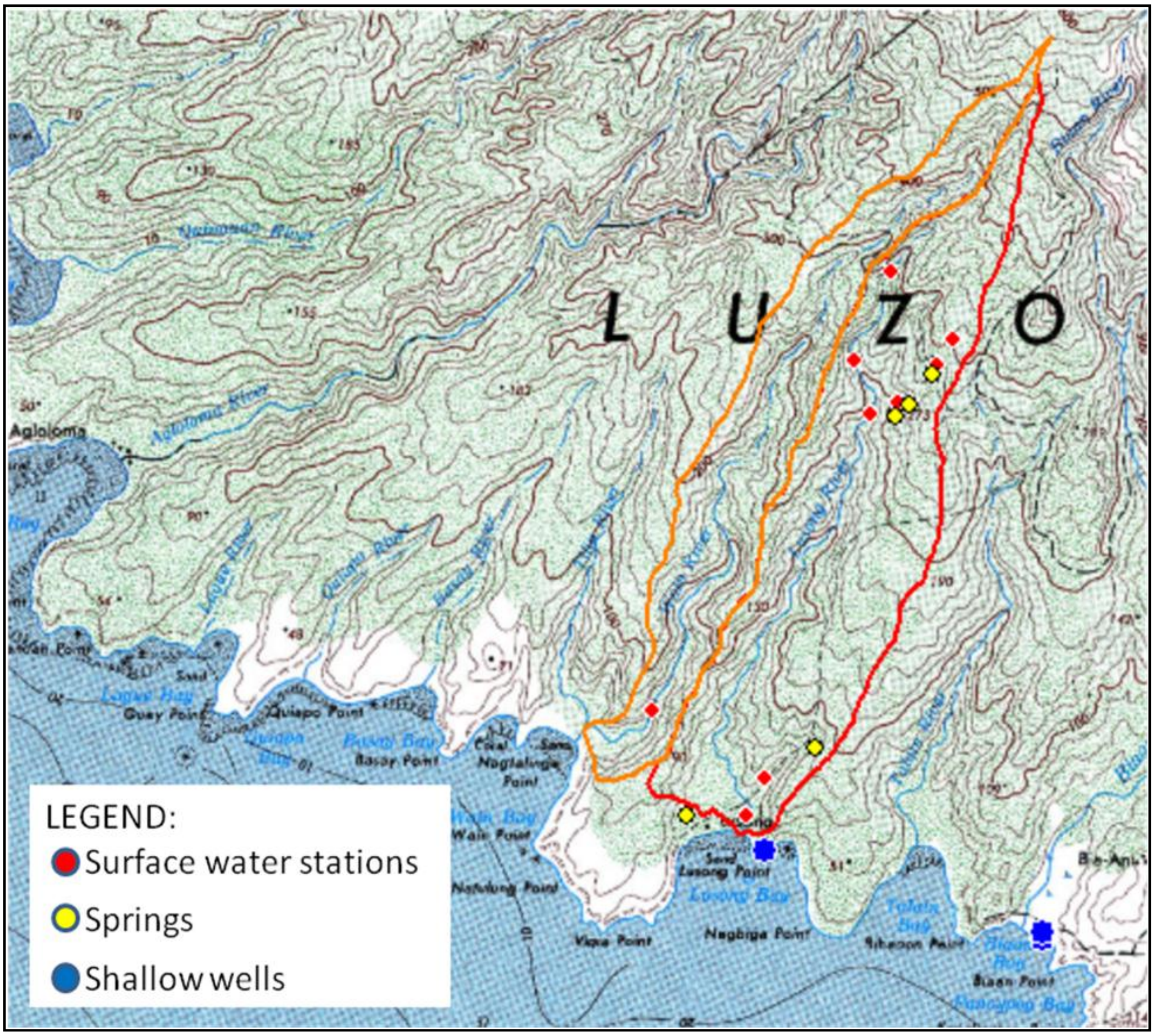


Figure 2-30 Groundwater Inventory Map

From the groundwater and surface water inventory, it was observed that most of the groundwater sources within the basin were free flowing springs in which flows come from the fractured rocks in the mountains and eventually discharges into the river. This indicates major aquifer manifestation in the area. Stream flow measurements for surface water were conducted upstream and downstream.

The flow measurements for piped springs were carried out using volumetric method while stream flow measurements were estimated by float method. The specific locations of all the stations in latitude-longitude coordinates were observed using a GPS instrument.

Figure 2-31 shows the location of inventoried springs, shallow wells and the river stations where actual discharge were measured. Among the inventoried groundwater sources, there were three (3) shallow wells, which were manually pumped, have an average depth of 6 meters. Only one of these shallow wells is located within the project area.



Source: MEZ EISR 2017

Figure 2-31 Locations of Groundwater and Surface Water Stations within and around the Proposed Project

2.2.1.3 Current and Major Water Users

Based from the records of National Water Resources Board (NWRB), two (2) water permits were issued to water users within the proximity of the study area. The list is provided in **Table 2-17** and are shown in **Figure 2-32**. Both grantees draw water from deepwells and are outside of the drainage areas within the project site.

In particular, there were no existing water rights issued for water users within the study area.

Table 2-17 NWRB's Summary of Existing Water Permits within the proximity of the Project

Permit	Grantee	Location	Source	Latitude	Longitude	Q (L/s)	Purpose
012311	Mariveles Water District	Balon Anito, Mariveles	Deepwell	14-26-25	120-28-43	60.00	Domestic
016725	Sta. Monica Homeowners Assn., Inc.	Wiswis Camaya, Mariveles	Deepwell	14-26-55	120-29-50	2.00	Domestic

Source: MEZ EISR 2017

Figure 2-32 Locations of Groundwater Users/Permitees within the Proximity of the Proposed MCPP Project

2.2.1.4 Flooding

Flooding is not expected within the proposes Project since the area is within a relatively small watershed and has existing good drainage system. At the time of investigation which is on a rainy season, the discharge measured on both rivers were generally small. In case of developing the area and during periods of continuous and/or heavy rains, with properly designed storm drain system, runoff goes directly into the rivers/streams which readily discharge their loads in to Lusong and Wain Bays and into the West Philippine Sea.

2.2.1.5 Depletion of Water Resources/Competition in Water Use

The freshwater requirement of MPGC per project phase is 128 m^3/h (3,100 m^3/day) or a total of 256 m^3/h (6,200 m^3/day) for Phase 1 and Phase 2. This will be sourced from the water supply system of MEZ which has an initial capacity of 10,000 m^3/day and final water supply capacity of

30,000 m^3/day. Therefore, the MCPP will not deplete the available water resources. EFIHI shall ensure that it will provide adequate water supply to MCPP and the other locators in the future.

Nevertheless, the project will also actively support the watershed management program of EFIHI in addition to its own reforestation activities. These will be done in coordination with DENR and the LGU to ensure the reforestation activities are done in the most appropriate locations and the watershed management programs are done effectively.

A water conservation program will be developed and implemented in the entire plant, to optimize the water requirements of the plant. Treated wastewater will be used in sprinkling systems for the coal yard and the site landscape, or reused for toilet water supply.

2.2.2 Oceanography

2.2.2.1 Physical Oceanography

2.2.2.1.1 Bathymetry of West Philippine Sea

The bathymetry of the coastal area within the MCPP Project was obtained from digital navigation charts from Nautical Charts Online, as shown in **Figure 2-33**.

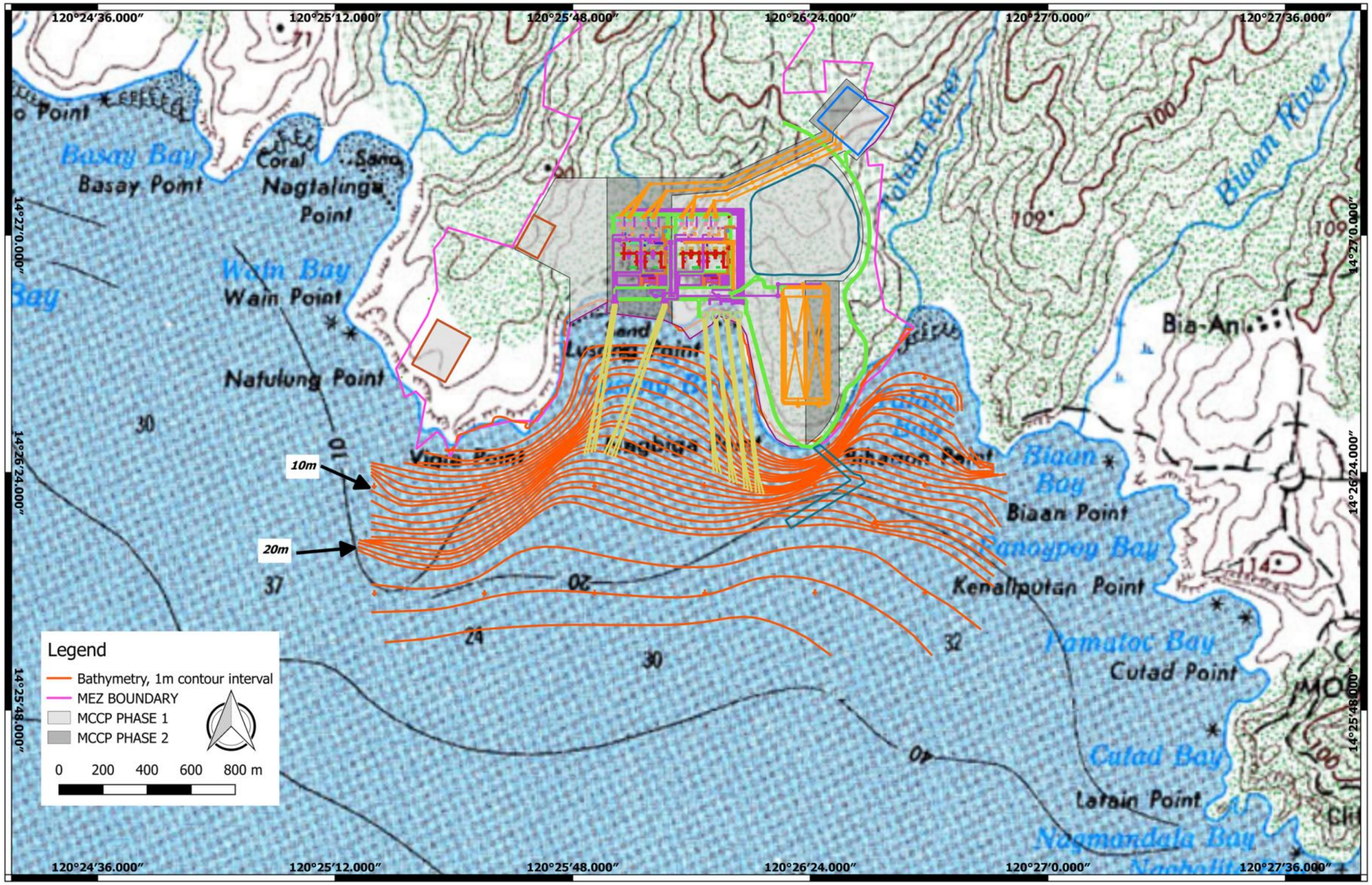
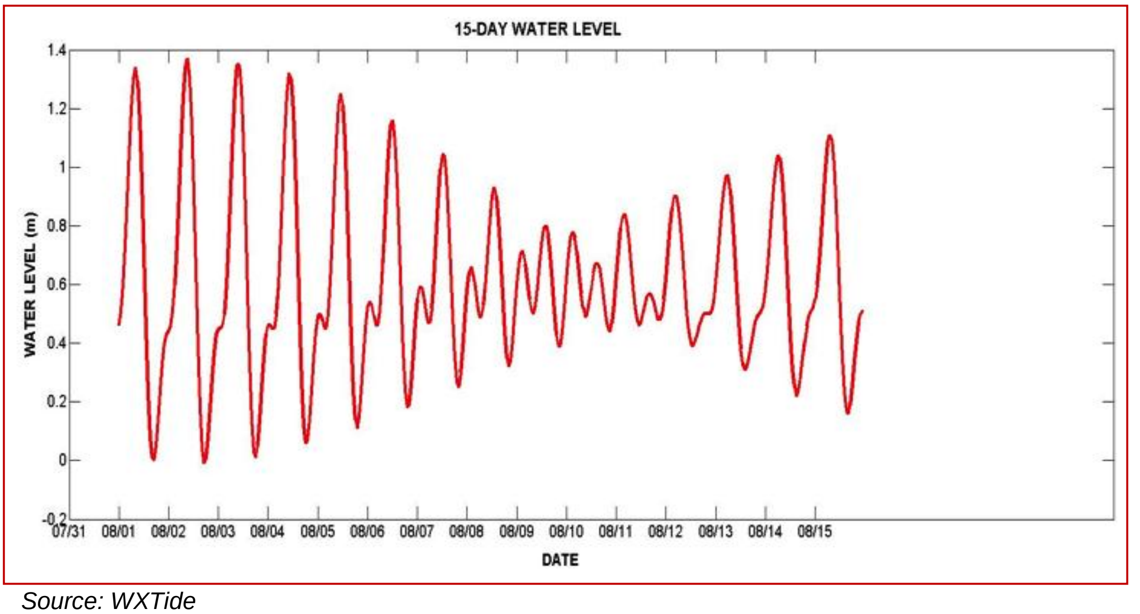


Figure 2-33 Bathymetry Map of West Philippine Sea

2.2.2.1.2 Tide

The coastal waters of Bataan are highly influenced by tidal currents typically 1.3m during spring tide and 0.4m during neap tide (**Figure 2-34**).



Source: WXTide

Figure 2-34 Fifteen Days Tidal Variation in the Nearest Tidal Station in Corregidor

2.2.2.1.3 Temperature, Salinity and Depth Profile

The temperature, salinity and depth profile at Lusong Beach were measured using the YSI Castaway Conductivity-Temperature-Depth (CTD) Profiler. The measurement was timed so as to do survey tracks on the same area at different tide phases. A total of eight (8) stations were surveyed during ebb and flood tide, as shown in **Figure 2-35**.

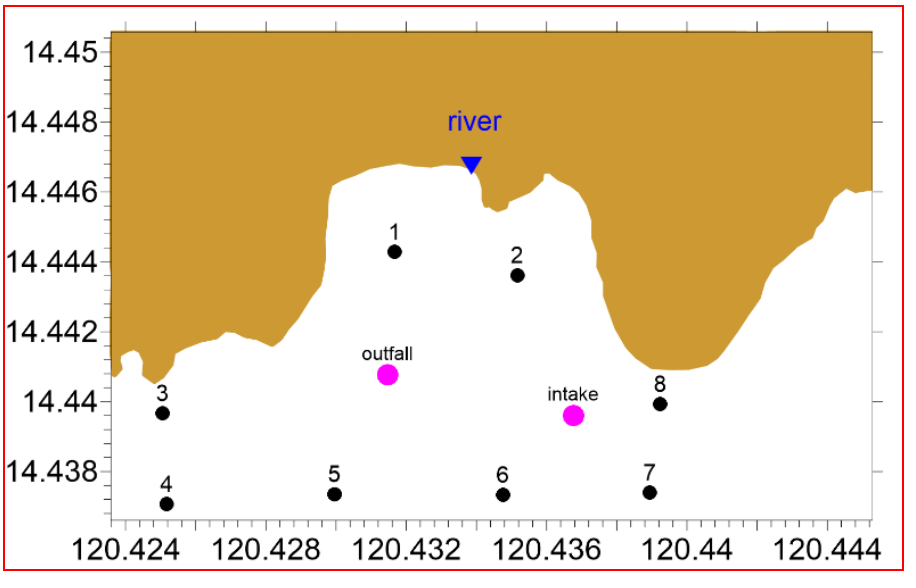
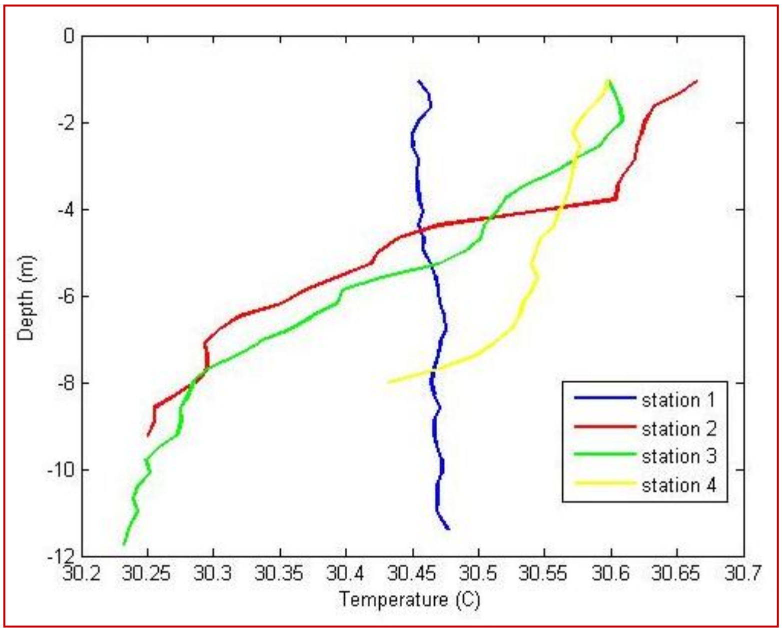


Figure 2-35 Sampling Stations for CTD Measurements during Ebb and Flood Tide

The temperature profile at four (4) sampling stations during flood and ebb tide is presented in **Figure 2-36**. It can be depicted that during ebb tide, the temperature decreases with increasing depths. The temperature within the top 12m varies by less than 1°C and ranges from 30.2-30.7°C.

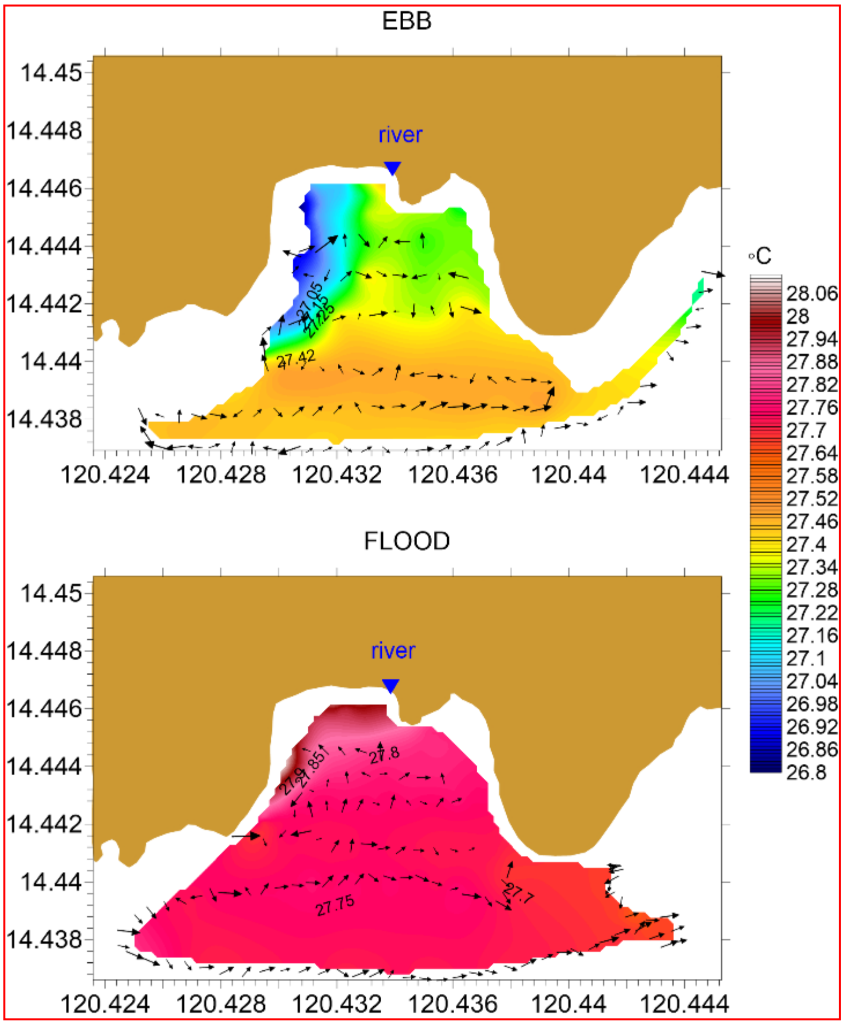
It can also be noted that the eastern part of Sitio Lusong is warmer compared to the western side with variations of less than 1°C.

Surface temperatures were also recorded during flood and ebb tide (**Figure 2-37**). As shown, comparatively colder waters govern the area's sea surface temperature distribution during ebb. Colder waters (that emanate from the river) can be seen advected in southward and westward direction. The opposite is, however, observed during flood where warmer waters from the SCS enter and dominate water condition inside the cove.



Note: Measurement conducted on December 22-23, 2017

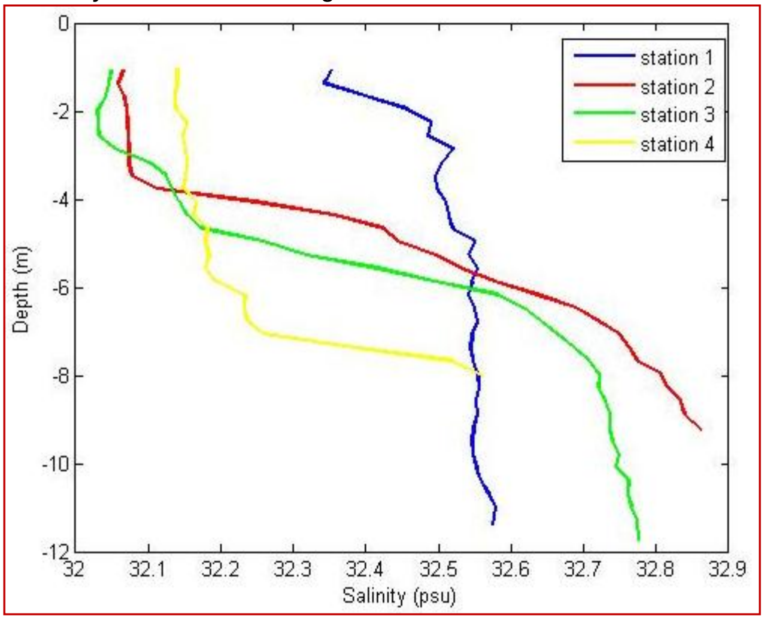
Figure 2-36 Temperature Profiles at Four Stations Across Depth during Flood and Ebb Tide



Note: Measurement conducted on December 22-23, 2017

Figure 2-37 Surface Water Temperature during Flood and Ebb Tide

The salinity profile shows very small vertical variations with values changing by less than 1 psu (**Figure 2-38**). The salinity at the surface ranges from 32–32.9 PSU.



Note: Measurement conducted on December 22-23, 2017

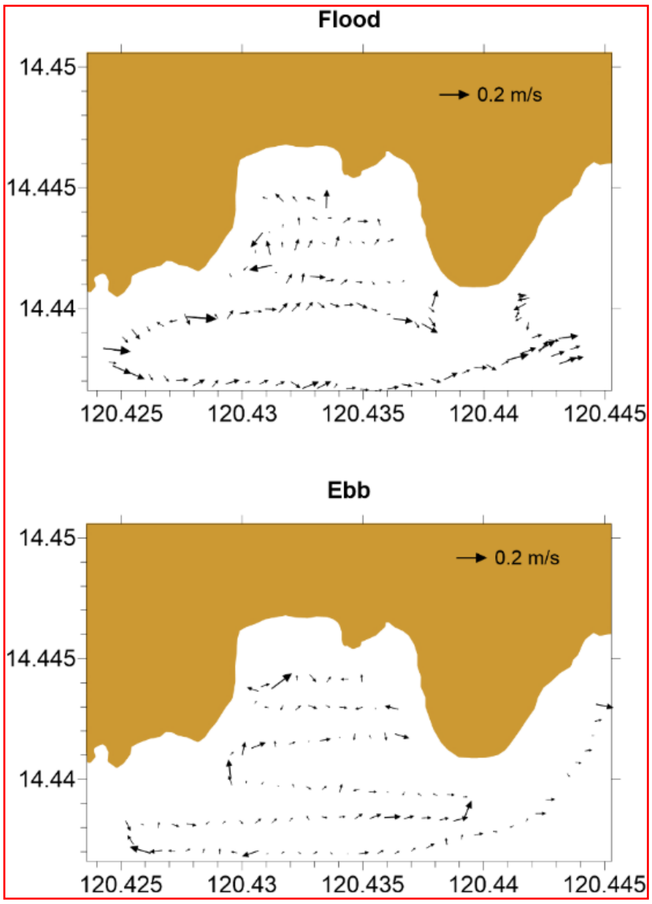
Figure 2-38 Salinity Profiles during Ebb Tide

2.2.2.1.4 Water Currents

The tidal circulation patterns were determined using a TRDI 300 Hz Workhorse Sentinel Acoustic Doppler Current Profiler (ADCP). The ADCP was mounted on the side of the boat, and towed across the Lusong Bay while logging at the same time the position of the boat using the Garmin Global Positioning System (GPS). The ADCP measured and recorded current magnitudes and directions and surface temperature at 30-second interval.

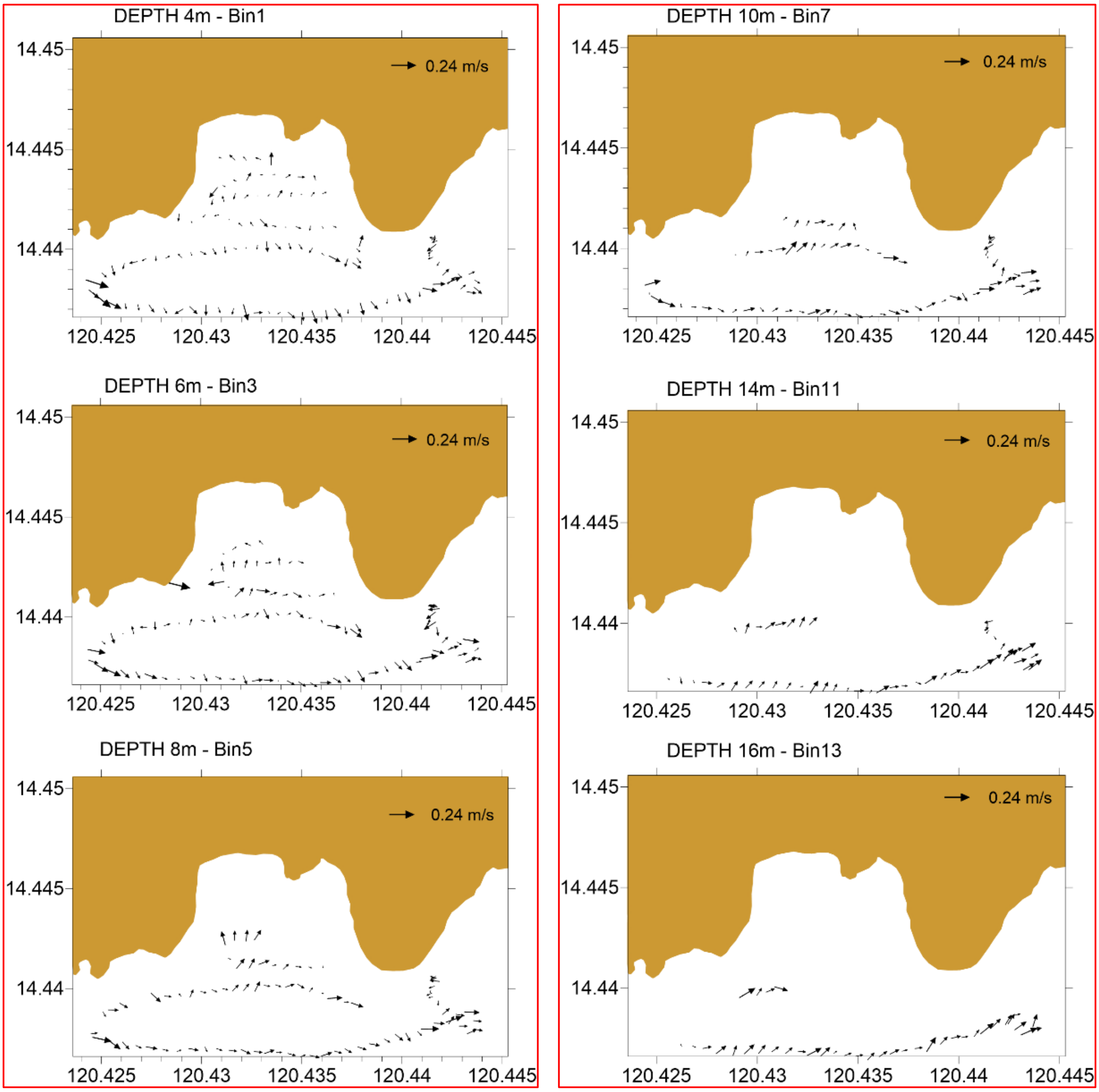
ADCP-derived depth average current velocities demonstrate the general water circulation patterns within and outside of the cove area (Figure 2-38). Despite current flow's lack of distinctive flow patterns, currents inside the cove can be seen to exhibit general northward and southward flows during (transition to) flood and ebb periods, respectively. The general current trend south of the cove's mouth, on the other hand, is demonstrated by currents moving towards the east.

Current velocities ranges from 0.16 to 0.24 m/s during flood and show velocity fields that do not vary significantly with depth (**Figure 2-39**). Relatively weaker currents ranging from 0.11 to 0.19 m/s conversely characterized current flow during ebb (**Figure 2-40**). The flow is strongest near the surface with maximum velocities reaching to approximately 0.2 m/s while beneath it were noticeably weaker current flows.



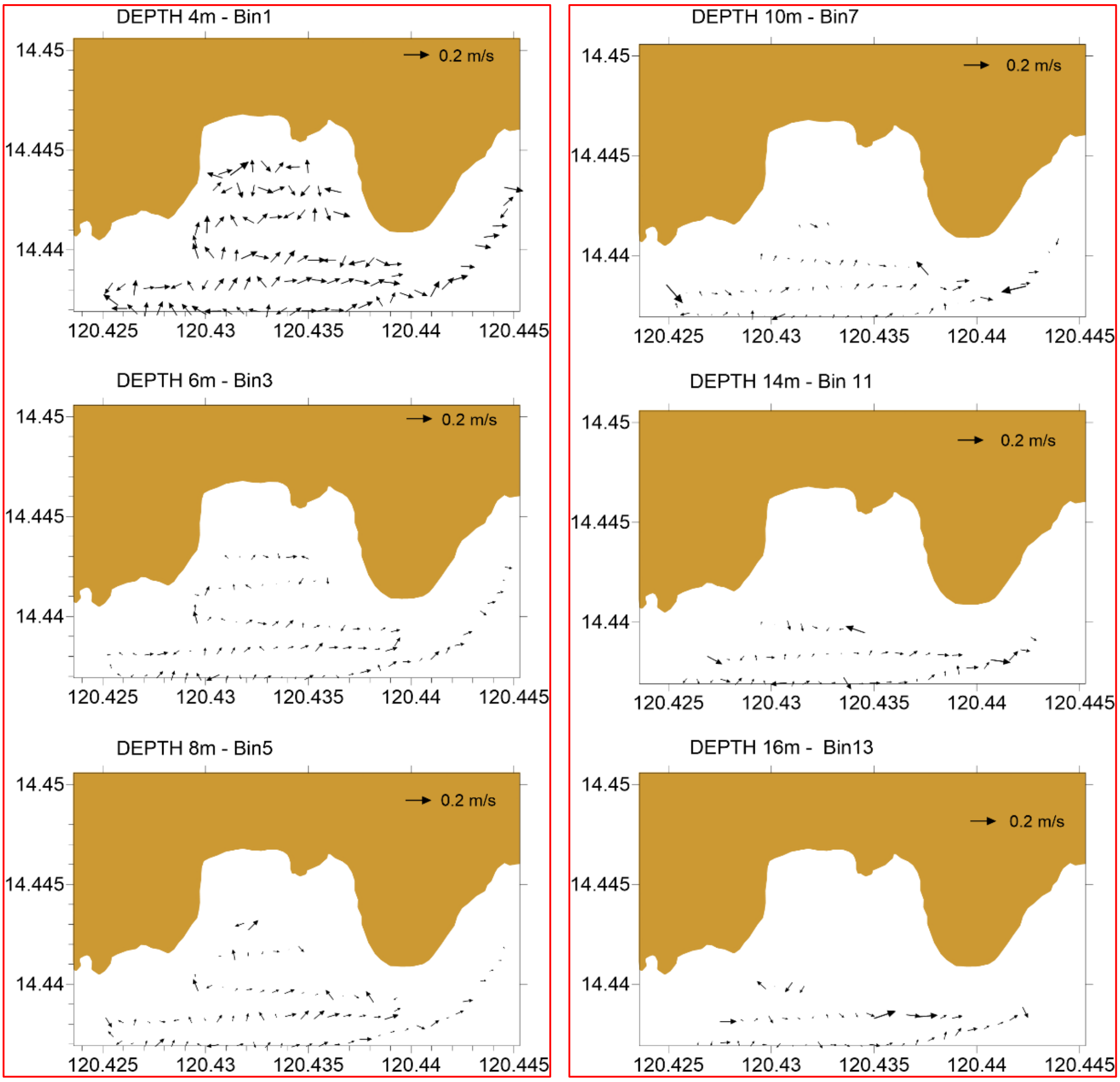
Note: Measurement conducted on December 22-23, 2017

Figure 2-39 Depth-Averaged Current Flow During Flood and EBB Tide



Note: Measurement conducted on December 22, 2017

Figure 2-40 Current Flow at 4m, 6m, 10m, 14m and 16m Depths during Flood Tide



Note: Measurement conducted on December 23, 2017

Figure 2-41 Current Flow at 4m, 6m, 10m, 14m and 16m Depths during EBB Tide

2.2.2.2 Thermal Plume Dispersion Modeling

The thermal plume dispersion is modeled using MIKE 3 software. The model is a flexible mesh modeling system and simulates unsteady flows taking into account density variations, bathymetry and external forcing such as meteorology, tidal elevations, currents and other hydrographic conditions.

Two (2) discharge pipes will be installed for each Phase of the proposed MCPP Project.The discharge and ambient velocities derived from field measurements and available information were used as input parameters in the model. Water elevation data initialized in the boundary conditions was based on DHI MIKE 21 Global Tide Constituents System. Values for discharge rate/volume was adjusted to account the simulation. Some adjustments were also made as to the average depth of the area because of some constraints on the depth at discharge. Details about the discharge parameters are presented in **Table 2-18.**

Table 2-18 Parameters and Base Conditions Set for MIKE 3 Hydrodynamic Model Runs

Input Parameter	Values
Courant Number	0.8
Bed Resistance	0.05 meters
Temperature Equation Range	-60 ºC to -10ºC
Cooling water discharge	20.56 x 8 cms
Initial Temperature	29 ºC
Excess temperature	2.8ºC
Intake Depth	10m below sea surface
Outfall Depth	6m below sea surface
Simulation Period	7/12/2014 – 7/13/2014

The tidal conditions to be input to the model was determined by using a form factor to measure the relative importance of diurnal and semidiurnal tides. From this, it was calculated that the dominant tide at the site is mixed, dominantly diurnal tide.

Tide levels at the site were also input to the Tidal Analysis and Prediction module of MIKE 3 to generate tidal boundary conditions. A mesh grid was then generated for the area near the intake and outfall structures of MCPP.

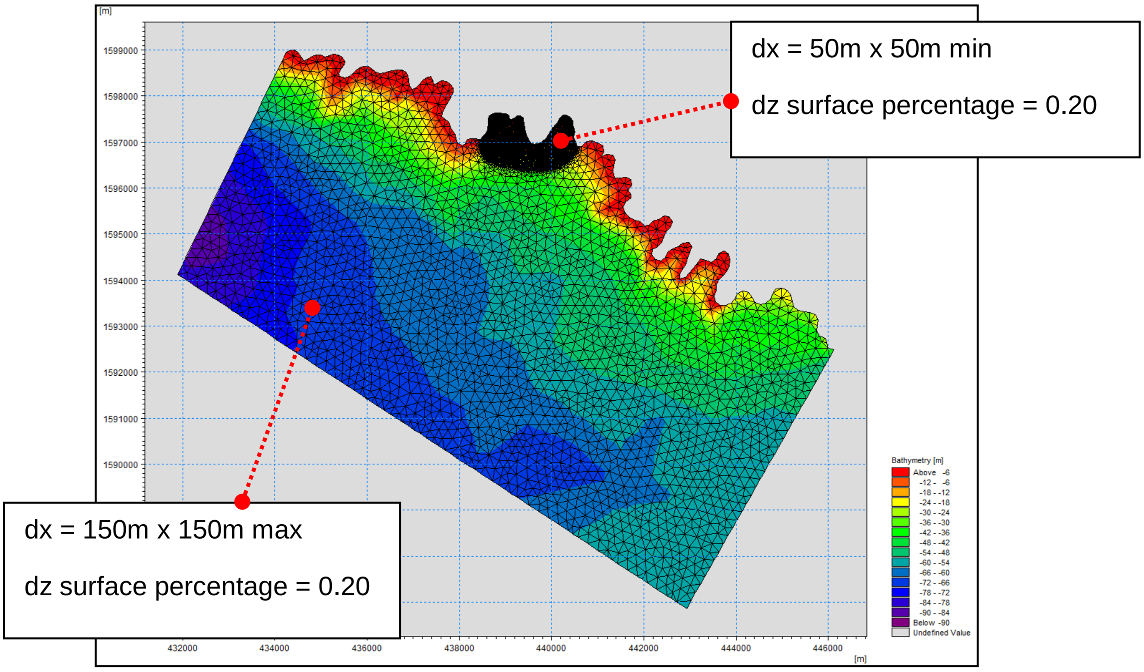


Figure 2-42 Mesh Grid at the Intake and Outfall Areas of Proposed MCPP Project

Modeling Results

The following **Figures 2-43** to **2-49** show the temperature profiles at different depths.

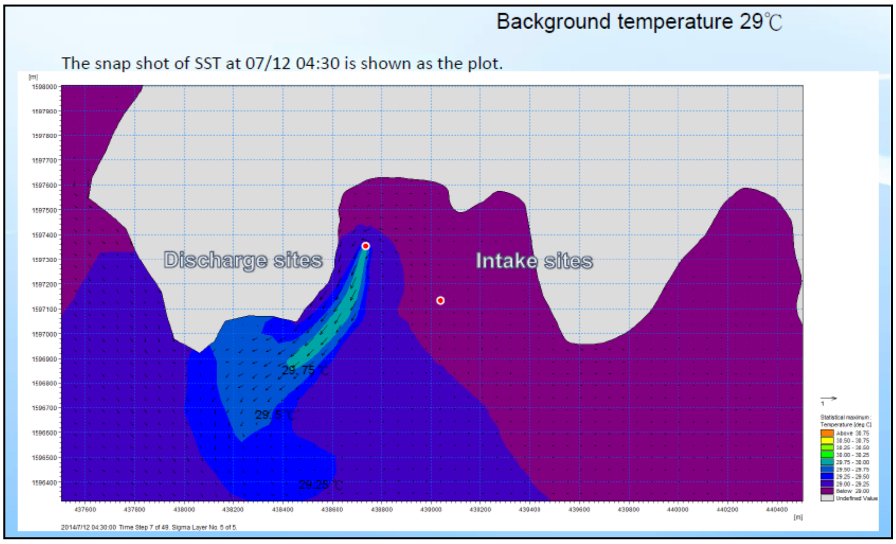


Figure 2-43 Snapshot of Simulated Sea Surface Temperature

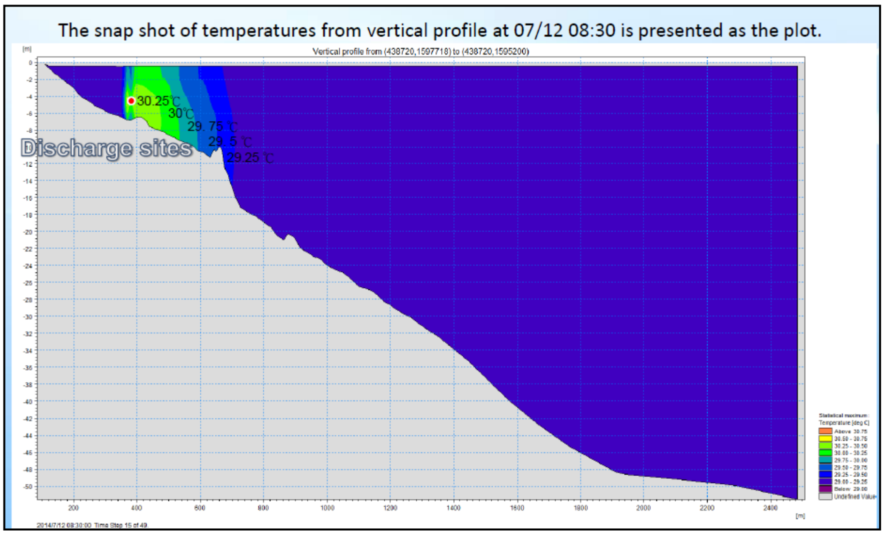


Figure 2-44 Vertical Profile of Simulated Sea Temperature

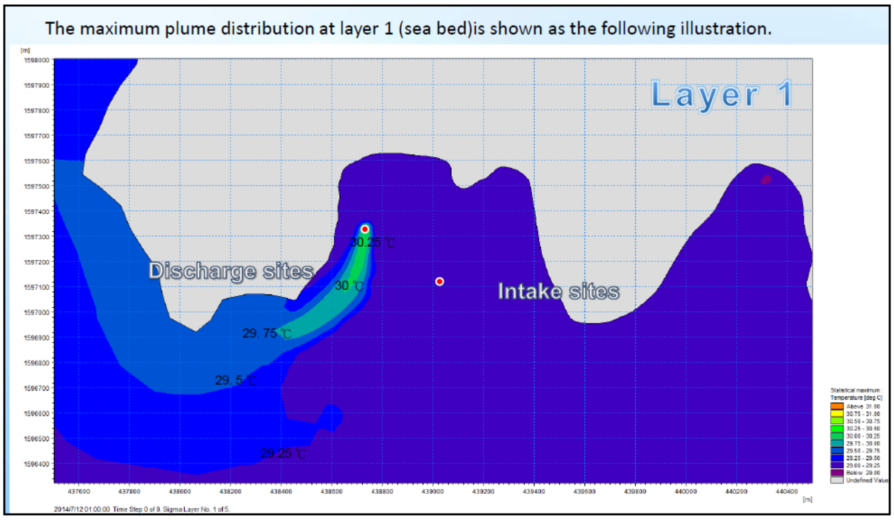


Figure 2-45 Simulated Seabed Plume Distribution

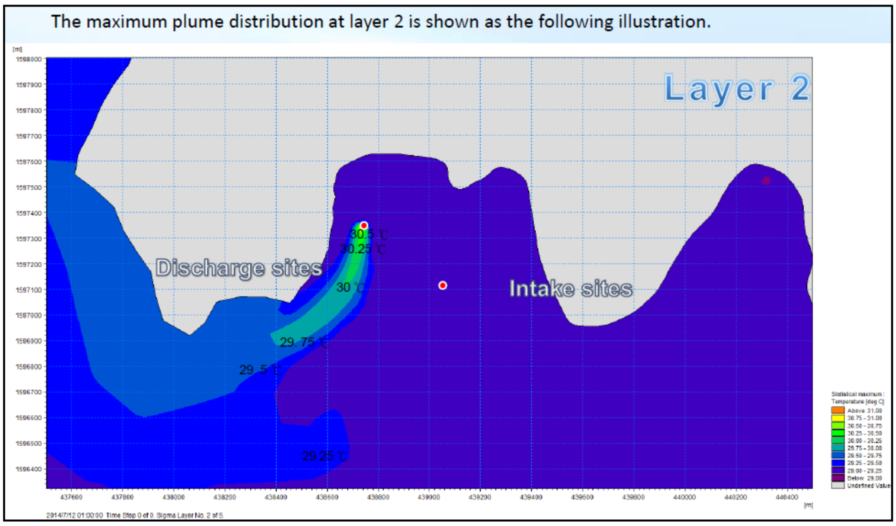


Figure 2-46 Plume Distribution at Layer 2 (Above Seabed)

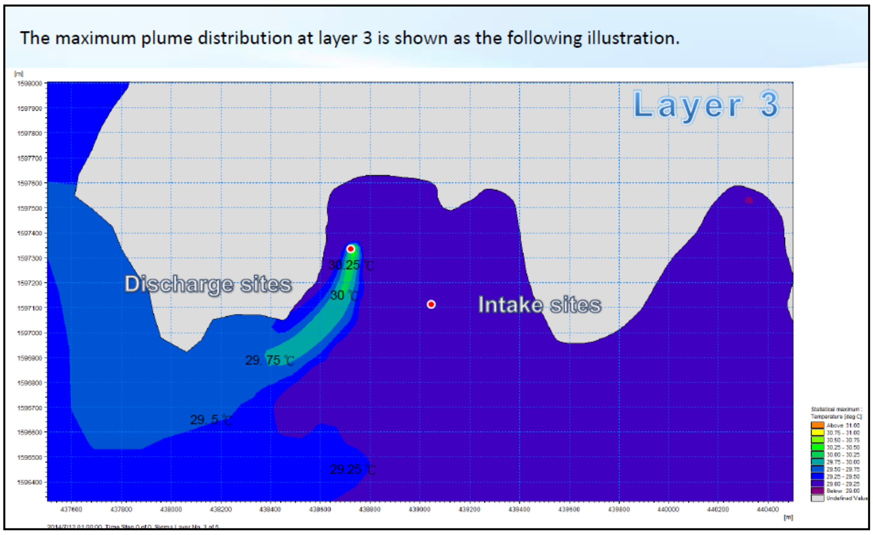


Figure 2-47 Plume Distribution at Layer 3

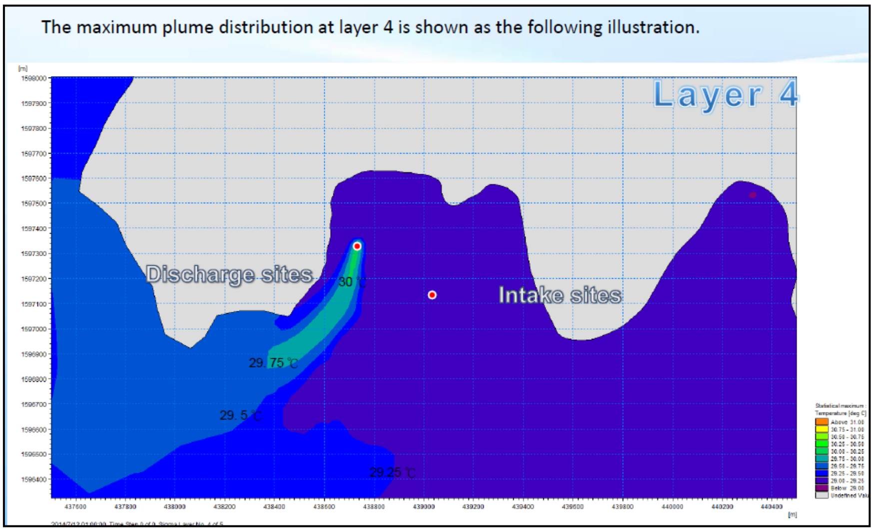


Figure 2-48 Plume Distribution at Layer 4

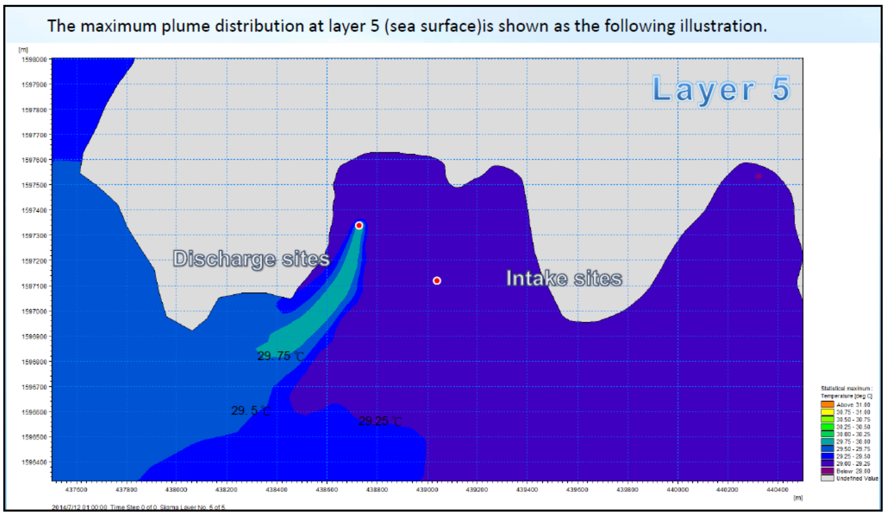


Figure 2-49 Plume Distribution at Layer 5 (Sea surface)

Simulation showed that the thermal plume is mainly influenced by the tidal currents in the bay near the MCPP. Intake head water temperature was predicted to reach 29.1°C, while maximum difference between background temperatures and thermal plume at discharge location at sea surface was predicted at 1.7°C.

2.2.2.3 Change/Disruption in Water Circulation Pattern, Littoral Current, Coastal Erosion and Deposition

The thermal discharge is not expected to have any impacts on coastal erosion and deposition. The nearby shoreline does not contain natural beach sediments. The large volume of discharged water will likely modify the water circulation pattern with offshore currents near the vicinity of the discharge pipe release point. This is driven by the inertia of the water exiting the pipe.

The MCPP will strictly comply to the requirement set by DAO 2016-08 to maintain the cooling water temperature at 3°C rise at the point of discharge. A cost-effective approach will be used, wherein roughly the same quantity of sea water at ambient temperature will be pumped into a huge thermal diffusion pool at the downstream of the syphon and a common pit after the condenser.

The temperature of cooling water after the condenser is estimated to reach 5.6°C rise over the ambient seawater temperature. Mixing with roughly the same quantity of sea water at ambient temperature within a suitable mixing time using an effective and diffusion mechanism and route will lower the effluent sea water temperature rise to 3°C at the point of discharge.

The thermal plume simulations have not been validated and it is important that a monitoring program be set in place to measure sea surface temperature fields continuously over long periods to resolve sea surface temperature spatial and temporal variations as well as to determine extent of the actual thermal plume. Such measurements can be accomplished by using moored thermistors, which measure temperature continuously for months at a time. Acquiring such temperature data and as estimate of its temporal and spatial variations will be an important dataset to validate the thermal discharge model.

2.2.2.4 Change in Bathymetry

Coastal erosion and sedimentation will bury the natural coastline. The risk factor to the change in bathymetry is significant especially when silt and spoil materials at the construction site are not controlled during construction period. Siltation and turbidity resulting from offshore excavation may adversely affect the area. However, this impact is temporary and may only be prevalent during the construction period of the proposed MCPP Project. It must be noted also that the nearby shoreline does not contain natural beach sediments that may enhance coastal erosion and deposition.

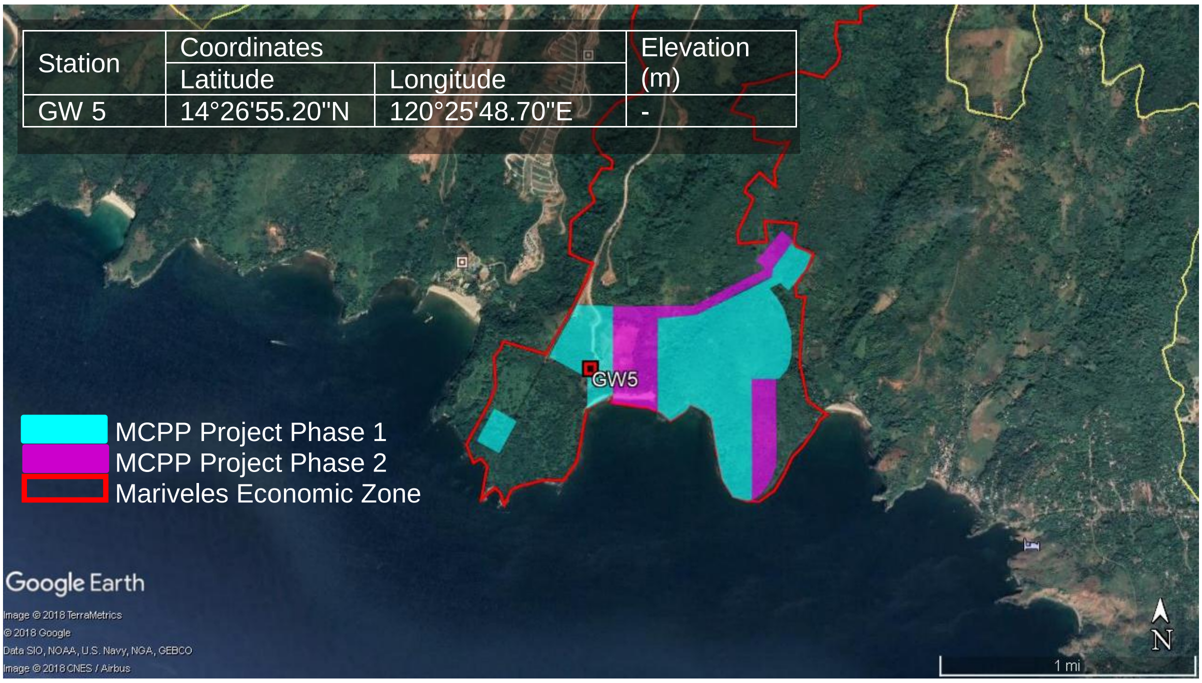
The jetty design of just piling with no construction of walls and breakwater, will not affect the bathymetry of the project area. Moreover, onshore excavation will be scheduled during dry season and siltation and soil erosion control measures such as silt traps will be installed prior to the conduct of excavation works.

2.2.3 Water Quality

2.2.3.1 Groundwater Quality

Groundwater quality is described based on the results of the study for MEZ project of EFIHI. There was only spring near the MCPP located at about 30 meters from the access road (Figure 2-57). The result of groundwater quality testing is presented in **Table 2-19**.

As shown, levels of pH, temperature, TSS, Cr, As, Hg, total hardness, Boron, Chloride, Oil and Grease, Phosphate and Sulfate measured at the groundwater station were conformant to the range of values set in the DAO 2016-08. The levels of Pb, Cd and fecal coliform count, however, exceeded the range of values set in the DAO 2016-08. Total hardness was recorded at 57 mg/L and the total coliform count was at 35x103 MPN/100 ml. Non-conformance of fecal coliform with the DENR guideline value could be linked to the easy access of animals to the sampling site. Cd may be present naturally in soil near the station, or along with Pb, has been introduced to the surrounding soil by human activity, owing to its proximity to an access road.



Note: GW – Groundwater
Source: MEZ EISR 2017 using Google Earth modified by Geosphere, 2016

Figure 2-50 Groundwater Quality Monitoring Station

Table 2-19 Results of the Groundwater Quality Analysis

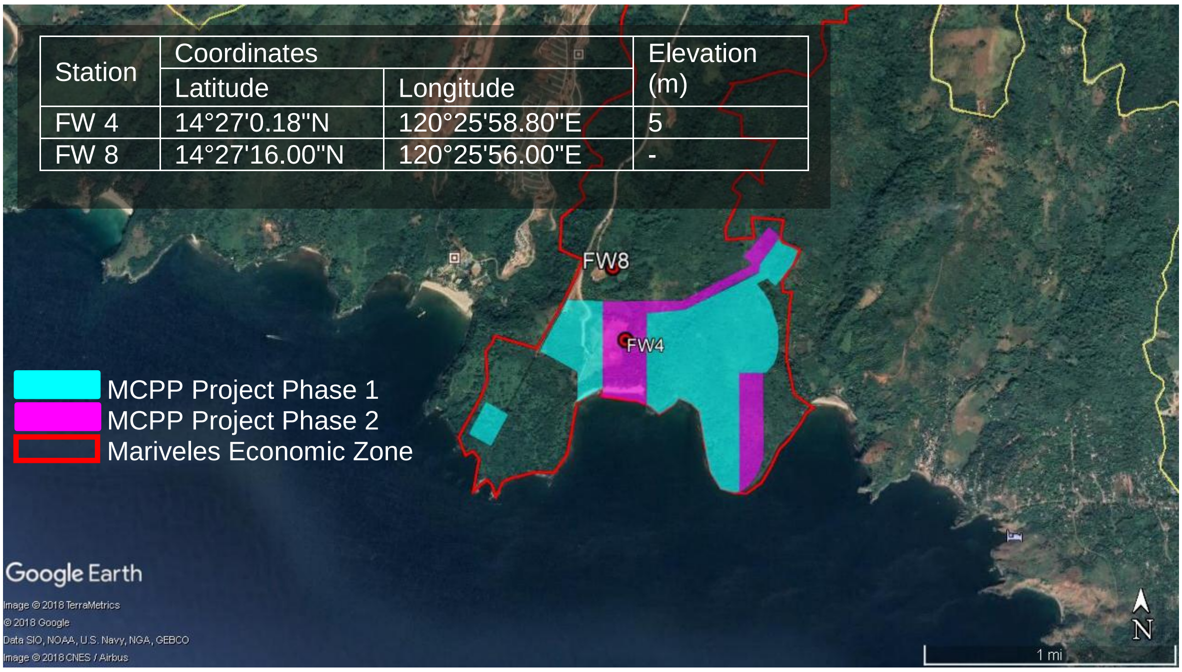
Parameters	Station	DAO 2016-08
	GW5	
Onsite		
pH	6.92	6.5-8.5
Temperature, ºC	26.2	26-30
Laboratory Analysis		
TSS, mg/L	11	50
Chromium, mg/L	<0.03	0.05
Arsenic, mg/L	<0.0009	0.05
Cadmium, mg/L	0.02	0.003
Lead, mg/L	0.075	0.01
Mercury, mg/L	<0.0001	0.001
Total Hardness as (CaCO3), mg/L	57	-
Boron	<0.1	0.5
Chloride	9.64	250
Oil & Grease	<0.5	1
Phosphate	0.15	0.5
Sulfate	1.85	250
Fecal Coliform	400	<1.1
Total Coliform	35x103	-

Notes: Sampling Date: GW5 - 12/08/2017
Source: MEZ EISR 2017

2.2.3.2 Freshwater Quality

As discussed in the EISR for MEZ project, Lusong River is a narrow and shallow freshwater body mainly comprised of boulders and big rocks interspersed with coarse pebbles and sand (**Plate 2-1**). Instream areas have significant amounts of leaf litter, especially at the upstream and midstream sections, and water was opaque. Lusong River has overhanging vegetation and partially open canopies particularly at the upstream and midstream sections, where 25%-50% of the channel was covered with overhanging vegetation. The upstream of Lusong River have boulders and big rocks occupying the instream bed, while coarse sand (or smaller particle sizes) covers the downstream section. It generally has moderate water flow along reaches and most sections have rugged terrain and steep slopes. The riparian vegetation of Lusong River is mostly natural. No significant fishing activity was observed at Lusong River. However, according to locals, minor fishing activity takes place during periods of high water and most fish are caught by electrofishing. The downstream section of Lusong River has other domestic uses such as for bathing and washing clothes, however, most sections are difficult to access due to its rugged terrain and steep slopes, hence are seldom used as passage way by locals. Based on this, Lusong River is classified under Class C – Recreational Water Class II.

Two (2) sampling stations were established in Lusong River (Figure 2-50). At each station, water quality meters were used to obtain on-site measurements of basic limnological variables which include Dissolved Oxygen (DO), pH, conductivity, salinity, total dissolved solids (TDS) and temperature. The average depths and widths of freshwater stations were measured using a meter stick and transect tape. Flow rate was estimated using float method.



Source: Google Earth modified by Geosphere, 2018

Figure 2-51 Freshwater Quality Monitoring Stations

Plate 2-1 Photographs of the Freshwater Sampling Stations

The results of analyses of freshwater samples were compared with the DENR Standard for Class C Waters set in DAO No. 2016-08. **Table 2-20** shows that the values of water quality parameters measured at two (2) freshwater stations in Lusong River fall within the DENR Standards for Class C Waters, except oil and grease level at FW4 and BOD_5, Cadmium and Fecal Coliform count at FW8. The concentration level of COD in the river was 40 mg/L. High value of oil and grease level in the station FW4 may be attributed to run-off coming from domestic activities along river banks and immediate vicinity. At Station FW 8, non-conformance of BOD_5 and fecal coliform with the DENR guideline value could be linked to the easy access of animals to the sampling site. High cadmium level detected in FW8 may indicate high concentration of cadmium in the surrounding soil.

Levels of in-situ water quality parameters at Lusong River generally fall within the normal/usual range of values observed in freshwater systems (Lampert and Sommers, 2007). DO levels were high at all stations, exceeding the optimal value of 5.0mg/L required by aquatic organisms. Average temperature values at FW 4 and FW 8 were 29.1 °C and 28.6 °C, respectively. pH regime at Lusong River is slightly basic. Conductivity values ranged from 80.9 µS/cm to 143.1 µS/cm. Salinity levels were generally low. Total Dissolved Solids (TDS) at FW 4 and FW 8 had elevated levels.

Table 2-20 Results of the Freshwater Quality Analysis

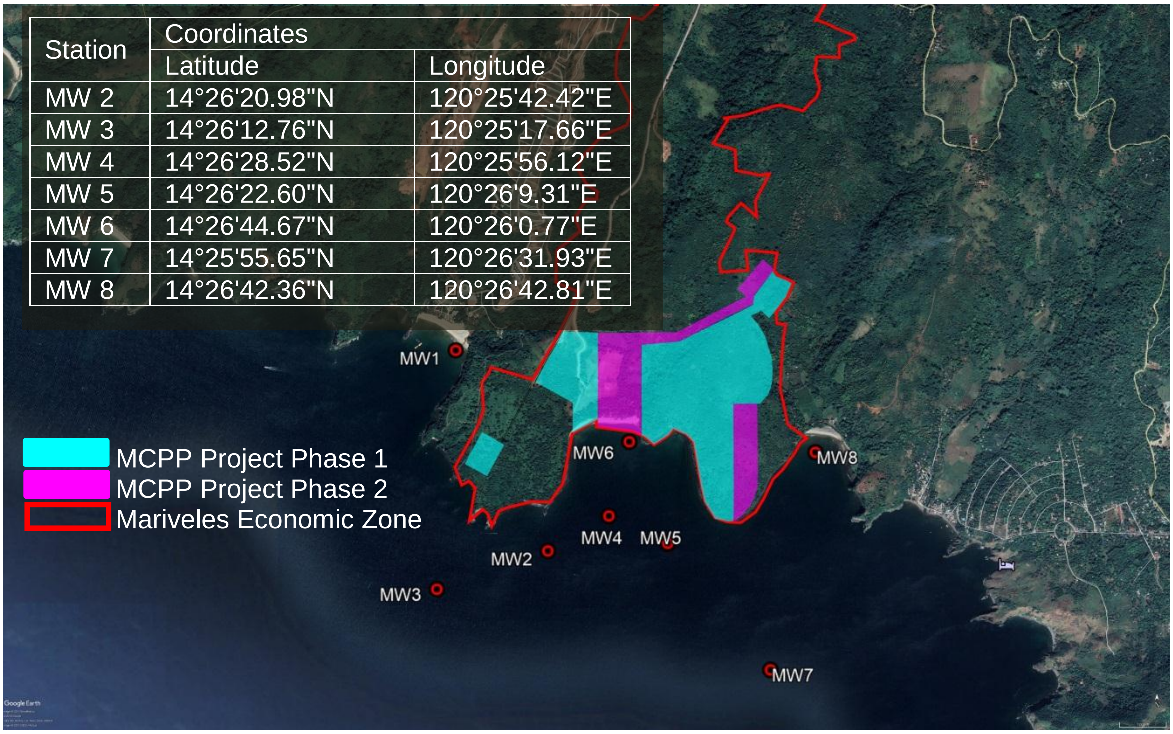
Parameters	**Stations**		**DENR Standards for Class C Waters**
	FW 4*	**FW 8**	
Onsite			
pH	7.2	7.10	6.5-9.0
Dissolved Oxygen, mg/L	6.2	7.43	
Temperature, ºC	29.1	28.6	25-31
Conductivity (uS/cm)	80.9	143.1	
Salinity (ppt)	0.1	0.121	
TDS (ppm)	163.9	70.37	
Depth (cm)	16.3	-	-
Width (m)	6.0	-	-
Flow Rate (m/s)	0.2	-	-
Laboratory Analysis			
TSS, mg/L	17	16	80
BOD_5, mg/L	5	23	7

Parameters	**Stations**		**DENR Standards for Class C Waters**
	FW 4*	**FW 8**	
Oil and Grease, mg/L	2.1	<0.5	2
Nitrate, mg/L	1.28	-	7
Phosphate, mg/L	0.083	0.0398	0.5
Chromium, mg/L	<0.03	<0.03	0.01
Arsenic, mg/L	<0.002	<0.0009	0.02
Cadmium, mg/L	<0.002	0.0227	0.005
Lead, mg/L	<0.006	0.0398	0.05
Mercury, mg/L	<0.0001	<0.0001	0.002
Boron, mg/L	<0.1	<0.1	0.75
COD, mg/L	40	40	-
Chloride, mg/L	8.01	8.08	350
Sulfate, mg/L	1.62	1.51	275
Fecal Coliform,	170	$23x10^2$	200
Total Coliform, MPN/100 ml	$35x10^2$	$28x10^3$	-

*Source: *EISR of MEZ, 2017*

2.2.3.3 Marine Water Quality

Marine water sampling was carried out on July 22-23, 2016 and December 8, 2017 to assess the physico-chemical properties of the marine water around the MCPP Project. Figure 2-51 presents the marine water quality sampling stations and their respective coordinates. The MEZ where the MCPP is to be located is an industrial area inclusive of its FLA and MLA. Consistent to this classification, the coastal water in Lusong Bay is classified as Class SC.



Note: MW – Marine Water
Source: Google Earth modified by Geosphere

Figure 2-52 Marine Water Quality Monitoring Stations

The results of analyses of marine water samples were described with reference to the standards for Class SC Waters set in DAO No. 2016-08, for . Table 2-21 shows that the values of water quality parameters measured at seven (7) marine water stations fall within the DENR Standards for Class SC Waters, except for Cadmium, Lead and Sulfate in all stations, oil and grease in stations MW 2 to MW 5 and fecal coliform in station MW4. The pH regime was slightly basic in all sampling stations, with pH values ranging from 7.12 to 7.64. Dissolved Oxygen (DO) levels exceed the minimum value for growth and survival of marine organisms, which is 5.0 mg/L. Conductivity and salinity levels varied little among stations ranging from 49.34 mS/cm to 49.6 mS/cm and 32.56 ppt to 32.69 ppt, respectively. Levels of BOD ranged from 5-10 mg/l, with the highest recorded at MW7 and the lowest at MW2 and MW3.

Exceedance of oil and grease levels in MW 2 to MW 5 may be attributed to the oil from motor boats of the fishermen fishing near the above-mentioned sampling stations. There are no readily apparent possible sources of exceedances for Pb, Cd and Sulfate in marine stations monitored. Further monitoring may be necessary to identify sources, although it is noted that the levels are similar across sampling points. Cd and/or Pb transport from soil via river systems are possible.

The certificate of analysis for marine water quality is given in **Annex 2-4.**

Table 2-21 Results of the Marine Water Quality Analysis

Parameters	Stations							DENR Standards for Class SC Waters
	MW 2	MW 3	MW 4	MW 5	MW 6	MW 7	MW 8	
Onsite								
pH	7.64	7.39	7.15	7.32	7.12	7.46	7.18	6.5-8.5
Temperature, ºC	32	31.9	31.9	35.6	32.2	32	31.8	25-31
DO, mg/L	6.8	6.76	6.98	8.1	6.84	6.84	6.8	5
Salinity, ppt	32.7	32.69	32.67	32.6	32.65	32.63	32.56	-
Chloride, g/L	18.1	18.1	18.1	18.0	18.1	18.1	18.0	-
TDS, ppt	24.33	24.3	24.28	24.21	24.26	24.25	24.14	-
Conductivity, ms/cm	49.6	49.59	49.57	49.47	49.54	49.5	49.34	-
Laboratory Analysis								
TSS, mg/L	43	31	13	42	18	38	59	80
BOD5, mg/L	5	5	6	8	7	10	8	-
Oil and Grease, mg/L	3.4	4.2	4.1	4.6	1.9	2.3	2.2	3
Chromium, mg/L	0.136	<0.03	<0.03	0.203	0.019	0.086	<0.03	0.05
Arsenic, mg/L	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.02
Cadmium, mg/L	0.046	0.051	0.04	0.049	0.021	0.048	0.053	0.005
Lead, mg/L	0.236	0.32	0.228	0.241	0.275	0.247	0.234	0.05
Mercury, mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.002
Boron, mg/L	<0.1	0.152	0.11	0.149	<0.1	0.134	0.191	5
COD, mg/L	815	1,181	1,363	1,323	1,483	1,283	1,483	-
Phosphate, mg/L	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	0.5
Sulfate, mg/L	2,664	2,660	2,406	2,402	2,468	2,472	2,584	275
Fecal Coliform, MPN/100 ml	<1.8	<1.8	680	<1.8	4	13	<1.8	200
Total Coliform, MPN/100 ml	2	<1.8	11x103	13	20	23	<1.8	-

Source: Geosphere

2.2.3.4 Degradation of Groundwater Quality

Fuel and Chemical Spill during Construction of the Proposed Project

The construction of the proposed MCPP Project involves the use of heavy equipment that can possibly cause an accidental fuel/chemical spill and may percolate into groundwater or directly enter an adjacent surface water body.

Temporary housing during construction phase would generate domestic wastes, which may contaminate groundwater through seepage as well as the marine environment through surface water run-off, especially during heavy rains. Chemicals and materials used during construction may contaminate the groundwater.

The MPGC shall strictly impose that fueling activities shall be done in the equipment staging area, away from drainage. To reduce the potential for groundwater contamination, fuels shall be stored and maintained in a designated equipment staging area. The designated responsible personnel for equipment fueling shall closely monitor the fueling activities and ensures that accidental spills are appropriately handled.

An emergency spill kit containing absorption pads, absorbent material, a shovel or rake, and other clean-up items shall be readily available on site in the event of an accidental spill. Containment structures and canals in the oil storage areas and motor pool area shall be provided.

Waste disposal protocols shall be strictly implemented at all phases of the proposed MCPP Project. Conduct regular groundwater quality monitoring at groundwater stations within and outside the proposed Project.

Fuel and Chemical Spill during Operation

The operation of the proposed MCPP Project could hypothetically result in localized contaminant loading into the soil due fuel leakage and spill and improper disposal of wastes. Accidental fuel, oil and chemical spill may occur in storage area, chemical storage area, tank truck unloading area, and turbine building area.

The following procedures for the handling and storage of fuel and hazardous materials shall be implemented to reduce the potential soil contamination within the vicinity of the proposed MCPP Project:

a) Fueling and lubrication of equipment shall be in designated and approved locations.
b) Washing, servicing and fueling of mobile equipment shall not be allowed within thirty (30) meters of a waterway or drainage
c) Storage of waste oils and lubricants shall be in a tank or closed container
d) Storage of greasy or oily rags or materials shall be in an appropriate and approved designated area that are not prone to spontaneous combustion
e) Storage of all hazardous materials shall be provided with secondary containment for spill such that it contains 110% of the volume of the largest container/vessel stored in the storage area
f) Prohibition on dumping of any contaminating material product to the environment, including waste oils
g) Formulation of Spill Prevention Procedures and a Spill Contingency Plan, a detailed response system to deal with accidents such as the release of petroleum, oils, or lubricants or the hazardous liquids. Make available on-site all equipment and materials necessary to execute a clean-up
h) Collection and storage of all wastes recovered during clean-up operations in labeled and secured containers for subsequent disposal by an accredited treatment facility
i) Training and awareness programs shall be conducted for all personnel

The fuel storage area will be provided with a secondary containment in the form of a bund containment wall. The bund containment wall will surround the fuel storage tank and will be sized to accommodate the volume for a full capacity spillage of the tank. In a major spillage scenario, the drain valve leading to the WWTS will be shut down. This will ensure the spill will be confined in the secondary containment.

All chemical storage tanks including portable storage tanks and drums will be provided with spill containment area or stored in bermed areas. The design of the spill containment will be sized to contain 110% of the capacity of the largest tank. Where multiple tanks are stored in a common bermed area, the bermed areas will be sized for 110% of the largest tank, plus 10% of the aggregate capacity of all other tanks within the bermed area. Other tanks will be provided with an allowance for the volume of the containment area.

The tank truck unloading area shall be installed with a berm, sized with sufficient capacity to contain 110% of the largest tank truck capacity and the volume displaced by the truck in the unloading area. The fuel oil and ammonia unloading spill containment area will be provided with a level transmitter for level monitoring and alarm in the DCS.

All routine handling or transfer of chemicals will take place within bermed areas to ensure that spills or leaks will be contained. Chemical feed skids, pot feeders, portable storage tanks, or drums will be installed or staged in bermed areas. Bermed areas for storing at least one spare portable tank or drum for each in service will be provided. All chemical containment areas will have protective coatings.

Due to minimal oil spill scenario, the whole turbine building will be provided with sufficient oily water drain that will direct the flow to the WWTS.

2.2.3.5 Degradation of Surface Water Quality During Construction

Increase in Turbidity

The construction of the proposed jetty, intake and outfall/discharge structures shall involve marine drilling and pipe laying activities in the near foreshore area. Inevitably, the local water quality will be affected in terms of localized increase in turbidity as a result of scouring of seabed and agitation in the water.
To control the spread of sediment, silt curtains will be utilized so that sediments disturbed are contained in the vicinity. In swift moving waters, it may be necessary to have more than one wall of silt curtains. Scheduling of construction activities during the dry season will also decrease sediment discharge from runoff.

Reduced Water Quality from Attending Vessels

Marine water quality can be affected in terms of the discharges and wastes from vessels and barges that bring in equipment and materials. Liquid wastes are domestic and oily wastes. Domestic waste may increase nutrient input in water that could contribute to algal bloom or eutrophication while oily wastes can be toxic to aquatic life.

The spillage of oil could also be a potential impact. This could be possible through the cargo vessels that would deliver the construction materials. In addition, heavy metal pollution from the petroleum by products is also possible. Oils spills and heavy metal pollution often lead to the reduction of water quality and consequently productivity of the local waters.

Discharge of wastes from attending vessels and other delivery vessels is prohibited. Proper disposal of bilge water and domestic wastes will form part of the contract document with contractors. Domestic and other wastes on board will be required to be stored in containers until it can be delivered onshore, where an accredited transporter and treater can receive and treat liquid wastes of vessels.

MPGC shall require contractors and their workers to undertake an environmental, health and safety briefing prior to the construction of the jetty and intake and outfall pipe-laying. There will be close supervision of offshore activities especially on the compliance of environmental requirements.

MPGC will ensure compliance with the following: IMO, MARPOL, PCG MC 01-94, DAO No. 35 S 1990, which will be stipulated in the Contract.

2.2.3.6 Degradation of Water Quality During Operation

2.2.3.6.1 Process and Oily Wastewater Generation during Operation

The Wastewater Treatment System (WWTS) of the proposed MCPP Project shall be designed to treat the following streams as a minimum:

a) Chemical wastewater from the water treatment system;
b) Treated oily wastewater from the turbine building, transformer area, oil storage area, etc.;
c) Boiler blowdown wastewater;
d) Air pre-heater washing wastewater;
e) ESP washing wastewater; and
f) Wastewater containing chemical cleaning agents used in boiler maintenance, etc.

MPGC shall ensure that wastewater are properly processed and treated to meet DENR effluent standards prior to discharge into the outfall.

Operational, Maintenance and Domestic Wastewater Generated during Operation

Wastewater generated during operations, which include domestic wastewater, may enter groundwater through seepage or coastal waters as surface runoff. This wastewater may degrade water quality in these areas and may increase organic load, levels of heavy metals, turbidity and TSS.

A sound wastewater and solid waste management plan shall be in place and strictly implemented. Monthly monitoring of key parameters for groundwater and marine water quality shall be conducted.

Impacts of Effluent on the Marine Ecosystem

Effluent from the WWTS of the proposed MCPP Project may affect the marine water quality and marine life in terms of eutrophication through high-nutrient discharge and result in localized mortality of soft bottom fauna, other benthic life form and fish. Solids and other contaminants in the effluent may disperse through currents and tides, which may affect other habitats.

To protect the marine water quality within the vicinity of the proposed MCPP Project, the surface run-off, wastewater from the Project and domestic sewage shall be treated to ensure that all discharges to the water are below the DENR standard for Class SC Waters.

Chemical Spills and Discharge of Bilge Water from Delivery Vessels

During the operation of the jetty, water quality within the area and immediate adjacent waters may be reduced due to spills and leaks, discharge of bilge water from delivery vessels. Bilge water from delivery vessels may contain a harmful and invasive aquatic organisms and pathogens, which, if introduced into the sea, may create hazard to the environment, human health, property or resources and impair biological diversity.

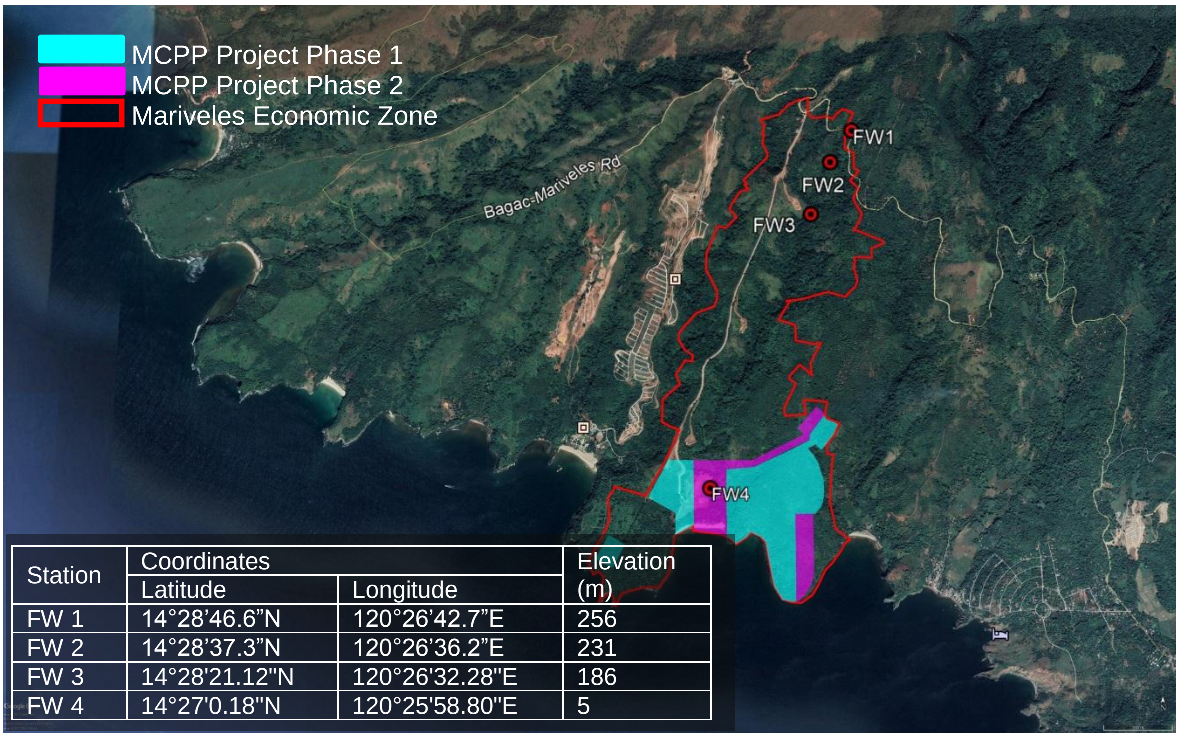
The effect of the proposed jetty on water quality is anticipated to be minor, the fact, that coal delivery is only done every week and, more importantly, the disposal of bilge water at the coast will be strictly prohibited.

All ships entering the Philippine Marine territory shall abide with the requirements of the Philippine Ports Authority (PPA) including the ship's bilge water management which has to be aligned with the International Maritime Organization (IMO) requirements to ensure that the entry of harmful and invasive aquatic organisms and pathogens will be prevented, controlled and minimized and will not contaminate the Philippine sea.

Proper disposal of bilge water and domestic wastes will form part of the contract document with contractors for the delivery of coal and other supplies.

2.2.4 Freshwater Ecology

The freshwater ecology at the proposed MCPP Project area is characterized using the data from MEZ EISR. As discussed in the MEZ EISR, freshwater ecology study was conducted at the stations established for freshwater quality assessment, as presented in **Figure 2-53**. However, only one station was established within the MCPP project site (FW4).



Station	Coordinates		Elevation (m)
	Latitude	Longitude	
FW 1	14°28’46.6”N	120°26’42.7”E	256
FW 2	14°28’37.3”N	120°26’36.2”E	231
FW 3	14°28'21.12"N	120°26'32.28"E	186
FW 4	14°27'0.18"N	120°25'58.80"E	5

Note: FW – Freshwater; FW 1 – Lusong 1; FW 2 – Lusong 2; FW 3 – Lusong 3; FW 4 – Lusong 4
Source: MEZ EISR using Google Earth modified by Geosphere

Figure 2-53 Freshwater Ecology Monitoring Stations

No significant fishing activity was observed at Lusong River during sampling. The downstream section of Lusong River has other domestic uses such as for bathing and washing clothes, however, most stations of River are difficult to access due to its rugged terrain and steep slopes, hence are seldom used as passage way by locals.

2.2.4.1 Plankton Communities

Plankton sampling was conducted at four (4) stations in reaches with partly open canopies, riffles not pools and with moderate water velocity (between 10 and 60 cm/sec). Plankton samples were obtained by passing a total volume of 100 l water through plankton net with a mesh size of 64 μ and a mouth diameter of 0.3 m. Two replicate samples of zooplankton and phytoplankton were collected from each station. Samples were placed in properly- labelled plastic containers, immediately fixed in formalin (5% by volume) and brought to the laboratory for processing and further analysis. Plankton enumeration was done using the Sedgewick counting chamber observed under a binocular microscope. Plankton were identified to the lowest possible taxa using taxonomic keys such as those of Mamaril et al. (1986), Segers (2004; 2007) and Bellinger and Sigee (2010).

2.2.4.1.1 Phytoplankton

Phytoplankton taxa richness and mean densities were low at four surveyed stations in Lusong River. Thirteen (13) algal taxa were recorded at four (4) stations in Lusong River (Table 2-22). Six (6) taxa belong to Bacillariophyta (diatoms), four to Chlorophyta (green algae) and three to Dinophyta (dinoflagellates). Lusong River was largely comprised of Bacillariophyta and Chlorophyta representing, 52.89% and 42.98%, respectively, of the total count. Mean algal densities at four surveyed stations were highly variable. FW 2 had moderate algal density (20 cells/l), dominated by Spirogyra (11 cells/l) and Melosira (8 cells/l). Low mean phytoplankton densities were recorded at FW 3 (7 cells/l). Melosira also dominated at this station with a mean abundance of 4 cells/l. Stations FW 1 and FW 4 had low mean algal densities with values of 1 cell/l and 3 cells/l, respectively.

Most of the phytoplankton taxa recorded have wide distribution and are generally common in shallow waters (Bellinger and Sigee, 2010). Spirogyra for instance is a broad-spectrum organism occurring in a wide range of habitats usually attached to a substratum (Bellinger and Sigee, 2010). On the other hand, the presence of Melosira at some stations of Lusong River may indicate eutrophic condition as this taxon is known to frequent shallow, small eutrophic waters (Bellinger and Sigee, 2010). The dominance of certain species of phytoplankton may be generally attributed to nutrient levels favouring their proliferation.

Table 2-22 Mean (no. of cells/ l) and Relative Mean Density (%) of Phytoplankton

Taxa	Lusong River					
	FW 1	FW 2	FW 3	FW 4	Overall Density	Relative Density
Bacillariophyta	0.00	8.25	5.00	2.75	4.00	52.89
Fragilaria	-	-	-	1.00	0.25	3.31
Melosira	-	8.00	3.50	-	2.88	38.02
Meridion	-	0.25	-	1.50	0.44	5.79
Navicula	-	-	0.75	-	0.19	2.48
Nitzschia	-	-	-	0.25	0.06	0.83
Rhizosolenia	-	-	0.75	-	0.19	2.48
Synedra	-	-	-	-	-	-
Chlorophyta	0.75	10.50	1.75	0.00	3.25	42.98
Scenedesmus	-	-	0.25	-	0.06	0.83
Spirogyra	-	10.50	-	-	2.63	34.71
Stigeoclonium	-	-	1.50	-	0.38	4.96
Tetraedron	0.75	-	-	-	0.19	2.48
Dinophyta	0.50	0.75	-	-	0.31	4.13
Ceratium fusus	0.25	0.50	-	-	0.19	2.48
Ceratium tripos	0.25	-	-	-	0.06	0.83
Dinophysis	-	0.25	-	-	0.06	0.83
Mean Density	1.25	19.50	6.75	2.75	7.56	100.00
SD	0.35	9.90	4.60	0.35		
Number of Taxa	3.00	5.00	5.00	3.00	13.00	

Source: MEZ EISR 2017

2.2.4.1.2 Zooplankton

Zooplankton taxa richness and mean densities were low at four surveyed stations in Lusong River. Only one zooplankton taxon, Testudinella belonging to Phylum Rotifera was recorded at Lusong River. This taxon was recorded at FW 1 and FW 4 stations with mean densities of 1 ind./l and 2 inds./l, respectively, while none was recorded at Stations FW 2 and FW 3 (Table 2-23). The occurrence of Rotifera at surveyed stations may indicate the presence of bacteria, detritus and phytoplankton. Rotifera feed primarily on this prey/ food items (Suthers and Rissik, 2009), hence their dominance suggest the presence of these food items at the study site.

Table 2-23 Mean (no. of inds./ l) and Relative Mean Density (%) of Zooplankton

Taxa	Lusong River					
	FW 1	FW 2	FW 3	FW 4	Overall Density	Relative Density
Rotifera	0.75	-	-	1.50	0.56	100.00

Testudinella	0.75	-	-	1.50	0.56	100.00
Mean Density	0.75	-	-	1.50	0.56	100.00
SD	1.06	-	-	2.12		
Number of Taxa	1.00	-	-	1.00	1.00	

Source: MEZ EISR 2017

2.2.4.1.3 Macrobenthos

A total of twelve (12) sediment samples were collected for the macrobenthos study. Collections were undertaken at three replicate zones of each station. Ten (10) trowelful of sediment was obtained from each replicate zone, which covered an area of about 1m2. Sediment samples were placed in properly-labeled Ziploc plastic bags and preserved in 5% formalin. Samples were brought to the laboratory for further processing. In the laboratory sediment samples were passed through a 1-mm mesh-sized sieve and all animals retained in the sieve were collected and sorted. Macrobenthos were transferred in plastic containers and preserved with 5% formalin. Specimens were identified to the lowest possible taxa using Haynes (2001) and Gapud and Raros (1986). Their abundances were recorded and expressed as number of animals/ m2. Methods of macrobenthos collection, preservation, and processing generally followed that of Barbour et al. (1999).

At least seven macrobenthos taxa were recorded at four stations combined in Lusong River (Table 2-24). Mollusca largely dominated the benthic macroinvertebrate community comprising 96.3% of the total count. Low abundances of macrobenthos were recorded for Annelida and Arthropoda, each representing a total density of 1 animal/m2. Mean macrobenthos abundance was highest at FW 4 (20 animals/m2), while relatively lower values were recorded at FW 1, FW 2 and FW 3 (5-7 animals/m2). Macrobenthos taxa richness were low at four surveyed stations, with values ranging from 1-4 taxa. Lusong4 had the highest number of macrobenthos taxa while Lusong2 had the lowest value. Melanoides comprised 56.9% of the total macrobenthos count, with an overall density of 21 animals/m2. This taxon dominated at most surveyed stations in Lusong (FW 1, FW 2 and FW 3). On the other hand, Thiara scabra dominated at Lusong4 with a mean density of 13 animals/m2 .

Algal-grazing Thiaridae dominated at Lusong River indicating an abundance of filamentous and benthic algae in these areas. This coincided with the dominance of filamentous green algae Spirogyra and chain-forming diatom Melosira, which may have served as their food items. Insect orders Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies), which are known indicators of good water quality were not observed at the surveyed stations. These Insect Families have high oxygen requirement and prefer areas with high dissolved oxygen levels (Barbour et al., 1999). The absence of these Insect Orders at the study site may indicate some degree of disturbance or may reflect seasonality in their occurrence.

Table 2-24 Mean (no. of animals/ m2) and Relative Mean Density (%) of Macrobenthos

Taxa	Lusong River					
	FW 1	FW 2	FW 3	FW 4	Overall Density	Relative Density
ANNELIDA	0.67	-	-	-	0.67	1.84
Oligochaeta	0.67	-	-	-	0.67	1.84
ARTHROPODA	0.33	-	0.33	-	0.67	1.84
Coleoptera larvae	0.33	-	-	-	0.33	0.92
Diptera	-	-	0.33	-	0.33	0.92
Tipulidae	-	-	0.33	-	0.33	0.92
MOLLUSCA	3.67	4.67	6.33	20.33	35.00	96.34
Gastropoda	3.67	4.67	6.33	20.33	35.00	96.34
Melanoides	3.67	4.67	6.33	6.00	20.67	56.89
Neritidae	-	-	-	1.33	1.33	3.67
Pomacea	-	-	-	0.33	0.33	0.92
Thiara scabra	-	-	-	12.67	12.67	34.87
Mean Abundance	4.67	4.67	6.67	20.33	36.33	100.01
SD	2.08	5.03	8.14	14.57		

Number of Taxa	3.00	1.00	2.00	4.00	7.00	

Source: MEZ EIS 2017

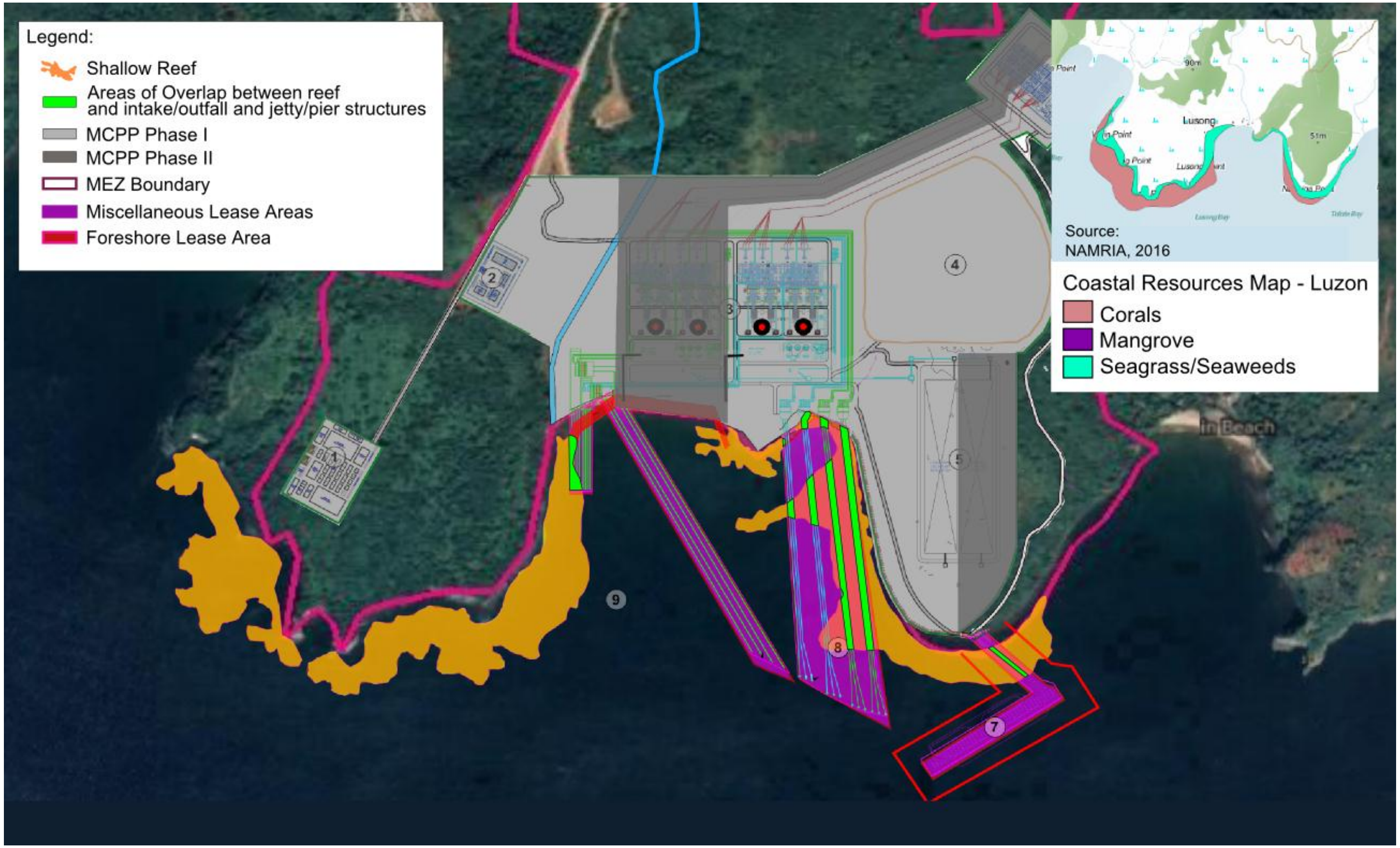
2.2.4.2 Project Impacts to Freshwater Ecology and Quality

With the installation of an Interceptor Canal by MEZ Station FW4 will no longer be applicable for water quality monitoring. The river will flow directly through the interceptor canal to the sea. Therefore, no impacts to freshwater ecology and quality are expected.

2.2.5 Marine Ecology

The coastal area of the proposed MCPP Project site was surveyed on July 16-17, 2016 to determine where the important coastal habitats exist. The relative locations of the coastal habitats based on the substratum type in the project site are presented in Figure 2-53. These locations were determined during the survey and through local information from fishermen in the study area.

No extensive seagrass beds are present in the primary impact area and control station of the study site. The coastline of the study site are fringed by coral communities, sandy areas and piles of rocks and large boulders. The fringing reefs in the primary impact area and in the established control stations showed high generic diversity and good coral cover. Mean hard coral cover in the study site was estimated at 39.17% (±7.69%), with massive Porites accounting for the majority of the intercepted coral in the stations surveyed.

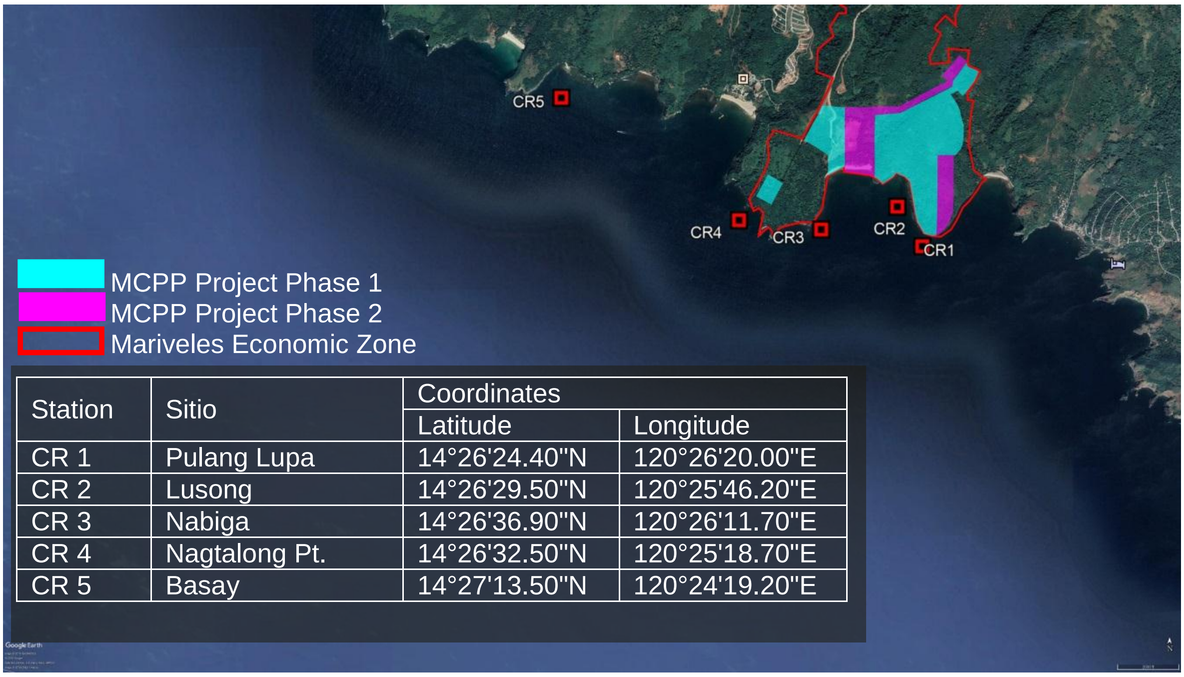


Source: Google Earth modified by Geosphere, 2018
Inset: Coastal Resources Map by NAMRIA, 2016

Figure 2-54 Coastal Habitat at the Vicinity of the Proposed MCPP Project

2.2.5.1 Coral Communities

The coral communities were studied in detailed at five (5) stations around the proposed MCPP Project site (CR1, CR2, CR3, CR4 and CR5) on July 16-17, 2016 using the Phototransect (PHOT) Method (Vergara and Licuanan, 2007) (**Figure 2-55**).



Station	Sitio	Coordinates	
		Latitude	Longitude
CR 1	Pulang Lupa	14°26'24.40"N	120°26'20.00"E
CR 2	Lusong	14°26'29.50"N	120°25'46.20"E
CR 3	Nabiga	14°26'36.90"N	120°26'11.70"E
CR 4	Nagtalong Pt.	14°26'32.50"N	120°25'18.70"E
CR 5	Basay	14°27'13.50"N	120°24'19.20"E

Note: CR – Coral Reef
Source: Google Earth modified by Geosphere, 2016

Figure 2-55 Location of Coral Reef Stations Surveyed in Eastern Mariveles

The reefs in the study site are characterized by narrow fringing coral communities that are established on top of large boulders of igneous rocks (Plate 2-3). In contrast, the reefs surveyed in CR5 in Basay have a more developed coralline substrate. Still, rocks form an important hard substratum in the shallower part of the reef. Aside from these shallow, fringing reefs, offshore mesophotic reefs of different sizes and located at different depths were also reported by local fishermen. These deep reefs however, were not included in the survey due to safety concerns.

Plate 2-2 Hard Corals and other Sessile Invertebrate Fauna Colonized Large Igneous Rocks in the Study Site

Across stations, hard corals comprised a significant portion of the reefscape and indicates a generally good overall development of the coral community in the study site (Figure 2-55). Algae in general (i.e., DCA + Algae), also comprised a large section of the reefs surveyed. Similarly, other invertebrate fauna were also relatively abundant across stations. Interestingly, recently killed (DC) corals, were intercepted across stations. It is estimated that 1.4% (Station CR3) to 3.8% (Station CR2) of hard corals in the study site died recently or have bleached. The observed hard coral mortality could be attributed mainly from prolonged elevated sea surface temperature brought about by El Nino. Bleached corals were observed on the reefs surveyed in a generally patchy distribution (**Plate 2-3**). Lastly, abiotic components remained more or less consistent across stations surveyed.

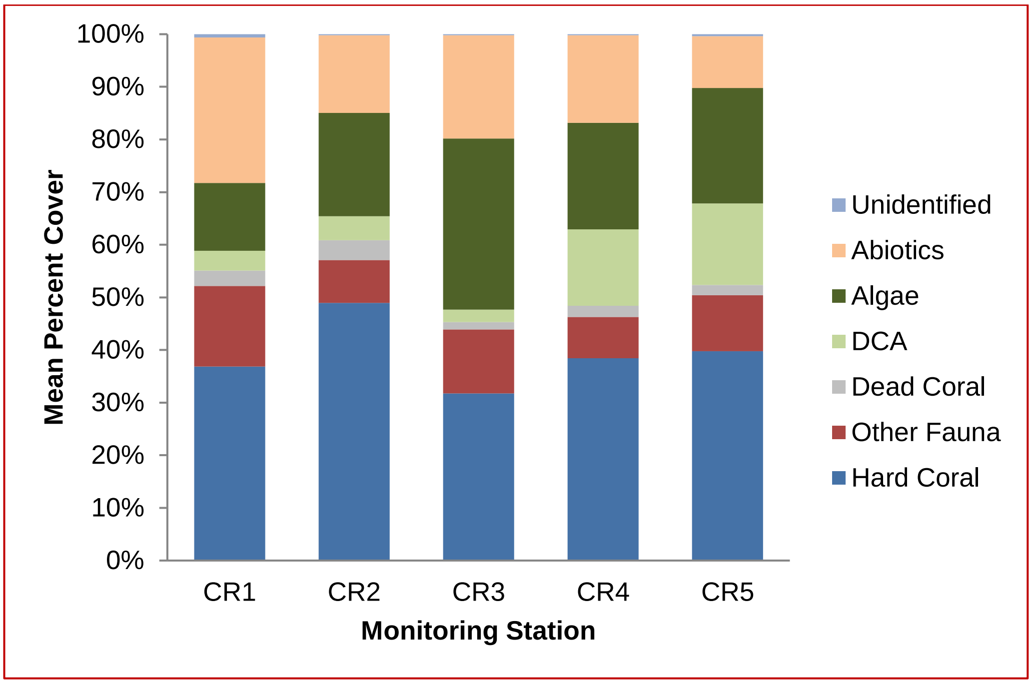
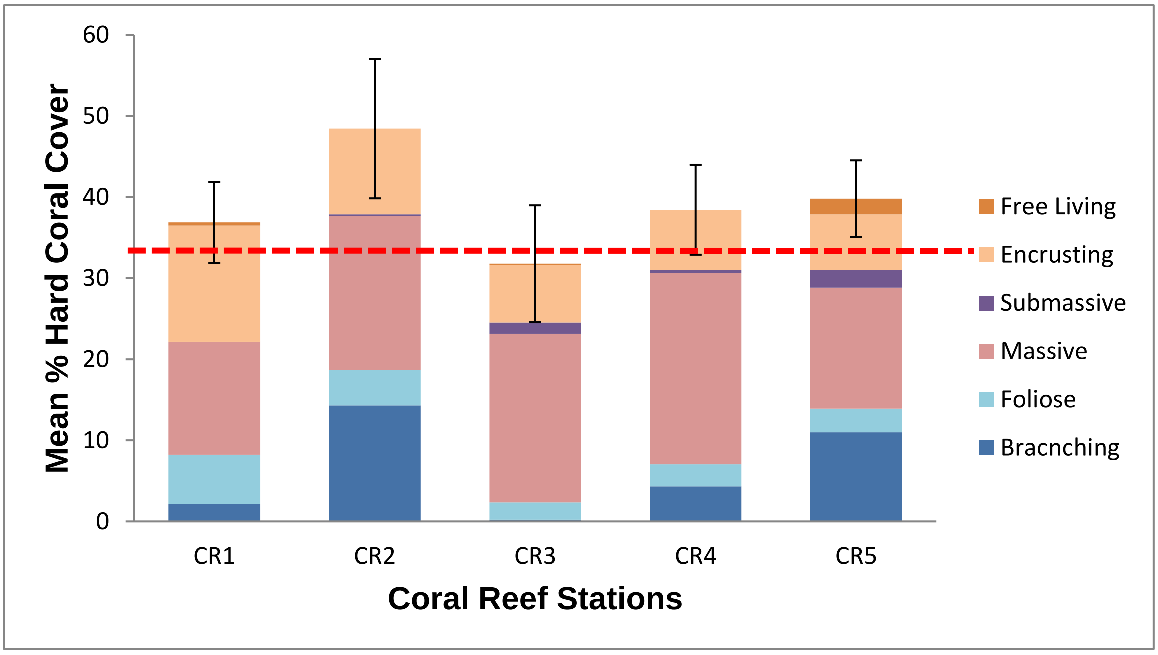


Figure 2-56 The General Benthic Features of the Coral Reef Areas surveyed in Eastern Mariveles

Plate 2-3. Coral Bleaching Observed Consistently in the Reefs Surveyed

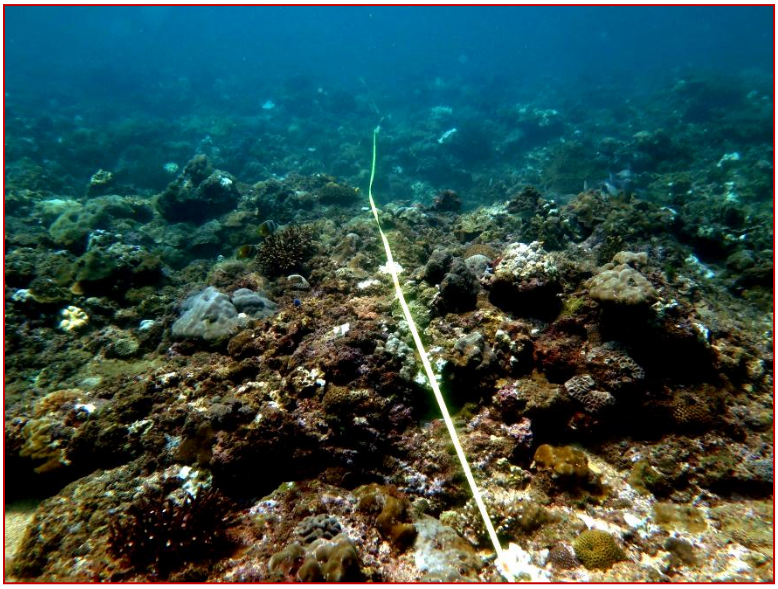
Overall, mean hard coral cover in the study was estimated at 39.17% (+ 7.69%), with four of the five stations surveyed falling within the good category (**Figure 2-57**). It was only in station CR3 where hard coral cover fell in the upper range of the fair category. Nonetheless, the difference in mean estimates of hard coral were statistically insignificant among stations surveyed (ANOVA, p=0.265). In terms of physical structure, the reefs surveyed were strongly influenced by massive corals (**Figure 2-58**). Mean percent cover of massive forms were consistent across stations. This is also true with encrusting forms. It was generally the branching forms that showed notable variabilities across stations surveyed. Mean cover of branching corals were higher in the stations that are relatively sheltered to the Southwest monsoon (i.e., CR2 and CR5). The observed low relief fringing reefs, particularly in CR1, CR2 and CR3 (Plate 2-5), and the low intercept of branching hard corals in the more exposed stations suggests that Southwest monsoon is a strong influencing factor on coral community development in the study site. Recruitment of hard corals was also evident in the reefs surveyed. Hard coral recruits were observed on dead coralline substrates and rocks (Plate 2-6).

The benthic reef community in the vicinity of the proposed MCPP Project site also showed a highly diverse aggregation of hard corals (Table 2-25). Overall, a total of 39 hard coral genera classified under 12 families were identified in the study site. Several faviids and other hard corals remained unidentified up to present. Porites (Plate 2-7) recorded the highest mean hard coral cover in the primary impact area. Porites was the dominant hard coral genus in CR1, CR3 and CR4, while it co-dominated the fringing reef of CR2 with Turbinaria. In contrast, the identified control station of CR5 in Sitio Basay, was predominated by branching Acropora (Plate 2-8). In this station, extensive Acropora growths were also observed beyond the transects deployed (Plate 2-9) Still, mean percent cover of Porites remained high in station CR5. The dominance of Porites is attributed to their high silt rejection ability, fast growth rate, and overall resilience (Loya, 1976; Cortes and Risk, 1985). These coral genera are considered as important reef builders in the Indo-Pacific region (Montaggioni, 2004). Other than Porites, Acropora and Turbinaria, the genus Favites was also commonly observed in the stations surveyed. The remaining majority of the hard corals intercepted were uncommon and were seldomly intercepted in each station.



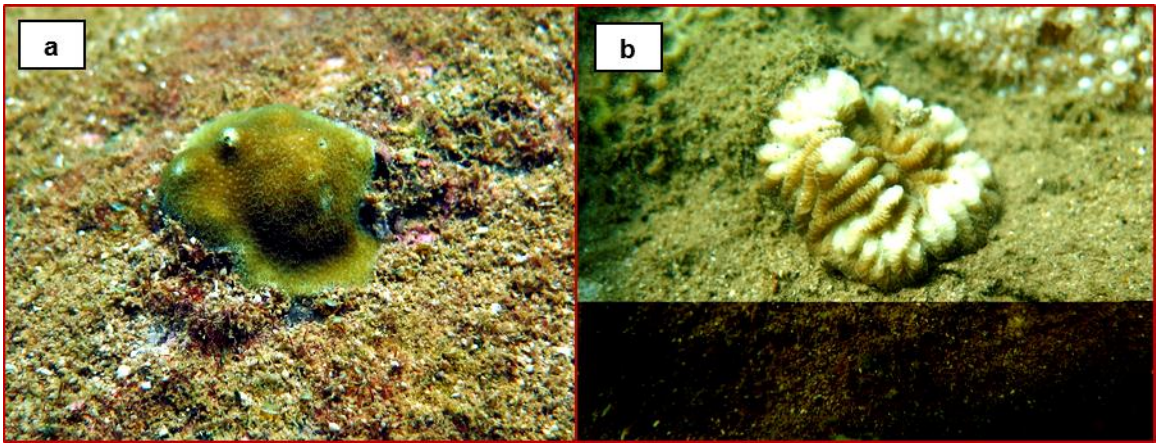
Note: The broken red lines mark the upper limits of the fair category.

Figure 2-57 Mean Percent Cover of Hard Corals



Note: Low relief fringing reefs were characteristic of reefs exposed to the Southwest monsoon.

Plate 2-4 Section of the Reef in Station CR3



Note: (a) Hard coral Porites and (b) Merulina amidst low relief algal growth

Plate 2-5 Hard Coral Recruits Commonly Observed Colonizing Dead Coralline Substrates and Rocks

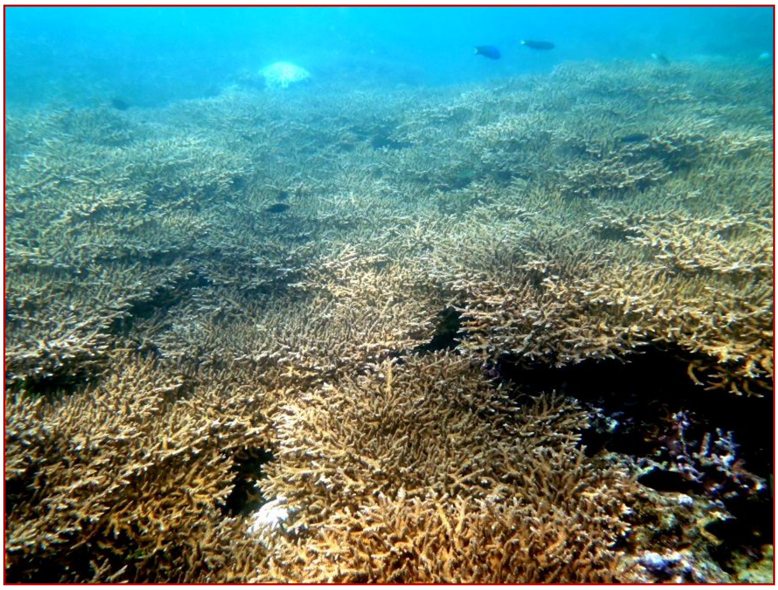
Table 2-25 Benthic Reef Community in the Vicinity of the Proposed MCPP Project

Taxa		Coral Reef Station					Importance Value
Family	Genera	CR1	CR2	CR3	CR4	CR5	
Acroporidae	Acropora sp.	-	6.18	-	2.94	9.02	0.093
	Astreopora sp.	-	0.20	-	-	0.20	0.002
	Montipora sp.	-	0.20	-	0.39	0.20	0.004
Agariciidae	Pachyseris sp.	-	-	0.39	0.20	-	0.003
	Pavona sp.	0.39	-	0.20	0.39	0.20	0.006
Dendrophylliidae	Turbinaria sp.	7.06	10.11	2.55	0.20	0.59	0.105
Euphyllidae	Euphyllia sp.	-	0.20	1.37	-	1.76	0.017
	Galaxea sp.	0.20	1.78	2.16	0.59	4.12	0.045
Faviidae	Cyphastrea sp.	0.39	1.59	0.98	1.37	0.20	0.023
	Echinophyllia sp.	-	-	-	-	0.20	0.001
	Echinopora sp.	-	0.20	0.20	0.20	0.39	0.005

Taxa		Coral Reef Station					Importance Value
Family	Genera	CR1	CR2	CR3	CR4	CR5	
	Favia sp.	0.98	0.59	0.78	2.35	0.78	0.028
	Faviid	0.78	0.60	0.98	0.78	1.37	0.023
	Favites sp.	1.57	4.15	3.73	4.31	3.53	0.088
	Goniastrea sp.	-	1.39	1.18	1.37	0.78	0.024
	Hydnophora sp.	0.59	0.79	-	0.39	0.20	0.010
	Leptoria sp.	-	-	-	0.20	-	0.001
	Merulina sp.	-	0.40	-	0.59	1.57	0.013
	Montastrea sp.	0.39	0.20	1.18	0.39	0.20	0.012
	Mycedium sp.	-	-	-	-	0.78	0.004
	Oulastrea sp.	0.20	-	-	-	-	0.001
	Oulophyllia sp.	-	0.40	0.20	-	-	0.003
	Pectinia sp.	0.20	-	-	-	-	0.001
	Platygyra sp.	0.20	0.79	0.59	0.78	0.59	0.015
Fungiidae	Ctenactis sp.	-	-	-	-	0.78	0.004
	Diaseris sp.	0.20	-	-	-	-	0.001
	Fungia sp.	0.20	-	-	-	0.98	0.006
	Lithophyllon sp.	0.39	-	0.20	-	-	0.003
	Podabacia sp.	-	-	0.20	-	-	0.001
Helioporidae	Heliopora sp.	0.98	-	0.59	0.20	0.98	0.014
Lobophylliidae	Acanthastrea sp.	-	-	0.20	-	-	0.001
	Lobophyllia sp.	0.39	-	0.39	-	-	0.004
	Symphyllia sp.	-	0.20	0.20	0.59	0.39	0.007
Milleporidae	Millepora sp.	0.98	1.20	0.20	0.78	0.98	0.021
Pleisiastreidae	Pleroygra sp.	-	-	-	-	0.20	0.001
Pocilloporidae	Pocillopora sp.	0.78	-	-	0.39	0.20	0.007
	Seriatopora sp.	0.59	6.92	-	0.78	-	0.042
	Stylophora sp.	0.20	0.20	-	-	0.20	0.003
Poritidae	Goniopora sp.	0.39	0.40	2.16	0.20	2.94	0.031
	Porites sp.	17.45	9.52	10.20	17.06	4.71	0.301
Unidentified	UNID-HC	1.37	0.79	0.98	0.98	0.78	0.025
Mean Hard Coral Cover		36.86	48.98	31.76	38.43	39.80	
Genus Count							

Plate 2-6 Relatively low relief, massive Porites were the most important reef building corals in majority of the stations surveyed.

Plate 2-7 Extensive growths of branching Acropora intercepted in Station CR5 (Basay)

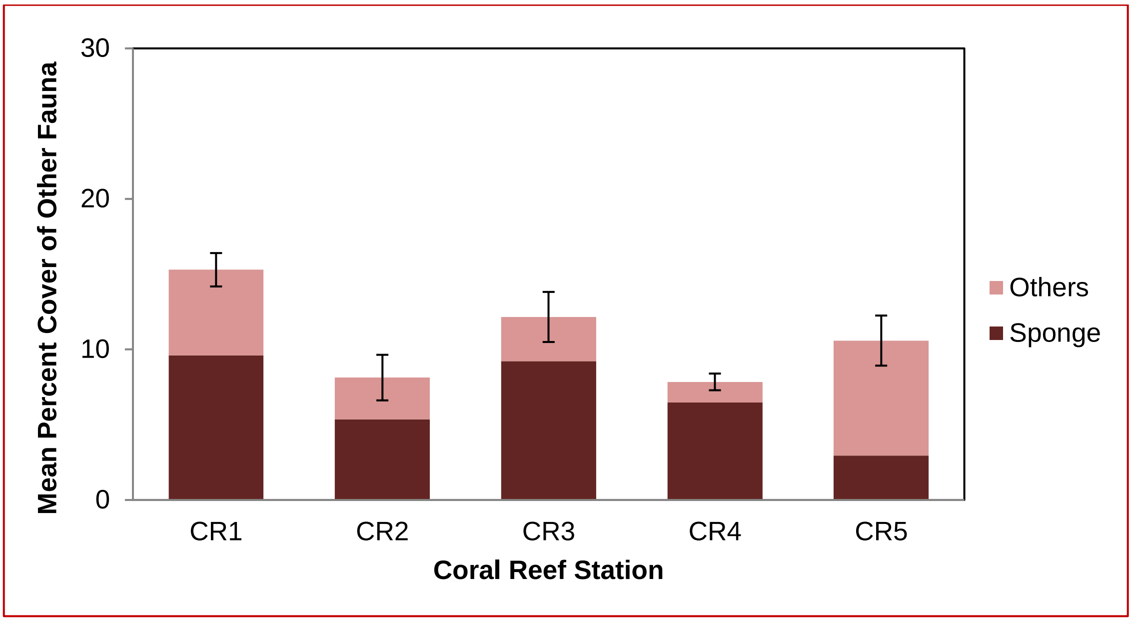


Note: This area of the reef was not intercepted in the baseline survey and was found several meters after transect 2

Plate 2-8 Extensive Growth of Branching Porites in Station CR5.

Excluding all hard corals in **Table 2-25**, all other fauna intercepted were classified under the "Other Fauna" (OT) category. This includes Hexacorallians with no skeleton (i.e. anemones, zoanthids and corallimorpharians) and octocorals (i.e., soft corals, sea pens, and sea fans). Mean percent cover of other invertebrate fauna were relatively low and varied significantly among stations (ANOVA, p=0.013). Mean estimated cover of Other Fauna across stations ranged from close to 8% in CR2 and CR4 to a high of 15.29% in CR1 (Figure 2-58). Overall, sponges remained as the most important OT in the reefs of the primary impact. In contrast, corallimorpharians (Plate 2-10) were more abundant than sponges in the control station of CR5. Sponges of different morphological features and sizes where intercepted in the assessment. However, sponges intercepted were mostly encrusting in form. Other faunal groups intercepted in the transects included hydroids, anemones, octocorals, hexacorals, tube worms, lophophorates, sea urchins and barnacles.

Although not intercepted, a predatory Crown of Thorns sea star (*Acanthaster plancii*) was observed in station CR1 (**Plate 2-10**).



Note: Heliopora and all octocorals were not classified under OT but were included in the hard coral category because of their rigid structure.

Figure 2-58 Mean Percent Cover of the Major Faunal Groups Under the OT Category

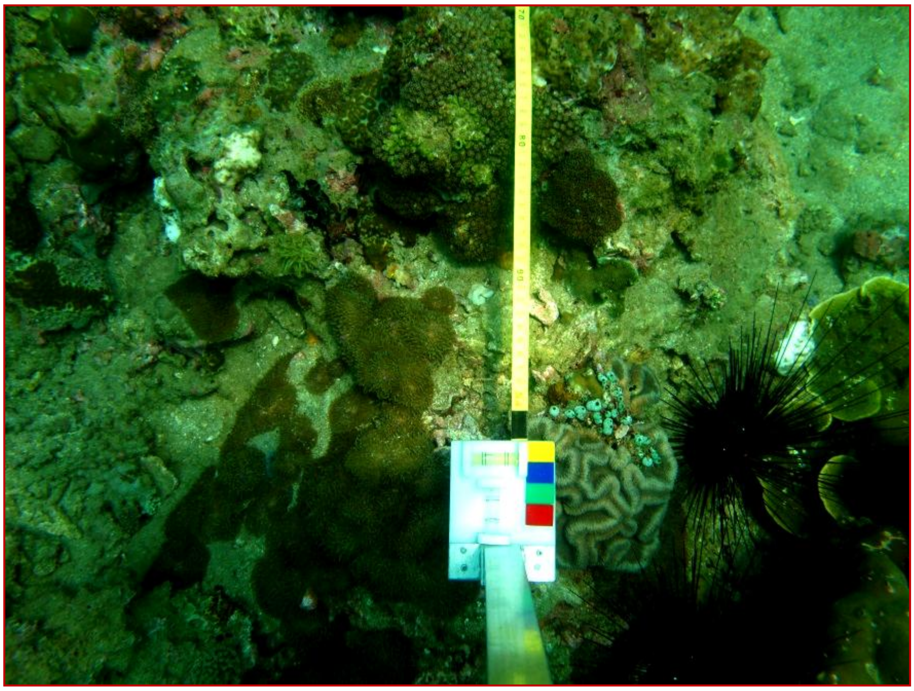


Plate 2-9 Corallimorpharians Found Abundantly in Station CR5

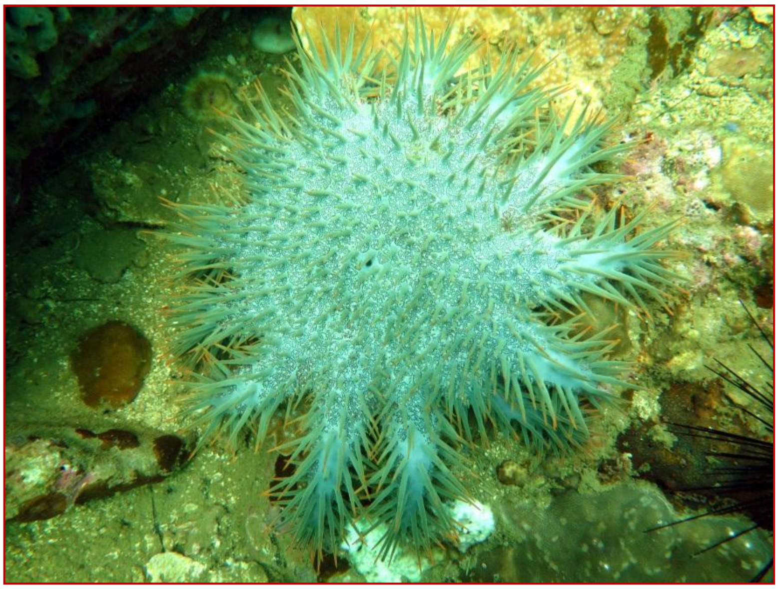
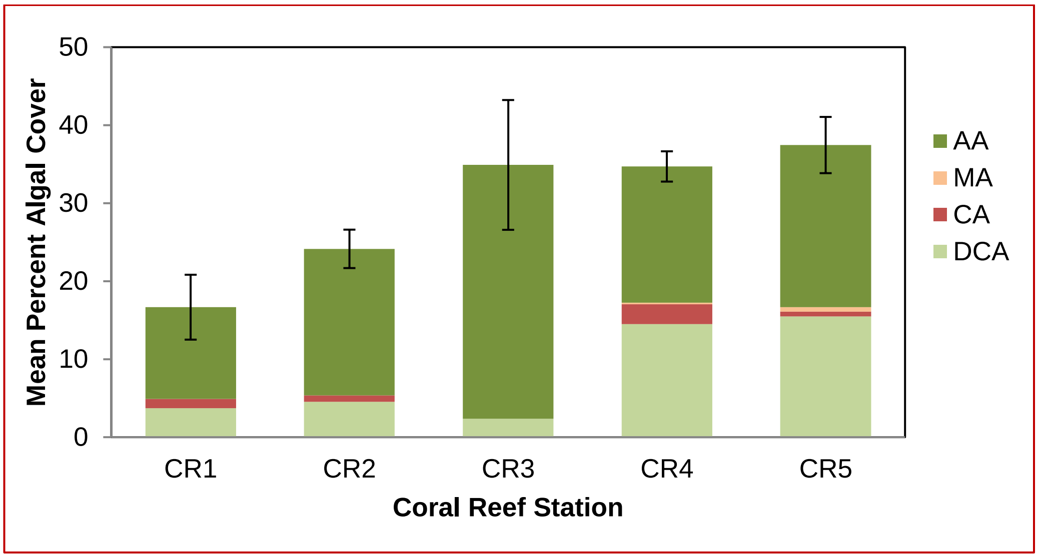


Plate 2-10 A Predatory Crown of Thorns Seastar (Acanthaster Plancii) Observed in Station CR1

Percent cover of the different algal types such as algal assemblages (AA), calcareous algae (CA), macro-algae (MA), and those sparsely growing on dead corals (DCA), were combined under the Total Algae class. Except in Station CR1, Total Algae covered a sizeable section of the reef areas surveyed. Algal cover in CR1 was significantly lowest among the stations surveyed (ANOVA, p=0.027) at 16.67% (**Figure 2-59**). This is less than half of the algal cover recorded in station CR5. Consistently, low relief algae under the algal assemblage class (**AA, Plate 2-11**) were the most commonly intercepted algal form across reef areas surveyed. As previously reported, the predominance of this algal form has strong negative implications on recruitment. Their dense growth, when left un-grazed, hinders coral recruitment and impacts the overall resiliency of the reef in the face of major perturbations. Mean cover of DCA was noticeably higher in CR4 and CR5. The sparse algal growth characteristic of this substrate could indicate a more intense grazing pressure and a potentially better chance of coral recruit survival in these stations.



Note: MA-Macroalgae; AA-Algal Assemblage; DCA-Dead coral with algae; CA-Coralline Algae.

Figure 2-59 Mean Percent Cover of the Major Algal Classes Under the Total Algae Category

Plate 2-11 Algal assemblage (AA) is characterized by dense growth of two or more low relief algal forms. This is the dominant algal form observed in majority of the stations observed in the five study sites.

The abiotic components, mostly of the loose type, covered a fair section of the reefs surveyed (**Figure 2-60**). Among the stations surveyed, CR1 was characterized by the abundance of exposed rock substrates. These substrates are ideal for colonization by a variety of opportunistic flora and fauna (Plate 2-13). In general, estimates of mean abiotic cover also did not significantly vary across stations (ANOVA, p=0.219) and, except for CR3, were generally patchy in distribution in the sections of the reefs surveyed.

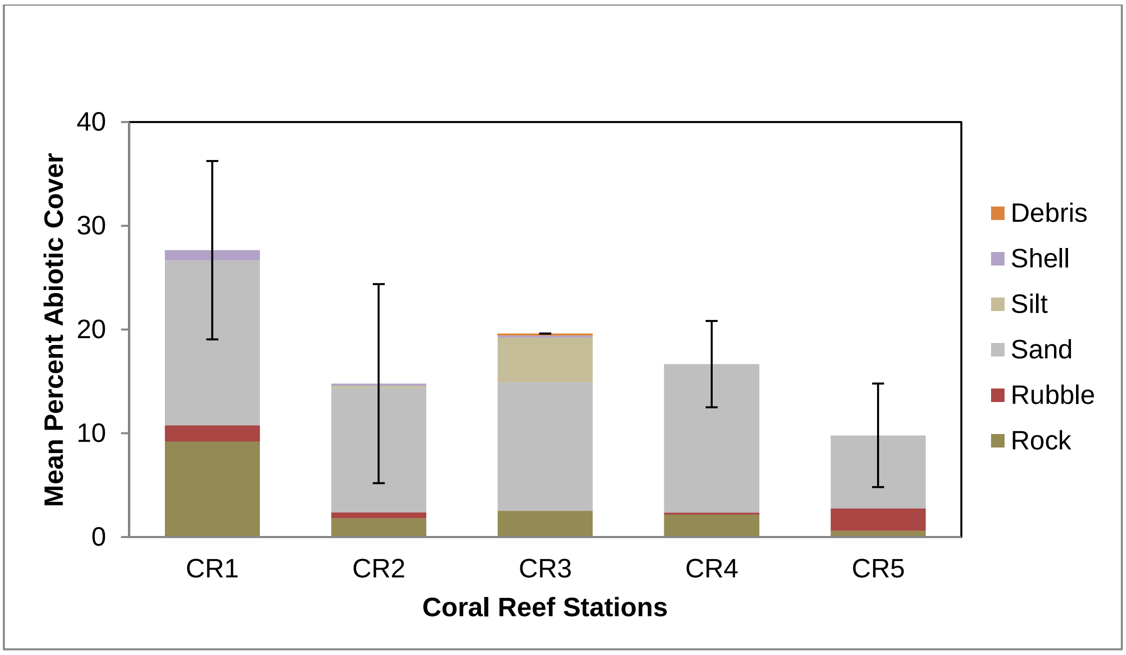


Figure 2-60 Mean Percent Cover of Abiotic Components Across the 5 Stations Surveyed in Eastern Mariveles (July 2016)

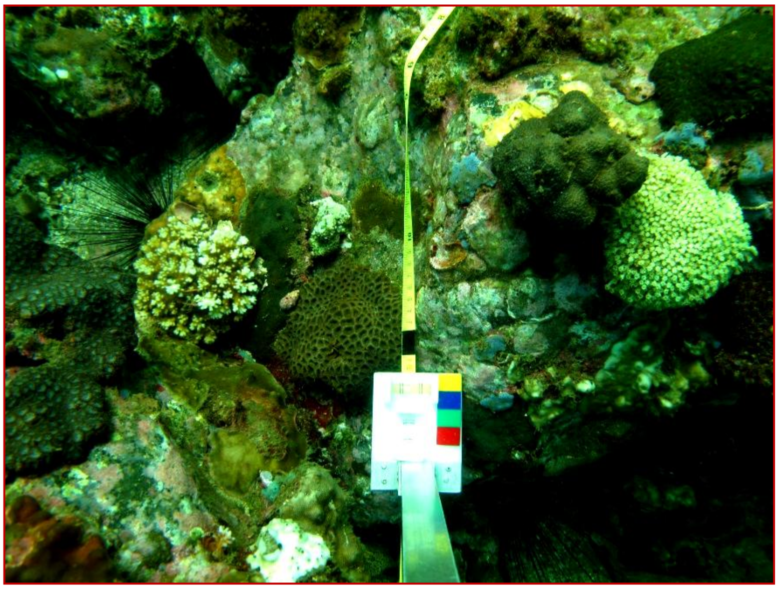


Plate 2-12 The large rocks fringing the main land mass of Mariveles provide excellent stable substrate for colonization of a diverse group of sessile invertebrate fauna.

2.2.5.2 Associated Reef Fish Assemblages

Associated Reef Fish Assemblages were also surveyed at five (5) Coral Reef Stations established within the vicinity of the proposed MCPP Project. The fish assemblages were surveyed using the Fish Visual Census technique as described by English et al. (1994). Fish were identified, counted and their sizes estimated along two 50m transects for each coral reef monitoring station. Fishes were identified up to the species level whenever possible with the aid of photographic field identification guides (i.e. Allen et al., 2012; Kuiter and Debelius, 2006; Randall, 2005). Total lengths were estimated to the nearest centimeter and the abundance of each species of a particular size estimated by actual counts. The biomass of each species of fish were then computed using the formula W=aLb where W was the weight in grams, L was the length in centimeters, and a and b were the species specific growth constants derived from the length-weight relationships (Kulbicki et al., 1993; Letourneur, 1998; Letourneur et al., 1998; Gonzalez et al., 2000; and FishBase, 2004).

Reef fishes were also categorized as “indicators”, “non-target/major”, or “commercial/target” species according to their importance and diet information from FishBase 2004. Indicator species are all corallivores or coral-feeding fishes that give an indication of the relative condition of the reef (Crosby and Reese, 1996). They include most butterflyfishes, some wrasse and damselfishes. Commercial or target fishes include species that are caught for sustenance and/or are sold for consumption. Most groupers, snappers, jacks, some wrasses, and even lionfishes represent this group. Non-target or major species are ecologically important because they hold unique niches and function as important trophic links. These fishes are usually numerous and conspicuous on reefs, and include most species of damselfishes, wrasses, and anthias, among others.

The coral reef survey stations stretched across about 3 km of coastline along Mariveles, Bataan. Four of the survey stations were within the predicted impact area (Stations CR1 to CR4), while a single control station located west of the impact area was established (Station CR5). The survey stations were comparable in that they were shallow fringing reefs of mainly rocky substratum with coral communities.

A combined total of 113 unique species of reef fish belonging to 26 families were identified from the five reef survey stations (Table 2-26). This aggregated total species richness was composed of 10 coral indicator species, 62 major species and 41 commercially important species. The major fish category was represented by 23 damselfishes (Pomacentridae) and 15 wrasses (Labridae), together with several cardinalfish (Apogonidae), trumpetfish (Aulostomidae), triggerfish (Balistidae), blennies (Blenniidae), butterflyfish (Chaetodontidae), hawkfish (Cirrhitidae), remora (Echeneidae), filefish (Monacanthidae), sweepers (Pempheridae), angelfish (Pomacanthidae), anthias

(Serranidae), pufferfish (Tetraodontidae), and the Moorish Idol Zanclus cornutus (Zanclidae). The target fishes indentified were parrotfish (Scaridae), groupers (Serranidae), rabbitfish (Siganidae), barracuda (Sphyraenidae), breams (Nemipteridae), goatfish (Mullidae), snappers (Lutjanidae), emperors (Lethrinidae), wrasses, soldierfish (Holocentridae), sweetlips (Haemulidae), flutemouth (Fistulariidae), triggerfish, and surgeonfish (Acanthuridae). The 10 coral indicator species all belonged to Chaetodontidae.

Table 2-26 Total Estimated Abundance of Fish Species (individuals/500m^2) Encountered at Five Survey Sites in Mariveles, Bataan (July 2016)

Family	Species	Category	CR 01	CR 02	CR 03	CR 04	CR 05	TOTAL ABUNDANCE
Acanthuridae	Acanthurus nigrofuscus	target	3	9	3	81	11	107
	Acanthurus pyroferus	target	1	-	-	-	-	1
	Ctenochaetus binotatus	target	19	-	-	1	3	23
	Ctenochaetus striatus	target	6	-	-	-	3	9
	Zebrasoma scopas	major	-	-	-	-	6	6
Apogonidae	Cheilodipterus macrodon	major	-	-	8	-	-	8
	Cheilodipterus quinquelineatus	major	-	-	-	-	2	2
Aulostomidae	Aulostomus chinensis	major	1	-	2	-	2	5
Balistidae	Balistapus undulatus	target	-	3	-	-	15	18
	Sufflamen chrysopterus	major	-	-	-	3	5	8
Blenniidae	Meiacanthus atrodorsalis	major	1	-	-	-	-	1
	Meiacanthus grammistes	major	4	2	5	2	-	13
Chaetodontidae	Chaetodon auriga	major	-	-	-	-	3	3
	Chaetodon baronessa	indicator	-	2	-	2	2	6
	Chaetodon citrinellus	indicator	3	-	-	3	-	6
	Chaetodon kleinii	major	5	11	11	24	11	62
	Chaetodon lunula	major	-	-	-	-	3	3
	Chaetodon lunulatus	indicator	2	22	-	1	18	43
	Chaetodon octofasciatus	indicator	-	-	-	-	4	4
	Chaetodon ornatissimus	indicator	-	7	-	2	8	17
	Chaetodon punctatofasciatus	indicator	-	1	-	3	11	15
	Chaetodon vagabundus	indicator	4	4	-	-	1	9
	Chaetodon xanthurus	indicator	2	3	5	8	9	27
	Forcipiger longirostris	major	-	-	-	-	6	6
	Heniochus chrysostomus	indicator	-	7	-	2	3	12
	Heniochus varius	indicator	-	-	-	1	-	1
Cirrhitidae	Cirrhitichthys falco	major	1	-	-	1	-	2
	Paracirrhites arcatus	major	2	4	-	2	2	10
Echeneidae	Echeneis naucrates	major	-	2	-	-	-	2
Fistulariidae	Fistularia commersonii	target	-	1	-	-	-	1
Haemulidae	Plectorhinchus chaetodonoides	target	-	-	2	-	-	2
	Plectorhinchus lineatus	target	-	-	-	-	3	3
Holocentridae	Myripristis hexagona	target	-	-	-	-	1	1
Labridae	Bodianus mesothorax	major	5	3	-	2	4	14
	Cheilinus oxycephalus	target	1	6	5	-	-	12
	Choerodon anchorago	target	-	-	-	-	1	1
	Cirrhilabrus cyanopleura	major	-	8	-	-	-	8
	Coris batuensis	major	-	2	-	-	-	2
	Coris gaimard	major	4	-	-	-	-	4
	Gomphosus varius	major	6	2	6	2	2	18
	Halichoeres hortulanus	major	11	5	-	5	8	29
	Halichoeres melanurus	major	1	2	-	-	1	4
	Halichoeres scapularis	major	-	1	1	-	-	2
	Halichoeres sp.	major	-	-	-	-	4	4
	Hemigymnus fasciatus	major	1	1	-	2	1	5

Family	Species	Category	CR 01	CR 02	CR 03	CR 04	CR 05	TOTAL ABUNDANCE
	Hemigymnus melapterus	target	-	3	-	-	-	3
	Labroides dimidiatus	major	3	-	3	3	7	16
	Macropharyngodon meleagris	major	2	2	-	5	-	9
	Oxycheilinus digrammus	target	-	-	-	1	1	2
	Oxycheilinus unifasciatus	target	1	-	-	1	-	2
	Stethojulis bandanensis	major	-	-	2	1	2	5
	Stethojulis trilineata	major	4	1	-	-	-	5
	Thalassoma hardwicke	major	-	10	-	13	1	24
	Thalassoma lunare	major	40	12	33	12	24	121
Lethrinidae	Gnathodentex aureolineatus	target	-	49	-	-	20	69
	Monotaxis grandoculis	target	-	-	-	-	1	1
Lutjanidae	Lutjanus kasmira	target	-	-	-	-	10	10
	Macolor niger	target	-	-	-	-	1	1
Monacanthidae	Pervagor janthinosoma	major	-	12	3	1	-	16
Mullidae	Mulloidichthys flavolineatus	target	-	-	6	-	-	6
	Parupeneus barberinus	target	-	1	-	-	1	2
	Parupeneus cyclostomus	target	-	-	-	6	-	6
	Parupeneus multifasciatus	target	7	5	11	20	9	52
Nemipteridae	Scolopsis bilineatus	target	4	1	-	-	2	7
	Scolopsis ciliatus	target	-	-	-	-	1	1
	Scolopsis trilineata	target	1	-	-	-	-	1
Pempheridae	Pempheris oualensis	major	-	-	-	-	1	1
	Centropyge vroliki	major	7	4	-	2	6	19
Pomacanthidae	Amphiprion clarkii	major	1	7	7	-	7	22
	Amphiprion frenatus	major	-	-	-	3	1	4
	Amphiprion ocellaris	major	3	2	-	-	-	5
	Chromis margaritifer	major	23	5	-	4	-	32
	Chromis retrofasciata	major	-	1	-	2	-	3
	Chromis ternatensis	major	-	-	-	-	4	4
	Chromis viridis	major	-	-	-	-	2	2
	Dascyllus reticulatus	major	37	23	-	1	92	153
	Dascyllus trimaculatus	major	4	8	11	7	39	69
	Neoglyphidodon melas	major	1	-	-	1	2	4
	Neoglyphidodon nigroris	major	-	-	-	-	1	1
	Plectroglyphidodon lacrymatus	major	2	9	-	4	15	30
	Pomacentrus adelus	major	-	-	-	2	4	6
	Pomacentrus amboinensis	major	-	-	-	-	13	13
	Pomacentrus bankanensis	major	-	2	15	17	-	34
	Pomacentrus brachialis	major	-	-	7	-	3	10
	Pomacentrus burroughi	major	-	-	14	-	-	14
	Pomacentrus coelestis	major	5	29	16	26	-	76
	Pomacentrus lepidogenys	major	1	-	-	-	-	1
	Pomacentrus moluccensis	major	-	1	-	-	1	2
	Pomacentrus philippinus	major	-	-	-	1	13	14
	Pomacentrus vaiuli	major	4	-	-	-	16	20
	Stegastes nigricans	major	-	-	9	-	-	9
Scaridae	Chlorurus bleekeri	target	-	1	-	1	-	2
	Hipposcarus longiceps	target	-	6	6	6	-	18
	Scarus forsteni	target	9	18	3	3	1	34
	Scarus ghobban	target	1	5	-	4	1	11
	Scarus hypselopterus	target	-	-	-	-	1	1
	Scarus niger	target	2	3	-	3	1	9
	Scarus rivulatus	target	10	-	-	11	16	37
	Scarus tricolor	target	-	-	-	-	2	2
Serranidae	Cephalopholis boenak	target	4	2	3	-	2	11
	Cephalopholis urodeta	target	-	1	-	-	-	1

Family	Species	Category	CR 01	CR 02	CR 03	CR 04	CR 05	TOTAL ABUNDANCE
	Diploprion bifasciatum	target	2	-	-	1	7	10
	Epinephelus merra	target	-	5	16	2	7	30
	Epinephelus sexfasciatus	target	-	2	-	-	1	3
	Pseudanthias huchtii	major	2	-	-	-	20	22
Siganidae	Siganus argenteus	target	-	3	-	-	-	3
	Siganus vermiculatus	target	-	1	2	1	-	4
Sphyraenidae	Sphyraena flavicauda	target	-	30	-	-	-	30
Tetraodontidae	Arothron manilensis	major	-	-	1	-	-	1
	Arothron nigropunctatus	major	1	-	1	-	1	3
	Canthigaster papua	major	1	-	-	-	-	1
	Canthigaster valentini	major	3	-	-	4	4	11
Zanclidae	Zanclus cornutus	major	19	26	8	8	7	68
	TOTAL		287	398	225	324	524	1,758
	total families	26						
	total species	113						
	total indicators	10						
	total majors	62						
	total targets	41						

The mean estimated fish species richness varied across survey stations and ranged from 24 species/250m^2 at CR3 (Nabiga) up to 52 species/250m^2 at CR5 (Basay-control) (**Table 2-27**). The mean total species richness was 38 species/250m^2 and 3 of the 5 survey stations had mean species richness below the mean total (CR1, CR3 and CR4), while mean fish species richness were greater than the mean total at 2 survey stations (CR2 and CR5). Across all survey stations major fish species were the most diverse, followed by target species and lastly by indicator species (Figure 2-61). Station CR5 (Basay-control) had the highest mean species richness among the survey stations and accordingly had the highest mean number of indicator species (7 indicators), major species (30 majors) and target species (16 targets). Station CR2 (Lusong) had the second highest mean estimated fish species richness with 40 species/250m2, and had the second highest number of indicator species (5 indicators) together with CR4 (Nagtalong Pt.), as well as a comparably high number of target species (15 targets). The mean number of major fish species at CR2 (Lusong; 21 majors), however, was less than that at CR5 and did not greatly differ from the estimates at CR1 (Pulang Lupa; 23 majors) and CR4 (Nagtalong Pt.; 22 majors). At the other end, Station CR3 (Nabiga) had the lowest mean species richness with only a single indicator fish species, 8 target species and 16 major species.

Table 2-27 Mean Fish Species Richness (Species/250m^2), Abundance (Individuals/250m^2), and Biomass (kg/250m^2) at Five Survey Sites in Mariveles, Bataan (July 2016)

Station	Family	Species	Abundance	Biomass
CR1 (Pulang Lupa)	14	36	144	3.58
CR2 (Lusong)	16	40	199	3.96
CR3 (Nabiga)	12	24	113	4.61
CR4 (Nagtalong Pt.)	13	37	162	2.24
CR5 (Basay-control)	16	52	262	8.37
MEAN	14	38	176	4.55

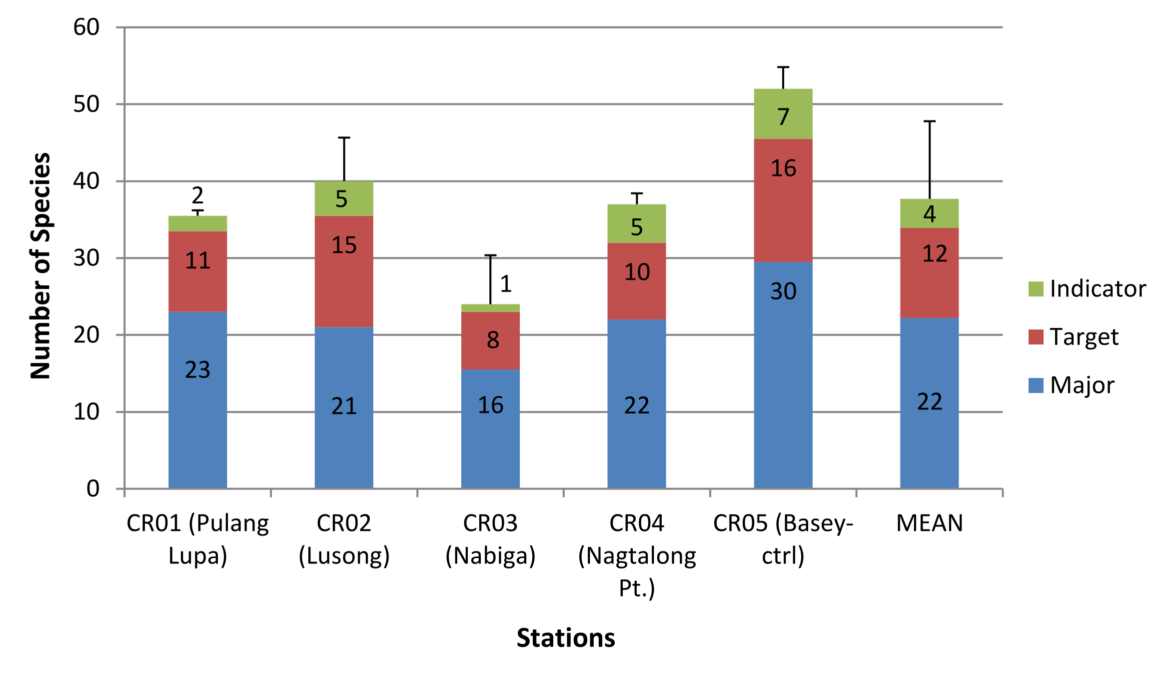


Figure 2-61 Mean fish species richness (species/250m2) and the composition of indicator, major and target species at five survey stations at Mariveles, Bataan (July 2016)

The mean total estimated fish abundance from the five reef survey stations was 176 individuals/250m^2 (**Table 2-26**). Mean fish abundance ranged from 113 individuals/250m^2 at Station CR3 (Nabiga) up to 262 individuals/250m^2 at CR5 (Basay-control). Fish abundance estimates were high relative to the mean total at CR2 (Lusong) and CR5 (Basay-control), and were relatively low at CR1 (Pulang Lupa), CR3 (Nabiga) and CR4 (Nagtalong Pt.). Major species were the most abundant fish at each of the survey stations. They comprised between 82 to 173 individuals/250m^2. Major fish species with the highest combined total abundance from the five survey stations included the damselfishes Dascyllus reticulatus, Dascyllus trimaculatus and Pomacentrus coelestis, the moon wrasse Thalassoma lunare, the butterflyfish Chaetodon kleinii, and the Moorish Idol Z. cornutus. These numerically dominant major species were also common across survey stations except of D. reticulatus which was not recorded along the survey transects at CR3 (Nabiga) and P. coelestis which was not observed at CR5 (Basay-control). Target fish were also relatively abundant and they were nearly as abundant as major fish at CR2 (Lusong) and CR4 (Nagtalong Pt.) where respective means counts of 78 and 71 individuals/250m^2 were estimated. Target fish counts was moderate at CR5 (Basay-control), and poor at CR1 (Pulang Lupa) and CR3 (Nabiga). The most abundant target species was the surgeonfish Acanthurus nigrofuscus. This surgeonfish was common occurred across stations but was most abundant at CR4 (Nagtalong Pt.). Other target species with notable total abundances were the bream Gnathodentex aureolineatus, the goatfish Parupeneus multifasciatus, the parrotfishes Scarus forsteni and Scarus rivulatus, and the grouper Epinephelus merra. Interestingly, except for the parrotfishes, these target species of fish are often associated with sandy bottoms adjacent to reefs (Allen et al., 2012). All together Scaridae and Acanthuridae were the most abundant target fish families. Parrotfish, however, were generally more common than surgeonfishes at the survey stations. Among the 10 species of butterflyfish that represented the coral health indicator species, the five most abundant were Chaetodon lunulatus, Chaetodon xanthurus, Chaetodon ornatissimus Chaetodon punctatofasciatus, and Heniochus chrysostomus.

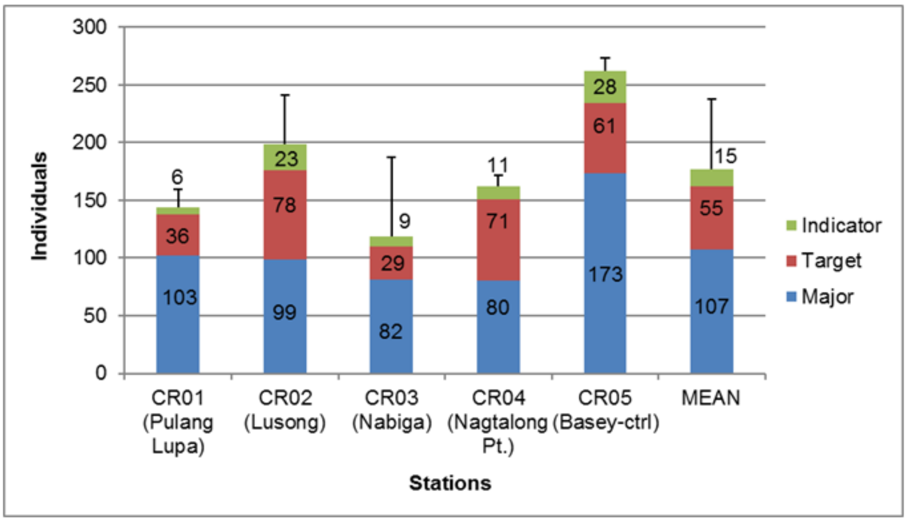


Figure 2-62 Mean fish abundance (individuals/250m) and the composition of indicator, major and target species at five survey stations at Mariveles, Bataan (July 2016).

The estimated mean biomass of fish was relatively low at four of the survey stations and was only relatively high at CR5 (Basay-control). Fish biomass ranged from 2.2 kg to 4.6 kg/250m2 at CR4 to CR3, but was 8.4 kg/250m2 at CR5. The mean total biomass of fish for the entire study area was 4.6 kg/250m2 and once again, only CR3 and CR5 had mean biomass estimates over this mean total. Major fish species contributed higher mean biomasses over target species across all the survey stations, except at CR2 (Lusong) where target species contributed more biomass than major fishes, and at CR1 (Pulang Lupa) where the biomass of target and major species were nearly equal. The most important major fish species in terms of its biomass contribution was the trumpetfish Aulostomus chinensis which had a total accumulated biomass of 7.67 kg. This was followed by the Moorish Idol Z. cornutus, the moon wrasse T. lunare, and the butterflyfish C. kleinii. The target species with the most notable contribution to the biomass in the area were the surgeonfish Ctenochaetus binotatus, the sweetlips Plectorhinchus lineatus, the snapper Lutjanus kasmira, the grouper E. merra, and the barracuda Sphyraena flavicauda. None of the coral indicator species were numerous enough or large enough to generate biomass in excess of 1 kilogram. The biomass of target species is an important parameter that provides a measure of the potential importance of a reef site in terms of its value to fisheries. Although the biomass of fish at the study site was relatively low (Hilomen et al., 2000), the variety and abundance of target species still make the area important in supporting to local fisheries.

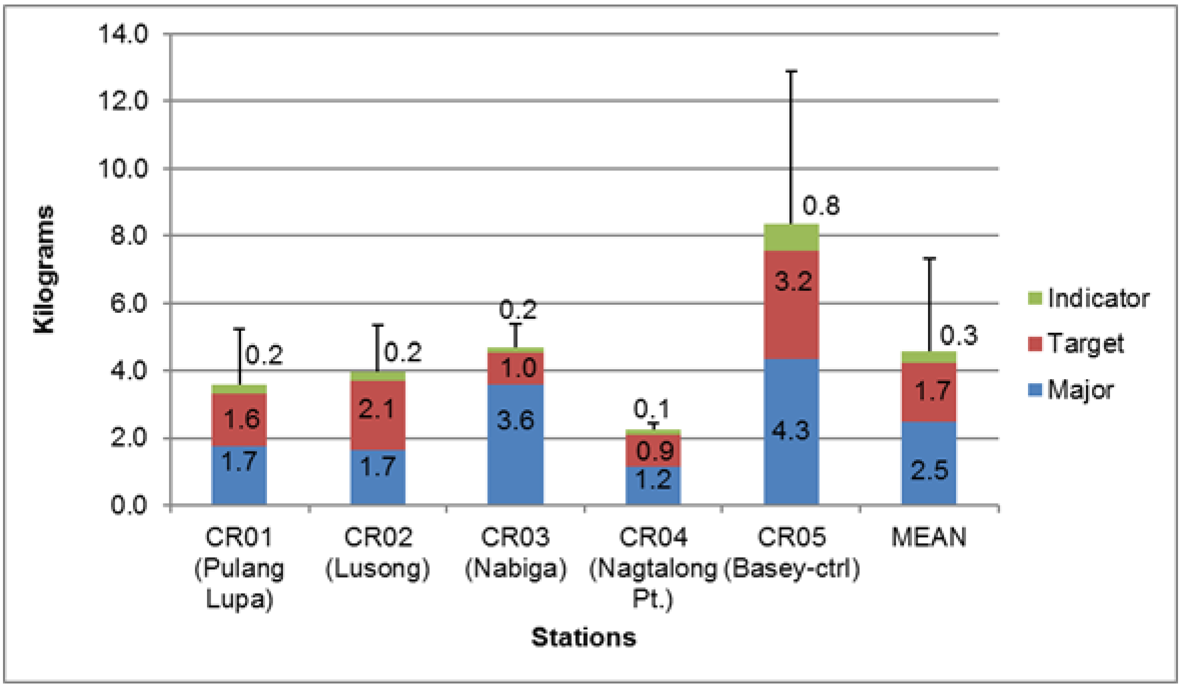


Figure 2-63 Mean fish biomass (kg/250m²) and the composition of indicator, major and target species at five survey stations at Mariveles, Bataan (July 2016)

2.2.5.3 Soft Bottom Communities

Marine sediments samples were collected from the seven (7) established sampling stations (**Figure 2-64**) within the vicinity of the proposed Project site. Two (2) replicate samples were collected from an estimated area of 0.02 m^2 in each station. The sediments were carefully placed inside sealed plastic bags and preserved with 10% formalin. Samples were brought to the laboratory for further processing. In the laboratory, sediment samples were passed through a one (1) mm mesh-sized sieve and all animals retained were identified using taxonomic keys, illustration guides and checklists (Poppe, 2008; de Bruyne, 2003; Tan and Chou, 1993) and their number counted. Abundances of soft bottom animals were reported as numbers 0.02/ m^2.

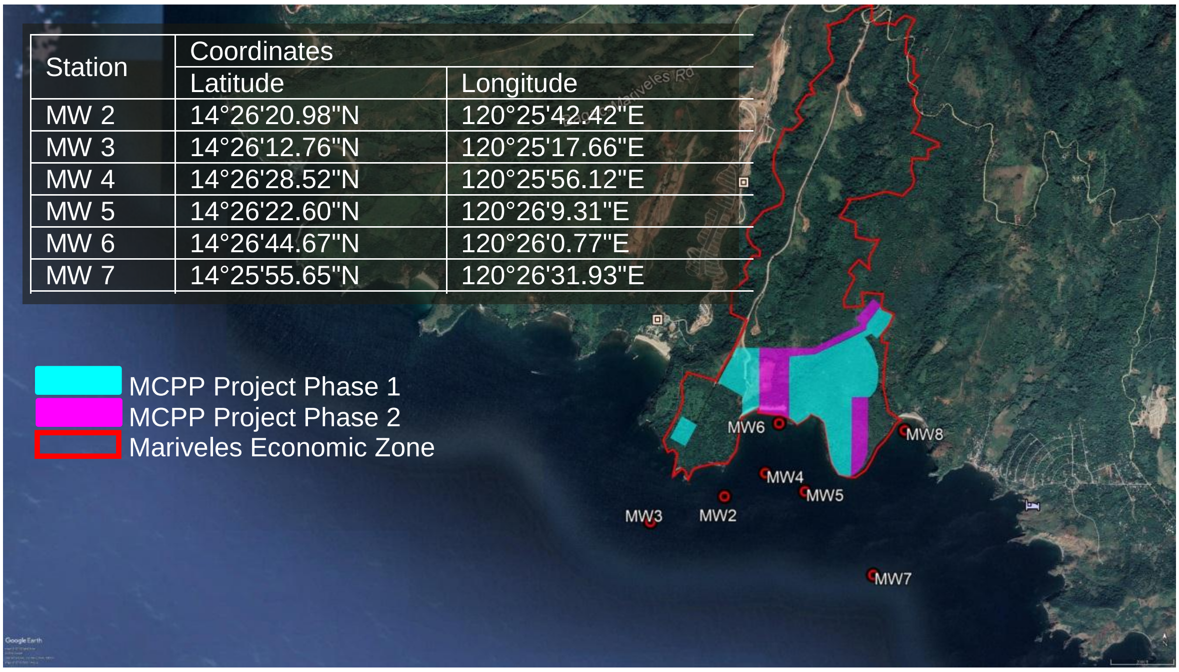


Figure 2-64 Marine Ecology Sampling Station Map

The soft-bottom community at seven (7) stations within the coastal area of the proposed MCPP Project comprised at least 41 taxa representing seven (7) animal phyla (Table 2-28 and Figure 2-65). The macrobenthos community was largely dominated by Foraminifera, comprising 99.04% of the total count. Low proportions were recorded for six (6) other remaining phyla such as Mollusca, Annelida and Arthropoda, each representing less than 1% of the total macrobenthos. Although low mean abundances were observed for the taxa, rich assemblages of Mollusca were observed with 22 taxa and Annelida with 8 taxa.

Table 2-28 Total and Relative Abundances of Soft-Bottom Fauna, July 2016

Taxa	Sampling Stations							Abundance	
	MW1	MW2	MW3	MW4	MW5	MW6	MW8	Overall	Relative
ANNELIDA	7.5	7.5	13.5	1.5	8.0	16.0	1.0	55.0	0.369
Polychaeta	7.5	7.5	13.5	1.5	8.0	16.0	1.0	55.0	0.369
Dorvilleidae	0.0	0.0	0.0	0.0	0.0	1.0	0.0	1.0	0.007
Glyceridae	1.0	1.0	0.5	0.5	0.5	3.5	0.0	7.0	0.047
Lumbrineridae	1.0	1.0	0.0	0.0	0.0	0.0	1.0	3.0	0.020
Nereididae	0.5	0.5	1.0	0.0	0.0	0.0	0.0	2.0	0.013
Paraonidae	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.5	0.003
Syllidae	5.0	5.0	5.0	1.0	6.0	11.5	0.0	33.5	0.225
tube-dwelling polychaetes	0.0	0.0	6.5	0.0	1.5	0.0	0.0	8.0	0.054
ARTHROPODA	2.0	2.0	1.0	0.0	1.5	1.5	0.0	8.0	0.054
Amphipoda	1.5	1.5	1.0	0.0	0.0	1.5	0.0	5.5	0.037
Cumacea	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.5	0.003
Decapoda (shrimp)	0.0	0.0	0.0	0.0	1.0	0.0	0.0	1.0	0.007
Isopoda	0.5	0.5	0.0	0.0	0.0	0.0	0.0	1.0	0.007
CHORDATA	0.5	0.5	0.5	1.0	0.0	1.0	0.5	4.0	0.027
Cephalochordata	0.5	0.5	0.5	1.0	0.0	0.5	0.5	3.5	0.023
Amphioxus	0.5	0.5	0.5	1.0	0.0	0.5	0.5	3.5	0.023
Vertebrata	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.5	0.003
fish larvae	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.5	0.003
FORAMINIFERA	2102.	2102.	2781.	2086.5	1920.	3426.0	353.5	14772.	99.045

Taxa	Sampling Stations							Abundance	
	MW1	MW2	MW3	MW4	MW5	MW6	MW8	Overall	Relative
	0	0	5		5			0	
Calcarina	1008.5	1008.5	1403.0	1097.5	900.0	1404.0	182.0	7003.5	46.958
Cycloclypeus	800.5	800.5	984.5	474.5	859.5	1298.0	119.0	5336.5	35.781
Operculina	293.0	293.0	394.0	514.5	161.0	724.0	52.5	2432.0	16.306
MOLLUSCA	0.5	0.5	9.0	40.5	1.0	10.5	12.0	74.0	0.496
Bivalvia	0.0	0.0	1.0	1.0	0.5	0.0	2.0	4.5	0.030
Lucinidae	0.0	0.0	1.0	0.0	0.0	0.0	1.0	2.0	0.013
Mactridae	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	0.007
Pectinidae	0.0	0.0	0.0	1.0	0.0	0.0	0.0	1.0	0.007
Thorny oyster	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.5	0.003
Gastropoda	0.5	0.5	8.0	39.5	0.5	10.5	10.0	69.5	0.466
Cerithiidae	0.0	0.0	0.0	2.0	0.0	0.0	1.0	3.0	0.020
Cerithiopsidae	0.0	0.0	0.0	2.5	0.0	0.0	0.0	2.5	0.017
Conus	0.0	0.0	0.0	0.0	0.5	0.5	0.0	1.0	0.007
Diastomatidae	0.0	0.0	3.0	22.0	0.0	1.5	3.0	29.5	0.198
Eulimidae	0.0	0.0	0.0	1.0	0.0	0.0	0.0	1.0	0.007
Fusinus	0.0	0.0	0.0	0.0	0.0	1.0	0.0	1.0	0.007
Muricidae	0.0	0.0	0.5	0.0	0.0	0.5	0.0	1.0	0.007
Nassarius	0.0	0.0	2.0	2.5	0.0	2.0	0.0	6.5	0.044
Neritidae	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.5	0.003
Pyramidellidae	0.0	0.0	0.0	0.0	0.0	2.0	2.0	4.0	0.027
Rissoellidae	0.0	0.0	0.0	1.0	0.0	0.0	0.0	1.0	0.007
Strombus	0.5	0.5	0.0	0.0	0.0	0.0	0.0	1.0	0.007
Terebridae	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.5	0.003
Triphoridae	0.0	0.0	2.5	8.0	0.0	2.5	1.5	14.5	0.097
Trochidae	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.5	0.003
Turritellidae	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.5	0.003
Umbonium	0.0	0.0	0.0	0.5	0.0	0.5	0.5	1.5	0.010
NEMERTEA	0.0	0.0	0.0	0.0	1.0	0.0	0.0	1.0	0.007
PRIAPULIDA	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.5	0.003
Mean Abundance	2113	2113	2806	2130	1932	3455	367	14915	100.00
SD	81	159	136	33	320	8	2		
Number of Taxa	12	16	17	12	18	17	9	41	

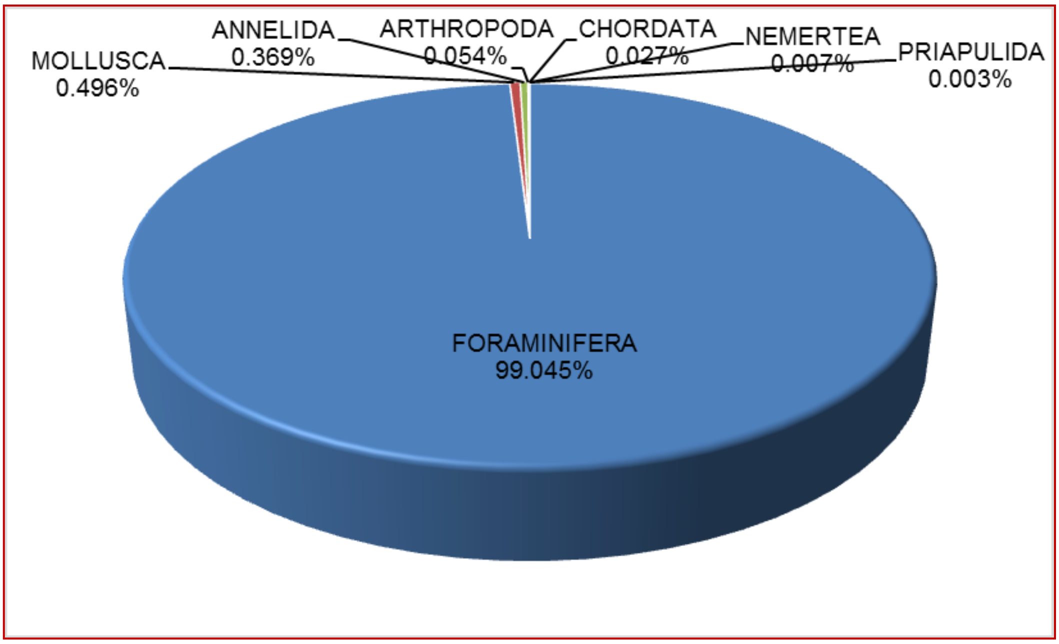


Figure 2-65 Relative Proportions of Soft-Bottom Phyla (July 2016)

Mean macrobenthos abundances were high at most surveyed stations. The highest mean density of soft-bottom fauna was recorded at MW6 (3,455 animals/0.02m^2), followed by that observed at MW3 (2,806 animals/0.02m^2). On the average, macrobenthos mean densities did not vary much among Stations MW1, MW2, MW4 and MW5 (mean abundances ranged from 1,932 animals/0.02m2 to 2,130 animals/0.02m^2). Meanwhile, the lowest mean macrobenthos abundance was recorded at MW8 with a value of 367 animals/0.02m^2 (**Figure 2-66**).

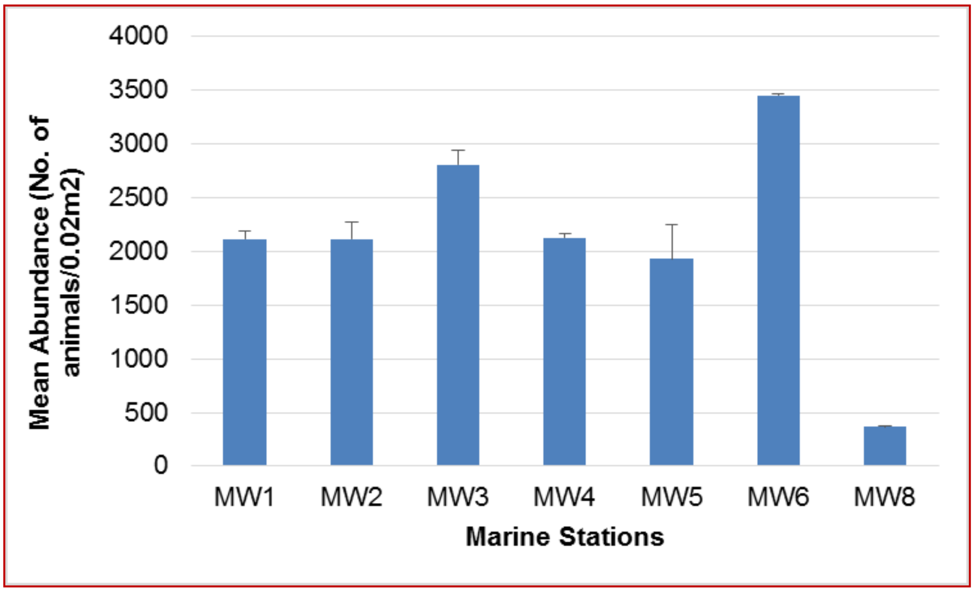


Figure 2-66 Mean Macrobenthos Abundance

Relatively higher macrobenthos taxa richness were recorded at MW2, MW3, MW5 and MW6 (16-18 taxa), compared to that recorded at stations MW1, MW4 and MW8 (9-12 taxa) (**Figure 2-67**).

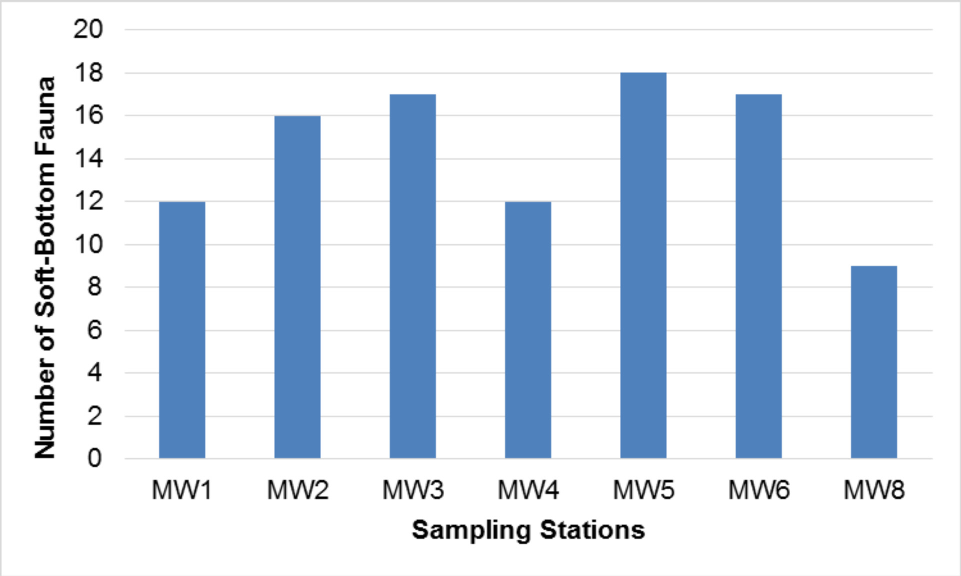


Figure 2-67 Macrobenthos Taxa Richness

Three Foraminiferan Genera consistently dominated at seven surveyed stations. Calcarina had the highest overall density (7,004 animals/0.02m^2), representing 47% of the total count. Cycloclypeus and Operculina ranked second and third, respectively, in terms of overall density (5337 animals/0.02m^2 and 2,432 animals/0.02m^2, respectively) (**Figure 2-68**).

The occurrence of high densities of Foraminifera at the study site suggests that their number are highly sufficient for them to perform their role in recycling of nutrients, particularly algal carbon. Macrobenthic composition also indicates that the coastal areas at the vicinity of the project site has a rich assemblage of soft-bottom fauna, which could serve as potential prey items for fish and other invertebrates.

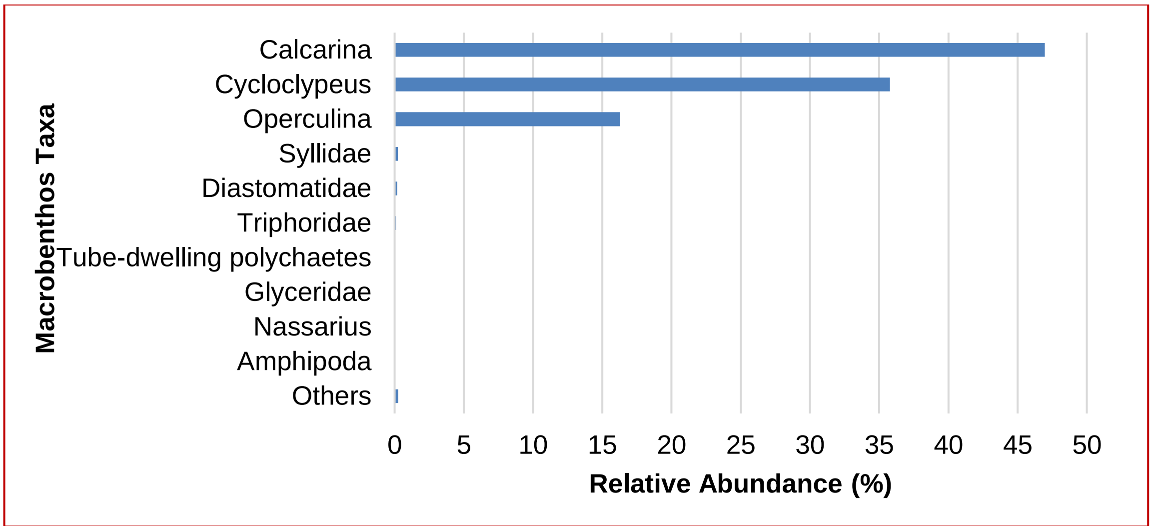


Figure 2-68 Relative Abundances (%) of Soft-Bottom Taxa

2.2.5.4 Plankton Communities

The samples of zooplankton and phytoplankton were collected from the eight (8) established sampling stations established within the vicinity of the proposed MCPP Project site. Plankton samples were collected using a net with a mesh size of 64 m and a mouth diameter of 0.30 m. At each site, the plankton net was lowered to 10m and hauled vertically at a rate not exceeding 1m/ s. Replicate samples of zooplankton and phytoplankton were collected from each station and placed in properly-labeled plastic containers. Phytoplankton and zooplankton samples were fixed with 10% formalin immediately after collection. All samples were allowed to stand undisturbed for about a week to allow organisms to settle at the bottom of the container. Excess liquid was carefully decanted until about 50 ml was left. For phytoplankton samples, a 1 ml aliquot subsample was placed in a Sedgewick-Rafter cell counter and was examined under a microscope. The same was done for the counting and enumeration of zooplankton samples. Planktonic organisms were identified to the lowest possible taxa using references such as those of Goswami (2004), Nishikawa and Toda (2004), Sekiguchi et al. (2004) and Verlencar (2004), and their numbers counted. Phytoplankton and zooplankton densities were expressed as no. of cells/ m^3 and no. of inds./ m^3, respectively.

The phytoplankton community at eight (8) stations combined in the coastal area of the proposed Project comprised at least 31taxa representing four (4) algal divisions (Table 2-29 and Figure 2-69). Bacillariophyta (diatoms) is the most dominant group representing 67% of the total count, followed by Dinophyta (dinoflagellates) representing 27.8% of the total count. Lower proportions were recorded for Cyanobacteria (blue-green algae) and Raphidophyta, which comprise of 4.1% and 1.1%, respectively.

Table 2-29 Overall Mean and Relative Mean Densities of Phytoplankton, July 2016

Taxa	Sampling Stations								Mean Density	
	MW1	MW2	MW3	MW4	MW5	MW6	MW7	MW8	Overall	Relative
Bacillariophyta	97014	93972	66173	64369	97721	90188	149782	65855	90634	67
Bacteriastrum	4881	1309	2688	2582	531	1874	4244	0	2264	2
Biddulphia	9231	3112	6578	10044	0	10716	39647	0	9916	7
Chaetoceros	18992	6437	6897	3395	20725	2476	0	1556	7560	6
Coscinodiscus	884	424	920	2617	6402	2193	0	3466	2113	2
Cyclotella	0	0	389	0	1521	0	0	566	309	0
Fragillariopsis	2440	4810	6826	1592	2759	5058	4704	0	3524	3
Lauderia	9620	3501	3678	2794	27658	6295	26667	0	10027	7
Lioloma	16870	5447	18710	5800	14501	7250	0	11353	9991	7
Navicula	0	0	813	0	3997	0	0	2228	880	1
Proboscia	3855	813	1132	2228	0	2157	6967	1981	2392	2
Pseudo-nitzchia	5199	13192	8559	7533	0	7180	12414	11884	8245	6
Rhizosolenia	3218	9938	389	2405	0	10964	15526	2228	5584	4
Thalassionema	12131	7639	2900	12379	19629	7533	0	8665	8860	7
Thalassiosira	9691	37348	5694	10999	0	26490	39612	21928	18970	14
Cyanobacteria	2476	2688	4209	5093	19877	2653	3997	3395	5548	4
Trichodesmium	2476	2688	4209	5093	19877	2653	3997	3395	5548	4
Dinophyta	21327	33140	39718	33140	65112	25182	54820	28683	37640	28
Ceratium furca	177	743	1521	389	920	1061	0	566	672	1
Ceratium fusus	601	778	566	318	1556	0	354	0	522	0
Ceratium gibberum	424	0	707	743	1698	0	0	0	447	0
Ceratium inflatum	884	1238	0	884	1061	0	920	0	623	1
Ceratium lineatum	0	0	389	0	672	0	0	0	133	0
Ceratium lunula	601	601	0	884	460	0	637	0	398	0
Ceratium macroceros	990	141	106	495	637	0	0	0	296	0
Ceratium trichoceros	35	212	495	849	1238	283	0	0	389	0
Ceratium tripos	566	884	566	460	1096	0	1026	0	575	0
Cylindrotheca	177	460	2370	1061	9302	460	0	601	1804	1
Dinophysis	495	4032	3006	1450	0	2546	17118	6154	4350	3
Lingulodinium	9655	18250	12166	11742	28860	12308	26879	15526	16923	13
Noctiluca	2865	955	637	743	2087	884	0	3254	1428	1
Peridinium	2405	1238	7144	3431	7003	1627	7887	1203	3992	3
Protoperidinium	1450	3608	10044	9691	8524	6013	0	1379	5089	4
Raphidophyta	955	707	920	35	3855	354	5058	531	1552	1
Chattonella	955	707	920	35	3855	354	5058	531	1552	1

Taxa	Sampling Stations								Mean Density	
	MW1	MW2	MW3	MW4	MW5	MW6	MW7	MW8	Overall	Relative
Mean Density	121771	130507	111019	102637	186565	118376	213656	98464	135374	100.0
SD	27460	14605	9653	6402	61471	13355	121492	41915		
Number of Taxa	28	27	29	28	25	22	17	19	31	

Note: Mean (no. of cells/m^3)
Source: GEOSPHERE 2016

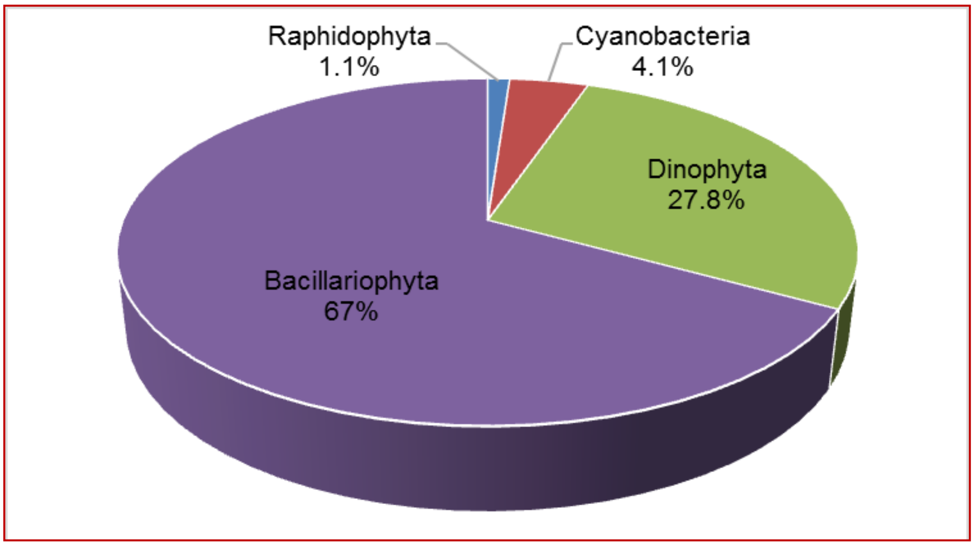


Figure 2-69 Relative Proportions (%) of Phytoplankton Divisions

Stations MW5 (186,565 cells/m^3) and MW7 (213,656 cell/m^3) had higher mean phytoplankton densities compared to that recorded at six remaining stations. On the average, phytoplankton abundances did not vary much among six remaining stations with values ranging from 98,464 cells/m3 to 130,507 cells/m^3 (**Figure 2-70**).

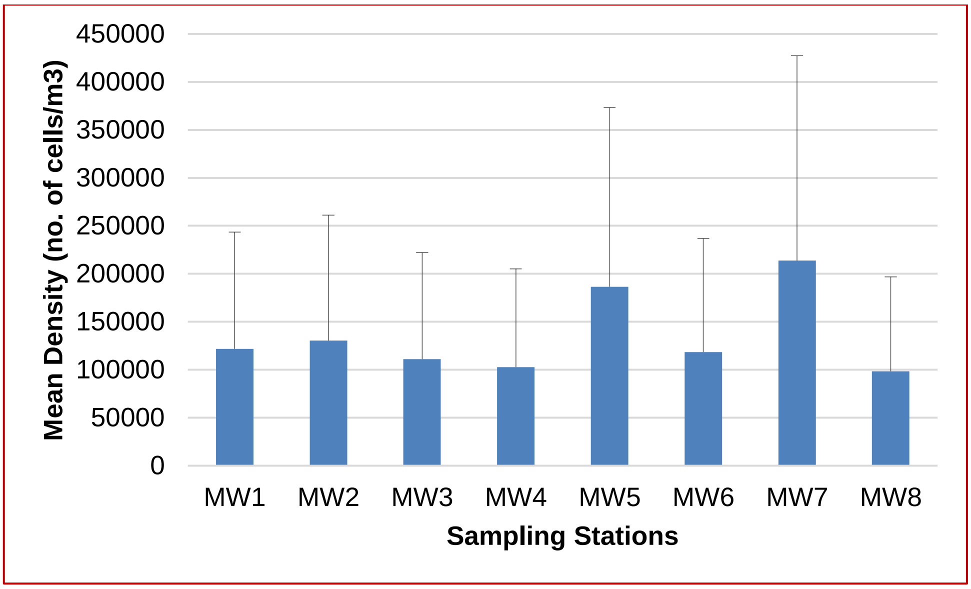


Figure 2-70 Mean Phytoplankton Densities (no. of cells/m^3)

The number of phytoplankton taxa ranged from 17 to 29, with the highest recorded at MW3 and the lowest at MW7. Phytoplankton taxa richness did not differ much at MW1 to MW5 (25-29 taxa). Meanwhile, relatively lower algal taxa richness were recorded at three remaining stations with values ranging from 17-22 taxa (**Figure 2-71**).

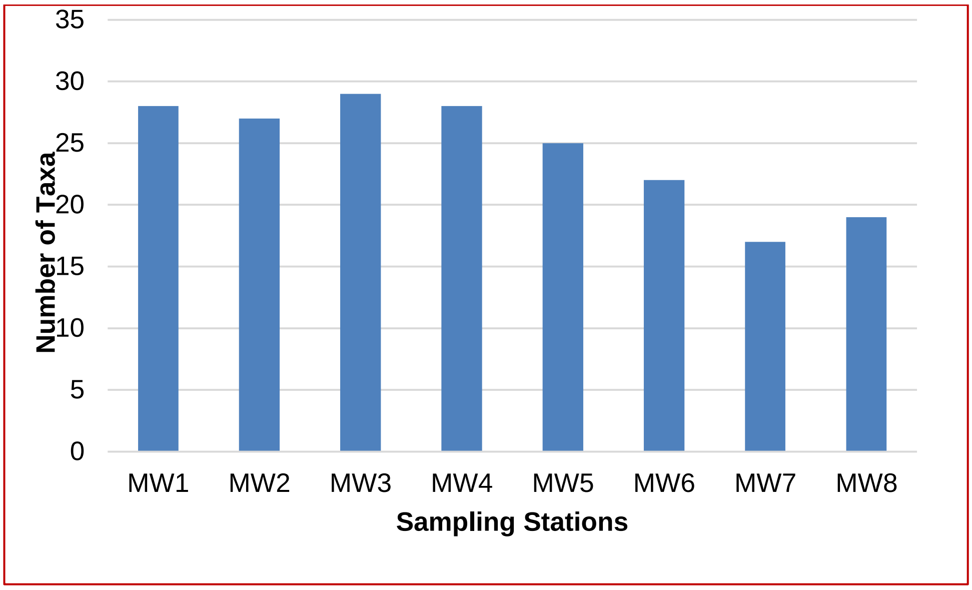


Figure 2-71 Number of Phytoplankton Taxa

Thalassiosira was the most abundant algal taxa representing 14% of the total count. This taxon dominated at four (MW1, MW2, MW7 and MW8) of the eight surveyed stations. On the other hand, Lingulodinium ranked second in terms of overall abundance and this taxon had the highest density at MW3, MW4 and MW5 (**Figure 2-72**).

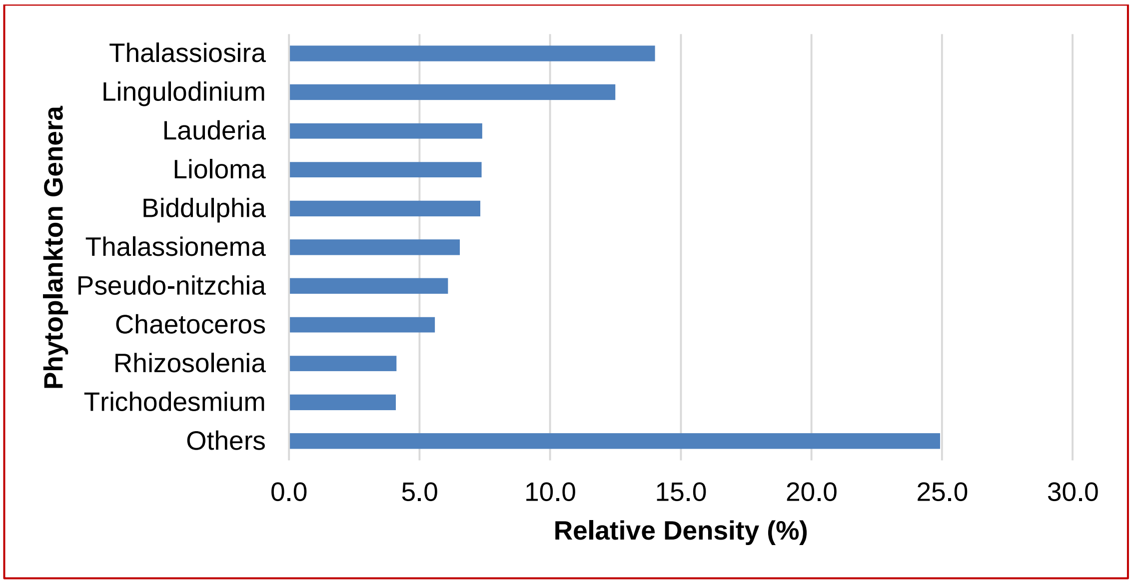


Figure 2-72 Relative Proportions (%) of Phytoplankton Taxa

The zooplankton community at eight (8) marine stations comprised at least 25 taxa representing eight (8) animal phyla. Arthropoda largely dominated the zooplankton community representing 63%

of the total count, followed by Protozoa comprising 26% of the total density. Lower proportions were recorded for six (6) remaining animal phyla such as Chordata and Chaetognatha, with relative abundance ranging from 0.02% to 3.7% (**Table 2-30** and **Figure 2-73**).

Table 2-30 Overall Mean and Relative Mean Densities of Zooplankton, July 2016

Taxa	Sampling Stations								Mean Density	
	MW1	MW2	MW3	MW4	MW5	MW6	MW7	MW8	Overall	Relative
Annelida	424	0	1132	141	106	177	0	248	279	1.0
Polychaeta-Nektochaeta larvae	248	0	637	141	35	141	0	141	168	0.6
Polychaeta-trochophore larvae	177	0	495	0	71	35	0	106	111	0.4
Arthropoda	12626	19381	29638	15845	16057	12945	18533	14713	17467	63.2
Calanoida copepodite	1556	2971	2971	1485	1485	1733	2193	813	1901	6.9
Calanoida female	318	1804	2759	2440	1167	1733	1521	1910	1706	6.2
Calanoida male	778	1167	2582	849	1309	1026	990	920	1203	4.4
Copepod nauplius	3926	6508	10186	5411	7215	4103	5942	4527	5977	21.6
crab zoea larva	177	0	71	71	71	106	248	35	97	0.4
Crustacean cypris larva	1273	920	2900	1662	1238	1379	1698	1096	1521	5.5
Cyclopoida copepodite	955	0	2653	920	920	672	2016	1309	1180	4.3
Cyclopoida female	1521	3714	2370	1592	1026	1096	2370	1662	1919	6.9
Cyclopoida male	707	2228	1415	495	1273	318	778	1096	1039	3.8
Harpacticoida	1379	0	1733	920	248	743	707	1344	884	3.2
shrimp larva	35	71	0	0	106	35	71	0	40	0.1
Chaetognatha	0	2087	1521	813	495	813	0	637	796	2.9
Sagitta sp.	0	2087	1521	813	495	813	0	637	796	2.9
Chordata	601	1061	2405	955	1061	920	212	990	1026	3.7
Fritillaridae	212	0	35	106	106	71	212	71	102	0.4
Oikopleuridae	389	1061	2370	849	955	849	0	920	924	3.3
Cnidaria	0	0	0	0	0	0	0	35	4	0.0
Obelia	0	0	0	0	0	0	0	35	4	0.0
Echinodermata	0	0	35	141	177	71	0	35	57	0.2
Bippinaria larva	0	0	0	0	141	0	0	0	18	0.1
Ophiopluteus larva	0	0	35	141	35	71	0	35	40	0.1
Mollusca	707	884	920	531	318	1238	1026	248	734	2.7
Bivalvia larva	212	531	248	460	141	318	813	141	358	1.3
Gastropoda veliger larva	495	354	672	71	177	920	212	106	376	1.4
Protozoa	6472	7746	12520	7498	4881	6366	7922	4739	7268	26.3
Discorbis	920	2688	3466	1415	1556	1096	1627	955	1715	6.2
Nonion	1521	2087	2334	1203	1698	990	2865	1061	1720	6.2
Parafavella	2829	0	4456	3784	212	3218	2264	2016	2348	8.5
Tintinnus tubulosus	1203	2971	2264	1096	1415	1061	1167	707	1485	5.4
Mean Density	20832	31159	48171	25925	23095	22529	27693	21645	27631	100.0
SD	250	250	6502	250	2351	2051	3451	2501		
Number of Taxa	21	15	22	21	24	23	18	23	25	

Note: Mean (no. of cells/m3)
Source: Geosphere 2016

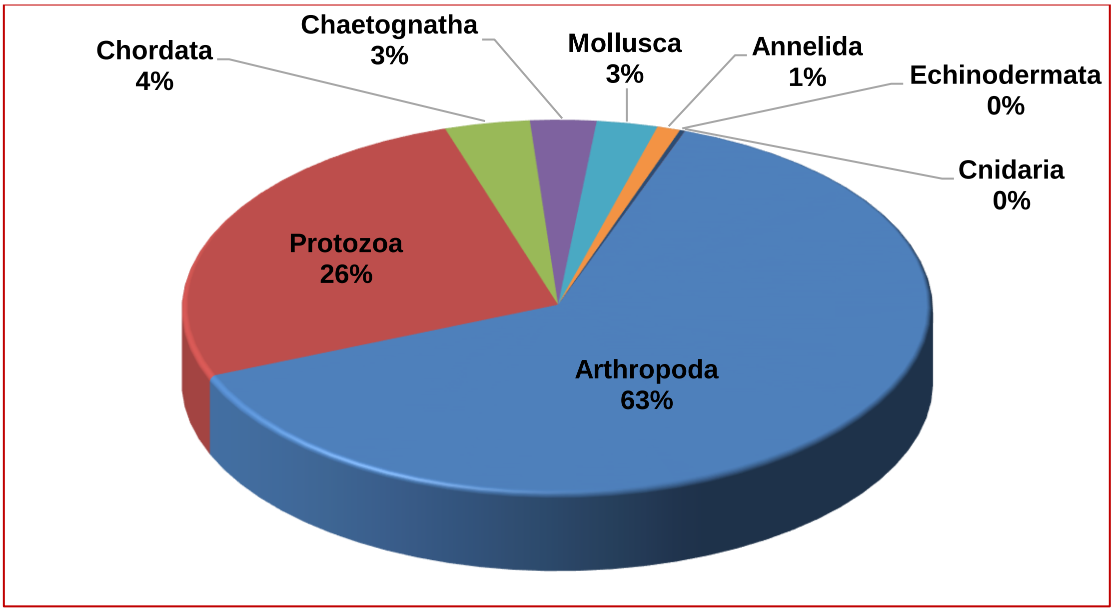


Figure 2-73 Relative Proportions (%) of Zooplankton Phyla

High densities of zooplankton were observed at eight surveyed stations. On the average, zooplankton abundance was highest at MW3 (48,171 inds./m3). MW2 station ranked second in terms of mean zooplankton density (31,159 inds,/m3). Relatively lower densities were recorded at six remaining stations ranging from 20,832 inds./m3 to 25,925 inds/m3 (**Figure 2-74**).

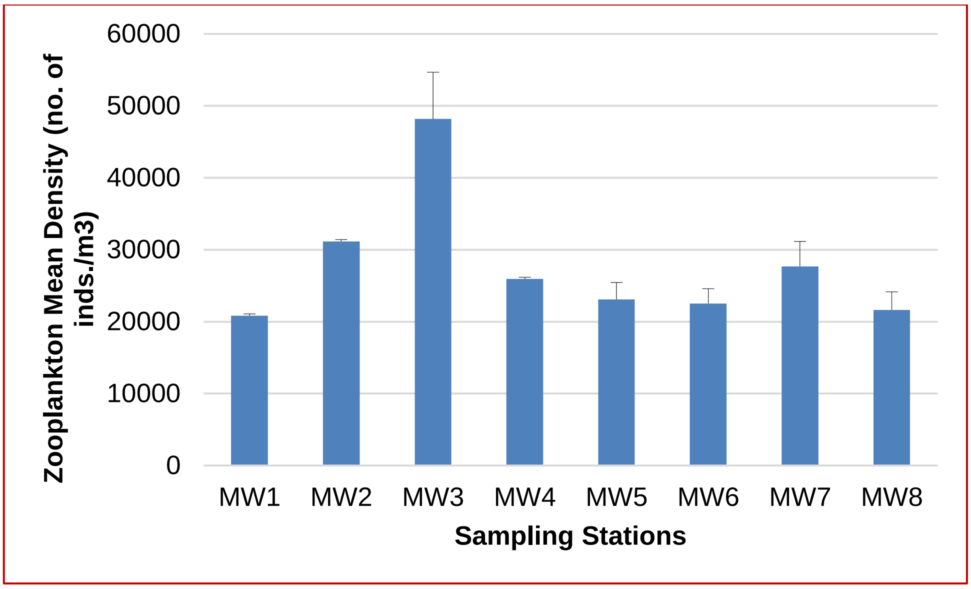


Figure 2-74 Mean Zooplankton Densities

The number of zooplankton taxa ranged from 18-25 taxa. Zooplankton taxa richness were high at six (MW1 and MW3, MW4, MW5, MW6 and MW8) of the eight surveyed stations, with number of taxa ranging from 21-25 taxa. Relatively lower values were recorded at MW2 and MW7, with 15 taxa and 17 taxa, respectively (**Figure 2-75**).

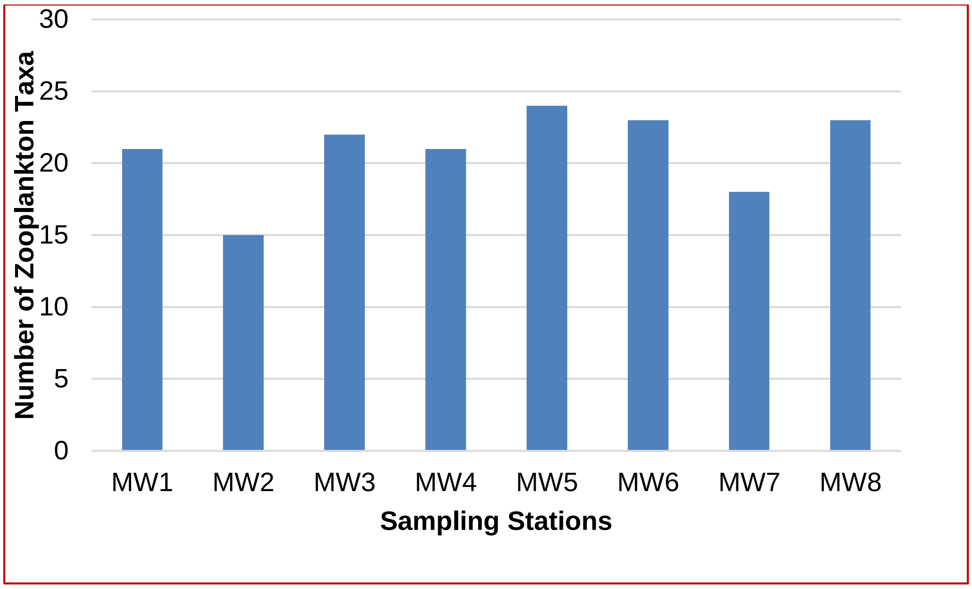


Figure 2-75 Number of Zooplankton Taxa

Copepoda nauplius largely dominated the zooplankton community at eight surveyed stations combined, with an overall mean density of 5,977 inds./m^3. This taxon consistently dominated at all stations, with values ranging from 4,103 inds./m^3 to 10, 186 inds./m^3. Parafavella ranked second in terms of overall relative density comprising 8.5% of the total count. High mean abundances were recorded for this taxon, particularly at six of the eight marine stations (mean densities ranged from 2,016 inds./m^3 to 4,456 inds./m^3). Calanoida copepodite and Cyclopoida female ranked third, with each having an overall relative abundance of 6.9%. Calanoida female as well as two protozoan genera were also recorded at high densities, and each comprised 6.2% of the overall zooplankton count (**Figure 2-76**).

High plankton densities and moderate taxa richness at eight marine stations suggest that sufficient type and number are present for planktivorous fish and invertebrates at the study site. The consistently high overall mean densities of Copepoda nauplii at surveyed stations indicates that the study site is favourable for survival and reproduction of zooplankton.

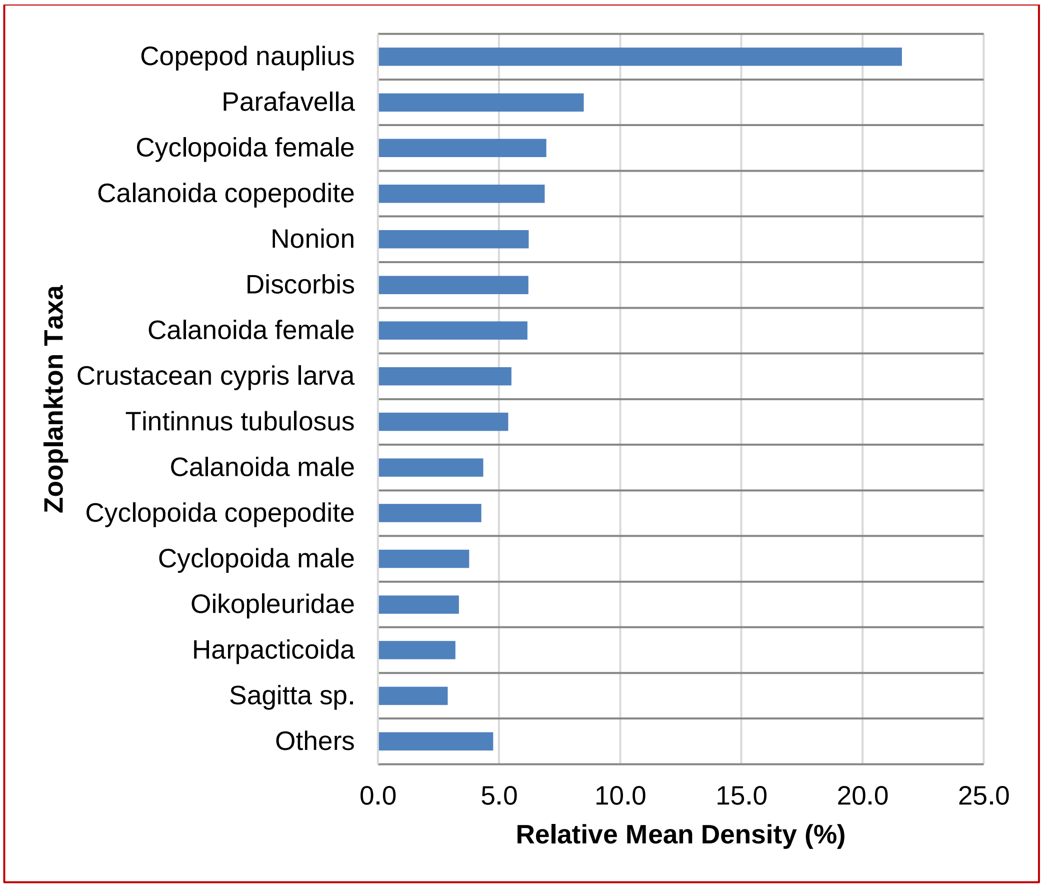


Figure 2-76 Relative Proportions (%) of Zooplankton Taxa

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

Erosion of Sediments and Silt

Sediments and silt are identified as major factors to the degradation of coastal habitats such as coral communities. Potential sources of these sediments come from construction activities on land such as clearing activities and unprotected stock piles of gravel and sand. Loose materials can be eroded to the marine environment and may suffocate feeding apparatus of corals. High deposition of silt also smothers fish eggs laid on the sediment floor and other benthic sessile organisms, diminishes food source by reducing the availability of light for photosynthesis.

Increased in turbidity significantly reduces light penetration and DO content in the water, which is detrimental to primary producers which require light for photosynthesis. The increase in sediment load increases nutrient levels in the water column which may cause localized eutrophication which is adverse to heavy nutrient sensitive planktons and seaweeds. Overall, suspended solid loading in the water column will lead to decline in primary productivity and, thereby, affecting the food pyramid in the aquatic ecosystem.

Nevertheless, it must be mentioned that the habitat disturbance and modification is not permanent. Coral reefs have been shown to be highly resistant. Disturbed reefs are rapidly colonized by both algae and fish. Structures introduced in a reef are likewise rapidly colonized. Therefore, the jetty and the intake and outfall structures may serve as artificial reefs for algae and encrusting fauna.

To avoid and reduce erosion of sediments and silt it is important to plan construction activities. A provision for canals and impoundments around the facility to trap erosion will be helpful to reduce this impact. In addition, covering stock piles with simple covers will reduce erosion during downpours.

Impact of the Jetty/Pier Facility on Coastal Resources

The design of a jetty/pier can potentially affect natural local circulation of water and create scouring of beach on one side and accretion on the other side. Designs that adversely affect local water circulation are those that impede natural flow of water such as walls. Altering the local water circulation will induce stress to the coral community and the ecosystem it supports.

In order to retain the local water circulation and minimize the stress to the coral community, MCPP shall utilize open design for its jetty and pier facilities.

Based on rough measurements on layout maps, the initial jetty structure is estimated to traverse 90 meters of corals along its length. The actual footprint of the jetty structure will be limited to the location of the support pillars. **Figure 2-77** below shows the estimated overlap of corals and jetty structure.

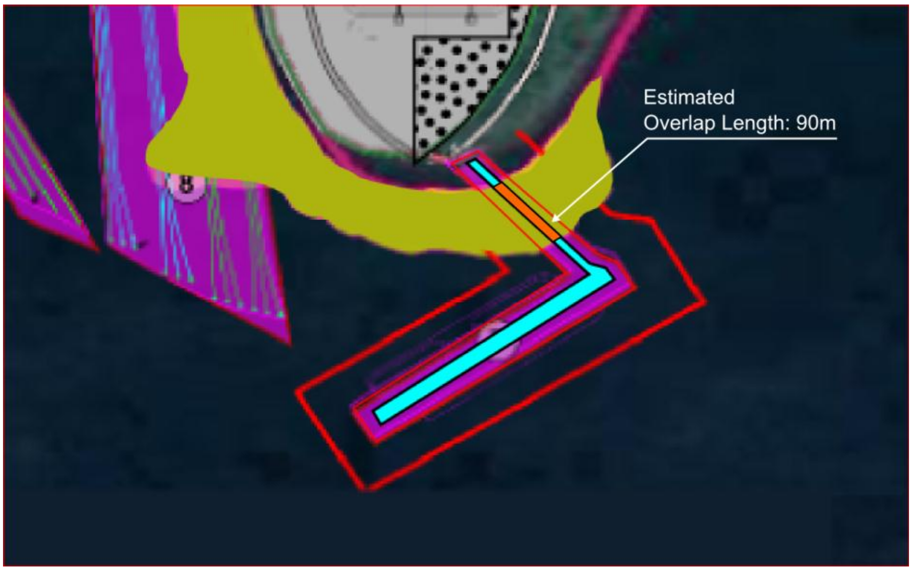


Figure 2-77 Jetty Structure Overlap with Corals

MPGC shall consider relocating the jetty structure to reduce the overlap length as much as possible. MPGC shall enlist the help of local fishermen to provide more information regarding the extent of corals, since the present data is only based on rough estimates.

Over the long term, the pier piles of the jetty can serve as artificial refuge for a wide variety of marine animals in the area and can enhance the diversity of the marine organisms.

Once the jetty structure is completed, the coral community in the area is expected to recover because the area will be off limits to extraction activities. This will provide time for recovery to animals in the coral community near the jetty. The experience in other pier facilities show that diverse marine life exist under the underwater pier piles of jetties of power plants e.g. Quezon Power in Mauban, Quezon, First Gas in Batangas, Bauang Power Plant in Bauang La Union. When this occurs then this will be a positive impact to the Project.

Re-suspension of Sediments and Silt from Construction Activities of Jetty/Pier

During the construction of the jetty/pier facility, the driving of pier piles into the substratum re-suspends sediments and silt which may potentially adversely affect the nearby coral communities. Sediments generated by the trenching and laying of intake and outfall structures can completely smother coral reefs and other benthic communities unless controlled. In addition, the noise created by driving pier piles may have negative impacts on sensitive marine animals such as dolphins and other marine mammals which use sonar to navigate. Fishes and other mobile animals may shun and move away of the area. However, these impacts will be temporary and limited during construction phase only. Associated reef fishes will move back after disturbance because of their high habitat fidelity.

Sediment and silt curtains will be put in place during construction and driving of pier piles to limit sediment and silt resuspension to the intake and outfall construction areas only.

Pollution from Bilge Water and Oil From Transport and Service Ships

Transport and service ships may discharge or leak bilge water and oil during the course of activities. These pollutants may adversely affect various marine flora and fauna.

To prevent this effect, it is highly recommended to include in the contract of transport and service ships a provision to dispose all forms of pollutants properly following internationally accepted conventions. Failure to follow this will result into some form of serious sanctions.

Disturbance of Navigational Lanes of Fishers and Local Transport

The start of construction activities will bring transport and service ships in the area. This may cause disruption to the usual navigation routes of fishers and local transport which can be annoying.

This impact can best be mitigated by meeting fishers and local transport and discuss to find mutually acceptable solutions. This disturbance is temporary in nature.

Anchor Damage

Anchor damage is another source of potential impact for the coral communities in the area. The anchors can break and crush corals.

Mooring buoy will be provided to avoid adverse effects of anchor damage.

Pollution from Cleaning and Maintenance Operations of the Proposed Project (e.g. Chlorine)

A major operational problem for power plants is the establishment of fouling communities (e.g. barnacles) on the opening and inside discharge structure and microbial fouling of condenser tube surfaces. Fouling reduces flow, clogs plumbing, reduces heat transfer efficiency and consumes entrained organisms. Microfouling results from the attachment of bacteria, protozoans and micro algae to material surfaces, whereas macrofouling communities are generally composed of epiphytic algae, anemones, annelids, ascidians, ecoprocts, mollusks and sponges.

Chlorine will be used in de-fouling the plant structures. Studies have shown that chlorine concentration exceeding two (2) ppm are lethal to marine organisms.

MPGC will only do anti-biofouling activities intermittently at acceptable standard chlorine levels. Well-trained and competent personnel safely shall undertake the maintenance of the facility. At the same time, safety shall be foremost in the protocol and dumping of pollutants to the environment without proper treatment shall be strictly prohibited.

Pollution from Coal Dust during Unloading

Unloading of coal can spill coal dust to the marine environment. This is typical to coal power plant in the country where the immediate bottom substratum surrounding the pier is settled with dust carbon brought about by spillage during coal unloading over time.

This can be prevented by considering the design (e.g. using screw type). Alternatively, placing cover on the bucket as well as the conveyor system will greatly minimize the spillage.

Thermal Pollution from Cooling Discharge Water

The design of cooling systems of power plants is usually in conformity to the standards set by regulating agencies. Thermal discharges are known to bring about changes in benthic communities. Without proper mitigation corals and seaweed located within a few meters of the discharge pipe may be adversely affected if temperature of discharge water exceeds the standards. Although, increase in temperature could hasten the growth and reproduction of macro algae and phytoplankton, the unwanted bloom of these organisms may deplete DO supply in the water column during night. Low DO level in the water would have serious impacts on sessile aquatic life because DO is critical for the respiration of all organisms. With thermal discharges, seaweed communities would shift towards the bluegreen algae structure, to the detriment of the grazers (herbivore fish) which require other more preferred leafy forms. The 3°C rise is the maximum tolerable change in ambient temperature level for most species. In corals, thermal effluents have known to cause expulsion of zooxanthellae pigments resulting to a phenomenon called 'coral bleaching' or coral whitening. In addition, corals have also been shown to reduce its growth under such bleaching conditions. Larger seaweeds are also known to be easily bleached and killed by increased temperature.

Some studies reveal that the increase in algae and fouling species due to increased temperature may increase the biomass of fishes (Neudecker 1987). For adult fishes, they are seldom directly affected by thermal effluents, because they can avoid them. In sum, the heated water discharged can radically alter existing aquatic life and favor organisms that are suited to higher temperature.

The impact will affect primarily the coral community in its vicinity only. The change in temperature within the outfall area is less than 1 degree during low tide and it reverts to much cooler temperatures during high tide. This will not be enough to cause mass bleaching in the area. However, monitoring of temperature during plant operation is highly recommended.

The modeling of the thermal plume showed that even during the worst scenario the temperature of seawater immediately after the discharge point will not exceed standards and will stay below the allowable 3^{o}C rise from ambient temperature. Moreover, MPGC shall install thermistors to monitor the seawater temperature on a monthly basis.

The current design of the thermal plume will be such that the temperature rise at the edge of the mixing zone will not be greater than 3°C in conformance with the DENR requirements. To maintain this condition, a monitoring system must be in place and external monitoring teams shall include increase in temperature in their regular monitoring activities.

Impingement on Marine Life by the Seawater Intake for Cooling Process of the Power Plant

There is concern about the possibility of fishes being sucked into the seawater intake for cooling process of the proposed Project. Fishes are likely able to swim away from perceived threats such as this. The sedentary species such as corals, invertebrates (snails, clams, etc.) and plankton will be susceptible to this threat. However, the size of the opening of the water intake is too small compared to the entire habitat of corals, invertebrates and the plankton. The amount of water intake to cool the facility will make very little impact on the population of corals, invertebrates and planktons.

Planktons in particular, are very abundant in oceans, as shown in the baseline monitoring results at sampling stations near the plant. They are also characterized by fast growth, fast reproduction and short life span. These factors mean that the effect of seawater intake on plankton density will likely be insignificant.

Studies have shown that fouling organisms attach and survive on the external and internal surfaces of pipes of the cooling systems of power plants.

2.2.5.6 Threat to Abundance, Frequency and Distribution

Considering the activities of the proposed Project, the threat will be limited and temporary during the construction phase.

Potential Project Impacts on Fish Communities and Proposed Mitigating Measures

The potential impacts of the project on the reef fish communities may be considered secondary responses to impacts that the coral reefs might suffer. Changes in the condition of the reef sites (i.e. improvements or declines in coral cover and/or algal cover) may result in concomitant changes in their associated fish communities. In general, the deterioration of water quality, and negative changes in the reef structure such as a decrease in coral cover, an increase algal dominance, and reductions in physical complexity, can trigger changes in the fish communities (Crosby and Reese, 1996; Freidlander and Parrish, 1998; Friedlander et al., 2003; Pratchett et al., 2008; Wilson et al., 2008; Arnold et al., 2010; Graham and Nash, 2013; Mumby et al., 2013).

Sources of the potential impacts of the project to the fish communities are shared with those identified for coral reefs. Sedimentation as driven by earth moving activities, spillage of coal materials, and the contamination of the coastal area with solid and liquid waste, can all affect the integrity of the coral community that can subsequently impact fish assemblages. The mitigating measures identified to assuage the impacts of these stressors on the coral communities are likewise applicable for fish communities.

The construction of an offshore berthing platform that utilizes vertical pylons can have positive impacts on the fish communities. While this may have immediate negative impacts on the reef (i.e. sediment re-suspension, noise pollution, etc.), this may be considered temporary. In the long term, such a structure may serve as habitat for fish, lending higher vertical complexity and microhabitat availability as the pylons are colonized by sessile benthic fauna. This artificial habitat can potentially invite both cryptic and highly mobile fish species. Such is the case in other locations in the country (i.e. Batangas City; Mauban, Quezon).

Another measure that may help off-set any potential negative impacts the proposed project may have on the fish communities in the area is the establishment of a marine sanctuary in the locale. The benefits of marine sanctuary to both benthic and fish communities, as well as to the local human communities, have been well-documented (Bohnsack, 1994; Cote et al., 2001; Abesamis and Russ, 2007; Evans et al., 2007; Samaniego, 2015). It is recommended that the proponents give due consideration in initiating and sustaining the establishment of a marine sanctuary at the study site. This will not only help protect the coral and fish assemblages and ease the impacts of the project, but will also highlight the proponent's social consciousness and commitment to environmental protection.

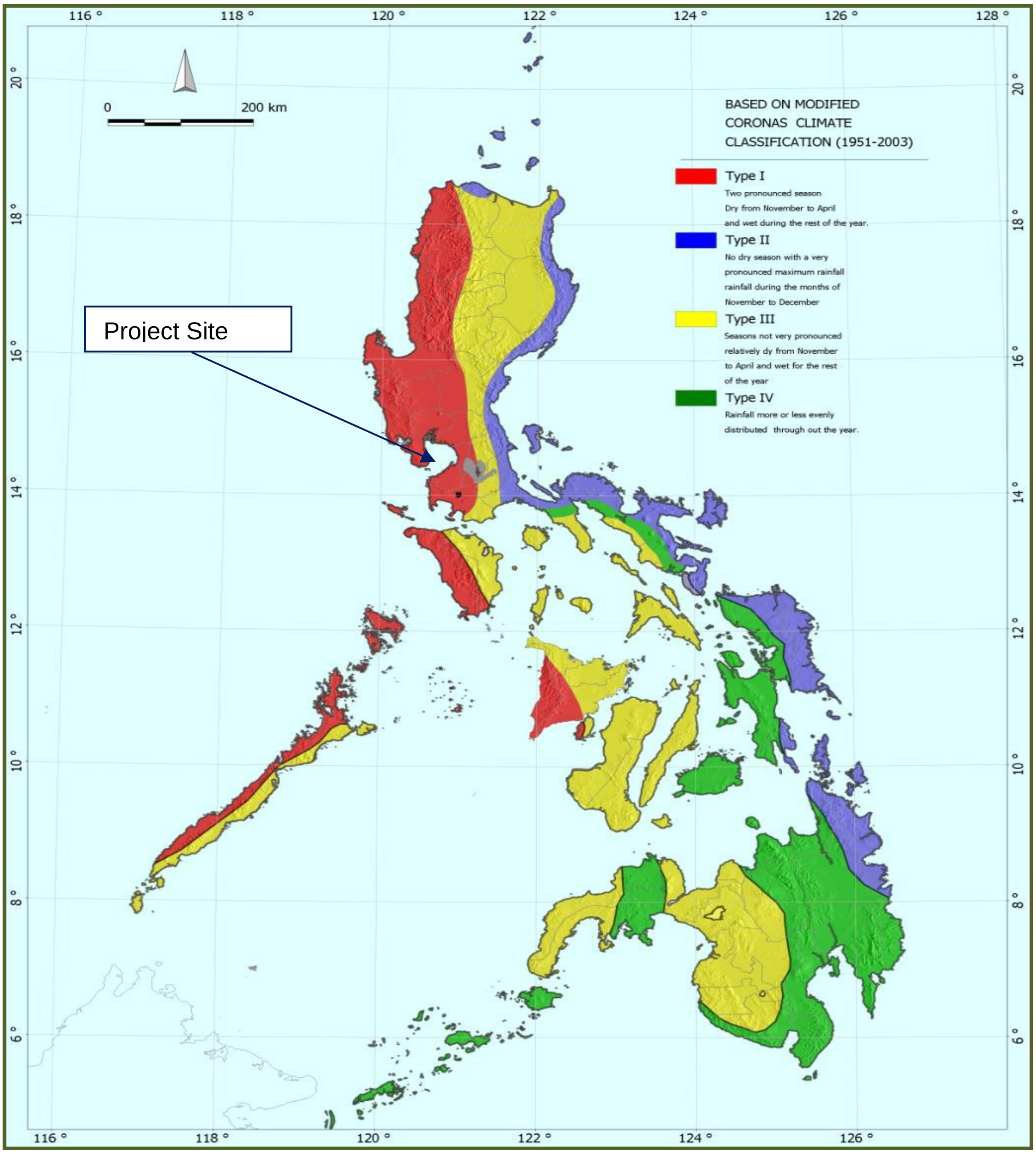
MPGC shall support the establishment of marine sanctuary by MEZ in cooperation with the LGU and concerned government agencies. The sanctuary shall be built near the power plant where it can be closely monitored from fishing and illegal activities. This will not only protect the rich diversity of the area but will also serve to secure plant facilities from accidental damage from fishing. Declaring this as a reserve will prevent multiple use conflicts.

2.3 AIR

2.3.1 Climatology and Meteorology

2.3.1.1 Climate Type

The climate at the proposed MCPP Project site falls under the Type 1 category based on the Modified Coronas Climate Classification of Philippine Climate (**Figure 2-78**). Type I climate is characterized by two (2) pronounced seasons, dry from November to April and wet from May to October with maximum period from June to September. Areas under this type of climate are generally exposed to the southwest monsoon during rainy season and get a fair share of rainfall as brought about by the tropical cyclones occurring during the maximum rainy period.



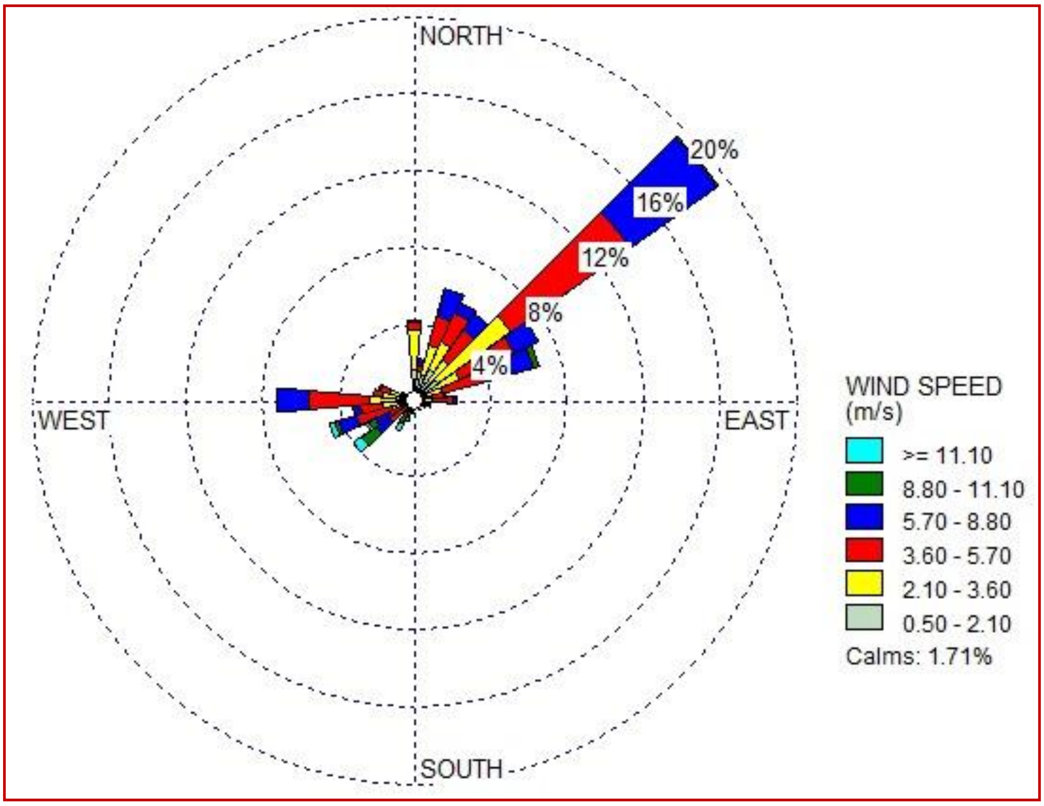
Source: PAGASA

Figure 2-78. The Philippine Climate Map

2.3.1.2 Wind Regime

The Sangley Point Synoptic Station is the nearest meteorological station of Philippine Atmospheric Geophysical and Astronomical Services Administration (PAGASA) to the proposed MCPP Project site. It is about 42 kilometers east from the Project site.

The windrose plot from the station, as shown **Figure 2-79**, shows that winds prevailing from northeast comprises of about 19.5% followed by east-northeast comprises of about 6%, a significant event produces north-northeast and westerly comprises of about 12% over the site. Of all hourly wind direction with an average wind speed of 2.10 meter per seconds, few winds exceed 11 meter per seconds and winds less than 0.5 meter per seconds occur from all directions. Calm conditions were observed 1.71% of the time. Strongest winds come from southwest and south-southwest occupying 1.7 % of the time.

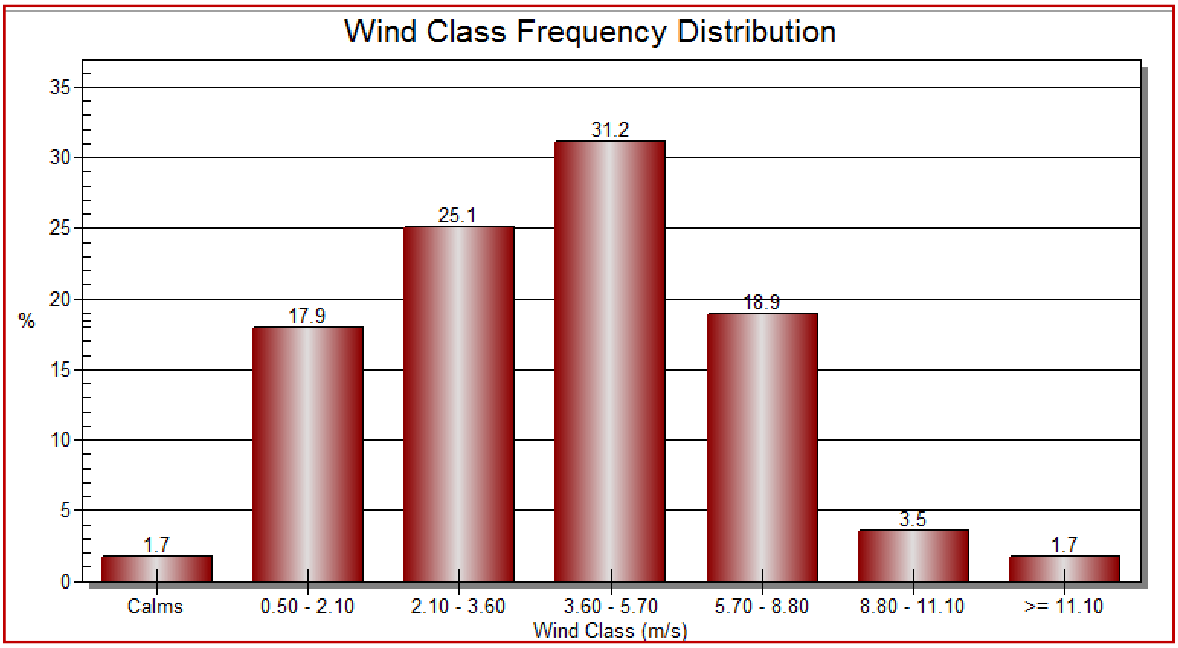


Source: *Plotted by WRPLOT View Version 7.0.0 Lakes Environmental*

Figure 2-79. Windrose Diagram for Bataan from Sangley Point Synoptic Station

The tropical condition can be attributed to the location of the project which is between 14 to 15 degrees north of equator. The monsoonal condition, on the other hand, refers to two seasonal wind regimes, the northeasterly winds and the southwesterly winds. From November to May the wind blows on a northeasterly direction with an average wind velocity of 3.08 meters per seconds. From June to October the southwesterly winds prevail with an average wind velocity of 1.96 meters per seconds.

Majority of wind speed in Bataan occupying 31.2 % of the total wind is 3.6 to 5.7 mps, as shown in **Figure 2-80**.



Source: WRPLOT View Version 7.0.0

Figure 2-80. Wind Class Frequency Distributions from Sangley Point Synoptic Station

2.3.1.3 Rainfall

Rainfall ranges from 9.4 mm to 457.2 mm, with an annual total of 2,078.4 mm. Least number of rainy days per month occurs in February to April; while the highest number or rainy days per month occurs in July and August.

Table 2-31. Rainfall Data

Month	Rainfall	
	Amount (mm)	No. of RD
January	16.9	4
February	11.1	2
March	9.4	2
April	18.5	2
May	139.1	10
June	264.5	15
July	422.4	20
August	457.2	21
September	341.8	19
October	224.3	15
November	110.5	11
December	62.7	7
Annual	2,078.4	127

Note: RD – Rainy Days
Source: PAGASA Sangley Point Synoptic Station

2.3.1.4 Relative Humidity

The mean annual relative humidity recorded at the PAGASA Sangley Point Synoptic Station is 78% with seasonal variation (i.e. mean monthly relative humidity range of 71% to 83% based from 1981-2010 meteorological data). The months of July to November are the most humid months of the year. Factors affecting humidity are changes in temperature and atmospheric circulation. The air is said to be saturated when it contains the maximum amount of water vapor possible at a given temperature. When the temperature of the air falls below the dew point, some of the water vapor contained in the air condenses, clouds form, and precipitation can result in the form of rain.

2.3.1.5 Temperature

The annual mean average temperature is 28.4°C with January being the coldest month having an average temperature of 26.6°C while the month of April and May are the warmest with an average temperature of 30.1°C.

The highest and lowest temperatures occur in the months of April to May and December to February, respectively. The mean maximum and minimum temperatures range from 29.3–30.1°C and 23.3–23.6°C, respectively.

The Climatological Normals recorded at Sangley Point Synoptic Station are presented in **Table 2-32.**

Table 2-32. Climatological Normals Recorded at Sangley Point Synoptic Station (1981-2010)

Month	Temperature (°C)						RH (%)	No. of Days with	
	Max	Min	Mean	Dry Bulb	Wet Bulb	Dew Point		Thunder	Lightning
January	30	23.3	26.6	26.8	23.9	22.8	79	0	0
February	30.8	23.6	27.2	27.4	24.1	22.9	76	0	0
March	32.7	24.6	28.6	28.7	25	23.7	74	1	1
April	34.4	25.9	30.1	30.3	26	24.6	71	2	5
May	34.1	26.1	30.1	30.3	26.5	25.3	74	11	16
June	32.8	25.8	29.3	29.5	26.4	25.4	78	14	18
July	31.7	25.3	28.5	28.6	26	25.1	81	16	17
August	31.3	25.2	28.3	28.2	25.8	25	83	13	14
September	31.4	25.2	28.3	28.4	25.9	25.1	82	15	16
October	31.4	25.3	28.4	28.4	25.8	24.9	81	9	14
November	31.1	25	28.1	28.1	25.3	24.3	80	4	5
December	30	23.9	27	27.1	24.3	23.3	79	1	1
Annual	31.8	24.9	28.4	28.5	25.4	24.4	78	86	107

Source: PAGASA Sangley Point Synoptic Station

Climatological extreme values from the 42-year monthly and annual summaries of temperature, rainfall, and wind speed are presented in **Table 2-33**. The recorded annual extreme high and low temperatures are 38.5°C and 18°C, respectively. The amount of extreme greatest rainfall is 475.4mm while the annual average extreme highest wind is 54m/s.

Table 2-33. Climatological Extremes Recorded at Sangley Point Synoptic Station (1981-2010)

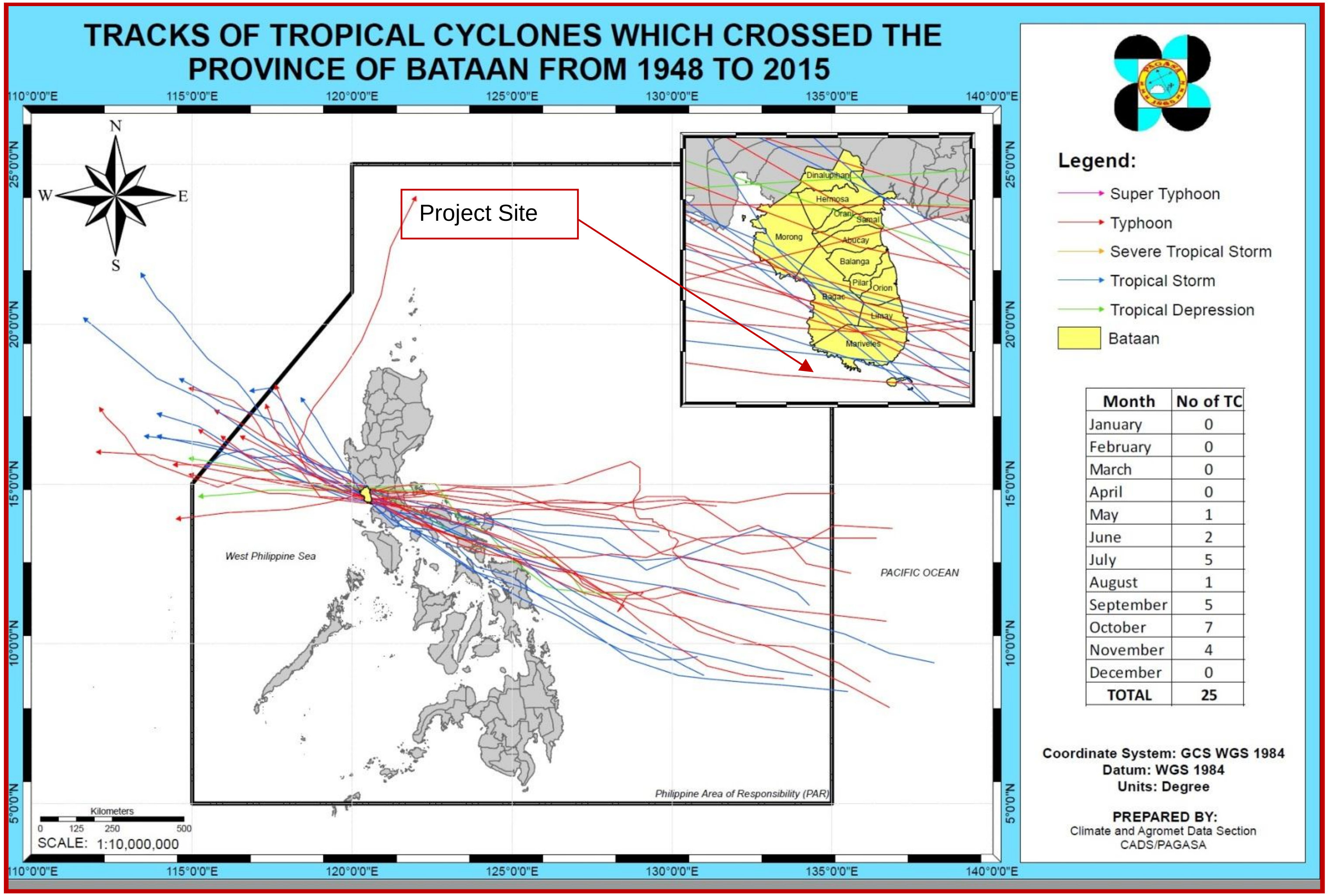
Month	Temperature, (°C)				Greatest Daily RF, (mm)		Strongest Wind, (m/s)		
	Date	High	Date	Low	Date	Amount	Date	Speed	Direction
Jan	01-25-1999	34.8	01-03-1982	19.0	01-12-1977	94.0	01-19-2010	17	ESE
Feb	02-28-1998	35.2	02-01-1982	18.0	02-27-2012	36.5	02-27-1992	15	ESE
Mar	03-29-1981	36.6	03-25-1980	19.1	03-22-2013	52.4	03-23-1998	24	ESE
Apr	04-07-1983	37.8	04-03-2007	21.5	04-24-1975	53.9	04-05-1996	16	ESE
May	05-16-1987	38.5	05-15-1980	22.0	05-26-1997	237.1	05-22-1976	27	SW
Jun	06-04-1987	38.4	06-16-1981	22.0	06-27-1985	172.4	06-08-2011	25	SE
Jul	07-25-2007	36.3	07-15-1982	21.2	07-20-2002	231.4	07-13-2010	54	E
Aug	08-16-2009	36.5	08-02-1994	22.0	08-19-2013	475.4	08-18-1990	30	W
Sep	09-02-1996	35.6	09-16-1979	21.0	09-22-2013	275.4	09-28-2006	44	NNW
Oct	10-08-1996	35.8	10-24-1988	21.0	10-05-1986	260.7	10-21-1994	45	NW
Nov	11-08-1978	36.4	11-26-1982	21.5	11-02-2000	171.2	11-03-1995	49	NW
Dec	12-06-1998	34.0	12-24-1985	20.0	12-10-2006	131.2	12-05-1993	22	NNW
Annual	05-16-1987	38.5	02-01-1982	18.0	08-19-2013	475.4	07-13-2010	54	E
Period of Record	1974-2015				1974-2015		1974-2015		

Source: PAGASA Sangley Point Synoptic Station

2.3.1.6 Cyclone Frequency

The most number of cyclones occur during the months of June to December. These tropical cyclones are associated with the occurrence of low pressure areas (LPA) normally originating from the North Western Pacific Ocean of the Philippine Area of Responsibility (PAR) and generally moving northwestward. PAGASA categorized these cyclones as tropical depressions (TD), with wind speeds up to 62 km/h; tropical storm (TS) with wind speeds of range 62-88 km/h; severe tropical storm (STS) with wind speeds of range 89-117 km/h, typhoon (TY) with wind speeds of range 118-220 km/h and super typhoon (STY), with maximum sustained winds of more than 220 km/h.

From 1948-2015 (period of 67 years) PAGASA determined an annual average of 20 tropical cyclones in the PAR with nine of these passing through the Philippine landmasses. Overall, PAGASA had tracked 25 tropical cyclones that crossed in the province of Bataan, which is shown in Figure 2-60. Figure 2-61 shows that the project site is under medium typhoon risk.



Month	No of TC
January	0
February	0
March	0
April	0
May	1
June	2
July	5
August	1
September	5
October	7
November	4
December	0
TOTAL	**25**

Source: PAGASA

Figure 2-81. Tracks of Tropical Cyclones which Crossed the Province of Bataan, 1948-2015

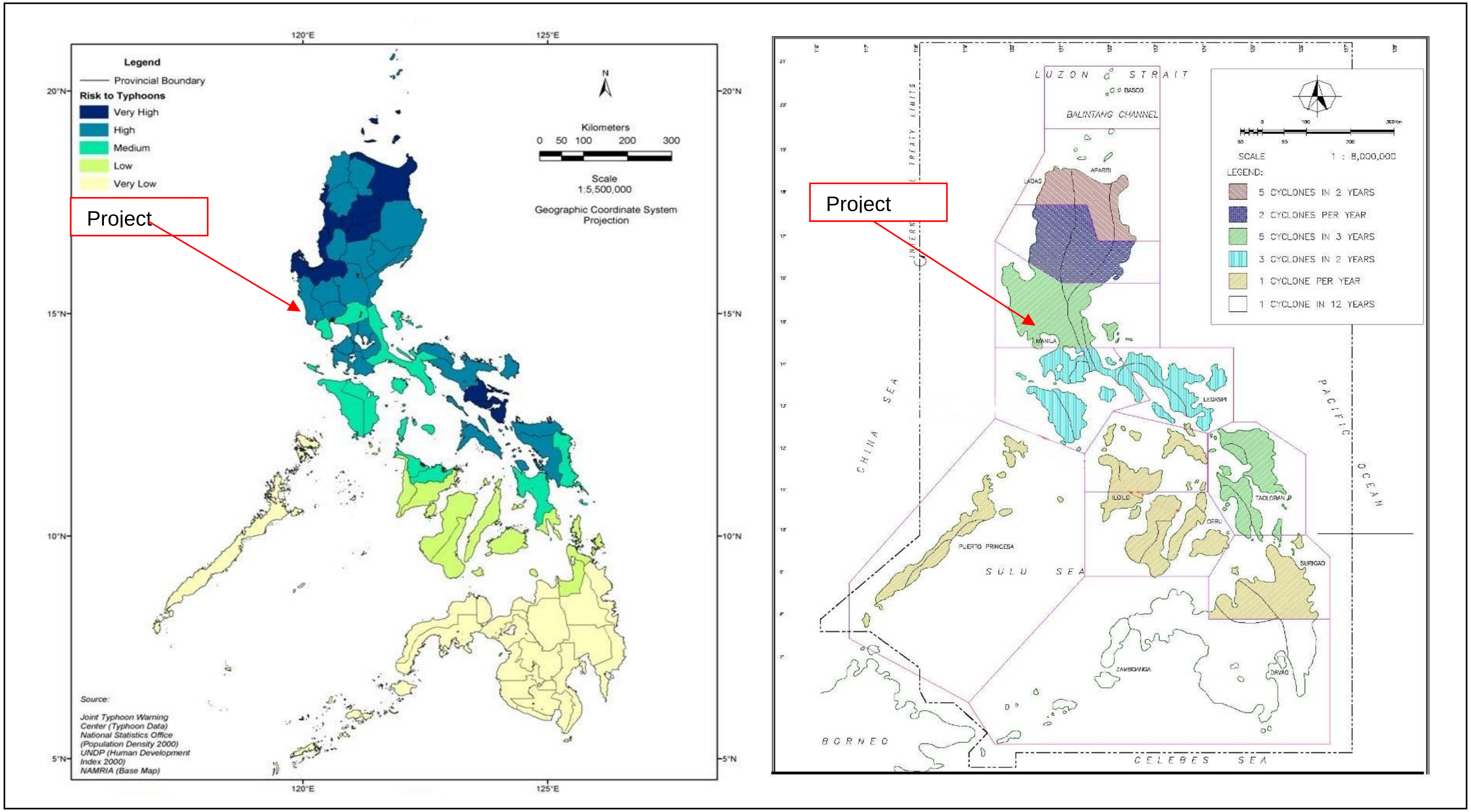


Figure 2-82. Philippine Typhoon Map

2.3.1.7 Change in the Local Micro-Climate

Temperature Change

The historic average annual ambient air temperature of Bataan is 28.4°C. The data indicate that there is little monthly or seasonal variation in the average temperatures. On a daily time-step, temperatures can vary by 5°C to 8°C on the average during a day, peaking above 30s and dropping to the low 20s overnight.

The climate change scenario for the Philippines as published by PAGASA in February 2011 indicates that the province of Bataan will experience an increase in temperature (Table 2-34).

Table 2-34. Seasonal Temperature Increase (in ºC) in 2020 and 2050 under Medium Range Emission Scenario

Observed Baseline (1971-2000)				Change in 2020 (2006-2035)				Change in 2050 (2036-2065)			
DJF	MAM	JJA	SON	DJF	MAM	JJA	SON	DJF	MAM	JJA	SON
26.4	28.7	27.6	27.3	1.0	1.1	0.8	1.0	2.0	2.1	1.7	1.9

Source: Climate Change in the Philippines, 2011 PAGASA

It is projected that the average monthly temperature over the period of 2006–2035 will increase by 0.8°C to 1.1°C while temperatures for the period of 2036-2065 will increase by 1.7°C to 2.1°C. The annual average temperature covering the period of 2006-2035 will rise to 31.2°C while 2036-2065 will rise to 32.2°C. **Table 2-35** and **Figure 2-83** present the projected monthly average temperature with climate change (Tave CC) and without climate change (Tave base).

Table 2-35. Projected Average Temperature

Month	Baseline (1971-2000)	2020 Projection (2006-2035)	2050 Projection (2036-2065)
DJF	26.4	27.4	28.4
MAM	28.7	29.8	30.8
JJA	27.6	28.4	29.3
SON	27.3	28.3	29.2

Source: PAGASA Sangley Point Synoptic Station, 1971-2000
Note: Calculated based on the PAGASA Climate Change in the Philippines, 2011

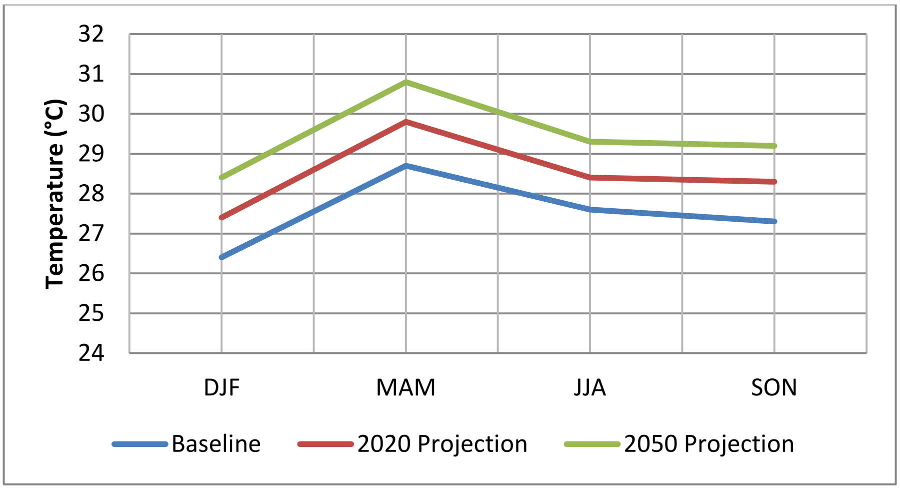


Figure 2-83. Change in Monthly Average Temperature for the Period of 2006-2065

For plant operations, the variability in daily temperatures together with the longer-term monthly average defines the design air temperature. The selection of the design temperature for the power plant reflects an optimization of plant productivity, operational and capital costs based on historical conditions. A higher design temperature would require greater capital costs as components would need to be redesigned, while a lower design temperature would adversely affect plant production.

The typical effect of temperature increases in the power plant operation is the decrease of power output leading to energy inefficiency. This is because an increase in air temperature reduces air density and the mass flow of air intake to the compressor, and creates a similar reduction in heat transfer efficiency of the air cooling system.

These losses result in reduced gas turbine power output and a reduction in the pressure ratio within the turbine, with a subsequent reduction in energy efficiency. To compensate for this, power plants can restore the mass flow by increasing the flow rate through the compressors. However, this increases power consumption of the compressor. Variation in other climate factors (pressure, humidity) can also affect performance but to a smaller degree and have not been identified as direct threats.

Rainfall Change

The historic average annual rainfall of Bataan is 2,078.4mm. Based from the climate change scenario for the Philippines as published by PAGASA in February 2011, the province of Bataan will have an increased and decreased rainfall in 2020 and 2050. It is projected that the average monthly rainfall over the period of 2006–2035 will increase by 2.78% to 9.4% and will decrease by 0.4% to 5.2%; while the rainfall for the period of 2036-2065 will increase by 1.5% to 29.1°C and will decrease by 8.1% to 8.2% (Table 2-36).

Table 2-36. Seasonal Rainfall Change (in %) in 2020 and 2050 under Medium Range Emission Scenario

Observed Baseline (1971-2000)				Change in 2020 (2006-2035)				Change in 2050 (2036-2065)			
DJF	MAM	JJA	SON	DJF	MAM	JJA	SON	DJF	MAM	JJA	SON
71.7	368.7	1326.2	872.6	2.7	-5.2	9.4	-0.4	-8.2	-8.1	29.1	1.5

Source: Climate Change in the Philippines, 2011 PAGASA

The annual average rainfall covering the period of 2006-2035 will rise to 500.2mm in August and will decrease to 8.9mm in March; while the rainfall for the period of 2036-2065 will rise to 590.2mm in August and will decrease to 8.6mm in March. Table 2-54 and Figure 2-63 present the projected the monthly average rainfall with climate change scenario for 2006-2035; and the monthly average rainfall with climate change scenario for 2036-2065.

Table 2-37. Projected Monthly Average Rainfall

Month	Baseline (1971-2000)	2020 Projection (2006-2035)	2050 Projection (2036-2065)
DJF	71.7	73.6	65.8
MAM	368.7	349.5	338.8
JJA	1326.2	1450.9	1712.1
SON	872.6	869.1	885.7

Source: PAGASA Sangley Point Synoptic Station, 1971-2000
Note: Calculated based on the PAGASA Climate Change in the Philippines, 2011

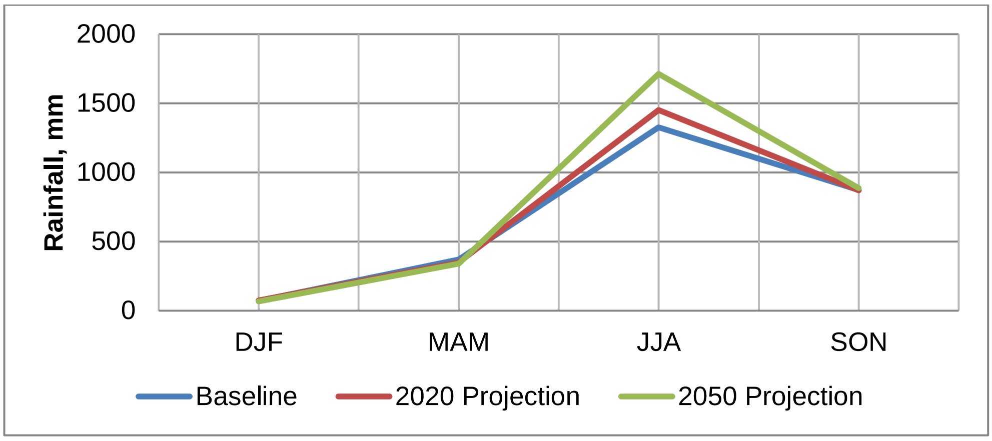


Figure 2-84. Computed Average Rainfall With and Without Climate Change Scenarios

Frequency of Extreme Events

Based from the climate change scenario for the Philippines as published by PAGASA in February 2011, the province of Bataan will have 1,855 days with maximum temperature of >35°C during the 2006-2035 period and 3,108 days during the 2036-2050 period; 5,701 dry days during the 2006-2035 period and 5,754 dry days during the 2036-2050 period; and 12 days with rainfall >200mm during the 2006-2035 period and 12 days during the 2036-2050 period, as presented in **Table 2-38**.

Table 2-38. Frequency of Extreme Events in 2020 and 2050 under Medium Range Emission Scenario

No. of Days w/ Tmax >35ºC			No. of Dry Days			No. of Days w/ Rainfall >200mm		
OBS (1971-2000)	2020	2050	OBS	2020	2050	OBS	2020	2050
355	1855	3108	889	5701	5754	8	12	12

Note: Based from the Frequency of Extreme Events in 2020 and 2050 under Medium Range Emission Scenario in Pampanga, a nearby province of Bataan
Source: Climate Change in the Philippines, 2011 PAGASA

2.3.1.8 Contribution in Terms of Greenhouse Gas Emissions (or GHG Mitigation Potential)

The Greenhouse Gas (GHG) emissions of the proposed MCPP Project include carbon dioxide, methane and nitrous oxides. Calculation of these GHG gases employs the Tier 1 Approach of the Intergovernmental Panel on Climate Change (IPCC) 2006 Guidelines using the following equations:

Equation 1:

CO2 emissions = FC x NCV x CEF x FC x K

Where:

FC	=	Fuel Consumption, MT
NCV	=	Net Calorific Value, Tj/MT
CEF	=	Carbon Emission Factor, MT C/Tj
FC	=	Fraction Carbon Oxidized
K	=	Molecular Weight Ratio of CO2 to C, (44/12)
A	=	Fuel Type

Equation 2:

CH4 emissions = (FC x NCV x EF x 1/1000 x 21)A

Where:

FC	=	Fuel consumption, MT
NCV	=	Net calorific value, Tj/MT
EF	=	Emission factor, kg/Tj
21	=	GWP of methane
1/1000	=	Conversion factor
A	=	Fuel type

Equation 3:

N2O emissions = (FC x NCV x EF x 1/1000 x 310)A

Where:

FC	=	Fuel consumption, MT
NCV	=	Net calorific value, Tj/MT
EF	=	Emission factor, kg/Tj
310	=	GWP of methane
1/1000	=	Conversion factor
A	=	Fuel type

Table 2-39 shows the summary of the GHG emissions from the proposed Project. Assuming that the power plant will operate at full maximum output capacity of 90% availability at load factor of 88% for a net capacity of 80% per annum for a period of 7,446hr/yr, the default CO2 emission factor of sub-bituminous coal from Table 2.2 of the IPCC 2006 Guidelines are 96,100kg of CO2/TJ; 1 kg of CH4/TJ for methane; and 1.5 kg of N2O/TJ for nitrous oxides.

Table 2-39. Summary of GHG Emissions of the Proposed Project

Emission Sources	Coal Consumption (MT/year)	Coal Heating Value (kcal/kg)	CO_2 Emission (MT/year)	CH_4 Emission (MT/year)	N_2O Emission (MT/year)
Proposed Boilers 1 to 8	5,724,480	4,008	9,225,264	96	144

The total estimated CO_2 emission from the operation of 8 boilers of MPGC based on IPCC 2006 is 9,225,264 MT/yr.

Table 2-40. INC/SNC Data

Year	Gg CO2/yr	GHG %

Year	Gg CO2/yr	GHG %
Global Levels		
2000	6,118,000	0.15
2010	7,936,000	0.12
2020	9,042,000	0.10
Energy Sector		
SNC		
2000	69,667	13.2
2020	100,402	9.19
INC		
2008 (Projected)	122,344	7.54

Note: a – Sectoral Trend in Global Energy Use and Greenhouse Gas Emissions, Climate Protection Division, Office of Air and Radiation, US EPA, 2006
INC – Initial National Communication on Climate Change
SNC – Second National Communication on Climate Change

The MPGC will utilize CFB Technology on which coal is pulverized between 30 to 40 µm as median diameter wherein it provides high combustion efficiency and less excess air. The energy efficiency of the technology results in optimum coal requirements per energy produced that gives relatively small amount of CO2 generation.

Other Scope 1 sources are the tailpipe emissions from the plants-controlled service vehicles. The emission factors for diesel were taken from US EPA Emission Factor for Greenhouse Gas (modified November 19, 2015) for diesel-powered Service Utility Vehicles (SUVs), Van, Pick-up and haul trucks. The activity data, emission factor as well as the results of the computation are tabulated in **Table 2-41**. The total CO2 emissions for vehicular emissions are estimated at 19,359 MT CO2/yr.

Table 2-41. Calculated CO2 Emissions for Scope 1 Sources

Emission Sources	No. of Units	Fuel Type	Fuel Consumption (L/km)	Assumed distance travelled (km/yr)	Fuel Consumption (L/yr)	Emission Factor (kg/L)	Calculated CO2 Emission (MT/yr)
30-tonner Truck	7	Diesel	10	15,000	1,050,000	2.7	2,835
Pick-up	7	Diesel	12	30,000	2,520,000	2.7	6,804
Service Van	10	Diesel	12	30,000	3,600,000	2.7	9,720
Total CO2 Emission							**19,359**

Scope 2 activities include the 5 MW ~ 20 MW from NGCP during construction through the local distribution utility, Peninsula Electric Cooperative, Inc. (PENELCO), and about 8MW for each of the 150 MW power block during commissioning, which will be sourced from other power plants of SMC Global Power business units or the through the Electricity Market.

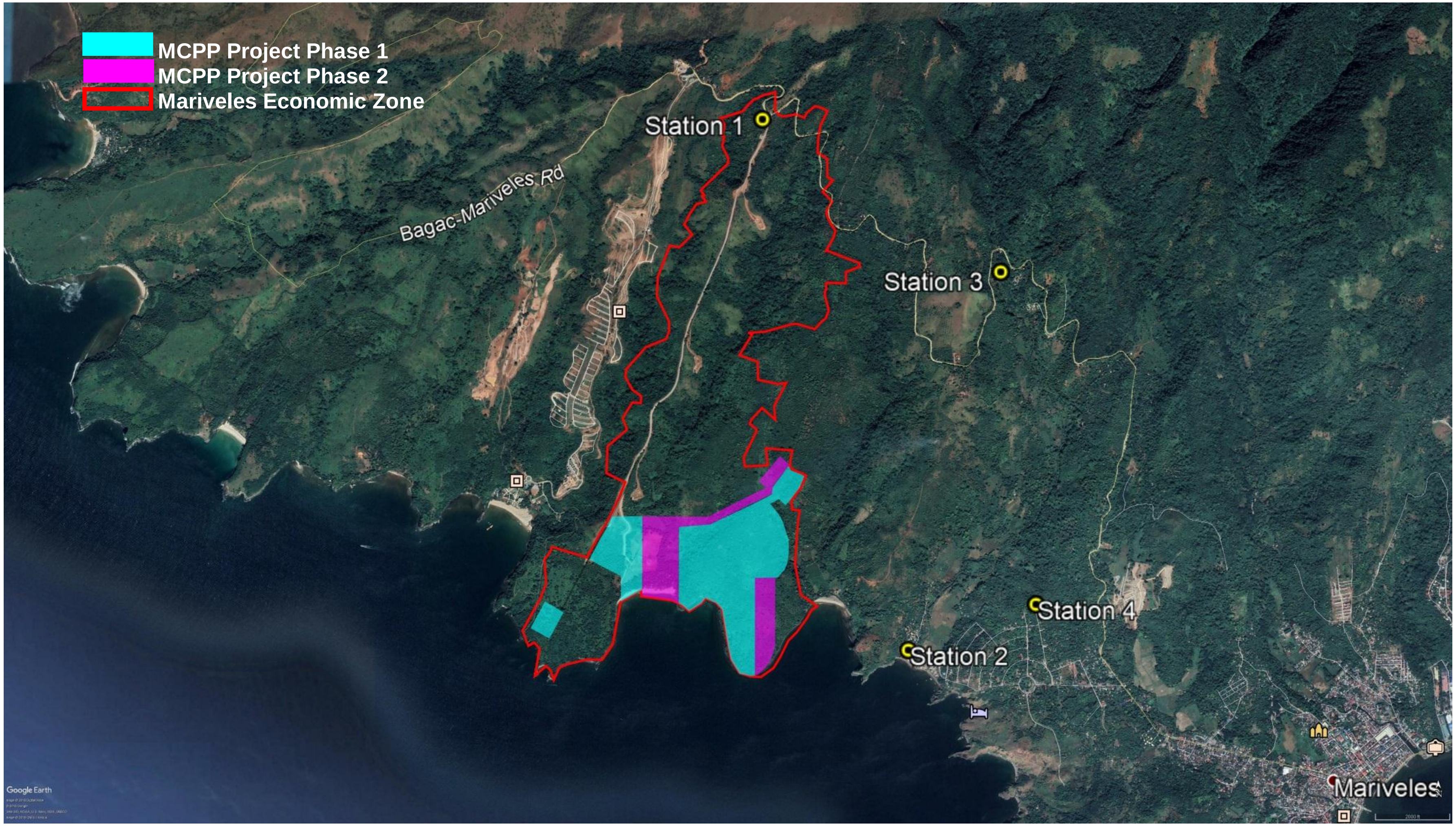
Moreover, MPGC will establish a “green buffer zone” which will allot an area of approximately 24 ha including open spaces located within the MCPP Project Area to mitigate some of the potential effect of emissions of the proposed Project.

2.3.2 Air Quality and Noise Level

The ambient air quality and noise level monitoring were conducted at four (4) sampling stations established within the project site and its vicinity on August 1-4, 2016. The collected data from the established sampling stations will serve as the baseline data for the proposed project. The descriptions of the sampling stations are presented in **Table 2-42**, while **Figure 2-85** shows the location.

Table 2-42. Description of Established Sampling Stations for Ambient Air Quality and Noise Level Monitoring

Station	Description	Coordinates		Averaging Period
		Easting, m	Northing, m	
Station 1	About 20 meters away from the Bagac-Mariveles Road north of the project site	224121.94	1602460.48	24-hour
Station 2	At the Barangay Hall of Lower Biaan east of the project site	225257.01	1598228.85	24-hour
Station 3	At the compound of Biaan Aeta Integrated School, northeast of the project site	226016.87	1601244.62	1-hour
Station 4	At the compound of Porto del Sol Subdivision, east-northeast of the project site	226276.99	1598593.95	1-hour



Source:Google Earth, modified by GEOSPHERE

Figure 2-85. Established Stations for Ambient Air Quality and Noise Level Monitoring for the Proposed MCPP Project of MPGC

2.3.2.1 Ambient Air Quality

The concentrations of TSP, PM_{10}, $PM_{2.5}$, SO_2, NO_2 and heavy metals (As, Cd, Cr+6, Pb, & Hg) were measured at the established sampling stations within the vicinity of the MCPP Project emissions, and prevalent wind direction in the area. Methods for sampling and analysis conformed to prescribed methods in Sec. 1(b) Rule VII Part II of the Clean Air Act Implementing Rules and Regulations (IRR). The measured concentrations were compared to the National Ambient Air Quality Guidelines Values (NAAQGV), Rule VII, Part II and the National Ambient Air Quality Standards for Source Specific Air Pollutants from Industrial Sources/Operations Section 1 Rule XXVI Part VII of the Clean Air Act IRR.

The results of monitoring as presented in **Table 2-43** and **Table 2-44** show that the concentrations of TSP, PM_{10}, $PM_{2.5}$, NO_2, and SO_2 for 24-hour averaging period in Stations 1 and 2 are all below the CAA limit of 230 µg/Ncm for TSP, 150 µg/Ncm for PM_{10}, 50 µg/Ncm for PM_{10}, 150 µg/Ncm for NO_2, and 180 µg/Ncm for SO_2. The concentrations of TSP, PM_{10}, NO_2, and SO_2 for 1-hour averaging period in Stations 3 and 4 are also below the CAA limit of 300 µg/Ncm for TSP, 200 µg/Ncm for PM_{10}, 260 µg/Ncm for NO_2, and 340µg/Ncm for SO_2.

Traces of heavy metals (lead, mercury and hexavalent chromium) at low concentrations were detected in Stations 1 and 2 for 24-hour averaging period. Arsenic at low concentrations was detected in Station 1 for 24-hour averaging periods.

Table 2-43. Results of 24-Hour Averaging Time for Ambient Air Quality Monitoring August 1-3, 2016

Parameters	Station 1	Station 2	CAA Limit
	Aug. 1-2, 2016 1615H-1615H	Aug. 2-3, 2016 1800H-1800H	
TSP, µg/Ncm	40.87	98.25	230
PM10, µg/Ncm	22.92	48.15	150
PM2.5, µg/Ncm	22.76	25.06	50
NO2, µg/Ncm	10.70	9.87	150
SO2, µg/Ncm	13.74	7.41	180
As, µg/Ncm	0.00011	ND	-
Cd, µg/Ncm	ND	ND	-
Cr+6, µg/Ncm	0.00066	0.00050	-
Hg, µg/Ncm	0.00474	0.00837	-
Pb, µg/Ncm	0.00003	0.00002	-

Note: ND – less than method detection limit (MDL)

Table 2-44. Results of 1-Hour Averaging Time for Ambient Air Quality Monitoring August 4, 2016

Parameters	Station 3	Station 4	CAA Limit
	Aug. 4, 2016 0830H-0930H	Aug. 4, 2016 1050H-1150H	
TSP, µg/Ncm	6.89	3.49	300
PM10, µg/Ncm	6.39	0.38	200
NO2, µg/Ncm	20.75	20.75	260
SO2, µg/Ncm	24.81	15.72	340

2.3.2.2 Degradation of Air Quality during Construction Phase

Dust emissions during construction of the proposed MCPP Project are associated with the removal of existing structures, hauling of dismantled materials, land clearing, ground excavation, cut and fill operations (i.e., earth moving) deliveries of construction materials and supplies and other related works. Dust emissions can vary from day to day, depending on the level of project activities, deliveries, and the prevailing meteorological conditions. However, these emissions are short-term, localized and temporary.

The following measures shall be employed to minimize dust emissions from construction activities of the proposed Project:

Access Road

The access roads shall be kept clear of dusty materials; or sprayed with water or a dust suppression chemical so as to maintain the entire road surface wet;

Use of Vehicle

Immediately before leaving the construction site, every vehicle shall be washed to remove any dusty materials from its body and wheels;

Whenever a vehicle leaving a construction site is carrying load of dusty materials, the load shall be covered entirely with clean impervious sheeting to ensure that the dusty materials do not leak from the vehicle;

Excavation and Earth Moving

The working area for excavation or earth moving operation shall be sprayed with water or a dusty suppression chemical immediately before, during and immediately after the operation so as to maintain the entire surface wet;

Exposed/excavated soil shall be properly compacted or treated by vegetation planting or sealing with shotcrete or other suitable surface stabilizer within six (6) months after the last construction activity at the construction site or part of the construction site where exposed soil lies;

Stockpiling of Dusty Materials

Any stockpile of dusty material shall be either covered entirely with impervious sheeting; placed in a covered area; or sprayed with water or a dust suppression chemical so as to maintain the entire surface wet.

Conduct of Ambient Air Quality Monitoring

Ambient air quality monitoring shall be conducted on a regular basis to monitor and assess the impacts during construction of the proposed MCPP Project.

2.3.2.3 Degradation of Air Quality during Operation Phase

During the operation phase, combustion of coal may result in emissions of particulates, SOx, NOx and CO, which if not appropriately abated, will degrade the air quality of the surrounding areas.

- Particulate emissions may be categorized as either filterable or condensable. Condensable particulate matter is a material that is emitted in vapor state, which later condenses to form homogeneous and/or heterogeneous aerosol particles. The condensable particulate emitted from boilers is primarily inorganic in nature. Filterable particulate matter emissions, on the other hand, depend predominantly on the grade of fuel fired. Combustion of lighter distillate oils result in significantly lower particulate matter formation than the combustion of heavier residual oils. In the case of the proposed Project, coal is expected to generate particulate emissions while fuel oil is anticipated to emit less particulate for it will only be utilized as fuel for start-up to aid in heating the fluidized bed. Further, filterable particulate matter emissions depend on the completeness of combustion and ash content.

- Most of the NOx formed during combustion is the result of two oxidation mechanisms: a) reaction of nitrogen in the combustion of air with excess oxygen at elevated temperatures, referred to as thermal NOx, and b) oxidation of nitrogen that is chemically bound nitrogen in the fuel, referred to as fuel NOx. The term NOx refers to the composite of Nitric oxide (NO) and NO2. Most of external fossil fuel combustion systems, emit about 95 percent of NOx in the form of NO.

  The formation of thermal NOx is affected by four (4) factors: (1) peak temperature; (2) fuel nitrogen concentration; (3) oxygen concentration and (4) time of exposure at peak temperature. The emission trends due to changes in these factors are generally consistent for all types of boilers: an increase in flame temperature, oxygen availability, and/or residence time at high temperatures lead to an increase in NOx production.

- SOx emissions are generated during coal combustion from the oxidation of sulfur contained in the fuel. The emission of SOx from conventional combustion system is predominantly in the form of SO2. Uncontrolled SOx emissions are almost entirely dependent on the sulfur content of the fuel and are not affected by boiler size, burner design, or grade of fuel being fired. On the average, more than 95% of the fuel sulfur is converted to SO2, about 1% to 5% is further oxidized to SO3, and 1 to 3 percent is emitted as sulfate particulate.

- The rate of CO emissions from combustion sources depends on the oxidation efficiency of the fuel. By controlling the combustion process carefully, CO emissions can be minimized. Thus, if a unit is operated improperly or not well maintained, the resulting concentrations of CO (as well as organic compounds) may increase by several orders of magnitude. Smaller boilers, heaters, and furnaces tend to emit more of these pollutants than larger combustors. This is because smaller units usually have a higher ratio of heat transfer surface area to flame volume than larger combustors have; this leads to reduced flame temperature and combustion intensity and, therefore, lower combustion efficiency.

  The presence of CO in the exhaust gas of combustion system results principally from incomplete fuel combustion. Several conditions can lead to incomplete combustion, including insufficient O2 availability; poor fuel/air mixing; cold-wall flame quenching; reduced combustion temperature; decreased combustion gas residence time; and load reduction (i.e., reduced combustion intensity). Since various combustion modifications for NOx reduction can produce one or more of the above conditions, the possibility of increased CO emissions is a concern for environmental, energy efficiency and operational reasons.

GHG emissions specifically CO_2 is produced during fuel combustion. Nearly all of the fuel carbon (99%) in fuel is converted to CO_2. This conversion is relatively independent of firing configuration. The majority of the fuel carbon not converted to CO_2 is due to incomplete combustion in the fuel stream.

Other pollutant that has significant impact to air quality is the emission of VOC. The VOC emission will be generated from fuel handling and transfer of oil to storage day tanks. Coal and ash particulates may also become suspended and dispersed into the air during unloading and transport, depending on wind speed and direction.

Air Dispersion Modeling of Emissions During Operation Phase

Methodology

The EMB MC 2008-03 “Guidelines for Air Dispersion Modeling” uses a tiered approach in assessing air contaminants concentrations against the Clean Air Act (CAA of 1999) air quality guidelines and standard. The tiered approach follows the USEPA guidelines that include:

- Screening-level dispersion modeling techniques conducted using worst-case input data rather than site-specific data; and

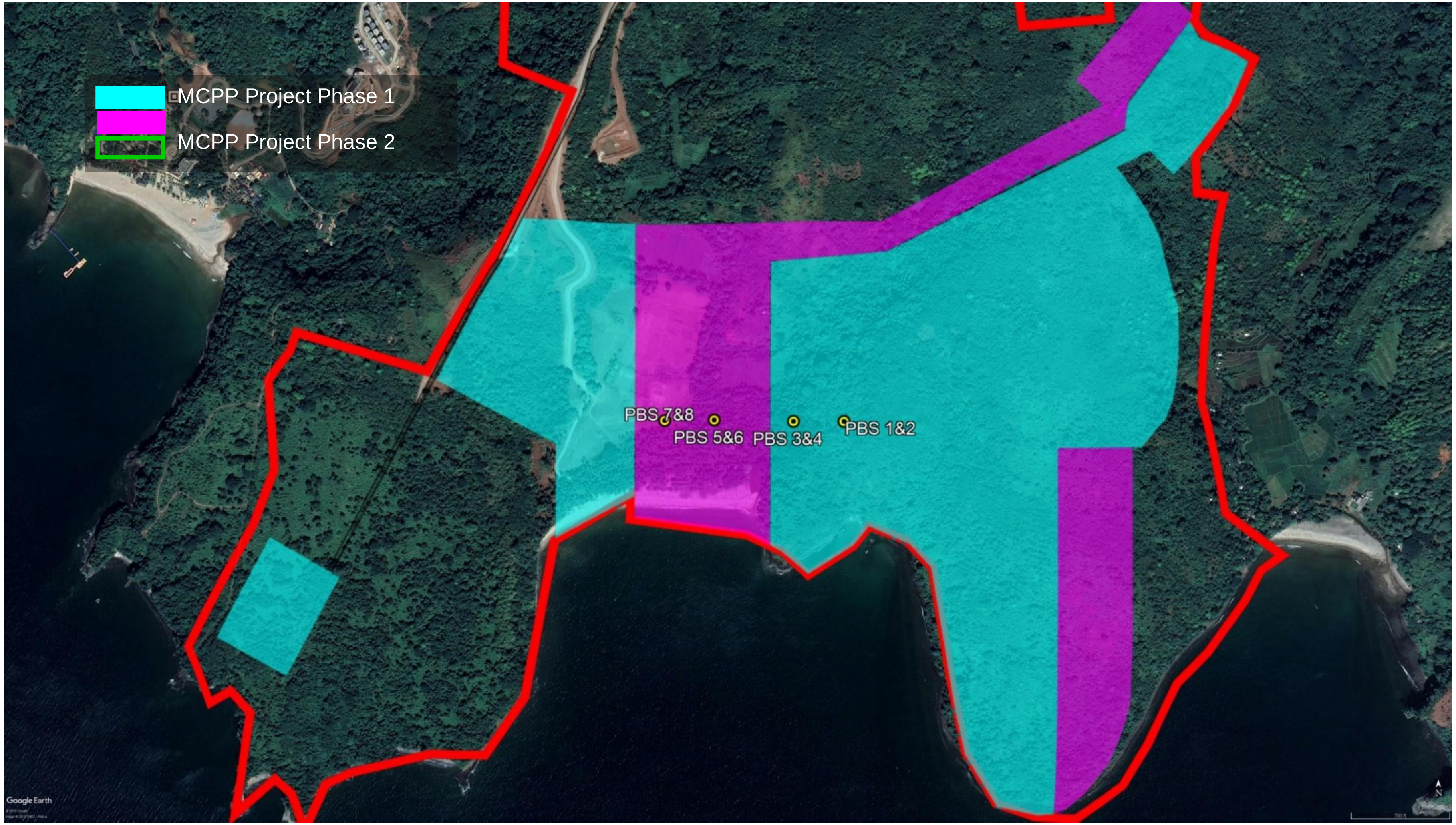
- Refined level dispersion modeling techniques conducted using site specific meteorological data or derived regional meteorological data.

A fundamental assumption of the tiered approach to model selection is that the simpler modeling techniques always yielded more conservative results. It is assumed that screening level models would always predict higher ground-level concentrations than refined modelling techniques, and that the refined models would predict higher impacts than the 'best-estimate' models.

The MC 2008-03 adopted the used of American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD). AERMOD was developed to replace the Industrial Source Complex Short-Term Version 3 (ISCST3) model. It includes a state-of-the science downwash algorithm and utilizes AERMET, a meteorological data processor that utilizes current planetary boundary layer theory to calculate the dispersion coefficients (σy and σz).

AERMOD model was used in this modeling report to assess and determine air quality impact due to the emissions of PM, SOx, NOx, and CO in the operation of the proposed project. The modeling with AERMOD was performed using the regulatory default option, which includes stack height adjusted for stack-tip downwash. The meteorological data set used is from the PAGASA Sangley Point Synoptic Station. The model utilized assessment to determine the level of the proposed development impacts on the surrounding environment, including terrain effects on the discharged plumes for one hour, 8-hours (for CO), 24-hour and annual averaging times, without the need for the use of conversion factors.

Plot Plan. The source subjected for the modeling is the boiler flue stacks of the proposed Project. **Figure 2-86** presents the general plant lay-out of the plant facility showing the location of the emission source. Label in yellow are the flue stacks which are identified as the sources for modeling.



Note: PBS-1 – Proposed Boiler Stack 1; PBS-2 – Proposed Boiler Stack 2

Figure 2-86. Plant Layout Showing the Location of Emission Sources

Air Quality Monitoring Data. Modeled ambient air concentrations only reflect the impacts from stationary industrial emission sources. The "background" concentrations measured as the baseline concentrations are typically added to the modeled ground-level concentrations from all identified sources. The background concentrations include emissions from industrial emission sources (e.g., area and mobile sources, distant point sources, etc.) and non-industrial emission sources (e.g., vehicles, recreational watercraft, etc.), which are not included in the model.

Emission Load of Each Source. The modeling scenarios considered in this study are as follows:

- Scenario 1: 4x150MW (Phase 1) under normal operating condition; and
- Scenario 2: 8x150MW (Phase 1 + Phase 2) under normal operating condition.

Under normal condition, boiler will run with air pollution control devices working such as ESP. Emission data used in the modeling were taken from the source emission testing report of the 150MW Thermal Power of SMC Consolidated Power Corporation located in Limay Bataan conducted by Berkman Systems, Inc (**Annex 2-5**).

Table 2-45 below presents the summary of the source parameters.

Table 2-45. Summary of Source Parameters

Parameter	Unit	Boiler Flue Stack							
		1	2	3	4	5	6	7	8
Coordinates									
Easting	Lat	14°26'54.94"	14°26'54.94"	14°26'54.96"	14°26'54.96"	14°26'55.07"	14°26'55.07"	14°26'55.03"	14°26'55.03"
Northing	long	120°26'9.09"	120°26'9.09"	120°26'5.45"	120°26'5.45"	120°25'59.69"	120°25'59.69"	120°25'56.07"	120°25'56.07"
Elevation	m	30	30	30	30	15	15	15	15
Fuel consumption	MT/yr	715560	715560	715560	715560	715560	715560	715560	715560
Operating hours	days/yr	8040	8040	8040	8040	8040	8040	8040	8040
Fuel sulfur content	%	1.49	1.49	1.49	1.49	1.49	1.49	1.49	1.49
Flue gas volumetric flow rate	Nm3/s	286.463	286.463	286.463	286.463	286.463	286.463	286.463	286.463
Flue gas velocity	m/s	23.98	23.98	23.98	23.98	23.98	23.98	23.98	23.98
Flue gas exit temperature	°C	421.90	421.90	421.90	421.90	421.90	421.90	421.90	421.90
Stack height above the ground	m	100	100	100	100	100	100	100	100
Stack inside diameter	m	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9
Emission Strength									
SO2	g/s	1.053223	1.053223	1.053223	1.053223	1.053223	1.053223	1.053223	1.053223
NO2	g/s	1.522185	1.522185	1.522185	1.522185	1.522185	1.522185	1.522185	1.522185
CO	g/s	0.784593	0.784593	0.784593	0.784593	0.784593	0.784593	0.784593	0.784593
TSP	g/s	0.464588	0.464588	0.464588	0.464588	0.464588	0.464588	0.464588	0.464588
PM10	g/s	0.371671	0.371671	0.371671	0.371671	0.371671	0.371671	0.371671	0.371671

Note:
1. Emission data are extracted from the Source Emission Testing Report of the 150MW CFB Boiler of SMC Consolidated Power Corp. conducted by Berkman Systems, Inc. dated December 15, 2016.
2. The Report has no PM10 result; therefore, PM10 is assumed to be 80% of TSP.
3. The PM in the Source Emission Testing Report is referred herein as TSP.

Modeling Result

Tables 2-46 to 2-47 give an overall summary of the predicted concentrations, i.e. maximum modeled concentrations for scenarios 1 and 2, respectively. The predicted peak 1-hour and 24-hour emissions of CO, SO_2, NO_2, TSP and PM_{10}, are within the CAA limit for Scenarios 1 and 2. The highest ground level concentrations of modeled parameters in the whole modeling domain occurred in uninhabited area of Barangay Biaan at a distance of about 3,300 meters north-northeast of the project for 1-hour averaging period and 3,000 meters north of the Project for 24-hour averaging period. The highest ground level concentrations predicted were for nitrogen dioxide followed by sulfur dioxide from the proposed sources.

Figure 2-87 to **Figure 2-96** show the isopleths of each modeled parameter for Scenario 1 while **Figures 2-97** to **Figure 2-106** show the isopleths of each modeled parameter for Scenario 2. The selected output files of the model run are attached in **Annex 2-6**.

Table 2-46. Summary of Predicted Maximum Concentration for Scenario 1

Parameters	Averaging Period	Location of Highest Concentration (m)		Predicted Maximum Concentration (μg/Ncm)	CAA Limit (μg/Ncm)
		X	Y		
TSP	1-hour	224496.97	1601430.93	34.16	300
	24-hour	223496.97	1601930.93	4.31	230
PM_{10}	1-hour	224496.97	1601430.93	27.33	200
	24-hour	223496.97	1601930.93	3.45	150
SO_2	1-hour	224496.97	1601430.93	77.44	340
	24-hour	223496.97	1601930.93	9.78	180
NO_2	1-hour	224496.97	1601430.93	111.92	260
	24-hour	223493.97	1601930.93	14.14	150
CO^a	1-hour	224496.97	1601430.93	0.0577	35
	8-hour	224496.97	1601430.93	0.0215	10

Note: a - mg/m³

Table 2-47. Summary of Predicted Maximum Concentration for Scenario 2

Parameters	Averaging Period	Location of Highest Concentration (m)		Predicted Maximum Concentration (μg/Ncm)	CAA Limit (μg/Ncm)
		X	Y		
TSP	1-hour	225287.37	1600730.96	60.68	300
	24-hour	223996.97	1601430.93	8.03	230
PM_{10}	1-hour	225287.37	1600730.96	48.54	200
	24-hour	223996.97	1601430.93	6.42	150
SO_2	1-hour	225287.37	1600730.96	137.56	340
	24-hour	223996.97	1601430.93	18.19	180
NO_2	1-hour	225287.37	1600730.96	198.81	260
	24-hour	223996.97	1601430.93	26.29	150
CO^a	1-hour	225287.37	1600730.96	0.1025	35
	8-hour	223996.97	1601430.93	0.0404	10

Note: a - mg/m³

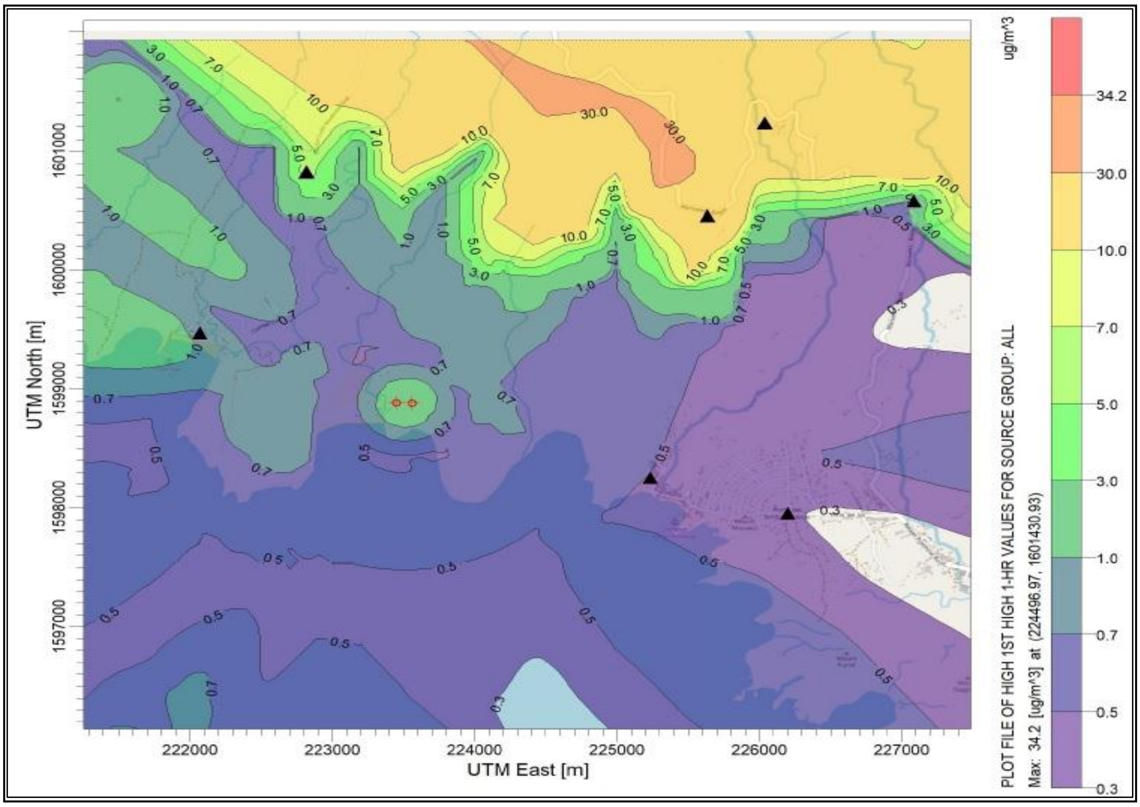


Figure 2-87. Isopleth of TSP Concentration 1-hour averaging period for Scenario 1

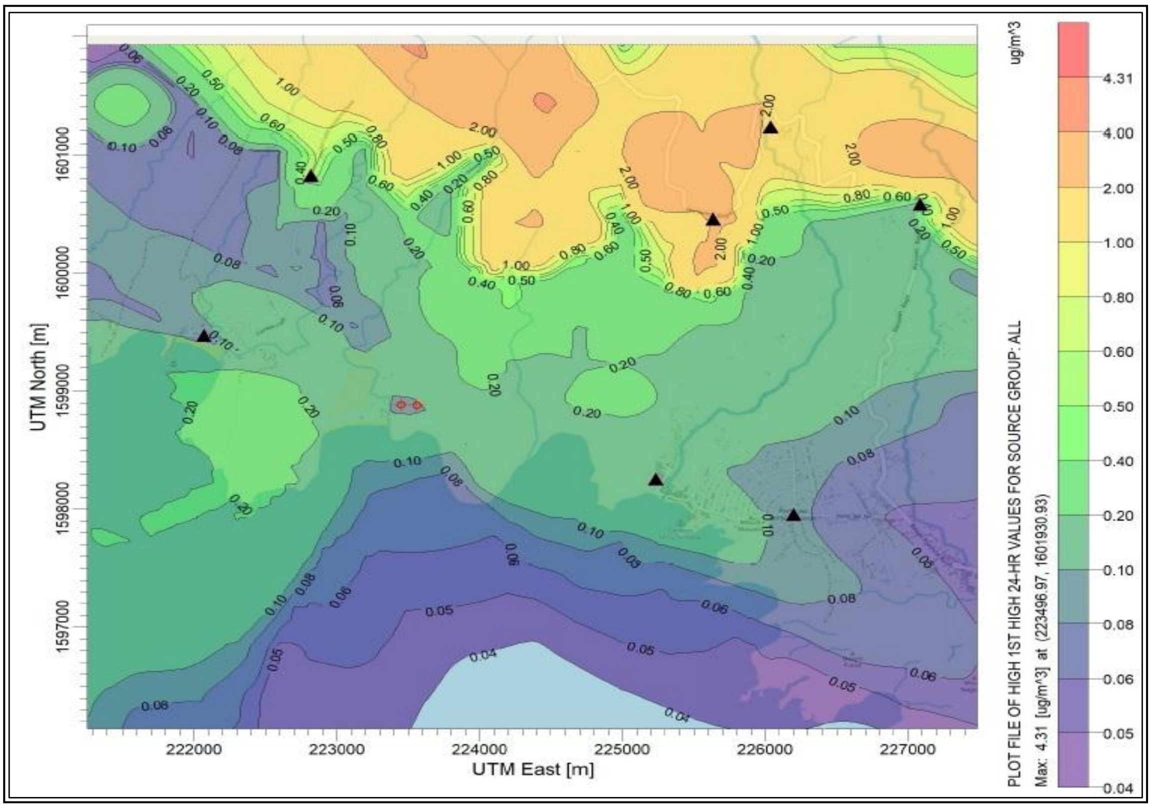


Figure 2-88. Isopleth of TSP Concentration 24-hour averaging period Scenario 1

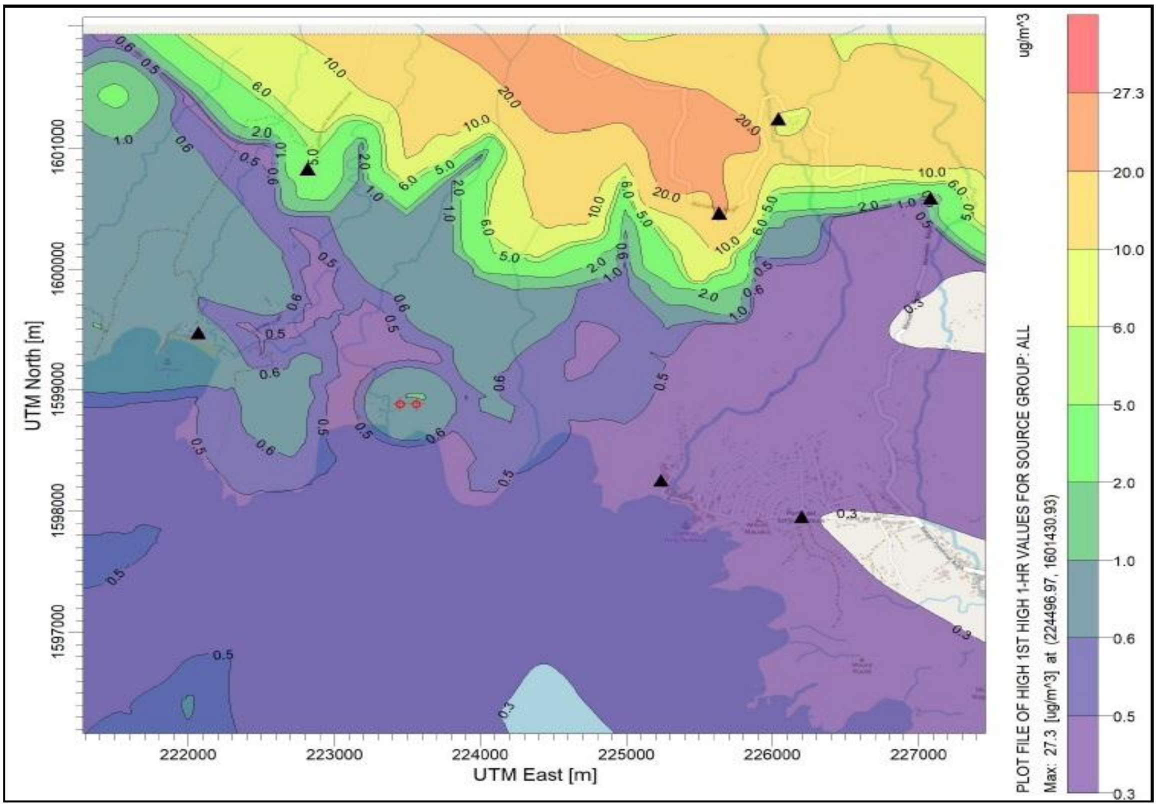


Figure 2-89. Isopleth of PM10 Concentration 1-hour averaging period for Scenario 1

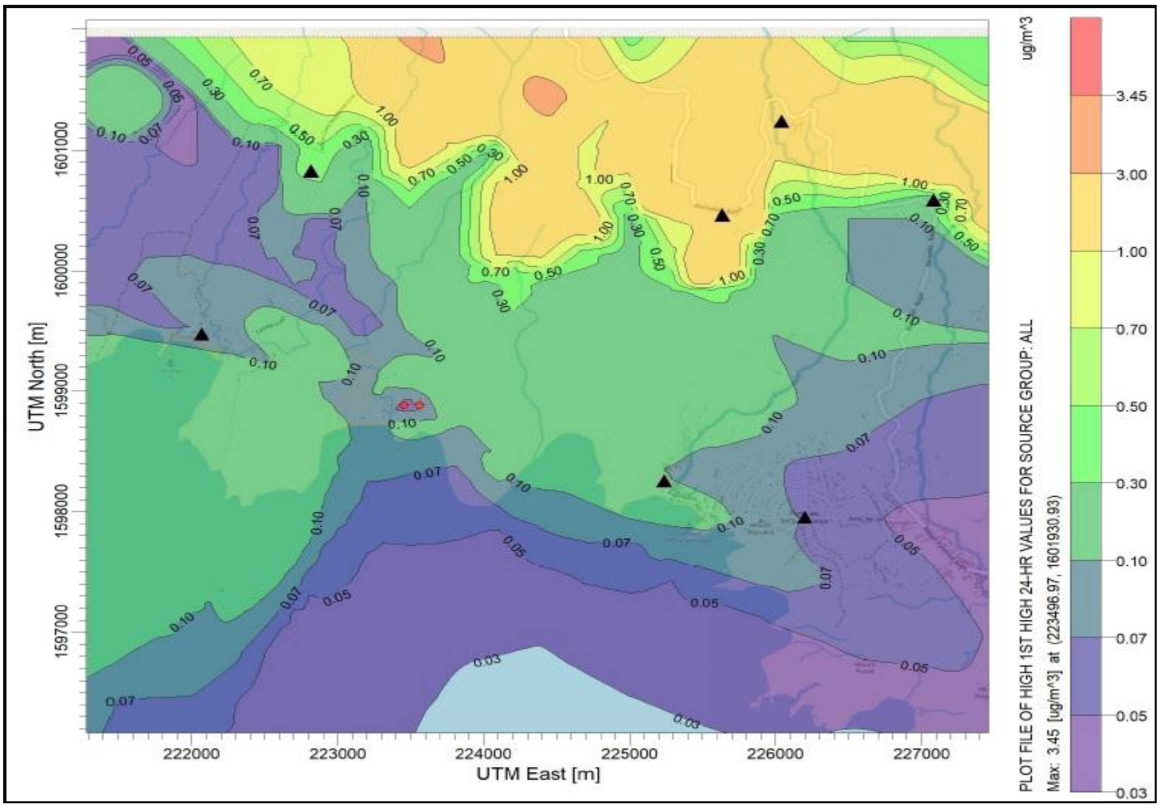


Figure 2-90. Isopleth of PM10 Concentration 24-hour averaging period for Scenario 1

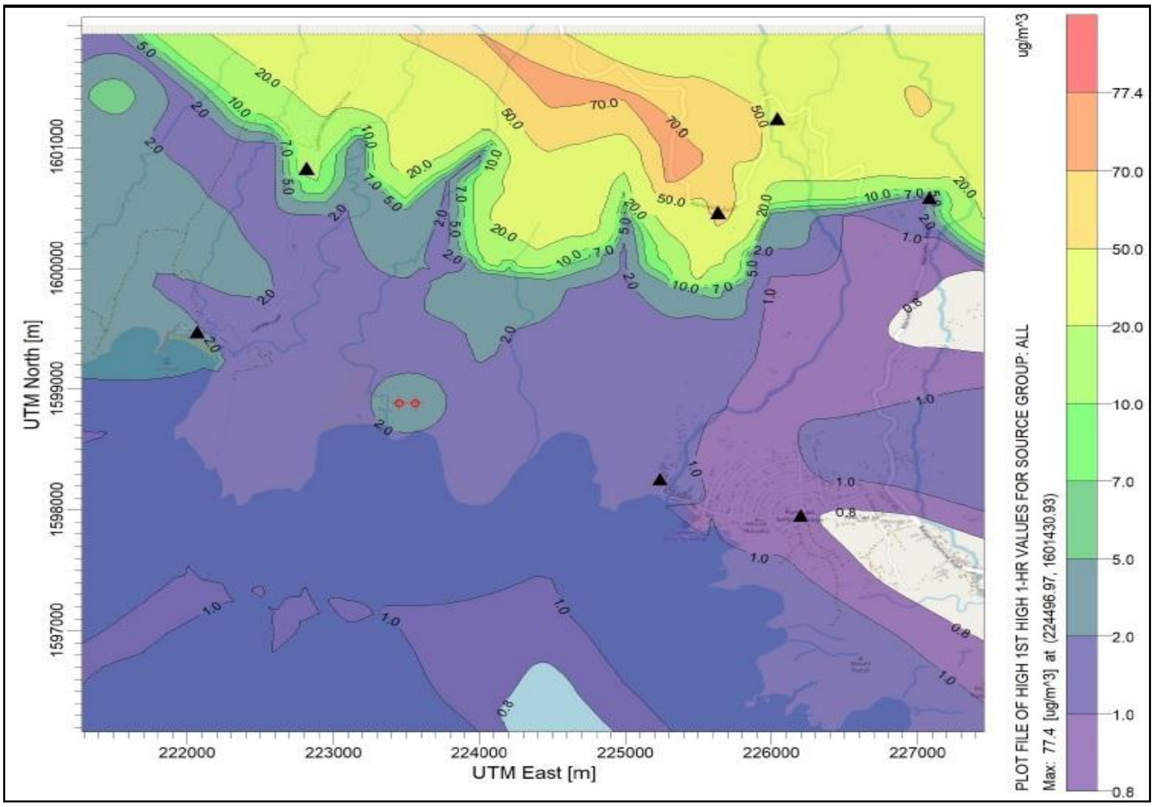


Figure 2-91. Isopleth of SO2 Concentration 1-hour averaging period for Scenario 1

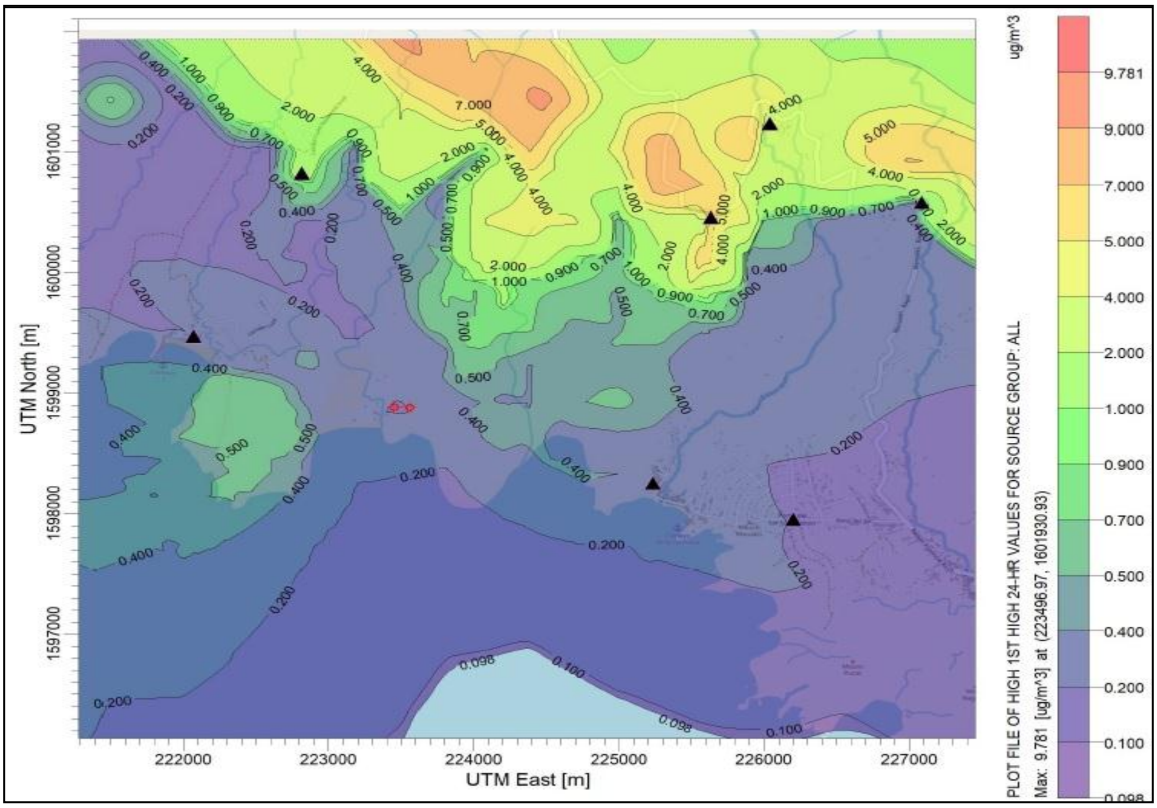


Figure 2-92. Isopleth of SO2 Concentration 24-hour averaging period for Scenario 1

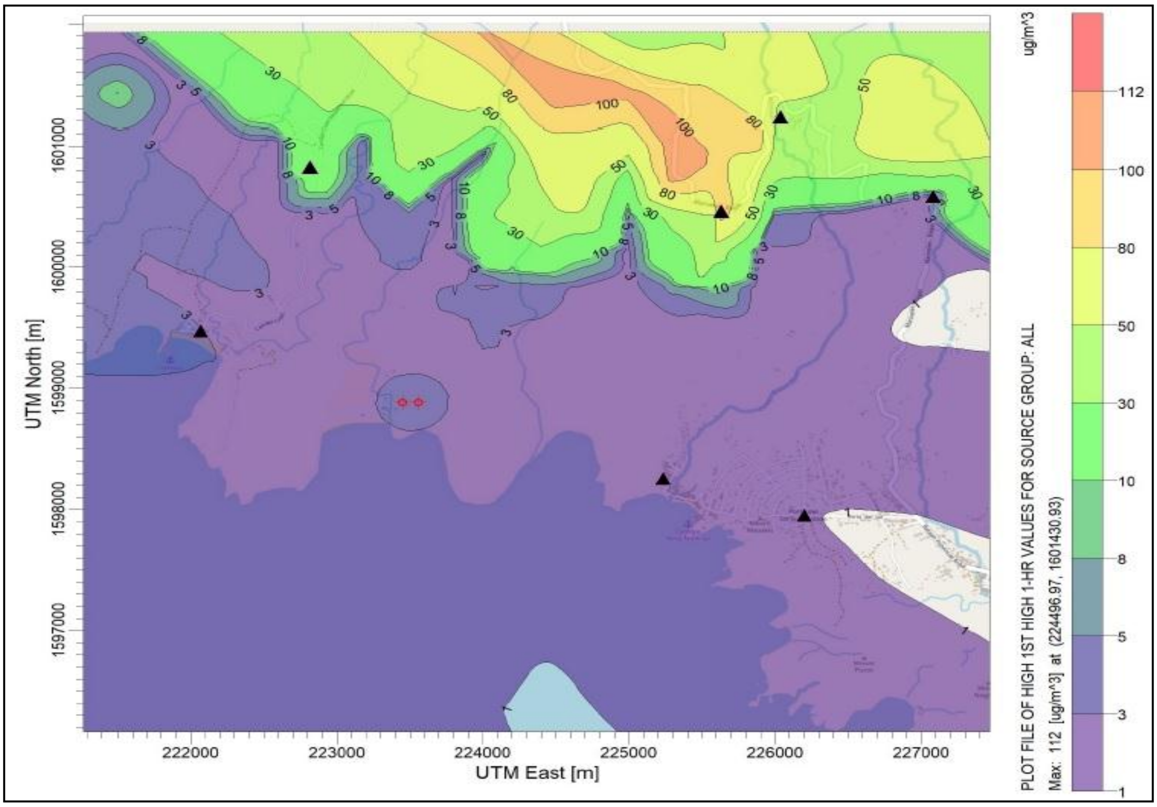


Figure 2-93. Isopleth of NO2 Concentration 1-hour averaging period for Scenario 1

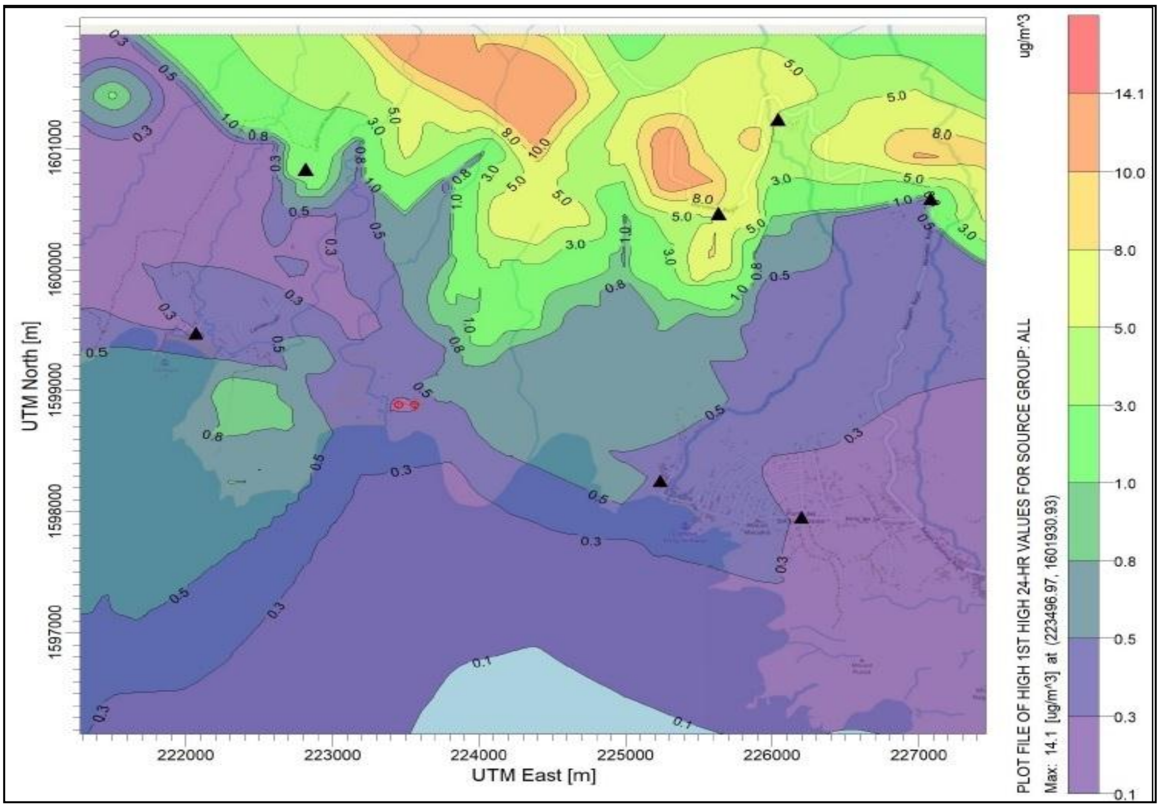


Figure 2-94. Isopleth of NO2 Concentration 24-hour averaging period for Scenario 1

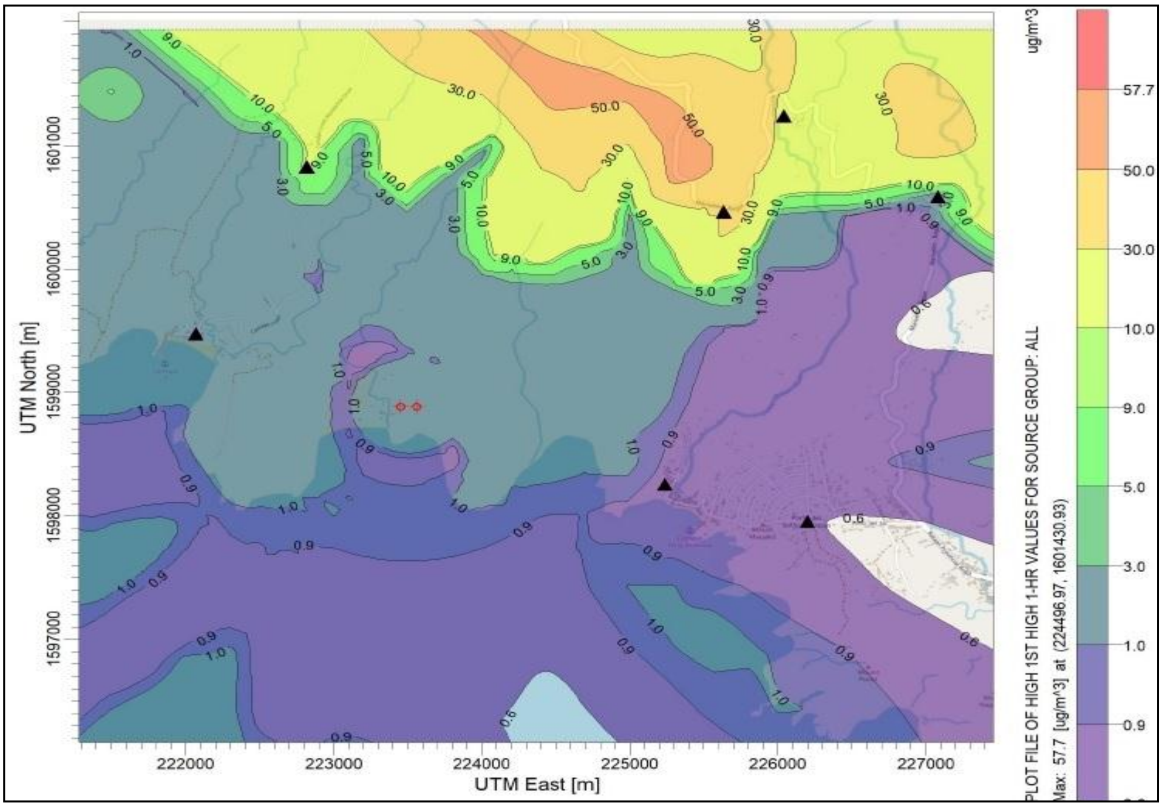


Figure 2-95. Isopleth of CO Concentration 1-hour averaging period for Scenario 1

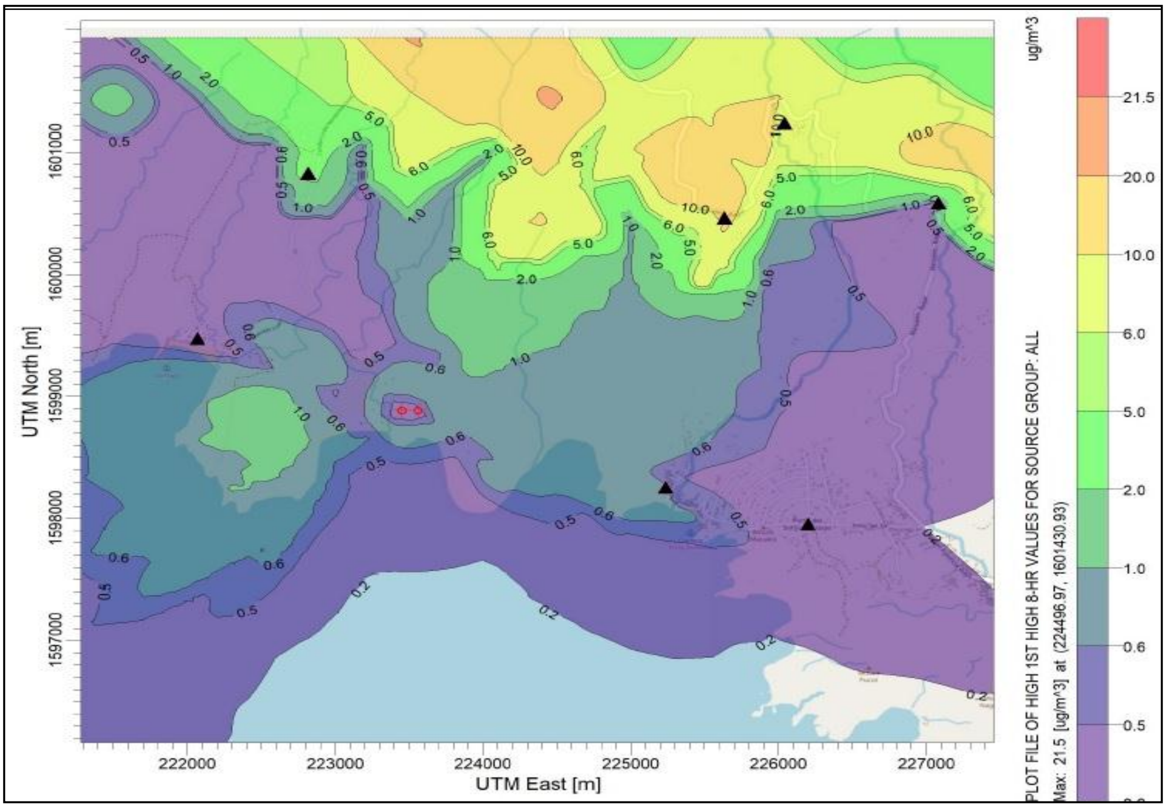


Figure 2-96. Isopleth of CO Concentration 24-hour averaging period for Scenario 1

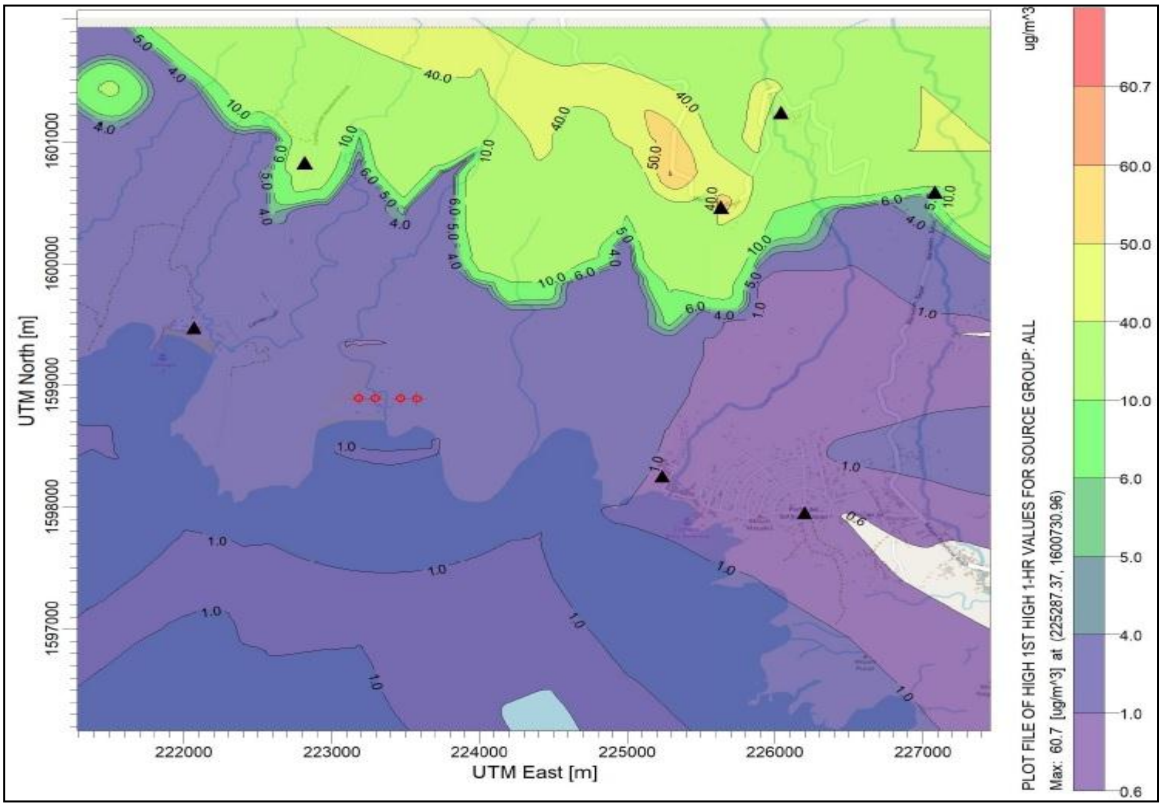


Figure 2-97. Isopleth of TSP Concentration 1-hour averaging period for Scenario 2

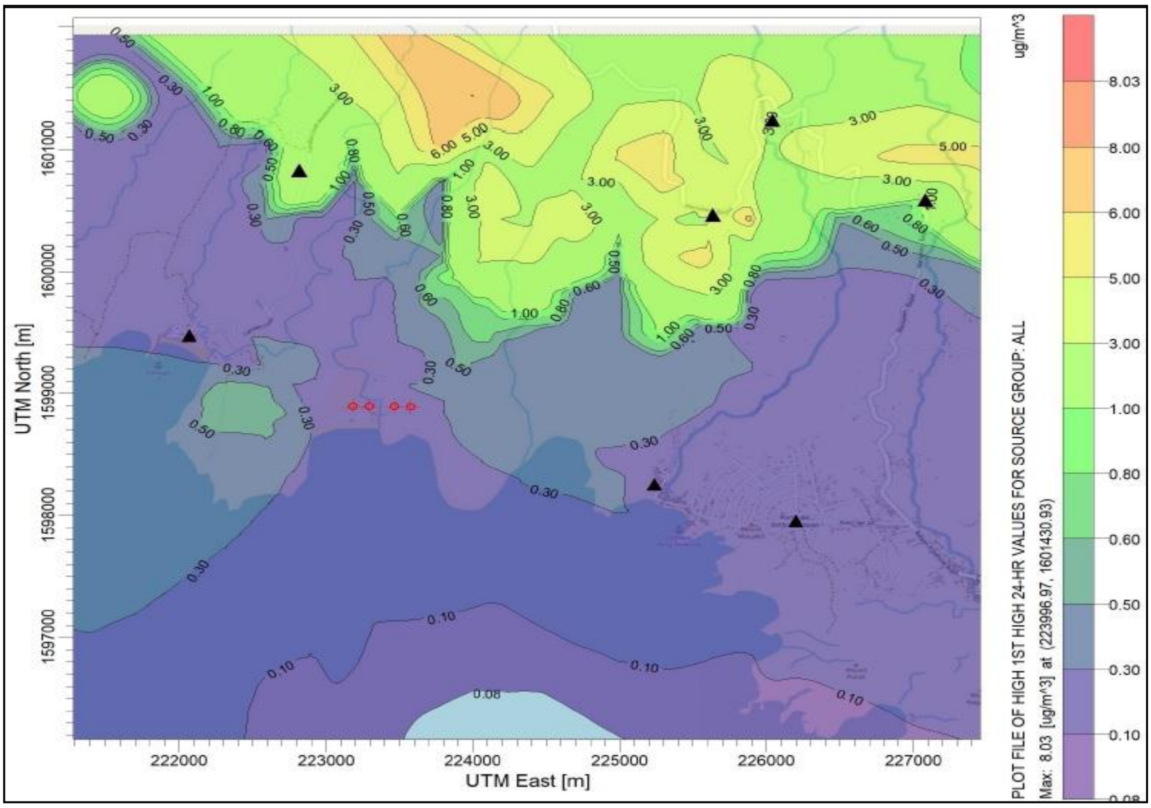


Figure 2-98. Isopleth of TSP Concentration 24-hour averaging period Scenario 2

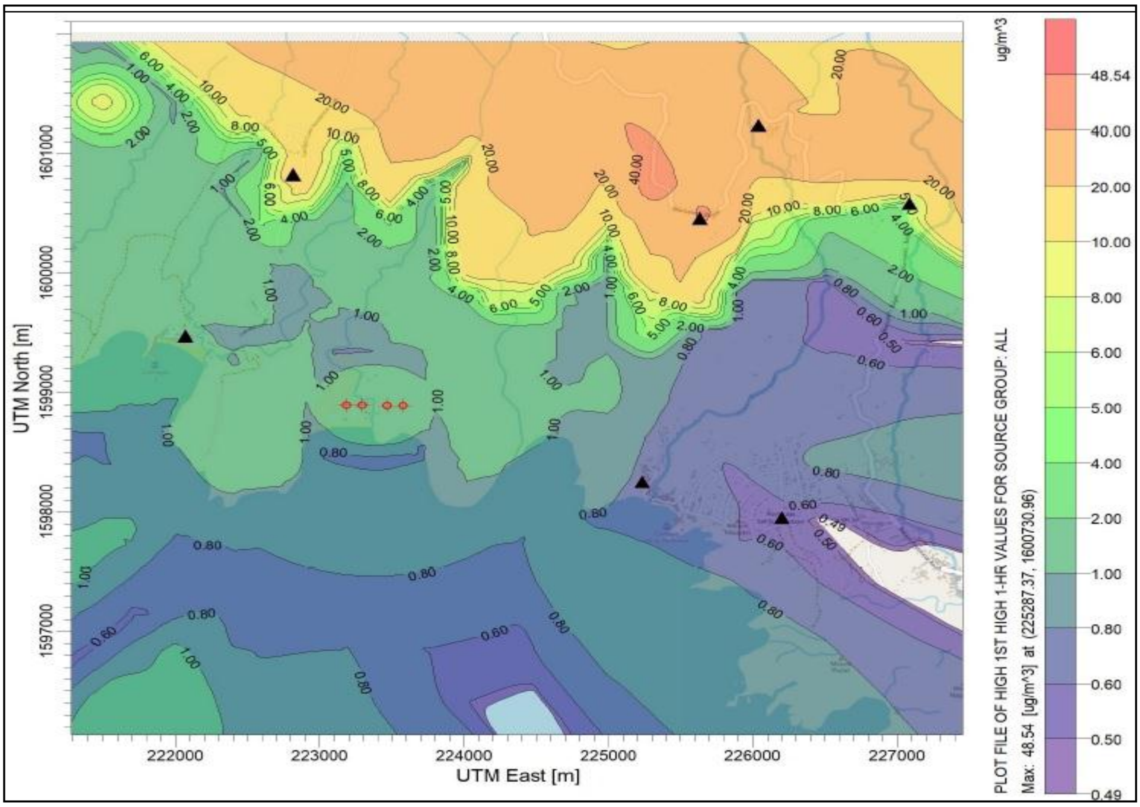


Figure 2-99. Isopleth of PM10 Concentration 1-hour averaging period for Scenario 2

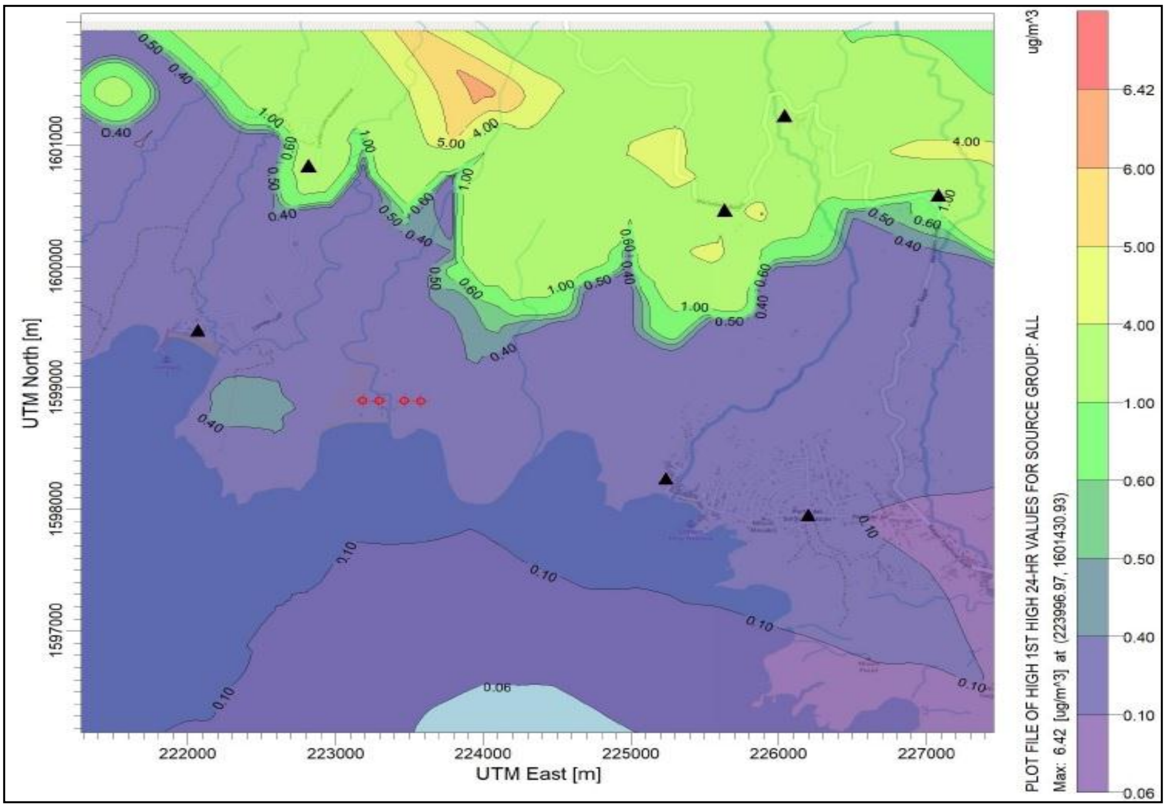


Figure 2-100. Isopleth of PM10 Concentration 24-hour averaging period for Scenario 2

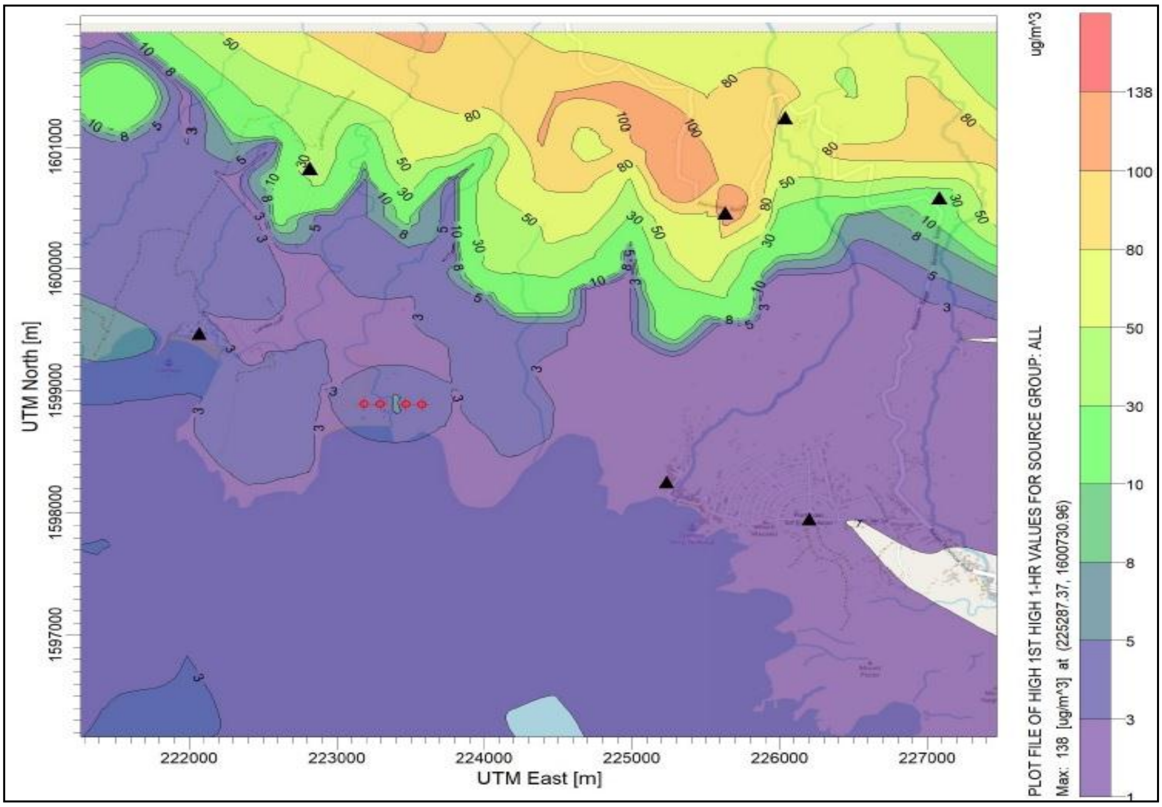


Figure 2-101. Isopleth of SO2 Concentration 1-hour averaging period for Scenario 2

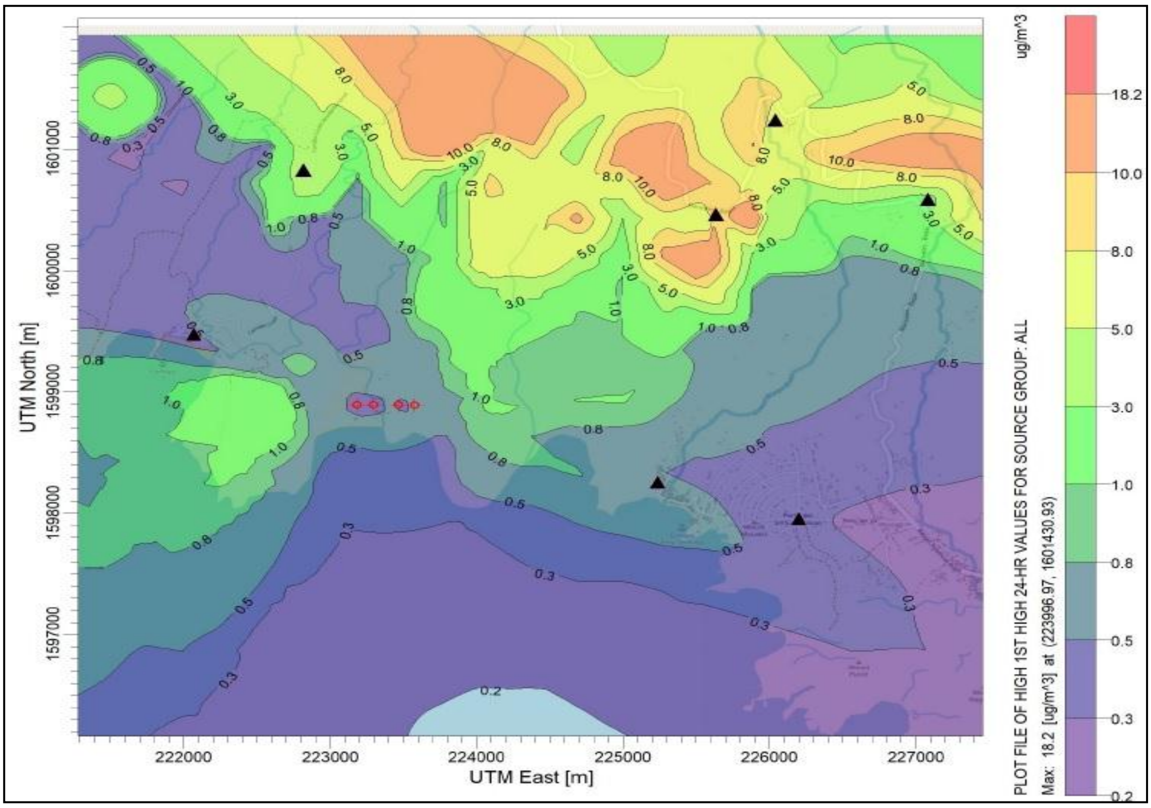


Figure 2-102. Isopleth of SO2 Concentration 24-hour averaging period for Scenario 2

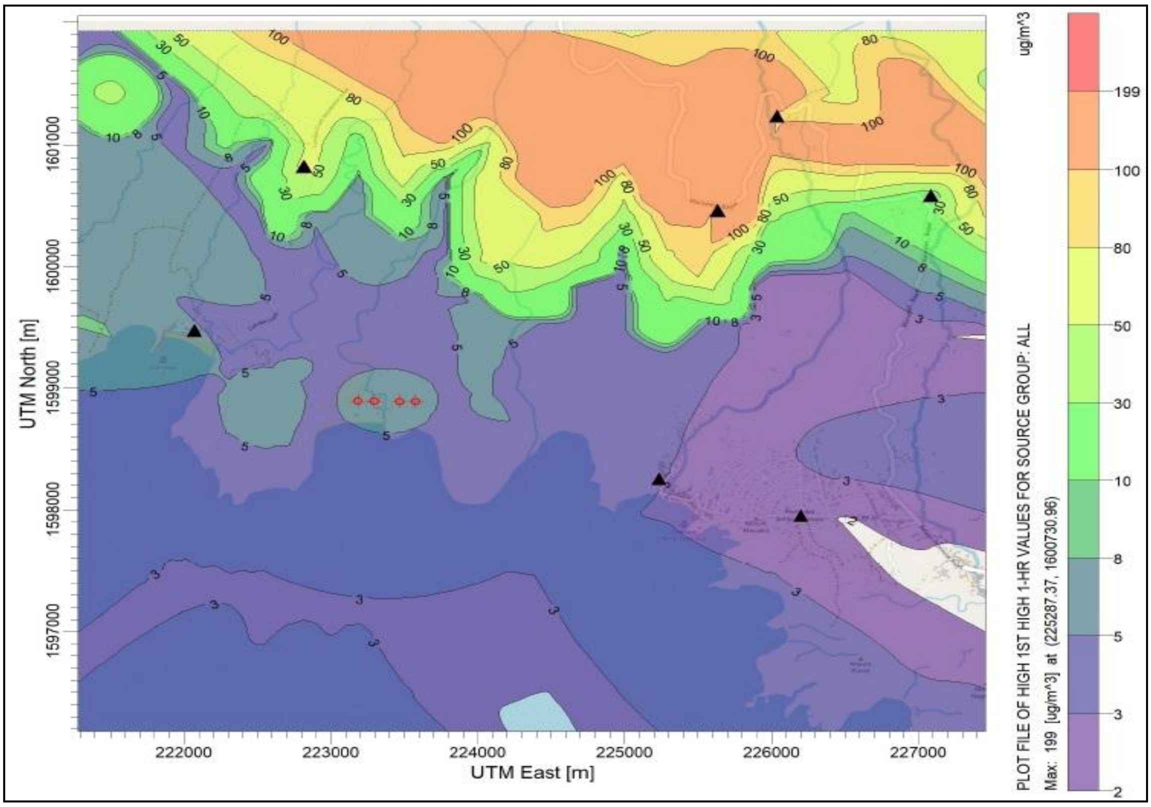


Figure 2-103. Isopleth of NO2 Concentration 1-hour averaging period for Scenario 2

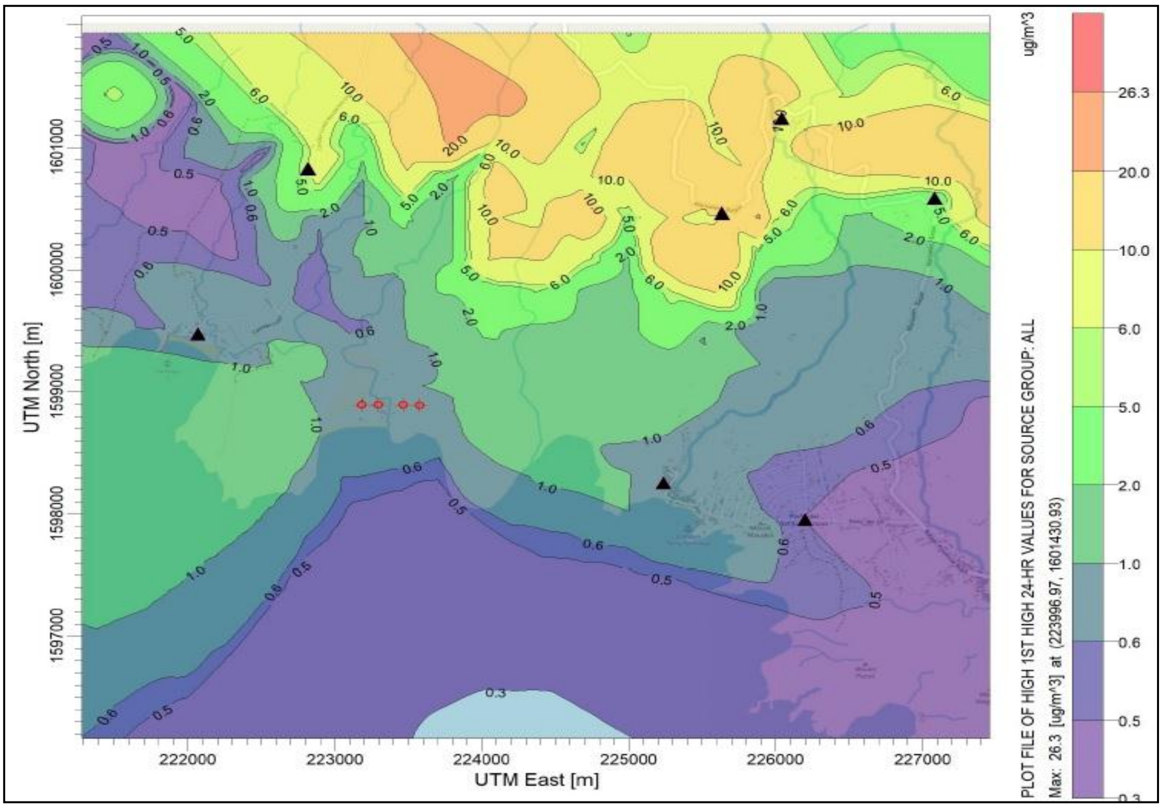


Figure 2-104. Isopleth of NO2 Concentration 24-hour averaging period for Scenario 2

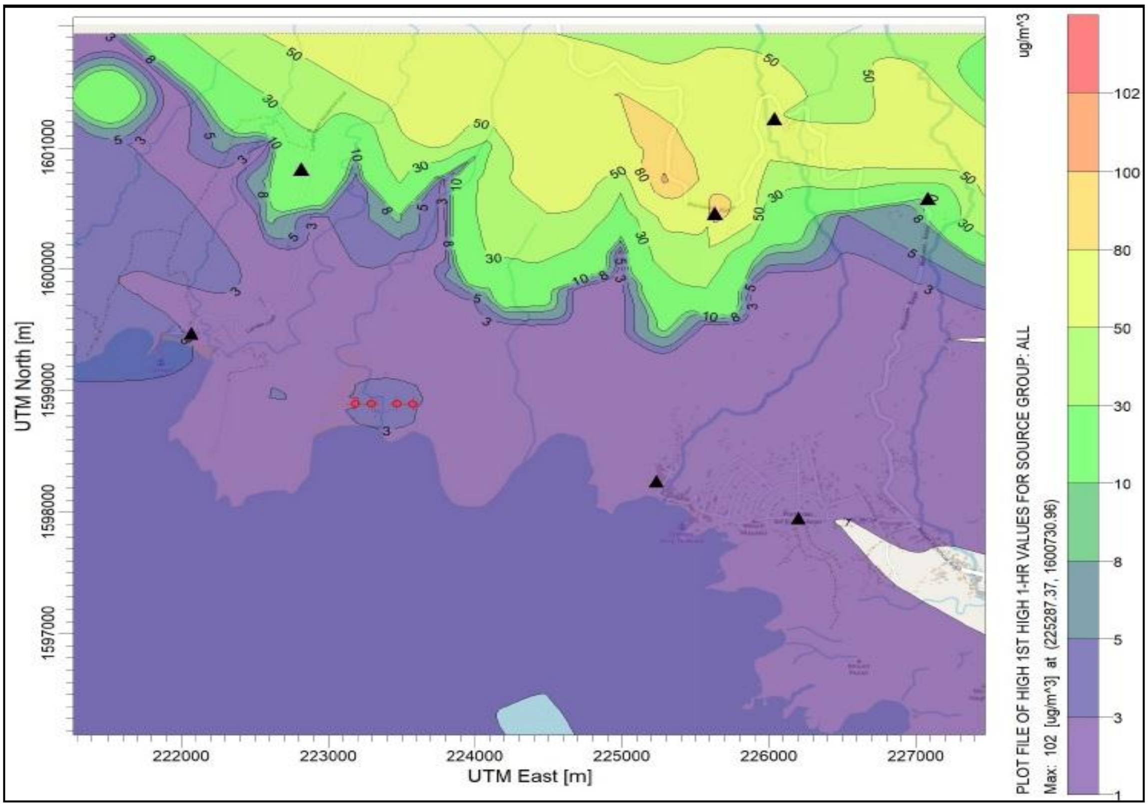


Figure 2-105. Isopleth of CO Concentration 1-hour averaging period for Scenario 2

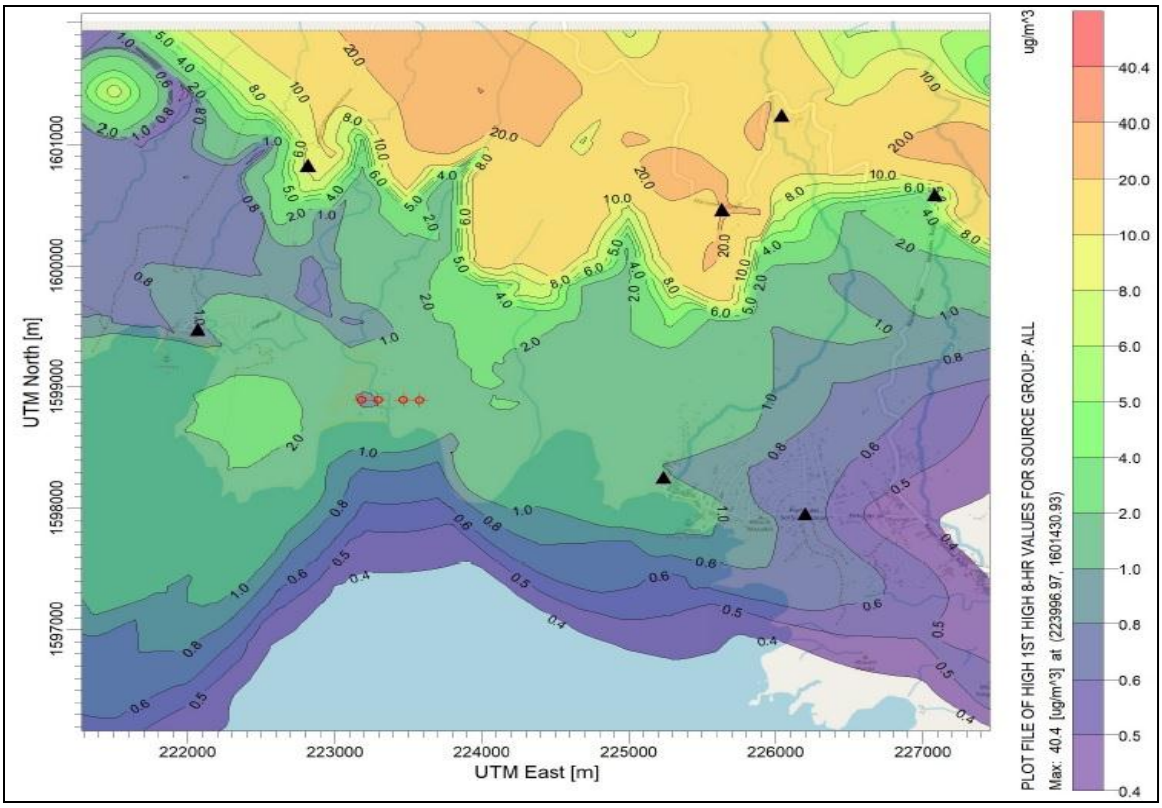


Figure 2-106. Isopleth of CO Concentration 24-hour averaging period for Scenario 2

Built-in measures inherent in the design of the CFB Technology Boilers are sufficient to reduce the potential impacts of the proposed MCPP Project on air quality.

- The CFB Technology allows the fuel to be burned at a relatively lower temperature compared to a conventional pulverized coal boiler, which reduces the NOx formation by approximately 60% due to a low combustion temperature of 800-900°C.

- Limestone injection will capture up to 98% of sulfur impurities from the fuel by reacting with it to form calcium sulfate, an inert material that is removed with the combustion and, thereby reducing SOx formation.

- ESP will be installed to remove particulates, particularly fly ash from the flue gas prior to its release through the stacks.

However, it shall be noted that upset conditions can occur during operation, and during such periods, EMB must be informed. Upset conditions may increase SOx and NOx emissions that need to be mitigated immediately. If upset conditions are extended, additional mitigating measures shall be implemented.

Stack emissions will be monitored to determine whether emissions comply with the National Emission Standards for Source Specific Air Pollutants (NESSAP, DAO 2000-81). Moreover, CEMS will be installed to monitor the emissions from the stacks.

Effect on air quality due to windblown coal and ash particulates will be insignificant as the coal handling system will be fully enclosed to eliminate the exposure of coal to open air, and therefore reduce the potential for particulates from being blown by wind.

To ensure that the ambient concentrations of NO_2, SO_2 and particulates in the project site and its vicinity are compliant to DENR standards, an ambient air quality monitoring will be conducted. As a further measure, trees shall be planted around at the project site which will serve as a natural buffer to prevent the migration of windblown particulates from the project site.

Air Dispersion Modeling of Ash Disposal Facility

This air dispersion modeling is conducted for the ash disposal facility of the Proposed 8x150MW Thermal Power Plant of Mariveles Power Generation Corporation. The ash disposal facility of the proposed thermal plant is just beside the power plant which is shown in the figure below. The ash is distributed onto the ash disposal facility by means of truck. The ash pond for Phase 1 will occupy an area (208,300 sqm.) at the southeast side of the property.

The main pollutant of concern is the fugitive dust from ash handling and disposal activities. Fugitive dust emission rates, generally TSP, PM_{10} and $PM_{2.5}$ have been determined using USEPA AP-42. **Table 2-48** below is the relevant emission parameters related to ash handling and storage.

Table 2-48. List of Activities That Generates Dust

Operation/Activity	Type	Description	Reference
Ash Handling	Truck loading and unloading	All activities that transfer source of dust from one transportation method to another	AP-42: Mining
Bulldozing	Bulldozers	Reforming of ash stockpile	AP-42: Mining
Wind/Site erosion	Ash stockpiles	Finely granulated dust is collected deposited across surrounding areas	AP-42: Mining

Vehicle traffic on unpaved roads	Trucks and tank cars	Transportation of ash from boilers to ash disposal facility	Emissions from unpaved road
Vehicle traffic on paved roads			Emissions from paved road

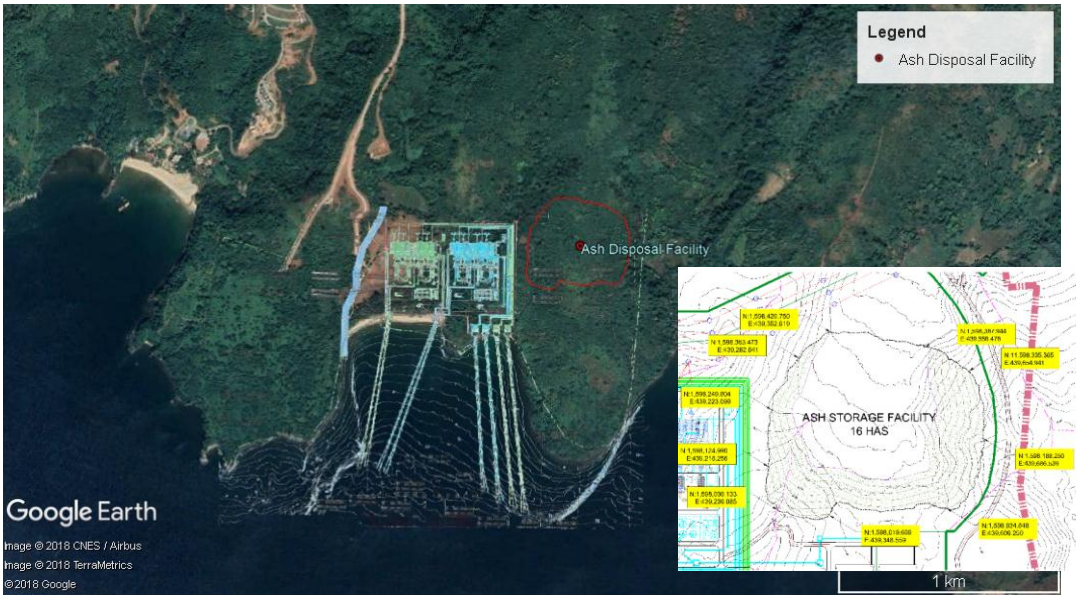


Figure 2-107. Map Showing Ash Disposal Facility

Methodology

Tier 4 of MC 2008-003 adopted AERMOD atmospheric dispersion model. AERMOD is the recommended tool for computing the dispersion of atmospheric pollutants within a few tens of kilometers from a regulated source. AERMOD is capable of simulating pollutants emitted from a non-buoyant area source such as a fly ash disposal site. AERMOD is a Gaussian plume model with the highest simulated pollutant concentrations at plume centerline and decreasing concentrations--following a Gaussian distribution--toward a plume's lateral (cross-wind) boundaries. AERMOD is a spatially-uniform steady state model in that it only considers one set of meteorological conditions for representing the entire period of pollutant transport from source to downwind receptor. The model calculates a pollutant concentration *C* based on a user-supplied emission rate *Q*.

The following regulatory default options will be used in AERMOD.

- Use the elevated terrain algorithms requiring input of terrain height data for receptors and emission sources;
- Use the calms processing routines;
- Include buoyancy-induced dispersion; and
- Use the routines for missing meteorological data processing.

Urban/Rural Land Use Assessment

Dispersion coefficients for air quality modeling were selected based on the land use classification technique suggested by Auer (Auer, 1978), which is the preferred method of the USEPA. The classification involves assessing land use within 3-kilometer radius of the proposed site. Urban dispersion coefficients should be selected if greater than 50% of the area consists of urban land use types; otherwise, rural coefficient apply.

Modeling Receptors

- Dispersion modeling domain is maximized to 7km x 7km with a grid interval of 500 meters. A nested grid is included with an interval of 200 meter centered from the ADF extending 3km x 3km. A more refined grid of 100-meter interval centered from ADF extending 4km x 4km. Figure 2-87 show the modeling grid in the modeling domain.

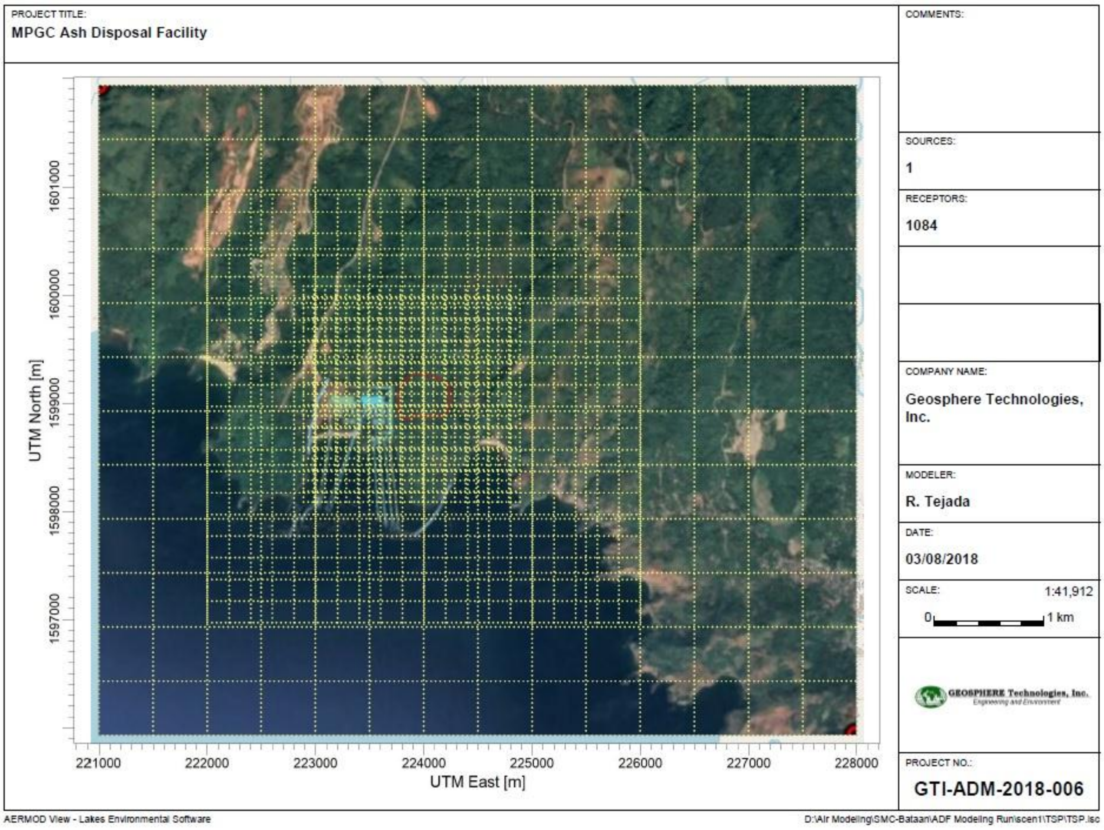


Figure 2-108. Modeling Grid in the Modeling Domain

Table 2-49. Air Sensitive Receptors (ASRs)

Receptor ID	Receptor Description	UTM Coordinates	
		Easting (m)	Northing (m)
ASR-1	Camaya Coast, “The Boracay of Bataan”	222069.67	1599478.68
ASR-2	Camaya Residential Subdivision Area	222817.16	1600829.04
ASR-3	Biaan Elementary School	225633.83	1600464.20
ASR-4	Biaan Aeta Integrated School	226038.96	1601233.27
ASR-5	DENR Office	227084.51	1600588.39
ASR-6	Lower Biaan	225235.23	1598257.03
ASR-7	Porto del Sol Subdivision	226200.49	1597956.75

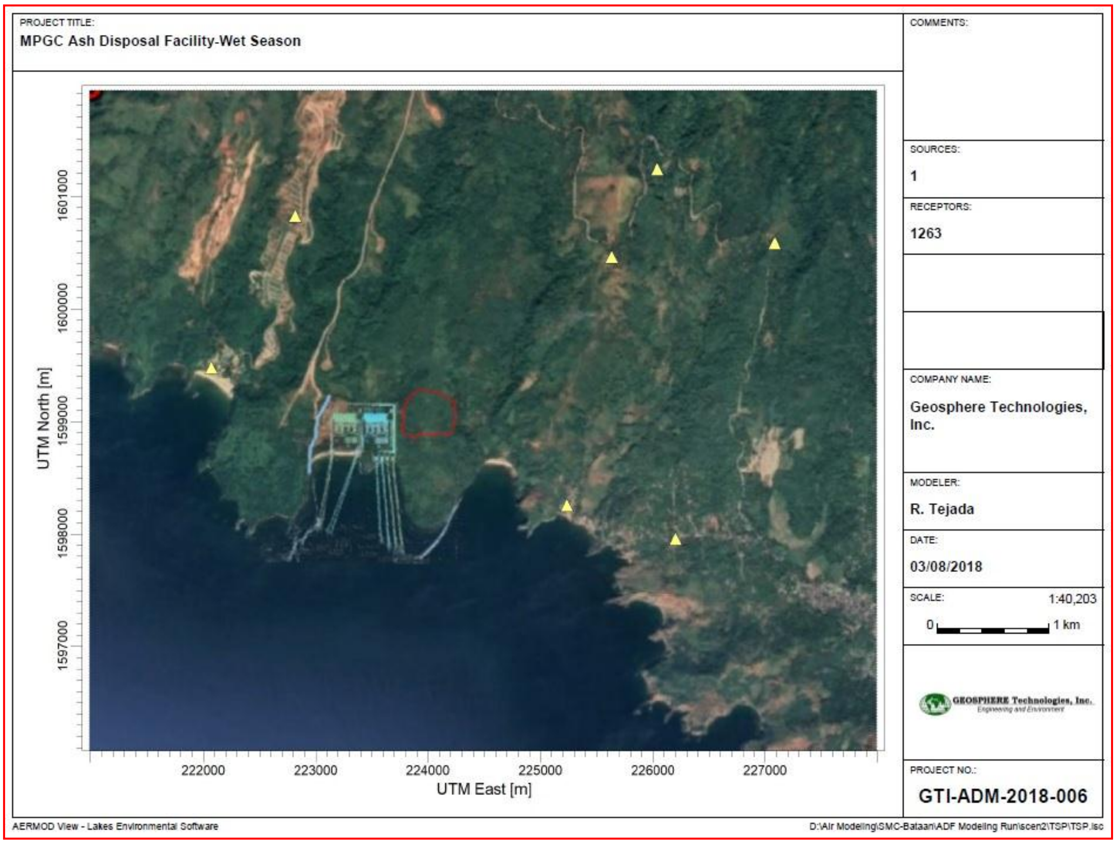


Figure 2-109. Location of Air Sensitive Receptors

Emission Calculation using USEPA AP-42

An emission inventory of TSP, PM_{10}, and $PM_{2.5}$ for ADF operation for wet and dry season is shown in the table below.

Table 2-50. Summary of Emission Inventory

Dust Emission Calculations			
1	**Truck Unloading (veh/hr)**	4	Estimated maximum truck flow
	Truck Volume (Mg)	10	Estimated
	Total Material Handling (Mg/hr)	40	Calculated
	Dust mitigation efficiency (%)	75	For four times daily watering
	TSP emission rate (kg/hr)	**0.0050**	Calculated based on AP-42 Table 11.9-4, Refer to Equation (1)
	PM10 emission rate (kg/hr)	**0.0043**	Assumed 86% of TSP Value
	PM2.5 emission rate (kg/hr)	**0.00301**	Assumed 70% of PM10 Value
2	**Truck Loading**		
	2-way truck flow (veh/hr)	4	Estimated maximum truck flow
	Truck volume (Mg)	10	Estimated
	Total material handling (Mg/hr)	40	Calculated
	Dust mitigation efficiency (%)	75	Four times daily watering
	TSP emission rate (kg/hr)	**0.090**	Calculated based on AP-42 Table 11.9-4, Refer to Equation (2)
	PM10 emission rate (kg/hr)	**0.0774**	Assumed 86% of TSP Value
	PM2.5 emission rate (kg/hr)	**0.0542**	Assumed 70% of PM10 Value

Dust Emission Calculations			
3	**Bulldozing**		
	Moisture content (%)	7.9	Mean value from AP-42 Table 11.9-3
	Silt content (%)	6.9	Mean value from AP-42 Table 11.9-3
	Dust mitigation efficiency (%)	75	Four times daily watering
	TSP emission rate (kg/hr)	**0.449**	Calculated based on AP-42 Table 11.9-2, Refer to Equation (3)
	PM10 emission rate (kg/hr)	**0.386**	Assumed 86% of TSP Value
	PM2.5 emission rate (kg/hr)	**0.271**	Assumed 70% of PM10 Value
4	**Vehicle traffic on unpaved road**		
	Silt content (%)	4.3	Mean value from AP-42 Table 11.9-3
	Moisture content (%)	2.4	Mean value from AP-42 Table 11.9-3
	Average weight of vehicle (Mg)	36	Estimated
	2-way truck flow (veh/hr)	4	Estimated maximum truck flow
	Average one-way travel distance w/in the site	1	Estimated
	Dust mitigation efficiency (%)	75	Four times daily watering
	Dust reduction due to speed control (%)	50	Speed limit reduced to 10 km/hr
	TSP emission rate (kg/hr)	**0.066**	Calculated based on AP-42 Sec 13.2.2, Refer to Equation (4)
	PM10 emission rate (kg/hr)	**0.030**	Calculated based on AP-42 Sec 13.2.2, Refer to Equation (4)
	PM2.5 emission rate (kg/hr)	**0.021**	Assumed 70% of PM10 Value
5	**Site erosion**		
	TSP emission rate (Mg/ha/yr)	0.85	AP-42 Table 11.9-4
	Total site area (m2)	208,300	Estimated
	Percentage exposed active work area (%)	20	Estimated
	Dust mitigation efficiency (%)	75	Four times daily watering
	TSP emission rate (kg/hr)	**0.101**	Calculated
	PM10 emission rate (kg/hr)	**0.087**	Assumed 86% of TSP Value
	PM2.5 emission rate (kg/hr)	**0.061**	Assumed 70% of PM10 Value
	Total TSP emissions	0.712	kg/hr
		$4.745E^{-6}$	$g/s/m^2$
	Total PM10 emissions	0.585	kg/hr
		$3.899E^{-6}$	$g/s/m^2$
	Total PM2.5 emissions	0.061	kg/hr
		$4.056E^{-7}$	$g/s/m^2$

Modeling Scenarios

Two modeling scenarios are considered in this study, the wet and dry season in case of accidents. The scenarios include emission caused by wind/site erosion from the stock pile in the ADF. The emissions from materials handling, bulldozing, and vehicle movement in the ADF is also included. All of these activities are included in the modeling during wet and dry season

The scenarios are described below:

- Scenario 1: ADF under dry season (November to April)
- Scenario 2: ADF under wet season (May to October)

Modeling Results

The maximum predicted ground level concentrations from the proposed ADF of MGCP are shown in the table below using on-site preprocessed MM5 meteorological data (Surface and Upper File Air Data) from the period January 1 – December 31, 2017. The contour plots showing the spatial distributions of the maximum predicted concentrations are also provided in the succeeding figures. The results of the modeling per averaging period and per season are discussed below.

Table 2-51. Summary of Modeling Results

Parameters	Averaging Period	Scenario	Maximum Predicted Concentration (µg/m3)	CAA Limit (µg/Nm3)
TSP	1-hour	Dry Season	169.22	300
	24-hour		53.28	230
	1-hour	Wet Season	169.80	300
	24-hour		63.15	230
PM10	1-hour	Dry Season	139.05	200
	24-hour		43.78	150
	1-hour	Wet Season	139.53	200
	24-hour		51.89	150
PM2.5	24-hour	Dry Season	4.55	50
	Annual		1.08	25
	24-hour	Wet Season	5.40	50

Modeling Results for 1-hour and 24-hour Averaging Period

<u>1-hour Averaging Period Dry Season</u>

The spatial distribution of predicted TSP and PM10 concentration for 1-hour averaging period during dry season shows that the most common concentrations are less than 8 µg/m3; and 5 µg/m3, respectively. The results of the modeling may be summarized as follows:

- No exceedances of the relevant National Ambient Air Quality Standards for Source-Specific Air Pollutants (NAAQSSSP) values are predicted by the modeling for TSP and PM10 in the whole modeling domain and in any of air sensitive receptors (**Table 2-51**).

- The highest 1-hour predicted concentrations of TSP and PM10 is 169.23 µg/m^3 and 19.05 µg/m^3, respectively and is located at coordinates 224203.50 m E. 1598948.00 m N. at approximately 235 meters southeast from the center of ADF.

- The contour figures (**Figure 2-110** and **Figure 2-111**) generally show that impacts of particulate emission from ADF is within the plant project site.

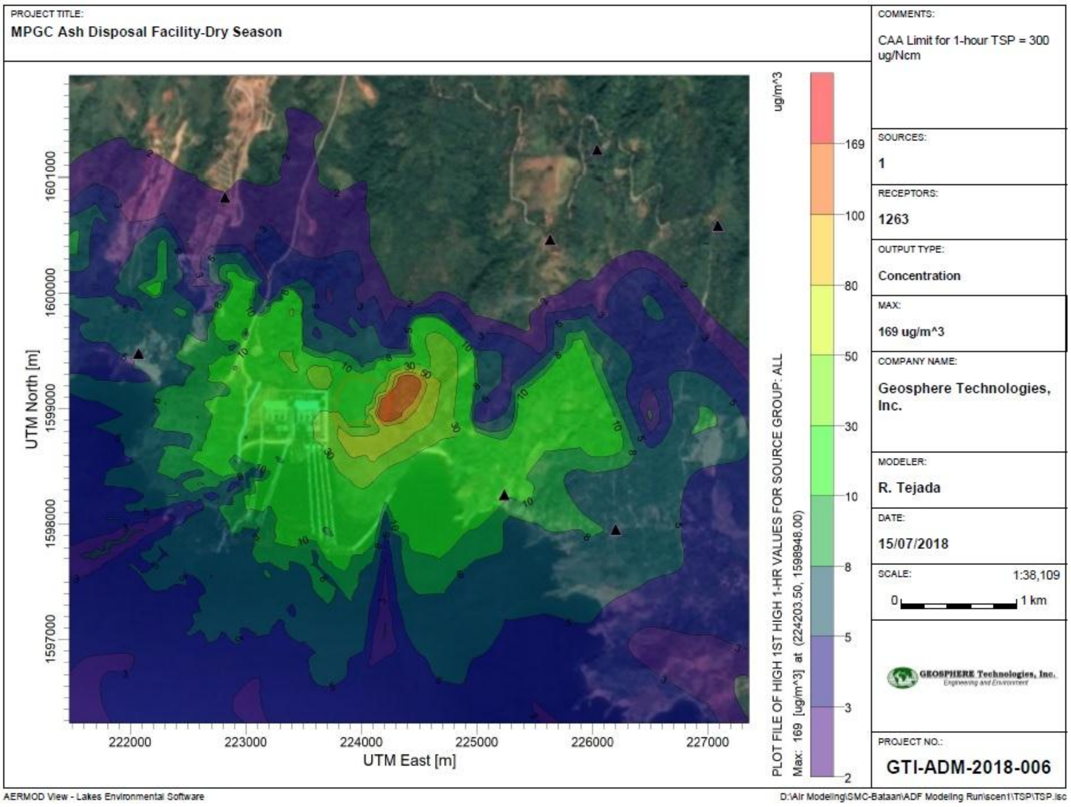


Figure 2-110. Highest 1-hour Average TSP Concentration (Dry Season) for the Modeled Year January 1 – December 31, 2017

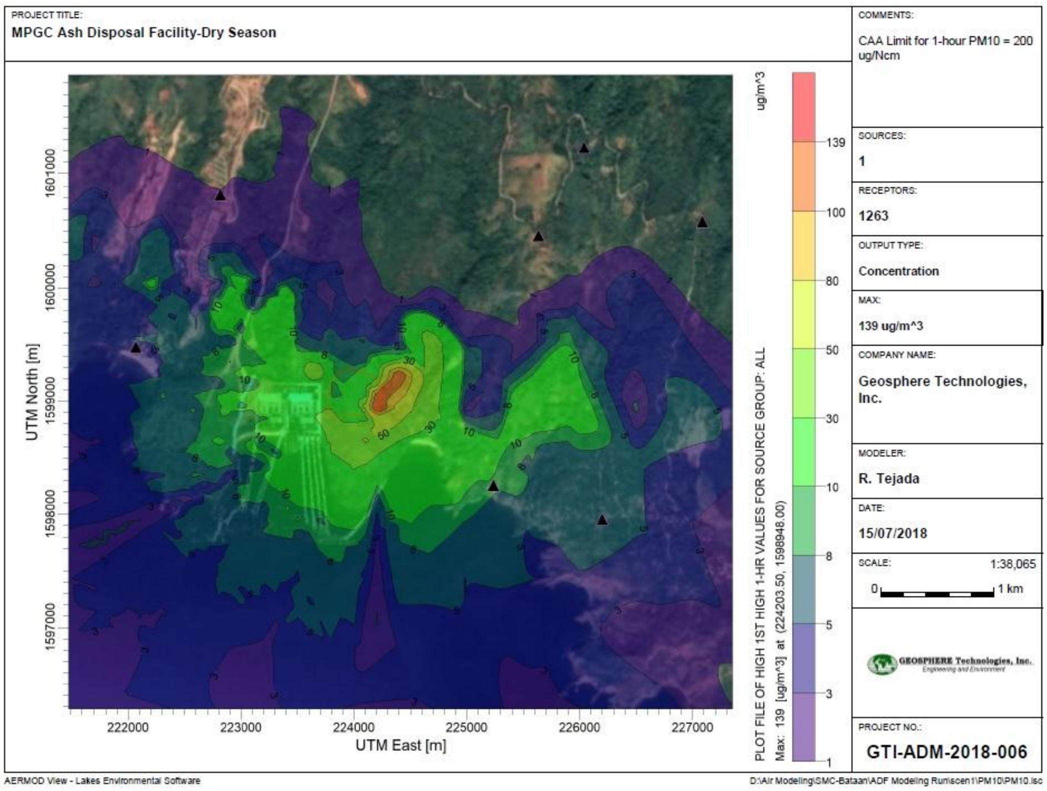


Figure 2-111. Highest 1-hour Average PM10 Concentration (Dry Season) for the Modeled Year January 1 – December 31, 2017

1-hour Averaging Period Wet Season

The spatial distribution of predicted TSP and PM10 concentration for 1-hour averaging period during dry season shows that the most common concentrations are less than 8 µg/m3 and 5 µg/m3, respectively. The results of the modeling may be summarized as follows:

- No exceedances of the relevant NAAQSSSP values are predicted by the modeling for TSP and PM10 in the whole modeling domain and in any of air sensitive receptors (**Table 2-51**).

- The highest 1-hour predicted concentrations of TSP and PM10 is 169.80 µg/m3 and 139.53 µg/m3, respectively and is located at coordinates 224203.50 m E. 1598948.00 m N. at approximately 235 meters southeast from the center of ADF.

- The contour figures (**Figure 2-112** and **Figure 2-113**) generally show that impacts of particulate emission from ADF is within the plant project site.

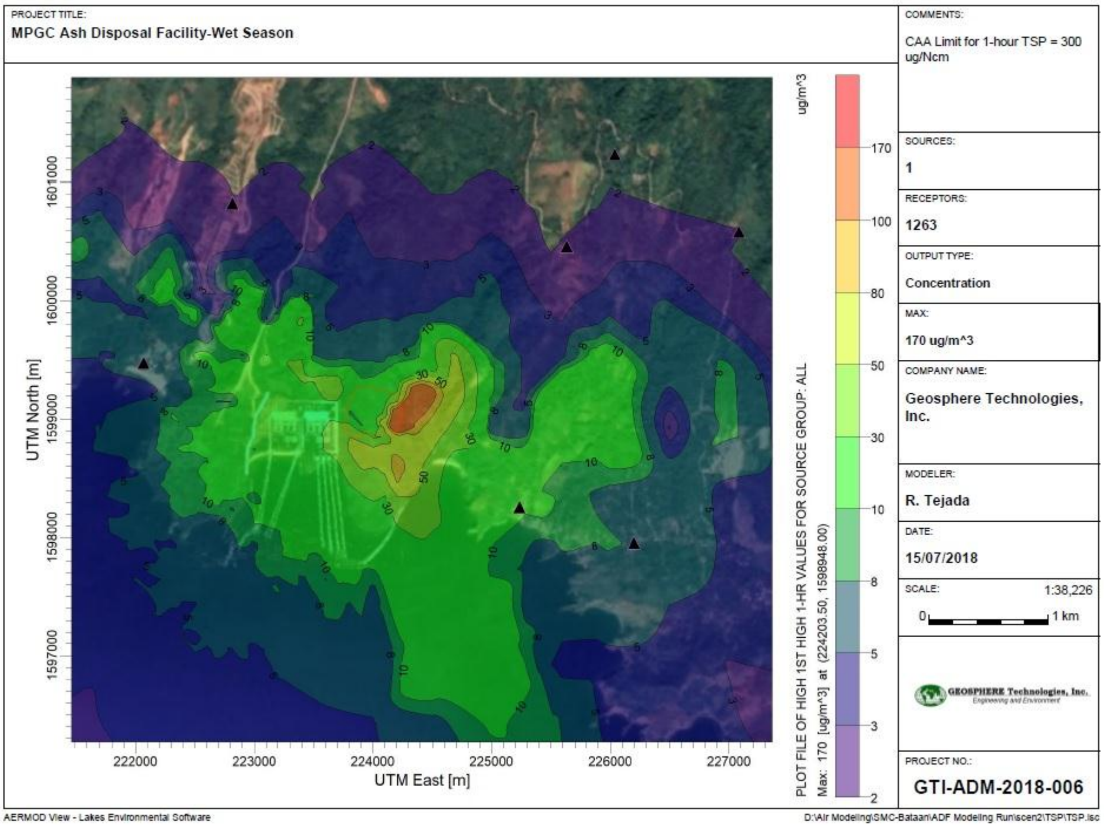


Figure 2-112. Highest 1-hour Average TSP Concentration (Wet Season) for the Modeled Year January 1 – December 31, 2017

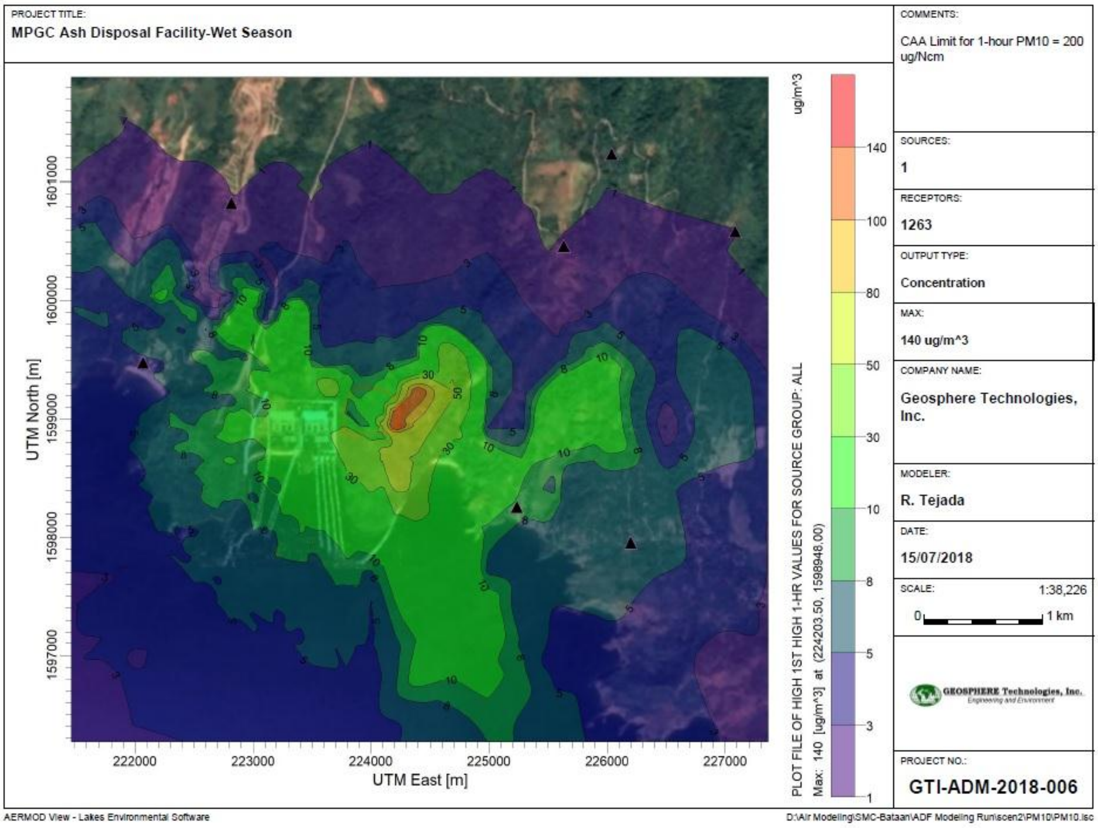


Figure 2-113. Highest 1-hour Average PM10 Concentration (Wet Season) for the Modeled Year January 1 – December 31, 2017

24-hour Averaging Period Dry Season

The spatial distribution of predicted TSP, PM_{10}, and $PM_{2.5}$ concentrations for 24-hour averaging period during dry season shows that the most common concentrations are less than 3 µg/m^3, 1 µg/m^3 and 0.08 µg/m^3, respectively. The results of the modeling may be summarized as follows:

- No exceedances of the relevant National Ambient Air Quality Guideline Values (**NAAQGV**) values are predicted by the modeling for TSP, PM10, and PM2.5 in the whole modeling domain and in any of air sensitive receptors (**Table 2-51**).

- The highest 1-hour predicted concentrations of TSP, PM_{10}, and $PM_{2.5}$ is 53.28 µg/m^3; 43.78 µg/m^3; and 1.08 µg/m^3, respectively and is located at coordinates 224203.50 m E. 1598948.00 m N. at approximately 235 meters southeast from the center of ADF.

- The contour figures (**Figure 2-114** to **Figure 2-116**) generally show that impacts of particulate emission from ADF is within the plant project site.

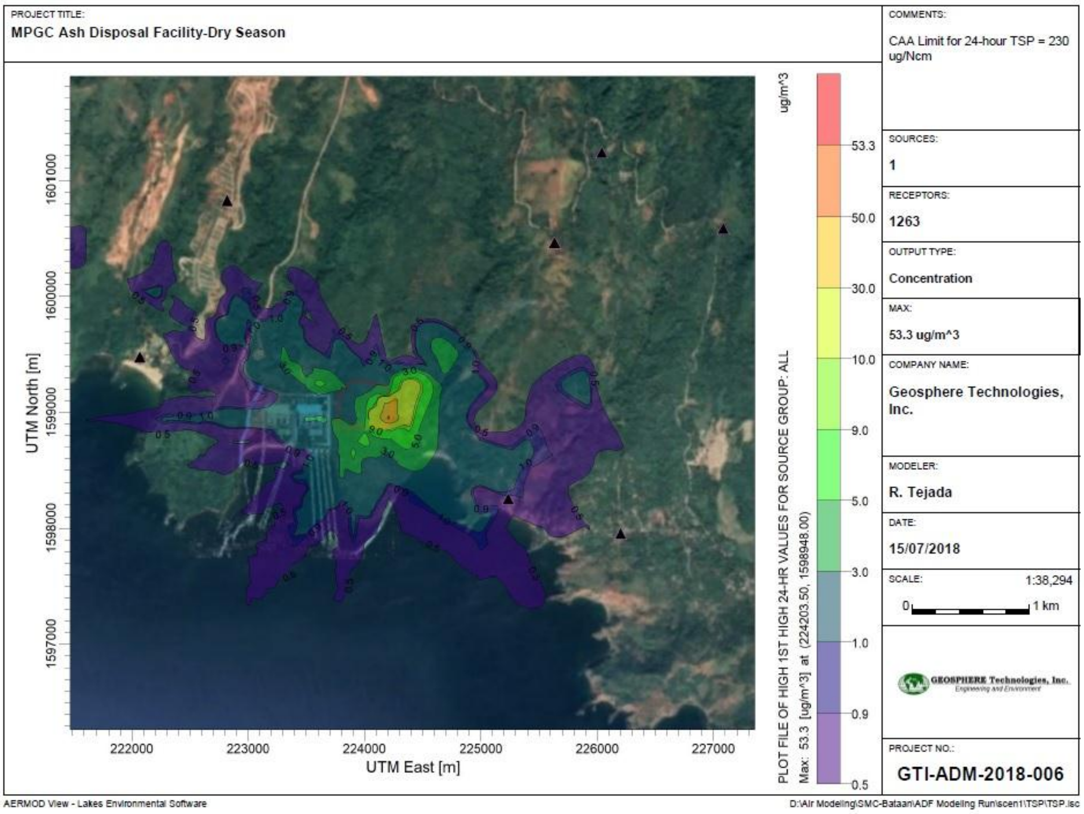


Figure 2-114. Highest 24-hour Average TSP Concentration (Dry Season) for the Modeled Year January 1 – December 31, 2017

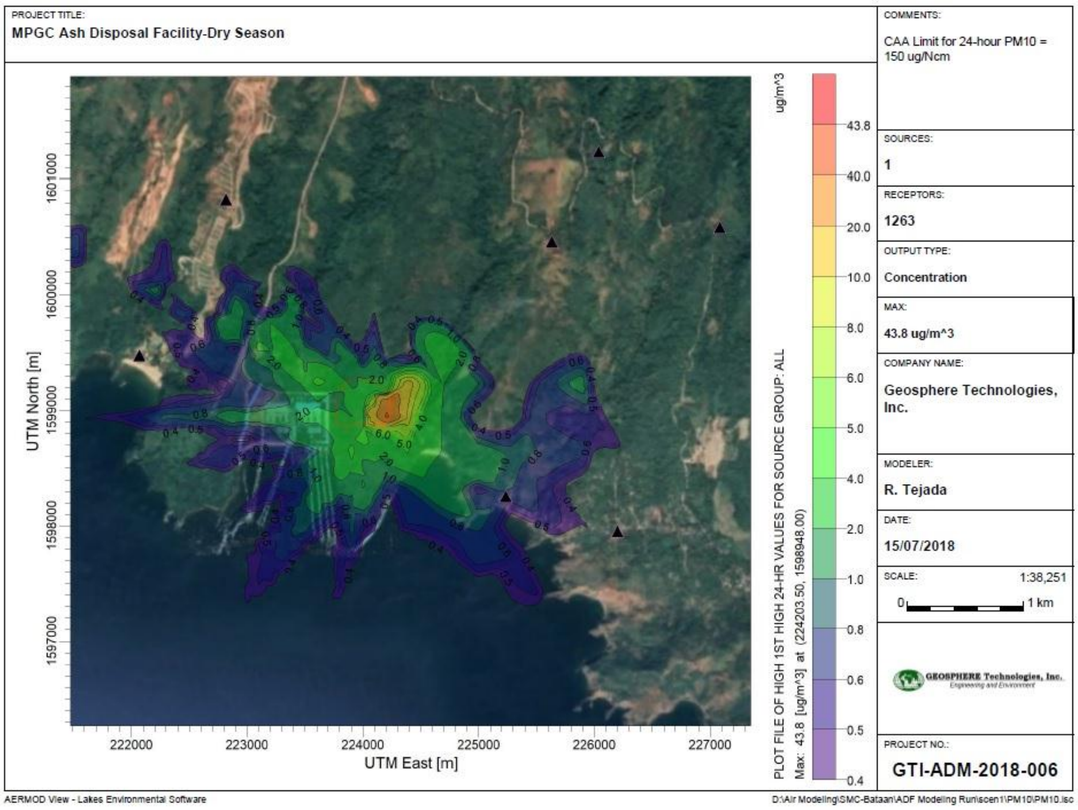


Figure 2-115. Highest 24-hour Average PM10 Concentration (Dry Season) for the Modeled Year January 1 – December 31, 2017

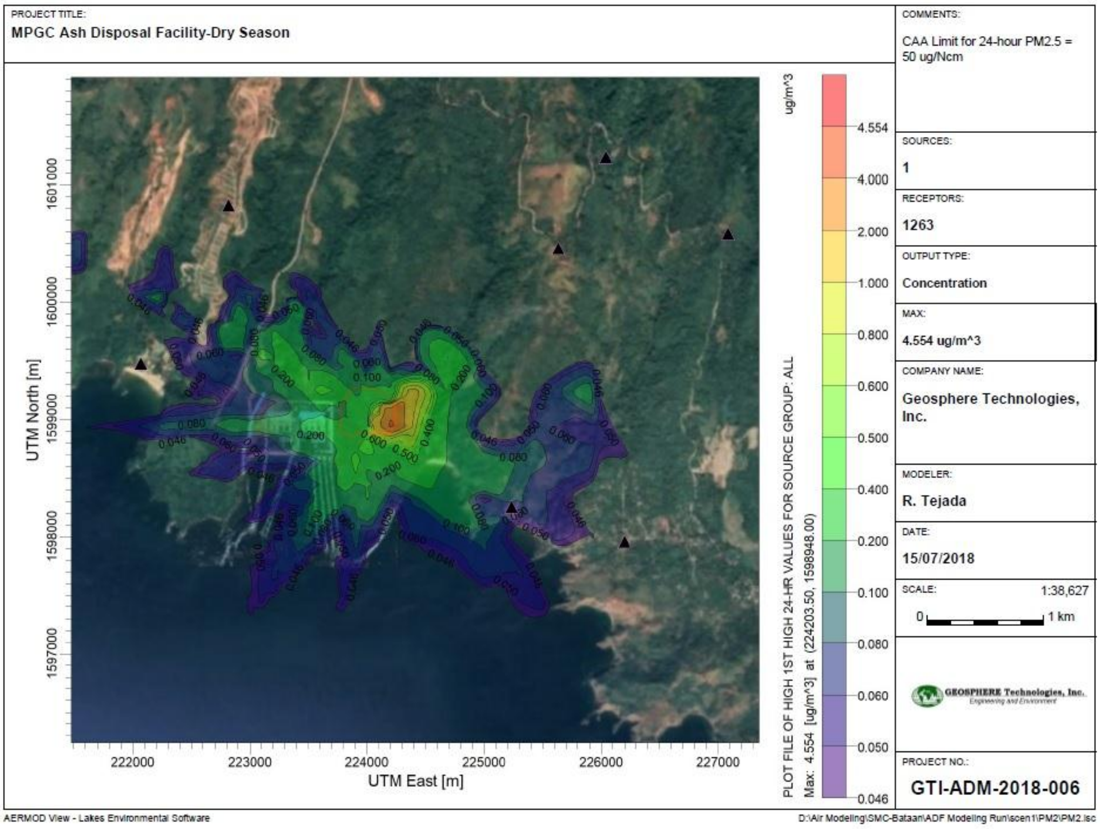


Figure 2-116. Highest 24-hour Average PM2.5 Concentration (Dry Season) for the Modeled Year January 1 – December 31, 2017

<u>24-hour Averaging Period Wet Season</u>

The spatial distribution of predicted TSP, PM_{10}, and $PM_{2.5}$ concentrations for 24-hour averaging period during dry season shows that the most common concentrations are less than 3 µg/m^3; 1 µg/m^3 and 0.08 µg/m^3, respectively. The results of the modeling may be summarized as follows:

- No exceedances of the relevant NAAQGV values are predicted by the modeling for TSP, PM10, and PM2.5 in the whole modeling domain and in any of air sensitive receptors (**Table 2-51**).

- The highest 1-hour predicted concentrations of TSP, PM_{10}, and $PM_{2.5}$ is 63.15 µg/m^3, 51.89 µg/m^3 and 5.40 µg/m^3, respectively and is located at coordinates 224203.50 m E. 1598948.00 m N. at approximately 235 meters southeast from the center of ADF.

- The contour figures (**Figure 2-117** to **Figure 2-119**) generally show that impacts of particulate emission from ADF is within the plant project site.

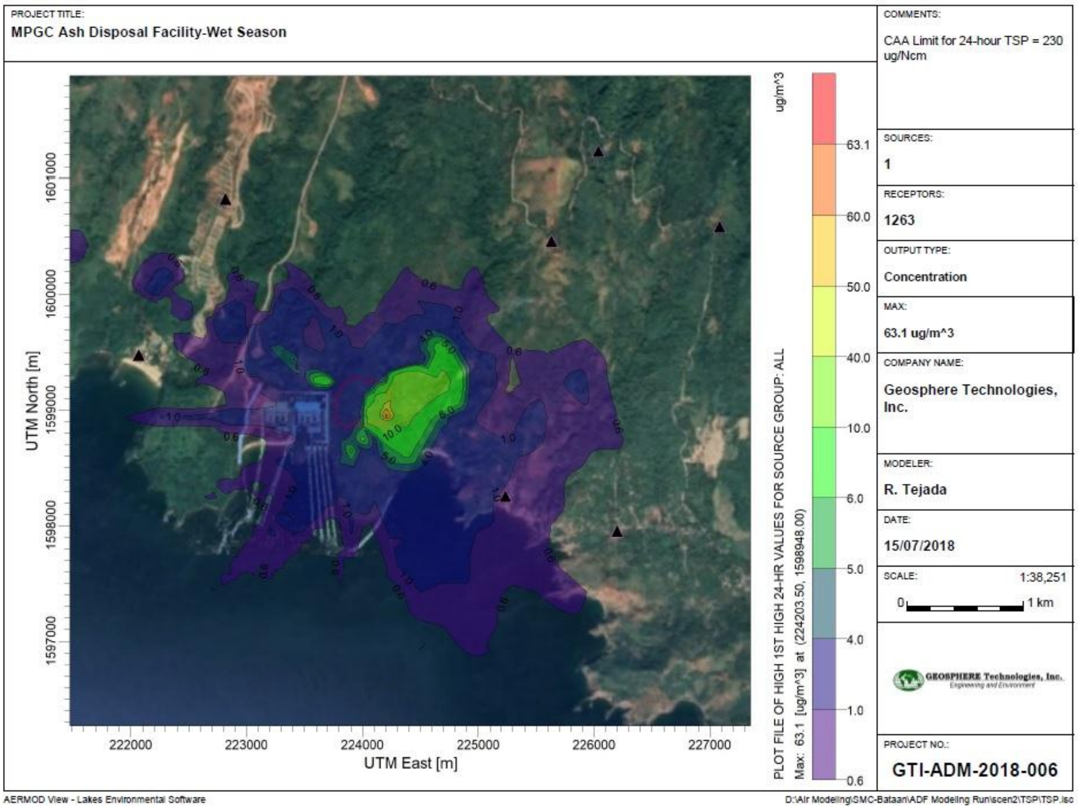


Figure 2-117. Highest 24-hour Average TSP Concentration (Wet Season) for the Modeled Year January 1 – December 31, 2017

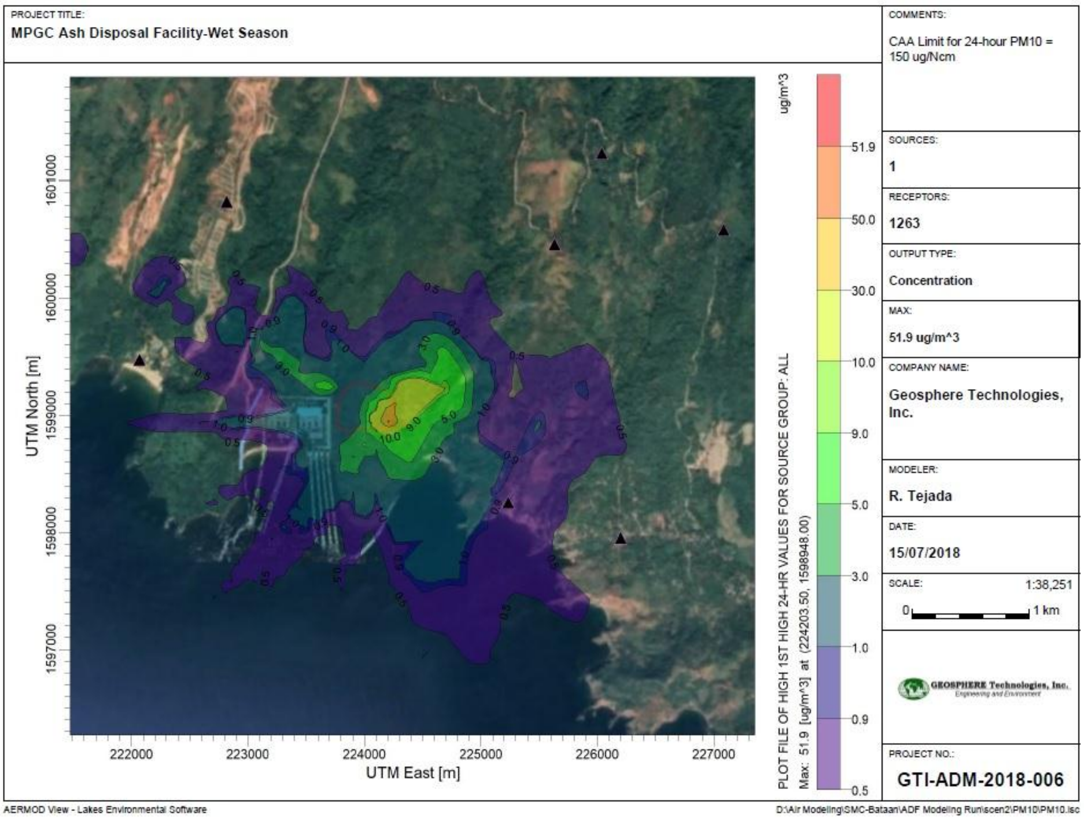


Figure 2-118. Highest 24-hour Average PM10 Concentration (Wet Season) for the Modeled Year January 1 – December 31, 2017

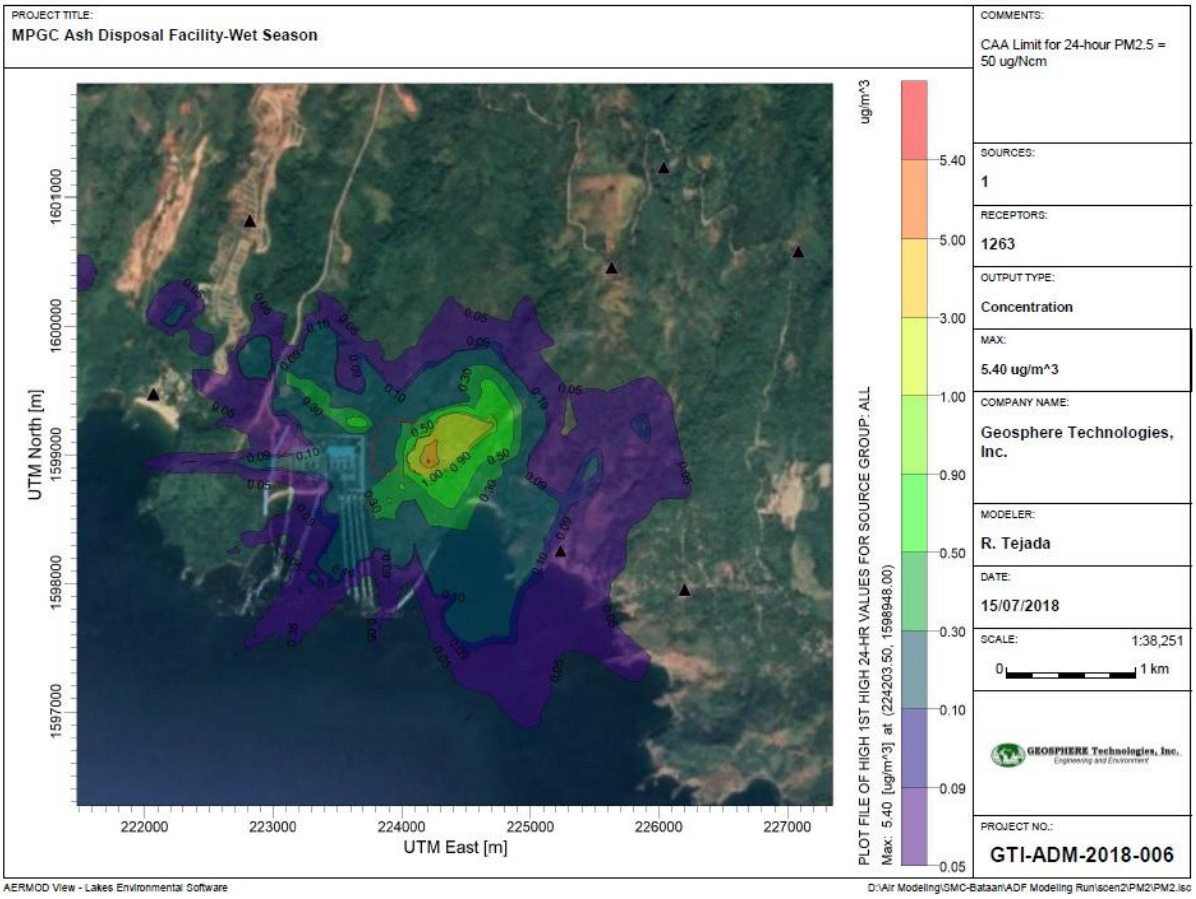


Figure 2-119. Highest 24-hour Average PM2.5 Concentration (Wet Season) for the Modeled Year January 1 – December 31, 2017

2.3.2.4 Noise Levels

Noise levels were measured at the sampling stations established for ambient air quality monitoring on August 1-4, 2016. As shown in the results are provided in **Table 2-52**, the median noise levels at four (4) sampling stations exceed the noise standards for commercial, school and residential areas pursuant to the noise levels standard as prescribed in Section 78, Table 1 of the 1978 NPCC Rules and Regulations, Environmental Quality Standard for Noise in General Areas.

Major sources of noise during sampling are waves motorboats, wind blows and sounds from birds, insects and other animals.

Table 2-52. Results of 24-Hour Noise Level Monitoring, August 1-4, 2016

Sampling Period	Date	Time	Median SPL db(A)	DENR Standards *
Station 1: About 20 meters away from the Bagac-Mariveles Road north of the project				
Morning	August 2, 2016	0746H-0750H	65.8	60
Daytime	August 2, 2016	1340H-1345H	65.1	65
Evening	August 1, 2016	1832H-1837H	63.8	60
Nighttime	August 1, 2016	2230H-2235H	58.9	55
Station 2: Barangay Hall of Lower Biaan east of the project site				

Sampling Period	Date	Time	Median SPL db(A)	DENR Standards *
Morning	August 3, 2016	0700H-0705H	63.6	60
Daytime	August 3, 2016	1152H-1158H	60.8	65
Evening	August 2, 2016	1900H-1905H	64.4	60
Nighttime	August 2, 2016	2200H-2206H	61.2	55
Station 3: Biaan Aeta Integrated School, northeast of the project site				
Daytime	August 4, 2016	0940H-0945H	59.5	50
Station 4: Porto del Sol Subdivision, east-northeast of the project site				
Daytime	August 4, 2016	1200H-1205H	62.9	55

Source: Noise Measurement, GEOSPHERE Technologies, 2016
Note: Noise standard applied are Class A-residential area as prescribed in Section 78, Table 1 of the 1978 NPCC Rules and Regulations, Environmental Quality Standard for Noise in general areas.

2.3.2.4.1 Generation of Noise during Construction Phase

During construction phase, noise will be generated by the construction equipment for earth moving activities. Trucks will be used to haul the removed materials that cannot be stockpiled or disposed on-site and to bring in necessary materials for construction. Typical construction vehicles include bucket trucks, cranes or digger derricks, backhoes, pulling machines, pole trailers, or dumpsters. Foundation structures are constructed using a standard drill rig to bore a hole to the required depth. If water is encountered, pumps will be used to move the water either to adjacent low land areas or to waiting tanker trucks for proper disposal. After the construction is completed, the project area is graded up to the desired level and cleaned up.

All of these operations produce noise that may impact adjacent communities/residential areas within the immediate vicinity of the project. However, normal work schedules usually restrict noise producing activities to daytime hours.

The power mechanical equipment typically used during construction and the corresponding equivalent sound power levels are presented in **Table 2-53**. As a worst case scenario for this modeling, it is assumed that all equipment listed are running at the same time during construction. The predicted noise measurement for construction activities were determined by summing logarithmically the sound power levels. Since there is no EMB published noise modeling guidelines and procedures, the computation used are based on international technical guidelines and procedures.

This assessment was carried out based upon the preliminary estimates of likely construction activities, plant selection and utilization. In the absence of reference, the noise data for individual items of construction equipment in terms of source Sound Power Level (PWL) was taken from Hong Kong Environmental Protection Department's "Technical Memorandum on Noise from Construction Work other than Percussive Piling and Technical Memorandum of Noise from Percussive Piling."

An inventory of typical equipment items expected to be used during the construction phase and their indicative sound power levels are presented **Table 2-53**.

Table 2-53. Equivalent PWL of Power Mechanical Equipment during Construction Phase

Power Mechanical Equipment	PWL [dB(A)]
Jackhammer	104
Chipping gun	93
Air compressor	96
Bulldozer	89
Lejeune gun	89

Power Mechanical Equipment	PWL [dB(A)]
Backhoe	86
Forklift	85
Hand hammer	85
Welding torch	84
Chopsaw	80
Truck	78
Heavy-duty bulldozer	99
Crawler crane <35 ton Non-insulated cab	94
Laborers	90
Power shovel	88
Shop work	95
Rubber tired crane, <35 ton Insulated cab	81
Truck-mounted crane	79
Tower crane	74
Dozer	102
Paver	90
Front-end loader	90
Roller	98
Heavy equipment	90
Gravel plant	102
Crane	99

Source: Neitzel, R., N. Seixas, M. Yost, and J. Camp., 1998

The total estimated sound power level for all construction equipment is 109.9 dB(A). The modeling guidelines used is the Technical Memorandum on Noise of Hongkong Environmental Protection Department, Noise Control Authority. Noise levels shall be summed in a pairwise fashion and the final total rounded to the nearest whole dB(A), with values of 0.5 or more being rounded up.

Table 2-54 shows the summation of noise levels. The summed noise assumed to be at the center of the project site.

Table 2-54. Summation of Noise Levels

Difference in dB(A) Between Two Noise Levels Being Summed	Amount in dB(A) to Add to the Higher Noise Level
0 to 0.5	3.0
1.0 to 1.5	2.5
2.0 to 3.0	2.0
3.5 to 4.5	1.5
5.0 to 7.0	1.0
7.5 to 12.0	0.5
More than 12.0	0

Source: Technical Memorandum on Noise, Hongkong Environmental Protection Department

The total power level takes into account assumed maximum numbers of equipment and an assumed ‘on-time’ for the equipment, that is, period in percentage terms during which the equipment will be operating. Construction activities are predicted to be in worst case scenario where 24-hour operation is expected. Noise prediction for construction activities in the Project was derived using CUSTIC 2.0 modeling software, which is capable of executing predicted noise contours showing sound pressure as it moves away from the source.

Noise Sensitive Receivers

Noise sensitive receiver (NSR) are the locations or areas where dwelling units or other fixed, developed sites frequent human use occur. The description, coordinates and locations of the selected NSR are provided in **Table 2-55** and **Figure 2-120**.

Table 2-55. Description, Distance, Direction, and Coordinates of the NSRs

Modeling ID	Description	Distance from the Source	Direction	UTM Coordinates	
				Easting, (m)	Northing, (m)
NSR-1	Camaya Coast "The Boracay of Bataan"	951	NW	222051	1599478
NSR-2	Camaya Residential Subdivision Area	1,698	N	223611	1602788
NSR-3	Biaan Elementary School	3,514	ENE	225618	1600467
NSR-4	Biaan Aeta Integrated School	4,289	NE	226014	1601246
NSR-5	Porto del Sol Subdivision	3,685	ESE	226181	1597963
NSR-6	Lower Biaan	2,725	ESE	225260	1598218

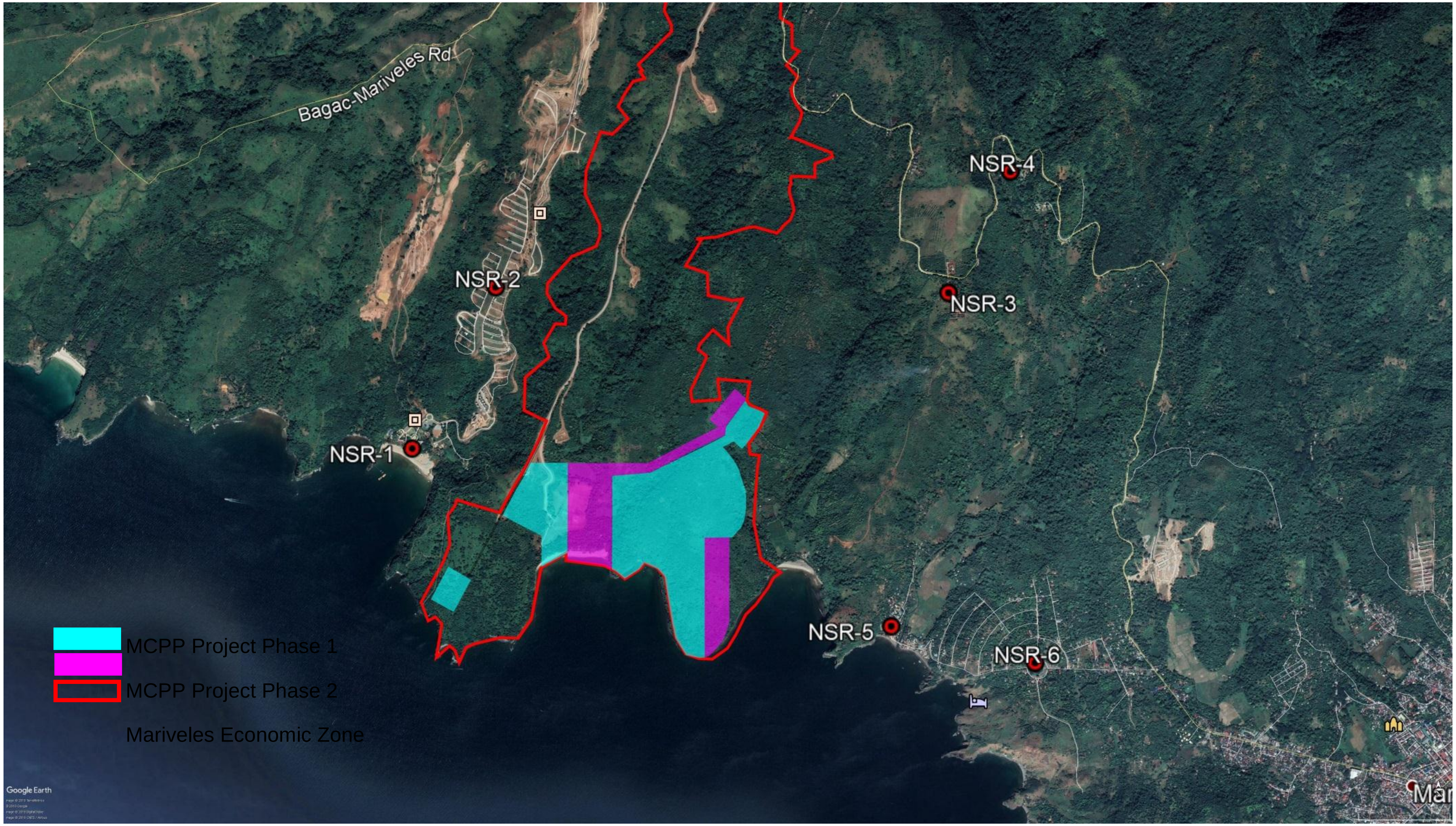


Figure 2-120. Location of Noise Sensitive Receptors

Modeling Input Data

The following input data were used to execute the noise simulation for the construction phase of the proposed MCPP Project:

- External source: External means a noise source placed out of a building (for example, a vehicle engine).
- Noise power (dB): This is the noise power at source position in decibels.
- Ambient Data: Ambient conditions are defined by the land and atmospheric conditions in the vicinity of the pollutant emission.
- Terrain – the data will use to draw topographical lines.
- Scale command – Use to set the scale in the X-axis width (in meters).

The Scale use for the model is 1000 m x 1000 m which is a scale view of CUSTIC 2.0. The following assumptions were made to execute the model:

- Ambient Temperature - 30°C
- Relative Humidity – 90%
- Frequency – 500 Hz

Noise Modeling Results

Presented in **Table 2-56** is the predicted sound pressure level at each receiver. The modeling result shows that the allowable noise level in all NSRs are within the standard, therefore noise emission during preconstruction and construction is not expected to cause significant impacts to the surrounding environment. The simulation is on 24-hours continuous operation. The predicted noise contour is presented in **Figure 2-121**.

Table 2-56. Predicted Noise Level at Nearest Sensitive Receiver during Construction

Station No	Description/ Identification	Distance from the Project Site, (m)	Predicted Noise Level, dB(A)	Allowable Noise Level, dB(A)		
				Daytime	Morning/ Evening	Nighttime
NSR-1	Camaya Coast "The Boracay of Bataan"	951	20.90	55	50	45
NSR-2	Camaya Residential Subdivision Area	1,698	11.14	55	50	45
NSR-3	Biaan Elementary School	3,514	2.38	55	50	45
NSR-4	Biaan Aeta Integrated School	4,289	0.0	55	50	45
NSR-5	Porto del Sol Subdivision	3,685	0.15	55	50	45
NSR-6	Lower Biaan	2,725	14.64	55	50	45

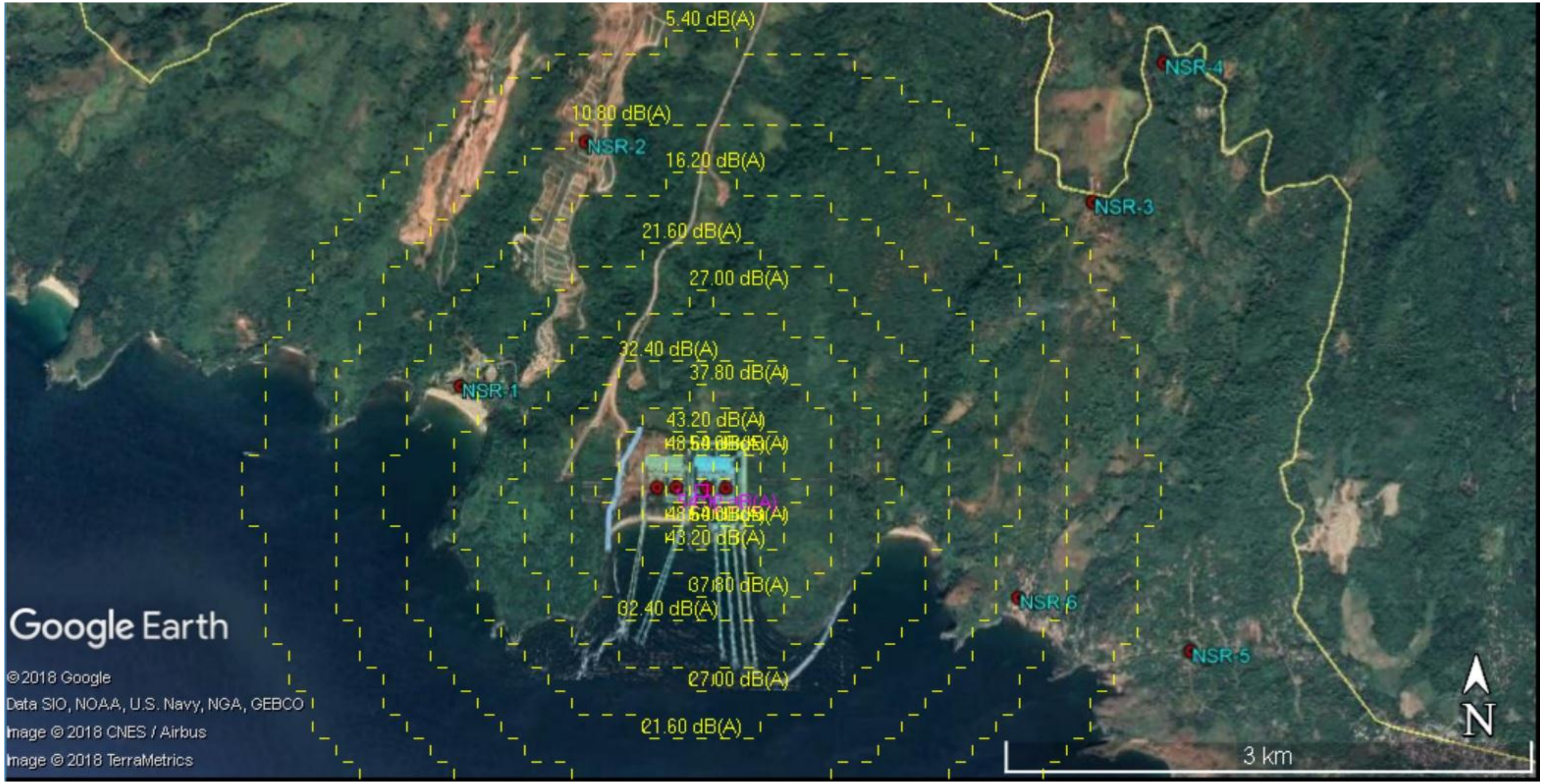


Figure 2-121. Predicted Noise Contour during Construction of the Proposed Project

Management and Mitigation Measures

MPGC shall consider the following measures prior to commencement of construction activities:

- Scheduling certain high noise emitting works to more acceptable times of day;
- Use of the most environmentally acceptable equipment which are properly maintained and silenced;
- Use of the least intrusive method of work;
- Proper instruction and supervision of staff; and
- Acoustic screening.

The following are the noise control measures that will be applied for the protection of employees working on site as well as the nearest sensitive receptor:

- It is advisable that electrically powered plant shall be preferred, where practicable, to mechanically powered alternatives. If mechanical powered plant will be used, it shall be fitted with suitable silencers and mufflers;
- Defective equipment/parts with abnormal noise and/or vibration will be either repaired replaced;
- Schedule the use of equipment/machines emitting high noise like pile driver during day time operation while, minimize use during night time operation;
- All employees working on site shall be provided with proper ear protectors;
- During truck transport along or beside the residential area, traffic transportation will be limited during night operation; and
- The Contractor shall comply with all current statutory environmental legislation at all times.

2.3.2.4.2 Generation of Noise during Operation

The sound power level during operation was assumed to be at steady state base load and bypass operations and will not consider following activities:

- Commissioning phase;
- Failure conditions;
- Emergency conditions; and
- Other abnormal operating conditions.

The sound power levels derived/anticipated for each equipment item identified during the operation of the proposed Project were based on the given equipment noise data/sizes/dimensions extracted from an existing Noise Assessment of a coal-fired power plant, as described in **Table 2-57**. However, it is advised that the detailed design shall be updated to reflect equipment data whenever the design changes.

Table 2-57. Equivalent PWL of Power Mechanical Equipment during Operation Phase

Power Mechanical Equipment	PWL, dB(A)
Main steam boiler	103.6
Steam turbine generator unit	110.2
Transformer	87.3
Boiler feed pump, Pumps	107.7
- Main/aux oil pumps	98.8
- Chemical injection system	86.8
- Condensate pump	100.1
- Oil pump	98.7
- Other	89.8
- Vacuum pumps	100.2

Power Mechanical Equipment	PWL, dB(A)
- Cooling water pump	99.6
Air compressor (instruments)	114.3
Air compressor (service)	109.5
- General operations (materials handling)	105.8
- General operations (Coal crushing and screening)	102.1
- General operations (Conveyors)	67.1
- General operations (Fans)	111.6

Source: Noise Assessment of a coal-fired power plant in the Erongo Region, Namibia, Airshed Planning Professionals (Pty) Ltd., South Africa, May 2012

The total estimated sound power level for all assumed operation equipment was 102.1 dB(A). Predicted noise was carried out using CUSTIC 2.0 noise model.

Modeling Input Data

The following input data were used to execute the noise simulation for the proposed Project:

- Internal source such as boiler, turbine, ash handling, compressors or any other noise source placed inside of a building.
- Noise power (dB): This is the noise power at source position in decibels.
- Ambient Data: Ambient conditions are defined by the land and atmospheric conditions in the vicinity of the pollutant emission.
- Terrain – the data will use to draw topographical lines.
- Scale command – Use to set the scale in the X-axis width (in meters)

The Scale use for the model is 1200 m x 1200 m grid which is a scale view of CUSTIC 2.0. The following assumptions were made to execute the model:

- Ambient Temperature - 30°C
- Relative Humidity – 80%
- Frequency – 500 Hz

Noise Modeling Results

The predicted noise levels in all sensitive receptors for the operation of the proposed MCPP Project, as exhibited in **Table 2-58**, are all below the noise condition during daytime, morning/evening and night time. Therefore, the noise contribution from the operation of the Project is not expected to cause any significant noise impacts to the surrounding environment. The predicted noise contours for the operation is presented in **Figure 2-122**.

Table 2-58. Predicted Noise Level at Nearest Sensitive Receiver for Operation

Station No	Description/ Identification	Distance from the Project Site, (m)	Predicted Noise Level (SPL), dB(A)	Allowable Noise Level, dB(A)		
				Daytime	Morning/ Evening	Nighttime
NSR-1	Camaya Coast "The Boracay of Bataan"	951	13.20	55	50	45
NSR-2	Camaya Residential Subdivision	1,698	3.44	55	50	45
NSR-3	Biaan Elementary School	3,514	0.0	55	50	45
NSR-4	Biaan Aeta Integrated School	4,289	0.0	55	50	45
NSR-5	Porto del Sol Subdivision	3,685	0.0	55	50	45
NSR-6	Lower Biaan	2,725	6.94	55	50	45

Station No	Description/ Identification	Distance from the Project Site, (m)	Predicted Noise Level (SPL), dB(A)	Allowable Noise Level, dB(A)		
				Daytime	Morning/ Evening	Nighttime

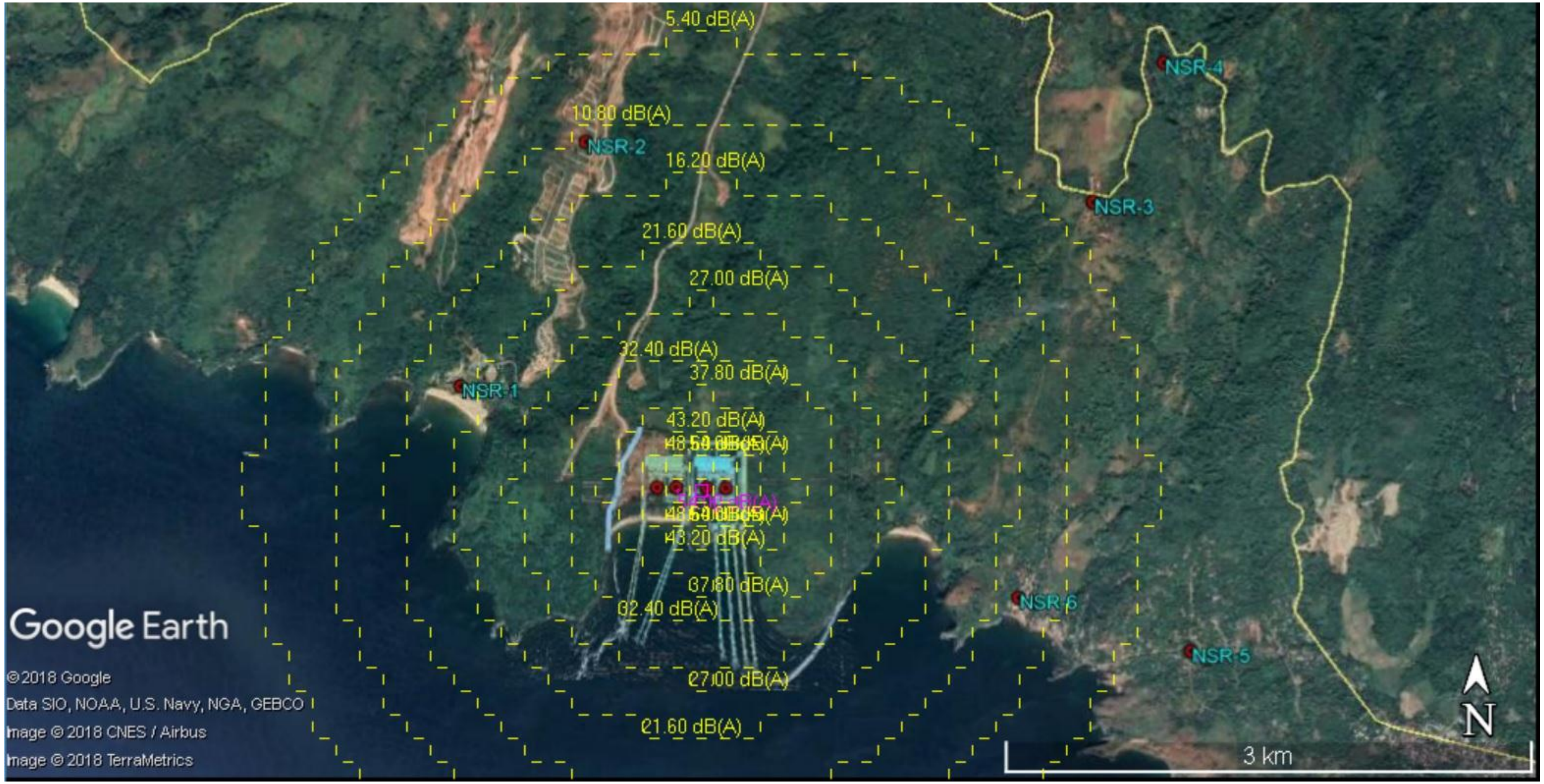


Figure 2-122. Predicted Noise Contour during Operation of Proposed Project

Management and Mitigation Measures

The external equipment to be installed in the proposed Project guarantees noise levels less than 85 dB(A) when measured at 1.5 m while noise sources that may have higher noise level will be installed inside the powerhouse building.

The following equipment will be installed with noise reduction measures:

- Pneumatic control valves will be certified by relevant International codes and standards. Control valve will automatically return to safe/pre-determined position upon signal and/or air supply failure until the process operating requirements or the system will dictate to stay put response. A digital positioner will be supplied in the DCS which will be equipped with two way HART communication capable to communicate to the Plant Resource Manager (PRM) installed in the DCS. This ensures the general PWL will not exceed 85 dB(A) at one meter from surface of valve;
- In the air compressor system, air inlet silencer and filter will be installed to the air compressors to reduce noise;
- Air compressors and emergency diesel generators will be equipped with noise attenuation enclosures; and
- Steam turbine and boiler equipment will be enclosed and provided with silencers at the exhaust; and
- The steam drum, super heater and re-heater safety valves will be provided with an absorptive silencer.

Defective equipment/parts with abnormal noise and/or vibration will be either repaired or replaced.

Vibration Monitoring System will be considered to be installed for various equipment such as the Induced and Forced Draft Fans and boiler feed pumps.

2.4 PEOPLE

2.4.1 Demography

Mariveles is located in a cove in the southernmost tip of Bataan Peninsula. It is bounded in the East by Manila Bay and the North Channel separating it from Corregidor; in the south and the west by South China Sea; in the northwest by Bagac; and in the North by Limay. It is approximately 173km overland from Manila and just one (1) hour away by fast crafts. The municipality is predominantly hilly and mountainous. Its landscape is being dominated by the Mariveles Mountain whose highest peak, Pentigan towers as 1,388 masl.

2.4.1.1 Land Area, Population, Household Population, Population Density and Growth Rate

Mariveles Municipality and its eighteen (18) barangays belong to the partly urban areas in the Philippines. While some of the barangays developed modern urban structures, some others, especially those which are seated in the outlying areas, remained rural. Mariveles Municipality has an estimated land area of 15,930 ha, which is 12% of the total land area of Bataan and the third biggest municipality in the whole province in terms of land area. Barangay Biaan, the host barangay of the proposed MCPP Project, has the largest area covering 5,504 hectares or 34.55% of the municipality's total land area.

August 2015 population census conducted by the then National Statistics Office (NSO) and now the Philippine Statistics Authority (PSA) had recorded 127,536 persons in the Municipality of Mariveles, Bataan. The municipality has a total household population of 30,847 with a household size of 4.1. The five (5) most populous barangays are Alasasin, Camaya, Balon-Anito, Mt. View and Ipag. **Table 2-59** presents the land area and 2015 population per barangay of Mariveles.

Table 2-59 Land Area and Population per Barangay of Mariveles

Barangay	Land Area			Population	
	Area (ha)	Percentage	Classification	Number, 2015	Density
Alasasin	2,379.63	14.94%	Urban	15,047	632.33
Alion	651.78	4.09%	Rural	3,264	500.78
Balon-Anito	888.17	5.58%	Urban	12,286	1,383.29
Baseco	263.75	1.66%	Rural	4,581	1,737.53
Batangas II	558.12	3.50%	Urban	5,951	1,066.26
Biaan	5,504	34.55%	Rural	1,837	33.38
Cabcaben	1,629	10.23%	Urban	6,427	394.54
Camaya	912.37	5.73%	Urban	14,869	1,629.71
Ipag	662	4.16%	Urban	10,010	1,512.08
Lucanin	300	1.88%	Urban	5,169	1,723.00
Malaya	500	3.14%	Urban	4,910	982.00
Maligaya	692	4.34%	Rural	4,407	636.85
Mt. View	482.01	3.03%	Urban	10,461	2,170.29
Poblacion	31.43	0.20%	Urban	7,938	25,256.12
San Carlos	2.19	0.01%	Urban	1,517	29,686.89
San Isidro	25.64	0.16%	Rural	5,761	22,468.80
Sisiman	67.48	0.42%	Rural	6,221	9,219.03
Townsite	380.43	2.39%	Rural	6,880	1,808.48
Total Mariveles	15,390	100.00%		127,536	828.69
Total Bataan	137,300			760,650	554.01
Total Region III	1,823,080			11,218,177	615.34
Total Philippines	30,000,000			100,981,437	336.60

Note: Urban-rural barangay classification - barangay should have at least 1,000 inhabitants, the occupation is predominantly non-farming or fishing and/or meet the following: population density of at least 500 persons/sq.km or regardless of population with street pattern or network of streets, at least 6 establishments, at least 3 of the following: town hall, church, public plaza, park or cemetery, market place, school hospital or health center

Source: National Statistics Office, 2010 Census and Housing Population; Philippine Statistics Authority, Total Population by Province, City, Municipality and Barangay as of August 1, 2015; Socioeconomic Profile of Mariveles, 2016

The population of Mariveles, Bataan increased by 2.63% from 112,707 in 2010 to 127,536 in 2015. On the other hand, the population of Brgy. Biaan, the host barangay, increased by 3.39% from 1,571 in 2010 to 1,837 in 2015. **Table 2-60** presents the population history and annual growth rate per barangay of Mariveles from 2010-2015.

Table 2-60 Annual Growth Rates per Barangay of Mariveles

Barangay	Total Population		Annual Growth Rate (%)
	2010	2015	
Alasasin	11,606	15,047	5.93
Alion	3,015	3,264	1.65
Balon-Anito	10,255	12,286	3.96
Baseco	3,440	4,581	6.63
Batangas II	5,122	5,951	3.24
Biaan	1,571	1,837	3.39
Cabcaben	6,269	6,427	0.50
Camaya	12,077	14,869	4.62
Ipag	9,430	10,010	1.23
Lucanin	3,570	5,169	8.96
Malaya	5,211	4,910	-1.16
Maligaya	4,416	4,407	-0.04
Mt. View	8,843	10,461	3.66
Poblacion	8,074	7,938	-0.34
San Carlos	1,592	1,517	-0.94
San Isidro	5,816	5,761	-0.19
Sisiman	5,837	6,221	1.32
Townsite	6,563	6,880	0.97
Total Mariveles	112,707	127,536	2.63
Total Bataan	687,482	760,650	2.13
Total Region III	10,137,737	11,218,177	2.13
Total Philippines	92,337,852	100,981,437	1.87

Source: PSA 2015 Census of Population and Housing

2.4.1.2 Gender and Age Profile

In 2015, PSA had recorded a total population of 127,536 in Mariveles. The recorded data also shows that Mariveles had more males than females. The sex ratio or the number of males for every 100 females was 102. The proportion of the population aged 0 to 14 was 28.13%. The productive aged 15 to 64 years comprised 68.60% of the total population while only 3.27% of the population were 65 years old and above. **Table 2-61** and **Figure 2-123** present the Percent Distribution of Household Population by Age and Sex of Mariveles.

Table 2-61 Total Population by Age Group and Sex, 2015

Age Group	Number of Population		
	Total	Male	Female
Under 1	2,335	1,236	1,099
1 - 4	9,430	4,914	4,516
5 - 9	11,977	6,161	5,816
10 - 14	12,146	6,248	5,898
15 - 19	13,835	7,355	6,480
20 - 24	13,389	6,928	6,461
25 - 29	11,529	5,827	5,702

Age Group	Number of Population		
	Total	Male	Female
30 - 34	10,282	5,185	5,097
35 - 39	9,897	4,925	4,972
40 - 44	7,633	3,792	3,841
45 - 49	6,875	3,419	3,456
50 - 54	5,834	2,769	3,065
55 - 59	4,866	2,202	2,664
60 - 64	3,356	1,587	1,769
65 - 69	2,031	933	1,098
70 - 74	934	390	544
75 - 79	647	238	409
80 years and over	540	168	372
Total	127,536	64,277	63,259

Source: PSA, 2015 Census of Population and Housing

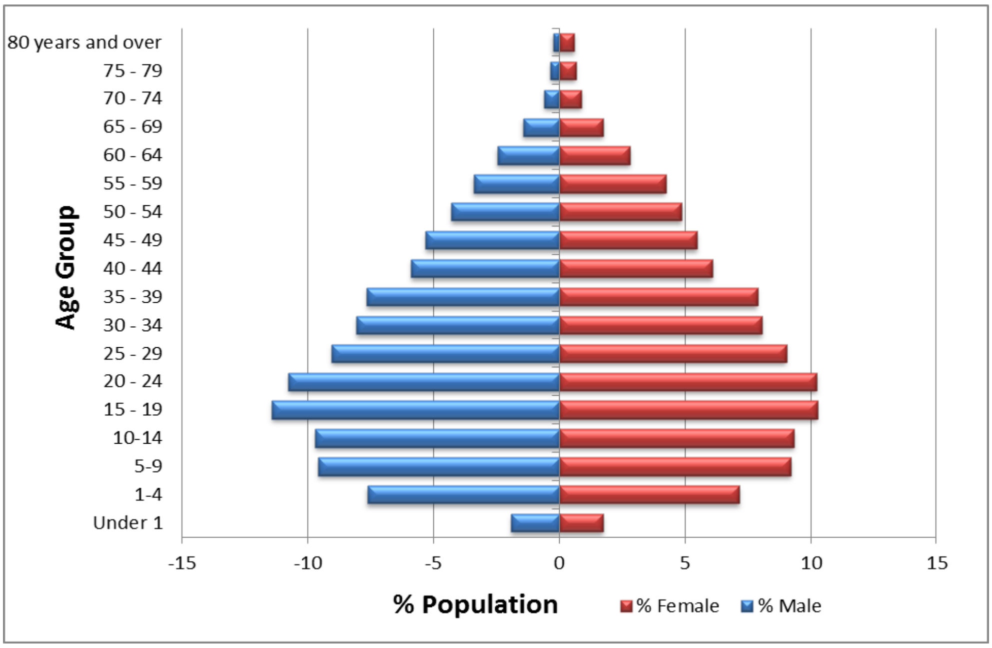


Figure 2-123. Age-Sex Distribution Pyramid

2.4.1.3 Literacy Rate and Profile of Educational Attainment

In 2015, majority (99.66%) of the household population over ten (10) years old and over in Mariveles are literate. The recorded data also showed that females have higher literacy rate (99.71%) than males (99.61%). **Table 2-62** shows the literacy of the household population 10 years old and over by age group and sex.

Table 2-62 Literacy of the Household Population 10 Years Old and Over by Age Group and Sex, 2015

Age Group	Household Population 10 years old and over			Literate		
	Both Sexes	Male	Female	Both Sexes	Male	Female

Age Group	Household Population 10 years old and over			Literate		
	Both Sexes	Male	Female	Both Sexes	Male	Female
Total	101,308	49,929	51,379	100,960	49,732	51,228
10 - 14	12,089	6,221	5,868	12,050	6,194	5,856
15 - 19	12,869	6,471	6,398	12,830	6,447	6,383
20 - 24	12,820	6,417	6,403	12,792	6,404	6,388
25 - 29	11,317	5,661	5,656	11,287	5,641	5,646
30 - 34	10,111	5,064	5,047	10,087	5,048	5,039
35 - 39	9,758	4,833	4,925	9,740	4,824	4,916
40 - 44	7,520	3,728	3,792	7,489	3,706	3,783
45 - 49	6,799	3,370	3,429	6,781	3,361	3,420
50 - 54	5,765	2,725	3,040	5,741	2,714	3,027
55 - 59	4,807	2,165	2,642	4,788	2,155	2,633
60 - 64	3,333	1,571	1,762	3,320	1,559	1,761
65 years old and over	4,120	1,703	2,417	4,055	1,679	2,376

Source: PSA, 2015 Census of Population and Housing

In 2015, about 23.44% of the household population 5 years old and above are elementary graduate, 49.17% are high school graduate, 2.18% are graduate of post-secondary education and about 9.91% are degree holder. Of the degree holder, 44.92% are males and 55.07% are females. **Table 2-63** presents the household population by highest grade/year completed, age group, sex in Mariveles in 2015.

Table 2-63 Household Population by Highest Grade/Year Completed, Age Group, Sex in Mariveles, 2015

Highest Grade/Year Completed, Sex and City/Municipality	Total Population 5 Years Old	Age																		
		5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20 - 24	25 - 29	30 - 34	35 and over
MARIVELES																				
Both Sexes	115,771	2,321	2,408	2,518	2,378	2,352	2,494	2,361	2,474	2,316	2,501	2,686	2,496	2,733	3,043	2,877	13,389	11,529	10,282	42,613
No Grade Completed	1,982	1,290	136	29	17	9	13	9	6	7	9	36	35	16	17	7	43	37	31	235
Pre-School	2,729	1,026	1,419	202	38	10	7	3	1	3	1	2	-	1	2	-	6	1	4	3
Special Education	47	-	1	1	1	1	2	2	3	3	7	1	1	4	4	2	4	4	5	1
Elementary	27,142	-	852	2,286	2,322	2,332	2,472	2,347	1,842	657	320	211	177	148	176	168	801	782	831	8,418
1st - 4th Grade	13,452	-	852	2,286	2,322	2,332	1,864	482	189	107	78	48	41	39	35	35	177	194	207	2,164
5th - 6th Grade	4,068	-	-	-	-	-	608	1,423	405	99	72	41	30	25	34	25	118	107	129	952
Graduate	9,622	-	-	-	-	-	-	442	1,248	451	170	122	106	84	107	108	506	481	495	5,302
High School	56,929	-	-	-	-	-	-	-	622	1,646	2,162	2,436	1,985	1,714	1,537	1,445	7,223	6,655	5,920	23,584
Undergraduate	13,569	-	-	-	-	-	-	-	622	1,646	2,162	2,128	729	375	257	249	957	832	690	2,922
Graduate	43,360	-	-	-	-	-	-	-	-	-	-	308	1,256	1,339	1,280	1,196	6,266	5,823	5,230	20,662
Post-Secondary	2,524	-	-	-	-	-	-	-	-	-	-	-	1	1	3	44	434	425	346	1,270
Undergraduate	103	-	-	-	-	-	-	-	-	-	-	-	1	1	3	2	24	23	14	35
Graduate	2,421	-	-	-	-	-	-	-	-	-	-	-	-	-	-	42	410	402	332	1,235
College Undergraduate	12,433	-	-	-	-	-	-	-	-	-	-	-	290	845	1,299	1,145	2,675	1,269	1,171	3,739
Academic Degree Holder	11,474	-	-	-	-	-	-	-	-	-	-	-	-	-	-	62	2,149	2,304	1,918	5,041
Post Baccalaureate	74	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	11	5	54
Not Stated	437	5	-	-	-	-	-	-	-	-	2	-	7	4	5	4	50	41	51	268
Male	58,127	1,226	1,250	1,277	1,204	1,204	1,264	1,224	1,263	1,218	1,279	1,398	1,339	1,460	1,643	1,515	6,928	5,827	5,185	20,423
No Grade Completed	1,045	676	81	18	12	2	8	4	4	4	6	16	16	7	9	5	24	25	20	108
Pre-School	1,434	548	732	106	19	5	5	3	1	1	1	2	-	-	2	-	3	-	3	3
Special Education	28	-	1	1	-	-	2	2	1	2	4	1	-	2	4	-	2	3	3	-
Elementary	14,123	-	436	1,152	1,173	1,197	1,249	1,215	972	389	202	144	118	100	134	110	535	517	552	3,928
1st - 4th Grade	7,083	-	436	1,152	1,173	1,197	950	269	122	73	56	38	30	25	26	23	126	139	147	1,101
5th - 6th Grade	2,143	-	-	-	-	-	299	725	217	58	45	24	22	16	28	17	79	81	78	454
Graduate	4,897	-	-	-	-	-	-	221	633	258	101	82	66	59	80	70	330	297	327	2,373
High School	28,759	-	-	-	-	-	-	-	285	822	1,064	1,235	1,076	968	826	754	3,786	3,486	3,015	11,442
Undergraduate	7,068	-	-	-	-	-	-	-	285	822	1,064	1,087	417	210	160	140	585	497	385	1,416
Graduate	21,691	-	-	-	-	-	-	-	-	-	-	148	659	758	666	614	3,201	2,989	2,630	10,026
Post-Secondary	1,061	-	-	-	-	-	-	-	-	-	-	-	-	-	2	23	212	213	159	452
Undergraduate	49	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1	12	10	5	19
Graduate	1,012	-	-	-	-	-	-	-	-	-	-	-	-	-	-	22	200	203	154	433
College Undergraduate	6,272	-	-	-	-	-	-	-	-	-	-	-	128	380	663	594	1,468	567	583	1,889
Academic Degree Holder	5,155	-	-	-	-	-	-	-	-	-	-	-	-	-	-	25	867	990	819	2,454
Post Baccalaureate	27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	3	18
Not Stated	223	2	-	-	-	-	-	-	-	-	2	-	1	3	3	4	31	20	28	129
Female	57,644	1,095	1,158	1,241	1,174	1,148	1,230	1,137	1,211	1,098	1,222	1,288	1,157	1,273	1,400	1,362	6,461	5,702	5,097	22,190
No Grade Completed	937	614	55	11	5	7	5	5	2	3	3	20	19	9	8	2	19	12	11	127
Pre-School	1,295	478	687	96	19	5	2	-	-	2	-	-	-	1	-	-	3	1	1	-
Special Education	19	-	-	-	1	1	-	-	2	1	3	-	1	2	-	2	2	1	2	1
Elementary	13,019	-	416	1,134	1,149	1,135	1,223	1,132	870	268	118	67	59	48	42	58	266	265	279	4,490
1st - 4th Grade	6,369	-	416	1,134	1,149	1,135	914	213	67	34	22	10	11	14	9	12	51	55	60	1,063
5th - 6th Grade	1,925	-	-	-	-	-	309	698	188	41	27	17	8	9	6	8	39	26	51	498
Graduate	4,725	-	-	-	-	-	-	221	615	193	69	40	40	25	27	38	176	184	168	2,929
High School	28,170	-	-	-	-	-	-	-	337	824	1,098	1,201	909	746	711	691	3,437	3,169	2,905	12,142
Undergraduate	6,501	-	-	-	-	-	-	-	337	824	1,098	1,041	312	165	97	109	372	335	305	1,506
Graduate	21,669	-	-	-	-	-	-	-	-	-	-	160	597	581	614	582	3,065	2,834	2,600	10,636
Post-Secondary	1,463	-	-	-	-	-	-	-	-	-	-	-	1	1	1	21	222	212	187	818
Undergraduate	54	-	-	-	-	-	-	-	-	-	-	-	1	1	1	1	12	13	9	16
Graduate	1,409	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20	210	199	178	802
College Undergraduate	6,161	-	-	-	-	-	-	-	-	-	-	-	162	465	636	551	1,207	702	588	1,850
Academic Degree Holder	6,319	-	-	-	-	-	-	-	-	-	-	-	-	-	-	37	1,282	1,314	1,099	2,587
Post Baccalaureate	47	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	5	2	36
Not Stated	214	3	-	-	-	-	-	-	-	-	-	-	6	1	2	-	19	21	23	139

Source: PSA, 2015 Census of Population and Housing

2.4.2 In-migration

Most of the households (96.38%) in Mariveles are non-movers, as presented in **Table 2-64**.

Table 2-64 Households Reporting Intention to Reside in Mariveles of Residence Five Years from 2010

Total Number of Households	Residence Five Years from 2010				
	Same Province/ Municipality (Non-movers)	Same Province Different Municipality (Domestic Short Distance Movers)	Different Province (Domestic Long-Distance Movers)	Foreign Country (Immigrants)	Not Reported
26,106	25,160	80	467	80	319

Note: Figures are based on 20% sample households. Details may not add up to total due to rounding off.
Source: NSO, 2010 Census of Population and Housing

2.4.3 Profile of Indigenous People

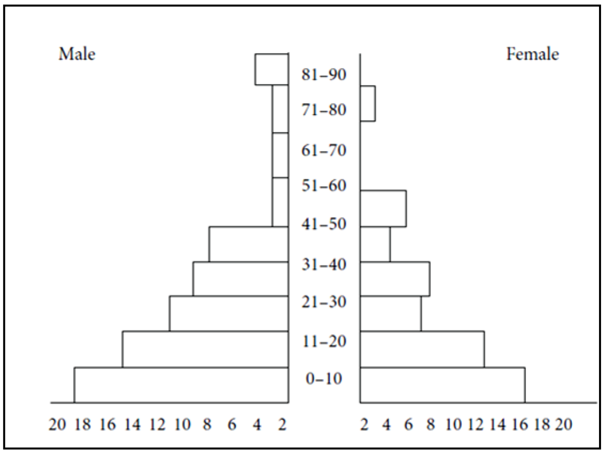
2.4.3.1 Aeta Magbukún Origin and Culture

The Aeta Magbukún can be found living near the fringe of the Manila Bay/South China Sea and the forest cover of Mount Mariveles in the Philippines (Balilla et al., 2013). They constitute one of the 5 main groups of Aeta tribes in Central Luzon and is the least known of all Aeta groups. They have descended from the Negrito ethnolinguistic group, and this is manifested in their physical traits, language and culture.

The recent official use of the term 'Aeta Magbukún' refers to both the Indigenous language and people of Bataan peninsula, specifically that of the Aeta groups from Morong, Mariveles and Limay (McHenry et al., 2015). The Chieftain of the Aeta Magbukún explained the term Magbukún originated from the word buk ud/magbukud, which literally means “to separate from” in the Aeta Magbukún language (Balilla et al., 2013). The Aeta Magbuk´un, and women in particular, are known for their reclusive shyness in social situations, particularly outside of their own bayan-bayanan (village/hamlet) located in Barangay Biaan, Mariveles. Despite this shyness, in some situations Aetas are known to passionately defend their distinctiveness as Aeta Magbuk´un as opposed to other Aeta groups and non-Aeta alike. The Aeta Magbuk´un present themselves as a distinguished Aeta group that has lived relatively independently since pre-European colonization.

2.4.3.2 Demography

In 2008, the total population of the Aeta Magbukún’s bayan-bayanan was 107, with a total of 21 nuclear families (Balilla et al., 2013). Population sex ratios included 63 (59 percent) males and 44 (41 percent) females, with 72 (67 percent) of the total population aged between zero and thirty (**Figure 2-124**). The average size of an Aeta Magbukún nuclear family is five family members, including the mother and father. In the period from 1990 to 2008, there was an average of three live births per annum. Only ten (9%) of the community are non-Aetas, and all of them are spouses of Aetas. Thus, ten out of twenty-one (47 percent) married couples in the bayan-bayanan are of mixed marriage (Balilla et al., 2013).



Source: Balilla et al., 2013

Figure 2-124. Aeta Magbuk´un Population Pyramid

2.4.3.3 Livelihood Practices

The livelihood practices of Aeta Magbuk´un includes pangangalakal, pamamatibat or pagdadanso (women oraging for wild tubers and freshwater shelfish), pamumuay (harvesting honey), pangangati (trapping Red Jungle Fowl or labuyo), pangangaso (hunting wild boars and monkeys, and very rarely, deer), paninilo (setting traps for wild boars and wild cats), pag-uuling (charcoal production), wage-working for the cattle ranchers near their community, elementary agriculture, planting in their gasak (swidden field) sweet potatoes, cassava, bananas and etc (Peninsula Ecosystems & Health Foundation Inc., 2016).

Of the mentioned practices, two are considered as Aeta’s main source of livelihood: Pamumuay or honey gathering and Pag-uuling or charcoal production. The male members of the tribe practice pamumuay. Aeta boys start their pamumuay training at a young age and by the time that they are teenagers, they are able to gather honey on their own, climbing the forest’s highest trees to harvest it. They are able to harvest up to 1-2 gallons of honey from a large panilan or beehive (**Plate 2-18**).

At the onset of the rainy season, the Aeta begins their charcoal production (**Plate 2-19**). With the honey-rich dry season over, the Aetas shift to another subsistence strategy. Charcoal is of high demand in the town's market. Large-scale charcoal production in itself is an unsustainable practice and is even against the law. The Aetas, however, reason out that charcoal making is a traditional practice of theirs and that only dead and dried forest trees are used.

Source: Peninsula Ecosystems & Health Foundation Inc., 2016

Plate 2-18. (A) An Aeta climbing a tree for honey harvesting. (B) An Aeta holding a beehive

Source: Peninsula Ecosystems & Health Foundation Inc., 2016

Plate 2-19. Charcoal Production of Aetas

2.4.3.4 Religious Philosophy

The Aeta Magbukun believes in God as the Supreme Being. Exposure to Christianity has had much influence in the religious practices of the tribe. Preferences toward various Christian groups range from Catholic to Protestant, often depending upon the favorability of the current priest or individuals ministering among them. Despite the many outside influences, the Aeta's have retained their traditional perspectives, interweaving the new with their cultural beliefs (Peninsula Ecosystems & Health Foundation Inc., 2016).

Aeta Magbukun's worldview is deeply linked to traditional animistic concepts. A mix of basic Christian beliefs – a syncretism ascribed to their being predominantly Catholic while at the same time staying true to their remarkable relationship with nature.

2.4.3.5 Kinship and Sociopolitics

The social organization of the Aeta Magbuk´un revolves around the nuclear family as the basic social unit of the community. However, this nuclear family is interdependent on other nuclear families bound together by kinship. Kinship defines social norms, obligations, and relationships based on social rather than biological relationships among family groups or clans.

The Aeta Magbuk´un community in Barangay Biaan is almost entirely made up of a single-family grouping, the Maingat clan. Of the twenty-one nuclear families, seventeen of them belong directly to the Maingat clan. The remaining four nuclear families do not belong to a single-family grouping, although they are still closely associated with the Maingat clan.

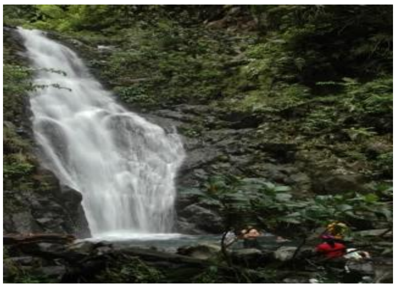
The dominant political structure among the Aeta Magbuk ´un of Mariveles, at present, is a democratized “Tribal Council,” composed of elected Aeta officials. The Tribal Council is made up of the Chieftain, two tribal kagawad (councilors), a secretary, a treasurer, and an auditor. The Tribal Council’s primary concern is the representation of Aeta affairs to the Municipal Council, including decision-making, conflict resolution, and the formulation and implementation of specific tribal decrees. As family groups provide the basic structure of the Aeta Magbuk´un’s social organization and sociopolitical structure, the current Tribal Council officers, including the Chieftain, are all from the Maingat clan. The Magbuk´un Tribal Council, headed by the chief, govern the community and are generally selected on the strength of their political influence.

2.4.4 Physical Cultural Resources and Landscapes

The province of Bataan is a symbol of democracy and freedom having been the last fortress of Filipino-American soldiers against the Japanese forces until it fell captive on April 9, 1942. On 1578, The Spaniards on their way to conquer Manila, first set foot on the island known to their Cebuano guide as Mariveles. Under the Spanish control, the people of the village of Samento were converted into Christianity then churches were built in Poblacion and Cabcaben. **Table 2-65** presents the heritage and cultural resources in the host municipality of Mariveles.

Table 2-65 Significant Heritage and Cultural Resources in Mariveles

Natural Attractions	Description
Zero Kilometer Marker 	In 1647, the Dutch naval forces perpetrated the Abucay Massacre and the descended Chinese Limahong used Lusong point at the western side of Bataan as a launching place; the Bataan Death March to Capas, Tarlac which started in the Municipality of Mariveles and Bagac. The commemorative shrine marks the spot called Zero Kilometer Marker at Poblacion, Mariveles. The Shrine is depicted by a bayonet thrust to the ground with a helmet, symbolically slun over the rifle butt.
Balon Anito Hot Spring 	Called the “dead volcano,” it is frequented by elderly people who go to soak their feet in the water of the therapeutic hot spring at the mouth of the volcano. It is located in Barangay Balon Anito, Mariveles, approximately 4.5 km. (aerial distance) from the project site.
Camaya Coast	The Camaya Coast is a beach resort with a residential development in the municipality of Mariveles in Bataan. It is approximately 1 km west of the project site.

Natural Attractions	Description
	
Mt. Tarak 	Tarak Ridge is a well-known destination on Mount Mariveles with its jump-off point situated at Barangay Alas-asin, Mariveles. It is a 5 – 6 hours of mountain climbing from Brgy. Alas-asin, Mariveles to the peak of Mt. Tarak which stands at 1,130ft. above sea level
Paniquian Falls 	Paniquian Falls is one of the famous destination of mountaineers during mountain trekking at Tarak ridge.

Source: Mariveles Municipal Profile

2.4.5 Public Services

Water Supply. Mariveles Water District and the Bataan Economic Zone Water System (BEZWS) are the water supply system providers in Mariveles. The Mariveles Water District serves the town proper, while the BEZWS serves the Bataan Export Processing Zone (BEPZ) area (now FAB). Common sources of water in areas without existing water systems are shallow and deep wells and springs.

Power Supply. The electricity in Mariveles is provided by PENELCO, National Power Corporation (NAPOCOR) and FAB. PENELCO supplies electricity to fifteen (15) barangays, while NAPOCOR provides electricity to two (2) barangays. The FAB is powered by a 59 MW power plant.

Communication. The municipality has one (1) Postal Office located at the municipal hall and a sub-station at the AFAB. It has also a telegraph facility. Telephone and mobile communication services are provided by PLDT, Globe and Smart Telecommunications and Oceanic Wireless Network Inc. In addition, telegraphic and courier services in the municipality are provided by PT&T, RCPI, Telefast, DHL, JRS, Fax and Parcel, and Del Bros-UPS.

Education Facilities. In 2009, Mariveles has forty (40) day care centers; eighteen (18) public and five (5) private elementary schools; four (4) public and five (5) private high schools; one (1) public and two (2) private college institutions; and one (1) technical schools.

Environment and Waste Management. In 2005, the ESMO in Mariveles was created by the SB Council of the Municipality of Mariveles in order to effectively and efficiently complies with the provision of the RA 9003 commonly known as The Solid Waste Management Act. As supplemented by Municipal Ordinance No. 40-2004, ESMO's primary function is to manage the solid waste of the municipality and to maintain the cleanliness program of Mariveles. In 2005, the total manpower of the ESMO is 77 with seventeen (17) regular/casual employees and sixty (60) volunteers. There were eight (8) garbage trucks, one (1) payloader and one (1) garbage grinding machine.

The EMSO then conducted a clean-up at the old dumpsite of Mariveles and used the garbage recovery facility. The operation of the facility is to convert the biodegradable waste materials into fertilizer. This will ensure additional income out of waste materials and provide farmers of this municipality with cheap organic fertilizers.

In 2009, the Municipality of Mariveles issued Kautusang Pambayan Blg. 71-2009 "Kodigo ng Sanidad sa Bayan ng Mariveles 2009". Section 6 of the Sanitary Code of the Municipality of Mariveles requires all establishments, stall holders and similar establishments to have separate garbage can (biodegradable, non-biodegradable and recyclable) with cover and proper label in accordance to R.A. 9003 (Ecological Solid Waste Management Act) prior to the issuance of Sanitary Permit. (Seksiyon 4 Par. C-Mun. Ord. No.6-99) – all garbage, filths and other waste shall be placed in a proper receptacle for collection of garbage collectors.

Peace and Order/Crime. In 2009, the Municipality of Mariveles had one (1) police station, five (5) police clusters, one (1) fire truck and one (1) police patrol car. The police-population ratio was 3%, the total crime volume was 46 and the crime rate was 25.

2.4.5.1 Socio-Economic Data

Local Government/Municipal Income and Revenues, Internal Revenue Allocation. The Municipality of Mariveles has the second highest IRA within the Province of Bataan from 2011-2015 as presented in **Table 2-66**.

Table 2-66 IRA for the Municipalities and City of the Bataan Province (2010-2015)

Municipality/ City	2011	2012	2013	2014	2015	%	Rank
Abucay	57,154,976	55,487,391	60,018,030	67,914,929	77,399,111	3.4	10
Bagac	56,410,469	54,686,670	61,444,859	69,507,850	79,267,483	3.5	8
Dinalupihan	104,830,897	101,932,979	115,862,273	131,383,168	149,900,463	6.7	3
Hermosa	75,134,998	72,964,720	84,046,952	95,228,824	108,642,463	4.8	4
Limay	72,581,004	70,492,135	79,394,297	90,005,935	102,716,664	4.6	6
Mariveles	117,996,321	114,710,490	134,375,395	152,520,513	174,176,697	7.7	2
Morong	57,621,774	55,862,725	60,639,495	68,644,160	78,328,495	3.5	9
Orani	74,346,393	72,247,766	80,395,640	91,063,786	103,821,285	4.6	5
Orion	65,468,413	63,599,728	71,630,351	81,092,661	92,422,772	4.1	7
Pilar	57,784,181	56,117,319	58,286,037	65,972,117	75,184,786	3.3	11
Samal	51,243,923	49,739,062	54,211,956	61,627,033	68,873,390	3.1	12
Balanga City	274,396,467	236,093,507	252,142,241	283,499,361	323,963,617	14.4	1
TOTAL	1,675,614,420	1,586,352,698	1,750,403,640	1,976,757,377	225,358,4557		

Source: Department of Budget Management,2015

However, because of its mountainous terrain, there are only few area suited for rice farming and most of its agricultural lands are engage in corns, cassava, orchards and other upland farming products. Agricultural workers only attributed with 5% of the total population and therefore contributed less in municipal per capita. Meanwhile, like agriculture, fishing industry also contributed less to municipal income despite of the fact that the municipality is surrounded by body of water.

Industries, Commercial Establishments and Activities. Mariveles has an industrial area of approximately 3,834.05 ha or 24% of the total municipal area. This includes the FAB, PNOC Industrial Estates, Baseco Compound and other companies/industries located in Mariveles. FAB has a total land area of 1,600 ha, which is about 42% of the total industrial area of the municipality. About 345 ha are allocated for industrial infrastructures. Most of the products being produced are for export.

Based on the socioeconomic profile of the municipality in 2016, there were 57 firms that were operating within the municipality. About 21,142 workers are directly or indirectly employed in these firms. The dominant industries that are presently operating are garments and footwear industries. Other industries or companies operating are San Miguel Corporation (SMC), Asian Terminal Inc. (ATI), ELECTRUCK, Mariveles Shipyard Corporation (MSC) and GNPower Ltd., Co.

The municipality has two public market which one was operated by the municipality and five wet markets operating around Mariveles.

Employment Profile. In 2015, Mariveles has 56,262 gainful workers where in most of workers (29.8%) are involved in crafts and related trades. **Figure 2-125** shows the percentage of gainful workers per age group while **Table 2-67** shows the top five occupation of workers in Mariveles as of 2015. **Table 2-68** presents the statistics of gainful workers in Mariveles as of 2015.

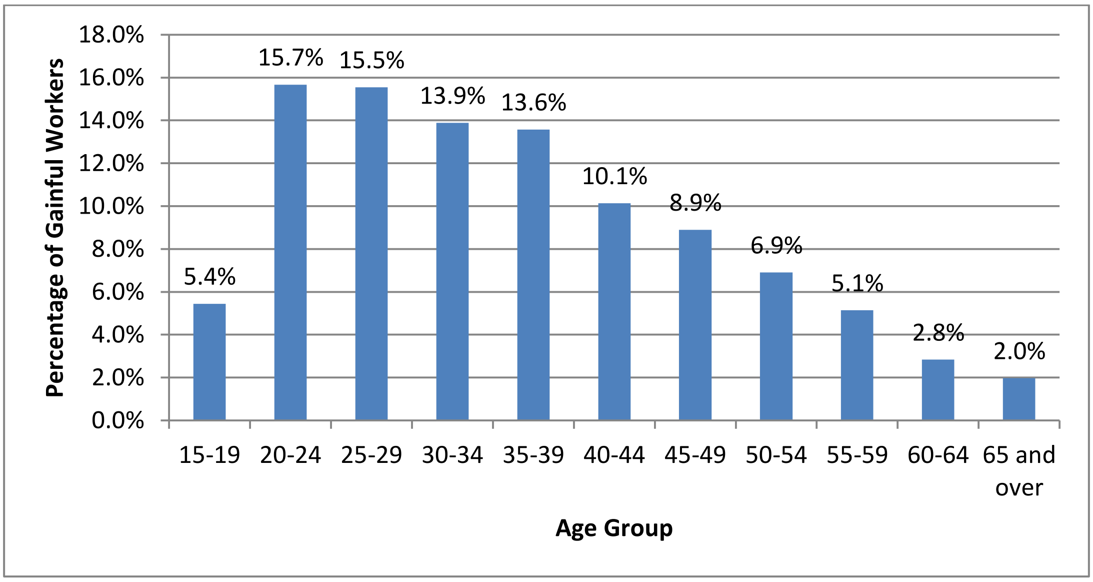


Figure 2-125. Percentage of Gainful Workers per Age Group

Table 2-67 Top Five Occupation of Workers in Mariveles, 2015

Occupation	Number of Individuals	Percentage
Craft and Related Trades Workers	16,773	29.8%
Plant and Machine Operators and Assemblers	7,337	13.0%
Service and Sales Workers	6,506	11.6%
Technicians and Associate Professionals	6,352	11.3%
Elementary Occupations	6,231	11.1%

Source: NSO, 2015 Census of Population and Housing

Table 2-68 Gainful Workers in Mariveles, 2015

Major Occupation Group	Gainful Workers, 15 Years Old and Over	Age Group										
		15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65 and over
Managers	3,311	12	125	238	301	428	385	461	451	417	274	219
Professionals	2,635	5	510	626	461	356	210	178	140	84	50	15
Technicians and Associate Professionals	6,352	443	1,321	1,181	972	761	509	445	330	234	99	57
Clerical Support Workers	2,982	73	694	757	491	318	166	152	143	106	59	23
Service and Sales Workers	6,506	290	688	814	866	834	726	737	583	510	267	191
Skilled Agricultural Forestry and Fishery Workers	4,090	209	342	403	455	484	424	458	405	367	272	271
Craft and Related Trades Workers	16,773	899	2,905	2,851	2,512	2,662	1,872	1,267	895	533	241	136
Plant and Machine Operators and Assemblers	7,337	359	1,030	956	955	1,079	818	820	592	410	219	99
Elementary Occupations	6,231	767	1,202	916	797	706	588	480	339	226	113	97
Armed Forces Occupations	36	-	1	4	3	10	4	6	5	3	-	-
Other Occupation Not Elsewhere Classified	-	-	-	-	-	-	-	-	-	-	-	-
Not Reported	9	8	-	-	-	-	-	1	-	-	-	-
Total	56,262	3,065	8,818	8,746	7,813	7,638	5,702	5,005	3,883	2,890	1,594	1,108

Source: NSO, 2015 Census of Population and Housing

2.4.5.2 Health and Sanitation

Vital Health Statistics. Table 2-69 presents the number of live births and deaths from 2011 to 2015 in Mariveles, Bataan. **Table 2-69** and **Figure 2-126** show the decrease in the number of livebirths from 2012 to 2015. The total number of deaths slightly increased initially from 2011 to 2013, but decreased (to a lower level than in 2011) in 2014.

Table 2-69 Vital Health Statistics by Year, Mariveles, Bataan

Vital Health Statistics	2011	2012	2013	2014	2015
Livebirths	1051	1255	1139	1005	912
Males	505	638	573	515	
Female	546	617	566	490	
No. of Deaths	277	302	336	102	221
Infant deaths	12	16	14	15	4
Maternal deaths	0	2	0	2	0
Neonatal deaths	0	0	0	0	0
Perinatal deaths	3	14	3	7	7
Deaths <5 yrs. Old	14	18	18	16	4

Source: MHO, Mariveles, Bataan

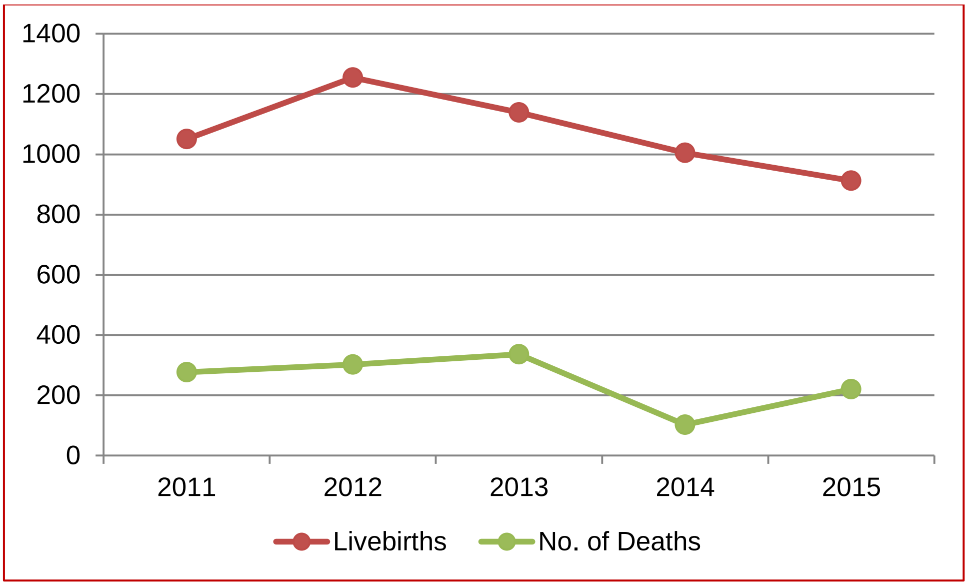


Figure 2-126. Vital Health Statistics by Year, Mariveles, Bataan

Morbidity. The most common disease in Mariveles is acute upper respiratory infection. This is followed by wounds, dengue fever then diarrhea. The other causes of diseases are coronary artery disease, hypertensive vascular disorder (CAD/HCVD/HPN), urinary tract infection (UTI), skin disorder and systemic viral infection. **Table 2-70** shows the significant decrease in the number of acute upper respiratory infection and wounds in the last five years. All other leading causes of diseases decreased in the same period, except for dengue fever. Dengue fever increased in number from 2013 to 2015.

Table 2-70 Leading Causes of Morbidity for the Last Six Years

Causes	Number of Cases					
	2011	2012	2013	2014	2015	2016
AURI	2,405	3,013	6,244	2,194	909	9,973
Wound	1,577	1,,856	1,619	933	750	2,901
CAD/HCVD/HPN	931	518	1,228	-	77	469
UTI	730	891	898	638	77	5,999
Diarrhea	670	564	624	686	116	783
Skin Disorder	388	329	862	315	75	160
Pneumonia	346	-	-	-	-	-
Dengue	300	239	145	104	230	-
Vehicular accidents	-	479	721	320	-	-
Systemic viral infection	294	619	552	412	31	-
Gastritis/PUD	-	-	309	255	-	162
PTB	-	-	378	570	-	-
Total	7,641	8,508	13,580	6,427	2,265	20,477

Source: Mariveles Health Profile, 2016

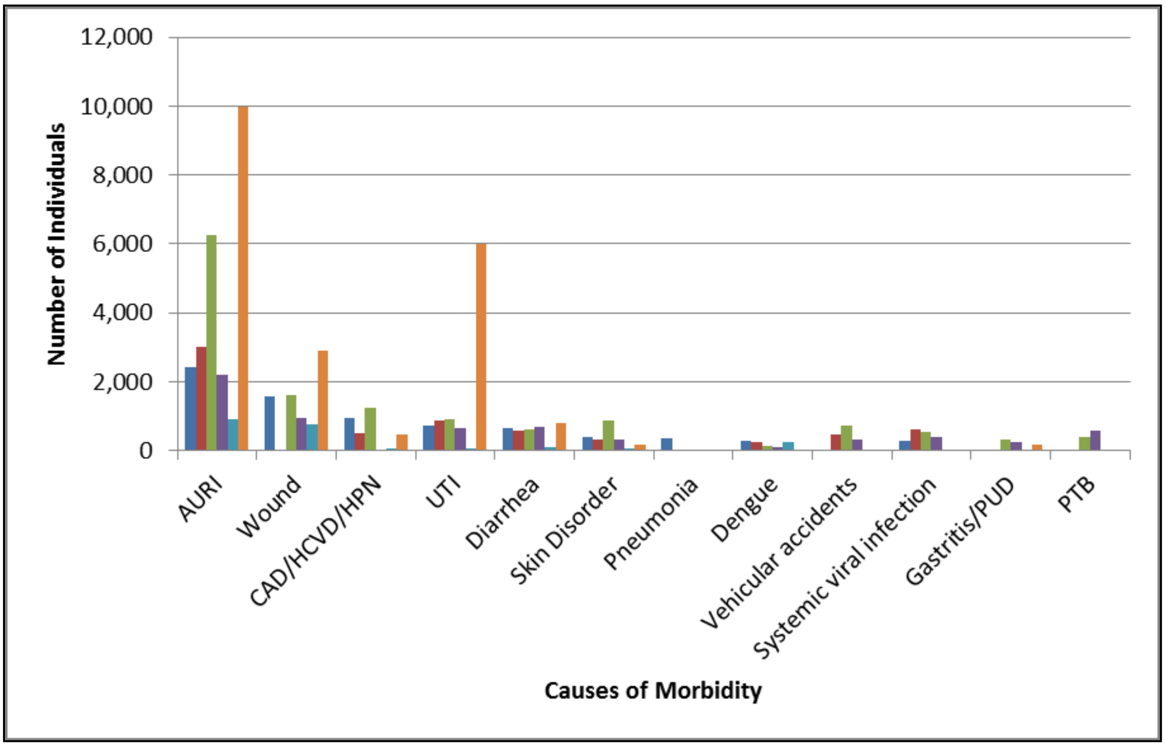


Figure 2-127. Causes of Morbidity in Mariveles, Bataan

Mortality. The leading causes of deaths in Mariveles, Bataan in 2015 include cancer of all kinds (31), myocardial infarction, cardiovascular (heart) diseases, pneumonia, multiple organ failure, tuberculosis, sepsis, cerebrovascular accident (CVA) or stroke, and traumatic head injury. (**Table 2-71**). Myocardial infarction (heart attack) overtook heart diseases as leading cause of death from previous year.

Table 2-71 Leading Causes of Mortality

Causes	Number of Cases, 2014			Number of Cases, 2015		
	Male	Female	Total	Male	Female	Total
Diseases of the heart	49	15	64	13	8	13
Cancer, all kinds	14	8	22	31	20	31
CVD/CVA	13	7	20	4	2	4
Pneumonia	13	6	19	5	8	5
Myocardial Infarction	-	-	0	30	16	30
Tuberculosis, all kinds	13	5	18	7	1	7
Sepsis	-	-	0	1	5	1
Multiple organ failure	3	6	9	10	9	10
Traumatic Head Injury	-	-	0	4	1	4
COPD	12	4	16	-	-	0
Renal Failure	13	6	19	-	-	0
Asphyxia	6	1	7	-	-	0
Total	136	58	194	105	70	175

Source: Mariveles Health Profile, 2015

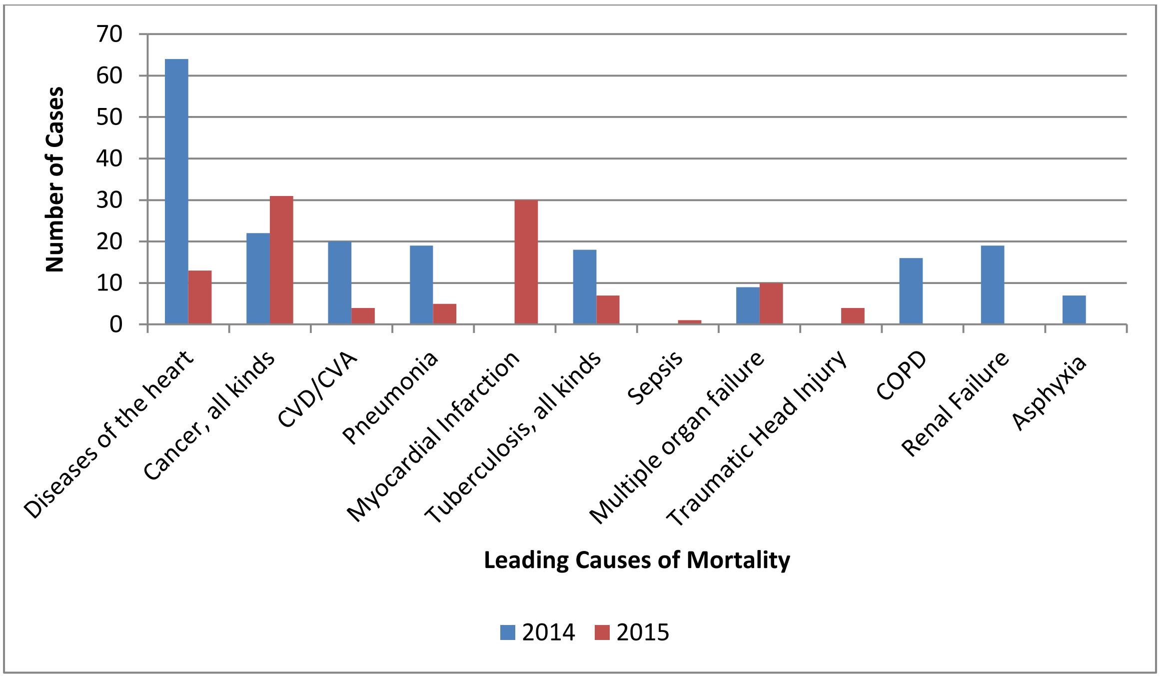


Figure 2-128. Leading Causes of Mortality in Mariveles, Bataan, 2014-2015

Health Resources and Programs. The municipality of Mariveles has one private secondary hospital, a maternity clinic and ten (10) private clinics. The government has provided one mental hospital, three rural health units (RHU), 18 barangay health stations (BHS), 13 satellites of barangay, one rehabilitation unit and two emergency units where residents can consult their health problems (**Table 2-72**).

Table 2-72 Medical Health Facilities, 2015

Medical Facilities	Number
Private secondary hospitals	1
Government hospitals	1 (Mariveles Mental Hospital)
Private maternity clinic	5
Government maternity clinic (bemonc)	1

Medical Facilities	Number
Private outpatient clinics	10
Rural health units	3
Barangay health stations	18
Barangay health satellites	13
Rehabilitation center for pwd (LGU)	1 (LGU)
24-hours emergency/first aid clinic	2 (LGU)

Source: Mariveles Health Profile, 2015

The Municipal Health Unit (MHU) of Mariveles has one Medical Health Officer (MHO) or physician and assisted by other four (4) rural health physicians (RHP), three (3) rural health dentists (RHD), seven (7) public health nurses (PHN) and 31 rural health midwives (RHM). The other health personnel include three (3) rural sanitary inspector (RSI), four (4) medical technologists, one (1) radio-technician, three (3) nutritionists and five (5) nursing attendants (**Table 2-73**). They all implement the health programs of the Department of Health (DOH) presented in **Table 2-74**.

Table 2-73 Health Personnel of the Municipal Health Unit, Mariveles, Bataan

	Total	Regular	Casual	Contractual
MHO	1	1	0	0
RHP	4	4	0	0
RHD	3	3	0	0
PHN	7	7	0	0
RHM	31	24	5	2
RSI	3	3	0	0
MEDTECH	4	4	0	0
RADTECH	1	1	0	0
Nutritionists	3	3	0	0
Nursing Attendant	5	1	2	2
Total	62	51	7	4

Source: Mariveles Health Profile, 2015

The Health Programs of the DOH implemented by the Municipality of Mariveles are presented in **Table 2-74**.

Table 2-74 Health Programs of the DOH

No.	Services
1	Family Planning
2	National tuberculosis Program
3	Control of diarrheal diseases
4	Cardiovascular diseases
5	Under five clinic
6	Malaria and Dengue Control
7	Diabetes Clinic
8	Leprosy Control
9	Diabetes Clinic
10	Control of Acute Respiratory Infection
11	Nutrition Services
12	Women's Health
13	Cancer Prevention and Awareness

Source: Mariveles Health Profile, 2016

Table 2-75 enumerates the availability of medical specialists who serve the community as private practitioners. Majority of the doctors are pediatricians, followed by general medicine practitioners.

Table 2-75 Private Health Practitioners, 2015, Mariveles, Bataan

Field of Specialization	Number of Practitioners
General Medicine	5
Internal Medicine/Cardiology	1
Obstetrics-Gynecology	5
Pediatrics	4
General Surgery	4
Otorhinolaryngology (ENT)	1
Ophthalmology	2
Orthopedic Surgery	1
Psychiatry	1
Dentistry	8
Optometry	1
Midwifery	8
Total	41

Source: Mariveles Health Profile, 2015

Environmental Health and Sanitation Profile. **Table 2-76** show the environmental sanitation indices in 2014. One hundred percent of the households (21,008) have access to safe water. Most of the households are supplied with safe water directly to their homes through a pipe system (81.6%). Fourteen percent (14%) of them still get water from direct sources (level 1) like streams and springs.

Many of the households keep a sanitary type of toilet (96%), while only 85% of the households have a satisfactory way of disposing their solid waste. About 96% of the households possess the basic sanitation facilities required.

Sixty-three percent (1,369) of food establishments have sanitary permit, while 95.6% of food handlers have health certificates.

Table 2-76 Environmental Sanitation Program, 2014-2015. Mariveles, Bataan

Parameter/Indicator	2014		2015	
	Number	%	Number	%
No. of Households (HH)	21,008	-	21,576	-
No. of HH with access to safe water	21,008	100	21,576	100
HH with access to Level I water supply	3,006	14	3,014	14
HH with access to Level 2 water supply	855	4	855	4
HH with access to Level 3 water supply	17,146	81.6	17,707	82
HH with Sanitary Toilet Facilities	20,231	96	20,824	97
HH with satisfactory disposal of solid waste	2,189	85	20,138	93
HH with complete basic sanitation facilities	1,369	96	20,006	93
No. of Food Establishments	2,189	-	2,181	-
No. of Food Establishments with Sanitary Permit	1,369	62.5	1,243	57
No. of food Handlers	2,378	-	2,513	-
No. of food Handlers with Health Certificate	2,274	95.6	-	-

2.4.6 Barangay Profile of Biaan

Land Area. Barangay Biaan, the host barangay for the proposed MCPP Project, has a total land area of 5,504 ha. Barangay Biaan has 12 sitios, namely: Lower Biaan, Talain, Lusong, where the proposed MCPP Project is to be located, Wain/Camaya Coast, Nagtalinga, Basay, Quiapo, Lake, Aglaloma, Sitio 31, Barrio Site and Upper Biaan/Bayan-bayanan. The Lower Biaan is considered as center of the barangay wherein the barangay hall, chapel, barangay plaza, and most of the households are located.

The proposed MCPP Project is to be located in Lusong which is approximately 15-25 minutes boat ride from Lower Biaan.

Demography. Barangay Biaan has a total population of 1,837 in 2015.

Communication, Water and Power Supply. Cellular phone signal of both SMART/Sun Cellular and Globe Telcos are available as well as telephone lines (landline) and radio transceiver signal. Electricity connection provided by PENELCO is available for most of the households in the barangay. The water supply of most households is from deepwells and springs. Water supply system is also available to some households

Education. Primary school facilities are available in Barangay Brgy. Biaan which includes two (2) Daycare Centers located in Lower Biaan and Upper Biaan and two (2) elementary schools, namely: Biaan Aeta Integrated School (in Upper Biaan) and Sto. Niño Elementary School (in Lower Biaan). Secondary school facilities are also available in Biaan Aeta Integrated School.

Employment/Income and Revenues. The source of income of the households were employment, farming/fishing, small-time businesses and etc. Most (50%) of the households are fishermen while about 25% of households were government/private employees. Some 23% of the households were farmers, 1% were self-employed and the remaining were engaged at different kinds of businesses. The Internal Revenue Allotment (IRA) of the barangay increased from P1,187,406.00 in 2013 to P1,688,594.00 in 2015.

Agricultural Livelihood. Farming is practiced in the barangay specifically for rice and some root crops such as camote and cassava. Plenty of cashew, coconut, banana and mango may also be observed within the barangay. Population of livestock and poultry are all backyard-raising, both as source of food and working animals such as swine, goat, chicken, calve and carabaos

Health and Sanitation. Barangay Biaan has six (6) health workers. At present, the health workers report in the barangay hall since the barangay health center is under construction. For sanitation, approximately 90% of the total households have available toilet facility while ten (10) percent has no available toilet and commonly disposes human wastes in the periphery of their houses.

2.4.7 Socio-Economic, Perception and Health Survey

The perception survey was conducted to the host Sitio Lusong in Barangay Biaan. The survey covers the demographic characteristics, the source of income, the knowledge about the new structures and their attitude towards the proposed Project. **Table 2-77** presents the number of respondents surveyed in Sitio Lusong.

Table 2-77 Number of Respondents of Socio-Economic and Perception Survey

Barangay	Male	Female	Total Number of Respondents
Sitio Lusong, Barangay Biaan	2	8	10

2.4.7.1 Host Barangay – Sitio Lusong, Barangay Biaan

Demographic Characteristic

Majority (80%) of the respondents are women while only 20% are men. Most (60%) of the respondents were born in the Barangay. All respondents are Tagalog. Majority (30%) are within the bracket of 51-60 years old. Majority (50%) had finished elementary school, 40% had finished high school and 10% had finished vocational school. Most (90%) of the respondents are married having 1-3 children (50%). Majority (90%) of the respondents are Catholics by religious affiliation.

Migration/Settlement History

Most of the respondents (50%) have stayed in the Barangay for 21-30 years and 20% of the respondents have stayed in the Barangay for 51-60 years.

Income and Employment

The husband (90%) is contributing a major portion. About 50% have an earning of PhP1,000 to PhP4,999 per month and 40% have an earning of PhP5,000 to PhP9,999 per month.

Since the Barangay is within the shoreline, about 40% of the respondent are fishermen.

Community & Land Resource

Most of the respondents (80%) indicated that having no access road is the main problem in their community followed by insufficiency of school, job opportunities and street lights. Thus, suggesting that provision of access road (90%) must be priority and importance. Forty percent (40%) of the respondents owned their land and cultivate mostly banana (20%).

Perception

All respondents knew about the proposed MCPP Project of MPGC, learning about it from the Barangay Officials (80%). The respondents considered the proposed project to have a positive effect, such as provision of job opportunities (100%); provision of access road (50%); and additional income to the barangay (50%). On the other hand, generation of noise and dust are the main negative impacts raised by the respondents.

2.4.7.2 Health Survey

Smoking and Drinking Habits

Twenty percent (20%) of the respondents smoke and drink liquors (**Table 2-78**). Majority of smokers smoke for more than 21 years with 16 sticks to 1 pack of cigarettes per day (**Table 2-79**). Chronic obstructive pulmonary disorder (COPD) is the disease predisposed by smoking one pack of cigarette for ten years and above. It is manifested by chronic cough, wheezing and progressive difficulty of breathing in the 50-year old smoker. Moreover, excessive and prolonged liquor drinking can result to alcoholic hepatitis and cirrhosis.

Table 2-78Smoking and Drinking Habits

Habit	Respondents
Smoking	20%
Drinking	20%

Source: GEOSPHERE 2016

Table 2-79 Duration of Smoking and Drinking

Duration	Smoking	Drinking
6-10 years	0	10%
21 years and above	20%	10%

Source: GEOSPHERE 2016

Site of Medical Consultation

Majority of the respondents (90%) consult the midwife at BHS for their health problems.

Diseases and Illnesses

The most common diseases encountered by the respondents in Sitio Lusong are muscle pain, sinusitis, UTI, skin disease, diarrhea and hypertension (**Table 2-80**). Except for muscle pain, other diseases reported are also in the top causes of morbidity in Mariveles for 2016. Most common illness experienced and reported by the survey respondents also indicate upper respiratory illnesses and skin diseases.

Table 2-80 Causes of Diseases

Diseases	Respondents
Muscle Pain	60%
Sinusitis	20%
UTI	20%
Skin disease	10%
Diarrhea	10%
Hypertension	10%
Illness during 2012-2016	Respondents
Cough	80%
Itching or watering of eyes	30%
Skin rashes	10%
Sneezing	10%

Source: GEOSPHERE 2016

Medicines Taken by Respondents

The medicines usually taken by the respondents are the medicine for cough (Tuseran, Carbocystein and Lagundi) for fever (Paracetamol). However, majority of respondents do not take any medications.

Table 2-81 Medicines Taken by the Respondents

Medicine	Respondents
Tuseran Forte	10%
Paracetamol	20%
Carbocystein	20%
Lagundi	10%
None	70%

Source: GEOSPHERE 2016

Sources of Medicines

Most of the respondents source their medicines from the pharmacy and MHU/RHU, as shown in **Table 2-82**.

Table 2-82 Sources of Medicines

Source	Respondents
Pharmacy	80%
MHU/RHU	40%
None	20%

Source: GEOSPHERE 2016

Toilet Facility

Majority (70%) of the respondents have no toilet at home and 40% of the respondent are using toilet facilities shared by the community (**Table 2-83**).

Table 2-83 Toilet Facility

Type	Respondents
No toilet	70%
Shared by Community	40%
Shared by Household	10%
No Answer	20%

Source: GEOSPHERE 2016

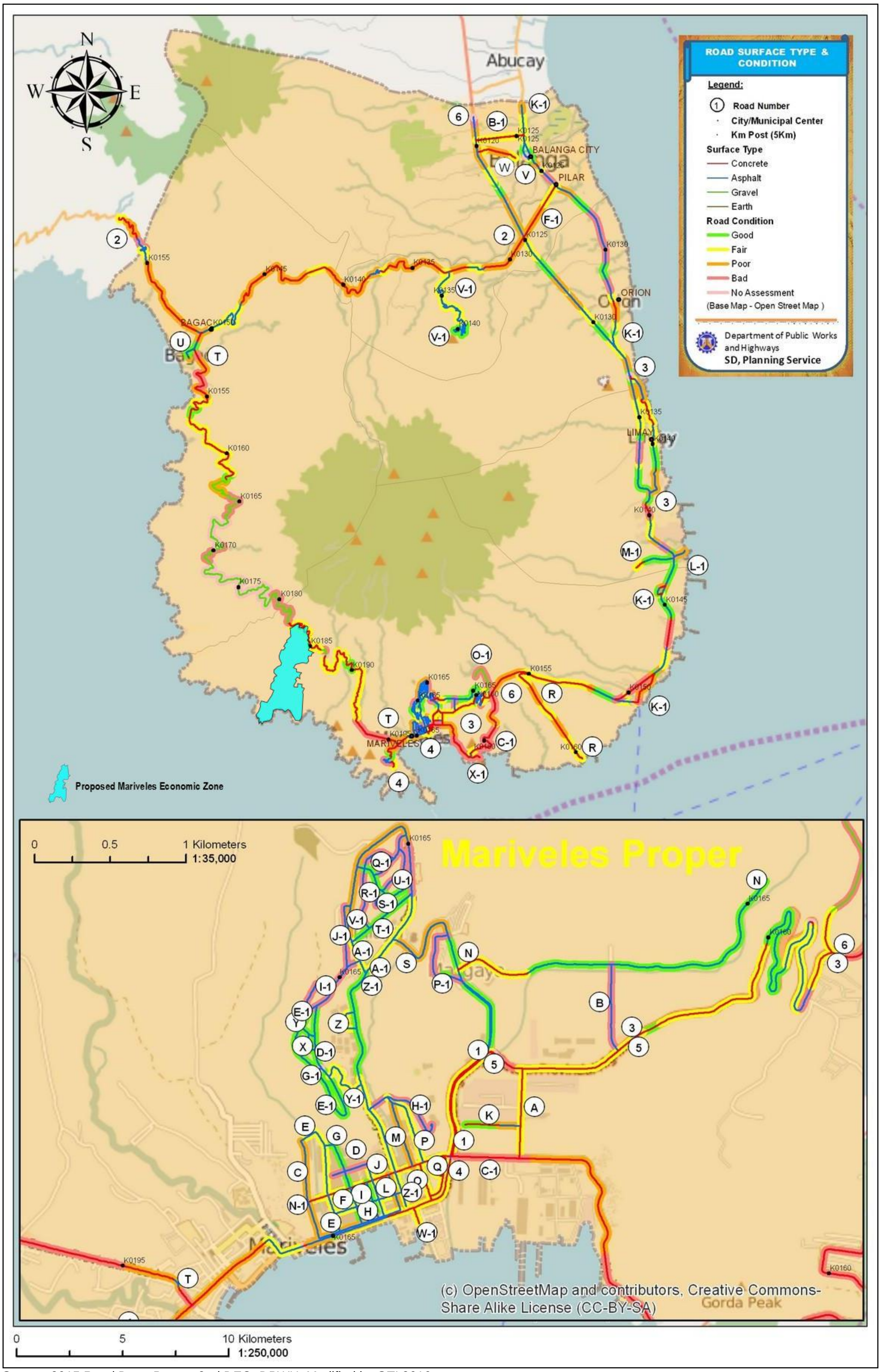
Water Sources

All (100%) of the respondents source their water from communal supply.

2.4.8 Road Networks, Existing Transportation and Traffic Situation

Road Network. **Figure 2-129** shows the road surface type and condition within the area of Bataan 2nd District Engineering Office of the Department of Works and Highways (DPWH). Within the Bataan 2nd DEO area, the total length of existing secondary roads is 86.41 km wherein 12.91 km of the road is in good condition, 27.57 km is fair condition, and 36.41 km and 1.32 km are in poor and bad conditions, respectively. About 1.32 km of the secondary roads was not assessed (Table 2-96). The total length of tertiary roads within the Bataan 2nd DEO area is 121.47 km. About 19.32 km and 42.73 km of the roads are in good and fair conditions, respectively. On the other hand, 18.99 km and 28.83 km are in poor and bad conditions, respectively.

According to the Comprehensive Land Use Plan of the municipality, Mariveles has a total road network of 246.096 kilometers. These are classified into National, Provincial, Municipal and Barangay roads. The total length of national road within the municipality is 74.167 km. This serves as main access of Mariveles to the adjacent municipalities. The provincial road, which is 62.326 km connects the different barangays to the national road while the municipal road, which is 5.938 km in length, are found within the urban area. The barangay road is about 103.665 km. The road inventory is presented in **Table 2-84**.



Source: 2015 Road Data, Bataan 2nd DEO, DPWH; Modified by GTI 2016

Figure 2-129. Road Networks within the Area of Bataan 2nd District Engineering Office of DPWH

Table 2-84 Length of Roads and Condition Rating, 2015

DEO / Functional Classification / Road Name / Road Number		Condition Rating					
		Good	Fair	Poor	Bad	No Assessment	Total
	Secondary Roads	12.91	27.57	36.41	8.20	1.32	86.41
1-1	Ave of the Philippines Main A	-	1.54	0.06	-	-	1.60
	Concrete	-	1.54	0.06	-	-	1.60
2-2	Gov JJ Linao Rd	-	7.34	21.70	0.80	0.34	30.19
	Concrete	-	2.67	20.14		0.26	23.07
	Asphalt	-	4.68	1.57	0.80	0.08	7.12
3-3	Jct Layac-Balanga-Mariveles Port Rd	2.29	4.89	2.55	0.16	0.18	10.07
	Concrete	0.12	3.02	0.14	-	0.09	3.36
	Asphalt	2.17	1.87	2.41	0.16	0.09	6.70
4-4	Mariveles-Talaga Bay Rd	0.59	1.55	1.25	0.78	0.17	4.35
	Concrete	0.54	0.98	1.08	-	0.11	2.72
	Asphalt	0.05	0.57	0.17	0.78	0.06	1.63
5-5	Mindanao Avenue	-	0.87	-	0.15	0.03	1.05
	Concrete	-	0.87	-	0.15	0.03	1.05
6-6	Roman Expressway	10.03	11.38	10.84	6.31	0.60	39.16
	Concrete	-	3.34	2.46	4.43	0.15	10.38
	Asphalt	10.03	8.04	8.38	1.87	0.45	28.78
	Tertiary Roads	19.32	42.73	18.99	28.83	11.61	121.47
A	10th Ave	-	0.57	-	-	-	0.57
	Concrete	-	0.57	-	-	-	0.57
B	11th Ave	-	-	-	0.55	-	0.55
	Asphalt	-	-	-	0.55	-	0.55
C	1st Ave	-	-	0.63	-	-	0.63
	Asphalt	-	-	0.63	-	-	0.63
D	1st St	-	-	-	0.25	-	0.25
	Asphalt	-	-	-	0.25	-	0.25
E	2nd Avenue	-	0.76	-	-	-	0.76
	Asphalt	-	0.76	-	-	-	0.76
F	2nd St	-	0.45	-	-	-	0.45
	Asphalt	-	0.45	-	-	-	0.45
G	3rd Ave	0.61	-	-	-	-	0.61
	Asphalt	0.61	-	-	-	-	0.61
H	3rd St	-	0.11	0.44	-	0.01	0.56
	Asphalt	-	0.11	0.44	-	0.01	0.56
I	4th Ave	0.24	-	-	-	-	0.24
	Asphalt	0.24	-	-	-	-	0.24
J	5th Ave (R01110LZ)	-	0.35	-	-	-	0.35
	Asphalt	-	0.35	-	-	-	0.35
K	5th St (R01120LZ)	0.23	-	0.14	-	-	0.37
	Concrete	0.23	-	-	-	-	0.23
	Asphalt	-	-	0.14	-	-	0.14
L	6th Ave	-	-	0.24	-	-	0.24
	Asphalt	-	-	0.24	-	-	0.24
M	7th Ave	-	-	0.43	-	-	0.43
	Asphalt	-	-	0.43	-	-	0.43
N	7th St	1.89	0.49	-	-	-	2.37
	Concrete	-	0.49	-	-	-	0.49
	Asphalt	1.89	-	-	-	-	1.89

DEO / Functional Classification / Road Name / Road Number		Condition Rating					
		Good	Fair	Poor	Bad	No Assessment	Total
O	8th Ave	-	0.25	-	-	-	0.25
	Concrete	-	0.25	-	-	-	0.25
P	9th Ave	-	0.50	-	-	-	0.50
	Asphalt	-	0.50	-	-	-	0.50
Q	Administration Ave	-	0.51	-	-	-	0.51
	Concrete	-	0.51	-	-	-	0.51
R	Alas-Asin Port Rd	-	3.35	1.99	-	-	5.35
	Concrete	-	3.35	1.99	-	-	5.35
S	Ave of the Phils	1.44	-	0.56	-	-	2.00
	Asphalt	1.44	-	0.56	-	-	2.00
T	Bagac-Mariveles Rd	2.56	14.64	4.03	12.12	10.93	44.28
	Concrete	2.56	14.64	2.18	3.95	0.22	23.54
	Asphalt	-	-	0.06	-	-	0.06
	Gravel	-	-	1.79	8.18	10.72	20.68
U	Bagac-Poblacion Rd	1.00	-	0.53	-	-	1.54
	Concrete	-	-	0.48	-	-	0.48
	Asphalt	1.00	-	0.05	-	-	1.05
V	Balanga Poblacion Rd	0.77	0.23	-	-	0.06	1.06
	Concrete	-	-	-	-	0.03	0.03
	Asphalt	0.77	0.23	-	-	0.03	1.03
W	Balanga-Cadre Rd	-	0.90	1.00	-	-	1.90
	Concrete	-	0.90	1.00	-	-	1.90
X	Bay View St	0.14	-	-	-	-	0.14
	Asphalt	0.14	-	-	-	-	0.14
Y	Blue Ridge	0.11	-	-	-	-	0.11
	Asphalt	0.11	-	-	-	-	0.11
Z	Dormitory Rd	-	0.21	-	-	-	0.21
	Asphalt	-	0.21	-	-	-	0.21
A-1	Elliptical Rd (R01138LZ)	-	0.87	0.95	0.31	-	2.13
	Asphalt	-	0.87	0.95	0.31	-	2.13
B-1	Enrique A. Garcia Ave.	-	4.56	-	-	-	4.56
	Concrete	-	4.56	-	-	-	4.56
C-1	EPZA By-Pass (Baraso Country Rd)	-	0.58	1.82	5.02	0.06	7.47
	Concrete	-	0.50	1.74	4.96	0.06	7.26
	Asphalt	-	0.08	0.08	0.05	-	0.21
D-1	Executive Heights A	0.76	-	-	-	-	0.76
	Asphalt	0.76	-	-	-	-	0.76
E-1	Executive Heights B	0.80	-	-	-	-	0.80
	Asphalt	0.80	-	-	-	-	0.80
F-1	Gov JJ Linao Rd	-	1.06	1.79	-	-	2.85
	Concrete	-	1.06	1.79	-	-	2.85
G-1	Green Ridge	-	-	-	-	0.04	0.04
	Asphalt	-	-	-	-	0.04	0.04
H-1	Hilltop Rd	-	-	-	0.60	-	0.60
	Asphalt	-	-	-	0.60	-	0.60
I-1	Housing A	-	-	-	0.66	-	0.66
	Asphalt	-	-	-	0.66	-	0.66
J-1	Housing B	-	-	-	0.42	-	0.42
	Asphalt	-	-	-	0.42	-	0.42
K-1	Jct Layac-Balanga-Mariveles Port Rd	2.86	4.76	3.83	4.74	0.44	16.63
	Concrete	0.05	0.34	2.40	0.32	0.29	3.40
	Asphalt	2.81	4.41	1.43	4.42	0.16	13.24

DEO / Functional Classification / Road Name / Road Number		Condition Rating					
		Good	Fair	Poor	Bad	No Assessment	Total
L-1	Lamao Access Rd	-	-	0.61	-	-	0.61
	Asphalt	-	-	0.61	-	-	0.61
M-1	Lamao DND Forestry Rd	1.42	0.55	-	-	-	1.97
	Concrete	-	0.55	-	-	-	0.55
	Asphalt	1.42	-	-	-	-	1.42
N-1	Luzon Ave (South)	-	0.94	-	-	0.02	0.96
	Concrete	-	0.94	-	-	0.02	0.96
O-1	Mariveles By-Pass Rd	-	0.29	-	1.69	-	1.98
	Concrete	-	0.26	-	-	-	0.26
	Gravel	-	0.03	-	1.69	-	1.72
P-1	Medium Cost Housing	0.06	-	-	0.45	-	0.51
	Concrete	0.06	-	-	-	-	0.06
	Asphalt	-	-	-	0.45	-	0.45
Q-1	Mt Apo	-	-	-	0.35	-	0.35
	Asphalt	-	-	-	0.35	-	0.35
R-1	Mt Arayat	-	-	-	0.13	-	0.13
	Asphalt	-	-	-	0.13	-	0.13
S-1	Mt Banahaw	0.46	-	-	-	-	0.46
	Asphalt	0.46	-	-	-	-	0.46
T-1	Mt Dipolog	0.49	-	-	-	-	0.49
	Asphalt	0.49	-	-	-	-	0.49
U-1	Mt Pinatubo	-	-	-	0.33	-	0.33
	Asphalt	-	-	-	0.33	-	0.33
V-1	Mt Samat Rd	2.78	4.41	-	0.66	0.05	7.89
	Asphalt	2.78	4.41	-	0.66	0.05	7.89
W-1	Road to Pier	-	0.11	-	-	-	0.11
	Concrete	-	0.11	-	-	-	0.11
X-1	Sisiman Port Rd	-	-	-	0.55	-	0.55
	Concrete	-	-	-	0.55	-	0.55
Y-1	United Nation Drv	-	0.44	-	-	-	0.44
	Asphalt	-	0.44	-	-	-	0.44
Z-1	Visayas Ave (R01124LZ)	0.71	0.87	-	-	-	1.58
	Asphalt	0.71	0.87	-	-	-	1.58
Total		32.23	70.30	55.40	37.03	12.93	207.88

Source: 2015 Road Data, Bataan 2nd DEO, DPWH
Notes:
1.) Road data provided are as of 25 November 2015.
2.) The unit of measure for Road Data is kilometers.
3.) No Assessment refers to Road Sections that are either under construction and/or segments with length below the 50-meter gauging length.
4.) National Roads are classified into:
Primary Roads - roads that connect cities of > 100,000 population.
Secondary Roads - other roads which complement with the national arterial roads to provide access to main population and production centers of the country.
Tertiary Roads - other existing roads under DPWH which perform a local function. (In the map, these roads are represented only by letters.)

Table 2-85 Road Inventory, Mariveles

Type of Road	Total	Concrete	Asphalt	Gravel
National	74.167	13.066	39.246	21.855
Provincial	62.326	20.206	21.114	21.006
Municipal	5.938	3.802	1.695	0.441
Barangay	103.665	41.125	50.805	11.735
Total	246.096	78.199	112.860	55.037

Source: 2002 CLUP of Mariveles

Transportation Services and Traffic. Transportation. Numerous transport vehicles are operating in the municipality, namely: inter-provincial bus companies, provincial and mini buses, jeepneys, tricycles, ferry boats, fishing boats and cargo vessels, and private air crafts. Existing transportation facilities are bus terminals, BASECO and BEZ wharfs, Mariveles Port, Bataan Storage Corp. Pier and helipads are facilities within the economic zone.

Transport services within, to and from Mariveles are provided by a network of public utility buses and jeepneys and tricycle franchises. There are two (2) bus companies operating in Mariveles. These are Genesis Transport Service and Bataan Transit. Both have bus terminals are located in Lakandula St., Poblacion/San Isidro, Mariveles. There are also mini-buses that ply the Balanga-Mariveles route. The vicinity of the market serves as the terminal of both jeepneys and tricycles. The jeepneys ply the longer route while tricycles serve as means of transport within the inner arteries of the municipality.

Most shipping activities occur in the Mariveles harbor, a seaport owned by the national government. Foreign cargo vessels are located in this seaport with exportable items from the Freeport Area of Bataan. Jet ferries take the Mariveles to Manila and back via the Manila Bay.

The host Barangay Biaan can be reached thru different modes of transportation such as public utility jeepneys (PUJ), private vehicles and tricycles, which roam within the barangay via provincial road (Mariveles-Bagac Road) from Mariveles proper (Barangay Poblacion). The sitios of the barangay can be reached thru the Mariveles-Bagac road. The sitio Talain and Lusong can also be reached from Barangay proper (Lower Biaan) via 15-20 minutes boat ride.

2.4.9 Displacement of Settlers

There will be no settlers and properties that will be displaced, land ownership transfer, right-of-way conflict and land use conversion for the proposed Project of MPGC will be cited in the MEZ of EFIHI.

2.4.10 In-migration

Influx of migrant workers during the construction and operation phases of the proposed MCPP Project will intensify the competition for jobs of locals. Migrant workers may bring in cultures and views not acceptable to the locals. Sometimes, the presence of foreign labor in the area is associated with increased crime rate, sprouting of squatters and other social ills.

Locals who are qualified shall be given the opportunities and priority to seek employment from the proposed MCPP Project. MPGC and its Contractors shall maximize the use of local labor as possible.

2.4.11 Cultural/Lifestyle Change

There are no indigenous people residing in the project area, therefore, there are no perceived effects of cultural change on the indigenous people.

In terms of lifestyle, there is not much change projected since there is already an existing coal-fired power plant in the area. Some residents may have to increase the pace of their lifestyle to keep up with the increased demands of employment and livelihood opportunities.

2.4.12 Impacts on Physical Cultural Resources

The proposed MCPP Project site is located within MEZ which is classified as an industrial area. Moreover, there will be no direct impact on the identified tourist spots and other physical cultural resources and landscapes that have historical or cultural significance since they are relatively distant from the project site.

Furthermore, MCPP will design the appearance of the plant’s exterior using green and earth colors, to blend to the natural surroundings of the plant. Green buffer zone along the perimeter will also act as noise barrier to contain the noise within the plant site.

Since the Project involves earthmoving activities, possible unearthing of artifacts and archeological remains is inevitable. In the event that an archaeological asset is discovered during the course of construction period, the following procedure shall be implemented:

- MPGC must preserve the potential archaeological finds and report it immediately to the National Museum.
- Closely coordinate with the National Museum on the appropriate course of action in protecting the archaeological finds.
- Cease immediately all construction activities in the vicinity of the find/feature/site;
- Hire an archaeological professional, recognized by the National Museum, to ensure the following are carried out:
- Delineate the discovered find/feature/site;
- Record the coordinates of the find location, and all remains are to be left in place;
- Secure the area to prevent any damage or loss of removable objects;
- Assess, record and photograph the find/feature/site;
- Undertake the inspection process in accordance with all project health and safety protocols under direction of the Health and Safety Officer;
- Conduct all investigation of archaeological soils by hand;
- Keep all finds, osteological remains and samples and submit to the National Museum as required;
- In the event that any artefacts need to be conserved, secure approval from the National Museum;
- Provide an on-site office and finds storage area to allow storage of any artefacts or other archaeological material recovered during the monitoring process;
- In the case of human remains, in addition to the above, contact the National Museum and adhere to the guidelines for the treatment of human remains; and
- If skeletal remains are identified, tap an osteo-archaeological to examine the remains.
- Implement the following process for conservation: Hire a conservator, if required.

The consulting archaeologist completes a report on the findings and submits to the National Museum
National Museum reviews the report and informs when works can resume.

2.4.13 Threat to Delivery of Basic Services/Resource Competition

In view of the entry of migrant workers and increase of economic activities due to the proposed MCPP Project, there could be overburdening of public social services in the area and possible resource competition in terms of food, water supply, electricity and medical supply.

To prevent competition for public basic services, the Project will provide temporary housing/ construction camp for non-resident workers with recreational facility and on-site medical clinic staffed by at least a doctor and nurse. Moreover, MPGC will source its water supply from EFIHI water system primarily sourced from Lusong River. Power supply will be sourced from the power plant itself.

2.4.14 Threat to Public Health and Safety

The potential air and water pollutants generated during the various phases of the project may have adverse impacts on the health of operation workers and residents of nearby communities, specifically those along the property boundaries. This impact to the health of the residents may be worsened by increased temperature and frequent rainfall events brought about by climate change.

Workers, particularly those on field, may be exposed to ergonometric stress and increased levels of noise, dust and heat. They may also be exposed to physical hazards associated with heavy lifting, moving heavy equipment, etc.

Infectious diseases among workers caused by viruses and bacteria (i.e. fungus and parasites) may spread to the residents if the workers live and mingle with the community. Existence of dengue and malaria cases is unpredictable due to the nearness of the Project site to the reservoir and foreseen contained and stagnated waters. This impact to the health of the residents may worsen by increased temperature and frequent rainfall events brought about by climate change.

An IEC plan shall be formulated and implemented to inform the local communities of the project, the project activities, the duration, the person/company responsible for the operation and the management of the project. It shall also contain information on safety aspects like portions of operation areas and equipment that shall be avoided.

Medical check-up will be part of the CSR Program of MPGC to monitor the occurrence of unusual health problems that can be associated with the proposed Project. MPGC shall coordinate with the barangay health unit to create a barangay health database from the medical check-ups. Vaccines shall be provided to protect workers from different kinds of infectious and non-infectious diseases.

The following measures will be implemented to reduce risks of threats to Occupational Safety and Health (Accidents and infectious disease):

a) Preparation of Occupational Safety and Health Management Plan.
b) Inclusion of medical certificate in the requirements for hiring of workers to ensure that they are fit to work.
c) Ensure that the construction workers are provided with proper training on construction operating procedures, occupational health and safety procedures and emergency preparedness and response procedure.
d) Preparation of Construction Management Plan including storage of equipment and machinery, and access route of heavy vehicles considering health and safety of workers.
e) Close coordination with the nearest hospitals in the active construction site for immediate transfer and/or further evaluation and medical management of the patient.
f) Provision of safe and clean water for drinking, appropriate sanitary facilities such as toilets and waste bins.
g) Provision of appropriate personal protective equipment (PPE) to all construction workers, particularly to the personnel working on heights, heavy and electrical equipment, and tunneling activities.
h) Provision of medical/first aid kits at the construction area. Establishment of Health and Safety Desk or Medical Station at the active construction sites to safeguard the health of the workers and local residents and to provide immediate response during unexpected incidents/emergencies.
i) All occupational injuries and diseases shall be recorded, analyzed and submitted to DOLE annually.

2.4.15 Generation of Local Benefits from the Project

The direct benefits resulting from this Project include the creation of employment for local residents and non-local manpower in the area. During construction of the proposed MCPP Project, MPGC would provide temporary about 2,500-3,000 employment to local residents. During operation, 200-250 new positions will be required. Potential positive effects of the manpower influx will include demand for retail and other services, which may increase economic activities and benefits for some local businesses, including food suppliers and other retailers. It is expected also to increase business opportunities in terms of the project needs for construction materials, supplies, concrete aggregates and social services.

Aside from the generation of job opportunities for the direct and indirect impact barangays, opportunities for business establishments is also expected to be created by the proposed MCPP Project. Another benefit is under DOE ER 1-94 which provides a percentage share to LGUs for every kW-hr sale of electricity. The fund that will be accessed by the concerned LGUs from the DOE will be used for electrification, development and livelihood fund and reforestation/watershed management. Another benefit is the generation of revenues from taxes, permits and other dues for the local government units.

To enhance the employment opportunities brought by the proposed MCPP Project, MPGC shall regularly coordinate with the LGU of Mariveles, specifically at the barangay level regarding the hiring of temporary workers during construction phase and regular workers during operation phase to ensure that the workers being considered are legitimate residents in the area. Moreover, by hiring local residents, some of the social conflicts associated with uncontrolled in-migration can be minimized.

The respective contractor shall be responsible to provide accommodation for their workers and equipped with the necessary social infrastructure. Workers and professional personnel from outside the area will stay in temporary accommodation. Increased traffic in the project area during construction will be controlled on and off site to minimize traffic hazards to road users.

Vocational and skill training and entrepreneurship courses will be undertaken prior to construction to enable local people to be competitive in securing employment and work contracts related to the proposed Project. These programs shall be carried out in coordination with the LGU of Mariveles and other concerned agencies.

2.4.16 Traffic Congestion

An increase in vehicular traffic will be expected during construction phase of the proposed project due to the movement of construction equipment; the delivery of construction materials by haulers and trucks; and the additional commuters—the construction workforce during rush hours in the morning and the afternoon. The entry and exit of the construction equipment and vehicles into and out of the project site will increase the volume of vehicles passing the access roads.

Employee traffic is anticipated during rush hours in the morning and late in the afternoon. Additional traffic can also be expected at the beginning and end of weekly work cycles, when migrant workers report for work on a Monday and go home for the weekend.

Management measures to alleviate overland traffic impacts during construction are the following:

- Delivery of construction materials during off peak hours;
- Detailed truck scheduling;
- Formulation of an overland traffic management scheme in coordination with the host Barangay Biaan, the municipality of Mariveles and other pertinent agencies;
- Provision of adequate parking areas; and
- Posting of appropriate traffic sign and warning.

MPGC shall prepare a traffic management system, which will minimize possible traffic volume in the area.

3.0 ENVIRONMENTAL MANAGEMENT PLAN

The MPGC is committed to minimize significant adverse impacts, which could arise from the construction, operation and abandonment of the proposed MCPP Project. It will do so by formulating an Environmental Management Program (**EMP**) to manage the Project's impacts, adopt the best available proven control technologies and procedures, undergo a continuing process of review and positive action in the light of available monitoring results and continuing consultation with the local communities.

Basically, the EMP will aim to achieve an exemplary environmental performance in the construction and operation of a power plant. In order to meet this goal, the following activities/measures/programs will have to be implemented:

- Environmental Policy;
- Application of Mitigation/Management Measures;
- Environmental Monitoring Program;
- Social Development Program;
- Emergency and Contingency Plan;
- Information, Education and Communication Plan;
- Reforestation Program for Buffer Zone;
- Construction Contractor's Program; and
- Institutional Plan and Hiring of an Environmental/Safety Officer.

3.1 ENVIRONMENTAL POLICY

The Environmental Policy of the MPGC can be summarized in three (3) statements, as follows:

- To produce electricity using high-efficiency, state-of-the-art technology and practices with the minimum possible adverse impact on the environment and surrounding community;
- To design and operate the plant safely and in an environmentally-responsible manner according to world class standards and in full compliance with all applicable laws and regulations; and
- To conduct continuous dialogue with the host community as well as all stakeholders to ensure protection and enhancement of the quality of the environment and to contribute to the sustainable development of the country.

To carry out this Environmental Policy, the MPGC commits to regularly evaluate the environmental impacts of the proposed MCPP Project, its facilities and jetty operations all throughout the construction and operation phases; and maintain good communication/relations with the local communities.

Furthermore, the MPGC Management shall issue work instructions/controls for defining the manner of conducting an activity and inspection procedure to ensure application of the mitigation measures. Documentation of the supervision and monitoring results for the Project shall be done to test the effectiveness of mitigation measures and impact controls.

The MPGC Management will inform the community and the local government about its environmental policies and program through its IEC Program.

3.2 MANAGEMENT AND MITIGATION

The main emphasis of environmental management of the proposed MCPP Project will be on air quality and safety factor of the plant. Other priorities will be treatment of effluent to meet the DENR standards, avoidance of thermal pollution above the permissible standards, maintenance of buffer zone to enhance biodiversity and to provide sinks for GHG emissions.

The mitigation measures are formulated to reduce the adverse environmental impacts that have been identified and enhance the beneficial impacts as a result of the proposed MCPP Project. The mitigation measures have been discussed in **Chapter 2** of this EISR after the assessment of each impact. The Impact Management Plan outlines the predicted impacts of the proposed Project as well as its prevention/mitigation and enhancement measures.

3.3 ENVIRONMENTAL MANAGEMENT PROGRAMS

The following are the EMPs that will be implemented for the proposed Project:

- **Air and Water Quality and Ecology Monitoring Program.** Monitoring of the environment in the surrounding area during construction and after the start-up of the plant shall be undertaken to establish the construction and plant operational water quality conditions, survey the degree of changes, and assess the effects of pollutants. Pre-operational and regular water quality monitoring of ground, freshwater and marine waters shall be implemented to ensure the effectiveness of plant pollution control measures and ensure that the DENR water quality standards will not be violated. Utmost concern will be focused on marine water quality. Programs will be made with LGUs to conserve marine water quality, especially concerning parameters with elevated values.

- **Solid and Hazardous Wastes Management System.** The proposed Project operation mainly generates industrial solid and hazardous wastes which include ash, slag, wasted conveyor belts and barrels, oily sludge, consumables, damaged equipment, spent lubricants and other chemicals. Utmost concern will be focused on ash production, handling and disposal. Two (2) systems will be in place for the Ash production, handling and disposal: the Bottom Ash Handling System and the Fly Ash handling system.

- **Stormwater Management and Drainage Plan.** MPGC shall install a storm drainage system especially along the access/maintenance roads, stormwater detention/retention pond and coal yard run-off pond.

- **Emergency Preparedness and Response Plan.** Emergency response/procedures will be developed for accidents due to equipment/machinery failure or malfunction; and calamity from flood and typhoon occurrences, a major seismic event or earthquake. Evacuation maps shall be posted at different areas of the Project site. Evacuation drills shall be conducted to assess the applicability of the plan.

- **Fire Protection system.** A comprehensive fire detection, alarm system and fire protection system is designed for the facility to provide a high degree of protection for plant buildings and other auxiliary facilities. The Fire Protection System shall consist of fire suppression systems, independent fire detection systems, standpipe, fire hose stations, fire loop system, and portable fire extinguishers to protect the asset, buildings and facilities. Fire drill shall be undertaken regularly to ensure preparedness of the personnel in the event of fire or fire risks.

- **Telecommunication System.** All required facilities necessary to interface with NGCP for telecommunications, remote monitoring, remote metering, remote control of the frequency and Automatic Generation Control (**AGC**) shall be installed and furnished.

- **Social Development and IEC Program.** An Indicative Social Development Plan (**ISDP**) Plan was done through consultation with the decision makers of the project affected municipality and barangays, the Barangay Chairmen, LGUs and the Government agencies such as, the, MSWD, the Municipal Heath Officer (**MHO**), Department of Education (**DepEd**), NGOs, the Community Relations Officer of MPGC and residents of Barangay Biaan. The indicative sustainable social development plan that will be formulated is based on the government requirement R.A 7279/DAO 2003-30 revised and the mandated corporate responsibility of MPGC aligning the programs to the mandated development programs as required by the Department of Interior and Local Government (**DILG**) in the Internal Revenue Allotments (**IRA**).

- **Health and Safety Plan.** The Health and Safety Plan for the community especially the directly affected/impact area involves the following: a) A Medical and Dental Program; and b) Emergency Disaster Health Program. Health and Safety plan for the workers will also be created and implemented.

- **Reforestation Program for Buffer Zones.** The need for a buffer zone is clearly stressed in the light of filtering emissions, neutralizing the noise level at the property line, creating a habitat for displaced vegetation, and improving the aesthetics of the Project site.

- **Construction Contractors Program.** The contract between MPGC and the respective contractors shall incorporate rules, regulations and conditions to ensure that the mitigating, management and enhancement measures in the EISR and the conditions stipulated in the ECC are strictly followed.

Table 3-1 Impact Management Plan for the Proposed Project

Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact	Prevention/Mitigation/Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement
PRE-CONSTRUCTION PHASE						
Pre-construction phase covers activities like planning, feasibility study, drawing of plans and permit procurement.						
CONSTRUCTION PHASE						
	LAND Land use and Classification					
Cut and fill activities Construction of the proposed Project		• Change/Inconsistency in Land Use	• The Project site is an industrial land and consistent with the general land use of Mariveles and therefore there is no issue with the change in land use.	N/A	NA	NA
		• Encroachment to ECA	• The Project site has not encroached in an ECA.	MPGC and Contractor	NA	NA
		• Impairment of visual aesthetic	• Establishment of buffer zones • Regular coordination with Camaya Coast Resort owner	MPGC and Contractor		
		• Devaluation of land value as a result of improper solid waste management	• Implementation of the Solid Waste Management Plan • Utilization of the ash storage facility within MCPP	MPGC and Contractor		
	Geology/ Geomorphology	• Change in surface landform/terrain/slope	• Backfill materials shall be compacted to the required density. • Soft materials will be excavated and replaced by engineered backfill	MPGC and Contractor		Part of EPC contract cost
		• Change in sub-surface underground geomorphology	• The excavations done at the site shall cause permanent but low level of disturbance. • Strict conformance to the recommendations of the geotechnical study			

Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact	Prevention/Mitigation/Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement
		• Inducement of subsidence, liquefaction, landslides, mud/debris flow	• Since the area is already developed, the possibility of experiencing landslides and/or mud/debris flow is nil.			
Site clearing and construction of project facilities Use/Storage of Oil/Fuel Solid wastes from construction activities and	Pedology	• Soil erosion	• Construction of soil erosion control measures either by engineering structure or planting of grasses/trees. • Placement of excavated soil materials in appropriate stockpile areas with avoidance of stockpiling along drainage ways/creeks. • The soil stockpiles will be covered with plastic sheets/geotextile, or planted with grasses/ small shrubs for erosion control. • Scheduling of excavation work/earth movement during dry months.	MPGC and Contractor	150,000.00	Part of EPC contract cost
		Soil Contamination	• Development and implementation of a solid waste management program that shall include proper waste segregation and good housekeeping • Proper handling of oil products and equipment maintenance. • Oil sludges shall be properly contained in leak proof containers prior disposal. Oil contaminated materials should be collected, stored and disposed by DENR-accredited waste treater. • Fuel storage should be contained	MPGC and Contractor	Include in TOR or scope of contractor	

Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact	Prevention/Mitigation/Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement
			with an impervious bund which is designed to handle 110% of the tank capacity.			
	Terrestrial Ecology	• Removal of vegetation	Project site within Mariveles Economic Zone (MEZ) is already developed and cleared of vegetation cover. However, MPGC shall establish a 24.53 ha buffer zone and native species shall be used for vegetation, as these would be expected to have good survival rate.			
	WATER					
Mobilization of construction equipment and materials Generation of domestic waste	Water Quality	• Degradation of surface and groundwater quality	• Provision of containment structures and canals in the storage areas for oil and the motor pool area • Return of contaminated cans/containers of hazardous materials such as paints, thinners, wood preservatives and others to the supplier/producer for treatment and safe disposal • Putting in place erosion control measures along drainage ways prior to construction such as silt traps and sedimentation basins • Scheduling of construction activities during the dry season, when necessary • Immediate stabilization of exposed soils/barren areas with indigenous drought resistant plants • Work to minimize destruction to	MPGC and Contractor	500,000.00	Part of EPC contract cost

Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact	Prevention/Mitigation/Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement
			seabed through the use of geotextile silt curtains to control the spread of sediment • Prohibit the discharge of bilge water from attending vessels and other delivery vessels • Ensure compliance with the following: MARPOL, PCG-MC 01-94, DAO No. 08 S. 2016 to be stipulated in the Contract of Contractors • Regular monitoring of surface and groundwater quality			
Construction of the proposed jetty and discharge outfall	Marine Ecology	• Threat to existence and/or loss of important local species and habitat • Threat to abundance, frequency and distribution	• Construction of siltation ponds to prevent sediment from being washed into the area. • Stockpiles shall have appropriate drainage to prevent erosion of silt to the bay. • Adequate and proper drainage system • Careful planning for the layout of offshore facilities to avoid significant adverse impacts on the marine habitat in the area • To control the spread of sediment, silt curtains will be utilized so that sediments disturbed are contained in the vicinity. In swift moving waters, it may be necessary to have more than one wall of silt curtains. • Regular monitoring of plankton and marine benthic invertebrates	MPGC and Contractor		Part of EPC contract cost

Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact	Prevention/Mitigation/Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement
			shall be conducted to evaluate effects of siltation on the composition and abundances of these biota. • Support a marine sanctuary to be established by EFIHI in cooperation with LGU			
	AIR					
	Meteorology/ climatology	• Change in local climate and local temperature	• MPGC shall establish a 24.53ha buffer zone and native species shall be used for vegetation, as these would be expected to have good survival rate.			
Mobilization of Construction Equipment and Materials	Air Quality and Noise	• Degradation of Air Quality	• Every main haul road shall be paved with concrete, bituminous materials, hardcores or metal plates; keep the road clear of dusty materials; spray the road with water or a dust suppression chemical so as to maintain the entire road surface wet; and immediately before leaving a construction site, every vehicle shall be washed to remove any dusty materials from its body and wheels; • Where a vehicle leaving a construction site is carrying a load of dusty materials, the load shall be covered entirely by clean impervious sheeting to ensure that the dusty materials do not leak from the vehicle; • The working area of any	MPGC and Contractor	500,000.00	Part of EPC contract cost

Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact	Prevention/Mitigation/Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement
			excavation or earth moving operation shall be sprayed with water or a dusty suppression chemical immediately before, during and immediately after the operation so as to maintain the entire surface wet; • Exposed earth shall be properly treated by compaction, turfing, hydroseeding, vegetation planting or sealing with latex, vinyl, bitumen, shotcrete or other suitable surface stabilizer within six (6) months after the last construction activity on the construction site or part of the construction site where the exposed earth lies; • Any stockpile of dusty material shall be either covered entirely by impervious sheeting; placed in an area sheltered on the top and the three (3) sides; or sprayed with water or a dust suppression chemical so as to maintain the entire surface wet. • Periodic watering of aggregates storage piles or covering or enclosure if material is especially dusty. • Provision of water sprays and chemical dust suppressants or oil on roadways • Ambient air (TSP) monitoring			

Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact	Prevention/Mitigation/Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement
			• Creation of buffer zone as filter for emissions			
		• Increase in ambient noise level	• Scheduling certain high noise emitting works to more acceptable times of day • Use of the most environmentally acceptable equipment which is properly maintained and silenced • Use of the least intrusive method of work • Proper instruction and supervision of staff • It is advisable that electrically powered plant shall be preferred, where practicable, to mechanically powered alternatives. If mechanical powered plant will be used, it shall be fitted with suitable silencers and mufflers • Defective equipment/parts with abnormal noise and/or vibration will be either repaired replaced • Schedule use of equipment/machines emitting high noise like pile driver during day time operation while, minimize use during night time operation • All employees working on site will be provided with proper ear protectors • Conduct noise level monitoring			
	PEOPLE					
Implementation of	Local residents	• Increase income for	• Positive Impact	MPGC	100,000.00	Part of EPC

Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact	Prevention/Mitigation/Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement
livelihood projects		residents				contract cost
Hiring of workers	Local residents	• Increase in local employment	• Priority employment for qualified local residents without discrimination to women	MPGC Contractor in coordination with host barangay		Part of EPC contract cost
Increase in taxes and revenues	Local community	• Improvement in infrastructures and social services	• Diligent payment of taxes/revenues	MPGC		Part of EPC contact cost
Accidents	Local residents	• Construction-related hazards	• Environment, health and safety training prior to construction	MPGC Contractor		Part of EPC contract cost
OPERATION PHASE						
	LAND					
Foundation Stability	Geology	• Subsidence and Liquefaction	• Structural monitoring of buildings/facilities especially after each earthquake • Formulation of detailed Emergency Preparedness and Response Plan	MPGC, MMT and Contractor	200,000.00	Part of Operation cost
Generation of ash wastes	Pedology	• Soil contamination with heavy metals	• Regular monitoring of heavy metals in soil (Pb, Hg, Cd, Cr^{+6}, etc.) through sampling and analysis	MPGC MMT EMB	60,000.00	Part of Operation cost
Open area upstream of the power plant facilities and sedimentation in the power plant vicinity		• Soil erosion	• Planting of trees within the vicinity of the project site to serve as buffer for soil erosion • Sedimentation control structures (sedimentation ponds/dams) will be established within the power plant vicinity.	MPGC, MMT, LGU, EMB	50,000.00	Part of Operation cost
Utilization of coal for fuel	Terrestrial Ecology	• Possible off-site impacts • Generation of power plant emissions	• MPGC shall establish a buffer zone and native species shall be used for vegetation, as these	MPGC	200,000.00	Part of Operation cost

Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact	Prevention/Mitigation/Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement
			would be expected to have good survival rate.			
	WATER					
Presence of water-based structures	Oceanography	• Change in coastal processes	• Implementation of shoreline protection measures such as sand bypass/relocation operation and engineering and vegetation measures, in the event of shoreline erosion and accretion	MPGC	200,000.00	Part of Operation cost
		• Increase productivity of benthic fauna due to colonization of jetty piles by reef-dwelling biota • Re-colonization of benthic communities in the jetty area	• Implement exclusion zone and place visible markers to protect the area from intrusion and disturbance • Design jetty piles (e.g., rough surface) to hasten colonization by sessile organisms	NA	NA	NA
Plant generation of process wastewater and thermal effluent Use of Hypochlorite in bio-fouling activity	Water Quality	• Degradation of water quality	• Installation of WWTS that will efficiently treat operation wastewater • Installation of STP to treat the domestic wastewater generated • MPGC shall install thermistors to monitor the seawater temperature on a monthly basis	MPGC	30,000,000.00	Part of Operation cost

Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact	Prevention/Mitigation/Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement
	Marine Ecology	• Threat to abundance, frequency and distribution of species • Loss of important species • Loss of habitat	• Installation of screens at the intake structure • Frequent cleaning and maintenance of intake structure • Using the lowest possible hypochlorite concentration and proper and regular maintenance of the underwater structures • Installation of sensor mechanism to control dosage of the sodium hypochlorite level at the outlet to 2 ppm Support a marine sanctuary to be established by EFIHI in cooperation with LGU	MPGC	250,000.00	Part of Operation cost
Use of fuel and chemicals	Groundwater Quantity	• Groundwater contamination	• Daily supervision of possible leaks or spillages in the fuel storage tanks • Regular maintenance to minimize pipe tank leaks or ruptures • Use of coal ash by cement plants	MPGC, MMT	200,000.00	Part of Operation cost
	AIR					
Utilization of coal for fuel	Air Quality	• Degradation of Air Quality	• The CFB Technology allows the fuel to be burned at a relatively lower temperature, which reduces the NOx formation by approximately 60% due to a low combustion temperature of 800-900ºC. • Limestone injection shall capture up to 98% of sulfur impurities from the fuel by reacting with it to form calcium sulfate, an inert material that is removed with the	MPGC, MMT and Contractor	20,000,000.00	Part of Operation cost

Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact	Prevention/Mitigation/Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement
			combustion and, thereby reducing SO_x formation. • EP shall be installed to remove 99.5% of particulates, particularly fly ash from the flue gas prior to its release through the stacks. • CEMS shall be installed to have real time monitoring of emissions at the stack • Stack will be constructed at 110 m to have proper air dispersion • Conduct ambient air quality monitoring and stack emissions testing			
		• Dust Generation from Material Handling in ADF	• Implement wet handling of ash • Loading directly into trucks to be transported to cement plants to minimize storage volume			
Use of air compressor and emergency generators Operation of steam turbine and boiler equipment	Noise Quality	• Increase in ambient noise level	• Air compressors and emergency generators will be equipped with noise attenuation enclosures; • Steam turbine and boiler equipment will be enclosed and provided with silencers at the exhaust; and • The steam drum, super heater and re-heater safety valves will be provided with an absorptive silencer. • Conduct noise level monitoring	MPGC, MMT and Contractor	150,000.00	Part of Operation cost
	PEOPLE					
	Waste Management	• Generation of sewage/solid waste	• Provision of STP, portable toilets and latrines, no litter signs, waste can	MPGC, MMT	200,000.00	Part of Operation cost

Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact	Prevention/Mitigation/Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement
			• Applying the hierarchy of measures: Reduce, Segregate, Re-use, Recycle and Dispose • Proper disposal of non-recyclable wastes through an accredited contractor			
Hiring of workers	Population	• Change in population (size, distribution) • In-migration	• Priority hiring of qualified local residents in coordination with the Municipal Gov't and host barangay • Training program and skill transfer for local residents	MPGC, LGU	200,000.00	Part of Operation cost
	Social services	• Overburdening of public social services	• Priority hiring of qualified local residents • On-site medical clinic staffed by at least a doctor and a nurse • Provision of an ambulance	MPGC	600,000.00	Part of Operation cost
	Health	• Introduction of disease between migrant and local workers	• Clean bill-of-health as a condition for employment • Medical check-up shall be included in CSR program to monitor the occurrence of unusual health problems that can be associated with the proposed Project • Provision of potable water, sanitary facilities and garbage bins for workers • Provision of Medical clinic and a safety officer to monitor safe working conditions • Provision of Medical/First Aid kits in all work places • Provision of an ambulance	MPGC	300,000.00	Part of Operation cost

Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact	Prevention/Mitigation/Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement
Operation of the power plant	Local residents	• Increased social and economic financial activity	• Positive impact, no mitigation required	MPGC	NA	NA
Spontaneous combustion of coal	Local properties	• Fire hazard	• Regular compaction and watering of coal pile once the temperature exceeds 90°C • Installation of temperature monitoring system, water sprinkler system and fire hydrants in the coal yard • Provision of fire suppression systems, fire detections systems, fire host stations and portable fire extinguishers • Full enclosure of the coal yard • A “first-in-first out policy of handling of coal • Transferring, cooling and immediate use of affected portions of the stock • Provision of a fire truck	MPGC	200,000.00	Part of Operation cost
ABANDONMENT PHASE						
	LAND					
Decommissioning	Pedology	• Soil contamination with heavy metals	• The Abandonment Rehabilitation Plan shall be followed strictly with emphasis on the strategy of sustaining erosion/ sedimentation control within and adjacent vicinity of the power plant and rendering the Project area free of soil contamination for heavy metals (Pb, Hg, Cd and Cr^{+6})	MPGC, MMT, EMB	60,000.00	Part of Abandonment cost
	Terrestrial Ecology	• Increase biodiversity due to retention of	• Positive impact. Continual propagation of seedlings for	MPGC	NA	NA

Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact	Prevention/Mitigation/Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement
		buffer zone	future use.			
	WATER					
Disposal of waste	Water Quality	• Degradation of water quality	• Collection of spills • Removal and/or neutralization of chemicals • Continuous water quality monitoring	MPGC, MMT, EMB	200,000.00	Part of Abandonment cost
	AIR					
	Air Quality and Noise	• Degradation of air quality • Increase in noise levels	• Watering during dismantling to minimize dusts • Proper maintenance of vehicles • Use of noise suppressors/mufflers • Limiting noisy activities during daytime • Conduct noise level monitoring	MPGC, MMT, EMB	200,000.00	Part of Abandonment cost
	PEOPLE					
Hiring of workers for demolition and abandonment activities	Local residents	• Increase in temporary employment • New skills developed for decommissioning may be marketable elsewhere	• Priority for qualified local residents	MPGC	NA	NA
Loss of jobs/ employment		• Reduction in employment opportunities to include the staff of local contractors with long-standing service contracts with the project	• Six (6)-month notice prior to termination of contract to give ample time to look for next employment • Effective management via consultation, planning and communications with affected workers • Financial support within a human resources plan	MPGC	NA	NA
	Demographic	• Out migration of affected project personnel to				

Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact	Prevention/Mitigation/Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement
		seek work elsewhere				
Decommissioning activities	Local Community	• Nuisance	• Formulation and implementation of decommissioning impact management plan	MPGC	30,000,000.00	Part of abandonment cost

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

The Environmental Risk Assessment (**ERA**) is conducted as part of the EIA Study requirement for the proposed MCPP Project in Barangay Biaan, Mariveles. The operation of the proposed Project involves the handling of corrosive, reactive, flammable and toxic substances. Fire explosion and release of toxic vapor are among the most common threats that are considered in the ERA.

This ERA report is in accordance with the prescribed format stipulated in the RPM of DAO 2003-30, Implementing Rules and Regulations of PD 1586, establishing the PEISS. The primary objective of this ERA is to perform a preliminary qualitative risk assessment/ screening to identify, describe and evaluate the possible impacts arising from the development and operation of the proposed Project on the communities and the environment. The general objective of this report shall be as follows:

- To identify and characterize the hazardous substances that will be handled, used, and stored at the proposed Project;
- To identify the requirements or the degree of ERA preparation based on the results of the inventory as compared with Threshold levels prescribed in Annex 2-7e of the RPM DAO 2003-30.
- To present the physical and chemical properties of these substances;
- Discussion of the hazards associated with the use and storage of these substances; and
- To establish mitigation measures to prevent harmful consequences to human health and possible damage to the environment.

4.1 BASIC ERA CONCEPTS

Accidents. Specific unplanned event or sequence of events that has a specific undesirable consequence. Most accidents are caused by the failure of people, equipment, supplies or surroundings to behave or react as expected.

Hazard. Characteristics of the system/plant/process/substance that represents a potential for an accident or an adverse impact on public or the environment. It is the combination of a material and an operating environment such that certain unplanned events could result in an accident.

Risk. Usually defined as the probability and magnitude of causing loss to personnel, property and/or environment.

There are two (2) kinds of risk: hazardous substances risk which is defined as risk from toxic, flammable or explosive nature materials in the process; and physical risk defined as risk from extreme conditions. For this case, ERA will focus in the hazards associated with the operation of the coal fired power plant.

Chemical Risk. This is the risk associated with direct exposure with hazardous substances without ignitions.

Physical Risk. These are the risks involved when flammable and hazardous substances are ignited through either leaks or catastrophic failure. These physical events can be triggered by intentional bombing, accidental ignition, leakage, tank failure by earthquake and structure collapse and lightning.

Risk Management. The process of weighing a policy alternative and selecting the most appropriate regulatory and management actions integrating the results of risk assessment with engineering data and with social and economic concerns to reach a decision.

Toxicity. The ability of a substance to produce by non-mechanical means once it reaches a susceptible site on or on the body.

4.2 HAZARD IDENTIFICATION

The following are the major substances stored, used, and handled at the proposed Project: diesel oil, neutral amine, hydrazine and sodium phosphate. The selection of the hazardous substance for evaluation is mainly based on the nature and the quantity of material that will be stored on-site. If these substances fall in any category definitions of Annex 2-7e, it is considered hazardous and will be included in this study. The results are summarized in **Table 4-1**.

Table 4-1 Summary of Hazardous Substance Categorization

Category	Applicable Criteria	Evaluation	Criteria Met?
Diesel Oil			
Explosives	Substances or preparations which create risk of an explosion by shock, friction, fire, or other sources of ignition.	Not explosive in normal form (liquid)	No
Flammable Substance	Substances and preparations having a flash point range of 21°C to 55°C and capable of supporting combustion.	Flash point > 60°C NFPA 704 Flammability = 2 (https://cameochemicals.noaa.gov/chemical/11452)	Yes
Oxidizing Substances	Substances which give rise to highly exothermic reaction when in contact with other substances, particularly flammable substances.	Diesel oil belongs to aliphatic saturated hydrocarbons which are mostly unreactive. They are not affected by aqueous solutions of acids, alkalis, most oxidizing agents, and most reducing agents. (http://cameochemicals.noaa.gov/chemical/11452#section2)	No
Toxic Substances	Low, medium, high, very high and extreme toxicity of substances or preparations.	Value of *a* based on LC_{50} = 6 Value of *b* based on Vapor Pressure = 1 Toxicity Class (*a* + *b*) = 7 (Medium Toxicity based on Table 1 in Annex 2-7e of RPM)	Yes
Unclassified Substances	Substances or preparations that react violently with water (Type A), and substances or preparations which release or liberate toxic gas in contact with water (Type B).	Insoluble in water. No known hazardous reaction. (http://cameochemicals.noaa.gov/reactivity/documentation/RG29-RG100)	No
Neutral Amine*			
Explosives	Substances or preparations which create risk of an explosion by shock, friction, fire, or other sources of ignition.	Containers may explode in fire (http://nj.gov/health/eoh/rtkweb/documents/fs/0576.pdf)	Yes
Flammable Substance	Substances and preparations having a flash point range of 21°C to 55°C and capable of supporting combustion.	Flash point ~ 32.2°C NFPA 704 Flammability = 3 Highly flammable based on Annex 2-7e of RPM	Yes
Oxidizing Substances	Substances which give rise to highly exothermic reaction when in contact with other substances, particularly flammable substances.	Neutralizes acids in exothermic reactions to form salts plus water (https://cameochemicals.noaa.gov/chemical/496)	Yes
Toxic	Low, medium, high, very high	Value of *a* based on LC_{50} = 7	Yes

Category	Applicable Criteria	Evaluation	Criteria Met?
Substances	and extreme toxicity of substances or preparation.	Value of *b* based on Vapor Pressure = 1 Toxicity Class (*a* + *b*) = 8 (High Toxicity based on Table 1 in Annex 2-7e of RPM)	
Unclassified Substances	Substances or preparations that react violently with water (Type A), and substances or preparations which release or liberate toxic gas in contact with water (Type B).	Soluble in water (https://cameochemicals.noaa.gov/chemical/496)	No
Hydrazine			
Explosives	Substances or preparations which create risk of an explosion by shock, friction, fire, or other sources of ignition.	Hydrazine is highly explosive in the presence of oxidizing materials and metals (MSDS 2005)	Yes
Flammable Substance	Substances and preparations having a flash point range of 21°C to 55°C and capable of supporting combustion.	Flash point ~ 52.2°C NFPA 704 Flammability = 4 Highly flammable based on Annex 2-7e of RPM	Yes
Oxidizing Substances	Substances which give rise to highly exothermic reaction when in contact with other substances, particularly flammable substances.	Reducing agent	No
Toxic Substances	Low, medium, high, very high and extreme toxicity of substances or preparation.	Value of *a* based on LC_{50} = 4 Value of *b* based on Vapor Pressure = 1 Toxicity Class (*a* + *b*) = 5 (Not included in Toxicity Class on Table 1 in Annex 2-7e of RPM)	No
Unclassified Substances	Substances or preparations that react violently with water (Type A), and substances or preparations which release or liberate toxic gas in contact with water (Type B).	Soluble in water (https://cameochemicals.noaa.gov/chemical/5019)	No
Sodium Phosphate			
Explosives	Substances or preparations which create risk of an explosion by shock, friction, fire, or other sources of ignition.	Slightly explosive in the presence of heat	No
Flammable Substance	Substances and preparations having a flash point range of 21°C to 55°C and capable of supporting combustion.	Non-flammable	No
Oxidizing Substances	Substances which give rise to highly exothermic reaction when in contact with other substances, particularly flammable substances.	No data	-
Toxic Substances	Low, medium, high, very high and extreme toxicity of substances or preparation.	**LC_{50} data not available.**	-

Category	Applicable Criteria	Evaluation	Criteria Met?
Unclassified Substances	Substances or preparations that react violently with water (Type A), and substances or preparations which release or liberate toxic gas in contact with water (Type B).	Soluble in water (https://cameochemicals.noaa.gov/chemical/5019)	No

*Note: *As Cycloamine*

Using the data in **Table 4-1** and the Threshold Levels of hazardous substances prescribed in Annex 2-7e of the RPM DAO 2003-30, the level of coverage for projects handling, storing, and using hazardous substances and mixtures, as presented in **Table 4-2**.

Table 4-2 Threshold Inventory Level for Hazardous Substances Identified

Hazardous Substance	Total Storage Capacity	Description of Container	Category	Threshold Inventory		Remarks
				Level 1	Level 2	
Diesel Oil	265.5 tons[1]	One (1) tank	Flammable	5,000	50,000	RS
			Toxic	10	50	Level 2
Neutral Amine[2]	0.692 tons[2]	One (1) tank	Explosive	10	50	RS
			Highly Flammable	50	200	RS
			Oxidizing Substance	50	200	RS
			High Toxicity	5	20	RS
Hydrazine	0.404 tons[3]	One (1) tank	Explosive	10	50	RS
			Highly Flammable	50	200	RS
Sodium Phosphate	1.300 tons[4]	One (1) tank	-	-	-	-

Note: [1] At 885 kg/m^3 Diesel Oil
[2] As Cycloamine at 865 kg/m^3(https://cameochemicals.noaa.gov/chemical/496)
[3] At 865 kg/m^3 Hydrazine (https://cameochemicals.noaa.gov/chemical/5019)
[4] At 1,620 kg/m^3 Sodium Phosphate Tri-basic (https://cameochemicals.noaa.gov/chemical/4521)
RS – RiskScreening

The result of the categorization and classification of the quantity of substance to be stored on site shows diesel oil falls within the Level 2 category. Therefore, both QRA and Emergency/Contingency Plan based on the QRA results are required to be prepared.

Risk screening however was done in lieu of a QRA at this time because (1) the required data and information for a QRA will be only available after the detailed engineering design phase; and (2) the proponent may submit the QRA prior to operation. MPGC may also prepare a Hazard Operability (**HAZOP**) study in lieu of the QRA (subject to approval of EMB) and this will be completed only upon project operation.

4.3 PHYSICAL AND CHEMICAL PROPERTIES OF THE IDENTIFIED HAZARDOUS SUBSTANCE

Tables 4-3 to **4-6** provide information for the hazardous substances.

Table 4-3 Physical and Chemical Properties of Diesel Oil

PROPERTY	DESCRIPTION
Physical State	Black liquid with the odor of tar. Liquid is shipped at elevated temperature. Insoluble in water and usually less dense than water. (USCG, 1999)

PROPERTY	DESCRIPTION
Synonyms/Trade Names	Industrial Diesel
CAS #	68476-34-6
Water Solubility	Insoluble in water.
Flash Point	60° C
Specific Gravity	0.841 at 60.8 ° F (USCG, 1999)
Boiling Point	282 -338 ° C
Melting Point	0 ° F
Vapor Density	>5
Vapor pressure	2 mmHg (0.0027 bar) at 20° C
LC_{50} (4hr)	4.10mg/L (rat, inhalation)
Exposure Limits:	
PEL-TWA	Not listed
TLV-STEL	Not listed

Table 4-4 Physical and Chemical Properties of Neutral Amine

PROPERTY	DESCRIPTION
Physical State	A clear colorless to yellow liquid with an odor of ammonia
Synonyms/Trade Names	-
CAS #	108-91-8
Water Solubility	Very Soluble
Flash Point	28° C
Specific Gravity	0.8647 at 77 ° F (EPA, 1998)
Boiling Point	134.5 ° C
Melting Point	0.1 ° F
Vapor Density	3.42 (EPA, 1998)
Vapor pressure	1.4 kPa at 20 ° C
LC_{50} (4hr)	>700 mg/m^3 (rat, inhalation)
Exposure Limits:	
ACGIH TWA	10 ppm
OSHA STEL	10 ppm

Table 4-5 Physical and Chemical Propertles of Hydrazine

PROPERTY	DESCRIPTION
Physical State	A colorless, fuming oily liquid with an ammonia-like odor.
Synonyms/Trade Names	-
CAS #	302-01-2
Water Solubility	Soluble
Flash Point	125.6 ° F (EPA, 1998)
Specific Gravity	1.011 at 59 ° F (EPA, 1998)
Boiling Point	236.3 ° F at 760 mm Hg (EPA, 1998)
Melting Point	36 ° F (EPA, 1998)
Vapor Density	-

PROPERTY	DESCRIPTION
Vapor pressure	14.4 mm Hg at 77 ° F (EPA, 1998)
LC50 (4hr)	570 ppm (rat, inhalation)
Exposure Limits:	
ACGIH TWA	0.01 ppm
OSHA STEL	-

Table 4-6 Coal Specifications to be Supplied for the Proposed MCPP Project

Description	Unit	Range	Design
Total Moisture (AR basis)	%Wt	< 34.00	33.96
Proximate Analysis (AR basis)			
- Moisture	%Wt	< 14.0	14.0
- Volatile matter	%Wt	28.5 < V.M. < 33.5	30.56
- Fixed Carbon	%Wt	25.0 < F.C. < 35.5	28.67
- Ash	%Wt	1.0-12	6.82
Sulfur (AR basis)	%	0.5 < S < 1.5	1.49
Fuel Ratio (AR basis)	FC/VM	Min. 0.70	0.94
Size (AR basis)	mm	Max. 50	≤ 50
Ultimate Analysis (AR basis)			
- Carbon	%Wt	37.0 < C < 54.0	42.97
- Hydrogen	%Wt	2.2 < H < 3.75	3.00
- Nitrogen	%Wt	< 1.0	0.59
- Oxygen	%Wt	< 13.0	11.42
- Sulfur	%Wt	0.5 < S < 1.5	1.49
- Ash	%Wt	6.0 < Ash < 15.0	6.82
Higher Heating Valve (AR basis)	kcal/kg	Min. 4,000	4,008
Ash Fusion Temperature (IDT)	ºC	>1,150	-
Ash Analysis			
- SiO_2	%Wt	30-60	26.89
- Al_2O_3	%Wt	10-30	17.12
- Fe_2O_3	%Wt	Max. 20	9.06
- CaO	%Wt	Max. 13	17.24
- MgO	%Wt	Max. 10	1.99
- Na_2O	%Wt	$Na_2O + K_2O < 3.5$	1.68
- K_2O	%Wt		0.34
- Others, Chlorine	%Wt	-	<0.12

Source: MPGC, 2016

4.4 STABILITY AND REACTIVITY INFORMATION

The stability and reactivity information indicate how stable the substance is and describe the condition under which it is unstable or can react dangerously. Unstable substances may breakdown (decompose) and cause fires or explosion or cause the formation of new chemicals which may be more toxic or flammable than the original material.

Condition such as heat, sunlight, and aging of the substance can cause unstable substances to break down. Therefore, these materials require special storage and handling precautions. Some substances chemicals can create a hazard because they have a tendency to undergo a particular type of chemical reaction called polymerization. This reaction may generate a lot of heat and may generate enough pressure to burst a container or may be explosive. Substances that tend to react in this way often contain additives called inhibitors, which reduce or eliminate the possibility of an uncontrolled polymerization.

Some substances may create a hazard if they come in contact with water (water-reactive chemicals). Others may ignite spontaneously when exposed to air. Incompatible materials are materials that may react violently or explosively if they are mixed or brought together. These materials shall be stored separately and shall not be mixed unless special procedures are followed.

Awareness of these information shall help MPGC to store and handle the material safely and avoid mixing incompatible materials. The stability and reactivity information of the hazardous substances identified are presented in Table 4-7.

Table 4-7 Stability and Reactivity Information

Substances	Stability	Incompatibility	Hazardous Decomposition Products	Polymerization
Diesel Oil	Stable under normal conditions. Avoid sources of ignition such as flames, hot surface, sparks, and electrical equipment	May react with strong oxidizers such as chlorine, concentrated oxygen, and sodium hypochlorite or other hypochlorites.	Thermal decomposition products may include CO, CO_2, oxides of sulphur and nitrogen, and other toxic gases	Will not occur.
Neautal Amine	Normally stable, even under fire conditions.	May be incompatible with isocyanates, halogenated organics, peroxides, phenols (acidic), epoxides, anhydrides, and acid halides.	When heated to decomposition, it emits highly toxic fumes.	Will not occur
Hydrazine	Capable of detonation or explosive decomposition or explosive reaction but requires a strong initiating source or must be heated under confinement before initiation.	Incompatible with oxidizers, hydrogen peroxide, nitric acid, metal oxides, and strong acids. May ignite spontaneously if mixed with hydrogen peroxide or with nitric acid. Decomposes with flame on contact with many metallic oxide surfaces [Haz. Chem. Data (1966)]. Forms explosive metal hydrazides when mixed with alkali metals in	When heated to decomposition it emits highly toxic fumes of nitrogen oxide and ammonia.	Hazardous polymerization may not occur.

Substances	Stability	Incompatibility	Hazardous Decomposition Products	Polymerization
		presence of ammonia [Mellor 8, Supp. 2:95(1967)]. Ignites spontaneously if mixed with nitrous oxide [Mellor 8, Supp. 2:214(1967)]. Reacts explosively with potassium and sodium dichromate [Mellor 11:234(1946-1947)].		

4.5 HAZARDS AND DANGERS THAT MAY BE IMPOSED BY THE IDENTIFIED HAZARDOUS SUBSTANCE

There are three (3) main types of hazards that are expected to occur at the proposed Project: (i) fires, (ii) explosions and (iii) release of toxic materials into the ground or atmosphere. These hazards can arise from the handling, storage and processing of large quantities of flammable and/or acute toxic materials. Such accidents can occur while the materials are being transferred from vessels into the storage facility, while the proposed Project in operation as it produces electricity and while the waste materials are being disposed. Fires can expose people and resources to heat radiation, explosions cause blast overpressure and projectiles that can cause harm and the accidental release of toxic materials can cause the affected surrounding communities.

- **Fires** are caused when flammable materials are ignited. The resulting flames can expose people and materials to heat. The intensity of heat is known to decrease rapidly proportional to distance from the open flame. Since the power plant is relatively isolated from the public, fires from the power plant generally pose little risk to public. All fires experienced in the coal fired power plant are expected to be confined to the vicinity of the equipment where the flammable materials are released.

- **Explosions** occur when flammable vapors and gases are ignited or when flammable substances are released at high temperatures and elevated pressures. The effects of explosions include shock wave which is the sudden increase of high pressure into the surroundings.

- **Release of toxic materials** occurs when hazardous substances such as hydrogen sulfide, sulfur dioxide or any other harmful power plant's by-products are accidentally released into the atmosphere or surroundings. Such releases occur usually during fire or other catastrophic accidents in the power plant. Such a release can pose threat if the gas or materials reach populated areas outside of the power plant.

4.5.1 Diesel Oil

The diesel oil may form flammable mixtures with air when heated above the flash point. In the presence of hot spots, there is a special risk of fire or explosion under certain conditions involving accidental release of vapor or leaks of product under pressure.

During accidental release of diesel oil, an immediate precautionary measure is to isolate spill or leak area for at least fifty (50) meters (150 feet) in all directions. When it involves large spill, we take into consideration initial downwind evacuation for at least 300 meters (1000 feet).

Prolonged or repeated contact may cause skin irritation. Vapors or mists are irritating for mucous membranes, notably in the eyes. May cause central nervous system depression with nausea, headache, dizziness, vomiting, and incoordination. If swallowed accidentally, the product may enter the lungs due to its low viscosity and lead to the rapid development of very serious pulmonary lesions (medical survey during 48hours).

4.5.2 Neutral Amine

Neutral or neutralizing amines such as cyclohexylamine (CHA), methoxypropylamine (MPA), monoethanolamine (ETA), and morpholine are typically used in boilers and somehow help reduce iron levels in wastewater discharges of power plants. They are weak bases that are typically classified in terms of their neutralizing capacity and basicity. However, they are quite corrosive and are considered potential sensitizers. Neutralizing amines are very hazardous: when in contact with eye, it causes redness, watering and itching; it also causes skin inflammation which is mainly characterized by itching, scaling, reddening and blistering; and it also causes harmful effects when inhaled or ingested. They are incompatible with substances such as strong acids, strong oxidizers and mineral acids since reaction with these compounds cause formation of harmful products. Neutral amines may cause formation of hazardous decomposition products (oxides of carbon and nitrogen) when exposed to extreme heat.

4.5.3 Hydrazine

Hydrazine is used to control dissolved oxygen levels in boiler feedwater, as it is a colorless liquid which is highly soluble in water. It is a powerful reducing agent that reduces oxygen to form nitrogen and water. At high temperatures and pressure, it will also form ammonia, which increases the feedwater pH level, reducing the risk of acidic corrosion. Irritation of the eyes, respiratory tract, and skin from exposure to hydrazine may take place and cause severe exposure that causes temporary blindness. Hydrazine is also flammable in the presence of open flames, sparks, heat, and oxidizing materials and it is highly explosive in the presence of oxidizing materials and metals and incompatible with moisture and acids. Due to the extreme corrosive potential of this chemical and its reactivity with moisture and oxidants, hydrazine in the environment is of great concern. While the ecotoxicity is not known, the products of biodegradation of hydrazine are toxic. Potentially hazardous short- and long-term degradation products are to be expected

4.5.4 Coal

Coal is the primary fuel for the operation of the proposed Project. Although coal can be handled safely, there are explosion hazards which are accentuated as the particle size is reduced. Particle sizes of coal which can fuel a propagating explosion occur within thermal dryers, cyclones, pulverized-fuel systems, grinding mills, and other process or conveyance equipment. There are three (3) necessary elements which must occur simultaneously to cause a fire: fuel, heat, and oxygen. These elements form the three legs of the fire triangle. By removing any one of these elements, a fire becomes impossible. On the other hand, for an explosion to occur, there are five (5) necessary elements which must occur simultaneously: fuel, heat, oxygen, suspension, and confinement. These form the five sides of the explosion pentagon. Like the fire triangle, removing any one of these requirements would prevent an explosion from propagating.

Fuel

Coal, as a primary fuel, must meet several requirements in order to be explosive. These requirements are volatile ratio, particle size, and quantity. The volatile ratio is a value established by the former United States Bureau of Mines to evaluate the explosibility of coals based on large-scale tests in the Experimental Coal Mine. The volatile ratio is defined as the volatile matter divided by the summation of volatile matter and fixed carbon of the coal. This method for calculating the volatile ratio produces a value independent of the natural or added incombustible in the coal. It has been determined that coals with a volatile ratio exceeding 0.12 present a dust explosion hazard. All bituminous coals fall into this category. The volatile ratio of the coal to be used in the proposed Project is 0.52 therefore; the coal will present a dust explosion hazard.

Heat

The third requirement for explosibility is related to the quantity of coal dust available, known as the minimum explosive concentration (**MEC**). This is the minimum quantity of dust in suspension that will propagate a coal dust explosion and generate sufficient pressure to cause damage. The MEC for bituminous coal is approximately 0.10 ounce per cubic foot or 100 grams per cubic meter. In other words, if footprints are visible in coal dust on the floor or the coal dust is seen on the walls of a plant, then there is enough coal dust at that particular location to propagate an explosion. Therefore, at the proposed Project particularly in the Coal yard area, it is advised that coal dust on floor or in the wall of the facility shall be minimized.

Moreover, the presence of other flammable dusts or gases can lower the MEC of the coal, which increases the hazard. On the other hand, the hazard can be lessened with the addition of ash, rock dust, inert gas, and any other inert material.

The heat requirements to complete the fire triangle or the explosion pentagon can be in the form of temperature or energy.

The ignition temperature of a coal dust cloud decreases as the volatile content increases. At high volatile contents, the ignition temperature of a coal dust cloud approaches a limiting temperature as low as 440EC (824EF). Further increases in size result in rapid rise in the ignition temperature requirements. As the particle size decreases, the coal dust becomes easier to ignite. The ignition temperature of a coal dust layer also decreases as the volatile content increases. At high volatile contents, the ignition temperature of a coal dust layer approaches a limiting temperature as low as 160EC (320EF). With dust layers on hot surfaces, the minimum ignition temperature decreases sharply as the thickness of the deposit is increased. This is due to the fact that thicker dust layers capture and hold heat more readily. For the bituminous coal to be used in the proposed Project will have a minimum ignition temperature of 455^{o}C.

Electrical or frictional sparks can also provide the heat source for initiating a fire or explosion. Dust clouds of lignite and subbituminous coals can ignite with as little as 30 millijoules of energy. Therefore, all coal dusts shall be regarded as prone to ignition when exposed to the frictional sparks of badly maintained machinery or when they become contaminated with tramp metal. For mixtures of coal dust and flammable gas, the critical minimum ignition energy is that which affects the gas. When ignited, the gas releases sufficient energy to suspend and ignite a coal dust cloud.

Oxygen

As the volatile content of a coal increases, less oxygen is required to complete the fire triangle or the explosion pentagon. Less oxygen is also required as the rank of the coal decreases. Semi-anthracite has a very low volatile content and lignite is at least as volatile as high-volatile bituminous coals. However, at ambient temperatures, the oxygen content must be reduced to below 13% to prevent ignition of bituminous coal dusts with a strong ignition source.

Suspension

For fires to occur suspension is not a necessary step but completion of the explosion pentagon does require that the fuel be placed in suspension. There is certainly danger present whenever coal dust is placed in suspension because, in most circumstances, it need only find a heat source to initiate an explosion. If a coal dust layer on the floor is smoldering, an explosion is imminent if the layer is somehow placed into suspension. In this case, heat to satisfy the fire triangle and the explosion pentagon is already present. Therefore, Good housekeeping practices are extremely important inside a plant because process equipment is not always able to withstand the internal pressures generated by an explosion. Once the explosion flame and pressures burst from the confinement into the plant, a secondary explosion may be fueled by any additional dust suspended by the blast. When good housekeeping practices have eliminated coal dust in the plant, there would not be any fuel to allow a continuation of the explosion flame. This secondary explosion is responsible for the most damage to the plant itself. Also, the secondary explosion is usually responsible for the loss of lives or the serious injuries to personnel that occur.

Confinement

Confinement is not a leg of the fire triangle, but to complete the explosion pentagon, it is essential. Basically, confinement keeps the fine coal particles in close proximity after they are placed in suspension. Without the closeness, heat transfer could not occur rapidly enough to allow continued propagation. Without confinement, a propagating explosion is not possible, but rather, only a large fireball with no appreciable forces associated with it. If an explosion is vented to the atmosphere outside the plant, confinement is eliminated and only part of the coal forced out of the vent will be burned, with the remaining unburned coal falling to the ground. As with the suspension leg of the explosion pentagon, if confinement is lost, the air speed will drop, additional coal dust will not be placed in suspension, and the explosion will extinguish.

4.6 INFORMATION RELATING TO THE SAFETY MANAGEMENT SYSTEM FOR THE ESTABLISHMENT

In order to reduce the onsite and offsite risks, special attention shall be given to the designs, layouts and emergency plans for all identified hazardous materials, during the detailed design phase of the project. Furthermore, it is suggested that safety reviews are undertaken during the various stages of the project, to reduce the risk and therefore the significance of the potential impacts. With mitigation measures in place, the significance of the potential impact would be reduced to **low** (-**ve**)**.** The probability of this event happening is very unlikely, making the significance of this impact low.

4.6.1 Storage and Safety Measures

Hazardous chemicals to be used in the coal fired power plant will either directly involve the operation of the power plant or as secondary chemicals to be used in the demineralization, condensate polishing facility which include the following:

Methods of Dust Prevention and Removal in Coal Handling and Storage System

Three (3) types of dust control will be provided: dust suppression, dust removal, and cleaning.

(i) Dust Suppression

- Water mist spray or surfactant -type dust suppressions will be provided throughout the coal handling system at every conveyor transfer point; and
- The coal yard will be equipped with water spray equipment to cover the complete coal pile.

(ii) Cleaning

Two (2) types of cleaning will be provided:

- A water cleaning system with a waste pit and pumps will be provided for the unloading wharf, transfer station, crusher room, conveyor structure floors and truck station. The wastewater will be pumped to the coal pile run-off sedimentation pond; and
- The coal silo bay will be provided with a vacuum cleaning system. The system will be arranged so that the vacuum cleaning vehicle can connect with the vacuum dust collection piping wherever it reaches the place needing cleaning.

One (1) vacuum vehicle will meet the operation of four (4) intakes at a time. One (1) tool storage box and flexible hose will be provided.

(iii) Dust Removal

- The transfer towers will be provided with dust collection systems to limit the dust content in the air in each building. Dust collectors will be provided for the unloading hoppers, the emergency reclaim hopper, the crusher house, and the silo bay. The system will collect dust at locations where it is generated;
- All dust collectors will be sized to permit simultaneous operation of the two (2) belt conveyor systems;
- The dust collecting system will be interlocked with the coal handling equipment. It will operate with the belts and stop in two (2) minutes after the belt conveyor has stopped. When the dust collector used for coal transfer points serves two (2) belt conveyors and one (1) belt conveyor is in operation and the other is in standby, the switch-over damper in the dust collecting branch ductwork will be automatically changed over. The damper in the dust collecting branch ductwork serving the operating belt conveyor is automatically open and the other automatically closed;
- An independent dust collecting system will be provided for coal transfer point in the silo bay;
- Independent dust collecting system will be provided for the coal silos of the units;
- The coal silo dust collecting system is used to dilute or extract the methane accumulated at the upper portion of the silo and keep the silo always under negative pressure to reduce dust dispersing during coal unloading. The fans and motors and the rest of the electrical equipment in this area will be explosion-proof; and
- In case one dust collector is used by several coal silos, an automatic switch-over damper will be provided for the dust collecting branch ductwork of each coal silo. Consideration will be made toward maintaining a minimum flow in each leg at all times to prevent fallout and plug age.

During operation of the dust collector the damper on the dust collecting branch ductwork on the unloading coal silo will be opened automatically and the damper on the branch ductwork of the coal silo which is not unloading will be closed automatically.

In handling coal at the coal yard, the recommended Personal Protective Equipment (**PPE**) and Working Environment Requirements are given in **Table 4-8**.

Table 4-8 Recommended Personal Protective Equipment and Working Environment Requirements

Parameter	PPE and Working Environment Requirement
Respirator	If workplace conditions warrant a respirator, a respiratory protection program that meets OSHA 29 CFR1910.134 must be followed. Refer to NIOSH 42CFR84 for applicable certified respirators.
Eye Protection	Wear safety goggles. An eye wash station and drench shower shall be readily available near the handling and use areas.
Ventilation	Local exhaust ventilation system.

The following are the preventive/mitigating measures during the loading, unloading and the storage of coal for the proposed Project.

4.6.2 Hazardous Substance Safety Measures

The power plant will be installed and constructed with the following equipment and devices to mitigate and or prevent potential fire or explosion as well as spill and leaks during handling and storing:

Spill Containment

Fuel, and other chemicals transport, forwarding, and storage can result to spillages and leakages. Spill containment provisions will be incorporated into the Project to meet all national, provincial and local regulations and requirements. Spill containment will be provided for the following areas:

- Retainage basin, with trenches and sump, immediately surrounding the steam turbine lube oil tank, filters, purification equipment, and EHC skid to contain spilled capacity of the steam turbine equipment on-skid oil volume;
- Oil filled transformers;
- Diesel/Fuel oil equipment, storage, and unloading areas;
- Chemical equipment, storage, and unloading areas: (i) ammonia truck unloading and pumping station, (ii) water treatment equipment including the neutralization tank, (iii) CFBC boiler chemical feed area, and (iv) electric boiler chemical feed area;
- Seawater pump house;
- Combustible materials storage room; and
- Battery rooms.

Secondary containment areas will be provided with lockable manual drain valves or manually controlled sump pumps to release accumulated water or liquids into the appropriate drain system.

Each liquid-filled transformer will be furnished with a concrete spill containment basin as part of its foundation design. Each basin will be manifolded together to a common sump, where the combined capacity of the basins and sump are sized for 110% of the capacity of the largest single transformer oil storage volume, plus the deluge water during a 30-minute fire quench event, or the rainfall collected in the basins and sump during a worst case 24-hour rainfall event, whichever is greater.

The oil/water sump will be provided with two (2) 110% capacity, one (1) for operation and another for standby, pumps or a locked closed drain valve, either of which discharge to an oil/water separator. The oil-water separator will have a design flow rate sufficient to process storm water collected in the basins and sump from a worst-case 24-hour rainfall event within 4 hours.

The fuel oil storage tank will be furnished with a concrete spill containment basin as part of its foundation design. The basin will be sized for 110 % of the capacities of the tank, plus the deluge water during a 30-minute fire quench event, plus six (6) inches (15.2 cm) of free board. An oil/water sump will be furnished and sized to accommodate the worst-case rainfall over the area of fuel oil storage tank spill containment basin. The oil-water sump will be provided with 110% capacity, for operation and for standby, pumps. Individual spill containment basins will be sufficiently sized so that no overflow occurs during an oil/water discharge event while draining to the oil/water separator.

All chemical storage tanks, including portable storage tanks and drums, will be provided with spill containment area or stored in bermed areas. Spill containment features will be sized to contain 110% of the capacity of the largest tank. Where multiple tanks are stored in a common bermed area, the bermed areas will be sized for 110% of the largest tank, plus 10% of the aggregate capacity of all the other tanks within the bermed area. Allowance will be made for the volume of the containment area lost to other tanks.

Tank trucks will fill bulk storage tanks and will have fill connections piped to a central tank truck unloading area. The unloading area will be bermed with sufficient capacity to contain 110% of the largest tank truck capacity, plus the volume displaced by the truck in the unloading area. The fuel oil unloading and ammonia unloading spill containment area will be provided with a level transmitter for level monitoring and alarm in the DCS.

All routine handling or transfer of chemicals will take place within bermed areas. Chemical feed skids, pot-feeders, portable storage tanks, or drums will be installed or staged in bermed areas. Bermed areas for storing at least one spare portable tank or drum for each in service will be provided. All chemical containment areas will have protective coatings.

Containment areas that have storage drums and portable storage tanks will be designed such that the drum and tanks are accessible to forklifts for replacement or refilling of the tanks. The bermed areas will be designed to provide spill containment during all such refill or transfer operations. All chemical containment areas including the tank truck unloading areas will be covered to prevent accumulation of storm water.

Conceptual Oil Spill Management Program

A comprehensive site-specific Oil Spill Management Program is still up for development since the Project has not yet reached the final detailed design stage wherein at that point, a program that is tailor fit for the Project will be adopted. The development of the program will be based on the concepts described as follows:

There are three (3) areas in the Facility in which a possible oil spill can occur; namely, (i) at the Diesel Oil Storage area, (ii) at the Transformer Area and (iii) at the Turbine Building. As a standard, all these areas will have oily water drains that will direct water (rainwater, water for washing, etc.) possibly contaminated with oil to the WWTS. The discussion below further describes the conceptual oil spill management system for each area.

Diesel/Fuel Oil Storage Area

The fuel oil will be stored in two (2) tanks whose sizes will each range from a minimum of 400 m^3, to a maximum of 600 m^3 depending on the final design. This area is the most critical for a large volume oil spill scenario because of the volume of fuel oil stored. Aside from the standard oily water drain incorporated in the design to address minimal oil spills, a secondary containment area in the form of a bund containment wall will also surround both tanks. The secondary containment will be sized to accommodate the volume for a full capacity spillage of both tanks. In a major spill scenario, the drain valve leading to the WWTS will be shut down. This will ensure that the oil spill will be confined in the secondary containment area which will make for a manageable re-pumping of the fuel oil back to the storage tanks after repairs have been made. In the scenario of a fire outbreak and other hazards due to the oil spill.

Transformer Area

The transformer area will also have an oily water drain which directs it first to a nearby single catchment basin. The size of the concrete catchment basin is enough to accommodate the total volume of oil coming from all the transformers plus a one (1) hour firefighting water volume. This serves as the secondary containment for the transformer area that ensures that during a full volume oil spill scenario, which is usually accompanied by transformer fire, the area of concern is limited only up to the catchment basin. This makes for a manageable situation during such scenario. During normal operations, the basin will have a volume level sensor that, when it reaches a certain level, will automatically start a pump that will direct water to the WWTS. This same pump is shut-off during a transformer fire scenario effectively limiting the situation.

Turbine Building

Possible oil spills coming from the Turbine Building are considered very minimal since most equipment use only small amounts of oil. Equipment oil leaks and water contaminated with oil during washing and flushing of equipment are the most likely source. Due to this minimal oil spill scenario, providing the whole turbine building with sufficient oily water drain that will direct the flow to the WWTS is adequate.

The proposed Project will be equipped with Fire Protection System, which consists of the following: Comprehensive fire detection, alarm system and fire protection system is designed to provide a high degree of protection for plant buildings and other auxiliary facilities. The Fire Protection System will provide fire suppression systems, independent fire detection systems, standpipe, and fire hose stations, fire loop system, and portable fire extinguishers to protect the facility buildings and lube oil facilities in the event of fire or fire risks such as excessive heat or smoke.
The proposed MCPP Project will have completely separate sets of National Fire Protection Association (**NFPA**) 850 compliant fire-fighting equipment with the exception of the coal handling and storage system, water supply system, exhaust stack, WWTS, telecommunication system and firefighting system which shall all be designed and sized to meet the requirements of the four (4) units.

Water will be supplied from three (3) fire water pumps (diesel, electric, and jockey) which take suction from the fire/service water storage tank with a capacity of 500,000 gallons or 1,892.7 m^3.

Hose stations equipped with hoses, wrenches and adjustable nozzles will be located at various locations throughout the facility. Portable fire extinguishers will be provided at all fire hose stations in addition to other key locations.

Common fire alarm signals from various facility areas to the DCS will be provided.

4.6.3 Workers Safety Measures

Recommended safety measures such as use of Personnel Protective Equipment (**PPE**) for workers to be exposed in hazardous substances and also during emergency response are discussed below.

Light Diesel Oil

When working with Diesel Oil, it is recommended to use protective gloves and goggles or face shield. (USCG, 1999)

Neutral Amine

Workers are encouraged to wear proper protective equipment such as rubber gloves, impermeable apron and shoes to avoid direct contact with neutralizing amines. It should also be noted that these amines must not be stored near strong oxidizers or acids to avoid unwanted chemical reactions. They must also be kept away from different sources of ignition and must be used with adequate ventilation to avoid suffocation during inhalation. When in contact with skin, proper wash with soap and water must be done repeatedly to avoid long term harmful effects.

Hydrazine

Individuals working with hydrazine should wear the following protective equipment: gloves, full suit, approved/certified vapor respirator, face shield and boots. Hydrazine must be kept away from different sources of ignition and oxidizing materials to avoid unwanted decomposition reactions.

4.6.4 Hazard and Operability (HAZOP) Study

MPGC will conduct a HAZOP for its proposed MCPP Project to provide detailed information on hazards and operability problems of the proposed project. The HAZOP will involve identification of possible deviations from the normal expected process and the corresponding consequences.

The HAZOP concept is to review the plant in a series of meetings, during which a multidisciplinary team methodically "brainstorms" the plant design, following the structure provided by the guide words. Consequently, the process requires that all team members participate (quantity breeds quality in this case). The team focuses on specific points of the design (called "study nodes"), one at a time. At each of these study nodes, deviations in the process parameters are examined using the guide words.

4.7 EMERGENCY RESPONSE POLICY AND GENERIC GUIDELINES

4.7.1 Identification of Potential Emergencies

Emergencies are unforeseen events or episodes that are caused by natural forces and circumstances that may result to negative effects to people, property and the surrounding environment. As a preliminary step in developing an effective emergency response policy, it is important to identify the potential emergency scenarios that would most likely occur. **Table 4-9** lists the most probable emergencies that could happen in future operation of the proposed Project.

Table 4-9 Emergency Scenarios for the Project

Type of Emergency Situation	Possible Causes	Potential Effects
Fire	• Electrical short-circuits, overloading of equipment • Accidental ignition of combustible materials • Combination of incompatible chemicals (chemicals used for water treatment)	• Partial or total loss of equipment and property • Injuries and fatalities to personnel
Earthquakes	• Movement/rupture of nearby fault lines Volcanic eruption	• Failure of concrete structures (i.e. Collapse, dam breach, etc.) • Injuries and fatalities to personnel and downstream communities
Release of Toxic Substances	• Equipment malfunction • Accidental spillage • Man-made errors	• Health hazards to the employees, workers and nearby communities. • Degradation of affected parameter (i.e. contamination of soil and water).
Occupational Safety Accidents	• Improper training and supervision of personnel • Equipment and facility failure • Lack of full understanding regarding the surrounding environment • Possible collapse of bench/ trench and siltation pond collapse	• Injuries and fatalities to personnel • Partial and total loss of equipment
Tsunami	• Movement/Rupture of nearby fault lines • Volcanic Eruption • Intense Earth movement	• Failure of concrete structures • Injuries and fatalities to personnel and downstream communities
Flooding	• Location of the Philippines as a typhoon prone area • Complex weather systems • Topography of the area	• Collapse of lightly built structure • Destruction of the project site facilities • Injuries and fatalities to personnel and downstream communities

Type of Emergency Situation	Possible Causes	Potential Effects
Storm Surge	• Location of the Philippines as a typhoon prone area • Complex weather systems • Intense rainfall, wind and high tides	• Injuries and fatalities to personnel and downstream communities

Emergency situations may also require different levels of classification and response procedures, depending on the degree of situations. These levels will be referred to as: 1) incident, 2) emergency, and 3) crisis.

Incident situations present minor events that may require partial or total mobilization of the proposed Project's resources to effectively deal with an accident. This episode may present very minimal injuries and/or partial damages to property.

Emergency situations require the utilization of the proposed Project's all resources, with the assistance of local emergency responders, and additional resources from MPGC main office. This episode may present serious injuries and some fatalities, and could result to severe or total damage to the property.

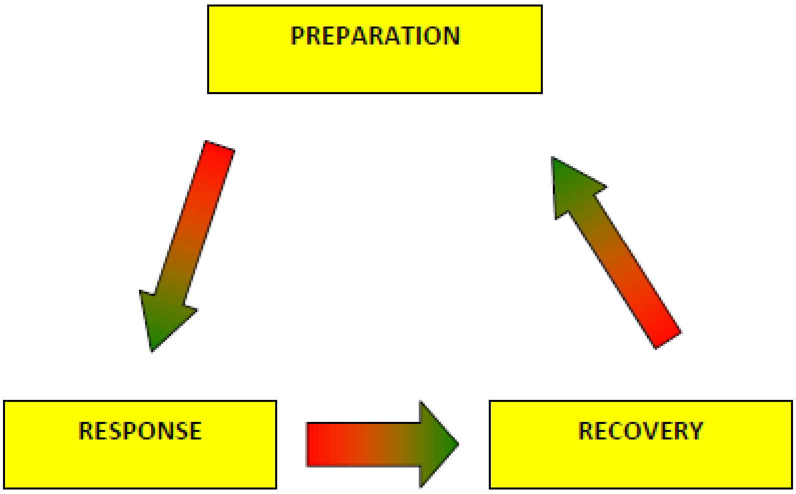
Crisis situations are the worst conditions, which require the utilization of the proposed Project and MPGC's full resources, and possibly, assistance from the national government to address the event. This episode may present multiple fatalities, total destruction of facilities, and severe/total damage to the surrounding community.

4.7.2 Emergency Plan

The Emergency Plan is a management structure that is intended as a guide for MPGC personnel during emergency situations. This structure may or may not be similar to the existing organizational/management hierarchy of the Project, although comparison on roles and responsibilities can be used as reference.

The implementation of the emergency plan is a standard practice that is currently being integrated as part of company policies. Its objective is to establish an orderly and systematic approach in addressing an emergency situation, and in turn, decrease further injuries/fatalities and loss of property.
Forming the emergency plan requires MPGC to select among the different skills and knowledge of its personnel at the proposed Project. The selection process will involve background checks, training and skills learning, and voluntary application of selected personnel. The proposed project will follow the schematic diagram and procedures presented in
Figure 4-1 and Table 4-10. The roles and responsibilities of each personnel involved in the emergency plan are listed in **Table 4-11.**

The designation of MPGC personnel and their corresponding responsibilities may be changed during different types of emergency scenarios that were previously identified in this section. Therefore, if such case will exist, MPGC will train and designate personnel appropriately to deal with each type of emergency situation.



Preparedness- development of actual plans should an emergency happen and elimination or avoidance of hazards from happening or occurring
Response- is the execution of the plans and procedures during an actual emergency plan
Recovery- is the retrieval of important assets and restoration of the site prior to the emergency

Figure 4-1 Emergency Response Plan

Table 4-10. Emergency Response Procedures for Different Scenarios

Preparation	Response	Recovery
A. Fire • Orientation and training of personnel on fire safety • Conduct regular fire drills • Installation and regular testing of firefighting devices (i.e. fire hoses, fire extinguishers, smoke detectors, sprinkler system) • Regular inspection of electrical equipment and lines, and replacement as necessary, for any defects or malfunctions • Proper storage of all flammable items in secure and proper containers and storage facilities • Implementation of a 'no-smoking' policy in plant facilities • Placement of emergency numbers and communication equipment in conspicuous areas for easier	• Personnel are advised not to panic to prevent further injuries • Personnel are advised to follow emergency evacuation procedures • Report immediately any presence of smoke, sparks, or open flame to authorized personnel • If the fire can still be contained, use fire extinguishers immediately • Disconnect electrical or fuel connections, and shut-down all affected equipment • If possible, remove all flammable materials from the fire scene to avoid further contact • For responders, wear the proper fire protection attire (i.e. fire suit, boots, breathing apparatus) • Avoid using or pouring water over fuel or alcohol	• Avoid returning to the fire scene, as long as necessary, unless declared for safe entry • Check personnel and find out if there are injuries or trapped/injured persons that may need assistance • Report any important incidents that require immediate attention • Secure important items and equipment from unauthorized access from outsiders, after the building is declared safe for re-entry • If the fire damage is minimal, or facility is recoverable, make necessary corrective measures to prevent the accident from re-occurring

Preparation	Response	Recovery
notification • Emergency exits and evacuation procedures shall be put in place, and kept free from any obstructions • Regular maintenance of plant equipment	fires, and electrical fires	
B. Earthquakes • Make necessary preparations, which includes equipment and facility checks to prevent injuries in an event of an earthquake • All loose items must be secured to prevent falling • Placement of heavy materials near the ground • Storage of flammable items in designated safe areas • Personnel/tenants are familiarized to safe locations, emergency response equipment and evacuation routes	• Personnel are advised not to panic to prevent further injuries • Personnel are advised to protect themselves by getting under sturdy structures • Personnel are advised to stay away from sharp, flammable, or heavy items • Personnel are advised to prepare immediate evacuation of the facility if necessary • All gas and electric equipment are shut down	• If there are no threats of aftershocks, check other personnel that may be trapped, injured, or needs further assistance • Avoid returning to the facility if it is deemed structurally unstable, or declared unsafe • Conduct thorough inspection of the facility's premises for any unusual cracks/gaps in the ground or walls • Check for possible fires and advice authorities for appropriate response • Secure important items and equipment from unauthorized access from outsiders, after the building is declared safe for re-entry • Inspect the facility for any major structural defects,
C. Release of Toxic Substances • Regular visual inspection for potential leaks and corrosion • Inspection of facilities, containers and equipment for any signs of leaks or spills	• Report immediately to supervisor • Stop operations in the area affected by spillage and stop appropriate source • Stop vehicles engines in the affected area • Follow strictly instructions of supervisor in charge of cleaning operations • Do not resume operations or any movements until the supervisor gives clearance	• All spills should be cleaned up immediately using proper conditions, which include stopping and containing the spill or leak Arrest the spill and take steps to prevent repeat.
D. Occupational Hazards • Formation of emergency response teams for each department • Provision of first-aid kits and emergency equipment on critical workstations • Training of personnel on proper equipment handling and other safety practices	• Report immediately any accidents, especially those considered life threatening • Immediate application of first-aid • Removal of the affected personnel on the accident site • Bring the affected personnel to the nearest	• Perform corrective measures on equipment and procedures • Provision of additional safety procedures, equipment, and training

Preparation	Response	Recovery
• Posting of safety reminders on workstations • Provision of safety features such as adequate lighting, guide rails, and safety signage	first aid station or hospital if necessary	
E. Tsunami • Loose articles, which may be subject to movement by wind force or earth movement, will be secured in such areas as necessary to prevent them from becoming hazards. • Remove obstructions to the drainage system	• Personnel are advised not to panic to prevent further injuries • Personnel are advised to protect themselves by getting under sturdy structures, and avoid staying outdoors • Personnel are advised to stay away from sharp, flammable, or heavy items • Personnel are advised to prepare immediate evacuation of the facility if necessary • All gas and electric equipment are shut down	• Avoid returning to the facility if it is deemed structurally unstable, or declared unsafe • Secure important items and equipment from unauthorized access from outsiders, after the building is declared safe for re-entry • Make corrective measures to prevent the further hazards from affecting personnel and property
F. Flooding • Prior to the incoming storm, secure all loose items (i.e. lamp post, roofs, loose planks, and other light materials) by adding extra guy wires or reinforcing materials • Remove obstructions to the drainage system • If there is a storm warning from PAGASA, monitor any possible developments especially for the expected forecast, path and intensity of the storm, and other important weather parameters	• Personnel are advised to protect themselves by getting under sturdy structures, and avoid staying outdoors • Personnel are advised to stay away from items that may be blown away by strong winds and electrical mains • Continuous monitoring of the weather conditions • All gas and electric equipment are shut down	• Inspect the facility for any major structural defects, cracks, unstable items, and other potential hazards • If necessary, repair broken power lines, fuel lines, and other utilities • Secure important items and equipment from unauthorized access from outsiders, after the building is declared safe for re-entry
F. Storm Surge • Prior to the incoming storm, secure all loose items (i.e. lamp post, roofs, loose planks, and other light materials) by adding extra guy wires or reinforcing materials • Remove obstructions to the drainage system • If there is a storm warning from PAGASA, monitor any possible developments especially for the expected forecast,	• Personnel are advised to protect themselves by getting under sturdy structures, and avoid staying outdoors Personnel are advised to stay away from items that may be blown away by strong winds and electrical mains • Continuous monitoring of the weather conditions • All gas and electric equipment are shut down	• Inspect the facility for any major structural defects, cracks, unstable items, and other potential hazards If necessary, repair broken power lines, fuel lines, and other utilities • Secure important items and equipment from unauthorized access from outsiders, after the building is declared safe for re-entry

Preparation	Response	Recovery
path and intensity of the storm, and other important weather parameters		

Table 4-11. Roles and Responsibilities in the Emergency Plan

Emergency Response Personnel	Roles and Responsibilities
Incident Commander	• Overall in-charge of operations during an event of an emergency • Gives direction and orders to the response teams in managing the emergency
Safety Officer	• Supervises the daily safety performance of operations and maintenance procedures, including emergency response procedures
Liaison Officer	• Secures the necessary permits and training certification for the personnel
Public Information Officer	• Performs communication duties in behalf of MPGC to the media, government officials, and the local population • Issues relevant warnings and advisories to concerned authorities
Operations Team	• Performs the actual response, rescue, and retrieval of personnel and equipment during an event of an emergency
Planning/Intelligence Team	• Devices programs and policies for proper response procedures • Informs the operations team regarding the nature and type of response procedure for the Operations Team • Identifies potential hazards and performs recommendations to authorities
Logistics Team	• Provides the necessary supplies and equipment for the Operations Team • Provides additional support/assistance to the Operations Team
Finance and Administration Team	• Provides the assessment of expenses and allocates the necessary financial resources for the other Teams • Performs the disbursement of claims and compensation for affected personnel, property and the community

4.7.3 Safety and Health Program

Mariveles Power Generation Corp. (MPGC) gives priority on the safety of its employees and their working environment. It developed this program for accident and injury prevention through the implementation of plant rules and guidelines that shall involve management, supervisors, and employees in identifying and eliminating hazards that may develop during work process.

4.7.3.1 Safety and Health Program

The management will spearhead in the formation of a safety committee, develop a system for identifying/correcting hazards, prepare for foreseeable emergencies, provide appropriate trainings and establish a disciplinary policy to ensure strict compliance.

4.7.3.1.1 Company Safety Policy

It is basic policy that no task is so important that an employee must take a risk of injury/illness or violate a safety rules. Active involvement in safety practices is then encouraged to make the area a safe place to work.

It is the daily duty of every employee to be cautious of unsafe conditions. In addition to this, supervisors or accountable managers are responsible in overseeing the actions of employees and to take prompt action in eliminating unsafe practices and hazards in the workplace.

4.7.3.2 Accident/Incident Investigation Reporting

It is very advantageous for every employee to be prepared for any emergency to prevent further injury, property damage and loss of limb or even life. An emergency preparedness plan must then be prepared and strictly implemented.

4.7.3.2.1 Preventive Measures

Prevention of accidents by eliminating potential threats/hazards and anticipating other probable causes is an effective way of creating a safe and healthy environment.

- Emergency Response Program

The emergency response program shall be implemented by an emergency response team composed of equipped and trained personnel who will be tasked to handle and manage this program, assist other employees to safety and to avoid any damage or injuries. Proper training and orientation of concerned team members will be accorded in order to prepare them in responding appropriately in any emergency situation they may encounter.

- Personal Protective Equipment

The Personal Protective Equipment (PPE) is a set of safety gears worn by personnel that is designed to provide sufficient safeguard against occupational-related illnesses and to prevent life threatening injuries.

PPE such as safety hats, safety shoes, gloves and dust mask and ear plugs will be provided as necessary. This is to ensure safe and protected personnel working in safe working environment. MPGC will make the usage of PPE a mandatory policy for personnel that are working inside the Project premises. Guests and visitors are also required to wear PPE as necessary.

4.7.3.2.2 Incident Response Procedure

In case of unavoidable accidents, injuries or any work-related illnesses, this should be reported and investigated on immediately so as to determine the appropriate action to be conducted.

- Recording and review

It is mandatory that employees are to report any injury or work-related illness to their immediate supervisor regardless of how serious. Minor injuries such as cuts and scrapes can be entered on the first aid only log. More serious injuries are to be reported and recorded properly for future review.

- Incident Investigation

It is imperative that an incident scene should not be disturbed except to aid in rescue or make the scene from further incidence. In case of an incident resulting in death or serious injuries, a preliminary investigation will be conducted by the immediate supervisor of the injured person(s), a person designated by management, an employee representative of the safety committee, and any other persons whose expertise would help the investigation.

The investigating team will obtain written statements from witness, photograph the incident scene and machines/equipment involved. The said team will also document as soon as possible after the incident, the condition of equipment and anything that may be relevant in the work area. A written "Incident Investigation Report" is necessary. The report should include a sequence of events leading up to the incident, conclusions derived from the incident and any recommendations to prevent a similar incident in the future.

- Damage Control

Damage cost as a result of accident in realty is unquantifiable, especially when damage to life and limb is involved. Cost of properties, structure and equipment including its effect on existing productivity is quantifiable. Any employee may be subject to on-the-spot termination when a safety violation places the employee or co-workers at risk of permanent disability or death.

4.7.3.3 Plant Safety Rules and Guidelines

For specific plant operations, MPGC will implement the rules and guidelines presented in **Table 4-12** so as to ensure compliance of proper protocols and the safety and well-being of all the employees.

Table 4-12. Plant Safety Rules and Guidelines Matrix

Plant Safety Rules and Guidelines	Description
Accountable Managers	MPGC shall submit to the NGCP a list of Accountable Managers who are duly authorized to sign the Fixed Asset Boundary Documents on behalf of the MPGC and any change to the list shall be communicated to NGCP at least six (6) weeks before the change becomes effective.
Amended Connection Agreement	If there is a modification to existing connection to the grid, MPGC shall secure the required amended connection agreement with NGCP prior to the actual modification of the existing connection to the grid.
Application For Connection Or Modification	MPGC shall submit to NGCP the completed application form for connection or modification of an existing connection to the grid. Which include the following: a. A description of proposed connection which shall comprise the MPGC development at the connection point. b. The relevant standard planning date listed in article 6.4 and c. The completion date of the proposed MPGC development.
Connection Agreement	MPGC shall submit to NGCP information, reports, safety rules, test and commission programs, electrical diagram, statement and readiness to connect, certification of approval to connect, and the other requirements as prescribed by ERC.
Connection Point Drawing Requirement	MPGC shall prepare and submit to NGCP the Connection Point Drawing for MPGC's side of the Connection Point, in accordance with the schedule specified in the Connection Agreement or Amended Connection Agreement. The Connection Point Drawing shall provide an accurate record of the layout and circuit connections, rating and identification of Equipment, and related apparatus and devices at the Connection Point.
Equipment Standards	All equipment to be used shall comply with the requirements of IEC Standards, ANSI or their equivalent national standards and shall be designed, manufactured, and tested in accordance with the quality assurance requirements of the ISO 9000 series.
Excitation Control System	MPGC's generating units shall be fitted with a continuously setting automatic excitation control system to control the terminal voltage without instability over the entire operating range of the generating unit.
Fixed Assets Boundary Document	The fixed asset boundary documents for any connection point shall provide the information and specify the operational responsibilities of NGCP and MPGC for high voltage equipment including the communication and metering equipment.
Frequency Variations	MPGC shall maintain its generating units to remain in synchronism with the grid for 5 seconds in case the system frequency momentarily rises to 62.4 Hz of falls to 57.6 Hz.

Plant Safety Rules and Guidelines	Description
Generating Unit Capability Tests	MPGC shall comply in accordance with the standards and procedures prescribed by NGCP to confirm the compliance of MPGC's generating unit to operate within their generation parameter and to meet the applicable requirements of the grid code.
Generating Unit Power Output	MPGC's generating units shall supply continuous active power output as specified within the frequency range of 59.7 to 60.3 Hz and any decrease of power output occurring in the frequency range of 59.7 to 57.6 Hz shall not be more that the required proportionate value of the system frequency decay. MPGC's generating units shall be capable of supplying its active power and reactive power outputs within the voltage variations as specified to section 5.2.3 during normal conditions. MPGC's generating unit shall be capable of supplying its active power output within the limits of 0.85 power factor lagging and 0.90 power factors leading at the generating units' terminals, in accordance with its reactive power capability curve.
Grid Data Registration	MPGC shall submit to NGCP the data relating to the Connection Point and MPGC's Development shall be registered according to the following data categories: a. Forecast Data – MPGC's best estimate of the data being projected of the five (5) succeeding years. b. Estimated Equipment Data – MPGCs best estimate of the value of parameters and information about the Equipment for the five (5) succeeding years. c. Registered Equipment Data – shall contain validated actual values of parameters and information about the Equipment that are submitted by MPGC to NGCP at the connection date. The Registered Equipment Data shall include the Connected Project Planning Data, which shall replace any estimated values of parameters and information about the Equipment previously submitted as Preliminary Project Planning and Committed Project Planning Date.
Grid Impact Studies	NGCP shall take all necessary measures that the proposed MPGC development will not result in the degradation of the grid.
Grid Protection	MPGC shall design, coordinate and maintain its protection System to ensure the desired speed sensitivity, and selectivity in clearing faults on the User's side of the Connection Point. This protection System shall be coordinated with the NGCP protection System.
Harmonics	MPGC shall ensure that its system shall not cause the harmonics in the grid to exceed the limit specified in section 3.2.4 of the grid code for 230 KV systems.
Meter Testing and Calibration	MPGC and NGCP through ERC shall test and seal the meters and recalibrate or replace such meter if found to be outside the acceptable accuracy stipulated in the grid Code.
Metering Equipment Standard	The voltage and current transformers, meters and integrating pulse recording for metering equipment shall comply with the grid code and IEC standard or its equivalent national standard for metering.

Plant Safety Rules and Guidelines	Description
Operational Responsibilities of Other Grid Users	MPGC shall be responsible for the following: a. Assisting NGCP in maintaining Power Quality in the Grid during normal conditions by correcting MPGC facility that causes Power Quality problems. b. In ensuring that it's System will not cause the Degradation of the Grid. It shall also be responsible in undertaking all necessary measures to remedy the Degradation of the Grid that its System has caused. c. In providing and maintaining voltage control Equipment on its System to support the voltage at the Connection Point. d. In providing and maintaining Reactive Power supply facilities on its System to meet its own Reactive Power Demand. e. In maintaining an Automatic Load Dropping scheme, as necessary, to meet the targets agreed to with NGCP. f. In executing the instruction of NGCP during emergency conditions.
Power Quality Standards	MPGC shall maintain and ensure that their equipment can operate reliably and safely within the limits specified in article 3.2 during normal conditions and can withstand the limits specified in the Grid Code.
Preparation for Fixed Asset Boundary Document	MPGC shall provide the information that will enable NGCP to prepare the Fixed Asset Boundary Document, in accordance with the schedule specified in the Connecting Agreement or Amended Connecting Agreement. The Fixed Asset Boundary Document for the Equipment at the Connection Point shall include the details of the lines or cable emanating from NGCP and MPGC's sides of the Connection Point.
Protection Arrangements	The protection of MPGC's generating units and equipment and their connection to the grid shall be designed, coordinated and tested to achieve the desired level of speed, sensitivity, and selectivity in fault clearing and to minimize the impact of faults on the grid. MPGC shall be solely responsible for the protection system of the electrical equipment and facilities at its side of the connection point and the fault clearance time for a fault on the generators system shall not to be longer than 120 milliseconds
Requirements Relating To The Connection Point	MPGC generator's Equipment shall be connected to the grid and the connection point shall be controlled by a circuit breaker that capable of interruption by the maximum short circuit at the point of connection. Disconnect switches shall also be provided and arranged to isolate the circuit breaker foe maintenance purpose.
Safety Coordination	MPGC shall comply in accordance to the safety rules and local safety instruction relating to the safety precautions and on its high voltage equipment. Likewise, MPGC will adopt the Philippine Electrical Code (PEC) Parts 1 and Part 2 and the Occupational safety health standards.
Scheduling and Dispatch	

Plant Safety Rules and Guidelines	Description
Responsibilities Of Distribution and Other Users	MPGC shall submit their demand data for grid operating program to be used in scheduling and dispatch and shall ensure implementing of all dispatch instruction from NGCP.
Speed-Governing System	MPGC's generating units shall be fitted with the a fast-acting speed-governing system to provide frequency control under normal and isolated operating conditions from the grid in accordance with article 7.6 of the grid code.
Submission of Planning Data	MPGC shall submit to NGCP the relevant Standard Planning Data and the Detailed Planning Data specified and in accordance with the requirement prescribed in Grid Code. The required Standard Planning Data shall consist of information necessary for NGCP to evaluate the impact of any MPGC Development on the Grid. The detailed Planning Data shall include additional information necessary for the conduct of a more accurate Grid planning study.
Transient Voltage Variations	MPGC shall ensure that the its system shall be designed and operated to include devices that will mitigate the effects of transient over voltages and shall take into accounts the effects of electrical transients when specifying the insulation of its equipment.
Unbalance Loading Withstand Capability	MPGC's generating unit shall meet the requirements of voltage unbalance as specified in section 5.2.5 of the grid code and shall also be required to withstand without tripping the unbalance loading during clearance by the backup protection of a closed-up phase to phase fault on the grid or, in the case of an embedded generating unit, on the user system.
Voltage Fluctuation and Flickery Severity	As required, MPGC shall ensure that the maximum flicker severity shall not exceed 1.0 unit in short term and 0.8 units in long term.
Voltage Unbalance	MPGC, during normal operating condition, shall not exceed the limit for the maximum Negative sequence unbalance factor and maximum zero sequence unbalance factor at the connection point in the grid as specified in section 3.2.5 of the grid code.
Voltage Variation	MPGC shall comply to specified requirement on the Voltage Variation at Connection Point with the Grid within the limit specified in section 3.2.3 in the grid code.

5.0 SOCIAL DEVELOPMENT PLAN/FRAMEWORK AND IEC FRAMEWORK

5.1 SOCIAL DEVELOPMENT PLAN/FRAMEWORK

The Social Development Plan (**SDP**) was prepared through conduct of consultation with the decision makers of Mariveles, and Barangay Biaan on September 15, 2016 and a review of the CSR Programs of MPGC as presented by SMC Foundation, Inc.

The SDP consultation aims to determine the indicative programs that would enhance the social condition of the affected community which are consistent with the mandates of the concerned government agencies; and would enable them to enhance their self-reliance in the context of the proposed MCPP Project. The SDP consultation also provides an opportunity for identifying the following:

- key socio-economic issues and concerns by the various stakeholders, including those that were raised during consultations;
- recommended measures in response to the issues and concerns that were raised;
- lead agency or organization responsible in implementing the measures; and
- setting of timelines to implement these measures consistent with the plans and programs of the lead agencies.

The information collected from the perception survey will also form part of the SDP for the proposed MCPP Project that mainly addresses the perceived fears of environmental degradation due to pollution on land, water, air and health risks.

The SDP aims to enhance the identified programs and design the appropriate development programs that would be the basis for the preparation of the DOE required five-year Social Development and Management Plan (**SDMP**) upon the continued operation of the proposed Project. The various programs identified are in the areas of health and safety; education; peace and order; environment and sanitation; and spirituality. Multi-sectoral representatives are the Inter-agency Government Offices (MSWD, MAO, MPDO/ENRO, MHO, PNP) from the youth, senior citizens, church/religious organizations and the LGUs. The recommended SDP will be presented to the Inter-agency representatives in consideration of their mandate to deliver services in coordination with the LGU and MPGC. This includes the municipality and barangay IRAs to maximize the resources with MPGC's socio-economic commitments as mandated by law. For sustainability, the Social Development Technical Working Group sits as Ad hoc Committee in coordination with MPGC CSR Team to oversee the implementation of the SDMP, to make their report to the Multi-partite Monitoring Team (**MMT**).

MPGC has indicated its commitment to support the SDP in partnership with the LGUs, NGOs, POs and other concerned government agencies. It is expected that in the long term, the economic benefits from tax revenues, the funds from the mandated services of the inter-agencies and the socio-economic benefits from DOE ER No. 1-94 will be the contributing sources of funds together with the IRA of the Barangays to sustain the implementation of the SDP.

Table 5-1 presents the ISDP for the proposed Project of MPGC.

Table 5-1. Social Development Plan for the Proposed MCPP Project

Concern	Responsible Community Member/Beneficiary	Government Agency/ Non-government Agency and Services	PROPONENT	Indicative Timeline	Source of fund
Gender Responsive <u>Livelihood/and Credit Facilities</u> (Men, Women, Youth & elderly)	• Barangay Chairman • Kagawad for Agriculture • Barangay Chair for Women • Qualified Project Affected Men, Women, Youth & Elderly	**LGU, Municipal Planning Office** **MSWD, TESDA, DA** • Development Community Micro-finance Facilities • Product and Marketing Information System Development: • Cooperative Development **TESDA/TLRC** • Skills training in handicraft, food preservation (dried fish) • Technical/electrician/mechanic/driving	**MPGC CRO** • Provision of 3-day extensive training on Food Preservation (in coordination with TESDA/ TLRC) which includes start-up business package for 20 residents of Barangay Biaan. • Create opportunities for the barangay to address their most basic asset in growth and development – land and resources. • Equity among the men and women in the access and control of economic opportunities.	Construction Operation	LGU–IRA MPGC CSR
Health and Safety Climate Change Environment Health Risk from the construction and operation of the proposed MCPP Project Contagious Diseases	• Barangay Kagawad for Health • Barangay Kagawad for Senior Citizen • Barangay and Sitio Health Workers • Barangay Nutrition Scholars • Barangay Disaster Risk Reduction Coordinating Council	**MHO/MSWD/MDRRMC** • Community Health Awareness Project • Upgrading of Facilities and Equipment • Supply and Medicines • Construction of New Lying-in Clinic and RHU Office Building **Regular Programs**	**MPGC CRO** • Organize medical missions and provision of medicines to directly affected community (PhP 180 per patient for 500 patient)	Construction Operation	LGU –IRA/ MPGC CSR

• Malnourished Babies and Children • Problems of Potable Water and Sanitation • Lack of Health Facilities and Development Program • Expensive quality drugs • Proliferation of unhealthy lifestyle • Neglect of Senior Citizen • Enhancement of Senior Citizen's benefits		• Maternal Care and Child Health Care ○ Prenatal, Intra-natal, Post-natal ○ Child birth in health centers or hospitals • Nutrition and Food for Growth Program ○ Malnutrition ○ Supplemental feeding • Health Facilities Development Program • Water and Sanitation Program • Provide potable water system • Improvement of Access to Low Cost Quality Drugs through the Botika ng Barangay • Advocacy on Healthy Lifestyle • Provide assistance to Senior Citizens and Persons with Disability • Barangay Disaster Management Training			
Education and Recreation • Community/School children lack training for disaster preparedness • Lack of knowledge about the construction and operation of a Coal Fired Power Plant • Lack of school rooms • Lack of teachers • Scholarship for qualified students • Alternative education for adults who lack	• Barangay Kagawad for Education • Barangay School Head Teacher/Principal	**DepEd/MHO/ME/MDRRC** • Production of IEC Materials on Climate Change & Disaster Management in relation to the operation of the proposed MCPP Project • Include in the school curriculum the operation of a coal-fired thermal power plant • Disaster Preparedness and Response Program • Construction/Rehabilitation of additional School Buildings • Provision/Hiring of additional teachers • Construction of school fences • Upgrading of parks & playground • Teachers orientation & skills training • Basic Literacy and Numeracy/*Sulong*	**MPGC CRO** • Provision of Technical Education Scholarship ○ Skills training based on the technical needs of MCPP Project ○ Includes TESDA training fee and meal allowance ○ 20 scholars at PhP10,000 each per year.	Construction Operation	LGU–IRA/ MPGC CSR

literacy and numeracy skills • Maintenance of Culture and Sports school activities		*Dunong* Program • Technical Education and Skills Development Program • Setting-up of scholarship program for qualified students • Literacy Programs & Alternative Education • Opening of Technical/Vocational Courses **Sports** • Purchase of Sports Equipment • Establishment of Sports Program (i.e. scholarship, etc.)			
Environment and Sanitation • Indiscriminate disposal of waste • No proper toilets and sewage system	• Barangay Kagawad for Environment	**MPDO/MENRO/MHO/BFAR (Climate Change Programs)** • Enforcement/Implementation of Ecological Solid Waste Management Ordinance and Integrated Solid Waste Management Plan • Establishment of Recycling Industry • Establishment of Collection and Transport System • Health programs • Provide water sealed toilets • Monitor water quality for consumption • Development of MRF and Solid Waste Management System • Prevention/Control of Land, Water, Air and Noise Pollution • Control of Soil Erosion and Siltation • Construction of STP	**MPGC CRO** • Training on MRF and Solid Waste Management System/ Plan for 20 participants from Barangay Biaan	Construction Operation	LGU –IRA/ MPGC CSR
Infrastructure • Improvement and rehabilitation of	• Barangay Chairman • Barangay Kagawad for Infrastructure	**MPDO/ME/ DPWH** • Road Rehabilitation	**MPGC CRO**	Construction Operation	LGU –IRA/ MPGC CSR

barangay roads					
Peace and order • Maintenance of peace & order	• Barangay Kagawad for Peace and Order • Barangay Tanod	**LGU/PNP** • Capacitate and Strengthen Barangay Tanods in peace keeping	**MPGC Chief Security Officer**	Construction Operation	LGU –IRA/ MPGC CSR
Spiritual	• Barangay Assigned Catholic Priest • Pastor of different denomination	**Parish Priest/Pastor**	**MPGC CRO**	Construction Operation	MPGC CSR

5.2 INFORMATION, EDUCATION AND COMMUNICATION

Information materials such as brochures, videos, slide, pamphlets and posters will be prepared and distributed by MPGC. These materials will provide information about the project details such as benefits and risks that will result from its implementation. As well, focus group discussions and community open forum will be carried out to disseminate important information to affected residents. The IEC program will be implemented in close coordination with concerned LGUs, NGOs, and stakeholders. **Table 5-2** presents the IEC Plan of MPGC.

Table 5-2. Information Education and Communication Plan for the Proposed MCPP Project

Needs	Implementation	Community Implementation Plan (Strategies)	Government/ Non-Government Agency Services	Proponent	Cost Estimate (PhP)
• Province of Bataan • Municipality of Mariveles • Barangay Biaan: Full Information about: ❑ The EIA process ❑ The nature and operation of the proposed coal-fired thermal power plant ❑ The consequential impacts on the residents of the community and their mitigation measures ❑ The benefits of the Project on their Socio-cultural/ economic and bio-physical environment of the affected residents as they address the major issues of air and water pollution using IEC ❑ Full information on the decommissioning plan of the project.	Before project implementation During project operations	**1. Primer/Brochure (print media)** This strategy is effective in explaining in detail the subject matter, done in a simplified manner and in the language of the people. This strategy, likewise, uses illustrations to further clarify the processes that are to be done. It is a good vehicle for IEC to provide updates and relevant issues of the MCPP Project during construction and operation. A. The EIA process must be illustrated and simplified in the language of the affected community written in English & Tagalog. B. The Thermal Power Plant Project This shall contain: - the project description, project time frame, project facilities, management of Social and Environmental impacts, potential project benefits, graphic illustration about the process of thermal power plant operation, the process of EIA, roles and responsibilities of the stakeholders - Philippine Clean Water Act of 2004 - R.A. No. 8749 (Philippine Clean Air Act of 1999); - R.A. 9003 Ecological Solid Waste Management C. Benefits ❑ The Social Development and Management Plan - Gender Responsive Livelihood and Credit Facilities - Education and Recreation - Health and Safety - Environment and Sanitation R.A.9003 - Peace and order	1. Municipality & Barangay Information Officers 2. Elementary and High School Students 3. Barangay Committee on Education and Culture 4. Barangay Gabay sa Mamamayan Action Center	• MPGC Community Relations Officer (**COMREL**)	50,000.00

Needs	Implementation	Community Implementation Plan (Strategies)	Government/ Non-Government Agency Services	Proponent	Cost Estimate (PhP)
		- Spiritual D. Grievance On the residents who will be affected by the proposed Project activities showing their right to complain for violations of ECC conditions **2. Consultations** These are face to face encounters where participants and facilitators of knowledge and skills develop strategies to respond to the needs of the communities in the context of what is appropriate for their capabilities and resources ❑ Using the interpersonal approach, the Community Relations Officer shall maintain regular consultations with the barangay for an open dialogue on the issues, problems and concerns related to the implementation and sustainability of the project. ❑ Group discussion of the sectoral groups which will be affected in the project activities, the legal processes with the application of priority job placement, and other benefits ❑ Workshops on Solid Waste Management and Preparation of IEC materials ❑ Workshops on Coastal Resource Management ❑ Workshop on community Disaster and Risk Management **3. Posters and Wall Comics** ❑ A graphic illustration of information on “What is a Coal-Fired Thermal Power Plant?” and the rationale of the project in the context of their life-ways based on DOE ER 1-94. ❑ Community-Based Solid Waste Management and information about R.A.9003 and DAO 2004-1 ❑ Community-Based Climate Change Management/ Disaster Risk Management.			

Needs	Implementation	Community Implementation Plan (Strategies)	Government/ Non-Government Agency Services	Proponent	Cost Estimate (PhP)
		4. Cell phone Patch Consultation ❑ Using the Cell Phone feed-back mechanism through the Barangay Counsel in project affected barangay. **5. Barangay Forum and Phone Patch Up** ❑ This strategy enables the MPGC to discuss the progress of the proposed MCPP project with key-persons of the company/resource persons weekly. This also encourages multi-sectoral interest groups to ask questions through phone patches.			

5.3 CORPORATE SOCIAL RESPONSIBILITY

The MCPP will adopt the corporate social responsibility established by SMC in their other various projects to help the community in Barangay Biaan by extending services and activities with regards to health, environment, education and, livelihood and development.

5.3.1 Health

SMC and MPGC shall help address the country's problem of inequity in access to basic healthcare services and proper nutrition through programs that cater to residents of their host communities. Aside from feeding programs for children, the company also provides community clinics that serve patients suffering from various ailments such as diabetes, tuberculosis and other cardiovascular diseases, and hold medical missions that give free medical and dental health services.

For Barangay Biaan, the health programs planned by MPGC will include quarterly visit to provide medical services like X-Ray, Electrocardiogram (ECG) and ultrasound examinations, dental services and free medicines.

The MPGC will also coordinate with the Barangay Health Unit to upgrade the Barangay Clinic.

5.3.2 Environment

SMC and MPGC share in the responsibility for environmental protection and sustainable development. The foundation covers the protection of land, water, and air and conducts coastal and creek clean-ups, as well as the planting of tree seedlings, around the country, particularly in their various host communities. Through the Coastal Resource Management, the company advocates the protection of coastal waters. This engages in mangrove reforestation, artificial reef installation and regeneration of marine resources. Training on waste management and donation of trash bins through plant facilities are also conducted.

5.3.3 Education

The MPGC shall adopt literacy programs already implemented by SMC in their various other projects, to meet the educational needs and extend the education services to the community in Brgy. Biaan.

SMC supports literacy in the Philippines through scholarship assistance, supplemental feeding, book donation and functional literacy programs. SMC implemented the "Malusog na Katawan, Matalas na Isipan" as a supplemental feeding project given to children from 4 to 8 years old for 4 to 6 months. The company also provides scholarship assistance to the underprivileged students in the communities where SMC operates. The company's book donation program called "Books for the Barrios" provided various reference materials on English, Science and Math, as well as the donation of used computers to public schools nationwide. The functional literacy program of the company provides the teaching of basic reading, writing and modern agricultural technologies to indigenous people as its main focus. It is mainly conducted by the local NGOs in the identified areas.

The MPGC will also provide scholarship programs aimed to help the members of the local community, particularly the out-of-school youth, to acquire technical and vocational skills. Free TESDA certification trainings will be rolled out enable the local workers from Barangay Biaan to be qualified for the jobs needed in the construction of MCPP.

5.3.4 Livelihood and Development

The MPGC shall also adopt livelihood and development programs already implemented by SMC in their various other projects.

The company promotes entrepreneurship to generate livelihood among families and communities. The company implemented several livelihood projects such as “Kawang-gawa”, which is a cooking demonstration and livelihood training initiative. Together with the LGU, MPGC shall identify and implement other livelihood programs suited for the needs of community in Brgy. Biaan.

For example, to provide added income to the local fishermen, they will be involved in the creation and maintenance of fish sanctuaries, as coordinated by LGU, EFIHI and MPGC; coral restoration program, and construction and deployment of artifical coral reefs.

Livelihood programs for women will be developed in coordination with the LGU. MPGC has, for example in their existing projects, outsourced its rags and cleaning implements to women in the host community. This program could be adapted to Brgy.Biaan.

Indigenous people living in Brgy. Biaan will be involved in creation and maintenance of the plant’s reforestation program. MPGC will outsource the seedlings from the local indigenous people, since they have local knowledge of the more resilient tree species with high survivability.

6.0 ENVIRONMENTAL COMPLIANCE MONITORING

The Environmental Compliance Monitoring presents the MPGC's commitment to conduct a self-monitoring activity wherein various measures are proposed in order to ensure that the impacts which will be caused by the proposed project are minimized and properly managed. This Environmental Compliance Monitoring takes reference to the provision of DAO 2003-30 RPM issued as MC 002 Series of 2007, which requires the establishment of the MMT, the Environmental Monitoring Fund (**EMF**) and the Environmental Guarantee Fund (**EGF**).

6.1 SELF-MONITORING PLAN

MPGC will conduct a self-monitoring activity of its environmental operations, and will regularly submit its Self-Monitoring Report (**SMR**) to the DENR. An initial Environmental Monitoring Plan (**EMoP**) is presented in **Table 6-1**. This EMoP follows Annex 2-20 of the DAO 2003-30. The plan is largely indicative and will be refined during project implementation.

Environmental monitoring involves all project phases; namely, construction, commissioning, operations and abandonment to determine and find explanation on any changes in the baseline data. This includes inventory of opened up areas, removal of structures and vegetation, volume of spoils, spaces opened up, built up structures, influx of workers, water consumption, jetty operations, waste generation, disposal of hazardous wastes, operating and maintenance of equipment, fuel and chemical storage and dismantling and removal of facilities and removal and disposal of demolition wastes.

Annex 6-1 presents the Project Environmental Monitoring and Audit Prioritization Scheme (**PEMAPS**).

Table 6-1. Environmental Monitoring Plan for the Proposed MCPP Project

Key Environmental Aspects	Environmental Component	Potential Impacts	Sampling & Measurement Plan				Lead Entity	Estimated Cost (PhP)	EQPL Management Scheme					
									EQPL Range			Management Measures		
			Parameter	Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
CONSTRUCTION PHASE														
	LAND													
• Mobilization of construction equipment and materials • Construction of power plant and other support facilities • Generation of domestic waste	Pedology	• Degradation of Soil Quality/Fertility	Pb, mg/kg	Standard Methods Dutch Standard	Semi-annual	S1-location of Admin building S2-location of Power plant (Phase 2) location S7-location of Staff house S8-location of ash storage and coal yard .	MPGC, Contractor & MMT	60,000	100	150	200	Review baseline conditions, which can confirm exceedances Otherwise conduct Investigation in the station wherein the exceedances occurred.	Identify and apply control measures if caused by MPGC Coordinate with the Operations Department as to the measures to do to avoid any spillages or contamination in the soil.	Hire 3rd party DENR accredited sampling firm to confirm results and conduct investigation Submit report to DENR
			Oil & Grease						1	3	5			
			Cd, mg/kg						4	5	6			
			As, mg/kg						35	40	45			
									6	8	10			
			Fe, mg/kg						6,000	8,000	10,000			
			Cr^{+6},mg/kg						1.5	1.8	2			
		Fuel spills/ Leakage	Occurrence of Leak	Visual inspection	Weekly; Daily at source of leak upon Action and limit levels		MPGC Contractor MMT	NA	Visible oil spill in the site, Spill Vol.: <1L	Visible oil, leak persists after clean-up; Spill Vol.: 1L to <100L	Visible oil, leak persists after clean-up; Vol.: >100L	Conduct investigation regarding the reason of the leak. Visual check of the oil tanks.	Conduct of leak test in the tank. Inspection of the tanks for the area where leakage occur. Disposal of any contaminated soil	Conduct of leak test. Do not use the tank unless the damage is fixed. Report the incident to the EMB Region 3. Disposal of contaminated soil
	Terrestrial	Threat to	Tree survival	Inventory	Semi-	Buffer Zone	MPGC	PhP	60%	50%	40%	Replant	Assess soil	Assess soil

Key Environmental Aspects	Environmental Component	Potential Impacts	Sampling & Measurement Plan				Lead Entity	Estimated Cost (PhP)	EQPL Management Scheme					
									EQPL Range			Management Measures		
			Parameter	Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
	Ecology	existence and/or loss of important local species Threat to abundance, frequency and distribution of important species	Rate in reforested areas (Buffer zone)		annual		Contractor MMT	700,000.00	survival rate			trees	quality of areas with low survival rate Identify if need to change species to increase survivability Replant trees	quality of areas with low survival rate Identify if need to change species to increase survivability Identify potential sources preventing tree survival Assess if soil remediation /enhancement is needed Replant trees
CONSTRUCTION PHASE														
	WATER													
• Mobilization of construction equipment and materials • Construction of power plant and other support facilities • Generation of	Groundwater Quality	Degradation of groundwater Quality	Cr^{+6}, mg/L	Grab sampling PNSDW Standard	Quarterly	GW5 (as described in Chapter 2 of the EISR)	MPGC Contractor MMT	50,000 per sampling	0.035	0.04	0.05	Review baseline conditions, which can confirm exceedances otherwise conduct investigatio	Review baseline conditions, which can confirm exceedances otherwise conduct investigation in the affected	Review baseline conditions, which can confirm exceedances otherwise hire a 3rd party
			As, mg/L						0.035	0.04	0.05			
			Hg, mg/L						0.0007	0.0008	0.001			
			Total Hardness as $(CaCO_3)$ mg/L						210	240	300			
			Total coliform MPN/100mL						0.77	0.88	1.1			
			Temp., °C	Measured on-site										
			pH						-	-	6.5-8.5			

Key Environmental Aspects	Environmental Component	Potential Impacts	Sampling & Measurement Plan				Lead Entity	Estimated Cost (PhP)	EQPL Management Scheme					
									EQPL Range			Management Measures		
			Parameter	Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
domestic waste			TDS	using					350	400	500	n in the affected stations wherein exceedances occurred including external factors.	stations wherein exceedances occurred including external factors. Conduct retesting to verify exceedances. If exceedances are caused by the plant, check and correct the process	environmental firm to conduct investigation in the area. If proven that the causes of exceedances are from MPGC, activities from the area of concern will be stopped until cause of the exceedances is fixed. If not, coordinate with the LGU, MMT and the DENR for correction
	Marine Water Quality	Degradation of marine water quality	Temp., ºC	calibrated water quality test meters	Quarterly	MW2 MW3 MW4 MW5 MW6 MW7 MW8 (as described in Chapter 2 of the EISR)	MPGC Contractor MMT	50,000 per sampling	-	-	25-31			
			DO, mg/L						5	4.5	4			
			TSS, mg/L	Grab sampling DAO 2016-08					56	64	80			
			Oil & Grease mg/L						2	2.5	3			
			Fecal Coliform, MPN/100ml						140	160	200			
			As, mg/L						0.014	0.016	0.02			
			Hg, mg/L						0.0014	0.0016	0.002			
			Cd, mg/L						0.0035	0.004	0.005			
			Cr^{+6}, mg/L						0.035	0.04	0.05			
			Pb, mg/L						0.035 * Interim values: Baseline + 10%	0.04 Interim values: Baseline + 15%	0.05 Interim values: Baseline + 20%			
			Note: Interim values will be used for parameters that exceed standards during baseline monitoring; trend will be monitored to check if standard values are attainable.											
	Marine Ecology	Decrease in abundances and change in composition of marine biota	Plankton, Benthic life forms, soft bottom communities	Plankton Net Sampling Chlorophyll A density	Semi-annually	MW2 MW3 MW4 MW5 MW6 MW7 MW8	MPGC Contractor MMT	250,000 per sampling	15% difference from baseline data	20% difference from baseline data	25% difference from baseline data	Conduct Investigation in the area particularly where species are	Conduct Investigation in the area particularly where species are known to decrease –	Hire a 3rd party environmental firm to conduct investigation in the

Key Environmental Aspects	Environmental Component	Potential Impacts	Sampling & Measurement Plan				Lead Entity	Estimated Cost (PhP)	EQPL Management Scheme					
									EQPL Range			Management Measures		
			Parameter	Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
			Monitoring of coral communities	Grab sampling Phototransect method	Semi-annually	CR1, CR2 CR3, CR4 CR5						known to decrease.	whether there is illegal fishing, etc. Determine possible sources of disturbance or distractions to the species of concern. Intensify surveillance and security in the area through coordination with the concerned agencies such as the navy or bantay-dagat.	area. If the results of the investigation show that the Project is the cause of the decrease in the number of species, the section which caused the said activity will be temporarily stopped unless the issue is resolved.
CONSTRUCTION PHASE														
	AIR													
• Mobilization of construction equipment and materials • Construction of power plant and other support facilities • Generation of domestic waste	Air Quality	Degradation of ambient air quality	TSP, µg/Ncm	Using High volume-gravimetric method of analysis Gas sampler Parasoniline Method of analysis	Quarterly	**24-Hours Averaging Time:** Station 1 – 20 meters away from the Bagac-Mariveles Road north of the project site	MPGC, Contractor & MMT	50,000 per sampling (including noise levels)	184	207	230	Check weather condition during sampling and if location is downwind of the area. Check	Check weather condition during sampling and if location is downwind of the area. Conduct site visit at said sampling	Hire a 3rd party DENR accredited sampling firm to confirm results and conduct investigation. Temporar
			PM_{10}, µg/Ncm						120	135	150			
			NO_2, µg/Ncm						120	135	150			
			SO_2, µg/Ncm						144	162	180			

Key Environmental Aspects	Environmental Component	Potential Impacts	Sampling & Measurement Plan				Lead Entity	Estimated Cost (PhP)	EQPL Management Scheme					
									EQPL Range			Management Measures		
			Parameter	Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
				for SO_2 Griess-Saltzman Method of analysis for NO_2		Station 2 – Barangay Hall of Lower Biaan						possible sources of pollution including external factors.	stations and hire a 3rd party DENR accredited sampling firm to confirm. If the source is not from the Project, coordinate it with LGU, DENR and the MMT for appropriate action.	ily stop certain aspects of the activities unless the problem has been resolved. If the source is not from the Project, coordinate it with LGU, DENR and the MMT for appropriate action.
			TSP, µg/Ncm			**1-Hour Averaging Time:** Station 3 - Biaan Aeta Integrated School Station 4 - Porto del So Subdivision			240	270	300			
			PM_{10}, µg/Ncm						160	180	200			
			NO_2, µg/Ncm						208	234	260			
			SO_2, µg/Ncm						272	306	340			
	Noise level	Increase in noise level	Noise Level (dBA)	Portable Noise Level Meter	Once a month (morning, daytime, evening and nighttime) Quarterly Reporting to DENR	NSR 1 – Camaya Coast (Class B)	MPGC, Contractor & MMT		Daytime-55 Morning/ Evening-50 Nighttime-45	Daytime-60 Morning/Evening-55 Nighttime-50	Daytime-65 Morning/Evening-60 Nighttime-55	Conduct survey at sampling stations to verify complaints. Check the sound level using sound meter. Determine possible causes.	Conduct retesting to validate the complaint/ If source of noise is from the Project, inform the Unit head in-charge to provide noise mitigation measures. Conduct noise monitoring to verify the limits	Conduct noise sampling with the presence of the DENR or a 3rd party environmental firm. Inform the operations or the area owner to stop activity
						NSR 2 – Camay Residential Subdivision (Class A)			Daytime-45 Morning/ Evening-40	Daytime-50 Morning/Evening-45	Daytime-55 Morning/Evening-50			

Key Environmental Aspects	Environmental Component	Potential Impacts	Sampling & Measurement Plan				Lead Entity	Estimated Cost (PhP)	EQPL Management Scheme					
									EQPL Range			Management Measures		
			Parameter	Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
									Nighttime-35	Nighttime-40	Nighttime-45		are already within limits. If source of noise is not from the Project, inform the MMT regarding possible source of noise for the group's investigation and coordination with LGU.	unless noise mitigation measures have been installed or the source of noise has been corrected. Upon installation of noise mitigation measures, conduct noise monitoring to verify if the noise level is already within limits.
						NSR 3 – Biaan Elementary School (Class AA)			Daytime-40 Morning/ Evening-35 Nighttime-30	Daytime-45 Morning/Evening-40 Nighttime-35	Daytime-50 Morning/Evening-45 Nighttime-40			
						NSR 4 – Biaan Aeta Integrated School (Class AA)								
						NSR 5 – Porto de Sol Subdivision (Class A)			Daytime-45 Morning/ Evening-40 Nighttime-35	Daytime-50 Morning/Evening-45 Nighttime-40	Daytime-55 Morning/Evening-50 Nighttime-45			
						NSR 6 – Lower Biaan (Class A)								
CONSTRUCTION PHASE														
	PEOPLE													
Hiring of workers	Local residents	Increase in local employment Increase income for residents	Composition of workforce		Semi-annually	NA	MPGC Contractor MMT	NA	60% of the employees are local residents (based on the skills and capacity)	55% of the employees are local residents (based on the skills and capacity)	50 % of the employees are local residents (based on the skills and capacity)	Increase employability of local residents by undertaking construction skills training prior to job hiring	Investigation of the reasons for not meeting the % local resident employment	Review employment memos, etc.

Key Environmental Aspects	Environmental Component	Potential Impacts	Sampling & Measurement Plan				Lead Entity	Estimated Cost (PhP)	EQPL Management Scheme					
									EQPL Range			Management Measures		
			Parameter	Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
OPERATION PHASE														
	LAND													
• Operation of power plant and other support facilities • Generation of domestic waste • Generation of coal ash	Pedology	Soil Contamination	Pb, mg/kg	Standard Methods Dutch Standard	Semi-annual	Coal Yard, Ash Disposal Facility (Other additional stations to be established as determined during the MMT meeting which will be agreed upon by the MPGC, EMB and MMT members.)	MPGC Contractor MMT	50,000	100	150	200	Review baseline conditions, which can confirm exceedances otherwise conduct Investigation in the station wherein the exceedances occurred.	Review baseline conditions, which can confirm exceedances otherwise conduct retesting to verify the exceedances. Coordinate with the Operations Department as to the measures to do to avoid any spillages or contamination in the soil. Submit report to EMB Region 3	Review baseline conditions, which can confirm exceedances otherwise coordinate with the DENR, MMT and the LGU to conduct soil rehabilitation/clean-up measures in the area which can be attributed to the Project.
			Hg, mg/kg						1	3	5			
			Cd, mg/kg						4	5	6			
			As, mg/kg						35	40	45			
			Zn, mg/kg						6	8	10			
			Fe, mg/kg						6,000	8,000	10,000			
			Cr^{+6},mg/kg						1.5	1.8	2			
		Fuel spills/ leakage	Volume of leak	Visual inspection	Upon report, stoppage of spills	Project site and off-site	MPGC Contractor MMT	NA	Spill Vol.: <1L Visible oil spill in the site.	Spill Vol.: 1L to <100L Visible oil spill in the site.	Spill Vol.: >100L Visible oil spill in the site.	Conduct investigation regarding the reason of the leak. Visual check of the oil tanks.	Conduct of leak test in the tank. Inspection of the tanks for the area where leakage occur.	Conduct of leak test. Do not use the tank unless the damage is fixed. Report the incident to EMB

Key Environmental Aspects	Environmental Component	Potential Impacts	Sampling & Measurement Plan				Lead Entity	Estimated Cost (PhP)	EQPL Management Scheme					
									EQPL Range			Management Measures		
			Parameter	Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
														Region 3.
• Operation of power plant and other support facilities • Generation of coal ash	Terrestrial Ecology	Threat to existence and/or loss of important local species Threat to abundance, frequency and distribution of important species	Species Importance values	Inventory	Annual	Buffer Zone	MPGC Contractor MMT	PhP 700,000.00	5% decrease of the result of the latest assessment	10% decrease of the result of the latest assessment	15% decrease of the result of the latest assessment	Conduct Investigation in the area particularly where species are known to decrease as per MPGC Guideline on Incident Investigation Procedure.	Conduct Investigation in the area particularly where species are known to decrease as per MPGC Guideline on Incident Investigation Procedure. Intensify surveillance and security in the area through coordination with the LGU (barangay tanods). Submit report to EMB Region 3	Hire a 3rd party environmental firm to conduct investigation in the area. Conduct investigation in the area. Determine possible sources of disturbance or distractions to wildlife. Intensify surveillance and security in the area through coordination with the LGU (barangay tanods). Conduct replanting activities.

Key Environmental Aspects	Environmental Component	Potential Impacts	Sampling & Measurement Plan				Lead Entity	Estimated Cost (PhP)	EQPL Management Scheme					
									EQPL Range			Management Measures		
			Parameter	Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
														Enclose the area by building walls around the buffer zone to prevent same incidents to occur, if necessary.
OPERATION PHASE														
	WATER													
• Operation of power plant and other support facilities • Generation of wastewater • Generation of coal ash	Groundwater Quality	Degradation of groundwater quality	Cr^{+6}, mg/L	Grab sampling PNSDW	Quarterly	GW5 (as described in Chapter 2 of the EISR)	MPGC Contractor MMT	50,000	0.035	0.04	0.05	Review baseline conditions, which can confirm exceedances otherwise conduct investigation in the affected stations wherein exceedances occurred including external factors as per MPGC Guideline on Incident Investigation Procedure.	Review baseline conditions, which can confirm exceedances otherwise conduct investigation in the affected stations wherein exceedances occurred including external factors as MPGC Guideline on Incident Investigation Procedure. Conduct retesting to verify exceedances.	Review baseline conditions, which can confirm exceedances otherwise hire a 3rd party If proven that the causes of exceedances are from the Project, operations from the area of concern will be stopped until cause of the exceedances is fixed.
			As, mg/L						0.035	0.04	0.05			
			Hg, mg/L						0.0007	0.0008	0.001			
			Total Hardness as $(CaCO_3)$, mg/L						210	240	300			
			Total coliform, MPN/100mL						0.77	0.88	1.1			
			Temp., ºC	Standard Measured on-site using calibrated water quality test meters										
			pH						-	-	6.5-8.5			
			TDS						350	400	500			
• Operation of power plant and other support facilities • Generation of wastewater and thermal effluent	Marine Water Quality	Degradation of marine water Quality	Temp., ºC		Quarterly	MW2 MW3 MW4 MW5 MW6 MW7 MW8 (as described in Chapter 2 of the EISR)	MGPC Contractor MMT	50,000	-	-	25-31			
			DO, mg/L						4	4.5	5 (min)			
			TSS, mg/L	Grab sampling DAO 2016-08					56	64	80			
			Oil & Grease, mg/L						2	2.5	3			
			Fecal Coliform, MPN/100ml						140	160	200			
			As, mg/L						0.014	0.016	0.02			
			Hg, mg/L						0.0014	0.0016	0.002			
			Cd, mg/L						0.0035	0.004	0.005			
			Cr^{+6}, mg/L						0.035	0.04	0.05			

Key Environmental Aspects	Environmental Component	Potential Impacts	Sampling & Measurement Plan				Lead Entity	Estimated Cost (PhP)	EQPL Management Scheme					
									EQPL Range			Management Measures		
			Parameter	Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
			Pb, mg/L						0.035 * Interim values: Baseline + 10%	0.04 Interim values: Baseline + 15%	0.05 Interim values: Baseline + 20%		If exceedances are caused by the plant, check and correct the process.	If not, coordinate with the LGU, MMT and the DENR for correction.
	Note: Interim values will be used for parameters that exceed standards during baseline monitoring; trend will be monitored to check if standard values are attainable.													
	Marine Ecology	Decrease in abundances and change in composition of marine biota	Plankton, Benthic life forms, soft bottom communities Monitoring of coral communities	Plankton Net Sampling Chlorophyll A density Grab sampling Phototransect method	annually annually	MW2 MW3 MW4 MW5 MW6 MW7 MW8 CR1, CR2, CR3, CR4, CR5	MPGC Contractor MMT	PhP 250,000 per sampling	15% difference from baseline data	20% difference from baseline data	25% difference from baseline data	Conduct Investigation in the area particularly where species are known to decrease.	Conduct Investigation in the area particularly where species are known to decrease – whether there is illegal fishing, etc. Determine possible sources of disturbance or distractions to the species of concern. Intensify surveillance and security in the area through coordination with the concerned agencies such as the navy or bantay-dagat.	If the results of the investigation show that the Project is the cause of the decrease in the number of species, the section which caused the said activity will be temporarily stopped unless the issue is resolved.
	Effluent	Water	Temp.	Grab	Quarterly	E1 – Sea	MPGC	150,000	-	-	3	Conduct	Conduct	Hire a 3rd

Key Environmental Aspects	Environmental Component	Potential Impacts	Sampling & Measurement Plan				Lead Entity	Estimated Cost (PhP)	EQPL Management Scheme					
									EQPL Range			Management Measures		
			Parameter	Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
	Quality	pollution due to domestic sewage (STP) Water pollution due to industrial wastewater	Change, °C	Sampling DAO 2016 08		Weir E2 – Intake E3 – Outfall	Contractor MMT					investigation on the possible causes of exceedances	investigation on the possible causes of exceedances. Retesting to verify the exceedances. Neutralize pH Increase parameter reduction (pH, TSS) of the WWTP facility as per its operating manual. Conduct retesting to confirm result of action. For heavy metal exceedance coming from oil spill within the plant, remove oil using oil sorbent pads	party environmental monitoring team to conduct the testing to validate results. Neutralize pH. Increase parameter reduction (pH, TSS) of the WWTP facility as per its operating manual. Conduct retesting to confirm result of action. For heavy metal exceedances coming from oil spill within the plant, remove oil using oil sorbent pads.
			pH						-	-	6-9			
			COD, mg/L						140	160	200			
			TSS, mg/L						70	80	100			
			Phosphate, mg/L						0.7	0.8	1			
			Sulfate, mg/L						385	440	550			
			Boron, mg/L						14	16	20			
			Cr^{+6}, mg/L						0.07	0.08	0.1			
			Ni, mg/L						0.21	0.24	0.3			
			Cu, mg/L						0.03	0.035	0.04			
			Zn, mg/L						1.2	1.3	1.5			
			As, mg/L						0.03	0.035	0.04			
			Cd, mg/L						0.007	0.008	0.01			
			Pb, mg/L						0.07	0.08	0.1			
			Hg, mg/L						0.003	0.0035	0.004			
			Oil & grease, mg/L						7	8	10			
			Discharge volume and temp. using thermistors											

Key Environmental Aspects	Environmental Component	Potential Impacts	Sampling & Measurement Plan				Lead Entity	Estimated Cost (PhP)	EQPL Management Scheme					
									EQPL Range			Management Measures		
			Parameter	Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
														If exceedances persist, operations in the area of concern will be temporarily stopped unless the exceedance is corrected.
OPERATION PHASE														
	AIR													
• Operation of power plant • Spontaneous combustion of coal	Air Quality	Decrease in Ambient air quality	TSP, µg/Ncm	Using High volume-gravimetric method of analysis Gas sampler Parasoniline Method of analysis for SO_2 Griess-Saltzman Method of analysis for NO_2	Quarterly	**24-Hours Averaging Time:** Station 1 – 20 meters away from the Bagac-Mariveles Road north of the proje Station 2 – Barangay Hall of Lower Biaan	MPGC Contractor MMT	50,000	184	207	230	Check weather condition during sampling and if location is downwind of the area. Check possible sources of pollution including external factors. Check status of furnaces and boilers for any upset or off-operating	Check weather condition during sampling and if location is downwind of the area. Conduct site visit at said sampling stations and hire a 3rd party DENR accredited sampling firm to confirm. Check emission of smoke stacks using CEMS. Conduct adjustments of	Hire a 3rd party DENR accredited sampling firm to confirm and conduct investigation. Check emission of smoke stacks using CEMS. Conduct adjustments of the unit's operation as per operating manual.
			PM_{10}, µg/Ncm						120	135	150			
			NO_2, µg/Ncm						120	135	150			
			SO_2, µg/Ncm						144	162	180			
			TSP, µg/Ncm			**1-Hour Averaging Time:** Station 3 – Biaan Aeta Integrated School Station 4 –			240	270	300			
			PM_{10}, µg/Ncm						160	180	200			
			NO_2, µg/Ncm						208	234	260			
			SO_2, µg/Ncm						272	306	340			

Key Environmental Aspects	Environmental Component	Potential Impacts	Sampling & Measurement Plan				Lead Entity	Estimated Cost (PhP)	EQPL Management Scheme					
									EQPL Range			Management Measures		
			Parameter	Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
						Porto del Sol Subdivision						parameters and have it adjusted accordingly as needed.	the unit's operation as per operating manual. If the source is not from the proposed Project, coordinate it with LGU, DENR and the MMT for appropriate action.	Temporarily stop certain aspects of the operations unless the problem has been resolved. If the source is not from the Project, coordinate it with LGU, DENR and the MMT for appropriate action.
		Decrease in air quality due to source emissions	PM, mg/Ncm	Using USEPA Methods 1 to 5	Continuous with manual stack testing Twice a year	Stack	MPGC, Contractor & MMT	30,000 per unit per sampling	120	135	150	Coordinate with operations and verify the status of furnaces and boilers for any upset or off operating parameters and have it adjusted accordingly as needed.	Hire a 3rd party DENR accredited sampling firm to confirm and conduct investigation. Check emission of smoke stacks using CEMS. Conduct adjustments of the unit's operation as per operating manual.	Hire a 3rd party DENR accredited sampling firm to confirm and conduct investigation. Check emission of smoke stacks using CEMS. Conduct
			SOx, mg/Ncm	Using USEPA Methods 1 to 4 and 6 or 8 as appropriate					500	600	700			
			NO_x, mg/Ncm	Using USEPA Methods 1 to 4 and Method 7					700	850	1000			
			CO, mg/Ncm						300	400	500			

Key Environmental Aspects	Environmental Component	Potential Impacts	Sampling & Measurement Plan				Lead Entity	Estimated Cost (PhP)	EQPL Management Scheme					
									EQPL Range			Management Measures		
			Parameter	Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
														adjustments of the unit's operation as per operating manual. Temporarily stop certain aspects of the operations unless the problem has been resolved.
		Ash handling dust emissions	TSP	Using High volume-gravimetric method of analysis	Quarterly	SE of ADF, where modeling predicts maximum concentration	MPGC, Contractor & MMT	30,000 per unit per sampling	240	270	300	Check weather condition during sampling Implement wetting; Adjust cover/shielding against wind direction	Check weather condition during sampling Implement wetting; Adjust cover/shielding against wind direction	Hire a 3rd party DENR accredited sampling firm to confirm and conduct investigation.; Implement wetting and suppression measures Re-sample for validation
			PM_{10}						160	180	200			
Use of air compressor and emergency generators	Noise level	Increase in noise level	Noise Level (dBA)	Portable Noise Level Meter	Once a month (morning, daytime,	NSR 1 – Camaya Coast (Class B)	MPGC, Contractor & MMT	10,000	Daytime-55 Morning/	Daytime -60 Morning	Daytime -65 Morning	Conduct survey at sampling stations to	If source of noise is from the proposed Project, inform	Conduct noise sampling in the

Key Environmental Aspects	Environmental Component	Potential Impacts	Sampling & Measurement Plan				Lead Entity	Estimated Cost (PhP)	EQPL Management Scheme					
									EQPL Range			Management Measures		
			Parameter	Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
Operation of steam turbine and boiler equipment					evening and nighttime) Quarterly Reporting to DENR				Evening-50 Nighttime-45	/Evening-55 Nighttime-50	/Evening-60 Nighttime-55	verify complaints as per MPGC Guideline on Noise Level Monitoring and Measurement Procedure. Check the sound level using sound meter. Determine possible causes.	the Plant Manager to provide noise mitigation measures. Conduct noise monitoring to verify if the level is already within limits. If source of noise is not from the Project, inform the MMT regarding possible source of noise for the group's investigation and coordination with LGU.	presence of the DENR or a 3rd party environmental firm. Inform the Operations or the area owner to stop activity unless noise mitigation measures have been installed or the source of noise has been corrected. Upon installation of noise mitigation measures, conduct noise monitoring to verify if the noise level is already within limits.
						NSR 2 – Camay Residential Subdivision (Class A)			Daytime-45 Morning/Evening-40 Nighttime-35	Daytime-50 Morning/Evening-45 Nighttime-40	Daytime-55 Morning/Evening-50 Nighttime-45			
						NSR 3 – Biaan Elementary School (Class AA) NSR 4 – Biaan Aeta Integrated School (Class AA)			Daytime-40 Morning/Evening-35 Nighttime-30	Daytime-45 Morning/Evening-40 Nighttime-35	Daytime-50 Morning/Evening-45 Nighttime-40			
						NSR 5 – Porto de Sol Subdivision (Class A) NSR 6 – Lower Biaan (Class A)			Daytime-45 Morning/Evening-40 Nighttime-35	Daytime-50 Morning/Evening-45 Nighttime-40	Daytime-55 Morning/Evening-50 Nighttime-45			
OPERATION PHASE														
	PEOPLE													
	Local	Increase in	Composition		Semi-	NA	MPGC &	NA	60% of	55% of	50 % of	Increase	Investigation of	Review

Key Environmental Aspects	Environmental Component	Potential Impacts	Sampling & Measurement Plan				Lead Entity	Estimated Cost (PhP)	EQPL Management Scheme					
									EQPL Range			Management Measures		
			Parameter	Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
	residents	local employment	of workforce		annual		MMT		the employees are local residents (based on the skills and capacity)	the employees are local residents (based on the skills and capacity)	the employees are local residents (based on the skills and capacity)	employability of local residents by undertaking construction skills training prior to job hiring	the reasons for not meeting the % local resident employment	employment memos, etc. Increase employability of local residents by undertaking construction skills training prior to job hiring
		Develop Local residents' Skills Training	Training completion rate		Annual	NA	MPGC, MMT	NA	50% of trainess did not compete the skills training	60% of trainees did not complete the skills training	70% of trainess did not complete the skills training	Conduct investigation regarding the turn out of the training activity	Conduct perception survey and do research of what is the preferred skills training of the stakeholders	Hire 3rd party experts to conduct investigation and do some assessment regarding the effective skills training for a certain group of people. Intensify the IEC.

Key Environmental Aspects	Environmental Component	Potential Impacts	Sampling & Measurement Plan				Lead Entity	Estimated Cost (PhP)	EQPL Management Scheme					
									EQPL Range			Management Measures		
			Parameter	Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
		Workers, Safety	Safe person-hours, injury, near miss and other safety performance indices	Incident reporting, surveys, included in the Health and Safety Plan of MPGC	Monthly report, act immediately on occurrence of accident	Project Site	MPGC & MMT	Part of Operational Cost	1 accident per year	1 accident per semi-annual	1 Accident per quarter	Safety re-training for workers involved in accident	Conduct departmental re-training of the workers on health safety rules and regulation Inspect the area wherein most accidents happen.	Inspect the area wherein most accidents happen. Conduct monitoring. Hire a 3rd party safety practitioner to conduct safety audit in the plant site.
		Health risks and safety of workers	Record of Illness	Review of medical records	Monthly	Project Site	NGCP	Part of Operational Cost	10% of workers ill	20% workers are ill	30% of workers are ill	Assess if illness are work-related; interview sick employees	Implement site-wide investigation of cause IEC campaign for illness prevention	Implement site-wide investigation of cause, isolate cases and prevent spread of illness; IEC campaign for illness prevention
		Increased social acceptability for the proposed	Question on approval/ disapproval for the proposed	Follow-up survey	Annually for 5 years and every 5 years	Municipality & affected barangay	MPGC & MMT	P60,000	50% says that project is unacceptable/degr	60% says that project is unacceptable/deg	70% says that project is unacceptable/de	Talk with the local stakeholders to check their stand	Intensify IEC and community relations.	Hire a 3rd party firm to conduct investigation in the

Key Environmental Aspects	Environmental Component	Potential Impacts	Sampling & Measurement Plan				Lead Entity	Estimated Cost (PhP)	EQPL Management Scheme					
									EQPL Range			Management Measures		
			Parameter	Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
		Project	MCPP Project and reason		thereafter				ading the environment.	rading the environment.	grading the environment.	on the issues to properly address it.		area.
			Project Related complaints	Listing of valid complaints	Monthly	Municipality and affected barangay	MPGC & MMT	NA	One (1) valid complaint in a month	Three (3) valid complaint in a month	Five (5) valid complaint in a month	Talk with the complainant Conduct investigation	Talk with complainants and conduct immediate investigation Intensify monitoring of usual complaints of stakeholders	Participation of MMT in the resolution of complaints
ABANDONMENT PHASE														
	LAND													
• Mobilization of Decommissioning equipment • Decommissioning of the power plant and other support facilities • Generation of domestic waste	Pedology	Soil Contamination	Pb, mg/kg	Standard Methods Dutch Standard	Semi-annual	To be established during the MMT meeting which will be agreed upon by the MPGC, EMB and MMT members.	MPGC Contractor MMT	PhP 60,000	100	150	200	Conduct investigation at the Project site and trace histories of oil spill in the area due to the overhauling of machine since it is already at the abandonment stage.	Conduct thorough investigation regarding the possible causes of exceedances.	Conduct soil rehabilitation and remediation
			Hg, mg/kg						1	3	5			
			Cd, mg/kg						4	5	6			
			As, mg/kg						35	40	45			
			Zn, mg/kg						6	8	10			
			Fe, mg/kg						6,000	8,000	10,000			
			Cr^{+6},mg/kg						1.5	1.8	2			
		Fuel spills/ leakage	Volume of leak	Visual inspection	Upon report, stoppage	Project site and off-site	MPGC Contractor MMT	NA	Spill Vol.: <1L	Spill Vol.: 1L to	Spill Vol.: >100L	Conduct investigation regarding	Conduct of leak test in the tank.	Conduct of leak test.

Key Environmental Aspects	Environmental Component	Potential Impacts	Sampling & Measurement Plan				Lead Entity	Estimated Cost (PhP)	EQPL Management Scheme					
									EQPL Range			Management Measures		
			Parameter	Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
					of spills				Visible oil spill in the site.	<100L Visible oil spill in the site.	Visible oil spill in the site.	the reason of the leak. Visual check of the oil tanks.	Inspection of the tanks for the area where leakage occur.	Do not use the tank unless the damage is fixed. Report the incident to EMB Region 3.
ABANDONMENT PHASE														
	WATER													
• Mobilization of Decommissioning equipment • Decommissioning of the power plant and other support facilities • Generation of domestic waste	Groundwater Quality	Degradation of groundwater Quality	Cr^{+6}, mg/L	Grab sampling	Quarterly	GW5 (as described in Chapter 2 of the EISR)	MPGC, Contractor & MMT	50,000	0.035	0.04	0.05	Review baseline conditions, which can confirm exceedances otherwise conduct investigation in the affected stations wherein exceedances occurred including external factors	Review baseline conditions, which can confirm exceedances otherwise conduct investigation in the affected stations wherein exceedances occurred including external factors Conduct retesting to verify exceedances. If exceedances are caused by the plant, check and correct the process	Review baseline conditions, which can confirm exceedances otherwise hire a 3rd party environmental firm to conduct investigation in the area. If proven that the causes of exceedances are from MPGC, activities from the area of concern will be stopped
			As, mg/L						0.035	0.04	0.05			
			Hg, mg/L						0.0007	0.0008	0.001			
			Total Hardness as $(CaCO_3)$, mg/L	PNSDW Standard					210	240	300			
			Total coliform, MPN/100mL						0.77	0.88	1.1			
			pH	Measured on-site using calibrated water quality test meters					-	-	6.5-8.5			
			TDS						350	400	500			
	Marine Water Quality	Degradation of marine water quality	Temp., ºC		Quarterly		MPGC Contractor MMT	50,000	-	-	25-31			
			DO, mg/L						4	4.5	5 (min)			
			TSS, mg/L	Grab sampling DAO 2016-08					56	64	80			
			Oil & Grease, mg/L						2	2.5	3			
			Fecal Coliform, MPN/100ml						140	160	200			
			As, mg/L						0.014	0.016	0.02			
			Hg, mg/L						0.0014	0.0016	0.002			
			Cd, mg/L						0.0035	0.004	0.005			
			Cr^{+6}, mg/L						0.035 * Interim values: Baseline + 10%	0.04 Interim values: Baseline +	0.05 Interim values: Baseline +			

Key Environmental Aspects	Environmental Component	Potential Impacts	Sampling & Measurement Plan				Lead Entity	Estimated Cost (PhP)	EQPL Management Scheme					
									EQPL Range			Management Measures		
			Parameter	Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
										15%	20%			until cause of the exceedances is fixed. If not, coordinate with the LGU, MMT and the DENR for correction
Note: Interim values will be used for parameters that exceed standards during baseline monitoring; trend will be monitored to check if standard values are attainable.														
ABANDONMENT PHASE														
	AIR													
• Mobilization of Decommissioning equipment • Decommissioning of the power plant and other support facilities	Air Quality	Decrease in Ambient Air Quality	TSP, µg/Ncm	Using High volume sampling-gravimetric method of analysis	Quarterly	**24-Hours Averaging Time:** Station 1 – 20 meters away from the Bagac-Mariveles Road north of the proje Station 2 – Barangay Hall of Lower Biaan	MPGC MMT	50,000	184	207	230	Check whether the area wherein exceedances occur is upwind or downwind of the Project site. Conduct investigation regarding the source of the pollutants in the area including external sources.	Conduct retesting of the parameters to validate results. Inspect the area where the possible source of pollution is. Report the incident to the DENR Region 3.	Hire a 3rd party DENR accredited firm to check validate results in the area. Inspect the site together with any DENR Representative.
			PM_{10}, µg/Ncm						120	135	150			
			NO_2, µg/Ncm						120	135	150			
			SO_2, µg/Ncm						144	162	180			
			TSP, µg/Ncm			**1-Hour Averaging Time:** Station 3 – Biaan Aeta Integrated School Station 4 –			240	270	300			
			PM_{10}, µg/Ncm						160	180	200			
			NO_2, µg/Ncm						208	234	260			
			SO_2, µg/Ncm						272	306	340			

Key Environmental Aspects	Environmental Component	Potential Impacts	Sampling & Measurement Plan				Lead Entity	Estimated Cost (PhP)	EQPL Management Scheme					
									EQPL Range			Management Measures		
			Parameter	Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
						Porto del Sol Subdivision								
• Mobilization of Decommissioning equipment • Decommissioning of the power plant and other support facilities	Noise level	Increase in noise level	Noise Level (dBA)	Portable Noise Level Meter	Once a month (morning, daytime, evening and nighttime) Quarterly Reporting to DENR	NSR 1 – Camaya Coast (Class B)	MPGC Contractor MMT	10,000	Daytime-55 Morning/ Evening-50 Nighttime-45	Daytime-60 Morning/Evening-55 Nighttime-50	Daytime-65 Morning/Evening-60 Nighttime-55	Conduct survey at sampling stations to verify complaints as per MPGC Guideline on Noise Level Monitoring and Measurement Procedure. Check the sound level using sound meter. Determine possible causes.	If source of noise is from MPGC, inform the Plant Manager to provide noise mitigation measures. Conduct noise monitoring to verify if the level is already within limits. If source of noise is not from the Project, inform the MMT regarding possible source of noise for the group's investigation and coordination with LGU.	Conduct noise sampling in the presence of the DENR or a 3rd party environmental firm. Inform the Operations or the area owner to stop activity unless noise mitigation measures have been installed or the source of noise has been corrected. Upon installation of noise mitigation measures, conduct noise monitoring to verify if the noise
						NSR 2 – Camay Residential Subdivision (Class A)			Daytime-45 Morning/ Evening-40 Nighttime-35	Daytime-50 Morning/Evening-45 Nighttime-40	Daytime-55 Morning/Evening-50 Nighttime-45			
						NSR 3 – Biaan Elementary School (Class AA)			Daytime-40 Morning/ Evening-35 Nighttime-30	Daytime-45 Morning/Evening-40 Nighttime-35	Daytime-50 Morning/Evening-45 Nighttime-40			
						NSR 4 – Biaan Aeta Itegrated School (Class AA)								
						NSR 5 – Porto de Sol Subdivision (Class A)			Daytime-45 Morning/ Evening-40 Nighttime-35	Daytime-50 Morning/Evening-45 Nighttime-40	Daytime-55 Morning/Evening-50 Nighttime-45			
						NSR 6 – Lower Biaan (Class A)								

Key Environmental Aspects	Environmental Component	Potential Impacts	Sampling & Measurement Plan				Lead Entity	Estimated Cost (PhP)	EQPL Management Scheme					
									EQPL Range			Management Measures		
			Parameter	Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
														level is already within limits.

6.2 MULTI-SECTORAL MONITORING FRAMEWORK

The MPGC shall establish an MMT for its proposed MCPP Project, which shall compose of the representatives from the following:

Agency/Organization	Responsibilities
• LGU of Mariveles • LGU of Barangay Biaan • Municipal Planning and Development Office	• Shall participate in actual monitoring work, prepare or concur with and sign the MMT monitoring reports. • Shall provide necessary information about local policies, plans and programs affecting MMT monitoring results and standards. • Shall advise the MMT of any complaints, information or reports from LGUs concerning the project.
• Department of Energy	• Shall participate in actual monitoring work, prepare or concur with and sign the MMT monitoring reports. • Shall provide necessary information such as update regarding the perceptible impact of the project on the sector/concern being represented.
• NGOs	• Shall participate in actual monitoring work, prepare or concur with and sign the MMT monitoring reports. • Shall provide necessary information such as update regarding the perceptible impact of the project on the sector/concern being represented.

The MMT shall be established to encourage public participation, to promote greater stakeholder vigilance and provide appropriate check and balance mechanisms in the monitoring of project implementation. The MMT is recommendatory to EMB. It has the primary responsibility of validation of MPGC's environmental performance, with the following specific functions:

- Validate project compliance with the coordination stipulated in the ECC and the EMP;
- Validate MPGC's conduct of self-monitoring;
- Receive complaints, gather relevant information to facilitate determination of validity of complaints or concerns about the project and timely transmit to the MPGC and EMB recommended measures to address the complaint;
- Prepare, integrate and disseminate simplified validation reports to community stakeholders; and
- Make regular and timely submission of MMT Reports based on the EMB-prescribed format.

With the proposed MCPP Project, the MPGC shall establish the MMT in accordance with the MMT Guideline as set forth by the MPGC, the DENR and the members of the MMT. An MMT member can be suspended or removed based on the guideline set by the MMT. Grounds for removal or suspension can be upon conviction of the culpable violation of the code of ethics, negligence of duty, excessive absences, cessation of representation (i.e. resignation from the sector/institution being represented in the MMT), grave misconduct, etc. The MOA signed by the MPGC and the MMT will be followed relative to replacement and proper turnover of the MMT responsibilities.

6.3 IMPLEMENTATION OF THE EMF AND EGF COMMITMENTS

The MPGC commits to establish an EMF, which will be agreed after the Workshop and Financial Plan (**WFP**) to support the activities of the MMT for compliance monitoring and Environmental Guarantee Fund (**EGF**). **Table 6-2** shows the EMF, EGF Trust Fund and EGF Cash Fund for the proposed Project.

Table 6-2. EMF, EGF Trust Fund and EGF Cash Fund for the Proposed MCPP Project

Type of Fund	Amount (PhP)
EMF (PhP)	1,000,000.00
EGF Trust Fund (PhP)	1,500,000.00
EGF Cash Fund (PhP)	1,000,000.00

The EMF shall be exclusively utilized to cover all costs attendant to the operation of the MMT.

The EGF shall be used exclusively for the following purposes:

- Immediate rehabilitation of areas affected by damages to the environment and the resulting deterioration of environmental quality as a direct consequence of the proposed MCPP Project construction, operation and abandonment;
- Just compensation of parties and communities affected by the negative impacts of the proposed MCPP Project;
- Conduct of scientific or research studies related to the proposed MCPP Project that will aid in the prevention or rehabilitation of accidents and/or environmental damages; and
- For contingency and clean-up activities, environmental enhancement measures, damage prevention programs and social equity measures including the necessary IEC and capability building activities related to the Project.

The EGF Trust Fund and EGF Cash Fund shall be replenished to its original amount annually or whenever the amount goes below 50% of the original amount. The EGF Trust Fund shall be renewed upon every expiration.

The amount of EGF Trust Fund and EGF Cash Fund are typical figures of EGF. Based on the assessment on geological hazard, there are no record of tsunami, landslide, etc. occurred in the project area.

7.0 ABANDONMENT/DECOMMISSIONING/REHABILITATION POLICIES AND GENERIC GUIDELINES

In the unlikely event that the MCPP Project becomes uneconomically viable or if by *force majeure* or acts of God, the Project will have to be terminated. A detailed abandonment plan shall be developed prior to the closure of the facilities and within the timeframe that will be specified in the ECC. The Abandonment and Decommissioning Plan will be prepared in accordance to DENR requirements and shall address the following:

- Proposed abandonment/decommissioning measures for the power plant and all auxiliary facilities constructed as part of the project.
- Removal of the existing hazardous and non-hazardous waste
- Site restoration
- Cost associated with the proposed abandonment/decommissioning activities and source of funds for the implementation of the activities
- Conformance to the requirements of the company, the local government, the DENR and other relevant agencies.

The plan will be submitted to the DENR for review and approval prior to the commencement of abandonment/decommissioning activities. MPGC Staff/Workers will be informed six (6) months prior to abandonment of the Project.

8.0 INSTITUTIONAL PLAN FOR EMP IMPLEMENTATION

The institutional organization of the MPGC as shown **Figure 8-1** contains people with their assigned responsibilities that require interaction between Mariveles Power Generation Corporation's different departments. The objective of this organization is to achieve the following:

- Economical and safety operations and maintenance of the project's components;
- Implementation of company policies;
- Environmental compliance and sustainability; and
- Promotion and enhancement of the social acceptability of the project.

The institutional organization will involve MPGC's top level management, since this group is responsible for providing the corporate direction and policies of the company. The policies shall then be disseminated to department heads and managers for implementation of the company personnel, including those who will be working on the operations of the project.

MPGC will also establish a partnership with relevant government agencies, various stakeholders and local host communities in relation to the project. This partnership is necessary to maintain a transparent and positive relationship for the proposed Project and its stakeholders, as well as to ensure that the environmental protection and enhancement measures are complied with.

The stakeholders of the project will be identified as the following:

- Municipality of Mariveles;
- Residents and community organizations that will be affected by the proposed project;
- Chamber of Commerce;
- Various industry organizations;
- Local peace-and-order councils (i.e., PNP, Coast Guard, Barangay Police); and
- other concerned non-government organizations.

MPGC commits to:

- Comply with the conditions that will be stipulated in the ECC and other related environmental laws;
- Foster mutually beneficial partnership and cooperation with host communities;
- Promote sustainable use and responsible development of resources by adopting appropriate technologies;
- Develop livelihood programs and upgrade skills of host communities to contribute and enhance the quality of life; and
- Develop training programs for its employees which will ensure that they will be continually prepared for the tasks assigned to them.

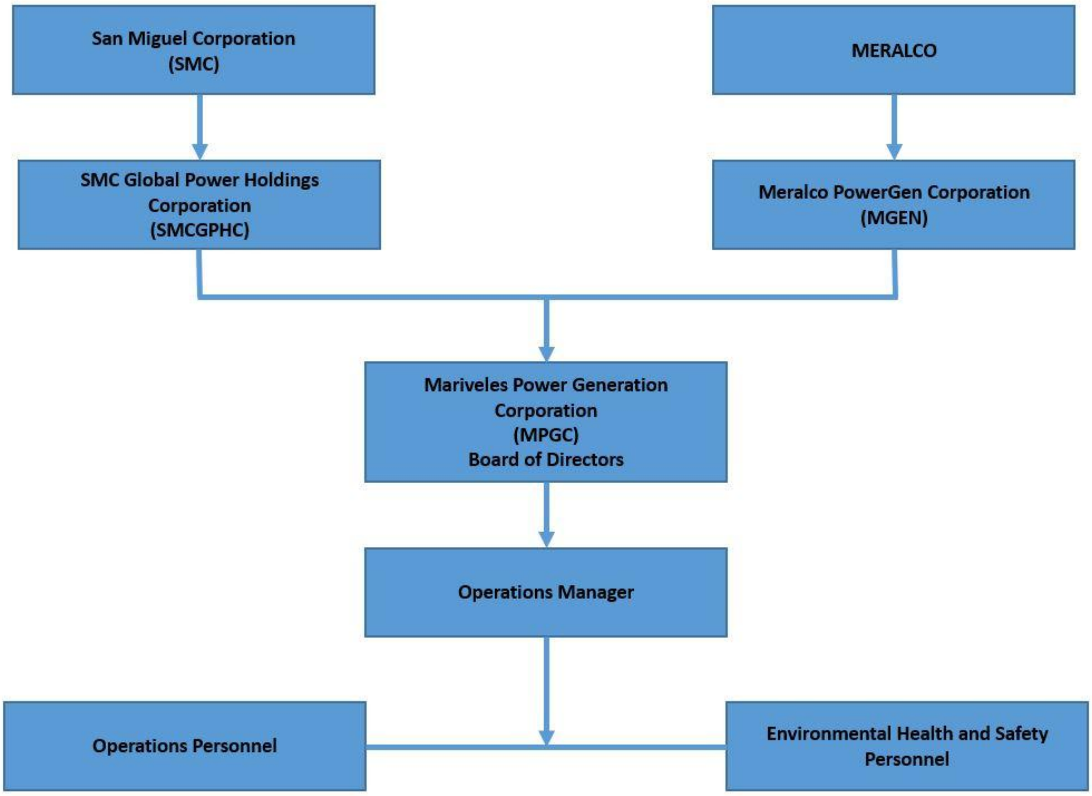


Figure 8-1 Institutional Plan Organizational Chart

8.1 GRIEVANCE REDRESS MECHANISM

8.1.1 Grievance Redress Mechanism Procedures

There are different mechanisms through which MPGC will handle complaints and grievances and feedback management, namely:

1. Multipartite Monitoring Team (MMT) - Besides environment monitoring, the team will also be tasked to receive and verify complaints from stakeholders against the plant and its operations;

2. Formation of Grievance Redress Mechanism Procedure. - This will manage the grievances from MPGC stakeholders to minimise the social risks to the business. The grievance process will provide an avenue for stakeholders to voice their concerns and give transparency on how grievances will be managed internally to reduce conflict and strengthen relationships between external stakeholders. Various channels for external stakeholders to vocalise their grievances may be through telephone, e-mail, personal appearance, and accomplishment of grievance form among others.

The Grievance Mechanism Procedure will serve as a process for receiving stakeholders' concerns, and the actions to address the concerns, wihout denying the stakeholder the right to seek other avenues for resolution. The MPGC will establish such a procedure for following objectives:

- Receive and facilitate the resolution of project stakeholders' concerns and grievances about environment-related project impacts which cannot be settled during public consultations, paying particular attention to the impacts on vulnerable groups;

- Measure to the risks and adverse impacts of the project; and
- Address project stakeholders' concerns and complaints promptly, using an understandable and transparent process that is gender responsive, culturally appropriate, and readily accessible to the country's judicial or administrative remedies.

- The GRM is composed of four (4) levels The Grievance officer of MPGC will be the contact point for receiving the grievances/complaints from the stakeholders.

Table 8-1 Levels of Grievance Redress Mechanism

	Environment Issue	Health and Safety Issue	Timeline
Contact Point	Grievance Officer of MPGC		Same day
1st Level	Health, Safety and Environment Officer		3 days
2nd Level	Health, Safety and Environment Committee		10 days
3rd Level	Multipartite Monitoring Team (MMT)	MPGC Management Level	15 days
4th Level	DENR - EMB	Court of Justice	

As part of the basic policies for the GRM, a grievance will be resolved in a timely manner at the lowest level possible. However, (a) if not settled at the lowest level, (b) if the aggrieved stakeholders are not satisfied with the action taken, or (c) the case is not acted upon after 15 days, the issue or concern will be taken to the next level.

The DENR and the Court of Justice will be the final decision maker for the complaint and grievance. All cases elevated to the 4th level will be outside the jurisdiction and control of this GRM.

8.1.2 Grievance Redress Mechanism Guidelines

The guidelines for GRM are as follows:

- All complaints received in writing, verbally or transmitted electronically will be documented and filed. Upon receiving a complaint from the aggrieved stakeholder, the Grievance officer will accomplish the Grievance Action Form (GAF).

- Aggrieved stakeholder will not be charged of any fees (administrative and legal fees) in filing of their grievance.

- The GAF will be stamped with a "Received" mark with corresponding control number, date of receipt and signature of the persons who received the said letter.

- Actions and decisions made with the received complaints/grievances/appeals by the HSEC, MMT and EMB-DENR will be reported and discussed by the Grievance Officer during regular meetings.

- If the grievance indicated in the letter cannot be readily addressed, the aggrieved stakeholder will be referred to the appropriate authority. The following will be indicated in the GAF: name of the authority to look for, date when the aggrieved stakeholder can meet with the said authority, and the venue for the meeting.

- In addition, the Grievance Officer of MPGC will publicize the grievance redress process in the form of handouts such as pamphlets, brochures or leaflets that are written in Filipino. All concerned institutions, including Barangays, LGUs, and the MPGC, will use the same handouts in explaining the grievance redress procedures to the aggrieved stakeholder who will come to them to raise their issue or concern. The handout will be disseminated through LGUs and Barangays as well as MPGC. The mechanism to be publicized at the website of MPGC and LGUs.

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