PROJECT DESCRIPTION FOR SCOPING

60 MW Gas Turbine Power Plant

Belgrove Power Corporation (BPC)

Barangay Malaya, Pililla, Rizal

Submitted to:

Environmental Management Bureau – Central Office

November 2021

PROJECT DESCRIPTION FOR SCOPING

---

60 MW Gas Turbine Power Plant
Belgrove Power Corporation

An Environmental Report By:

LCI ENVI CORPORATION
Unit 8L-M, Future Point Plaza 3
111 Panay Avenue, South Triangle
Quezon City, Metro Manila, The Philippines, 1103

Submitted To:

Department of Environment and Natural Resources
Environmental Management Bureau
EMB Building, DENR Compound, Visayas Avenue
Diliman, Quezon City

DOCUMENT TRACKING

VERSION NO.	REPORT COMPILED BY:	CHECKED BY:		APPROVED BY:		
		NAME	SIGNATURE	NAME	SIGNATURE	DATE
0	PC Go	JM Lim				
1						
2						
Distribution of Latest Version						
NO. OF COPIES	SUBMITTED TO:	DATE SUBMITTED	RECEIVED BY:		REMARKS:	
1	EMB-CO					
1	Belgrove Power Corporation					
1	LCI Envi Corp.					

Table of Contents

List of Tables

List of Figures

Annex

PROJECT DESCRIPTION

1 **Belgrove Power Corporation (BPC)** intends to construct and operate a 60 MW Gas Turbine Power Plant in Barangay. Malaya, Pililla, Rizal. The power plant will be composed of two generator units with 30 MW rated capacity per unit and will be operated to provide ancillary services to the national grid. Ancillary services, as defined in the Electric Power Industry Reform Act of 2001 (EPIRA), are services that are necessary to support the transmission of capacity and energy from resources to loads while maintaining reliable operation of the transmission system.

2 The proposed project will be operated to supply power when the national grid cannot deliver the power requirement, and to maintain the power quality, reliability and security of the grid. **Table 1-1** provides the summary of project information.

3 **BPC** is a wholly owned subsidiary of Fort Pilar Energy, Inc (FPEI). FPEI is a corporation primarily engaged in the business of exploration, generation, supply, distribution, and commercialization of various forms of energy.

Table 1-1: Basic Information on the Proposed Project, Proponent, and EIA Preparer

Project Name	**60 MW Gas Turbine Power Plant**
Project Location	Barangay Malaya, Pililla, Rizal
Project Area	1.333 Hectares
Project Type	Diesel-fired Power Plant
Project Size/Capacity	60 Megawatts
Project Proponent	**Belgrove Power Corporation** Office Address: Suite 2802, Discovery Center, 25 ADB Avenue, Ortigas Center, Barangay San Antonio, Pasig City Tel. No.: (02) 8633-9757 Authorized Representative: Atty. Joseph Omar A. Castillo
EIA Preparer	**LCI Envi Corporation** Office Address: Unit 8L-M, Future Point Plaza 3, 111 Panay Avenue, South Triangle, Quezon City Tel. No.: (02) 8442-2830 / Fax No.: (02) 8961-9226 Authorized Representative: Engr. Jose Marie U. Lim (EIA Team Leader)

1.1 PROJECT LOCATION AND AREA

4 The proposed project will be located inside the compound of the non-operational Malaya Thermal Power Plant and will utilize about 1.333 hectare of land. The proposed project site is already owned by the proponent. **Figure 1-1** shows the vicinity map of the proposed project site. The project site photos are attached as **Annex 1**.

1.1.1 Accessibility of the Project Site

5 The project site is about 60 kms from Quezon City. By land transportation, the proposed site can be accessed via Pililla-Jalajala-Pakil Road as shown in **Figure 1-2**.

1.1.2 Project Impact Areas

6 Initially, the direct impact area includes the 1.333-hectare project footprint while the areas in the immediate vicinity of the project site is considered as the indirect impact area (IIA). In accordance with the guidelines provided in DAO 2017-15, after the completion of the EIA study, the delineation of the direct and indirect impact areas will be updated. **Figure 1-3** presents the initial delineation of the impact areas.

- For the Land component, the direct impact area (DIA) pertains to the areas that will be cleared and developed for the construction and operation of the proposed project components, which are further detailed in **Section 1.4**.

- For the Water component, the DIA refers to the water supply that will be tapped for the water requirement of the project.

- For the Air component, the DIA covers the areas within Brgy. Malaya (host barangay), where the air quality may be affected during the construction and operation of the proposed project.

- For the People component, the IIA encompasses the communities in the host Municipality of Pililla particularly in Brgy. Malaya (host barangay), which are expected to benefit from the employment, business opportunities, taxes and other potential socio-economic contributions of the project.

Figure 1-1: General Vicinity Map of the Proposed Project

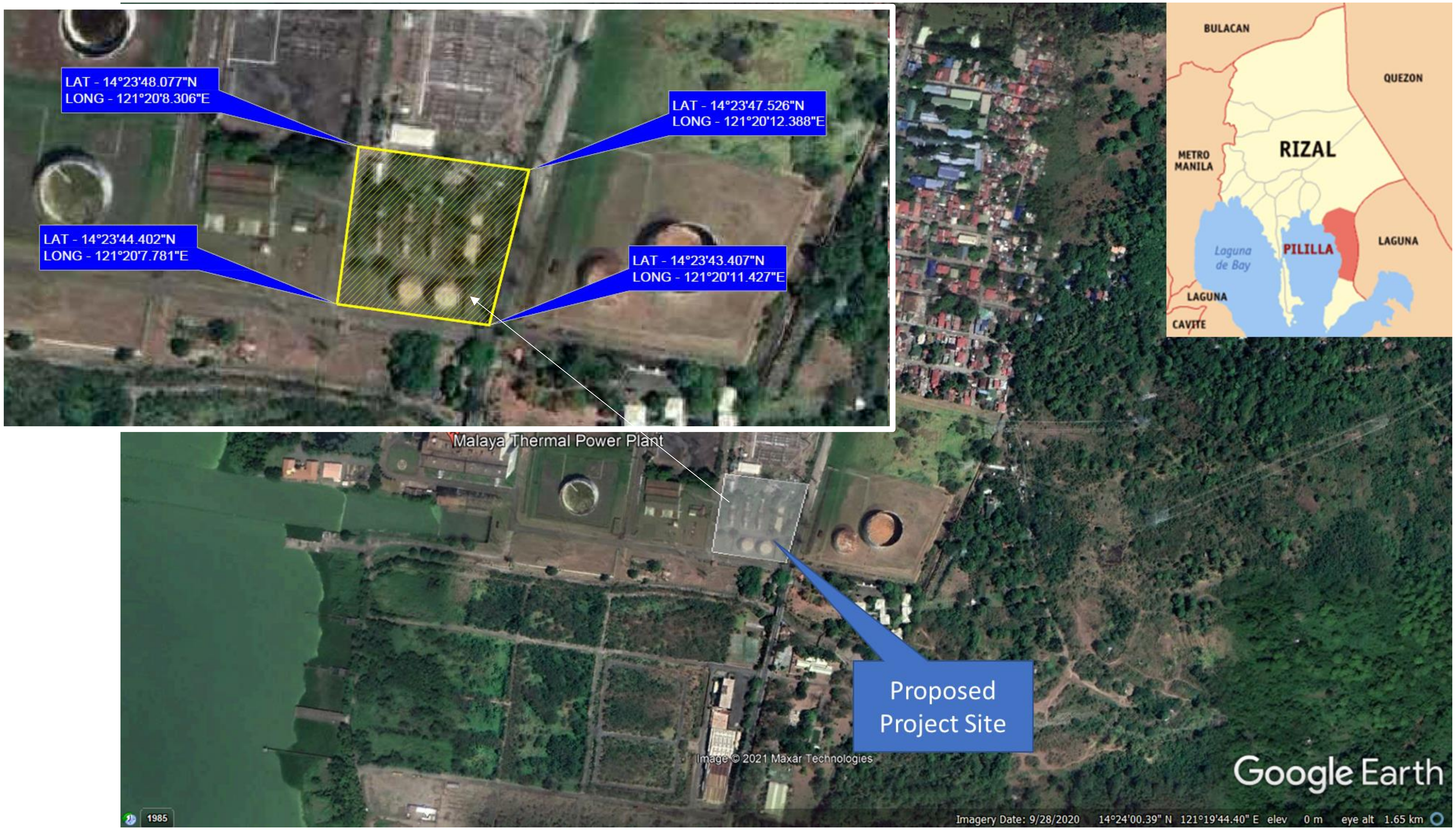

FIGURE TITLE:
GENERAL VICINITY MAP OF THE PROPOSED PROJECT

PROJECT PROPONENT:	PROJECT TITLE & LOCATION:	EIA REPORT PREPARER:
BELGROVE POWER CORPORATION	**60 MW Gas Turbine Power Plant** Brgy. Malaya, Pililla, Rizal	LCI ENVI CORPORATION

Figure 1-2: Accessibility to the Proposed Project Site

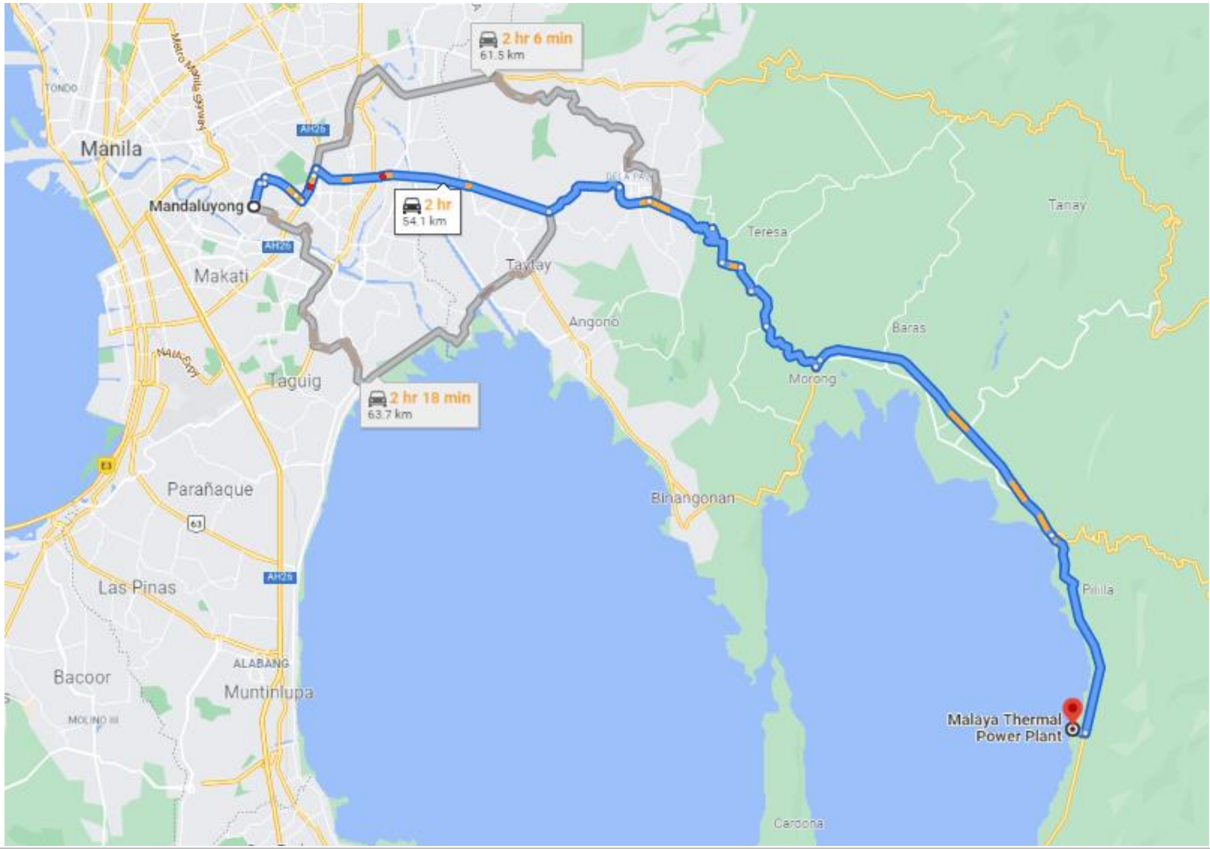

FIGURE TITLE:

ACCESSIBILITY TO THE PROPOSED PROJECT SITE

PROJECT PROPONENT:	PROJECT TITLE & LOCATION:	EIA REPORT PREPARER:
BELGROVE POWER CORPORATION	**60 MW Gas Turbine Power Plant** Brgy. Malaya, Pililla, Rizal	LCI ENVI CORPORATION

Figure 1-3: Direct and Indirect Impact Areas of the Proposed Project

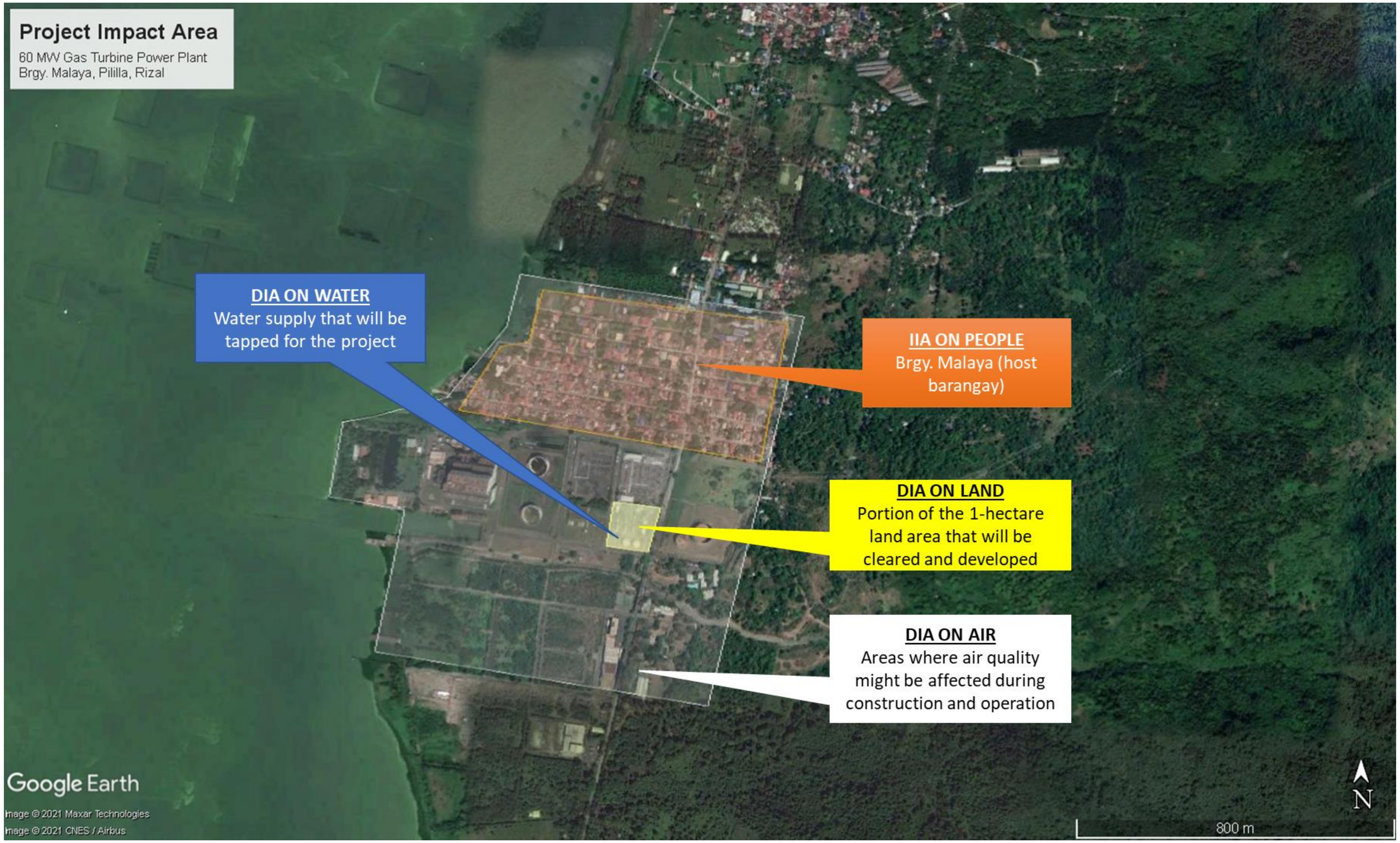

FIGURE TITLE: **DIRECT AND INDIRECT IMPACT AREAS OF THE PROPOSED PROJECT**		
PROJECT PROPONENT: **BELGROVE POWER CORPORATION**	PROJECT TITLE & LOCATION: **60 MW Gas Turbine Power Plant** Brgy. Malaya, Pililla, Rizal	EIA REPORT PREPARER: LCI ENVI CORPORATION

1.2 PROJECT RATIONALE

7 To ensure the reliability, quality, and security of supply of electric power in the country, the Department of Energy (DOE) recommended to the National Grid Corporation of the Philippines (NGCP) to secure ancillary services (AS). In 2019, the DOE released a department circular entitled "Adopting a General Framework Governing the Provision and Utilization of Ancillary Services in the Grid" with reference no. DC2019-12-0018. The circular provides the policy or guidelines relevant to the utilization of AS in the country. The Energy Regulatory Commission (ERC) also had drafted the Ancillary Services Procurement Plan of the country to inform the electric power industries on the procedures and requirements of the NGCP for the procurement of AS.

8 The project purpose is intended for peaking and ancillary services. In general, ancillary services are essential to sustaining the transmission capacity and maintaining the power quality, reliability, and security of the grid. Sudden fluctuations in the frequency and the voltage of the transmission system are typically brought about by the intermittent operations of renewable energy plants, unplanned outages of conventional power plants, as well as the daily operational cycle of large power consumers.

9 The project will serve as a source of ancillary service (i.e., primary, secondary, and tertiary reserves) for the Luzon grid and power quality improvement for distribution utilities to help ease the frequency and voltage problems.

1.3 PROJECT ALTERNATIVES

1.3.1 Site Selection

10 Technical, environmental, and land use considerations were taken in the selection of the site for the proposed project. The absence of critical habitats within the project site and its proximity to possible tapping point were some of the main factors that contributed to its selection. No other sites were considered for the proposed project.

1.3.2 Technology Selection/Resources

11 **BPC** intends to use Aeroderivative gas turbines have the highest availability of any thermal power technology. An aeroderivative gas turbine can be replaced in a power plant, such as a utility or power plant, within a few days for a major inspection, which translates to higher availability 98.2% as compared to power generated by reciprocating engines, which average 93% availability.
The following were considered in the technology selection:

- **High availability:** Aeroderivative gas turbines have the highest availability of any thermal power technology. An aeroderivative gas turbine can be replaced in a power plant, such as a utility or power plant, within a few days for a major inspection, which translates to higher availability—98.2% as compared to power generated by reciprocating engines, which average 93% availability.
- **Diverse fuel options:** Ability to operate on a wide spectrum of fuels—including natural gas, LPG (propane and butane), isopentane, ethanol, diesel, and Coke Oven gas—aeroderivative gas turbines can allow power customers to switch between fuels to save money, all without stopping, and without a reduction in power.

- **Fast installation:** Small and modular, aeroderivative engines can be transported, installed and commissioned in as little as 3 months, as compared to 12 – 18 months for reciprocating engines. They can be installed outdoors with minimal foundation requirements, making them an advantageous energy solution for any region across Africa that needs fast, clean, reliable power.
- **Fast response rate:** Aeroderivative gas turbines technology feature a power turbine and high-pressure shaft that work together to respond quickly to grid frequency fluctuations, helping create a more stable and reliable grid than that of reciprocating engines.
- **Lower emissions:** Equipped with best-in-class combustion systems, aeroderivative gas turbines can offer 15 or 25 ppm NOx without needing SCRs (selective catalytic reduction) or the use of ammonia.

12 Aeroderivative gas turbines derived from advanced aviation technology can provide reliable power that is cleaner, cheaper, and provides better grid stability than that produced by reciprocating engines, enabling grid operators to support greater penetration of renewable energy to the grid.

13 The following points are detailed in this document:

- Fast start & cyclic operation: Aeroderivative gas turbines can be started and loaded up to full load within five minutes from cold iron, with no maintenance penalty for daily start/stop operation.
- Grid stability & frequency control: By delivering excellent grid stability and frequency control for power generators and consumers, aeroderivative gas turbines help avoid blackouts and result in lower maintenance costs associated with grid-connected equipment
- Seamless renewables integration: While the high penetration of renewable power—such as wind or solar—greatly reduces grid stability, aeroderivative turbines provide the excellent frequency stability required to support the use of more renewables on the grid.
- Reliability & availability: Based on aviation technology, aeroderivative turbines provide reliable operation, with a fleet average reliability well above 99% and fleet average availability above 98%, with very few maintenance stops required.
- Emissions: Advanced combustion technology emits four times lower NOx and as much as 150 times lower methane emissions (a greenhouse gas up to 86 times1 more impactful than carbon dioxide) than reciprocating engines.
- Fuel flexibility: Aeroderivative turbines can operate seamlessly running on 100% natural gas to 100% propane, diesel or other fuels without the need for pilot fuels, increasing operational security and lowering fuel costs.
- Operational flexibility: In multi-unit configuration, aeroderivative turbines provide excellent operational flexibility. The highest efficiency gains are achieved when the power plant avoids part load operations by starting or stopping units as necessary to follow the grid load during its daily cycles.
- Lower operations & maintenance costs: A typical aeroderivative gas turbine requires up to 85 times less maintenance time during its life cycle compared to reciprocating engines. With fewer maintenance events needed, aeroderivative turbines offer much higher availability than reciprocating engines, lowering the cost of capital for available generating equipment. In addition, by reducing maintenance requirements, the operation team can be as much as four times smaller than for an equivalent reciprocating plant.

- Smaller footprint: With higher power density and a smaller number of turbines required, an aeroderivative simple cycle plant has a significantly smaller footprint than a reciprocating plant, which can lead to significant capital cost savings.

1.4 PROJECT COMPONENTS

14 The major components as well as the auxiliary facilities and pollution control devices for the proposed project are summarized in **Table 1-2**.

Table 1-2: Project Components

COMPONENT	DESCRIPTION/SPECIFICATION	AREA ALLOCATION
MAIN PROJECT COMPONENTS		
Aeroderivative Gas Turbine Generator	2 x 30MW unit complete with Gas Turbine, Generator, Switchgear and ancillaries.	4,000 sqm
AUXILIARY FACILITIES		
Interconnection Facilities	Composes of 230kV Transformer, Substation and Transmission Line connection.	1,000 sqm
Diesel Fuel Storage Tank	2 x 2,000,000 liters capacity for 9~10 days continuous operation.	1,600 sqm
Fuel Receiving & Supply System	Compose of pumps for receiving and supply of fuel to Gas Turbine	30 sqm

1.5 PROCESS/TECHNOLOGY

1.5.1 Aeroderivative Gas Turbine Generator (TM2500)

1.5.1.1 Gas Turbine Equipment

15 The LM2500 Gas Turbine Engine is the prime mover of the TM2500 MGTG set. This engine is a two-shaft design, with the Gas Generator section of the engine creating the aerodynamic thrust to rotate the Power Turbine, which then drives the coupled load. This design allows the Power Turbine to operate at a continuous speed of either 3000 rpm (50-Hz applications) or 3600 rpm (60-Hz applications), by varying gas generator speed; thereby eliminating the need for a speed reducing gearbox.

16 The main components of the Gas Turbine consist of the high-pressure/high-speed Gas Generator (GG) section, and low-pressure/low-speed Power Turbine (PT) section, which together are what is considered the complete Gas Turbine.

17 The Gas Turbine (GT) comes fully assembled with the following major components:

- Inlet Duct & Center-body (Bellmouth & Bullet-nose)
- Compressor Front Frame (CFF)
    - Accessory Gearbox (AGB)
        - AGB-driven Lube & Scavenge Pump (for TLO)
        - AGB-driven Variable Geometry (VG) Pump (for VSV's)
        - AGB-driven Hydraulic Starter & Clutch (for Starting/Cranking)
        - Transfer Gearbox (TGB)
    - Inlet Gearbox (IGB)
    - Radial Drive Shaft (connects IGB to AGB)

- High Pressure Compressor (HPC)
    - Variable Stator Vanes (VSV's)
- Compressor Rear Frame (CRF)
    - Combustor (internal), Fuel Manifolds, Fuel Nozzles
- High Pressure Turbine (HPT)
- Turbine Mid Frame (TMF)
- Power Turbine (PT)
- Turbine Rear Frame (TRF)

18 Torque developed aerodynamically in the Power Turbine (driven by hot exhaust gases rather than a mechanical connection) is transferred to the rotor of the alternating current (AC) generator through a flexible-diaphragm coupling, which is connected to the Rear Drive Adapter of the Power Turbine.

- Inlet Duct & Center-body (Bellmouth & Bullet-nose)

  The air inlet section consists of the Inlet Duct & Center-body, which are bolted to the forward flanges of the Compressor Front Frame. During operation, the inlet directs airflow into the Compressor Front Frame, which provides a smooth, non-turbulent airflow into the compressor. The Inlet Duct is fitted the Water Wash Manifold for injecting liquid cleaning solutions into the compressor. The inlet duct and center body are made of aluminum. HPC Stage 0 Inlet Guide Vanes (IGV) and Variable Stator Vanes control inlet airflow through the engine for any given core speed.

- Compressor Front Frame (CFF)

  Four integral frames are used on the engine to support the rotor. This produces excellent rotor stability and precise control of blade tip clearance. The integral frames include the Compressor Front Frame (CFF), Compressor Rear Frame (CRF), Turbine Mid Frame (TMF) and Turbine Rear Frame (TRF).

  The CFF assembly forms a flow path for compressor inlet air. The CFF supports the front bearing, inlet duct, compressor casing, and inlet gearbox, and also provides a location for the GG front mounts. The CFF also houses the #3 roller bearing.

    - Accessory Gearbox (AGB)

      Engine starting, lubrication, and speed monitoring of the compressor rotor are all accomplished by accessories mounted on the Accessory Gearbox (AGB). The AGB works in conjunction with the Inlet Gearbox (IGB) located in the hub of the Front Frame, the Radial Drive Shaft inside the 6 o'clock strut of the Front Frame, and the Transfer Gearbox (TGB) bolted to the forward end of the AGB. The Hydraulic Starter and the Lube and Scavenge Pump are mounted on the aft side of the AGB. The Air/Oil Separator and the VG Pump are mounted on the forward side of the AGB. Two gas generator speed sensors are also located on the AGB, which detect engine speed by monitoring gear rotation frequency.

    - Inlet Gearbox (IGB)

      Power to drive accessories is extracted from the compressor rotor through a large diameter hollow shaft, which is spline-connected to the turbine rotor. A set of bevel gears in the IGB transfers power to the Radial Drive Shaft, which transmits the power to another set of bevel gears in the TGB. A short horizontal drive shaft transmits the power to the AGB. Internal gears drive various accessory adapters in the AGB.

When the engine is being started/cranked, the IGB is being driven by the AGB. Conversely, when the engine is under self-power, the AGB is then being driven by the IGB.

- High Pressure Compressor (HPC)

The HPC is a 17-stage (Stage 0 IGV + 16 Stages), high-pressure ratio, axial flow design. Major components of the HPC are:

a) High Pressure Compressor Rotor (HPCR)
b) High Pressure Compressor Stator (HPCS)

The primary purpose of the compressor section is to compress air for combustion; however, some of the air is extracted for engine cooling and Customer use.

Air, taken in through the Front Frame, passes through successive stages of rotor blades and stator vanes, and is compressed further as it passes from stage to stage. After passing through 17 stages, the air has been compressed to a ratio as high as 24:1. The Inlet Guide Vanes (Stage 0) and the first 7 stages of stator vanes are variable; their angular position is changed as a function of compressor inlet temperature (CIT) and compressor speed. This provides stall-free operation of the compressor throughout a wide range of speed and inlet temperatures.

- High Pressure Compressor Rotor (HPCR)

  The HPCR is a spool-and-disk bolted joint structure. The rotor is supported at the forward end by a roller bearing in the CFF, and the aft end of the rotor is supported by a roller bearing in the CRF. Close clearances are obtained with a metal spray rub coating. Thin squealer tips on the blades and vanes contact the sprayed material. Abrasive action on the tips prevents excessive rub while obtaining minimum clearance.

- High Pressure Compressor Stator (HPCS)

  The HPCS consists of two forward casing halves and two aft casing halves, each split horizontally and bolted together. They house variable and fixed vanes, and provide a structural shell between the CFF and the CRF. Inlet Guide Vanes (IGV's) and Stages 1 through 7 are variable (Variable Stator Vanes). Their angular positions change as a function of turbine temperature and speed. This gives the vane airfoil the optimum angle of attack for efficient operation without compressor stall.

- Compressor Rear Frame (CRF)

The CRF internally houses the Combustor, and consists of an outer case, struts, hub, and the B-sump housing. Its outer case supports the Fuel Nozzles and Igniters. The CRF, in conjunction with the combustor cowl assembly, serves as a diffuser and distributor of compressor discharge air to the combustor. The CRF houses the #4 Ball Bearing and #4 Roller Bearing.

- Single Annular Combustor (SAC)

The Combustor is a single annular design (as opposed to a DLE) and consists of four major components riveted together: Cowl (Diffuser) assembly, Dome, Inner Liner, and Outer Liner. Thirty vortex-inducing axial Swirl Cups in the Dome (one at each fuel nozzle tip) provide flame stabilization and mixing of the fuel and air. The interior surface of the dome is protected from the high temperature of combustion by a cooling-air film.

Combustor liners are a series of overlapping rings joined by resistance-welded and brazed joints. They are protected from the high combustion heat by circumferential film-cooling. Primary combustion and cooling air enters through closely spaced holes in each ring. These holes help to center the flame and admit the balance of the combustion air. Dilution holes are employed on the outer and inner liners for additional mixing to lower the gas temperature at the turbine inlet. Combustor/turbine nozzle air seals at the aft end of the liners prevent excessive air leakage while providing for thermal growth.

- High Pressure Turbine (HPT)

The HPT is an air-cooled, two stage turbine, which uses the thrust created by combustion to drive the gas generator section of the engine. The High Pressure Turbine section consists of:

a) High Pressure Turbine Rotor (HPTR) - The HPTR extracts energy from the exhaust gas to drive the HPCR, to which it is mechanically coupled.
b) 1st Stage Nozzle - The Stage 1 HPT Nozzle directs high pressure gases from the combustion section onto stage 1 turbine blades at the optimum angle and velocity.
c) 2nd Stage Nozzle - The Stage 2 HPT nozzle directs the high pressure gases exiting from the Stage 1 turbine blades onto the Stage 2 blades at the optimum angle and velocity.

- Turbine Mid-Frame (TMF)

The Turbine Mid-Frame supports the aft end of the High-Pressure Turbine Rotor and the forward end of the Power Turbine rotor. The frame diffuser provides a smooth flow path for air flowing into the Power Turbine.

The TMF also houses the #5 roller bearing which supports the aft end of the HPT Rotor and the #6 roller bearing which supports the forward end of the Power Turbine rotor.

Power Turbine/Low Pressure Turbine (PT/LPT)

The Power Turbine (a.k.a. Low Pressure Turbine) consists of two casing halves split horizontally, stages 2 through 6 turbine nozzles, and six stages of blade shrouds. The following components make up the PT.

a) Low Pressure Turbine Rotor (LPTR) - The LPT Rotor is a 6-stage low pressure turbine rotor, and consists of six disks, each having two integral spacers. Each disk spacer is attached to the adjacent disk spacer by close-fitting bolts. Blades of all six stages contain interlocking tip shrouds for low vibration, and are retained in the disks by dovetails. The LPT Rotor maintains a speed of 3000 RPM for 50 Hz applications and 3600 RPM for 60 Hz applications.
b) Low Pressure Turbine Stator (LPTS) - The LPT Stator consists of two casing halves split horizontally, including turbine nozzles and blade shrouds.

- Turbine Rear Frame (TRF)

  The TRF consists of an outer casing, eight radial struts, and a stainless-steel hub. It forms the PT exhaust flow path and supports the aft end of the PT stator case. It also provides a mounting point for the outer cone of the exhaust system and GT rear supports. The struts contain service lines for lubrication and sump scavenging and venting. The TRF houses the #7 ball and #7 roller bearings.

- Exhaust System

  The Exhaust Diffuser provides a direct path from the Turbine Rear Frame exhaust flange and consists of an inner and outer duct (liner and tunnel), forming a diffusing passage into the Exhaust Collector. Combustion exhaust then flows through the Exhaust Collector and roof mounted Exhaust Silencer Stack, and exits the enclosure vertically.

  A high-speed flexible coupling shaft connects the low-pressure turbine/power turbine to generator. It consists of a forward adapter which mates with the power turbine, two flexible couplings, a distance piece, and an aft adapter which mates with the generator.

- Flexible Coupling

  A high-speed flexible coupling shaft connects the Low-Pressure Turbine/Power Turbine to the driven load (typically a generator). It consists of a forward adapter which mates with the Power Turbine Rear Drive Adapter, two flexible couplings, a distance piece, and an aft adapter which mates with the connected load. The flexibility in the coupling allows for minor deviations in between the turbine and generator shafts this flexibility aids in successful connection between the turbine and the generator.

1.5.1.2 AC Generator

19 The TM2500 MGTG set features an air-cooled generator, which is a two-bearing machine, equipped with a Brushless Rotating Exciter, Flying Bridge Array, and a brushless Permanent Magnet Generator (PMG) on the non-drive end. The rotor is supported by two split-sleeve bearings lubricated by a pressurized mineral oil system.

20 The AC generator operates at a synchronous speed of 3600 rpm for 60Hz applications and 300 rpm for 50Hz applications and is capable of continuously supplying an output voltage of 13.8 kV, at a frequency of 60 Hz at a power factor (pf) of 0.9 (90%), or 11.5 kV, at a frequency of 50 Hz at a power factor (pf) of 0.9 (90%).

- Generator Excitation and Regulation

  The generator excitation system provides the power required to ramp the generator output voltage up to the rated level during unit startup, and to maintain the voltage at the desired level during fluctuating load conditions. For detailed design information, operation data, and drawings, refer to the vendor documentation provided in this manual. The excitation system equipment is described below, and the function of each component is briefly described in the following paragraphs.

  The generator excitation system contains the following components and descriptions that follow:

  a) Permanent Magnet Generator (PMG) – mounted on the generator
  b) EX2100e Automatic Voltage Regulator-mounted in the GCP

c) Brushless Rotary Exciter – mounted on the generator
d) Rotating Rectifier Assembly – mounted on the generator rotor
e) Excitation Mode Switch
f) Generator Rotor and Stationary Output Winding
g) Generator-Output Switching and Automatic Synchronization

- Generator Protective Relay

  The Generator Protective Relay System is a microprocessor-based design used to provide protection, control, and monitoring of the AC generator, switchgear, and high-voltage bus network. The Integrated Generator Protection System (IGPS) is installed in the Generator Control Panel (GCP).

1.5.1.3 SAC Dual Fuel System with Water Injection

21 The LM2500 gas turbine has a fuel delivery system that is designed to start and run on either Liquid (Naphtha) Fuel or Natural Gas Fuel. This Dual Fuel System is also fitted with a Water Injection System for NOx suppression. Customer-supplied fuels and water are utilized for injection into the turbine's Single Annular (SAC) Combustor via Primary and Secondary Fuel Manifolds and Dual Fuel Nozzles. A Flow Splitter distributes liquid fuel to the left and right sides of the Primary and Secondary Manifolds.

22 All the water introduced for NOx suppression (regardless of gas or liquid fuel) is injected through the Liquid Fuel Secondary circuit.

- Liquid Fuel System

  The Liquid Fuel System includes the Liquid Fuel Boost Pump (MOT-2022) and Duplex Filters, and is mounted on the Turbine Trailer, with piping to the turbine enclosure. Fuel flow is then regulated by the Fuel Metering Valves, before passing into the turbine Combustor via the Primary and Secondary Liquid Fuel circuits and Dual Fuel Nozzles.

- Gas Fuel System

  The Gas Fuel System contains piping, valves, and a gas manifold connected to 30 fuel nozzles, and control and monitoring instrumentation. The Gas Fuel System requires Customer-provided gas fuel, pre-filtered to 5µ or less, with a Beta Ratio of β 200 minimum, at 520psig (±20psig).

- Water Injection System

  To control the amounts of oxides of nitrogen (NOx) emitted by the gas turbine engine during normal operation, demineralized water is injected into the combustor section of the gas turbine through the 30 fuel nozzles.

  Water scheduling for NOx abatement is usually based on measured exhaust NOx level. The approximate water flow required to achieve required NOx can be estimated from the performance computer program as a function of fuel flow, for each fuel. The actual amount of water flow required may vary ±20% of the estimated values.

1.5.1.4 Generator Lube Oil System

23 The Generator Lube Oil (GLO) System uses mineral oil to lubricate, cool, and clean the generator journal and thrust bearings. To prevent damage, the generator bearings must be lubricated when

in operation (rotor shaft turning). Lubricating oil must be supplied to the bearing assemblies during startups, at operational speeds, and while the unit is coasting to a stop after shutdown.

24 The generator bearings are pressure-lubricated, the bearing faces are grooved for even oil distribution and the drive-end bearing incorporates thrust pads to limit fore-and-aft movement of the generator rotor. Labyrinth seals and oil slingers are mounted on the generator rotor shaft to prevent oil leakage from the bearing housings. At operational speeds, the bearings are lubricated by oil from a pump-mounted outboard from the assembly and driven by the generator rotor. At startups and shutdowns, lubricating oil is provided by a DC motor auxiliary pump, which also serves as a backup in case of shaft pump failure.

25 To ensure that these lubrication requirements are met under all conditions, the GLO system has two types of lube oil pumps, a 125 VDC pump, and a generator shaft-driven pump.

1.5.1.5 Auxiliary Instrumentation System

26 Auxiliary Instrumentation is designed to monitor and protect the engine and generator during all operational conditions. Instruments monitor a wide variety of parameters, including pressure, temperature, vibration and speed. These instruments are constantly communicating to the Control System, when values go out of the required range (either low or high), the Control System automatically alerts the Operator of the problem or automatically shuts the equipment down if necessary.

1.5.1.6 Control System

27 The MGTG set is operated through use of an electronic Control System. This system is comprised of computerized control subsystems. The microprocessors and digital logic circuitry in these subsystems provide the speed and autonomy of operation required for safe and efficient operational control. The heart of the Control System is the GE Intelligent Platforms RX3i Programmable Logic Controller. Most of the operator interaction with the system will be via the Human/Machine Interface (HMI) on the GE supplied computer. When the MGTG is operated at site, the Operator will normally operate the MGTG set via the HMI (Local Mode), and on occasion (usually for maintenance purposes) the Operator can perform certain functions via the GCP (Local Mode).

28 The Control System manages all critical operations of the TM2500 MGTG set including all individual turbine-generator system monitoring and operating indicators, controls, and transmitters. The TCP and GCP house the majority of the Control System equipment, and additional modules are located in the MGTB. From the GCP, the Operator can initiate the turbine-generator’s automatic startup, fuel management, load assumption, and system operation. Critical parameters are constantly monitored from the Control System in the TCP and alarms, or shutdowns are initiated automatically, as appropriate, for out-of-tolerance conditions. Automatic fuel control and turbine sequencing are controlled by the Control System software and hardware. Operator interfaces, such as the HMI and local control switches on the GCP allow personnel to monitor and control the MGTG. Please refer to the drawings in the specific section of this manual to review the system components in further detail.

1.5.1.7 Fire and Gas Detection System

29 The Fire & Gas Detection System monitors the turbine enclosure for the presence of fire, and also for any accumulation of combustible gas. Aerosol is used as the fire-extinguishing agent. The Fire & Gas Detection System consists of an Eagle Quantum programmable microprocessor-controlled

panel that receives inputs from Thermal Spot Detectors, Combustible Gas Detectors, and Manual Release Stations. The panel is located in the GCP (Generator Control Panel).

1.5.1.8 Hydraulic Start System

30 The Hydraulic Start System hydraulically cranks the engine rotor at the necessary speeds for starting, purging, water washing, and conducting maintenance. Once the engine is under self-sustaining combustion, the system will disengage until needed. The Hydraulic Start System components are located mainly on the Auxiliary Skid and inside the Turbine Enclosure.

31 The Auxiliary Skid houses a shared TLO/Hydraulic Start Oil Reservoir (THO), and shared Fin/Fan air-cooled Heat Exchanger. Also on the Auxiliary Skid is the AC-powered Electro-Hydraulic Starter Motor, which drives the pump assembly, consisting of the Charge Pump, Filter, Main Pump, and variable SOV-actuated valve. The external portion of the system provides the pressurized hydraulic fluid to the engine mounted Hydraulic Start Motor and Clutch inside the turbine enclosure and delivers the required pressure to crank the engine. Hydraulic pressure rotates the starter, which engages the clutch and provides sufficient torque for starting the engine. Local gauges allow the Operator to monitor the system pressures and fluid levels.

1.5.1.9 Low Voltage AC & DC System

- AC System

The TM2500 has a dual-rated 480/400VAC system that provides power to the MCC. Inside the Control Trailer there is an additional dual-rated step-down transformer that provides 230/133VAC to the Lighting & Distribution Panel located in the MCC. The MCC provides power to a variety of electrical motors and components, such as fans, motors, igniters, and pumps. Refer to your unit’s electrical diagrams.

- DC System

Separate Battery and Battery Charger Systems furnish DC power for MGTG set operation. A 24 VDC System provides backup power for the Control System, and another provides backup power for the Fire and Gas Detection System. A 125-VDC system provides backup power for the Switchgear and DC Lube Oil Pumps.

Batteries are stored on battery racks in a battery enclosure of the Control Trailer. This separate area of the control house is ventilated to provide adequate air circulation in the battery enclosure.

1.5.1.10 Trailer System

32 The TM2500 MGTG set is a Trailer-Mounted, Mobile Gas Turbine Generator package. The trailer system allows for simplified transportation and set up of the package. When installed with all landing gear lowered, the trailers act as the foundation for the GTG set. There are three trailers used for the TM2500:

- Turbine Trailer - The main deck of the Turbine Trailer contains an inlet silencing system for the turbine and the turbine module. Located on the gooseneck of the trailer is the Auxiliary Skid, which contains the TCP (Turbine Control Panel) and turbine auxiliary equipment. When the package is fully installed, the Turbine Trailer is fitted with the Air Filter Modules, Exhaust Silencer Stack, and Ventilation Fan for the turbine enclosure.
- Generator Trailer - The main deck of the Generator Trailer contains the Generator, Generator Lube Oil System, Switch Gear, and Lube Oil Heat Exchanger. The gooseneck of the

Generator Trailer may be optionally removed in operational configurations to reduce overall footprint.

- Control Trailer - The Control Trailer contains the Control House, which houses the GCP (Generator Control Panel) and the MCC (Motor Control Center). Additionally, an externally accessed room is provided for the system batteries.

1.5.1.11 Turbine Lube Oil System

33 The Turbine Lube Oil System provides clean, cool oil to lubricate the engine, and to provide pressurized oil for operation of the Variable Geometry (VG) actuators. The entire system is driven by the engine's onboard Lube & Scavenge Pump, mounted on the Accessory Gearbox (AGB), and is pressurized whenever the engine is rotating. The TLO and Hydraulic Start Systems share the same (THO) Reservoir. There is also an external portion of the system mounted on the Auxiliary Skid to filter, cool, and deaerate the oil discharged from the internal portion of the system.

1.5.1.12 Ventilation and Combustion Air System

34 The Ventilation & Combustion Air (VCA) System filters and manages the air to cool and ventilate the turbine enclosure and generator, and the air used for combustion in the turbine. The turbine requires up to 168,000 scfm (4757 scmm) of filtered air for combustion, and 35,000 scfm (992 scmm) of filtered air for cooling and ventilating the enclosure.

35 The generator is equipped with a separate ventilation system that includes inlet filters, exhaust silencer, and pressure and temperature sensors. The generator rotor is equipped with fan blades to produce a flow of cooling air through the interior of the generator. The blades draw cool, filtered ambient air into the generator and circulate it around internal parts before expelling the now heated air through the generator exhaust vent.

1.5.1.13 Water Wash System

36 Over time, gas turbines experience a loss of performance due to contaminant deposits on internal components. This loss is indicated by a decrease in power output and an increase in heat rate. These deposits result from the ingestion of air that contains dirt, dust, and hydrocarbon fumes. A large portion of these contaminants is removed by inlet air filtration, but contaminants that pass through the filters then are deposited into the compressor and must be removed by water washing. Optimal turbine performance is then achieved by periodically cleaning the compressor.

37 During the washing operation, a water wash solution (a water and cleaning agent mix) is sprayed into the gas turbine at the proper pressure, temperature, and flow rate to wash the compressor. The wash is followed by a rinse cycle, which is designed to remove cleaning agent residue. Water Washing can be only performed while the unit is offline.

38 Off-line water wash is accomplished by spraying cleaning solution into the bell mouth while the engine is being motored by the starter. After a short wait to allow the engine to soak, the compressor is rinsed with water and allowed to dry. Off-line Water Wash will usually restore compressor performance.

1.5.2 Interconnection Facility

39 In order, to connect to the grid, the project will install a Gas Turbine 230kV substation and will be connected to existing National Grid Corporation of the Philippines (NGCP) Malaya Substation which is about 50~100 meters away.

1.5.3 Fuel Receiving and Supply System

40 Fuel shall be delivered either by truck or by barge via existing wharf receiving facility.

1.5.4 Diesel Fuel Storage Tank

41 Facility shall have 2 sets of diesel fuel storage with a capacity of about 2,000,000 liters each tank and has an inventory level of about 9~10 days of continuous operations.

1.5.5 Wharf Facility (Existing Facility)

42 The existing wharf receiving facility shall be used during barge delivery of fuel.

1.5.6 Demineralized Water Supply

43 Demineralized water requirement shall be sourced from the existing Malaya Thermal plant and hauled by truck and transfer to a demineralized water storage tank.

1.5.7 Wastewater Treatment

44 Wastewater from the facility shall be treated in a wastewater treatment facility before discharging to Laguna Lake.

Figure 1-4: Site Development Plan of the Proposed Project

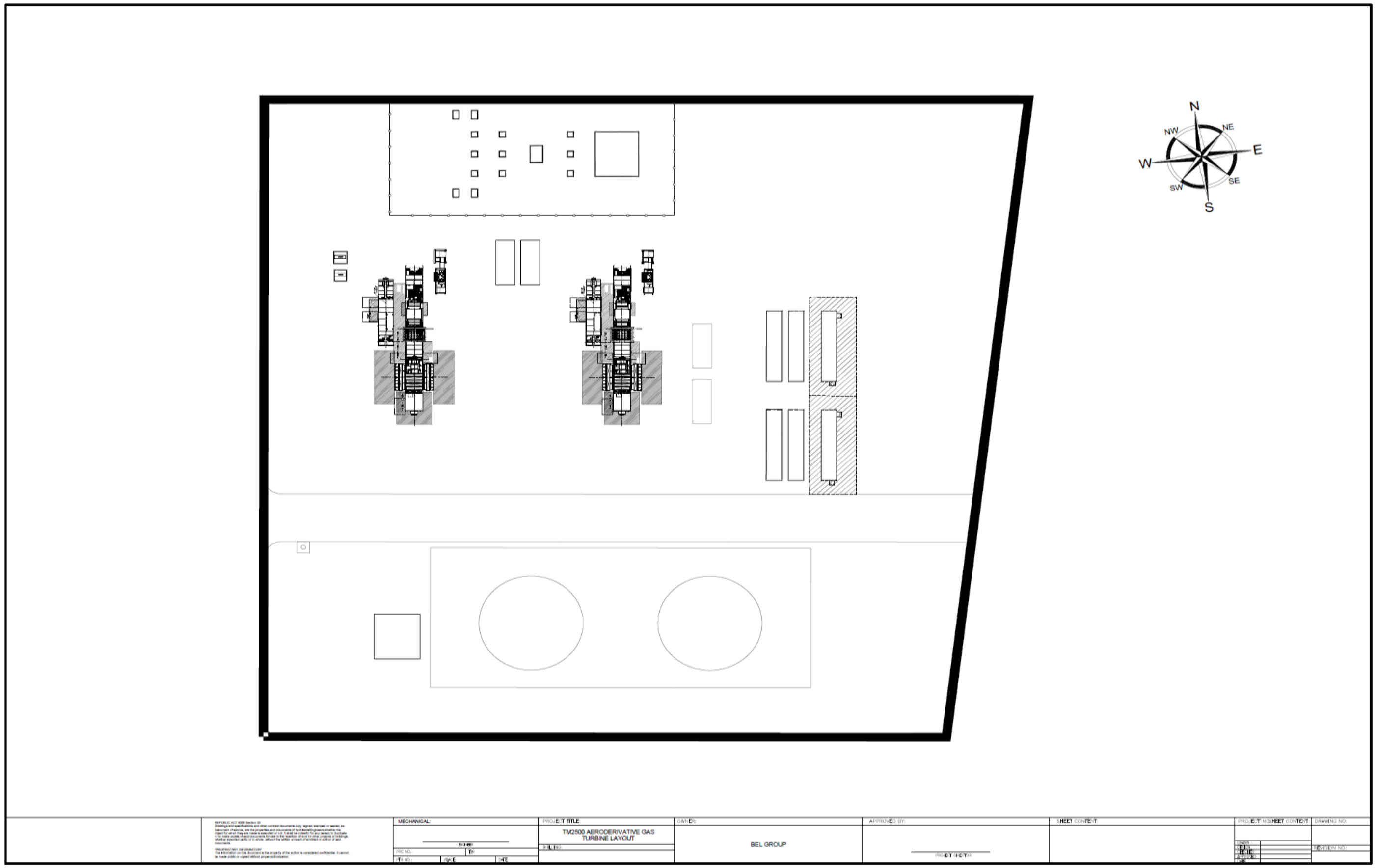

FIGURE TITLE:

SITE DEVELOPMENT PLAN OF THE PROPOSED PROJECT

PROJECT PROPONENT:	PROJECT TITLE & LOCATION:	EIA REPORT PREPARER:
BELGROVE POWER CORPORATION	**60 MW Gas Turbine Power Plant** Brgy. Malaya, Pililla, Rizal	LCI ENVI CORPORATION

1.6 PROJECT SIZE

45 The total maximum capacity of the proposed gas turbine power plant is 60 megawatts.

1.7 DEVELOPMENT PLAN, DESCRIPTION OF PROJECT PHASES, AND CORRESPONDING TIMEFRAMES

1.7.1 Pre-construction

46 This phase of the project includes preliminary site investigations as well as acquisition of necessary permits and clearances prior to project construction. The existing non-operating turbines will be dismantled and will be disposed in accordance with the applicable environmental guidelines.

1.7.2 Construction

47 The construction phase includes earthworks and civil works, procurement, and installation of power plant facilities and equipment. Welfare of workers must be insured during this phase through the implementation of appropriate occupational health and safety procedures.

48 Delivery of construction materials and equipment, as well as the power plant facilities will be through the major thoroughfares.

1.7.3 Operation

49 The operation of the proposed gas turbine power plant is expected to be 12/7 at 60MW capacity for 365 days per year.

50 Delivery of fuel shall be via truck or by barge using the existing wharf receiving facility inside the Malaya Thermal Plant.

1.7.4 Decommissioning/Abandonment/Rehabilitation

51 The proposed project is not expected to be abandoned in the next 25-30 years. However, ceasing of the power plant operations may be necessary due to the following potential scenarios:

- Unsustainable business operations due to economic downturns;
- Changes in zoning and other related ordinances of the Municipality of Pililla;
- Transfer of operations to other sites;
- Accidents and emergencies (either natural or man-made) resulting to severe facility damage and/or loss of human life; and
- Closure order from government agencies.

52 In the unlikely event of abandonment, **BPC** will initiate an Abandonment, Decommissioning, and Rehabilitation Plan.

1.8 PROJECT TIMELINE

53 **Table 1-3** shows the indicative project timeline. As shown in the table, the construction of the proposed project will start by June 2022 (upon securing ECC) while the target commercial operation is in December 2022.

Table 1-3: Indicative Project Timeline

Activity / Milestone	2021			2022												2023		
	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M
Pre-engineering works & ECC Application			■	■	■	■	■	■										
Detailed Engineering						■	■	■										
Construction (Civil work: Site Development, foundation etc..)								■	■	■	■	■						
Installation of Equipment													■					
Start-up & Commissioning														■				
Commerical Operation															■			

1.9 MANPOWER

54 **Table 1-4** summarizes the manpower requirements throughout the development phases of the proposed project. As shown, around 50~100 workers will be employed for the construction phase of the project, and an estimate of 10~20 personnel will be hired to oversee the entire operation and maintenance of the project. The proponent shall prioritize to hire local workers whose skills and experience match the specific needs of the project.

Table 1-4: Manpower Requirements per Project Phase

PROJECT PHASE	ESTIMATED MANPOWER REQUIREMENT	TASKS TO BE PERFORMED	SKILLS REQUIREMENT
Construction	50~100	• Perform civil, architectural, and electro-mechanical works	Engineers, project managers, skilled and non-skilled laborers
Operation	10~20	• Oversee the entire operations of the proposed project, including emergency situations; Ensuring the safety and welfare of its personnel • Maintain conformity of the proposed project to relevant government regulations, including tax payments, ECC compliance, etc. • Promote and uphold a harmonious relationship with the host community	Management and administration skills; over-all knowledge on the operation including key environmental, labor, and local ordinances
Abandonment	10	Implement the abandonment plan	As required

1.10 PROJECT COST

55 The indicative project cost for the proposed power plant is estimated at PhP3.80Billion that will include the following:

- Detailed engineering studies and designs, including the acquisition of necessary government permits and licenses;
- Site preparation/development;
- Construction of the power plant and support facilities;
- Procurement of necessary equipment and materials;
- Environmental management and protection, air pollution devices and water treatment facilities; and
- Environmental monitoring activities

1.11 PRELIMINARY IDENTIFICATION OF KEY ENVIRONMENTAL IMPACTS

56 To address the potential environmental impacts of the proposed project, an environmental management plan (EMP) will be prepared. The EMP presents the proposed mitigation and/or enhancement measures that can be employed during the different phases of the project development. The initial key environmental impacts identified, and the corresponding mitigating measures are presented in **Table 1-5**.

Table 1-5: Initial Environmental Management Plan

Environmental Component	Environmental Impacts	Management and Mitigating Measures
LAND	Accumulation of construction debris and other solid wastes during construction and operation	• Implementation of the solid waste management program by the contractor • Regularly transport of construction debris and other solid waste in the approved designated area by the DENR
	Generation hazardous wastes (used oil, busted bulbs)	• Implementation of hazardous waste management plan • Segregation of hazardous materials by waste type • Storage of wastes stored in sealed and labeled containers • Wastes are treated and disposed by DENR-EMB accredited transporters, haulers and treaters)
	Possible damage of nearby properties due to ground vibration during construction works	• Apply non-vibration and/or vibration-avoiding techniques during construction, if possible • Notify nearby residents about use of heavy equipment • Regularly monitor vibrations • For hauling trucks, comply with road weight limit standards to avoid ground vibration
WATER	Possible clogging of drainage due to siltation during construction	• Regularly remove silt and sediments • Establishment of siltation ponds, silt traps and erosion barriers
	Generation of domestic wastewater from construction and operation	• Follow basic housekeeping policies • Provision of sanitation facilities (i.e. portable toilets, showers, etc.)
	Possible water contamination due to oil spills/leakage during operation of the existing wharf facility	• Implementation of Oil Spill Management Plan • Proper handling and storage of fuel oil • Provision of oil spill kits
	Degradation of groundwater and surface water due to accidental oil leakages during operation	• Installation of oil and water separator tanks • Implementation of Oil Spill Management Plan • Possible installation of safety features for fuel storage tanks, such as, but not limited to, spill prevention and detection, bund wall, and secondary containment

Environmental Component	Environmental Impacts	Management and Mitigating Measures
AIR	Generation of dust during construction	• Minimization of unnecessary earth-movement • Regularly water construction sites that will generate dust • Avoid long exposure of excavated soil piles to strong winds by applying canvass covers
	Generation of air emissions & noise during construction	• Implementation of proper and regular maintenance of heavy equipment and vehicles • Perform noisy activities during daytime
	Generation of air emissions during operations	• Proper and regular maintenance of power plant engines • Regular ambient air and source emission monitoring • Possible installation of air pollution control devices
	Increase in ambient air noise during operations	• Possible incorporation of silencer in the engine system to reduce noise emissions • Maintenance of vegetation to serve as natural noise barriers
PEOPLE	Increased occupational safety and health risks during construction and operation	• All personnel are required to wear proper PPE • All civil and electro-mechanical works will be supervised by trained engineers • First-aid stations, safety equipment and signage shall be made available on working areas
	Generation of employment, taxes and additional income	• Prioritize hiring of qualified residents of the host communities • Prioritize purchasing of local items, if applicable, within the host communities
	Generation of traffic during construction	• Provision of early warning devices/road signs • Provision of parking spaces within project site • Implementation of Traffic Management Plan • Coordination with the concerned LGU offices

ANNEX 1
SITE PHOTOS

INGRID 150 MW Diesel Power Plant
Shell training center
Pililla-Jala-Jala-Pakil Rd
Proposed Project Site
Leading in Clean Initiatives
Taken on November 12, 2021

Brgy. Malaya
Proposed Project Site
Malaya Thermal Power Plant
Leading in Clean Initiatives
Taken on November 12, 2021


Laguna Lake
Brgy. Malaya
Proposed Project Site
Leading in Clean Initiatives.
Taken on November 12, 2021