Environmental and Social Impact Assessment Report (ESIA) – Part 6

Project Number: 51112-001
August 2018

INO: Jawa-1 LNG to Power Project

Prepared by ERM for PT Jawa Satu Power (JSP)

PLTGU Jawa 1 Independent Power Project

ANNEX E
ACOUSTICS ASSESSMENTS

Prepared for:

PT Jawa Satu Power (JSP)

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EXECUTIVE SUMMARY

Environmental Resources Management Australia Pty Ltd (ERM) on behalf of PT Jawa Satu Power (JSP) has completed a acoustics assessment for the PLTGU Jawa-1 project (the project).

The project involves the development of a Combined Cycle Gas Turbine (CCGT) power plant, a Liquefied Natural Gas (LNG) floating storage and Regasification Unit (FSRU), a 500kV power transmission line and substation.

These project elements will be developed within the Karawang, Bekasi and Subang Regencies of West Java, Indonesia.

Overview

Nuisance, or an unacceptable level of noise (and vibration) amenity, may arise due to construction and operational activities associated with new or existing developments. This potential for issues to arise is associated with air-borne, ground-borne and underwater emissions from significant project noise and vibration generating sources that are in close proximity to potentially sensitive human and wildlife receptors i.e. nearby dwellings, schools, churches, commercial/industrial facilities, or sea life near off-shore assets.

The assessment was conducted to achieve a scope of works that addressed these potential noise and vibration issues by evaluating, predicting and assessing construction and operational noise and vibration from the project (offshore, nearshore and onshore components) at the closest and/or potentially most affected sensitive receptors near the project site.

A qualitative assessment has been conducted for project noise and vibration components that have limited or no potential to generate any impacts at nearby receptors, whilst a quantitative assessment has been conducted for other components where a potential for impacts to occur has been identified. The focus of the quantitative assessment was air-borne construction and operational noise associated with the Jetty (piling), CCGT power plant (including piling and road traffic), the 500 kV transmission line and substation.

Findings

Based on the qualitative assessment documented in Chapter 2 of this report, potential construction (including road traffic) air-borne noise and ground-borne vibration impacts to human receptors and underwater noise impacts to wildlife receptors were identified.

On this basis, a construction noise assessment was completed as per Chapter 6 and recommended mitigation, management measures, safeguards and provisions provided in Chapter 8 of this report to target significant emission generating works and activities, for the various components associated with the project, that are proposed to occur within and near the project site.

The operational CCGT power plant, transmission line and substation results presented in Chapter 7 of this report identify that the predicted project noise levels are generally below project-specific noise criteria adopted for this assessment.

Evaluating the predicted noise levels with regard to the project-specific noise criteria and the method described in Section 5.1.2 of this report, identifies that predicted noise levels are not expected to exceed the adopted criteria. On this basis compliant noise levels are anticipated. Suitable safeguards and provisions are however provided in Chapter 8 of this report.

Residual Impacts and Closing

Construction and operational noise and vibration levels may be reduced and impacts (if any) minimised with the successful implementation of the recommended mitigation, management measures, safeguards and provisions provided in Chapter 8 of this report.

Impacts may not be reduced to negligible or minor levels for all receptors and for all project components and phases; however the recommendations presented here will assist ensure that any residual impacts are minimised as far as may be practically achievable.

No further recommendations for mitigation and management measures to those established by the findings of this acoustics (noise and vibration) assessment, and documented in this report, are provided or considered warranted, at this stage and unless significant construction and/or operational design changes occur.

JSP should however remain aware of the potential for nuisance, or an unacceptable level of amenity, to occur due to construction or operational noise and vibration and continue to plan for and then manage the works and design accordingly.

1 INTRODUCTION

This report has been prepared by Environmental Resources Management Australia Pty Ltd (ERM) on behalf of PT Jawa Satu Power (JSP). It presents the methodology, results and findings of the acoustics assessment (the assessment) conducted for the PLTGU Jawa-1 project (the project).

The project involves the development of a Combined Cycle Gas Turbine (CCGT) power plant, a Liquefied Natural Gas (LNG) floating storage and Regasification Unit (FSRU), a 500kV power transmission line and substation.

These project elements will be developed within the Karawang, Bekasi and Subang Regencies of West Java, Indonesia.

1.1 BACKGROUND

Nuisance, or an unacceptable level of noise (and vibration) amenity, may arise due to construction and operational activities associated with new or existing developments. This potential for issues to arise is associated with air-borne, ground-borne and underwater emissions from significant project noise and vibration generating sources that are in close proximity to potentially sensitive human and wildlife receptors i.e. nearby dwellings, schools, churches, commercial/industrial facilities, or sea life near off-shore assets.

The purpose of this assessment is to address these potential issues by evaluating, predicting and assessing construction and operational noise and vibration from the project (offshore, nearshore and onshore components) at the closest and/or potentially most affected sensitive receptors near to the project site.

A qualitative assessment has been conducted for project noise and vibration components that have limited or no potential to generate any significant impacts at nearby receptors, whilst a quantitative assessment has been conducted for other components where a potential for impacts to occur has been identified.

A consolidated summary of all acoustical factors and project phases that have been considered in this report is provided below:

- Air-borne noise and ground-borne vibration associated with the projects construction.
- Air-borne noise and ground-borne vibration associated with road traffic during the projects construction.
- Air-borne noise and ground-borne vibration associated with the projects operation.

- Air-borne noise and ground-borne vibration associated with road traffic during the projects operation.

The acoustical factors above have the most potential to impact on-shore human receptors, which is the focus of this assessment. Construction underwater noise impacts to wildlife receptors could also occur due to significant emission generating works and activities, for the various off-shore project components and phases, hence information regarding these project elements and potential impacts is also provided in this report.

This report has been prepared to present the methodology and findings of the assessment; provide an evaluation of potential project impacts; identify potential mitigation and/or management measures, that may be required to reduce emissions and minimise impacts at nearby sensitive receptors; provide recommendations for further acoustics assessment and/or additional mitigation, management measures and/or monitoring contingencies (if warranted); and then highlight any residual issues and impacts associated with project's noise and vibration.

1.2 PROJECT OVERVIEW

As noted above the project involves the development of a CCGT power plant, a LNG floating storage, FSRU, a 500kV power transmission line and a substation.

Further information regarding these project components is provided below:

- **Floating Storage and Regasification Unit (FSRU)** - an FSRU with a nominal capacity of 86,400 DWT will be permanently moored offshore at a distance of 4.79 nautical miles off the north Ciasem Bay coast. The FSRU will receive LNG deliveries from BP Tangguh via Tankers with capacities of 125,000 m^3 to 155,000 m^3. The FSRU will be equipped with facilities to regassify the LNG for delivery to an **Onshore Receiving Facility (ORF)**.

- **Gas Delivery Pipelines –** a subsea gas pipeline of approximately 14 km will be required to deliver gas to shore. An onshore pipeline of approximately seven kilometres will deliver gas to the ORF.

- **Seawater Water Intake** and **Cooling Water Outfall Discharge Pipeline –** a sea water intake pipeline and pump station will be established close to shore front while a cooling water discharge pipeline will also be established.

- **Jetty –** a Jetty will be built to support mobilisation of heavy equipment and material. The jetty will be constructed at Muara Village, approximately 1.34 kilometres from the mouth of the Cilamaya River. After the construction is complete the jetty will remain to support emergency operations and CCGT maintenance. The Jetty will occupy an area of 500 m^2 (50 m x 10 m). Dredging is expected to be carried out during construction.

- **1,760 MW CCGT power plant –** the CCGT power plant will occupy an area of approximately 36.7 Hectares. This will house the gas turbine buildings, cooling towers and associated facilities and infrastructure. Construction of the CCGT power plant will require a range of construction works including the installation of approximately 7,700 concrete piles.

- **Onshore Receiving Facility –** an onshore receiving facility will be developed to treat gas prior delivery to the Gas Turbines within CCGT power plant.

- **Construction and Access Road –** the construction road is a temporary road which will be used for the mobilisation of pipelines as well as the mobile heavy vehicles i.e. backhoes, excavators etc. An access road will be constructed between the equipment jetty and the power plant. An access road will be six metres in width and has one metre slope on both sides.

- **500 kV Transmission Line –** a 52.16 kilometre transmission line will be developed to transfer electricity from the power plant to the Cibatu Baru II/ Sukatani substation.

- **Cibatu Baru II/Sukatani Substation –** a 500kV substation will be developed to connect the 500kV transmission line to the Java-Bali grid.

Of particular importance to this acoustics assessment is the construction and operation of the CCGT power plant (including its access road during construction) and operation 500kV transmission line, as they are expected to generate noise with the most potential to impact nearby receptors, if suitable mitigation and/or management measures are not successfully implemented.

Other project components have some potential to generate impacts at nearby receptors , however the CCGT power plant and 500kV transmission line present the most significant project risk as applicable to noise impacts. An evaluation of all potential noise and vibration impacts is detailed in *Chapter 2* of this report, with a brief summary of the anticipated noise-generating activities associated with the operation of the CCGT power plant and 500kV transmission line provided below.

1.2.1 CCGT Power Plant

The 1,760 MW CCGT power plant will be developed on a 36.7 ha or 367 m^2 parcel of land located in Cilamaya Village, Cilamaya Wetan District and Karawang Regency. Cilamaya Village is located next to the site with some residences sharing a boundary with the site, which may pose an issue in regards to noise and nearby affected landowners.

The power plant complex will consist of five main buildings supported by other infrastructure, including the ORF, two turbine buildings, Heat Recovery Steam Generator (HRSG), Control and Electrical building (CEB), Cooling Towers, administration building and a workshop/warehouse building.

Anticipated noise-generating components associated with the operation of the CCGT power plant include:

- ORFs which are used to receive and measure the amount of gas used by the power plant, and houses a pig receiver, gas filters, pressure letdown skid, metering packages, indirect fired water bath heater, vent stack and flow computer building.
- Steam Turbine, which includes a Condenser, Condensate System, Feedwater System and an array of Air and Gas Systems.
- Cooling of the CCGT power plant through the use of indirect wet cooling system, using seawater cooling towers.
- Operation and maintenance of the Seawater Supply System and associated infrastructure (seawater intake structure and pumping stations), and Water Treatment and Waste Water Treatment Plants.

The most significant construction and operational noise emission sources are discussed further for the CCGT power plant in *Chapter 3* and assessed for the construction phase in *Chapter 6* and for the operational phase in in *Chapter* 7 of this report.

1.2.2 500 kV Transmission Line

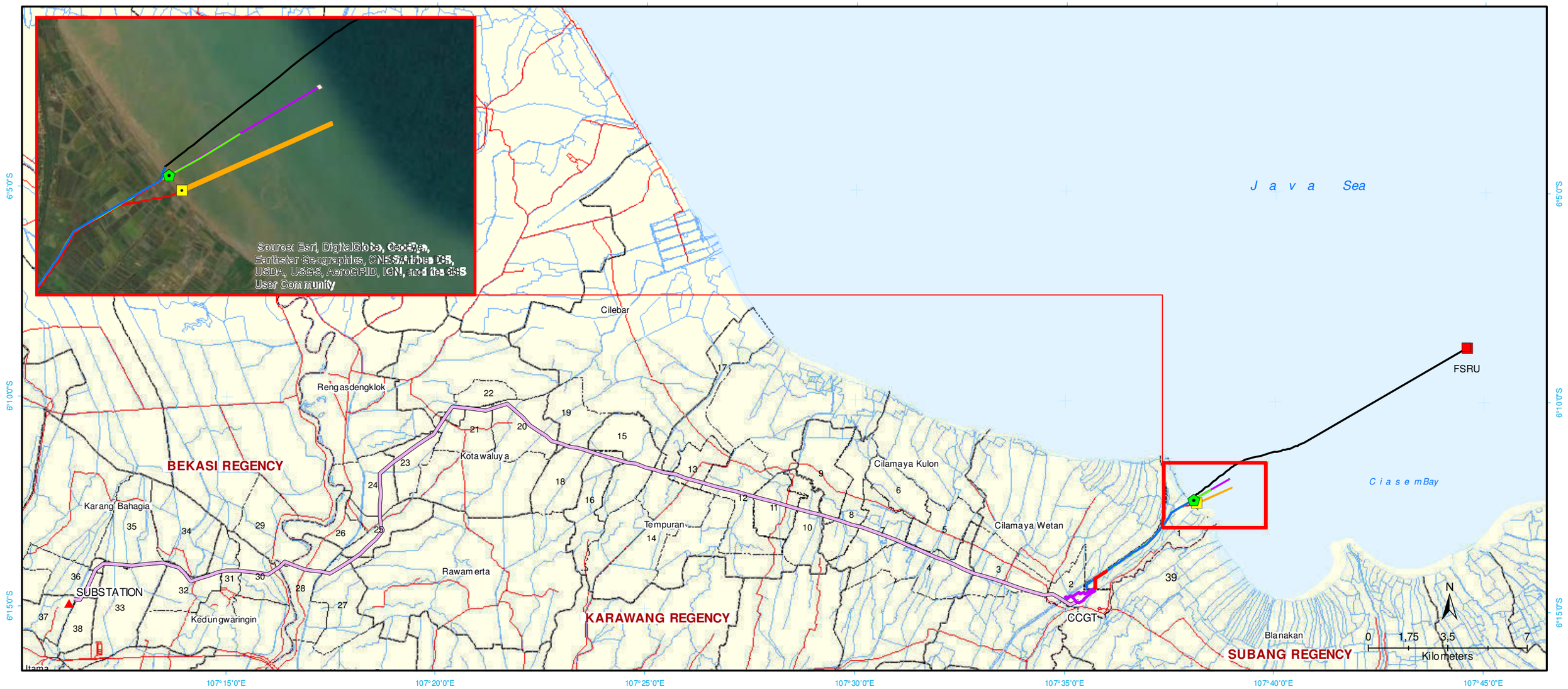
A 52.16 km 500kV transmission line will be established from the CCGT power plant in Cilamaya to Cibatu Baru II/Sukatani EHV Substation in Sukatani. The line will comprise 118 transmission towers with a transmission corridor of approximately 17 metres each side of the transmission lines established, as required by local regulation.

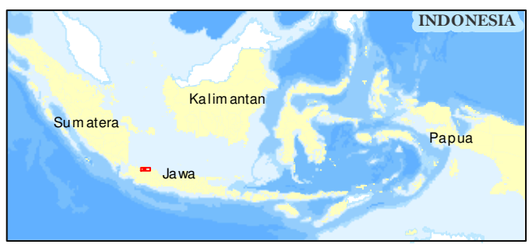
The line will run through two regencies; Karawang and Bekasi and will affect 35 villages. The proposed transmission line route crosses mainly areas of land used for agricultural purposes e.g. rice paddy fields etc.

The primary noise-generating activity associated with the operation of the transmission line is associated with corona noise which as discussed in *Chapter 3* and assessed in *Chapter 7* of this report.

1.3 SITE DESCRIPTION

The proposed project spans across sections of the Subang, Karawang and Bekasi Regencies of Western Java, approximately 100 kilometres east of Jakarta, Indonesia. The project, surrounding area and other items of importance to this assessment are identified in *Figure 1.1* to *Figure 1.3* below.





LEGEND

- Village Boundary
- District Boundary
- Regency Boundary
- Road
- River/Irrigation

Project Plan

- FSRU Loaction
- Jetty Location
- Pump Station
- Offshore Gas Pipeline from FSRU
- Discharge Pipeline
- Intake Pipeline
- Dredging Plan for Jetty Access
- Onshore Pipeline (Gas, Intake, and Outflow)
- Access Road to Pump Station and Jetty
- Transmission Line
- CCGT Power Plant

Impacted Village and Lcoation

Regency	District		Village
Karawang	Cilamaya Wetan	1.	Muara
		2.	Cilamaya
		3.	Suketani
	Cilamaya Kulon	4.	Sukamulya
		5.	Pasirukon
		6.	Muktijaya
		7.	Tegalurung
		8.	Manggungjaya
		9.	Sumurgeda
	Tempuran	10.	Jayanegara
		11.	Purwajaya
		12.	Pegadungan
		13.	Pancakarya
		14.	Lemahduhur
		15.	Lemahkarya
		16.	Dayeuhluhur
		17.	Tanjungjaya
	Rawamerta	18.	Sukaraja
	Cilebar	19.	Sukaratu

Regency	District		Village
Karawang	Kutawaluya	20.	Sindangsari
		21.	Sampalan
		22.	Waluya
		23.	Mulyajaya
	Rengasdengklok	24.	Karyasari
		25.	Kalangsuria
		26.	Kalangsari
	Karawang Barat	27.	Mekarjati
		28.	Tunggakjati
Bekasi	Pebayuran	29.	Bantarjaya
	Kedungwaringin	30.	Karangmekar
		31.	Mekarjaya
		32.	Karangharum
	Cikarang Timur	33.	Karangsari
	Karang Bahagia	34.	Karangmukti
		35.	Karangsatu
		36.	Karangrahayu
	Cikarang Utara	37.	Karangraharja
		38.	Waluya
Subang	Blanakan	39.	Blanakan

Source:
- Jawa Satu Power, 2017
- Administgration Map of Bekasi Regency, Government ofBekasi Regency 2011
- Indonesia Topographical Map Sheet1209-631 Cilamaya, First Edition, 1990
- Indonesia Topographical Map Sheet1209-542 Purwajaya, First Edition, 1990
- Indonesia Topographical Map Sheet1209-541 Rengasdengklok First Edition, 1999
- Indonesia Topographical Map Sheet1209-532 Sukatani, First Edition, 2001
- Indonesia Topographical Map Sheet1209-514 Cikarang, First Edition, 2000
- Indonesia Topographical Map Sheet209-523 Karawang,First Edition,1999
- Indonesia Topographical Map Sheet1209-524 Lemahabang, First Edition, 1999
- Indonesia Topographical Map Sheet1209-613 Jatisari, First Edition,1999

JAWA SATU POWER

Environmental and Social Impact Assessment (ESIA) for Jawa-1 Project

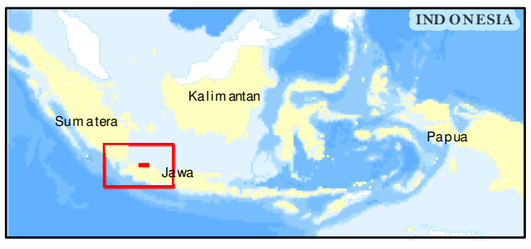
Figure 1.1
Project Location

ERM	Drawn By : IF & IA	Client :	Jawa Satu Power
	Checked By : FF	Date :	13/03/2018
	Revision :	Map Number :	

785000
786000
787000
788000
9310 000
9309 000
6°14'30"S
6°15'0"S
107°34'30"E
107°35'0"E
107°35'30"E
107°36'0"E
107°36'30"E

N-5
R4
NCA 4
N-4
R3
NCA 3
R2
NCA 2
N-1
N-3
R5
NCA 5
N-2
R1
NCA 1
R6
NCA 6

N
0 0,1 0,2 0,4
Kilometers



LEGEND

- Arterial Road
- River/Irigation
- Distict Boundary
- Regency Boundary

Project Plan

- Onshore Pipeline (Gas, Intake, and Outflow)
- Access Road to Pump Station and Jetty
- Transmission Line
- CCGT Power Plant
- Nearest Receiver

Sampling Point

- Samsung Noise Monitoring Location
- ESIA Noise Monitoring Location

Source:
- ESRI Online Imagery,2017
- Jawa Satu Power,2017

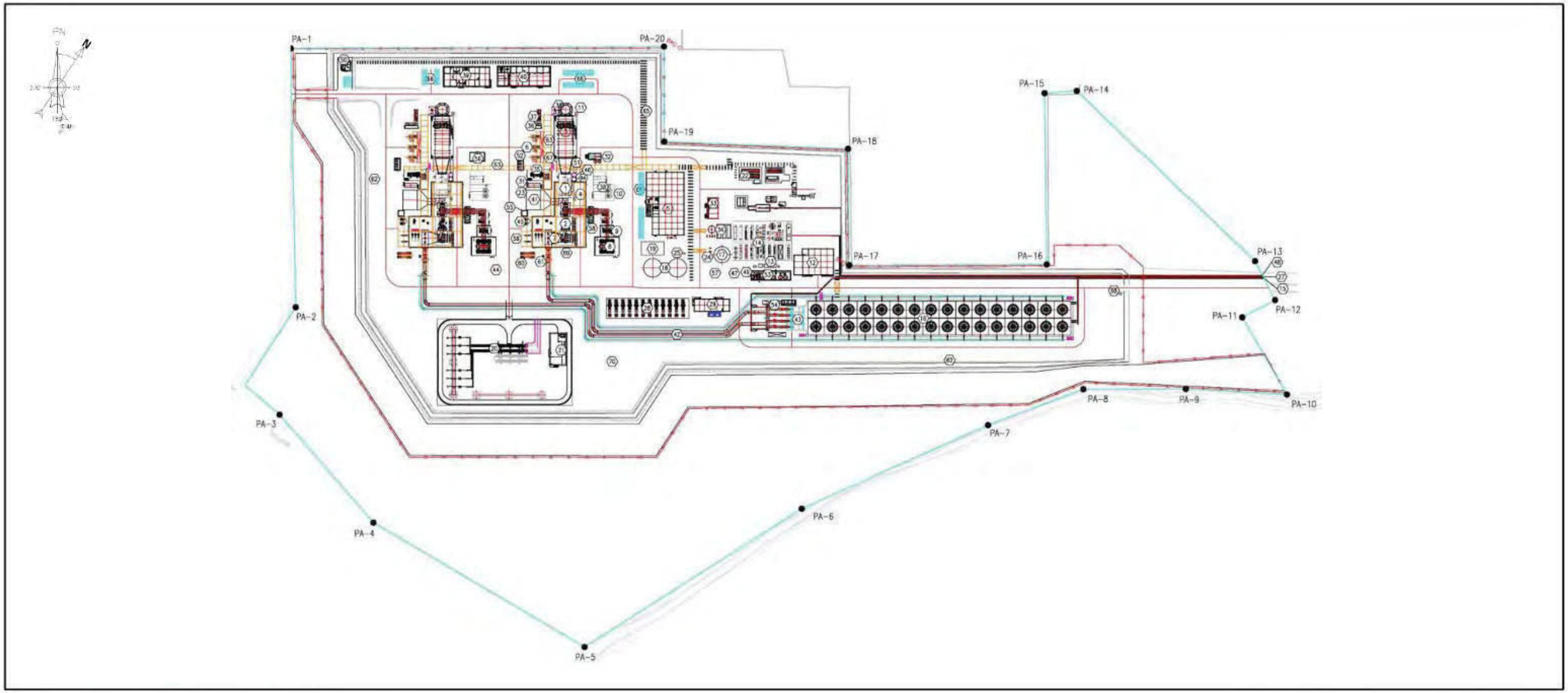
JAWA SATU POWER

Environmental and Social Impact Assessment (ESIA) for Jawa-1 Project

Figure 1.2
CCGT Power Plant
Noise Catchment Areas (NCA) and Receptors

ERM

Drawn By : IA	Client : Jawa Satu Power
Checked By : NL	Date : 13/03/2018
Revision :	Map Number :



LEGEND

JAWA SATU POWER

Environmental and Social Impact Assessment (ESIA) for Jawa-1 Project

Figure 1.3
CCGT Power Plant General Arrangement

Drawn By :	IA	Client :	Jawa Satu Power
Checked By :	NL	Date :	09/02/2018
Revision :		Map Number :	

ERM

1.4 ASSESSMENT OVERVIEW

This chapter summarises the methodology adopted to assess potential noise and vibration impacts associated with the project (offshore, nearshore and onshore components), at nearby receptors.

A qualitative assessment of project components and potential impacts is provided in *Chapter 2* of this report, for project components and phases where limited or no potential to generate impacts at nearby potentially sensitive receptors is anticipated, or where further assessment is not warranted at this stage as their impacts are readily mitigated or managed via standard industry practices.

Chapter 2 also presents the justification of the quantitative operational noise assessment for significant emission generating sources, such as the CCGT power plant facility and the 500 kV transmission line. Further information regarding these quantitative assessments is provided in *Chapter 3* below.

1.4.1 Key Features

The scope of this assessment is limited to the supplied project information and designs and was completed based on the information available at the time the assessment was conducted. The assessment includes consideration of the following features:

- Construction (including road traffic) air-borne noise and ground-borne vibration impacts to human receptors from significant emission generating works and activities, for the various on-shore components and phases associated with the development, that are proposed to occur within and near the project site.

- Construction underwater noise impacts to wildlife receptors from significant emission generating works and activities, for the various off-shore components and phases associated with the development, that are proposed to occur within and near the project site[1].

- Operational air-borne noise and ground-borne vibration impacts to human receptors from significant emission generating activities, for the various on-shore components and phases associated with the development (i.e. significant fixed infrastructure assets such as the CCGT power plant and the transmission line) that are proposed to occur within and near the project site.

[1] This acoustical feature is being assessed in more detail by other specialists but given its association with the potential project noise, has been evaluated in this assessment with conceptual recommendations being provided.

1.4.2 Scope Of Works

To achieve the assessment summarised in *Section 2.1* above the following scope of works was required:

- Reviewing existing relevant information and data to identify significant noise and vibration generating machinery and equipment that are being used, or activities undertaken, as part of the projects construction and operation.

- Identifying the closest and/or potentially most affected human (onshore) and wildlife (offshore) receptors situated within the potential area of influence of the project.

- Describing and quantifying (where possible) the existing acoustics environment and general noise conditions near the human and wildlife receptors identified above.

- Establishing project-specific noise and vibration criteria, with regards to the existing project design thresholds/limits (where available).

- Providing a quantitative construction and operational noise assessment by establishing project-specific noise models to predict levels from significant emission generating infrastructure, such as the Jetty, CCGT power plant, substation and the transmission line.

- Providing a comparison of the predicted levels to the project-specific noise criteria to identify project components and associated emissions that are likely to exceed criteria, and therefore, have potential to generate impacts at nearby potentially sensitive receptors.

- Providing a qualitative assessment of construction and operational noise and vibration generating project components and associated emissions that are unlikely to exceed criteria and have limited or no potential to generate impacts at nearby potentially sensitive receptors.

- Developing mitigation and management measures that are designed to reduce noise and vibration levels to acceptable or compliant values and estimating their effect. These measures are provided as recommendations, safeguards and provisions for construction and operational noise and vibration mitigation and management measures in this report. They are intended for consideration and implementation by JSP.

- Evaluating the magnitude and extent of potential residual impacts associated with the project's construction and operation. Then, providing recommendations for further acoustics assessment e.g. during detailed design and/or additional monitoring e.g. post construction, where the potential residual impacts warrant it.

It is beyond the scope of this assessment to evaluate whether the noise and vibration mitigation, management measures and/or monitoring options are feasible, reasonable or practical to implement at the project.

All recommendations, safeguards and provisions have been established and documented here to provide guidance and information regarding the projects potential compliance with the relevant criteria, limits and thresholds presented in this report.

1.4.3 Relevant Documents, Policy And Standards

This assessment has been conducted with due regard to the following documents, policy and standards:

- British Standards Institution (BSI, United Kingdom) – BS 6472 - *Guide to Evaluation of Human Exposure to Vibration in Buildings (1 Hz to 80 Hz)* (BS 6472), dated 1992.
- British Standards Institution (BSI, United Kingdom) – BS 5228 - *Code of Practice for Noise and Vibration Control on Construction and Open Sites* , Part 2: Vibration (BS 5228:2), dated 2009.
- Department of Environment and Conservation NSW (DECC, Australia) – *Assessing Vibration: a Technical Guideline* (DECC Guideline, 2006), dated February 2006.
- German Institute for Standardisation (GIS, Germany) – DIN 4150 Part 3: *Structural Vibration: Effects of Vibration on Structures* (DIN 4150:3), dated February 1999.
- International Organisation for Standardisation (ISO) 9613-2:1996 (ISO 9613:2) - *Acoustics - Attenuation of Sound during Propagation Outdoors - Part 2: General Method of Calculation*.
- Joint Nature Conservation Committee (JNCC) - *Annex A - Guidelines for Minimising the Risk of Disturbance and Injury to Marine Mammals from Seismic Surveys* (JNCC Annex A: Guideline, 2009), dated June 2009.
- Joint Nature Conservation Committee (JNCC) - *Guidelines for Minimising the Risk of Injury to Marine Mammals from Geophysical Surveys* (JNCC Guideline, 2017), dated August 2017.
- World Bank Group: International Finance Corporation (IFC) - *Environmental, Health, and Safety Guidelines for Thermal Power Plants* (IFC Thermal Power Plants Guideline, 2017), draft for second public consultation, dated May/June 2017.
- World Bank Group: International Finance Corporation (IFC) - *Environmental, Health and Safety (EHS) Guidelines - General EHS Guidelines: Environmental Noise Management*, Section 1.7 Noise (IFC 1.7 Noise), dated 30 April 2007.

- World Bank Group: International Finance Corporation (IFC) - *Environmental, Health, and Safety Guidelines for Electric Power Transmission and Distribution* (IFC Electrical Power Guideline, 2007), dated 30 April 2007.

1.5 ACOUSTICS GLOSSARY

A glossary of acoustical concepts and terminology as relevant to the assessment methodology described above and other acoustical features presented herein is provided in *Annex A* of this report.

2 EVALUATION OF POTENTIAL IMPACTS

The overall assessment features were summarised above in *Section 1.3* of this report. This chapter outlines an evaluation of all potential construction and operational noise and vibration sources and impacts for the various project components and activities.

This evaluation is a key feature of the assessment methodology established for a project of this scale and design and enables a focused assessment of the most significant issues with the potential to impact surrounding receptors or the broader community.

A qualitative assessment of select project components, phases and emissions is provided here where limited or no potential to generate impacts at nearby potentially sensitive receptors is anticipated, or where further assessment is not warranted at this stage as their impacts are readily mitigated or managed via standard industry practices.

Unless otherwise stated below, the plant, equipment and machinery, or activities undertaken, for the projects construction and operation may generate vibration that is perceptible in very close proximity to the source. However, potential annoyance/disturbance issues or cosmetic/structural damage is unlikely to occur at off-site receptors. This is due to the manner in which vibration dissipates rapidly with distance. Accordingly, the projects vibration generated during construction, including road traffic is expected to comply with the project-specific vibration criteria described in *Chapter 5* and summarised in *Table 5.9* of this report.

This chapter also presents the justification of the quantitative noise assessment approach for CCGT construction noise (include. road traffic), CCGT operational noise, operational substation noise and the 500 kV transmission line. Further information and technical methods regarding these quantitative assessments is provided in *Chapter 3* below.

2.1.1 Construction Noise and Vibration Impacts

An evaluation of likely construction (general works and activities, and road traffic) air-borne noise and ground-borne vibration impacts to human receptors has been conducted. An evaluation of likely construction underwater noise impacts to wildlife receptors was also completed.

General Construction (Onshore)

Based on the location, type and scale of construction works and activities that will be required for the onshore 1,760 MW CCGT power plant (including piling), noise impacts could occur if suitable mitigation and/or management measures are not implemented. Similarly, noise impacts could occur due to construction road traffic associated with the CCGT power plant, and other

project components requiring the transportation of staff, equipment, fill and other resources to the project via road.

Based on this evaluation of the potential magnitude and extent of impacts associated with these two key nearshore works and activities a quantitative assessment of their estimated emissions is provided in *Chapter 6* of this report. Recommendations for mitigation, management measures and/or monitoring contingencies are provided in *Chapter 8*, they are designed to reduce levels and minimise onshore noise impacts at nearby receptors.

Based on the location, type and scale of construction works and activities that will be required for a) the Onshore Receiving Facility, b) 500 kV Transmission Line, c) onshore gas delivery pipeline and d) Cibatu Baru II/Sukatani Substation, noise impacts are unlikely to occur. Noise emissions may be audible at times but they are not expected to be the dominant project (or ambient) noise source/s during their construction.

Furthermore, the total duration that these works will occur is limited when compared to that of other project components, for example the CCGT power plant. This is of particular importance with regard to the 52.16 km, 500 kV transmission line and onshore gas delivery pipeline where works will occur in a linear manner along the alignment of each component, meaning that emissions will occur at one location for a short period of time and then move away, along the alignment.

Based on the location, type and scale of construction works and activities that will be required for the a) onshore 1,760 MW CCGT power plant (including piling), b) Onshore Receiving Facility, c) 500 kV Transmission Line, d) onshore gas delivery pipeline and e) Cibatu Baru II/Sukatani Substation, vibration impacts (to human or building receptors) are unlikely to occur. Similarly, vibration impacts associated with construction road traffic are unlikely to occur.

Even though impact piling is proposed, the closest potentially sensitive structure is 90 metres from any proposed piling works, such that vibration levels are expected to be at or below 2 mm/s and compliant with the assessment criteria presented in *Section 5.2.2* of this report. Bulk earthworks are proposed within close proximity (< 10 metres) to nearby receptors however the plant, equipment and machinery that would typically be in use, or activities to be undertaken for bulk earthworks, are not considered a significant vibration generating source like that associated with impact piling.

Vibration may be perceptible at times but is not expected to be a significant and/or constant source or feature of the projects construction with the potential to annoy or impact nearby receptors/buildings. Furthermore, structural or cosmetic damage to nearby and potential sensitive structures is unlikely to occur as the plant, equipment and machinery, and or activities to be undertaken onshore, are do not represent significant vibration generating sources.

Based on the limited magnitude and extent of potential impacts associated with these select onshore works and activities no further assessment is warranted or provided herein. Regardless, potential safeguards and provisions, and monitoring contingencies including those that are commonly incorporated into good construction management practices, are provided in *Chapter 8* of this report.

General Construction (Nearshore)

Based on the location, type and scale of construction works and activities that will be required for the nearshore a) Seawater Water Intake, b) Cooling Water Outfall Discharge Pipeline and c) Jetty (including piling), it is unlikely that significant noise and vibration impacts would occur.

Despite the unlikely occurrence of impacts associated with the Jetty construction, a quantitative assessment of potential piling emissions has been conducted to demonstrate this projects component as piling is commonly recognised as a potential noise issue. Based on the limited magnitude and extent of potential impacts associated with Seawater Water Intake and Cooling Water Outfall Discharge Pipeline works and activities no further assessment is warranted or provided herein.

Potential safeguards and provisions, and monitoring contingencies including those that are commonly incorporated into good construction management practices, are provided in *Chapter 8* of this report.

General Construction (Offshore)

The evaluation of likely construction (e.g. piling) underwater noise impacts to wildlife receptors also identified a potential for issues to occur.

Based on the type of construction works and activities that will be required for the offshore a) Floating Storage and Regasification Unit (FSRU) and b) Gas Delivery Pipelines, it is likely that significant underwater noise impacts could occur that may warrant consideration of mitigation and management measures. This is limited however to significant underwater noise generating sources, such as piling, that would require specific measures to be implemented to minimise impacts to wildlife receptors. As noted earlier in this report, this acoustical feature is being assessed in more detail by other specialists

Given its association with the potential project noise, *Chapter 8* of this report presents recommended safeguard mitigation and management measures specific to this task that are commonly incorporated into good construction management practices. These recommended safeguards and provisions were derived with due regard to the JNCC Annex A: Guideline, 2009 and JNCC Guideline, 2017), dated August 2017.

2.1.2 Operational Noise and Vibration Impacts

An evaluation of likely operational air-borne noise and ground-borne vibration impacts to human receptors has been conducted. An evaluation of likely operational underwater noise impacts to wildlife receptors was also completed.

This General Operation (Onshore and Nearshore)

Based on the location, type and scale of operational activities proposed for the onshore a) 1,760 MW CCGT power plant, it is likely that significant noise impacts could occur that may warrant consideration of mitigation and management measures. To a lesser extent impacts warranting potential mitigation could occur for b) the 500 kV Transmission Line, and c) the Cibatu Baru II/Sukatani Substation. Unlike the statements made above for construction works and activities recommendations to reduce levels and minimise onshore impacts are best established via a quantitative (modelling) assessment. This modelling has been completed in detail for the CCGT power plant and then noise levels estimated at distance offsets for the 500 kV transmission line alignment and substation. These features are discussed in *Chapter 3* with results presented in *Chapter 7* this report.

A detailed assessment of operational vibration has not been conducted however based on a) the type of operational equipment that is required for the project and b) the distance offset to the closest and/or potentially most affected receptors, perceptible levels of vibration may be experienced. Specific recommendations for vibration mitigation and management measures are provided in *Chapter 8* of this report.

For the proposed operational activities associated with the nearshore a) Seawater Water Intake, b) Cooling Water Outfall Discharge Pipeline, c) Jetty, and d) Onshore Receiving Facility it is unlikely that significant noise and vibration impacts could occur that may warrant consideration of mitigation and management measures.

This is primarily due to significant influence of the key CCGT power plant operational activity noted above, or typical design measures that are implemented during detailed design of the project to ensure impacts are minimal, if any at all.

Operational Road Traffic (Onshore)

An evaluation of likely operational road traffic air-borne noise and ground-borne vibration impacts to human receptors identified that significant operational road traffic (noise and vibration) impacts from the project i.e. from vehicles on the access road are not anticipated.

Although project noise levels will be sometimes audible at receptors, the operational access road (constructed between the equipment jetty and the power plant) will have a limited number of vehicles generating minimal noise

emissions when compared to the overall site contribution from other site components. On this basis, significant operational road traffic (noise and vibration) impacts from the project are not anticipated and no further assessment is warranted or provided in this report.

General Operation (Offshore)

The evaluation of likely operational underwater noise impacts to wildlife receptors identified that significant issues are not anticipated to occur. This outcome is broadly based on the type of operational activities, plant, equipment and machinery that are proposed for the Project, and a general evaluation that they do not commonly cause underwater noise impacts.

This acoustical feature is however being assessed in more detail by other specialists and any recommendations by them for underwater noise mitigation and/or management measures (to reduce noise levels and minimise impacts) should be implemented.

3 ASSESSMENT METHODOLOGY

Based on the outcomes of the evaluation of impacts summarised in *Section 2* above, the key features of the quantitatively assessed acoustical feature and project components/phases are outlined in this chapter.

Information regarding the evaluation of impact significance with respect to the relevant local and international standards and guidelines for noise is provided in *Chapter 5* of this report, which also presents the project-specific assessment criteria.

3.1 CCGT CONSTRUCTION NOISE

Noise emissions from the CCGT power plant construction works will vary significantly depending on the type of activity being conducted e.g. site preparation, bulk earthworks, building construction and piling etc and the level of noise reducing mitigation being implemented. The distance offset to potentially sensitive receptors also influences the received noise level and magnitude of impacts.

Construction fleet noise emissions values (combined unmitigated emission from multiple sources) can vary but are commonly in the range of 110 dBA (e.g. site preparation, building construction etc), to 120 dBA (e.g. bulk earthworks or piling), up to 130 dBA (e.g. demolition). Given that demolition is not required, the focus of this assessment is site preparation, building construction, bulk earthworks and impact piling. Further information regarding the piling method and the noise reducing mitigation that are incorporated into the projects construction methodology are reproduced in *Annex C* of this report. In summary this includes:

- Pre-drilling to ten metres depth, at all piling locations.
- Use of pile caps and cushions, the latter consisting of five layers of high strength multiflex board.
- Installation of EGI fence adjacent to village area. Height and specification shall be determined after EPC test piling and noise monitoring, so a 2.4 metre barrier has been adopted to inform this assessment.

The work sequence for piling will be 1) Power Block #1 + Cooling Tower, then 2) Power Block #2 + WT/WWT, then 3) Admin Bldg/Worksop + BSDG, and then 4) MEB Tank with a maximum of 12 piling rig units (at peak) working concurrently. A +10.8 dBA adjustment has been applied (to the base L_W value of 120 dBA, $L_{eq,\,1\,hour}$) for each work sequence (+7.8 dBA where two work areas are identified) to account for uncertainties associated with the potential number of piling rigs that may be in use concurrently (and their location) during these activities.

Based on these noise emission values and key work areas, levels have been predicted (at nearby receptors) and compliant distance offsets (refer *Chapter 5* for the project-specific assessment criteria) have been estimated via calculation and overlayed on a map with aerial photography to identify the potential area of influence for each activity, refer *Chapter 6* of this report.

This mapping exercise, evaluation of impacts and recommended measures is based on the daytime (7AM to 10PM) period, when the majority of noise generating works, if not all, will occur. This report also presents a recommendation (refer *Chapter 8*) to restrict noise generating construction works (including CCGT piling) to the daytime period, as people are more sensitive to noise at night (10PM to 7AM).

3.2 CONSTRUCTION ROAD TRAFFIC NOISE

Noise emissions from road traffic (e.g. heavy vehicle haulage) during construction is contingent on the flows, mixes and speeds of vehicles using public or private access roads. The distance offset to potentially sensitive receptors also influences the received noise level and magnitude of impacts.

Section V.4, titled *Traffic Performance Analysis Of Future Construction* of the translated ANDALALIN states:

"*Mobilization of building materials in construction jobs Java Power Plant-1 will use a truck trailer, dump truck, boom truck, lorry, SPMT and water truck. Building materials were mobilized amounted to 57,000 m3 (± 2,865 trip or 8 trips / day for 360 working days) and soil embankment of 879 719 tonnes will be obtained from the Purwakarta or Subang (± 29324 trips or 163 trips / day or 7 trips / h in 180 weekdays using the dump truck 30 tons). In deploying the supply pipes and waste water disposal and gas pipelines in the gas pipeline ROW Pertamina Gas, mobilization sized pipes each as much as ± 1.650 pipes, pulleys and welding equipment carried by trucks as much as ± 400 trip. (Source proponent, PT. Java One Power)*".

Based on this information, two potential construction road traffic scenarios were established for the purposes of the noise assessment, as follows:

- Scenario 1 – dump trucks and material delivery trucks 30 pass-bys/hour.
- Scenario 2 – material delivery truck 2 pass-bys/hour.

A third representative worst-case road traffic noise assessment was also established on the basis of the vehicle flows identified in the air quality assessment completed for the project. This third scenario is as follows:

- Scenario 3 – heavy vehicles 1,000 pass-bys/hour.
- Scenario 4 – heavy vehicles 10,000 pass-bys/hour.

Based on these scenarios, inputs and known access roads, noise levels have been predicted (at distance offsets) and compliant distance offsets (refer *Chapter 5* for the project-specific assessment criteria) estimated via calculation and overlayed on a map with aerial photography to identify the potential area of influence for each activity, refer *Chapter 6* of this report.

These calculations were made using the CoRTN method, assuming vehicles travel back on the same route during a twelve hour daytime period, and assuming a) a 40km/hr vehicle speed, +2 dBA correction for a worn road surface, $L_{eq} = L_{10} - 3$ dBA and 0% grade. This mapping exercise, evaluation of impacts and recommended measures is based on the daytime (7AM to 10PM) period, when the majority of project road traffic will occur. This report also presents a recommendation (refer *Chapter 8*) to restrict construction road traffic to the daytime period, as people are more sensitive to noise at night (10PM to 7AM).

3.3 JETTY PILING NOISE

Noise emissions from Jetty piling construction works have been assessed with a method and set of technical inputs is consistent with that adopted for the CCGT power plant piling. A + 3dBA adjustment has been applied (to the base L_W value of 120 dBA, $L_{eq, 1\ hour}$) to account for pre-drilling to ten metres depth and use of pile caps and cushions, as these are unlikely to be required at the Jetty location. A +3 dBA adjustment has also been applied to account for uncertainties associated with the potential number of piling rigs that may be in use concurrently (and their location) during these activities.

3.4 CCGT OPERATIONAL NOISE

A detailed noise modelling exercise has been completed to predict and assess operational noise emissions associated with the CCGT power plants operation.

The assessment features, inputs and assumptions are provided in *Table 3.1* below, with further information regarding the significant CCGT operational noise sources and associated emissions data presented in *Section 3.3.1* and *Table 3.2*.

The noise emission sources listed in *Table 3.2* summarise the overall level from each significant operational CCGT power plant source. Within the model each of these sources was separated into the various equipment or building components (the model includes 19 key sources but a total of 149 emission components) so that the predicted noise levels provide an accurate representation of received values based on the size and layout of the CCGT power plant. As noted in *Table 3.1* a mixture of point sources, area sources, emitting facades and roofs, line sources and moving point sources have been adopted to accurately represent project emissions. Other noise modelling features are then described in *Section 3.2.2*, with the modelling layout presented in *Figure 3.1* and *Figure 3.2* below.

Table 3.1 Assessment Features, Inputs and Assumptions

ID	Feature	Description
1	General Acoustics	All sound pressure levels (LP) presented in this report (e.g. noise levels predicted at a receptor) are in decibels referenced to 2 x 10^{-5} Pa, with A-weighting applied. All sound power levels (LW) presented in this report (e.g. noise levels assigned to specific sources) are decibels referenced to 10^{-12}W, with A-weighting applied. LW is a measure of the total power radiated by a source. The "sound power" of a source is a fundamental property of the source and is independent of the surrounding environment. This differs from the LP which is the level of "sound pressure" as measured at distance by a standard sound level meter with a microphone. LP is the received sound as opposed to LW that is the sound 'intensity' at the source itself.
2a	Noise Modelling	CadnaA (Version 4.5) and Brüel and Kjær Predictor noise modelling software packages were utilised to calculate construction and operational noise levels using the ISO9613:2 and CONCAWE, 1981 noise propagation algorithms (international method for general purpose, 1/1 octaves). For sound calculated using ISO9613:2, the indicated accuracy is ±3dBA at source to receiver distances of up to 1000 metres and unknown at distances above 1000 metres.
2b		All noise modelling takes into consideration the sound power level of the proposed site operations, activities and equipment, and applies adjustments for attenuation from geometric spreading, acoustic shielding from intervening ground topography, ground effect, meteorological effects and atmospheric absorption. A mixture of point sources, area sources, emitting facades and roofs, line sources and moving point sources have been adopted to accurately represent project emissions.
2c		A ground factor of 0.7 was adopted for the modelling domain: 0.0 is hard and 1.0 is soft.
2c		Meteorological factors have been incorporated into the noise models based on representative conditions of the region, including an average temperature of 25° Celsius and a relative humidity of 80%. Modelling was undertaken for neutral (Class D) atmospheric stability conditions, nil winds.
3	Noise Source Data	Sound Power Level (LW, dBA) data (overall LW values and spectral data, level per frequency band in 1/1 octaves) incorporated into the project-specific operational noise model was provided for use in the assessment or derived by ERM based on items of similar duty or use. Further information regarding the operational source emission data is provided in *Section 3.3.1* below.
4	Receptors	A total of eleven key noise receptors near the CCGT power plant have been considered in this assessment. Receptors identified as N-1 to N-5 were adopted from the *Samsung C&T – Engineering and Construction Group (Samsung) – Indonesia Jawa-1 Noise Study Review – Ver. 07 - Cooling Tower Re-location to East-Side* report, dated 2016.7.9 and prepared by Samsung - Quality Technology Division, Technical Team (Samsung, 2016 Noise Study Review). An additional six receptors were identified for the CCGT power plant assessment to better understand the spatial extents of potential noise impacts. Noise Catchment Areas (NCA) were first established, these are areas where acoustic conditions are expect to be broadly similar for each area. Receptor points were then selected for each NCA where impacts were expected to be highest. These NCA's are identified in *Figure 1.2* of this report. Other receptors were identified at and near the substation and jetty as applicable to that assessment. All noise levels were calculated at 1.5 metres above ground level, with due regard to IFC 1.7 Noise requirements and other relevant acoustical standards. A receptor height of 1.5 metres is representative of a human in a seated position and is commonly adopted as a general noise assessment height.

3.4.1 Source Emission Data

As stated in Section 1.1.59 of the IFC Thermal Power Plants Guideline, 2017 "*principal sources of noise in thermal power plants include the turbine generators and auxiliaries; boilers and auxiliaries, such as coal pulverisers; reciprocating engines; fans and ductwork; pumps; compressors; condensers; precipitators, including rappers and plate vibrators; piping and valves; motors; transformers; circuit breakers; and cooling towers*".

Section 1.1.59 goes on to state that "*thermal power plants used for base load operation may operate continually while smaller plants may operate less frequently but still pose a significant source of noise if located in urban areas*", which aligns with the assumption drawn for this assessment that the proposed development and project CCGT power plant will generate constant emissions.

As stated in Section 1.1.60 of the IFC Thermal Power Plants Guideline, 2017 "*noise impacts, control measures, and recommended ambient noise levels are presented in Section 1.7 of the General EHS Guidelines. Additional recommended measures to prevent, minimize, and control noise from thermal power plants include*:

- *Siting new facilities with consideration of distances from the noise sources to the receptors (e.g. residential receptors, schools, hospitals, religious places) to the extent possible. If the local land use is not controlled through zoning or is not effectively enforced, examine whether residential receptors could come outside the acquired plant boundary. In some cases, it could be more cost effective to acquire additional land as buffer zone than relying on technical noise control measures, where possible;*

- *Use of noise control techniques such as: using acoustic machine enclosures; selecting structures according to their noise isolation effect to envelop the building; using mufflers or silencers in intake and exhaust channels; using sound-absorptive materials in walls and ceilings; using vibration isolators and flexible connections (e.g. helical steel springs and rubber elements); applying a carefully detailed design to prevent possible noise leakage through openings or to minimize pressure variations in piping; and*

- *Modification of the plant configuration or use of noise barriers such as berms and vegetation to limit ambient noise at plant property lines, especially where sensitive noise receptors may be present*".

Section 1.1.61 of the IFC Thermal Power Plants Guideline, 2017 recognises the effectiveness of noise modelling and as such modelling was completed to quantify the potential impact of the project's operation on surrounding receptors.

Noise emission source values (LW, dBA) were established based on information provided for significant noise generating plant, equipment and machinery, or activities to be undertaken, as associated with the near and onshore items noted above. Emission data for key power station sources was provided for noise modelling. The individual LW, dBA values are identified in *Table 3.2* below. The sound power levels listed include source mitigation.

Table 3.2 Significant Operational Noise Sources and Emissions Data

Assessment ID	Type	Sound Power Level (LW in dBA)
1	Condenser Vent	98
2	Cooling Tower, (per unit)	105
3	CT inlet	105
4	CT Inlet duct	108
5	CT Pump	85
6	Generator Package	103
7	GT Fan Casing	98
8	GT Inlet	107
9	GT Package	119
10	GT Vent Fan outlet	99
11	HP Water Feed Pump	105
12	HRSG Body	99
13	HRSG Inlet Duct	104
14	Pre Heat Pumps	103
15	ST Package	114
16	Stack Tip	101
17	HRSG stack	94
18	Transformers	93
19	Major Pumps	93

3.4.2 Other CCGT Power Plant Noise Modelling Features

Other noise modelling features associated with the CCGT power plant are provided below. The noise model layout, including the items described below, is identified in *Figure 3.1* and *Figure 3.2* below.

Buildings and Enclosures

The modelling has incorporated the presence of several **buildings and enclosures**, as discussed in the broader environmental assessment. These include the following buildings:

- There will be two cooling tower blocks, one for each single shaft CCGT unit. The preliminary design foresees 16 cells per unit, with each cell having dimensions 16 x 16 x 18.7 metres (18.7 metres high from finished ground level).

- Two turbine buildings, one for each of the two single shaft CCGT units. Each building has an area of 2,500 square metres (m^2) squared and will be 25 meters in height. Constructed of sheet steel.

- There will be two (2) HRSGs, one (1) for each single shaft CCGT unit. Each HRSG will be approximately 40 metres in height.

- Exhaust stacks for each CCGT unit with heights of 60 metres.

Ancillary buildings will provide noise shielding, including the administration building, the workshop and the electrical control buildings.

Project Design Noise Barriers

The project design includes the following **noise barriers**:

- A 17 metre high 300 metre long barrier located 20 metres from the southern façade of the cooling tower block.

- A 7 metre high 40 metre long barrier located 50 metres south west of the turbine hall and HRSG.

Discussion

Each of the buildings, enclosures, ancillary buildings and project design noise barriers have been incorporated into the CCGT power plant modelling, and hence the predicted noise levels presented in this report incorporate the noise reductions provided by these project components and features. Given the scale of the noise barriers already incorporated into the project design additional noise walls or barriers may have a reduced potential to further reduce noise from the CCGT power plant, at the most affected receptors.

Therefore, any recommendations, provisions, safeguards and contingencies, presented herein, focus on other noise reducing measures, such as the selection of quieter equipment or improving the acoustic performance of the specified buildings and enclosures. Suitable safeguards and provisions for the project design noise barriers are however provided to assist ensure that the noise reductions calculated via the noise modelling may be achieved.

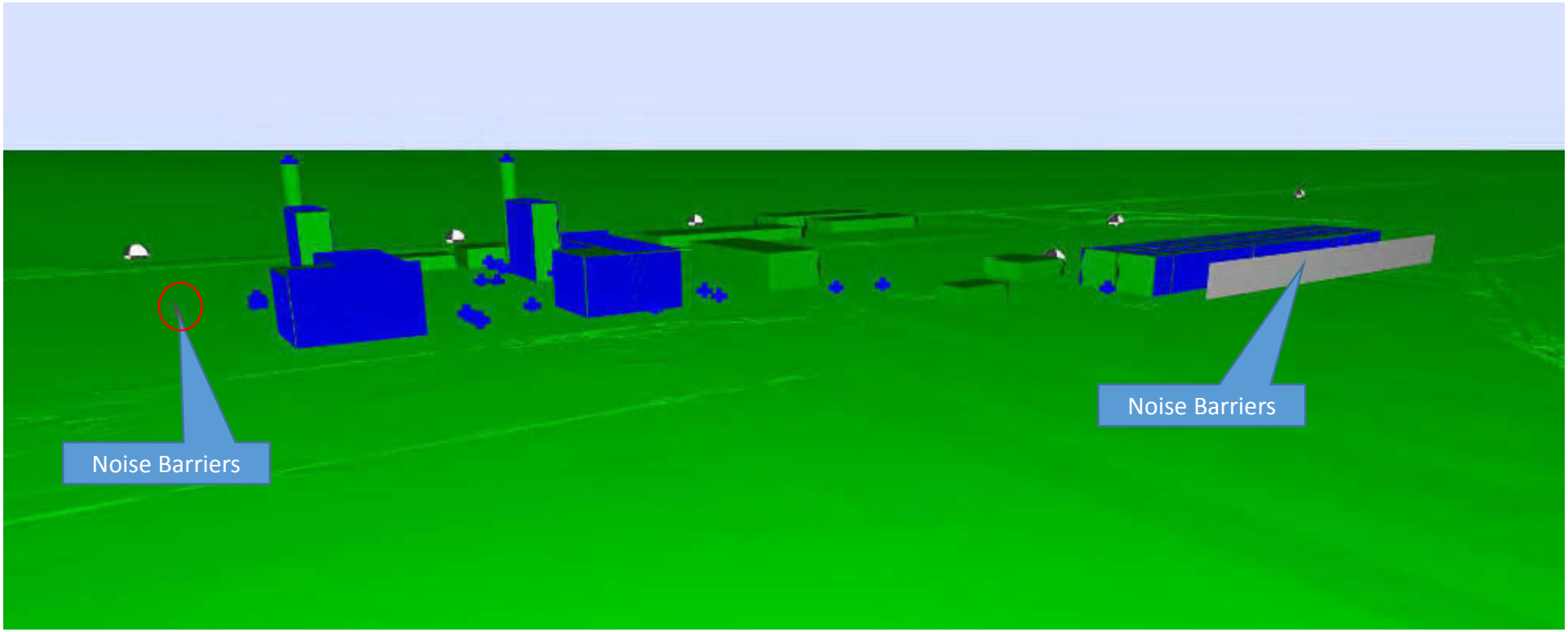


Figure 3.1
CCGT Power Plant Noise Model Layout
(View from South)

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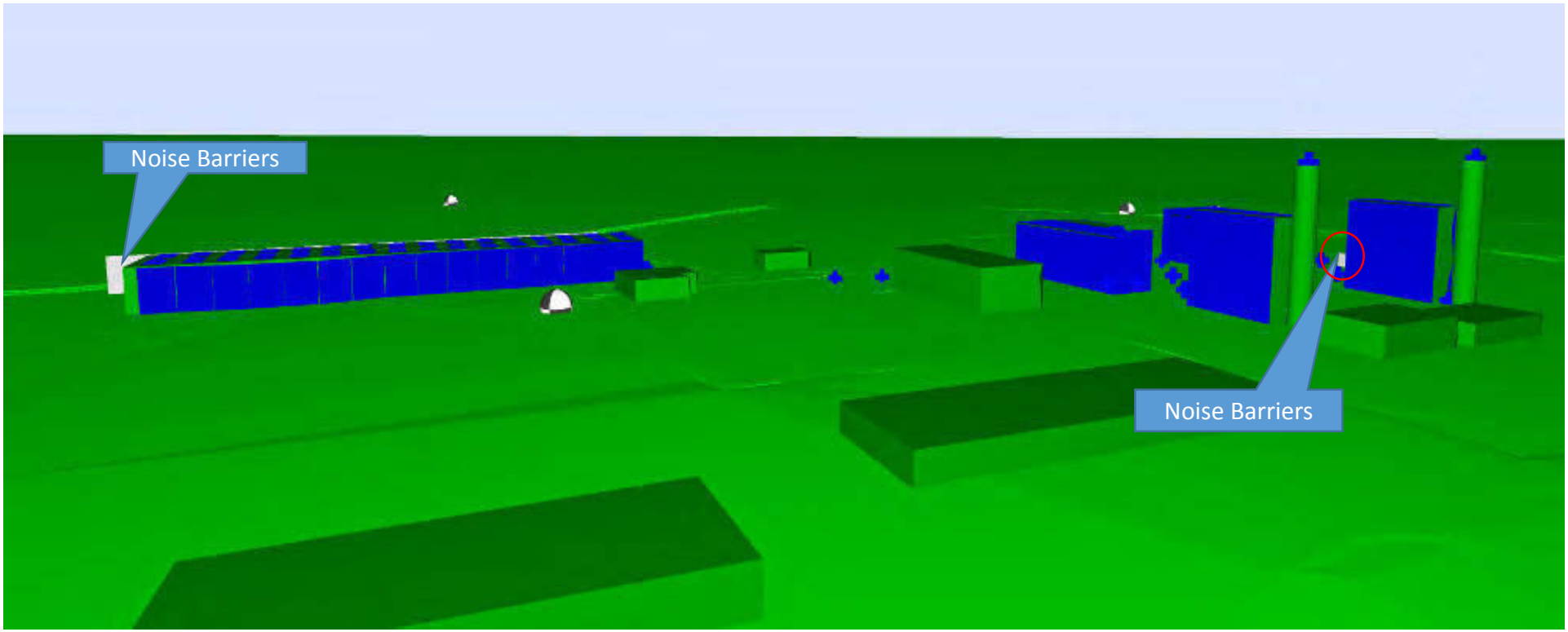

Figure 3.2
CCGT Power Plant Noise Model Layout
(View from North)

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3.5 SUBSTATION OPERATIONAL NOISE

Noise emissions from the Cibatu Baru II/Sukatani EHV Substation in Sukatani will vary significantly depending on the manufacturer, type and output of the key substation noise generating items, which are normally limited to transformers. Other substation items such as auxiliary transformers and capacitor banks etc generate noise but these emissions are normally insignificant than those that generated by a transformer. The distance offset to potentially sensitive receptors also influences the received noise level and magnitude of impacts.

Transformer noise emissions values (combined unmitigated emission from multiple sources) can vary but are commonly in the range of 85 to 95 dBA. For the purposes of this assessment three thresholds have been defined and assessed: 1) typical best-case (85 dBA), 2) typical norm (90 dBA) and 3) typical worst-case (95 dBA).

Based on these noise emission values and the substations location, noise levels have been predicted (at nearby receptors) and compliant distance offsets (refer *Chapter 5* for the project-specific assessment criteria) have been estimated via calculation and overlayed on a map with aerial photography to identify the potential area of influence of the substation, refer *Chapter 7* of this report.

This mapping exercise, evaluation of impacts and recommended measures is based on the more stringent night time period (10PM to 7AM) period, as the substation is anticipated to operate 24 hours per day and seven days a week.

3.6 TRANSMISSION LINE (OPERATIONAL) CORONA NOISE

Corona noise associated with the onshore 52.16 kilometre, 500 kV transmission line connecting the CCGT power plant to the Cibatu Baru II/ Sukatani substation.

A 52.16 kilometre 500kV transmission line is proposed to be established from the CCGT power plant in Cilamaya to Cibatu Baru II/Sukatani EHV Substation in Sukatani. As stated in the IFC Electrical Power Guideline, 2007 (Page 13) "*noise in the form of buzzing or humming can often be heard around transformers or high voltage power lines producing corona. Ozone, a colourless gas with a pungent odour, may also be produced. Neither the noise nor ozone produced by power distribution lines or transformers carries any known health risks*".

The IFC Electrical Power Guideline, 2007 goes on to state that "*the acoustic noise produced by transmission lines is greater with high voltage power lines (400-800 kilo volts, kV) and even greater with ultra-high voltage lines (1000 kV and higher). Noise from transmission lines reaches its maximum during periods of precipitation, including rain, sleet, snow or hail, or as the result of fog. The sound of rain typically masks the increase in noise produced by the transmission lines, but during other forms of precipitation (e.g. snow and sleet) and fog, the noise from overhead power lines can be troubling to nearby residents*".

These features are to be expected for the proposed development and as such modelling was completed to quantify the potential impact of transmission line operation on surrounding receptors based on an indicative line source emission value of 64 dBA per metre, at a nominal minimum height of 18 metres above ground level (minimum design height).

Consistent with the approach described in the IFC Electrical Power Guideline, 2007 this enables measures to be identified that are designed to mitigate impacts, where necessary. These may be implemented "*during project planning stages to locate rights-of-way away from human receptors, to the extent possible*".

Based on these noise emission values and the 500 kV transmission line alignment, compliant distance offsets (refer *Chapter 5* for the project-specific assessment criteria) have been modelled and overlayed on a map with aerial photography to identify the potential area of influence, refer *Chapter 7* of this report. Receptors within this potential area of influence have been identified and further evaluation provided.

This mapping exercise, evaluation of impacts and recommended measures is based on the more stringent night time period (10PM to 7AM) period, as corona noise emissions can occur at any time of day and the power distribution to the substation is anticipated to occur 24 hours per day and seven days a week.

4 EXISTING ENVIRONMENT

A key element in assessing environmental noise impacts is an understanding of the existing ambient and background noise levels at or in the vicinity of the closest and/or potentially most affected receptors situated within the potential area of influence of a project.

Existing vibration levels are less significant to the assessment as it is assumed that in the absence of the project, ambient vibration is imperceptible at the closest and/or potentially most affected receptors situated within the potential area of influence of a project. Hence, this chapter focuses on noise herein.

4.1 POTENTIALLY SENSITIVE RECEPTORS

All potentially sensitive receptors near the various project components were identified previously in *Figure 1.2* above. The potentially sensitive receptor locations where CCGT power plant emissions have been assessed are described in *Table 4.1* below.

Table 4.1 Potentially Sensitive Noise Receptor Locations

Noise ID	Desc.	GPS Co-ordinates (X and Y, Zone 48)	
N-1[1]	Residential (Dwelling) Receptor/s situated south-west of the CCGT power plant.	786166	9308897
N-2[1]	Residential (Dwelling) Receptor/s situated south of the CCGT power plant.	786376	9308737
N-3[1]	Residential (Dwelling) Receptor/s situated east of the CCGT power plant.	787390	9309099
N-4[1]	Residential (Dwelling) Receptor/s situated north of the CCGT power plant.	786369	9309369
N-5[1]	Residential (Dwelling) Receptor/s situated north-east of the CCGT power plant.	787326	9309880
R1[2]	Residential (Dwelling) Receptor/s situated south of the CCGT power plant, within NCA 1	786447	9308724
R2[2]	Workforce Accommodation Receptor situated west of the CCGT power plant, within NCA 2.	785997	9309012
R3[2]	Residential (Dwelling) Receptor/s situated north-west of the CCGT power plant, within NCA 3.	786192	9309274
R4[2]	Residential (Dwelling) Receptor/s situated north of the CCGT power plant, within NCA 4.	786542	9309507
R5[2]	Residential (Dwelling) Receptor/s situated east of the CCGT power plant, within NCA 5.	787397	9309090
R6[2]	Residential (Dwelling) Receptor/s situated south-east of the CCGT power plant, within NCA 6.	787113	9308727

1. Source: Samsung, 2016 Noise Study Review.
2. Source: identified for this assessment.

These locations were adopted from the Samsung, 2016 Noise Study Review or identified for this assessment via a rapid review of aerial photography and based on their proximity to key emission sources. These locations do not represent all receptors located in the vicinity or area of influence of the project but have been selected for the purposes of this assessment. They are considered to be representative of locations that will experience the highest CCGT power plant noise (or vibration levels) and most significant impacts associated with the construction and ongoing operation of the project. Where additional receptors are identified (beyond those presented in *Table 4.1* the predicted noise levels at the nearest assessed receptor (N-1 to N-5 and R1 to R6) provides an indication of potential project emissions and impacts that could be experienced at these other locations not specifically identified in this assessment.

4.2 EXISTING NOISE LEVELS

Existing ambient and background noise levels were measured for this assessment such that an understanding of the existing acoustics environment can be described and existing noise levels quantified. This section presents a consolidated summary of all measured data available at the time of this assessment and other items of importance. Existing (baseline) ambient noise level monitoring was also conducted in November 2015 at five (5) locations (IEE, 2016). Two (2) points i.e. Cilamaya IV State Primary School and Paddi Field in Cilamaya Village (N-2 and N-5 respectively) exceeded the noise level standards, particularly at night-time. This was due to the influence of road traffic and dominated by natural sounds such insects during evening and night time i.e. Cricket (Gryllidae) and Tonggeret (Tettigarctidae).

In addition to the monitoring conducted in November 2015 and July 2017 - Regulatory Environmental Monitoring (RKL and RPL) Semester 2, 2016 and Regulatory Environmental Monitoring (RKL and RPL) Semester 1, 2017also provided the noise monitoring data (SGK Cilamaya, 2016; SGK Cilamaya, 2017). Monitoring was conducted at five (5) points of a compressor for 24-hrs. It was noted that the main contributors to the noise emission during the monitoring activities were from the generator sets and from moving vehicles and road traffic.

The existing (baseline) environmental noise monitoring was also conducted at seven (7) monitoring points surrounding the CCGT power plant site in July 2017 for 48 hours (ERM, 2017). Exceedances of Indonesian regulatory standards were frequently recorded during business hours (09.00 – 22.00). This was believed to be due to high level of community activities and particularly traffic activity in and around the measurement points. Exceedances of IFC standards for ambient noise were also frequently recorded, particularly at night-time.

The baseline noise monitoring locations are identified in *Figure 4.1* and *Figure 4.2* below and a summary of all baseline monitoring results available at the time of this assessment are then provided in *Table 4.2* to *Table 4.6*.

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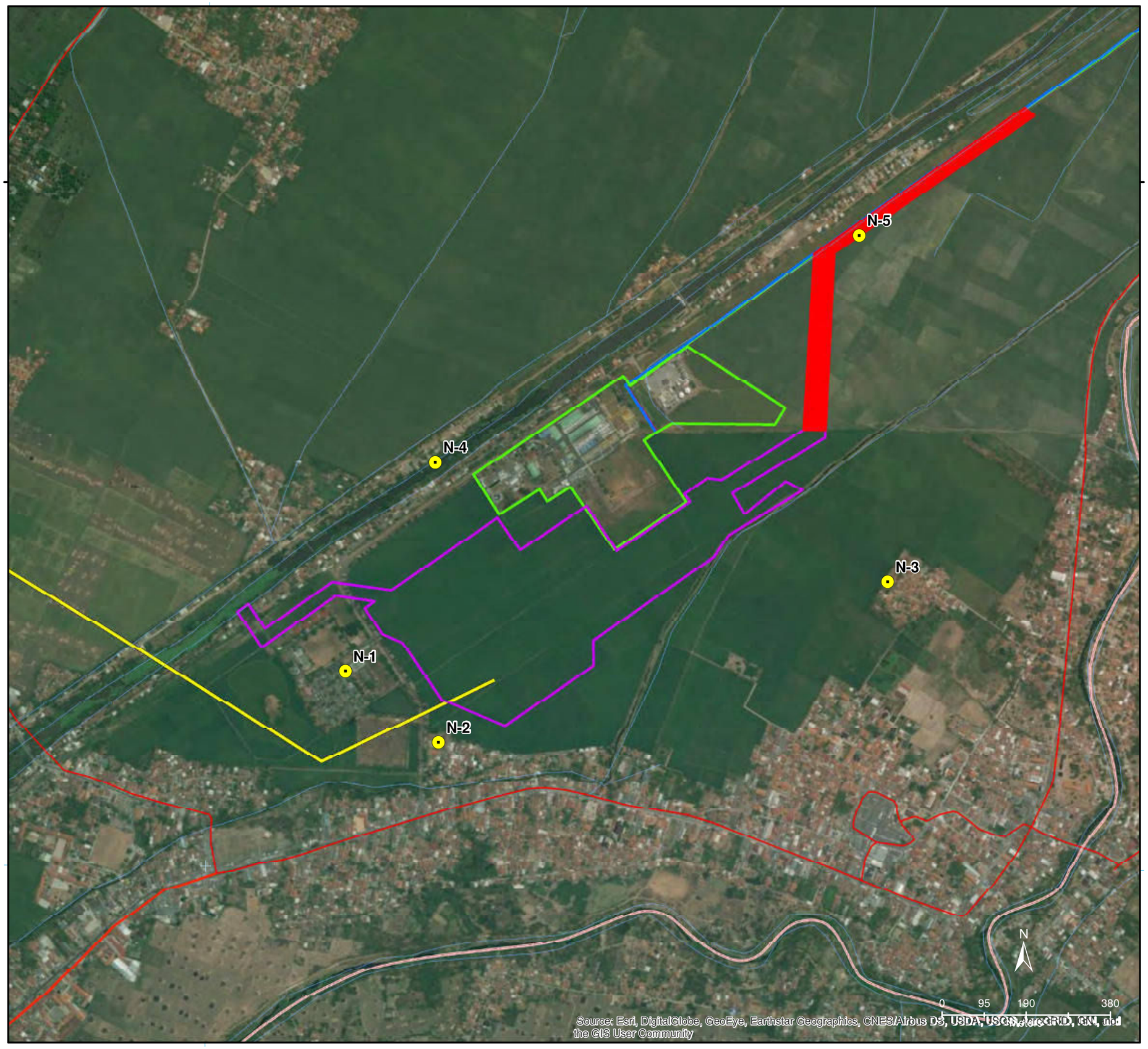
Figure 4.1
Samsung, 2016 Noise Study Review
Noise Monitoring Locations



LEGEND

- Jetty Location
- Pump Station
- Arterial Road (Public Road)
- Regency Boundary
- Offshore Gas Pipeline from FSRU
- Discharge Pipeline
- Intake Pipeline
- Dredging Plan for Jetty Access
- Onshore Pipeline (Gas, Intake, and Outflow)
- Access Road to Pump Station and Jetty
- Transmission Line
- CCGT Power Plant
- SKG Cilamaya

Sampling Point

- Noise Sampling Location

Coordinate of Noise Sampling Locationon Noise Review Study

Code	Geographic		UTM	
	South	East	X	Y
N1	-6,2460	107,5861	786166,00	9308896,00
N2	-6,2475	107,5880	786376,00	9308736,00
N3	-6,2441	107,5969	787369,00	9309098,00
N4	-6,2418	107,5879	786369,00	9309368,00
N5	-6,2442	107,5936	786997,00	9309091,00
N13	-6,2114	107,6370	791828,35	9312697,88
N14	-6,2204	107,6364	791758,75	9311696,86

Source:
- ESRI Online Imagery, 2017
- Jawa Satu Power, 2017

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	Checked By : FF	Date :	03/07/2018
	Revision :	Map Number :	

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Environmental and Social Impact Assessment (ESIA) for Jawa-1 Project

Figure 4.2
ESIA – Noise and Vibration Monitoring Locations.

LEGEND

- Road
- Regency Boundary
- Distict Boundary
- Cibatu 2 Substation
- Onshore Pipeline (Gas, Intake, and Outflow)
- Access Road to Pump Station and Jetty
- Transmission Line
- CCGT Power Plant
- SKG Cilamaya
- Cibatu 2 Substation

Sampling Point

- Noise Sampling Location
- Vibration Sampling Location

Source:
- Jawa Satu Power, 2017

ERM	Drawn By : IA & IF	Client : Jawa Satu Power	
	Checked By : FF	Date : 03/07/2018	
	Revision :	Map Number :	

Table 4.2 Noise Monitoring (IEE, 2016)

ID, Co-ordinates	Description	Measured Noise Levels
N-1 786166,9308897	In the PT Pertamina adjacent to existing staff housing area	Leq Daytime 55.0 dBA Leq Night-time 48.5 dBA Leq Day/Night 54.6 dBA
N-2 786376, 9308737	Cilamaya IV State Primary School	Leq Daytime 62.0 dBA Leq Night-time 51.5 dBA Leq Day/Night 60.9 dBA
N-3 787390, 9309099	Bunut Ageung Hamlet. Cilamaya Village. Cilamaya Wetan District	Leq Daytime 59.3 dBA Leq Night-time 45.4 dBA Leq Day/Night 57.8 dBA
N-4 786369, 9309369	In the Pertamina (adjacent to wall (irrigation area)	Leq Daytime 57.8 dBA Leq Night-time 51.7 dBA Leq Day/Night 57.5 dBA
N-5 786997, 9309091	Paddy field in Cilamaya Village. Cilamaya Wetan District	Leq Daytime 54.7 dBA Leq Night-time 51.5 dBA Leq Day/Night 55.4 dBA

1. Source: IEE, 2016 as presented in Annex B, Table B.20 of the March 2018 environmental assessment.

Table 4.3 Noise Monitoring (Report of Environmental Assessment, Table 2.9)

ID	Description	Measured Noise Levels
N-1	In the PT Pertamina adjacent to existing staff housing area	Leq Daytime 55.0 dBA Leq Night-time 44.9 dBA Leq Day/Night 52.6 dBA
N-2	Cilamaya IV State Primary School	Leq Daytime 59.4 dBA Leq Night-time 50.8 dBA Leq Day/Night 57.4 dBA
N-3	Bunut Ageung Hamlet. Cilamaya Village. Cilamaya Wetan District	Leq Daytime 56.9 dBA Leq Night-time 45.5 dBA Leq Day/Night 52.2 dBA
N-4	In the Pertamina (adjacent to wall (irrigation area)	Leq Daytime 59.9 dBA Leq Night-time 44.9 dBA Leq Day/Night 52.1 dBA
N-5	Paddy field in Cilamaya Village. Cilamaya Wetan District	Leq Daytime 55.5 dBA Leq Night-time 53.8 dBA Leq Day/Night 53.9 dBA

1. Source: Section 2.2.2, Table 2.9 of the Report of Environmental Assessment CCGT Java-1 power plant Development – Cilamaya – West Java.

Table 4.4 Noise Monitoring (Samsung, 2016 Noise Study Review)

ID	Description	Measured Noise Levels (Night time)
N-1	In the PT Pertamina adjacent to existing staff housing area	Leq (8 hour) 48.9 dBA
N-2	Cilamaya IV State Primary School	Leq (8 hour) 52.1 dBA
N-3	Bunut Ageung Hamlet. Cilamaya Village. Cilamaya Wetan District	Leq (8 hour) 45.6 dBA
N-4	In the Pertamina (adjacent to wall (irrigation area)	Leq (8 hour) 52.0 dBA
N-5	Paddy field in Cilamaya Village. Cilamaya Wetan District	Leq (8 hour) 51.5 dBA

1. Source: Section 2, *Samsung C&T – Engineering and Construction Group (Samsung) – Indonesia Jawa-1 Noise Study Review – Ver. 07 - Cooling Tower Re-location to East-Side* report, dated 2016.7.9 and prepared by Samsung - Quality Technology Division, Technical Team (Samsung, 2016 Noise Study Review).
2. Refer *Annex B* of this report for further information.

Table 4.5 Noise Monitoring (2017)

ID	Description	Measured Noise Levels
N7	Pertamina Cilamaya	Leq Daytime 56.5 dBA Leq Night-time 55.7 dBA Leq Day/Night 58.9 dBA
N8	Masjid Al-Hidayah	Leq Daytime 70.8 dBA Leq Night-time 73.0 dBA Leq Day/Night 74.6 dBA
N9	Pertamina Residential Area	Leq Daytime 57.5 dBA Leq Night-time 56.0 dBA Leq Day/Night 56.9 dBA
N10	GCC Residential Area	Leq Daytime 50.4 dBA Leq Night-time 51.0 dBA Leq Day/Night 53.1 dBA
N11	MTsN 2 Bekasi	Leq Daytime 41.9 dBA Leq Night-time 56.3 dBA Leq Day/Night 56.6 dBA
N12	Access road to GITET Development area	Leq Day/Night 53.2 dBA

1. Source: ERM, 2018b as presented in Annex B, Table B.22 of the March 2018 environmental assessment.

Table 4.6 Noise Monitoring (2018)

ID, Co-ordinates	Description	Measured Noise Levels
NEMF 1 (N17) S: 06o14'38.5" E:107o34'32.8"	Transmission line site. Adjacent residential, 48hr sample	Leq Daytime 60 dBA Leq Night-time 58 dBA
NEMF 2 S: 6°14'23.0" E: 107°33'34.0""	Transmission line site. Adjacent residential, 48hr sample	Leq Daytime 60 dBA Leq Night-time 58 dBA
NEMF 3 (N26) S: 6°14'34.1" E: 107°11'01.5"	Transmission line site. Adjacent residential, 48hr sample	Leq Daytime 72 dBA Leq Night-time 74 dBA
NEMF 4 (N19) S: 06o11'33.1" E: 107o24'46.6"	Transmission line site. Adjacent residential, 48hr sample	Leq Daytime 63 dBA Leq Night-time 55 dBA
NEMF 5 (N20) S: 06o10'14.1" E: 107o20'23.5"	Transmission line site. Adjacent residential, 48hr sample	Leq Daytime 62 dBA Leq Night-time 65 dBA
NEMF 6 (N21) S: 06o11'27.0" E: 107o19'08.7"	Transmission line site. Adjacent residential, 48hr sample	Leq Daytime 62 dBA Leq Night-time 54 dBA
NEMF 7 S: 6°14'19.3" E: 107°16'06.2"	Transmission line site. Adjacent residential, 48hr sample	Leq Daytime 57 dBA Leq Night-time 54 dBA
NEMF 8 S: 6°13'55.82" E: 107°16'26.92"	Transmission line site. Adjacent residential, 48hr sample	Leq Daytime 58 dBA Leq Night-time 54 dBA
NEMF 9 (N24) S: 6°14'23.8" E: 107°14'12.4"	Transmission line site. Adjacent residential, 48hr sample	Leq Daytime 62 dBA Leq Night-time 66 dBA
NEMF 10 (N25) S: 6°14'40.248" E: 107°11'21.66"	Adjacent residential 48hr sample	Leq Daytime 69 dBA Leq Night-time 67 dBA
AQJ1 (N15) S: 6°12'41.1" E: 107°38'13.4"	Coastal, Background no residential, 48hr sample	Leq Daytime 80 dBA Leq Night-time 53 dBA
AQJ1 (N16) S: 6°13'13.7" E: 107°38'11.3"	Coastal, nearest village, residential, 48hr sample	Leq Daytime 53 dBA Leq Night-time 45 dBA
N18	North of Kotawaluya	Leq Daytime 52.5dBA Leq Night-time 51.4 dBA
N22	Near substation	L90 45.2 dBA Leq Daytime 54.4 dBA Leq Night-time 57.6 dBA
N23	Near substation	Leq Daytime 54.4 dBA Leq Night-time 57.6 dBA

1. Source: ERM, 2018c as presented in Annex B, Table B.24 of the March 2018 environmental assessment.

4.2.1 Discussion

As is evident in the noise level data presented in *Table 4.2* to *Table 4.6* above, existing noise levels (recorded in the absence of the site being assessed) regularly exceed the applicable local and international noise guideline criteria/limits (refer *Chapter 5*) relevant to the assessment of "industrial" noise such as that associated with the project. These measured levels are however the all-encompassing values for any audible/detectable noise emission recorded during the monitoring events.

For the majority of measurement locations they are expected to be a combination of noise from existing industrial sources and ambient sound from animals (birds, insects, domestic, livestock etc), aircraft, distant traffic, local traffic, residential/occupants/villagers, rural hum, and/or wind-blown vegetation:

- For receptors near to the proposed CCGT power plant existing industrial noise is expected to have dominated during these measurements as they are located adjacent to an existing industrial operation, being the SKG plant, Pertamina's existing Gas Compressor Station. The main noise component/source at SKG Cilamaya are the three gas compressors which are driven by Solar Centaur gas turbines.

- For the majority of other receptors i.e. those situated away from SKG Cilamaya and the proposed CCGT power plant, i.e. along the 500 kV transmission line alignment and near to the substation, the noise level contribution from other existing industrial sources is expected to be minimal and ambient sound from a combination of animal (birds, insects, domestic, livestock etc), aircraft, distant traffic, local traffic, residential (occupants/villagers etc), rural hum, and/or wind-blown vegetation noise is expected to have dominated.

While the assessment of existing industrial contributions is not specifically addressed as part of the IFC guidance, these levels would contribute to cumulative industrial noise impacts at receptors near to the CCGT power plant.

The discussion provided above is relevant to describing the varying spatial and temporal acoustical conditions that are anticipated to occur across the broader project area. This discussion is also relevant to establishing the applicable noise assessment criteria in accordance with local and international guidance, as documented in *Chapter 5* of this report.

These local and international noise level guidelines address both fixed and background noise level based limits and assessment requirements to protect receptors from "industrial" noise disturbance (i.e. a direct project impact) and amenity (i.e. a change in the noise environment due to the projects operation) based issues.

5 ASSESSMENT CRITERIA

This chapter summarises the relevant local and international noise and vibration criteria and limits established with due regard to the relevant guidelines and standards presented in *Section 1.3.3* of this report.

These criteria were adopted for this assessment and utilised when conducting the evaluation of potential impacts, the construction noise assessment presented in *Chapter 6*, and for the operational noise assessment presented in *Chapter 7* of this report.

The criteria are adopted on a case by case basis when considering the applicable acoustical factor, project component and phase; as identified in *Chapter 6* and *Chapter 7* of this report. In all cases the most stringent local or international criteria or limit is adopted to define potential impacts and inform the recommendations of this report.

Guidance Note

These local and international noise criteria and limits are primarily intended for the assessment of industrial facilities where there is a risk of long-term noise impacts to occur. They are not specifically intended for the assessment of construction noise levels, where there is usually a risk of short to medium-term temporary noise impacts to occur.

These criteria and limits have been adopted in this assessment in the absence of applicable construction noise legislation, policy or guidelines and to provide a consistent manner by which all noise impacts may be assessed.

For large-scale projects it is uncommon that construction noise levels would comply with these criteria, especially at sites, such as that considered in this assessment, where there are receptors situated in close proximity (e.g. within 200 metres), and within the potential area of influence of the required construction.

For vibration however, the criteria and limits presented in this report are commonly complied to for both construction and operational phases, especially those associated with potential cosmetic and/or structural damage.

5.2 NOISE CRITERIA

5.2.1 Local Noise Criteria and Limits (48/MENLH/11/1996)

The Decree of Environment Minister No. 48 of Year 1996 (48/MENLH/11/1996) on Noise Level Quality Standard threshold limits given by this standard are set out below.

Table 5.1 Noise Limits – 48/MENLH/11/1996

Receptor Type	Limit, dBA
Industrial	70
Commercial	65
Residential	55
Institutional (school, hospital, place of worship)	55

1. 48/MENLH/11/1996 does not specify times of day that these limits apply hence it is assumed that they are applicable 24 hours per day.

5.2.2 IFC Noise Criteria (IFC 1.7 Noise)

The key document adopted for the terms of reference from which internationally accepted noise criteria were established is the IFC - *Environmental, Health and Safety (EHS) Guidelines - General EHS Guidelines: Environmental Noise Management*, Section 1.7 Noise (IFC 1.7 Noise), dated 30 April 2007.

The IFC 1.7 Noise fixed criteria values, for residential, institutional educational, industrial and commercial receptors are reproduced in *Table 5.2* below.

Table 5.2 IFC 1.7 Noise – Fixed Criteria Values

	Maximum Allowable (free field) Noise Levels - Leq, 1 hour in dBA	
Receptor	Day (7AM to 10PM)	Night (10PM to 7AM)
Residential, institutional, educational	55	45
Industrial, commercial	70	70

Permissible Increase In Noise

In addition the fixed values described above, IFC 1.7 Noise states that "*impacts should not exceed the levels presented, or result in a maximum increase in background levels of 3 dB at the nearest receptor location off-site*".

With regard to the permissible increase in noise limit stated above IFC 1.7 Noise notes that:

- "*highly intrusive noises, such as noise from aircraft flyovers and passing trains, should not be included when establishing background noise levels*"; and
- "*In general, the noise level limit is represented by the background or ambient noise levels that would be present in the absence of the facility or noise source(s) under investigation*".

The purpose of this assessment existing measured L_{Aeq} noise level parameter, for both the daytime and night time periods (in the absence of the site under assessment) has been adopted to quantify existing noise level conditions. Further information in regard to this approach is provided in the sections below.

5.2.3 Consolidated Noise Criteria

The local and international noise guideline criteria for the assessment of potential noise impacts are consolidated in *Table 5.3* below.

In the absence of defined periods for the 48/MENLH/11/1996 local guidance the IFC daytime (7AM to 10PM) and night time (10PM to 7AM) definitions have been adopted. In the absence of defined $L_{eq, T}$ noise parameters for the 48/MENLH/11/1996 local guidance the IFC $L_{eq, 1\ hour}$ parameter (in dBA) has been adopted.

The most stringent "fixed" criteria values for each receptor type are highlighted in **bold** typeset in the table below. Of course, the IFC 1.7 Noise permissible increase requirements are based on exiting noise conditions, hence they may be more or less stringent than the fixed values as evaluated on a case by case basis.

Table 5.3 Consolidated Local and International Noise Criteria and Limits

Receptor Type	48/MENLH/11/1996 Noise Limits Leq, 1 hour in dBA		IFC 1.7 Noise Limits, dBA (Fixed Values) - Leq, 1 hour in dBA		IFC 1.7 Noise Limits, dBA (Permissible Increase) - Leq, 1 hour in dBA	
	Daytime (7AM to 10PM)	Night time (10PM to 7AM)	Daytime (7AM to 10PM)	Night time (10PM to 7AM)	Daytime (7AM to 10PM)	Night time (10PM to 7AM)
Residential	55	55	55	**45**	Impacts should not exceed the levels presented (IFC fixed values), or result in a maximum increase in background levels of 3 dB at the nearest receptor location off-site.	
Institutional	55	55	55	**45**		
Educational	55	55	55	**45**		
Industrial	**70**	**70**	**70**	**70**		
Commercial	**65**	**65**	70	70		

1. As existing noise conditions vary from one receptor location to another, all potential areas of influence described in *Chapter 3* and presented in *Chapter 6* and *Chapter 7* have been defined based on the most stringent fixed criteria values presented in this table, as applicable to when emissions will occur e.g. daytime only, or both daytime and night.

Jetty Piling Noise Criteria

In the absence of measured existing noise levels at N14 (the closest and potentially most affected residential receptors situated near the Jetty) it has been assumed that existing levels do not exceed the 55 / 45 dBA fixed noise level criteria and as such the IFC 1.7 Noise Limits (fixed values) - $L_{eq,\ 1\ hour}$ in dBA apply. This is consistent with the approach adopted and described below for the CCGT Design Noise Levels to derive criteria as follows: L_{eq} + 3 dBA = $L_{eq,\ 1\ hour}$ project-specific criteria, for each receptor; where the existing ambient values already exceed the fixed value 55/45 dBA criteria.

CCGT Design Noise Levels / Criteria

The project-specific noise criteria for the eleven receptors (previously described in *Table 4.1* of this report) that have informed the projects CCGT power plant design to date are reproduced from the *Samsung C&T – Engineering and Construction Group (Samsung) – Indonesia Jawa-1 Noise Study Review – Ver. 07 - Cooling Tower Re-location to East-Side* report, dated 2016.7.9 and prepared by Samsung - Quality Technology Division, Technical Team (Samsung, 2016 Noise Study Review).

The Samsung, 2016 Noise Study Review focused on the most stringent night time criteria and as such daytime criteria values have been derived for this assessment based on the lowest measured noise level values ($L_{eq,\ daytime}$) presented in *Table 4.2* and *Table 4.3* of this report.

The basis of these project-specific night time criteria values as stated in the Samsung, 2016 Noise Study Review is: existing $L_{eq,\ 8\ hour\ night}$ + 3 dBA = $L_{eq,\ 1\ hour}$ project-specific criteria, for each receptor. This applies where the existing ambient values already exceed the fixed value 55/45 dBA criteria.

The same method has been adopted to derive daytime criteria as follows: $L_{eq,\ daytime}$ + 3 dBA = $L_{eq,\ 1\ hour}$ project-specific criteria, for each receptor, where $L_{eq,\ daytime}$ is the lowest measured value presented in *Table 4.2* and *Table 4.3* of this report. This applies where the existing ambient values already exceed the fixed value 55/45 dBA criteria.

For locations N-1 to N-5 identified in the Samsung, 2016 Noise Study Review the criteria values were adopted as reported. For each of the additional six receptors (R1 to R6) identified for this assessment the criteria value from the closest Samsung, 2016 Noise Study Review location (of N-1 to N-5) has been used.

The consolidated set of criteria values are presented in *Table 5.4* below; refer to *Annex B* of this report for the Samsung, 2016 Noise Study Review.

Table 5.4 Project-Specific CCGT Noise Criteria

Noise ID	Desc.	Noise Criteria, dBA – Leq, 1 hour	
		Daytime (7AM to 10PM)	Night time (10PM to 7AM)
N-1	Residential (Dwelling) Receptor/s situated south-west of the CCGT power plant	55.0	51.9
N-2	Residential (Dwelling) Receptor/s situated south of the CCGT power plant	62.4	55.1
N-3	Residential (Dwelling) Receptor/s situated east of the CCGT power plant	59.9	48.6
N-4	Residential (Dwelling) Receptor/s situated north of the CCGT power plant	60.8	55.0
N-5	Residential (Dwelling) Receptor/s situated north-east of the CCGT power plant	55.0	54.5
R1	Residential (Dwelling) Receptor/s situated south of the CCGT power plant, within NCA 1	62.4	55.1
R2	Workforce Accommodation Receptor situated west of the CCGT power plant, within NCA 2	55.0	51.9
R3	Residential (Dwelling) Receptor/s situated north-west of the CCGT power plant, within NCA 3	60.8	55.0
R4	Residential (Dwelling) Receptor/s situated north of the CCGT power plant, within NCA 4	60.8	55.0
R5	Residential (Dwelling) Receptor/s situated east of the CCGT power plant, within NCA 5	59.9	48.6
R6	Residential (Dwelling) Receptor/s situated south-east of the CCGT power plant, within NCA 6	59.9	48.6

5.2.4 *Impact Significance Ratings*

Noise impact assessment standards and guidelines (such as IFC 1.7 Noise) generally give threshold levels that, above which, emissions have the potential to create nuisance or disturbance, or they define changes in noise levels, from which significant noise impacts to the receptors' amenity may be expected.

In addition, typical noise impact assessment methodologies require an approach that combines impact magnitude with receptor sensitivity to determine impact significance, for the specific source under assessment (e.g. industrial noise), thus:

RECEPTOR SENSITIVITY x IMPACT MAGNITUDE

= IMPACT SIGNIFICANCE

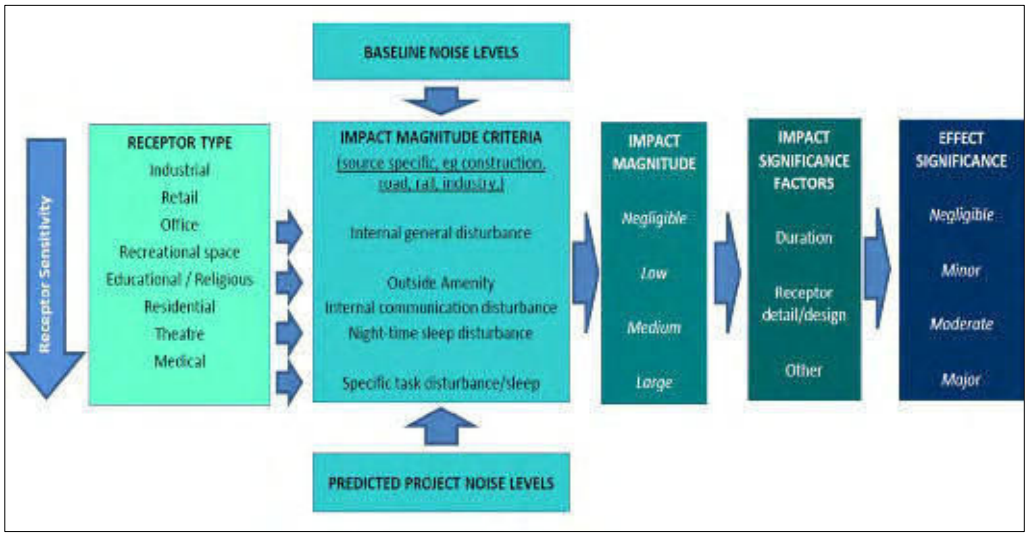
In applying guidance such as that described above it is necessary to scale impact magnitude into ranges required in an impact assessment. Hence an impact significance matrix has been developed that considers the following aspects:

- IFC Performance Standards on Environmental and Social Sustainability.
- Typical remote settings for projects where low background noise levels are commonly experienced.
- The variation of impacts associated with the duration or frequency of occurrence of potential construction and operational aspects.

A duration or frequency of "**long-term / constant**" is used to determine impacts for operational emissions, this is adopted for construction emissions. It is noted that some works and activities associated with the construction of the project are expected to qualify as either "**short-term /occasional**" or "**temporary / rare**" duration or frequency the given the overall construction schedule and programming the medium-term/often descriptor is considered most appropriate in the context of the broader project.

This approach is visually summarised as presented in *Figure 5.1* below and the outcomes of this impact evaluation are presented in Chapter 8 of the broader environmental assessment being prepared for the project.

Figure 5.1 Noise Impact Significance Assessment Process



5.3 VIBRATION CRITERIA

The key international documents adopted for the terms of reference from which vibration criteria (human exposure/annoyance and structural damage) were established are:

- British Standards Institution (BSI, United Kingdom) – BS 6472 - *Guide to Evaluation of Human Exposure to Vibration in Buildings (1 Hz to 80 Hz)* (BS 6472), dated 1992.
- British Standards Institution (BSI, United Kingdom) – BS 5228 - *Code of Practice for Noise and Vibration Control on Construction and Open Sites* , Part 2: Vibration (BS 5228:2), dated 2009.
- Department of Environment and Conservation NSW (DECC, Australia) – *Assessing Vibration: a Technical Guideline* (DECC Guideline, 2006), dated February 2006.
- German Institute for Standardisation (GIS, Germany) – DIN 4150 Part 3: *Structural Vibration: Effects of Vibration on Structures* (DIN 4150:3), dated February 1999.

Unlike noise where Impact significance ratings may be derived from incremental thresholds the combined impact magnitude with receptor sensitivity and/or exposure: vibration guidelines are typically adopted in a manner that recognises any levels that are predicted to exceed the criteria are likely to generate a significant impact that should be mitigated.

Values predicted to exceed the structural damage criteria would be considered a significant adverse impact and further detailed assessment, investigation or monitoring would likely be required.

5.3.1 Human Exposure and Annoyance Guidelines

The DECC Guideline, 2006 presents preferred and maximum vibration values for use in assessing human responses to vibration (based on BS 6472, 1992) and provides recommendations for measurement and evaluation techniques.

At vibration values below the preferred values, there is a low probability of adverse comment or disturbance to building occupants. Where all feasible and reasonable mitigation measures have been applied and vibration values are still beyond the maximum value, it is recommended the operator negotiate directly with the affected community.

The DECC Guideline, 2006 defines three vibration types and provides direction for assessing and evaluating the applicable criteria; examples of the three vibration types and has been reproduced in *Table 5.5*.

Table 5.5 Example of Types of Vibration

Continuous Vibration	Impulsive Vibration	Intermittent Vibration
Machinery, steady road traffic, continuous construction activity (such as tunnel boring machinery)	Infrequent: Activities that create up to 3 distinct vibration events in an assessment period, e.g. occasional dropping of heavy equipment, occasional loading and unloading.	Trains, intermittent nearby construction activity, passing heavy vehicles, forging machines, impact pile driving, jack hammers. Where the number of vibration events in an assessment period is three or fewer these would be assessed against impulsive vibration criteria.

The impulsive vibration criteria considered relevant to this assessment are then presented in *Table. 5.6* below.

Table 5.6 Criteria for Exposure to Impulsive Vibration

Place	Time	Assessment Criteria - Peak Velocity (mm/s)	
		Preferred	Maximum
Critical working areas (hospital operating theatres, precision laboratories)	Day or night time	0.14	0.28
Residences	Daytime	8.6	17
	Night time	2.8	5.6
Offices	Day or night time	18.0	36.0
Workshops	Day or night time	18.0	36.0

Intermittent vibration is assessed using the vibration dose concept which relates to vibration magnitude and exposure time.

Section 2.4 of the DECC Guideline, 2006 provides acceptable values for intermittent vibration in terms of Vibration Dose Values (VDV) which requires the measurement of the overall weighted RMS (Root Mean Square) acceleration levels over the frequency range 1 Hz to 80 Hz.

To calculate VDV the following formula is used:

$$VDV = \left[\int_0^T a^4(t)dt \right]^{0.25}$$

Where VDV is the vibration dose value in $m/s^{1.75}$, *a (t)* is the frequency-weighted RMS of acceleration in m/s^2 and *T* is the total period of the day (in seconds) during which vibration may occur. The acceptable VDV for intermittent vibration are reproduced in *Table 5.7* below.

Table 5.7 Criteria for Exposure to Intermittent Vibration

Location	Assessment Criteria - VDV, $m/s^{1.75}$			
	Daytime[1]		Night-time[1]	
	Preferred Value	Maximum Value	Preferred Value	Maximum Value
Critical working areas (hospital operating theatres, precision laboratories)	0.10	0.20	0.10	0.20
Residences	0.20	0.40	0.13	0.26
Offices, schools, educational institutions and placed of worship	0.40	0.80	0.40	0.80
Workshops	0.80	1.60	0.80	1.60

1. Daytime is 7AM to 10 pm and Night time is 10PM to 7AM.

5.3.2 Structural Damage Criteria

The DIN 4150-3 safe limit values (maximum levels measured in any direction at the foundation, or maximum levels measured in (x) or (y) horizontal directions, in the plane of the uppermost floor) are summarised in *Table 5.9* below.

Table 5.8 Structural Damage Safe Limit Values (DIN 4150-3)

Line	Type of Structure	Vibration Velocity in mm/s			
		Vibration at foundation at a Frequency of:			Plane of Floor of Uppermost Storey at all Frequencies
		Less than 10Hz	10Hz to 50Hz	50Hz to 100Hz[1]	
1	**Commercial Buildings:** Buildings used for commercial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50	40
2	**Residential Buildings:** Dwellings and buildings of similar design and/or use	5	5 to 15	5 to 20	15
3	**Sensitive Buildings:** Structures that because of their particular sensitivity to vibration do not correspond to those listed in Lines 1 or 2 and have intrinsic value (e.g. buildings that are under a preservation order)	3	3 to 8	8 to 10	8

1. At frequencies above 100Hz, the values given in this column may be used as a minimum.

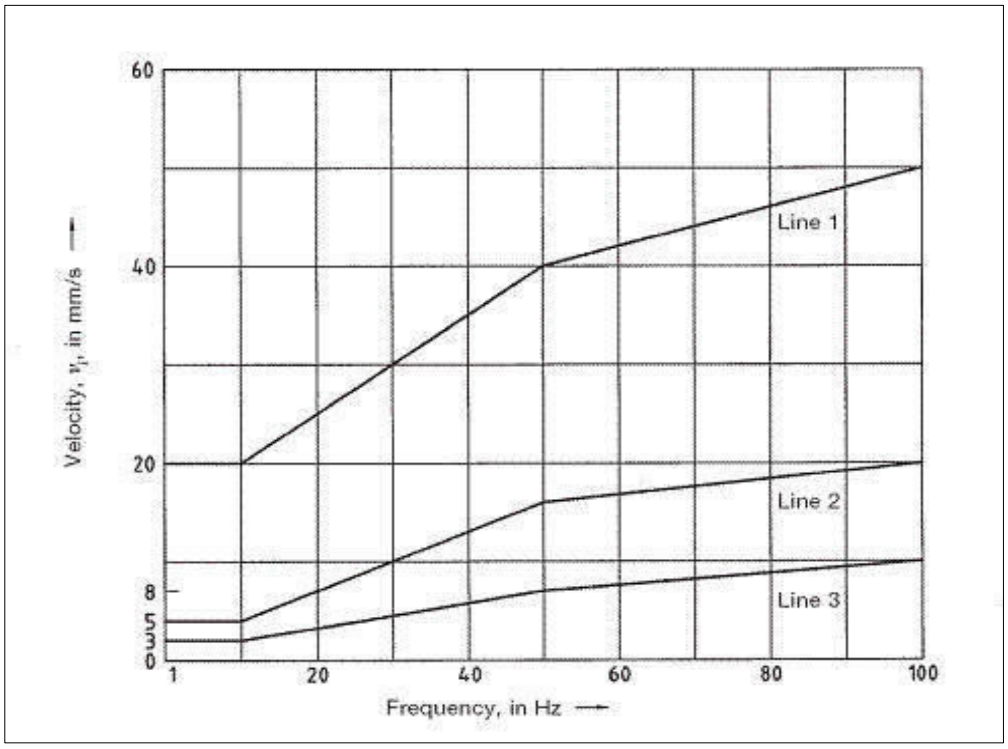
Guidance Note

These levels are safe limits, for which damage due to vibration is unlikely to occur. Damage is defined in DIN 4150 to include minor non-structural effects such as superficial cracking in cement render, the enlargement of cracks already present, and the separation of partitions or intermediate walls from load bearing walls.

Should such damage be observed without vibration levels exceeding the safe limits then it is likely to be attributable to other causes. DIN 4150 also states that when vibration levels higher than the safe limits are present, it does not necessarily follow that damage will occur.

As indicated by the criteria from DIN 4150 high frequency vibration has less potential to cause damage than that from lower frequencies - this is visually presented in *Figure 5.1* below. Furthermore, the point source nature of vibration from mining equipment causes the vibratory disturbances to arrive at different parts of nearby large structures in an out-of-phase manner, thereby reducing its potential to excite in-phase motion and hence reducing the potential for damage.

Figure 5.2 Structural Damage Safe Limits for a variety of building types



5.3.3 Project-Specific Vibration Criteria

Human annoyance and structural damage vibration criteria applicable to residential premises (as summarised above) have been adopted as the project-specific vibration criteria by which potential impacts have been assessed at the closest and/or potentially most affected sensitive receptor locations in the vicinity of the site.

This criterion summarised in *Table 5.9* includes recommended "Trigger Action Levels" for human annoyance vibration criteria which is considered appropriate for the assessment of intermittent vibration from construction, and operation of the project, as applied to residential (dwelling) premises.

Table 5.9 Project-Specific Vibration Criteria

Factor		Vibration Criterion	Trigger Action Level
Structural Damage		5 mm/s	3 mm/s
Human Disturbance	Daytime	0.2 VDV, $m/s^{1.75}$	3 mm/s
	Night time	0.13 VDV, $m/s^{1.75}$	1 mm/s

6 CONSTRUCTION NOISE ASSESSMENT

This chapter presents the results and findings of the construction noise assessment completed for the CCGT power plant (incl. piling, jetty (piling only) and transportation requirements for the broader project.

It is reiterated that the closest potentially sensitive structure is 90 metres from any proposed piling works, such that vibration levels are expected to be at or below 2 mm/s and compliant with the assessment criteria presented in *Section 5.2.2* of this report. Bulk earthworks are proposed within close proximity (< 10 metres) to nearby receptors however the plant, equipment and machinery that would typically be in use, or activities to be undertaken for this task, are not considered to be significant vibration generating sources like that associated with impact piling. Hence, this construction assessment focuses on potential noise impacts herein.

6.1 GENERAL CONSTRUCTION NOISE (CCGT & JETTY)

Based on the assessment methodology described in *Section 3.1* of this report the predicted CCGT and Jetty construction noise levels are presented in *Table 6.1* to *Table 6.7* below with comparison to the fixed value criteria for sensitive receptors (refer *Table 5.3*) and the consolidated project-specific noise criteria (refer *Table 5.4*).

Compliance is assessed based on the *Table 5.4* project design criteria ($L_{eq,\ 1\ hour}$ in dBA) for residential, institutional, educational receptors during both the daytime (7AM to 10PM) and night time (10PM to 7AM) assessment periods, and this data is highlighted in grey cells. Any noise levels exceeding criteria are highlighted in **bold** typeset.

A potential area of influence has been mapped for each of these works, defined by the most stringent daytime and night time noise criteria ($L_{eq,\ 1\ hour} \leq 55$ and 45 dBA), as identified in *Figure 6.1* to *Figure 6.7* below. The industrial noise receptor criteria ($L_{eq,\ 1\ hour} \leq 70$ dBA) is also shown. These maps do not apply for the assessment of compliance but have been produced to better understand the spatial extents of potential impacts and to define the measures presented in *Chapter 8* of this report.

It is reiterated the CCGT power plant impact piling maps and predicted levels incorporate the noise reducing mitigation measures summarised in *Section 3.1* and detailed in *Annex C* of this report i.e. pre-drilling to ten metres depth, at all piling locations; use of pile caps and cushions; and installation of EGI fence (assumed to be 2.4 metres for this assessment) adjacent to village area.

The impact piling maps and predicted levels also consider the work sequence for piling that will be 1) Power Block #1 + Cooling Tower, then 2) Power Block #2 + WT/WWT, then 3) Admin Bldg/Worksop + BSDG, and then 4) MEB Tank with a maximum of 12 piling rig units (at peak) working concurrently.

Table 6.1 Predicted CCGT Construction Noise Levels (Site Preparation / Building Construction Works, or similar)

Receptor	Project Construction Noise - Leq, 1 hour in dBA	Comparison to Criteria, dBA					
		Residential, Institutional, Educational Receptors				Commercial Receptors 65 dBA - Leq, 1 hour	Industrial Receptors 70 dBA - Leq, 1 hour
		Project Design Criteria (Table 5.4) - Leq, 1 hour		Fixed Value (55 day / 45 night) Criteria - Leq, 1 hour			
		Daytime (7AM to 10PM)	Night time (10PM to 7AM)	Daytime (7AM to 10PM)	Night time (10PM to 7AM)	Day / Night time (24 hour)	Day / Night time (24 hour)
N-1	55	0.0	**3.1**	0.0	**10.0**	-10.0	-15.0
N-2	58	-4.4	**2.9**	**3.0**	**13.0**	-7.0	-12.0
N-3	46	-13.9	-2.6	-9.0	**1.0**	-19.0	-24.0
N-4	51	-9.8	-4.0	-4.0	**6.0**	-14.0	-19.0
N-5	41	-14.0	-13.5	-14.0	-4.0	-24.0	-29.0
R1 (NCA 1)	60	-2.4	**4.9**	**5.0**	**15.0**	-5.0	-10.0
R2 (NCA 2)	84	**29.0**	**32.1**	**29.0**	**39.0**	**19.0**	**14.0**
R3 (NCA 3)	51	-9.8	-4.0	-4.0	**6.0**	-14.0	-19.0
R4 (NCA 4)	46	-14.8	-9.0	-9.0	**1.0**	-19.0	-24.0
R5 (NCA 5)	46	-13.9	-2.6	-9.0	**1.0**	-19.0	-24.0
R6 (NCA 6)	42	-17.9	-6.6	-13.0	-3.0	-23.0	-28.0

Table 6.2 Predicted CCGT Construction Noise Levels (Bulk Earthworks, or similar)

Receptor	Project Construction Noise - Leq, 1 hour in dBA	Comparison to Criteria, dBA					
		Residential, Institutional, Educational Receptors				Commercial Receptors 65 dBA - Leq, 1 hour	Industrial Receptors 70 dBA - Leq, 1 hour
		Project Design Criteria (Table 5.4) - Leq, 1 hour		Fixed Value (55 day / 45 night) Criteria - Leq, 1 hour			
		Daytime (7AM to 10PM)	Night time (10PM to 7AM)	Daytime (7AM to 10PM)	Night time (10PM to 7AM)	Day / Night time (24 hour)	Day / Night time (24 hour)
N-1	65	**10.0**	**13.1**	**10.0**	**20.0**	0.0	-5.0
N-2	68	**5.6**	**12.9**	**13.0**	**23.0**	**3.0**	-2.0
N-3	56	-3.9	**7.4**	**1.0**	**11.0**	-9.0	-14.0
N-4	61	**0.2**	**6.0**	**6.0**	**16.0**	-4.0	-9.0
N-5	51	-4.0	-3.5	-4.0	**6.0**	-14.0	-19.0
R1 (NCA 1)	70	**7.6**	**14.9**	**15.0**	**25.0**	**5.0**	0.0
R2 (NCA 2)	94	**39.0**	**42.1**	**39.0**	**49.0**	**29.0**	**24.0**
R3 (NCA 3)	61	**0.2**	**6.0**	**6.0**	**16.0**	-4.0	-9.0
R4 (NCA 4)	56	-4.8	**1.0**	**1.0**	**11.0**	-9.0	-14.0
R5 (NCA 5)	56	-3.9	**7.4**	**1.0**	**11.0**	-9.0	-14.0
R6 (NCA 6)	52	-7.9	**3.4**	-3.0	**7.0**	-13.0	-18.0

Table 6.3 Predicted CCGT Construction Noise Levels (Impact Piling, Work Sequence #1)

Receptor	Project Construction Noise - Leq, 1 hour in dBA	Comparison to Criteria, dBA					
		Residential, Institutional, Educational Receptors				Commercial Receptors 65 dBA - Leq, 1 hour	Industrial Receptors 70 dBA - Leq, 1 hour
		Project Design Criteria (Table 5.4) - Leq, 1 hour		Fixed Value (55 day / 45 night) Criteria - Leq, 1 hour			
		Daytime (7AM to 10PM)	Night time (10PM to 7AM)	Daytime (7AM to 10PM)	Night time (10PM to 7AM)	Day / Night time (24 hour)	Day / Night time (24 hour)
N-1	65	**10.0**	**13.1**	**10.0**	**20.0**	0.0	-5.0
N-2	64	**1.6**	**8.9**	**9.0**	**19.0**	-1.0	-6.0
N-3	58	-1.9	**9.4**	**3.0**	**13.0**	-7.0	-12.0
N-4	63	**2.2**	**8.0**	**8.0**	**18.0**	-2.0	-7.0
N-5	53	-2.0	-1.5	-2.0	**8.0**	-12.0	-17.0
R1 (NCA 1)	64	**1.6**	**8.9**	**9.0**	**19.0**	-1.0	-6.0
R2 (NCA 2)	61	**6.0**	**9.1**	**6.0**	**16.0**	-4.0	-9.0
R3 (NCA 3)	63	**2.2**	**8.0**	**8.0**	**18.0**	-2.0	-7.0
R4 (NCA 4)	61	**0.2**	**6.0**	**6.0**	**16.0**	-4.0	-9.0
R5 (NCA 5)	58	-1.9	**9.4**	**3.0**	**13.0**	-7.0	-12.0
R6 (NCA 6)	59	-0.9	**10.4**	**4.0**	**14.0**	-6.0	-11.0

1. *Work Sequence 1:* Power Block #1 + Cooling Tower. A +7.8 dBA adjustment was applied to each work area to account for uncertainties associated with the potential number of piling rigs that may be in use concurrently (and their location) during these activities.

Table 6.4 Predicted CCGT Construction Noise Levels (Impact Piling, Work Sequence #2)

Receptor	Project Construction Noise - Leq, 1 hour in dBA	Comparison to Criteria, dBA					
		Residential, Institutional, Educational Receptors				Commercial Receptors 65 dBA - Leq, 1 hour	Industrial Receptors 70 dBA - Leq, 1 hour
		Project Design Criteria (Table 5.4) - Leq, 1 hour		Fixed Value (55 day / 45 night) Criteria - Leq, 1 hour			
		Daytime (7AM to 10PM)	Night time (10PM to 7AM)	Daytime (7AM to 10PM)	Night time (10PM to 7AM)	Day / Night time (24 hour)	Day / Night time (24 hour)
N-1	63	**8.0**	**11.1**	**8.0**	**18.0**	-2.0	-7.0
N-2	63	**0.6**	**7.9**	**8.0**	**18.0**	-2.0	-7.0
N-3	56	-3.9	**7.4**	**1.0**	**11.0**	-9.0	-14.0
N-4	65	**4.2**	**10.0**	**10.0**	**20.0**	0.0	-5.0
N-5	52	-3.0	-2.5	-3.0	**7.0**	-13.0	-18.0
R1 (NCA 1)	63	**0.6**	**7.9**	**8.0**	**18.0**	-2.0	-7.0
R2 (NCA 2)	59	**4.0**	**7.1**	**4.0**	**14.0**	-6.0	-11.0
R3 (NCA 3)	63	**2.2**	**8.0**	**8.0**	**18.0**	-2.0	-7.0
R4 (NCA 4)	63	**2.2**	**8.0**	**8.0**	**18.0**	-2.0	-7.0
R5 (NCA 5)	56	-3.9	**7.4**	**1.0**	**11.0**	-9.0	-14.0
R6 (NCA 6)	58	-1.9	**9.4**	**3.0**	**13.0**	-7.0	-12.0

1. *Work Sequence 2:* Power Block #2 + WT/WWT. A +7.8 dBA adjustment was applied to each work area to account for uncertainties associated with the potential number of piling rigs that may be in use concurrently (and their location) during these activities.

Table 6.5 Predicted CCGT Construction Noise Levels (Impact Piling, Work Sequence #3)

Receptor	Project Construction Noise - Leq, 1 hour in dBA	Comparison to Criteria, dBA					
		Residential, Institutional, Educational Receptors				Commercial Receptors 65 dBA - Leq, 1 hour	Industrial Receptors 70 dBA - Leq, 1 hour
		Project Design Criteria (Table 5.4) - Leq, 1 hour		Fixed Value (55 day / 45 night) Criteria - Leq, 1 hour			
		Daytime (7AM to 10PM)	Night time (10PM to 7AM)	Daytime (7AM to 10PM)	Night time (10PM to 7AM)	Day / Night time (24 hour)	Day / Night time (24 hour)
N-1	64	**9.0**	**12.1**	**9.0**	**19.0**	-1.0	-6.0
N-2	63	**0.6**	**7.9**	**8.0**	**18.0**	-2.0	-7.0
N-3	55	-4.9	**6.4**	0.0	**10.0**	-10.0	-15.0
N-4	67	**6.2**	**12.0**	**12.0**	**22.0**	**2.0**	-3.0
N-5	51	-4.0	-3.5	-4.0	**6.0**	-14.0	-19.0
R1 (NCA 1)	63	**0.6**	**7.9**	**8.0**	**18.0**	-2.0	-7.0
R2 (NCA 2)	61	**6.0**	**9.1**	**6.0**	**16.0**	-4.0	-9.0
R3 (NCA 3)	67	**6.2**	**12.0**	**12.0**	**22.0**	**2.0**	-3.0
R4 (NCA 4)	63	**2.2**	**8.0**	**8.0**	**18.0**	-2.0	-7.0
R5 (NCA 5)	55	-4.9	**6.4**	0.0	**10.0**	-10.0	-15.0
R6 (NCA 6)	58	-1.9	**9.4**	**3.0**	**13.0**	-7.0	-12.0

1. *Work Sequence 3:* Admin Bldg/Worksop + BSDG. A +7.8 dBA adjustment was applied to each work area to account for uncertainties associated with the potential number of piling rigs that may be in use concurrently (and their location) during these activities.

Table 6.6 Predicted CCGT Construction Noise Levels (Impact Piling, Work Sequence #4)

Receptor	Project Construction Noise - Leq, 1 hour in dBA	Comparison to Criteria, dBA					
		Residential, Institutional, Educational Receptors				Commercial Receptors 65 dBA - Leq, 1 hour	Industrial Receptors 70 dBA - Leq, 1 hour
		Project Design Criteria (Table 5.4) - Leq, 1 hour		Fixed Value (55 day / 45 night) Criteria - Leq, 1 hour			
		Daytime (7AM to 10PM)	Night time (10PM to 7AM)	Daytime (7AM to 10PM)	Night time (10PM to 7AM)	Day / Night time (24 hour)	Day / Night time (24 hour)
N-1	61	**6.0**	**9.1**	**6.0**	**16.0**	-4.0	-9.0
N-2	62	-0.4	**6.9**	**7.0**	**17.0**	-3.0	-8.0
N-3	56	-3.9	**7.4**	**1.0**	**11.0**	-9.0	-14.0
N-4	64	**3.2**	**9.0**	**9.0**	**19.0**	-1.0	-6.0
N-5	52	-3.0	-2.5	-3.0	**7.0**	-13.0	-18.0
R1 (NCA 1)	63	**0.6**	**7.9**	**8.0**	**18.0**	-2.0	-7.0
R2 (NCA 2)	58	**3.0**	**6.1**	**3.0**	**13.0**	-7.0	-12.0
R3 (NCA 3)	62	**1.2**	**7.0**	**7.0**	**17.0**	-3.0	-8.0
R4 (NCA 4)	63	**2.2**	**8.0**	**8.0**	**18.0**	-2.0	-7.0
R5 (NCA 5)	56	-3.9	**7.4**	**1.0**	**11.0**	-9.0	-14.0
R6 (NCA 6)	59	-0.9	**10.4**	**4.0**	**14.0**	-6.0	-11.0

1. *Work Sequence 4:* MEB Tank. A +10.8 dBA adjustment was applied to this work area to account for uncertainties associated with the potential number of piling rigs that may be in use concurrently (and their location) during this activity.

Table 6.7 Predicted Jetty Piling Construction Noise Levels

Receptor	Project Construction Noise - Leq, 1 hour in dBA	Comparison to Criteria, dBA					
		Residential, Institutional, Educational Receptors				Commercial Receptors 65 dBA - Leq, 1 hour	Industrial Receptors 70 dBA - Leq, 1 hour
		Project Design Criteria (Table 5.4) - Leq, 1 hour		Fixed Value (55 day / 45 night) Criteria - Leq, 1 hour			
		Daytime (7AM to 10PM)	Night time (10PM to 7AM)	Daytime (7AM to 10PM)	Night time (10PM to 7AM)	Day / Night time (24 hour)	Day / Night time (24 hour)
N14	43	-12	-2	-12	-2	-22	-27

1. A +6 dBA adjustment has been applied to the predicted value at N14 (37 dBA) to account for a) the unmitigated use of the piling rig and b) uncertainties associated with the potential number of piling rigs (and other associated equipment) that may be in use concurrently during this activity.

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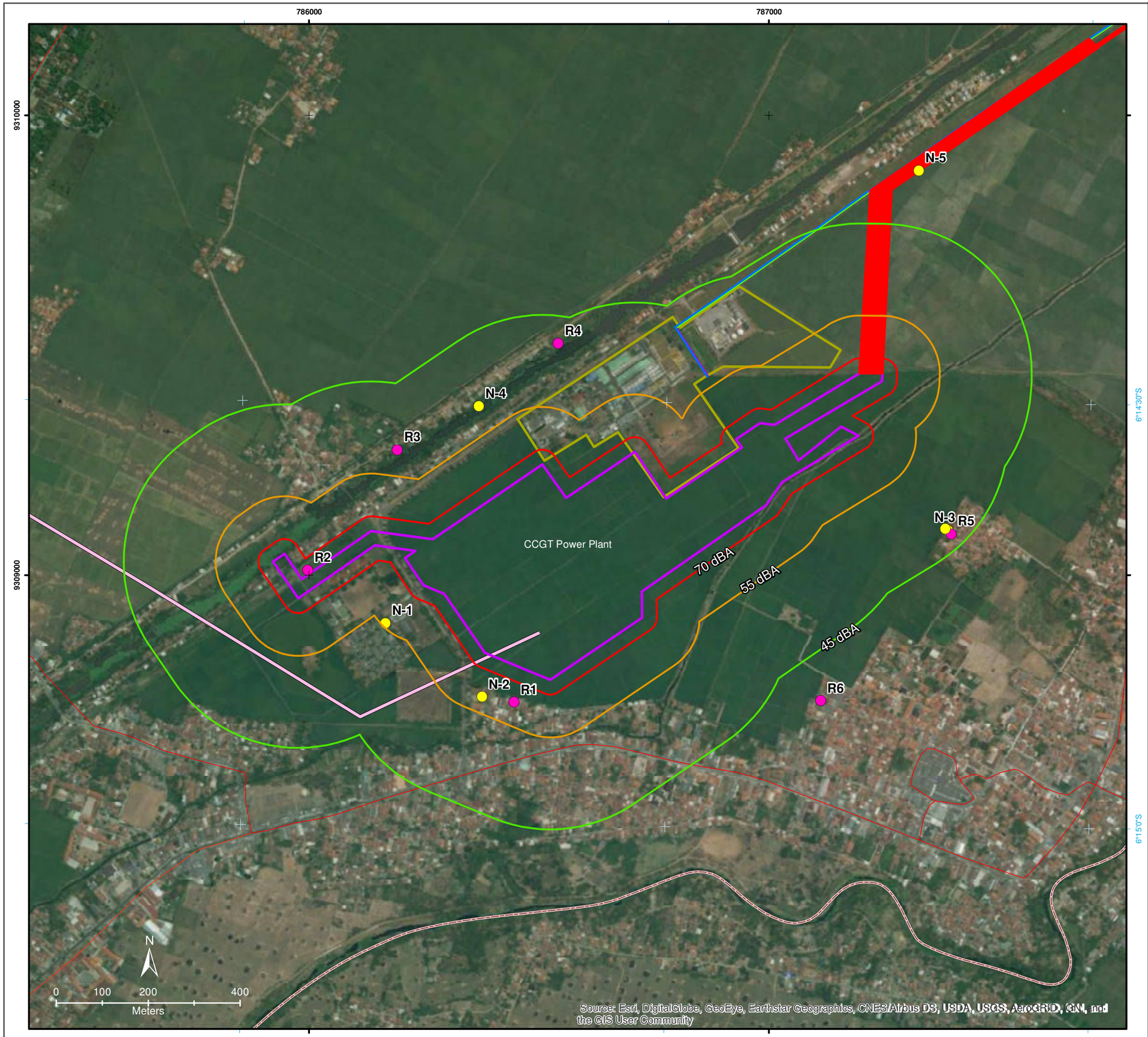
Environmental and Social Impact Assessment (ESIA) for Jawa-1 Project

Figure 6.1
Potential CCGT Area of Influence Construction Noise (Site Preparation/ Building Construction, or Similar)



LEGEND

- Road
- Regency Boundary
- Distict Boundary
- Cibatu 2 Substation
- Onshore Pipeline (Gas, Intake, and Outflow)
- Access Road to Pump Station and Jetty
- Transmission Line
- CCGT Power Plant
- SKG Cilamaya

Sampling Point

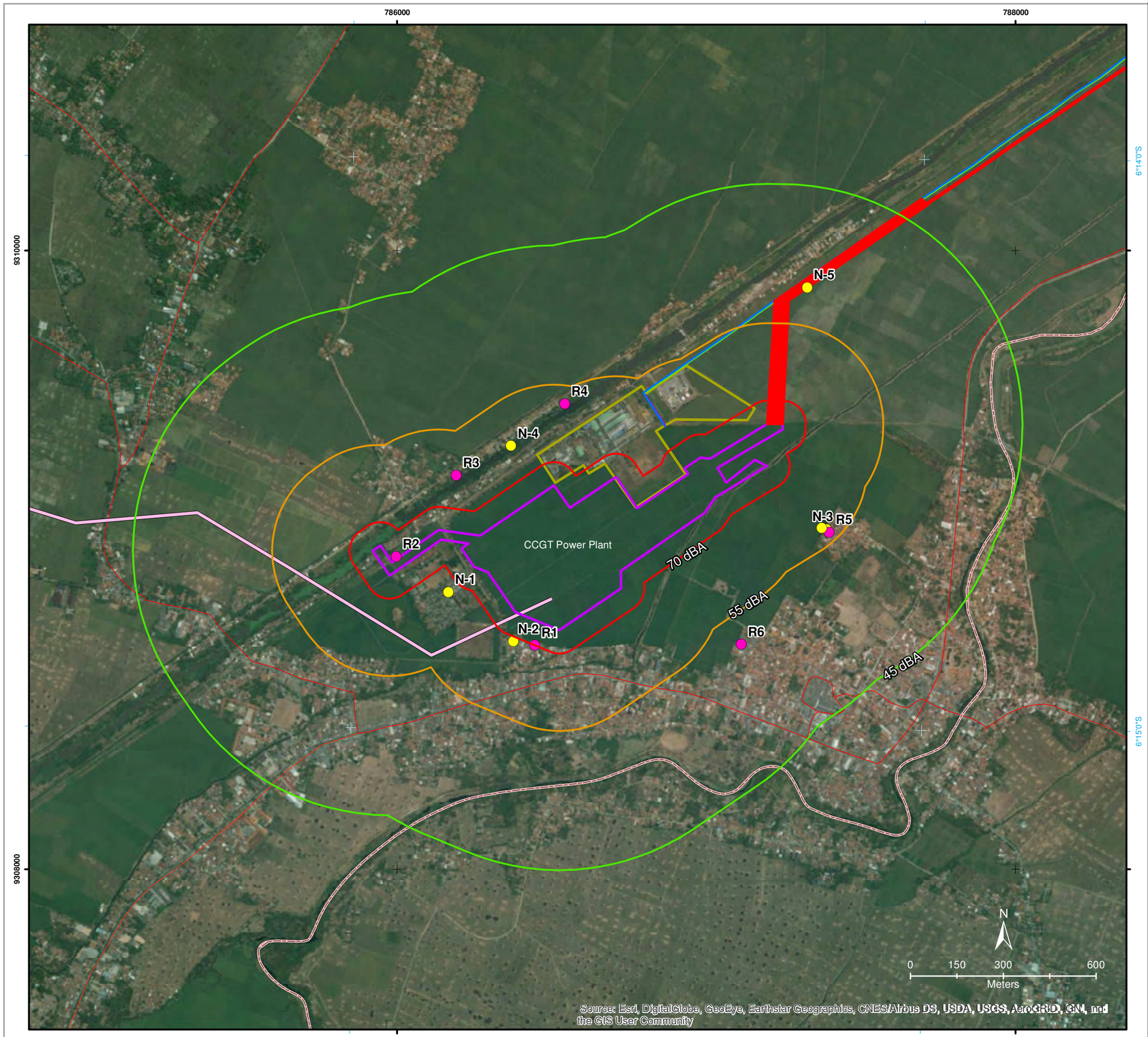
- Samsung Noise Monitoring Location
- ESIA Noise Monitoring Location

Noise Contour

- 45 dBA
- 55 dBA
- 70 dBA

Source:
- Jawa Satu Power, 2017
- ESRI Online Imagery, 2017

ERM	Drawn By : IA & IF	Client :	Jawa Satu Power
	Checked By : NL	Date :	03/07/2018
	Revision :	Map Number :	



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Environmental and Social Impact Assessment (ESIA) for Jawa-1 Project

Figure 6.2
Potential CCGT Area of Influence Construction Noise (Bulk Earthworks, or Similar)

LEGEND

- Road
- Regency Boundary
- Distict Boundary
- Cibatu 2 Substation
- Onshore Pipeline (Gas, Intake, and Outflow)
- Access Road to Pump Station and Jetty
- Transmission Line
- CCGT Power Plant
- SKG Cilamaya
- Cibatu 2 Substation

Sampling Point

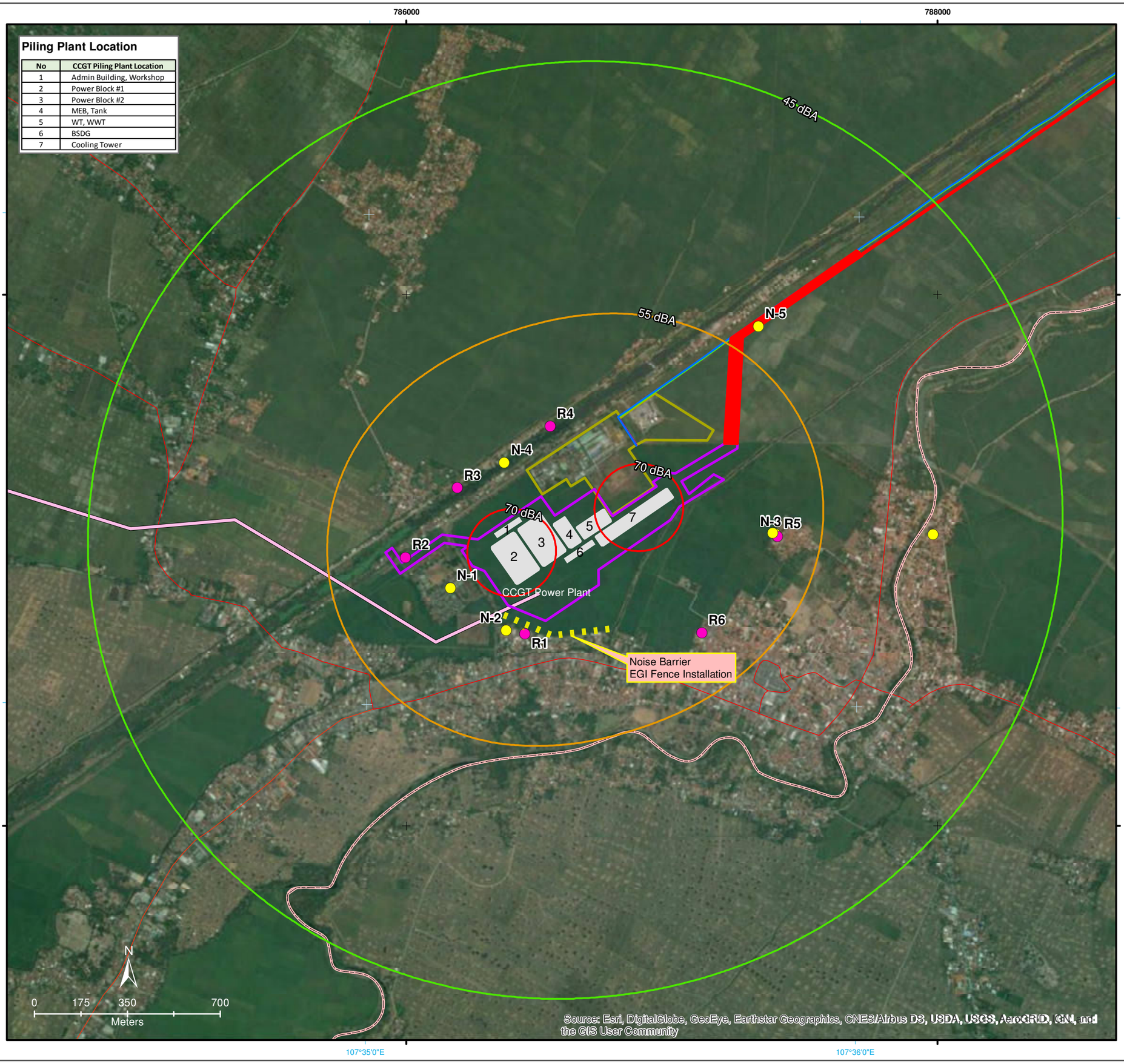
- Samsung Noise Monitoring Location
- ESIA Noise Monitoring Location

Noise Contour

- 45 dBA
- 55 dBA
- 70 dBA

Source:
- Jawa Satu Power, 2017
- ESRI Online Imagery, 2017

ERM	Drawn By : IA & IF	Client :	Jawa Satu Power
	Checked By : NL	Date :	03/07/2018
	Revision :	Map Number :	



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Environmental and Social Impact Assessment (ESIA) for Jawa-1 Project

Figure 6.3
Potential CCGT Area of Influence Construction Noise (Impact Piling, or Similar) Work Sequence #1

LEGEND

- Road
- Regency Boundary
- Distict Boundary
- Onshore Pipeline (Gas, Intake, and Outflow)
- Access Road to Pump Station and Jetty
- Transmission Line
- Noise Barrier - EGI Fence Installation
- CCGT Power Plant
- SKG Cilamaya

Sampling Point

- Samsung Noise Monitoring Location
- ESIA Noise Monitoring Location

Noise Contour

- 45 dBA
- 55 dBA
- 70 dBA

Source:
- Jawa Satu Power, 2017
- ESRI Online Imagery, 2017

ERM	Drawn By : IA & IF	Client :	Jawa Satu Power
	Checked By : NL	Date :	03/07/2018
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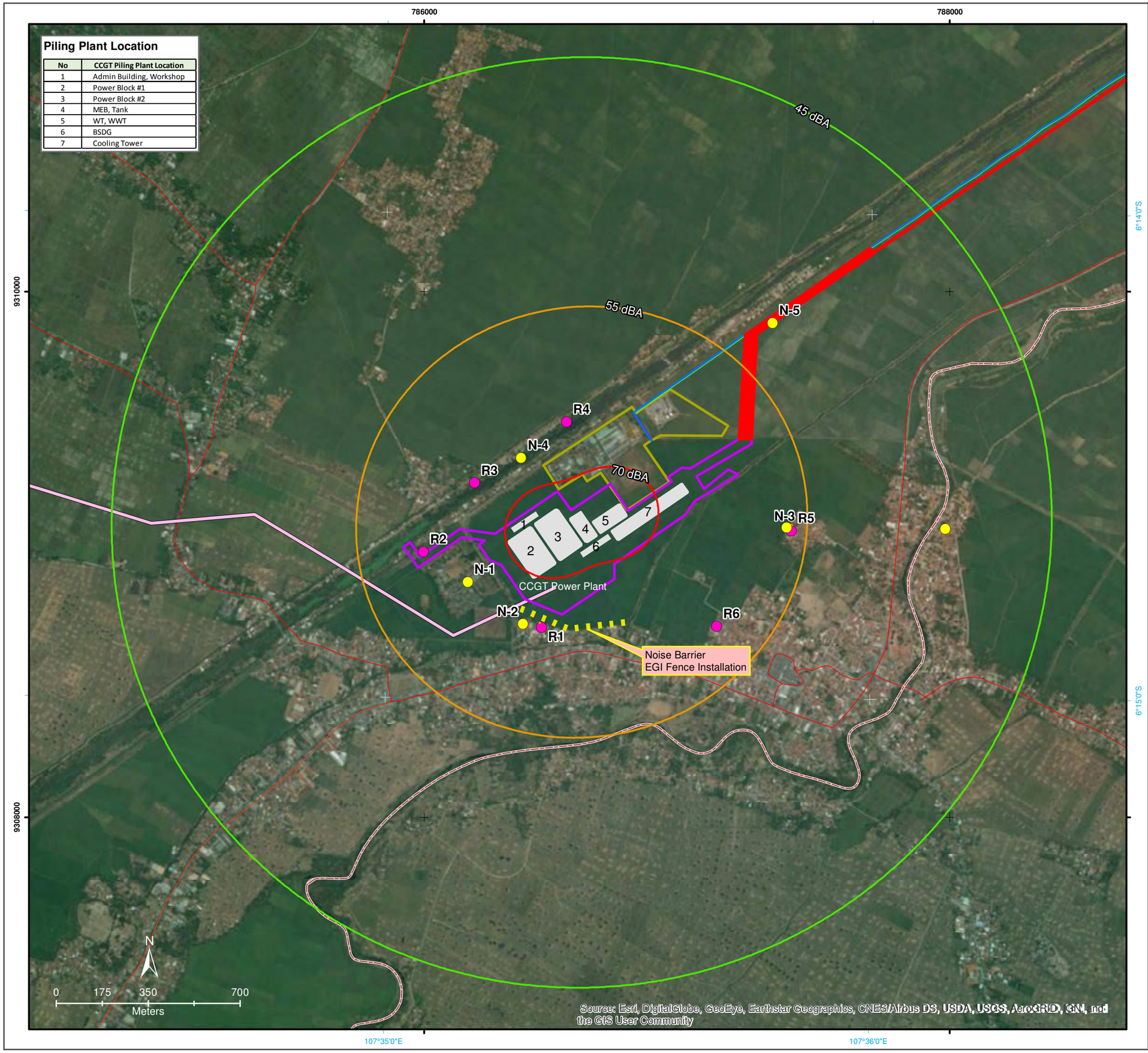

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Environmental and Social Impact Assessment (ESIA) for Jawa-1 Project

Figure 6.4
Potential CCGT Area of Influence Construction Noise (Impact Piling, or Similar) Work Sequence #2

LEGEND

- Road
- Regency Boundary
- Distict Boundary
- Onshore Pipeline (Gas, Intake, and Outflow)
- Access Road to Pump Station and Jetty
- Transmission Line
- Noise Barrier - EGI Fence Installation
- CCGT Power Plant
- SKG Cilamaya

Sampling Point

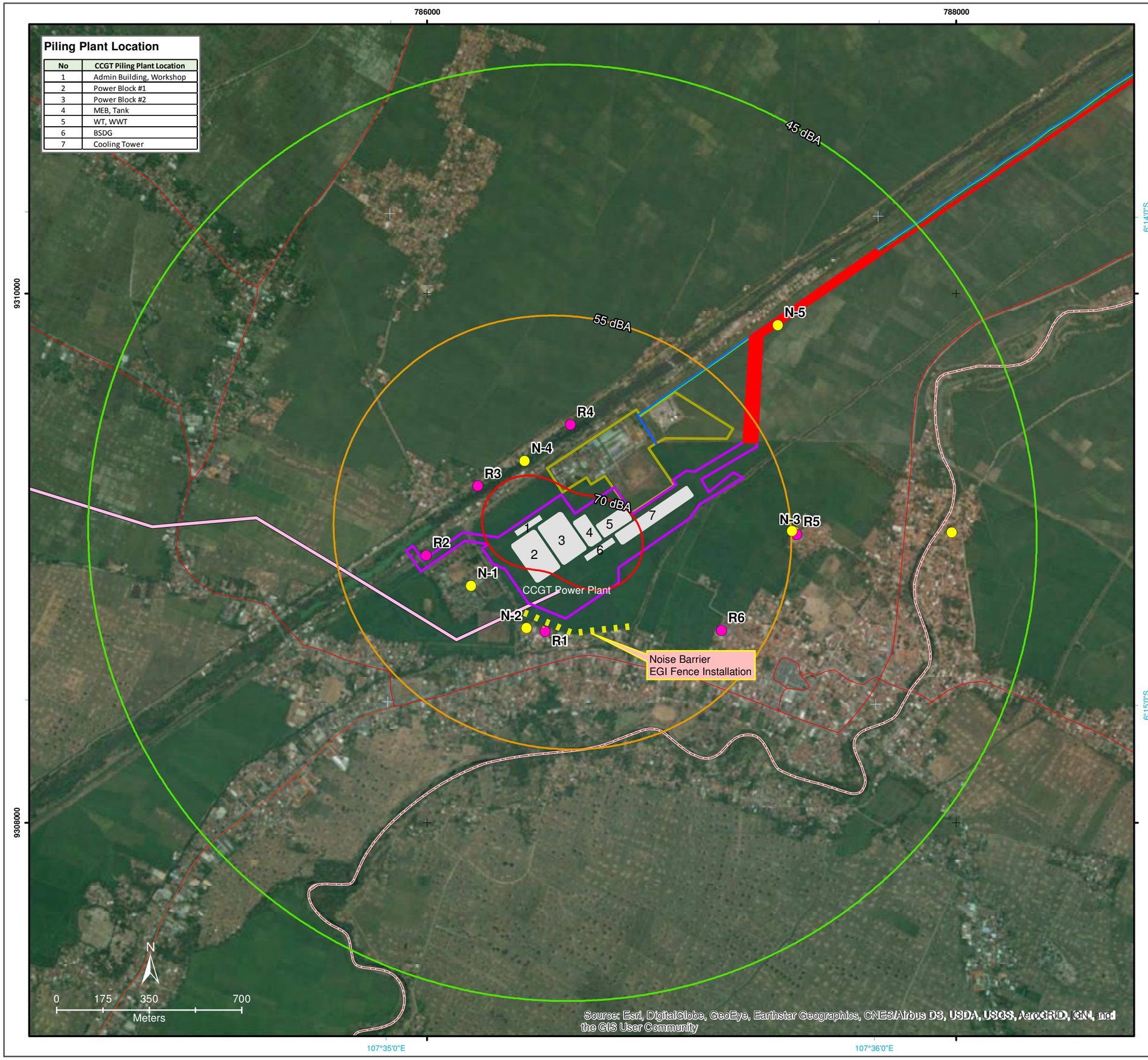
- Samsung Noise Monitoring Location
- ESIA Noise Monitoring Location

Noise Contour

- 45 dBA
- 55 dBA
- 70 dBA

Source:
- Jawa Satu Power, 2017
- ESRI Online Imagery, 2017

ERM	Drawn By : IA & IF	Client :	Jawa Satu Power
	Checked By : NL	Date :	03/07/2018
	Revision :	Map Number :	



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Environmental and Social Impact Assessment (ESIA) for Jawa-1 Project

Figure 6.5
Potential CCGT Area of Influence Construction Noise (Impact Piling, or Similar) Work Sequence #3

LEGEND

- Road
- Regency Boundary
- Distict Boundary
- Onshore Pipeline (Gas, Intake, and Outflow)
- Access Road to Pump Station and Jetty
- Transmission Line
- Noise Barrier - EGI Fence Installation
- CCGT Power Plant
- SKG Cilamaya

Sampling Point

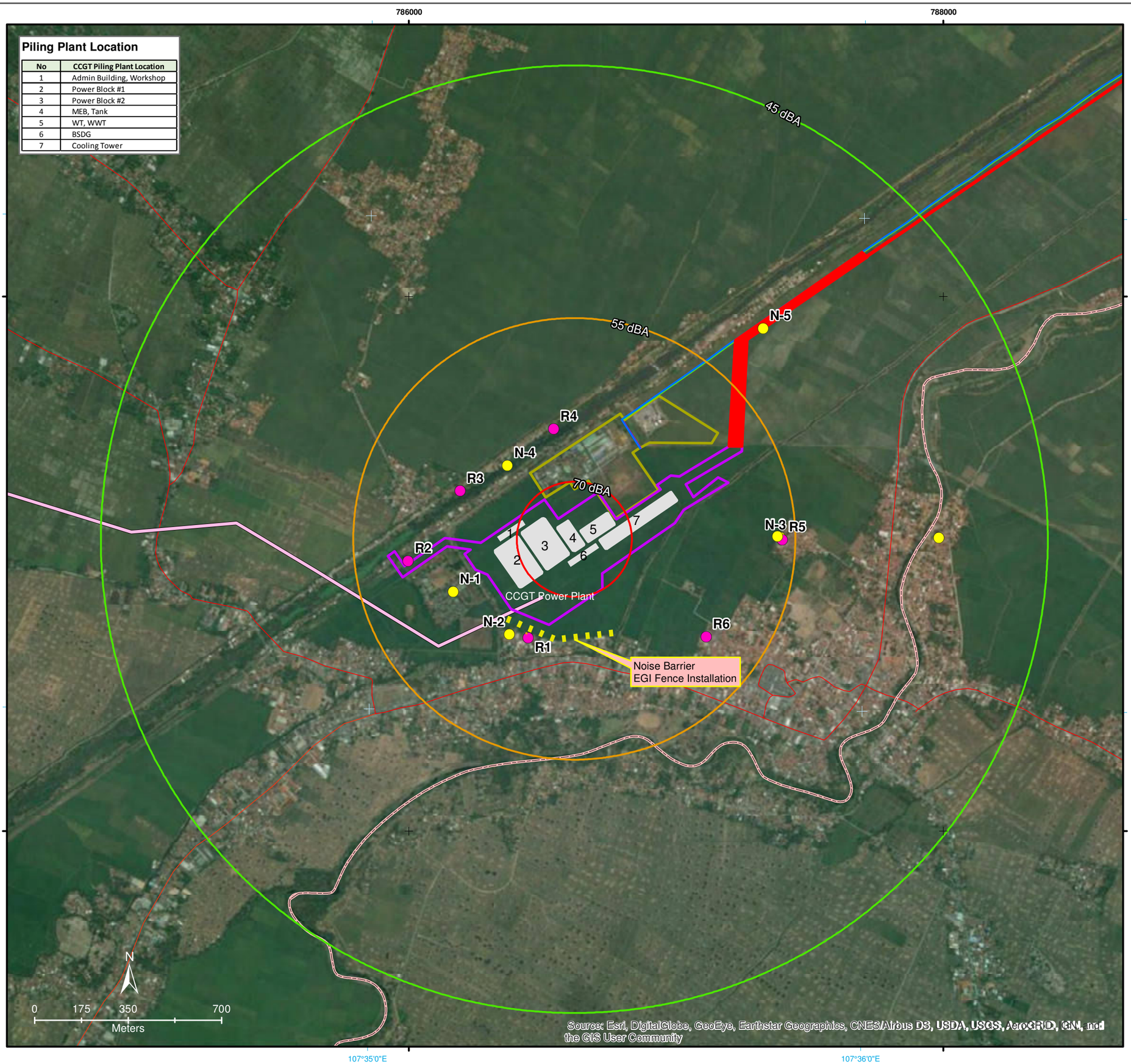
- Samsung Noise Monitoring Location
- ESIA Noise Monitoring Location

Noise Contour

- 45 dBA
- 55 dBA
- 70 dBA

Source:
- Jawa Satu Power, 2017
- ESRI Online Imagery, 2017

ERM	Drawn By : IA & IF	Client :	Jawa Satu Power
	Checked By : NL	Date :	03/07/2018
	Revision :	Map Number :	



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Environmental and Social Impact Assessment (ESIA) for Jawa-1 Project

Figure 6.6
Potential CCGT Area of Influence Construction Noise (Impact Piling, or Similar) Work Sequence #4

LEGEND

- Road
- Regency Boundary
- Distict Boundary
- Onshore Pipeline (Gas, Intake, and Outflow)
- Access Road to Pump Station and Jetty
- Transmission Line
- Noise Barrier - EGI Fence Installation
- CCGT Power Plant
- SKG Cilamaya

Sampling Point

- Samsung Noise Monitoring Location
- ESIA Noise Monitoring Location

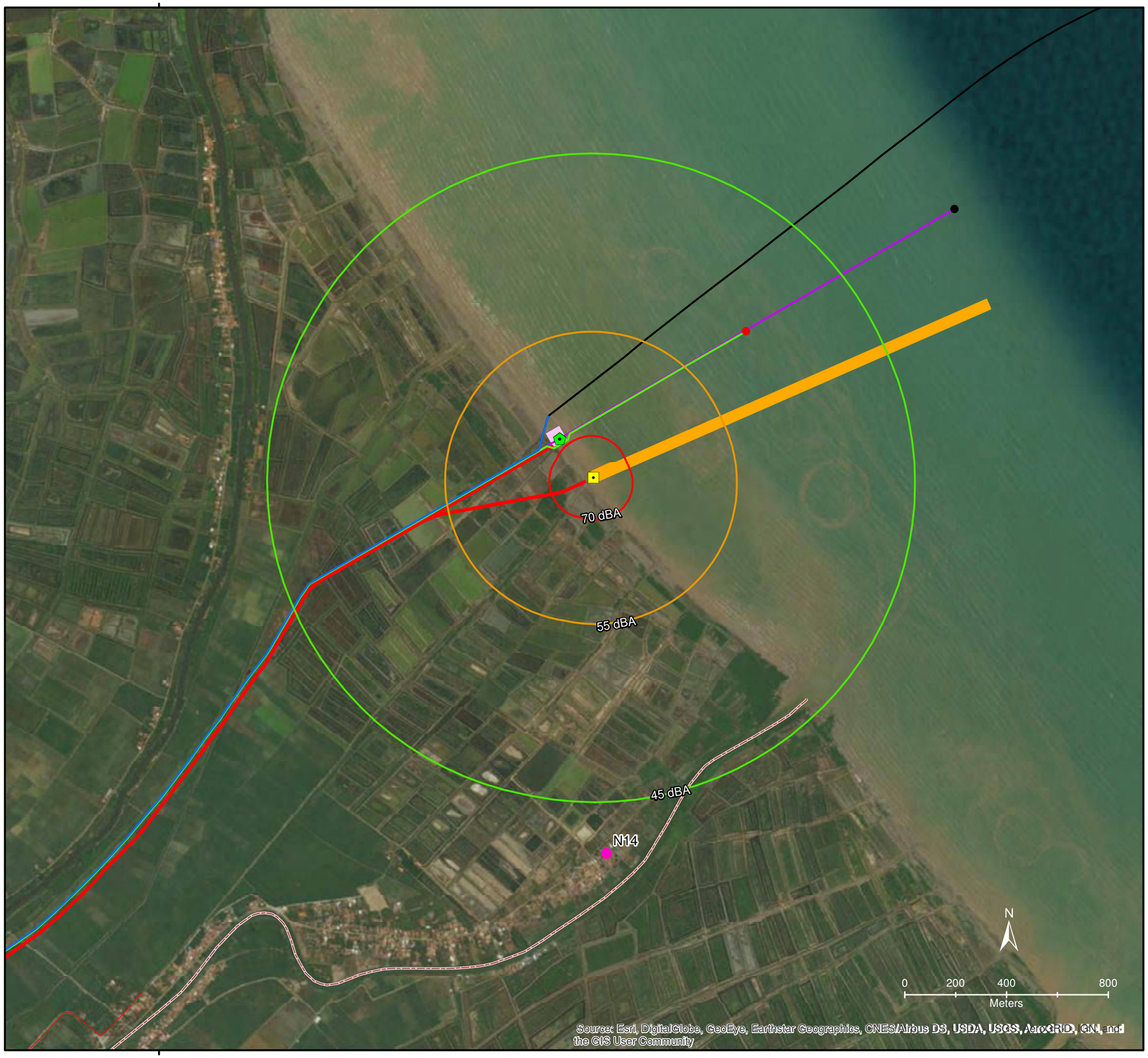
Noise Contour

- 45 dBA
- 55 dBA
- 70 dBA

Source:
- Jawa Satu Power, 2017
- ESRI Online Imagery, 2017

Drawn By :	IA & IF	Client :	Jawa Satu Power
Checked By :	NL	Date :	03/07/2018
Revision :		Map Number :	

ERM



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Environmental and Social Impact Assessment (ESIA) for Jawa-1 Project

Figure 6.7
Potential Jetty Piling Area Of Influence Construction Noise (Impact Piling, or Similar)

LEGEND

- Jetty
- Pump Station
- Water Intake Point
- Water Discharge Point
- Intake Pipeline
- Outflow Pipeline
- Gas Pipeline (Offshore)
- Dredging Plan
- Gas Pipeline (Onshore)
- Access Road

Sampling Point

- Noise Sampling Location

Offset Lines

- 45 dBA
- 55 dBA
- 70 dBA

Source:
- Jawa Satu Power, 2017
- ESRI Online Imagery, 2017

ERM	Drawn By : IA & IF	Client :	Jawa Satu Power
	Checked By : FF	Date :	03/07/2018
	Revision :	Map Number :	

6.1.1 Summary of Findings

The resultant noise levels presented in *Table 6.1* to *Table 6.6* and potential areas of influence mapped in *Figure 6.1* to *Figure 6.6* for the construction of the CCGT identify that **moderate** to **major** impacts could be generated depending on the works being conducted, their location, the time of day (day or night), and the proximity of the closest and/or potentially most affected receptors.

The resultant noise levels presented in *Table 6.7* and potential area of influence mapped in *Figure 6.7* for the Jetty impact piling identify that **negligible** or **minor** impacts (day or night) are anticipated at N14, the closest and/or potentially most affected receptor near the Jetty.

For the majority of work activities assessed and documented in *Table 6.1* to *Table 6.6* above, the predicted noise levels generally remain below 70 dBA at all receptors. For the site preparation, building construction and bulk earthworks scenarios documented in *Table 6.1* and *Table 6.2* significantly elevated noise levels are reported at receptor R2. This is due to the very close proximity (< 10 metres) of this receptor location to the projects north-western boundary.

Due to the less stringent criteria that applies to commercial and industrial receptors, impacts are considered to be significantly lower than that documented for residential, educational or institutional receptors.

Unlike operational emissions, noise associated with the CCGT construction do not represent a permanent impact or change in noise conditions, such that the assessment provided in accordance with the IFC 1.7 noise criteria is somewhat conservative. These CCGT construction emissions do not represent a constant source of noise that will occur on a day-to-day basis or for the duration of the construction schedule. These emissions will occur for only portions of the works, and during those works will not occur for the entire daytime periods. This is typical of construction works and for projects of this scale and nature.

Based on the **moderate** to **major** potential CCGT power plant construction impact significance defined above, a set of recommendations, safeguards, provisions and contingencies have been defined as presented in *Chapter 8* of this report.

Noise levels may be reduced and impacts minimised with the successful implementation of these measures. Following implementation of these measures, **moderate** residual impacts are anticipated. Impacts may not be reduced to be negligible or minor at all receptors and for all project components and phases; however the measures presented in *Chapter 8* will assist ensure that any residual impacts are minimised as far as may be practically achievable.

6.2 *CONSTRUCTION ROAD TRAFFIC NOISE*

Based on the assessment methodology described in *Section 3.2* of this report the predicted construction road traffic noise levels are presented in *Table 6.8* to *Table 6.11* below including a comparison to the consolidated project-specific noise criteria documented in *Table 5.3*.

Distance offsets that noise levels comply with the fixed value criteria are highlighted in grey cells. Any noise levels that exceed fixed value criteria are highlighted in **bold** typeset.

Discussion regarding the potential increase in noise levels is provided in *Section 6.2.1* below, with respect to the requirements of IFC 1.7 Noise and the existing noise levels documented in *Chapter 4* of this report.

A potential area of influence has been mapped for each of these road traffic scenarios, defined by the most stringent daytime noise criteria ($L_{eq,\ 1\ hour} \leq 55$ dBA), as identified in *Figure 6.8* to *Figure 6.10* below.

These maps have been produced to better understand the potential spatial extents of impacts and to define the measures presented in *Chapter 8* of this report.

Table 6.8 Scenario 1 - Dump Trucks & Material Delivery Trucks (30 pass-bys/hour)

Distance, metres[1]	Project Heavy Vehicle Noise - Leq, 1 hour	Comparison to Criteria			
		Residential, Institutional, Educational Receptors		Commercial Receptors	Industrial Receptors
		Daytime - 55 dBA	Night time - 45 dBA	Day/Night - 65 dBA	Day/Night - 70 dBA
5	67	**12**	**22**	**2**	-3
10	65	**10**	**20**	0	-5
20	62	**7**	**17**	-3	-8
40	61	**6**	**16**	-4	-9
70	55	0	**10**	-10	-15

1. Horizontal distance offset from roadway centre line in metres.

Table 6.9 Scenario 2 – Material Delivery Trucks (2 pass-bys/hour)

Distance, metres[1]	Project Heavy Vehicle Noise - Leq, 1 hour	Comparison to Criteria			
		Residential, Institutional, Educational Receptors		Commercial Receptors	Industrial Receptors
		Daytime - 55 dBA	Night time - 45 dBA	Day/Night - 65 dBA	Day/Night - 70 dBA
5	55	0	**10**	-10	-15
10	53	-2	**8**	-12	-17
20	50	-5	**5**	-15	-20
40	47	-8	**2**	-18	-23

1. Horizontal distance offset from roadway centre line in metres.

Table 6.10 Scenario 3 – Representative Case (1,000 pass-bys/day)

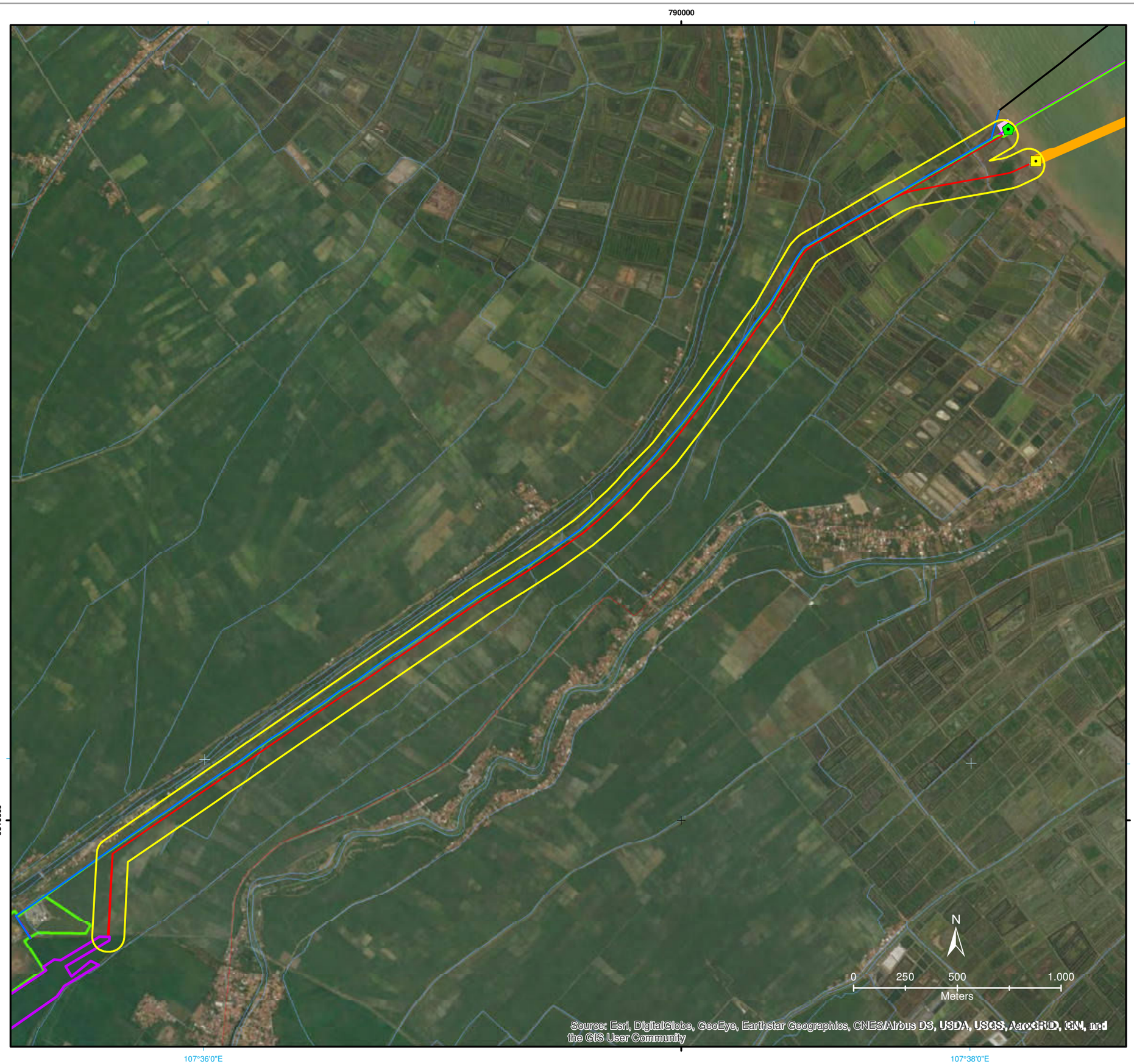
Distance, metres[1]	Project Heavy Vehicle Noise - Leq, 1 hour	Comparison to Criteria			
		Residential, Institutional, Educational Receptors		Commercial Receptors	Industrial Receptors
		Daytime - 55 dBA	Night time - 45 dBA	Day/Night - 65 dBA	Day/Night - 70 dBA
5	69	**14**	**24**	**4**	-1
10	66	**11**	**21**	**1**	-4
20	62	**7**	**17**	-3	-8
40	59	**4**	**14**	-6	-11
80	55	0	**10**	-10	-15

1. Horizontal distance offset from roadway centre line in metres.

Table 6.11 Scenario 4 – Representative Worst-case (10,000 pass-bys/day)

Distance, metres[1]	Project Heavy Vehicle Noise - Leq, 1 hour	Comparison to Limiting Criteria			
		Residential, Institutional, Educational Receptors		Commercial Receptors	Industrial Receptors
		Daytime - 55 dBA	Night time - 45 dBA	Day/Night - 65 dBA	Day/Night - 70 dBA
5	71	**16**	**26**	**6**	**1**
10	68	**13**	**23**	**3**	-2
20	65	**10**	**20**	0	-5
40	61	**6**	**16**	-4	-9
70	58	**3**	**13**	-7	-12
120	55	0	**10**	-10	-15

1. Horizontal distance offset from roadway centre line in metres.



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Environmental and Social Impact Assessment (ESIA) for Jawa-1 Project

Figure 6.8
Potential Road Traffic Area of Influence Construction Noise (Scenario1)

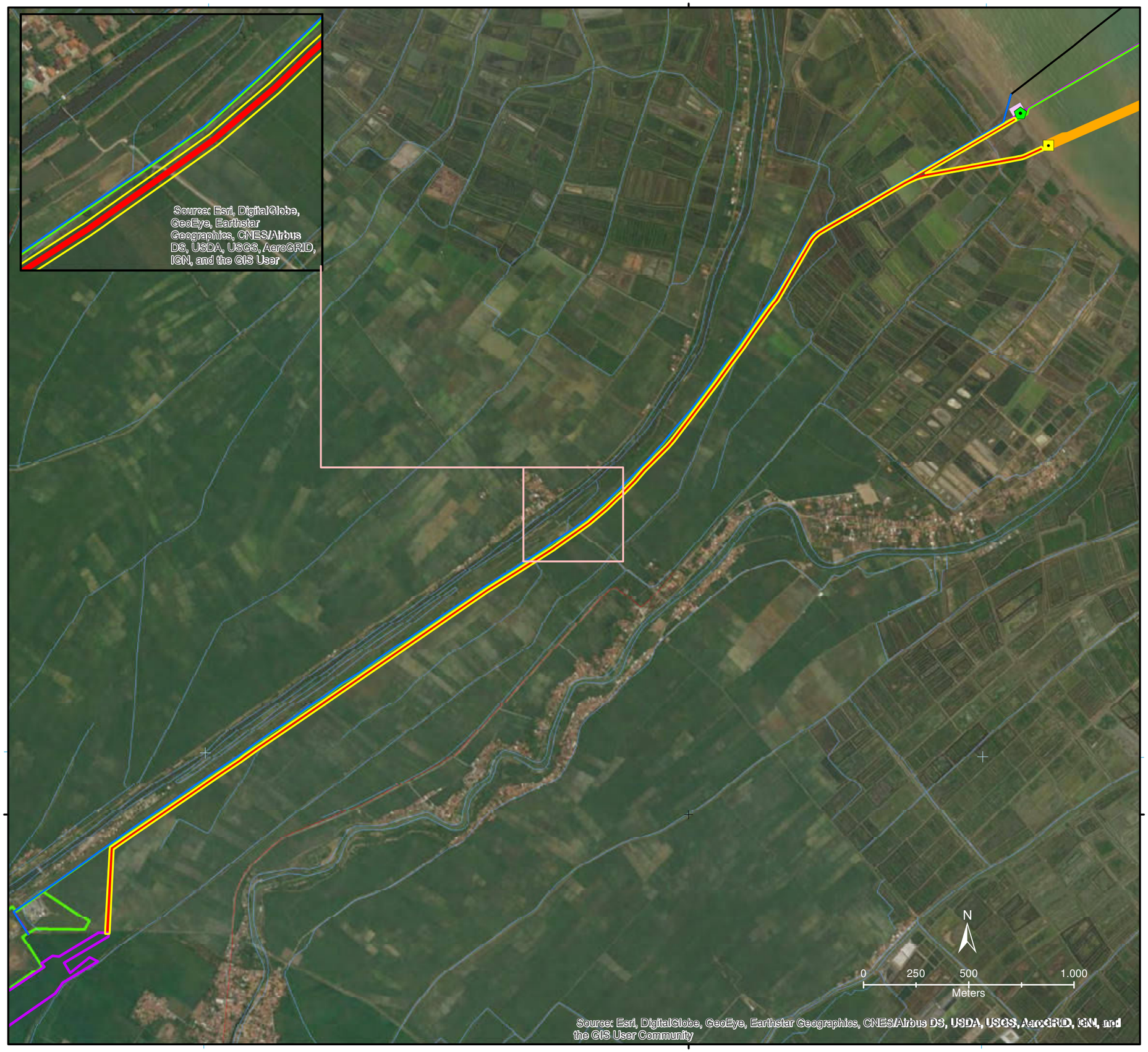
LEGEND

Project Plan

- Jetty Location
- Pump Station
- Offshore Gas Pipeline from FSRU
- Discharge Pipeline
- Intake Pipeline
- Dredging Plan for Jetty Access
- Onshore Pipeline (Gas, Intake, and Outflow)
- Access Road to Pump Station and Jetty
- CCGT Power Plant
- SKG Cilamaya
- Dump Truck and Material Delivery Trucks (30 pass-bys/hour)

Source:
- Jawa Satu Power, 2017
- ArcgGis-Online Satellite Image, 2018

ERM	Drawn By : IA & IF	Client :	Jawa Satu Power
	Checked By : NL	Date :	03/07/2018
	Revision :	Map Number :	



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Environmental and Social Impact Assessment (ESIA) for Jawa-1 Project

Figure 6.9
Potential Road Traffic Area of Influence Construction Noise (Scenario 2)

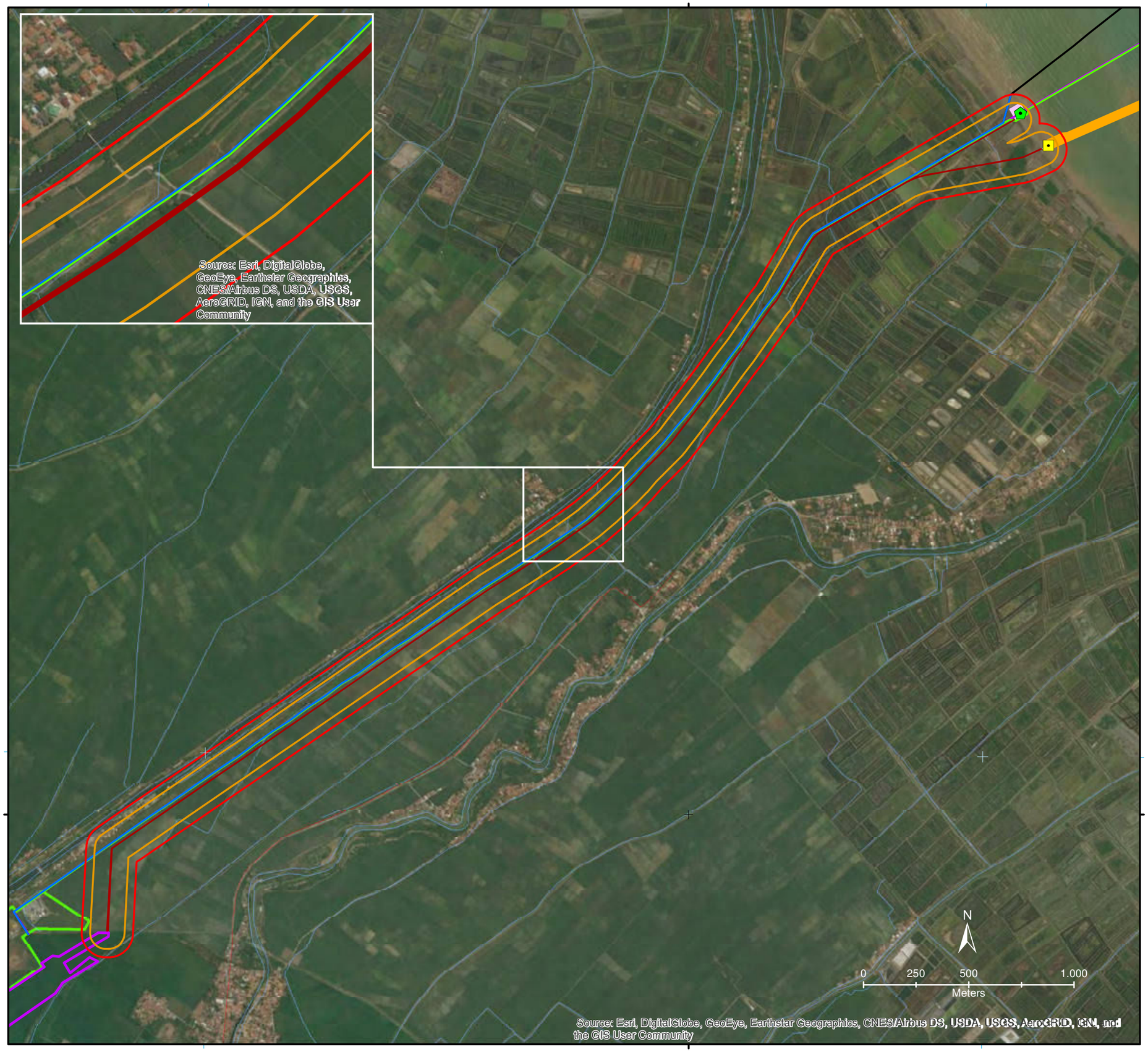
LEGEND

Project Plan

- Jetty Location
- Pump Station
- Offshore Gas Pipeline from FSRU
- Discharge Pipeline
- Intake Pipeline
- Dredging Plan for Jetty Access
- Onshore Pipeline (Gas, Intake, and Outflow)
- Access Road to Pump Station and Jetty
- CCGT Power Plant
- SKG Cilamaya
- Material Delivery Trucks (2 pass-bys/hour)

Source:
- Jawa Satu Power, 2017
- ArcgGis-Online Satellite Image, 2018

ERM	Drawn By : IA & IF	Client :	Jawa Satu Power
	Checked By : NL	Date :	03/07/2018
	Revision :	Map Number :	



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Environmental and Social Impact Assessment (ESIA) for Jawa-1 Project

Figure 6.10
Potential Road Traffic Area of Influence Construction Noise (Scenario 3 and 4)

LEGEND

Project Plan

- Jetty Location
- Pump Station
- Offshore Gas Pipeline from FSRU
- Discharge Pipeline
- Intake Pipeline
- Dredging Plan for Jetty Access
- Onshore Pipeline (Gas, Intake, and Outflow)
- Access Road to Pump Station and Jetty
- CCGT Power Plant
- SKG Cilamaya
- Representative Case (1,000 pass-bys/hour)
- Representative Worst-case (10,000 pass-bys/hour)

Source:
- Jawa Satu Power, 2017
- ArcgGis-Online Satellite Image, 2018

Drawn By :	IA & IF	Client :	Jawa Satu Power
Checked By :	NL	Date :	03/07/2018
Revision :		Map Number :	

ERM

6.2.1 Summary of Findings

The resultant noise levels presented in *Table 6.8* to *Table 6.11* and potential area of influence mapped in *Figure 6.8* to *Figure 6.10* for the projects construction road traffic identify that **moderate** to **major** impacts could be generated depending on the vehicle flows and the proximity of the closest and/or potentially most affected receptors.

Road traffic noise levels are predicted to be above the daytime IFC 1.7 Noise threshold (55 dBA) for receptors within 120 metres of the access road. Due to the less stringent criteria that applies to commercial and industrial receptors, impacts are significantly lower than that documented for residential, educational or institutional receptors

Consideration of existing noise levels near the project roads and distance offsets mapped in *Figure 6.8* to *Figure 6.10* identifies that existing levels already exceed the most stringent daytime IFC criteria (55 dBA). This is identifiable in the measured noise levels presented for N-5 in *Table 4.3* where existing daytime levels are 55.5 dBA resulting in an IFC 1.7 Noise (existing +3 dB) of 58.5 dBA. Despite these elevated existing noise level conditions, **moderate** to **major** impacts are anticipated.

Based on the **moderate** to **major** potential impact significance defined above for these construction road traffic features, a set of recommendations, safeguards, provisions and contingencies have been defined as presented in *Chapter 8* of this report.

Noise levels may be reduced and impacts minimised with the successful implementation of these measures. Following implementation of these measure, **moderate** residual impacts are anticipated. Impacts may not be reduced to be negligible or minor at all receptors and for all project components and phases; however the measures presented in *Chapter 8* will assist ensure that any residual impacts are minimised as far as may be practically achievable.

7 OPERATIONAL NOISE ASSESSMENT

Based on the methodology, inputs and assumptions described in *Chapter 3* of this report L_{eq} noise levels have been predicted for operational project components where a potential for impacts to occur has been identified. This includes operational noise emissions associated with the CCGT power plant, substation and corona noise emissions from the transmission line.

7.1 CCGT OPERATIONAL NOISE

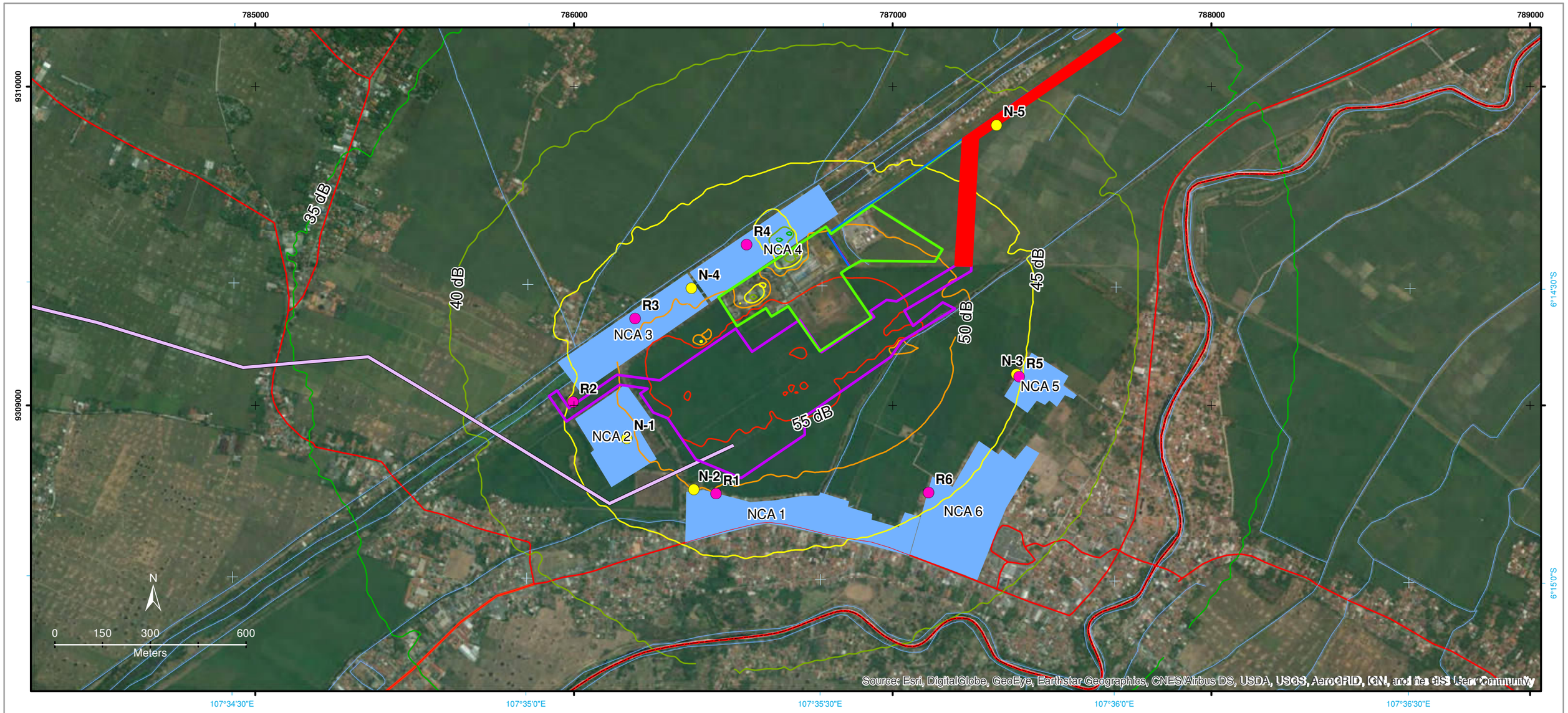
The resultant operational noise levels for the CCGT power plant, comparison to the consolidated project-specific noise criteria documented in *Section 5.1.3* and comparison to the project-specific CCGT noise criteria presented in *Table 5.4* of this report are presented in *Table 7.1* below.

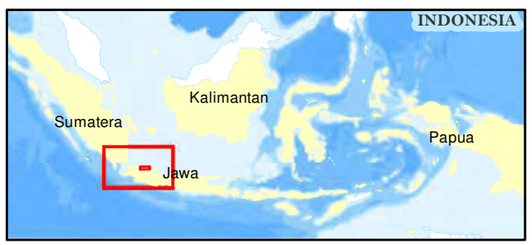
Compliance is assessed based on the *Table 5.4* project design criteria ($L_{eq, 1\ hour}$ in dBA) for residential, institutional, educational receptors during both the daytime (7AM to 10PM) and night time (10PM to 7AM) assessment periods, and this data is highlighted in grey cells. Any noise levels that exceed fixed value criteria are highlighted in **bold** typeset.

Noise contours, which illustrate the spatial extents of the predicted project CCGT power plant noise levels, are presented in *Figure 7.1* below.

Table 7.1 Predicted CCGT Power Plant Noise Levels

Receptor	Project Operation Noise - Leq, 1 hour in dBA	Comparison to Criteria, dBA					
		Residential, Institutional, Educational Receptors				Commercial Receptors 65 dBA - Leq, 1 hour	Industrial Receptors 70 dBA - Leq, 1 hour
		Project Design Criteria (Table 5.4) - Leq, 1 hour		Fixed Value (55 day / 45 night) Criteria - Leq, 1 hour			
		Daytime (7AM to 10PM)	Night time (10PM to 7AM)	Daytime (7AM to 10PM)	Night time (10PM to 7AM)	Day / Night time (24 hour)	Day / Night time (24 hour)
N-1	49.2	-5.8	-2.7	-5.8	**4.2**	-15.8	-20.8
N-2	50.2	-12.2	-4.9	-4.8	**5.2**	-14.8	-19.8
N-3	45.4	-14.5	-3.2	-9.6	**0.4**	-19.6	-24.6
N-4	48.4	-12.4	-6.6	-6.6	**3.4**	-16.6	-21.6
N-5	41.7	-13.3	-12.8	-13.3	-3.3	-23.3	-28.3
R1 (NCA 1)	50.0	-12.4	-5.1	-5.0	**5.0**	-15.0	-20.0
R2 (NCA 2)	45.3	-9.7	-6.6	-9.7	**0.3**	-19.7	-24.7
R3 (NCA 3)	49.2	-11.6	-5.8	-5.8	**4.2**	-15.8	-20.8
R4 (NCA 4)	47.9	-12.9	-7.1	-7.1	**2.9**	-17.1	-22.1
R5 (NCA 5)	45.2	-14.7	-3.4	-9.8	**0.2**	-19.8	-24.8
R6 (NCA 6)	45.9	-14.0	-2.7	-9.1	**0.9**	-19.1	-24.1





LEGEND

- Arterial Road
- River/Irigation
- Distict Boundary
- Regency Boundary
- Contour Line

Project Plan

- Onshore Pipeline (Gas, Intake, and Outflow)
- Access Road to Pump Station and Jetty
- Transmission Line
- CCGT Power Plant
- Nearest Receiver

Noise Contour (dB)

- 35 dB
- 40 dB
- 45 dB
- 50 dB
- 55 dB

Sampling Point

- Samsung Noise Monitoring Location
- ESIA Noise Monitoring Location

Source:
- ESRI Online Imagery, 2017
- Jawa Satu Power, 2017

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Environmental and Social Impact Assessment (ESIA) for Jawa-1 Project

Figure 7.1
CCGT Power Plant
Noise Contour Map

ERM	Drawn By : IA & IF	Client :	Jawa Satu Power
	Checked By : NL	Date :	03/07/2018
	Revision :	Map Number :	

7.1.1 Summary of Findings

The resultant noise levels presented in *Table 7.1* and noise contour mapping in *Figure 7.1* identify that **negligible** or **minor** impacts are anticipated at the closest and/or potentially most affected receptors.

Noise levels are predicted to exceed the most stringent night time IFC 1.7 Noise criteria however consideration of existing noise levels near the CCGT power plant identifies that existing levels already exceed these IFC criteria. This is identifiable in the *Table 5.4* project design criteria established with regard to the IFC 1.7 Noise (existing +3 dB) requirements. In this circumstance the existing + 3 dBA criteria applies at each receptor and predicted operational CCGT noise levels are determined to comply.

This compliance status and **negligible** or **minor** impact rating as is however contingent on the noise reducing mitigation measures identified in the project design being successfully implemented; therefore a set of monitoring based safeguards, provisions and contingencies have been defined as presented in *Chapter 8* of this report.

7.2 SUBSTATION OPERATIONAL NOISE

Based on the assessment methodology described in *Section 3.4* of this report the predicted substation noise levels are presented in *Table 7.2* including a comparison to the consolidated project-specific noise criteria presented in *Section 5.1.3*.

Any noise levels that exceed fixed value criteria are highlighted in **bold** typeset and discussion regarding the potential increase in noise levels is provided with respect to the requirements of IFC 1.7 Noise and the existing noise levels presented in *Section 4.2*.

The potential area of influence for this project component, defined by the most stringent applicable fixed noise criteria (45 dBA) as noted in *Table 5.3*, is identified in *Figure 7.2* below.

Table 7.2 Predicted Substation Noise Levels

	Predicted Noise Levels - Leq, 1 hour in dBA			Comparison to Limiting Criteria *(Typical Worst-case Only)*			
				Residential, Institutional, Educational Receptors		Commercial Receptors	Industrial Receptors
Receptor ID	Typical Best-case	Typical Norm	Typical Worst-case	Daytime - 55 dBA	Night time - 45 dBA	Day/Night - 65 dBA	Day/Night - 70 dBA
N10	22	27	32	-23	-13	-33	-38
N11	11	16	21	-34	-24	-44	-49
N12	12	17	22	-33	-23	-43	-48
N22	29	34	39	-16	-6	-26	-31
N23	22	27	32	-23	-13	-33	-38

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Environmental and Social Impact Assessment (ESIA) for Jawa-1 Project

Figure 7.2
Potential Substation Area of Influence Operational Noise

LEGEND

- Road
- Regency Boundary
- Distict Boundary
- Transmission Line
- Cibatu 2 Substation

Sampling Point

- ESIA Noise Monitoring Location

Area of Influence

- Typical Best-Case
- Typical Norm
- Typical Worst-Case

Source:
- Jawa Satu Power, 2017
- ESRI Online Imagery, 2017

ERM	Drawn By : IA & IF	Client :	Jawa Satu Power
	Checked By : NL	Date :	03/07/2018
	Revision :	Map Number :	

7.2.1 Summary of Findings

The resultant noise levels presented in *Table 7.2* and potential area of influence mapped in *Figure 7.2* identify that **negligible** impacts are anticipated at the closest and/or potentially most affected receptors.

Noise levels are predicted to be below the most stringent night time IFC 1.7 Noise criteria. Consideration of existing noise levels near the substation site identifies that existing levels do not exceed these IFC criteria during the daytime but do so during the night. This is identifiable in *Table 4.5* for locations N10 and N11 where existing daytime noise levels are less than 55 dBA but night time noise levels are more than 45 dBA. Regardless, the fixed criteria apply in this circumstance and predicted levels are 6 dBA or more below criteria.

This compliance status and **negligible** impact rating as is however contingent on the substation noise being designed accordingly; therefore a set of monitoring based safeguards, provisions and contingencies have been defined as presented in *Chapter 8* of this report.

7.3 TRANSMISSION LINE (CORONA) NOISE

Based on the assessment methodology described in *Section 3.5* of this report the predicted transmission line (corona) noise levels are presented in *Table 7.3* including a comparison to the consolidated project-specific noise criteria presented in *Section 5.1.3*.

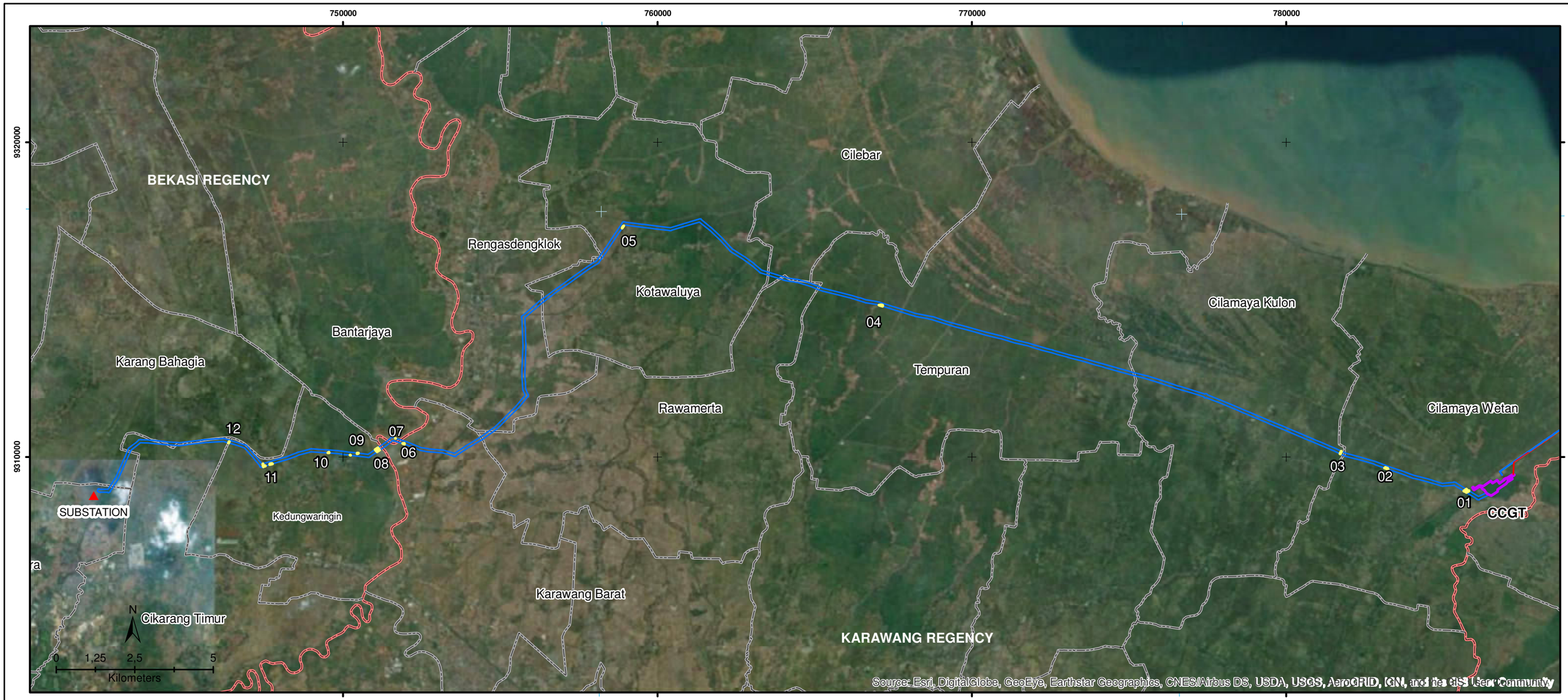
Any noise levels that exceed fixed value criteria are highlighted in **bold** typeset and discussion regarding the potential increase in noise levels is provided with respect to the requirements of IFC 1.7 Noise and the existing noise levels presented in *Section 4.2*.

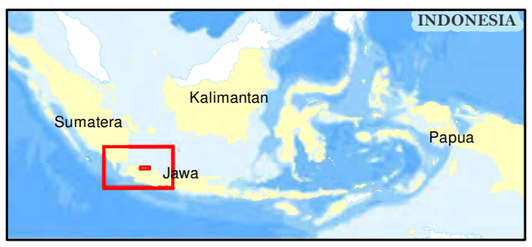
The potential area of influence for this project component, defined by the most stringent applicable fixed noise criteria (45 dBA) as noted in *Table 5.3*, is identified in *Figure 7.3* below.

Table 7.3 Predicted Transmission Line (Corona) Noise Levels

Distance, metres[1]	Project Heavy Vehicle Noise - Leq, 1 hour	Comparison to Criteria			
		Residential, Institutional, Educational Receptors		Commercial Receptors	Industrial Receptors
		Daytime - 55 dBA	Night time - 45 dBA	Day/Night - 65 dBA	Day/Night - 70 dBA
0	48.1	-6.9	**3.1**	-16.9	-21.9
10	47.6	-7.4	**2.6**	-17.4	-22.4
20	46.3	-8.7	**1.3**	-18.7	-23.7
30	45.0	-10.0	0.0	-20.0	-25.0
40	43.9	-11.1	-1.1	-21.1	-26.1
50	42.9	-12.1	-2.1	-22.1	-27.1
60	42	-13	-3	-23	-28
70	41.2	-13.8	-3.8	-23.8	-28.8
80	40.6	-14.4	-4.4	-24.4	-29.4

1. Horizontal distance offset from roadway centre line in metres.





LEGEND

- District Boundary
- Regency Boundary

Project Plan

- Sub Station
- Onshore Pipeline (Gas, Intake, and Outflow)
- Access Road to Pump Station and Jetty
- CCGT Power Plant
- Transmission Line Buffer 30 m

Receptors

Receptor Location (Village Name)

01 Cilamaya
02 Sukatani
03 Sukamulya
04 Lemahkarya
05 Waluya
06 Tunggakjati
07 Bantarjaya
08 Karangmekar
09 Karang mekar
10 Mekarjaya
11 Karangharum
12 Karangmukti

Source:
- Jawa Satu Power, 2017
- Peta Rupa Bumi Indonesia

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Environmental and Social Impact Assessment (ESIA) for Jawa-1 Project

Figure 7.3 Receptors Within Transmission Line Alignment (30 Meter Buffer)

ERM	Drawn By : IF & IA	Client :	Jawa Satu Power
	Checked By : FF	Date :	03/07/2018
	Revision :	Map No. :	

7.3.1 Summary of Findings

The results presented in *Table 6.3* above identify that predicted project noise levels (Leq, 1 hour) associated with the 500 kV transmission line are at or below the most stringent night time IFC noise criteria for receptors situated at distances ≥ 30 metres from the transmission line centre alignment. Predicted 500 kV transmission line project noise levels are however above this criteria value for receptors situated < 30 metres transmission line centre alignment.

The potential area of influence mapped in *Figure 7.3* identifies a total of 12 village locations where impacts could occur, warranting further consideration of existing noise level conditions and the IFC 1. (existing + 3 dBA) requirements.

For transmission line receptors near the CCGT existing noise levels already exceed the most stringent night time IFC 1.7 criteria. This is identifiable in the *Table 5.4* project design criteria established with regard to the IFC 1.7 Noise (existing +3 dB) requirements. In this circumstance the existing + 3 dBA criteria applies and the highest predicted transmission line noise levels (48.1 dBA) are determined to comply.

For transmission line receptors west of the CCGT, and approaching the substation existing noise levels already exceed the most stringent night time IFC 1.7 criteria. This is identifiable in *Table 4.6* where the lowest measured night time noise level, for monitoring conducted near the transmission line was 54 dBA. In this circumstance the existing + 3 dBA criteria applies and the highest predicted transmission line noise levels (48.1 dBA) are determined to comply.

The results identify that **negligible** or **minor** impacts are anticipated at the closest and/or potentially most affected receptors along the transmission line alignment. A set of monitoring based safeguards, provisions and contingencies have however been defined as presented in *Chapter 8* of this report.

8 RECOMMENDATIONS

This chapter presents recommendations, safeguards, provisions and contingencies for the construction and operational noise and vibration associated with the project.

These measures are based on the levels and potential impacts evaluated in *Chapter 2* and assessed in detail in *Chapter 6* and *7* of this report. They are designed to minimise impacts at the most affected receptors and on the broader community. The focus of potential construction (including road traffic) noise measures is air-borne noise impacts to human receptors and underwater construction noise impacts to wildlife receptors[2]. The focus of potential operational (CCGT power plant, substation and 500 kV transmission line) noise measures is contingencies for air-borne noise impacts to human receptors once the project is operational.

The construction safeguards and provisions are presented in *Section 8.1* below and target significant emission generating works and activities, for the various onshore components associated with the project, that are proposed to occur within and near the project site.

In addition, safeguards and provisions are provided in *Section 8.2* below for potential operational air-borne noise impacts to human receptors. These operational safeguards and provisions target operational noise verification and compliance monitoring for significant emission generating activities, for the various onshore components associated with the project (i.e. the CCGT power plant, substation and 500 kV transmission line) that are proposed to occur within and near the project site.

8.1 CONSTRUCTION PHASE

To assist ensure noise emissions associated with construction works and activities are reduced as far as possible and impacts minimised, the following mitigation and management measures are recommended.

8.1.1 General CCGT Construction (Site Preparation, Building Construction, Bulk Earthworks, or similar)

- CCGT construction work and activities should be carried out during the IFC daytime hours (i.e. 7AM to 10PM). Where possible the CCGT construction works and activities should conclude at 6PM daily, to further minimise impacts and provide respite outsiders standard business hours.

[2] This acoustical feature is being assessed in more detail by other specialists but given its association with the potential project noise, has been evaluated in this assessment with conceptual recommendations being provided.

- Any work that is performed outside these hours (i.e. during the night time period, 10PM to 7AM) should be suitably managed with a goal of achieving levels compliant with the most stringent night time IFC 1.7 Noise criteria (i.e. 45 dBA), at all potentially affected sensitive receptors. Where this is not possible it may be necessary to undertake the night works with agreement from nearby and potentially affected neighbours.

- Where works near R2, or any unforeseen activities in close proximity to other receptors, are to occur and these works are anticipated to generate high noise levels of >70 dBA, potential respite periods (e.g. three hours of work, followed by one hour of respite) should be implemented. Respite should be implemented if it is the preference of the affected receptors and if it is feasible and reasonable, and practicable, to implement during the works. In some circumstances respite may extend the duration of works and inadvertently increase noise impacts, hence due care should be taken when considering this management measure.

- Construction road traffic associated with CCGT works should be limited to the IFC daytime hours (i.e. 7AMto 10PM). Any traffic that is required outside these hours (i.e. during the night time period, 10PM to 7AM) should be suitably managed with a goal of achieving levels compliant with the most stringent night time IFC 1.7 Noise criteria (45 dBA), at all potentially affected sensitive receptors.

8.1.2 CCGT Piling (Impact Piling, or Similar)

- CCGT piling and activities should be carried out during the IFC daytime hours (i.e. 7AM to 10PM). Where possible the CCGT construction works and activities should conclude at 6PM daily, to further minimise impacts and provide respite outsiders standard business hours.

- Any work that is performed outside these hours (i.e. during the night time period, 10PM to 7AM) should be suitably managed with a goal of achieving levels compliant with the most stringent night time IFC 1.7 Noise criteria (i.e. 45 dBA), at all potentially affected sensitive receptors. Where this is not possible it may be necessary to undertake the night works with agreement from nearby and potentially affected neighbours.

- CCGT piling should be conducted as per the method summarised in *Section 3.1* and reproduced in *Annex C* of this report.

  - All noise reducing mitigation that is presented Annex C of this report should occur i.e. pre-drilling to ten metres depth, at all piling locations; use of pile caps and cushions, the latter consisting of five layers of high strength multiflex board; and installation of the EGI fence adjacent to the village area. The height and specification should be determined after EPC test piling and noise monitoring.

- The work sequence that is presented Annex C should be strictly adhered to and no more than 12 piling rig units should work concurrently unless an alternative work sequence and piling rig layout design/plan is identified that will reduce noise levels, or minimise impacts to those presented in this report.

- Where any unforeseen piling works will occur in close proximity to a receptor and these works are anticipated to generate high noise levels >70 dBA, potential respite periods (e.g. three hours of work, followed by one hour of respite) should be implemented. Respite should be implemented if it is the preference of the affected receptors and if it is feasible and reasonable, and practicable, to implement during the works. In some circumstances respite may extend the duration of works and inadvertently increase noise impacts, hence due care should be taken when considering this management measure.

- Construction road traffic associated with CCGT works should be limited to the IFC daytime hours (i.e. 7AM to 10PM). Any traffic that is required outside these hours (i.e. during the night time period, 10PM to 7AM) should be suitably managed with a goal of achieving levels compliant with the most stringent night time IFC 1.7 Noise criteria (45 dBA), at all potentially affected sensitive receptors.

8.1.3 All CCGT Works (incl. Piling)

- During the construction design, appropriate plant, equipment and/or machinery should be selected for each task and efficient work practices adopted to minimise the total construction period and the number of noise sources on the site. The quietest item of plant available should be selected where options that suit the design permit.

- During the works, unnecessary noise due to idling diesel engines and fast engine speeds should be avoided when lower speeds are sufficient.

- During the works, drivers should be instructed to travel directly to site and avoid any extended periods of engine idling at or near residential areas.

- During any night works, any activity that has the potential to generate impulsive noise should be completely avoided. These types of events are particularly annoying, especially at night and have the limited potential to generate sleep disturbance or awakening impacts.

- During the works, ensure all machines used on the site are in good condition, with particular emphasis on exhaust silencers, covers on engines and transmissions and squeaking or rattling components. Excessively noisy machines should be repaired or removed from the site.

- During the works, ensure that all plant, equipment and vehicles movements are optimised in a forward direction to avoid triggering motion alarms that are typically required when these items are used in reverse.

- Implementation of a community grievance mechanism and community consultation should occur.

8.1.4 CCGT Construction Noise Monitoring (All Works incl. Piling)

Regular monitoring of construction (including piling) noise levels should be conducted and an evaluation of compliance provided for. All site noise levels should be measured in the absence of any influential sources not associated with the project. If the measured project noise levels are below the predicted values and comply with the criteria presented in this report, no further mitigation or management measures may be required. If the measured project levels are above the predicted noise levels and/or criteria presented in this report, further mitigation and/or management measures should be considered and implemented, where feasible, reasonable and practical to do so.

8.1.5 Jetty Piling (Impact Piling, or Similar)

Noise modelling of Jetty piling works has identified that unmitigated emissions comply with the most stringent night time project-specific criteria (45 dBA) at the closest and/or potentially most affected receptor (N14) situated within the potential area of influence of these activities, as documented in *Section 6.1* of this report. On this basis, the noise reducing mitigation and management measures that are applicable to CCGT piling works, do not apply to Jetty piling, which can be undertaken a) at any time of day i.e. during the daytime or the night time and b) without implementing the noise reducing measures reproduced in *Annex C* of this report. JSP (or the piling contractor etc) should however remain aware of the potential for nuisance, or an unacceptable level of amenity, to occur due to piling noise and continue to plan for and then manage the project design accordingly.

8.1.6 Underwater Noise

As noted earlier in this report, this acoustical feature is being assessed in more detail by other specialists. Given its association with the potential project noise the following safeguard mitigation and management measures specific to this type of issue (that are commonly incorporated into good construction offshore management practices) are provided:

- Undertake significant offshore construction works and activities in the presence of 'Marine Mammal Observers" (MMO) where possible.

- Establish a mitigation zone for marine mammals around the area of activity. The size of the mitigation zone should be prepared to adequately protect any nearby marine life.

- Pre-works searches could be conducted before commencement of any significant works. The MMO would be strategically positioned in the most appropriate location to make a visual assessment to determine if any marine mammals are within the mitigation zone.

- Providing for construction works and activities to be delayed if marine mammals within the mitigation zone, and the inclusion of a full soft-start procedure. Soft-starts will involve starting equipment at low power, and gradually (and systematically) increasing the output until full power is achieved. The appropriate soft-start method is dependent upon the type of equipment and should be modified accordingly.

- Passive Acoustic Monitoring (PAM) could be undertaken in order to verify underwater noise and detect the vocalisation of marine mammals, especially in poor-visibility conditions (i.e. night works) if considered appropriate.

8.2 OPERATIONAL PHASE

Based on the generally compliant results presented in *Chapter 7* of this report, no additional noise mitigation of plant and equipment is required, however it is recommended that the noise reducing mitigation already incorporated into the CCGT project design is implemented.

All CCGT noise walls and barriers should be constructed from suitably dense material i.e. concrete or masonry, as per the layout and heights specified in the design and without any gaps or cracks that could reduce the acoustic performance of the barrier.

For the substation, noise generating equipment should be selected to achieve the emissions assessed in this report. Where they cannot be achieved boundary noise barriers or transformer bay walls should be implemented to reduce emissions to compliant values.

JSP should also remain aware of the potential for nuisance, or an unacceptable level of amenity, to occur due to operational noise and vibration and continue to plan for and then manage the project design accordingly.

8.2.1 Operational Noise Monitoring

Operational noise verification and compliance monitoring should be conducted to measure and compare the site (the CCGT power plant, substation and 500 kV transmission line) noise level contributions ($L_{eq,\ 1\ hour}$ in dBA) to a) the predicted values, and b) the criteria presented in this report. The same should occur if any validated noise or vibration complaints are received.

All site noise levels should be measured in the absence of any influential sources not associated with the project. If the measured project noise levels are below the predicted values and noise/vibration levels comply with the criteria presented in this report, no further mitigation or management measures may

be required. If the measured project levels are above the predicted noise levels and/or criteria presented in this report, further mitigation and/or management measures should be considered.

To provide confidence that this monitoring contingency is a potentially effective method by which additional CCGT mitgation could be considered and implemented if needed at a later date, an additional noise model scenario was run and incorporated conceptual noise reducing mitigation for each of the key noise generating sources.

The aim of this additional model was to identify if compliance with the most stringent IFC 1.7 Noise criteria of 45 dBA could be achieved. The level of reduction required was 0 dBA for three minor sources, 5 dBA for 14 sources and 8 dBA for two sources. This information is tabulated below in *Table 8.1* and these reductions could readily be achieved (if actually required) with higher performance enclosures, building facades or quieter equipment.

Table 8.1 Conceptual CCGT Mitigated Noise Source and Emissions Data

ID	Type	Actual Sound Power Level (LW in dBA)	Conceptual Reduction, dBA (LW in dBA)	"Mitigated" Sound Power Level (LW in dBA)
1	Condenser Vent	98	0	98
2	Cooling Tower (per unit)	105	5	100
3	CT inlet	105	5	100
4	CT Inlet duct	108	8	100
5	CT Pump	85	0	85
6	Generator Package	103	5	98
7	GT Fan Casing	98	5	93
8	GT Inlet	107	5	102
9	GT Package	119	5	114
10	GT Vent Fan outlet	99	5	94
11	HP Water Feed Pump	105	5	100
12	HRSG Body	99	5	94
13	HRSG Inlet Duct	104	8	96
14	Pre Heat Pumps	103	5	98
15	ST Package	114	5	109
16	Stack Tip	101	5	96
17	HRSG stack	94	0	94
18	Transformers	93	5	88
19	Major Pumps	93	5	88

9 CONCLUSION

ERM on behalf of JSP has completed a acoustics assessment for the PLTGU Jawa-1 project (the project).

9.1 OVERVIEW

Nuisance, or an unacceptable level of noise (and vibration) amenity, may arise due to construction and operational activities associated with new or existing developments. This potential for issues to arise is associated with air-borne, ground-borne and underwater emissions from significant project noise and vibration generating sources that are in close proximity to potentially sensitive human and wildlife receptors i.e. nearby dwellings, schools, churches, commercial/industrial facilities, or sea life near off-shore assets.

The assessment was conducted to achieve a scope of works that addressed these potential noise and vibration issues by evaluating, predicting and assessing construction and operational noise and vibration from the project (offshore, nearshore and onshore components) at the closest and/or potentially most affected sensitive receptors near the project site.

A qualitative assessment has been conducted for project noise and vibration components that have limited or no potential to generate any impacts at nearby receptors, whilst a quantitative assessment has been conducted for other components where a potential for impacts to occur has been identified. The focus of the quantitative (modelling) assessment was air-borne operational noise associated with the CCGT power plant and the 500 kV transmission line.

9.2 FINDINGS

Based on the qualitative assessment documented in *Chapter 2* of this report, potential construction (including road traffic) air-borne noise and ground-borne vibration impacts to human receptors and underwater noise impacts to wildlife receptors were identified. On this basis, a construction noise assessment was completed as per *Chapter 6* and recommended safeguards and provisions provided in *Chapter* 8 of this report to target significant emission generating works and activities, for the various components associated with the project, that are proposed to occur within and near the project site.

The CCGT power plant, substation and transmission line results presented in *Chapter 7* of this report identify that the predicted project noise levels are generally below project-specific noise criteria adopted for this assessment. Evaluating the predicted noise levels with regard to the project-specific noise criteria and the method described in *Section 5.1.2* of this report, identifies that predicted noise levels are not expected to exceed the adopted criteria. On this basis an acceptable level of noise impact is expected. Suitable safeguards and provisions are however provided in *Chapter 8* of this report.

9.3 RESIDUAL IMPACTS AND CLOSING

Construction and operational noise and vibration levels may be reduced and impacts (if any) minimised with the successful implementation of the safeguards and provisions provided in *Chapter 8* of this report.

Impacts may not be reduced to negligible (low) levels for all receptors and for all project components and phases; however the recommendations presented here will assist ensure that any residual impacts are minimised as far as may be practically achievable.

No further recommendations for mitigation and management measures to those established by the findings of this acoustics (noise and vibration) assessment, and documented in this report, are provided or considered warranted, at this stage and unless significant construction and/or operational design changes occur.

JSP should however remain aware of the potential for nuisance, or an unacceptable level of amenity, to occur due to construction or operational noise and vibration and continue to plan for and then manage the works and design accordingly.

REFERENCES

British Standards Institution (BSI, United Kingdom) – BS 6472 - **Guide to Evaluation of Human Exposure to Vibration in Buildings (1 Hz to 80 Hz)** (BS 6472), dated 1992.

British Standards Institution (BSI, United Kingdom) – BS 5228:2 - **Code of Practice for Noise and Vibration Control on Construction and Open Sites** (BS 5228-2), dated 2009.

Department of Environment and Conservation NSW (DECC, Australia) – **Assessing Vibration: a Technical Guideline** (DECC Guideline, 2006), dated February 2006.

German Institute for Standardisation (GIS, Germany) – DIN 4150 Part 3 - **Structural Vibration: Effects of Vibration on Structures** (DIN4150-3), dated February 1999.

International Organisation for Standardisation (ISO) 9613-2:1996 (ISO9613:2) - **Acoustics - Attenuation of Sound during Propagation Outdoors - Part 2: General Method of Calculation.**

Joint Nature Conservation Committee (JNCC) - *Annex A - Guidelines for* **Minimising the Risk of Disturbance and Injury to Marine Mammals from Seismic Surveys** (JNCC Annex A: Guideline, 2009), dated June 2009.

Joint Nature Conservation Committee (JNCC) - **Guidelines for Minimising the Risk of Injury to Marine Mammals from Geophysical Surveys** (JNCC Guideline, 2017), dated August 2017.

World Bank Group: International Finance Corporation (IFC) - **Environmental, Health, and Safety Guidelines for Thermal Power Plants** (IFC Thermal Power Plants Guideline, 2017), draft for second public consultation, dated May/June 2017.

World Bank Group: International Finance Corporation (IFC) - **Environmental, Health and Safety (EHS) Guidelines - General EHS Guidelines: Environmental Noise Management**, Section 1.7 Noise (IFC 1.7 Noise), dated 30 April 2007.

World Bank Group: International Finance Corporation (IFC) - **Environmental, Health, and Safety Guidelines for Electric Power Transmission and Distribution** (IFC Electrical Power Guideline, 2007), dated 30 April 2007.

Annex A

Acoustics Glossary

A.1 NOISE – ACOUSTICAL CONCEPTS AND TERMINOLOGY

A.1.1 What Is Noise And Vibration?

Noise

Noise is often defined as a sound, especially one that is loud or unpleasant or that causes disturbance[3] or simply as unwanted sound, but technically, noise is the perception of a series of compressions and rarefactions above and below normal atmospheric pressure.

Vibration

Vibration refers to the oscillating movement of any object. In a sense noise is the movement of air particles and is essentially vibration, though in regards to an environmental assessment vibration is typically taken to refer to the oscillation of a solid object(s). The impact of noise on objects can lead to vibration of the object, or vibration can be experienced by direct transmission through the ground, this is known as ground-borne vibration.

Essentially, noise can be described as what a person hears, and vibration as what they feel.

A.1.2 What Factors Contribute To Environmental Noise?

The noise from an activity, like construction works, at any location can be affected by a number of factors, the most significant being:

- How loud the activity is;
- How far away the activity is from the receiver;
- What type of ground is between the activity and the receiver location e.g. concrete, grass, water or sand;
- How the ground topography varies between the activity and the receiver (is it flat, hilly, mountainous) as blocking the line of sight to a noise source will generally reduce the level of noise; and
- Any other obstacles that block the line of sight between the source to receiver e.g. buildings or purpose built noise walls.

A.1.3 How to Measure and Describe Noise?

Noise is measured using a specially designed 'sound level' meter which must meet internationally recognised performance standards. Audible sound

[3] Copyright © 2011 Oxford University Press

pressure levels vary across a range of 10^7 Pascals (Pa), from the threshold of hearing at 20μPa to the threshold of pain at 200Pa. Scientists have defined a statistically described logarithmic scale called Decibels (dB) to more manageably describe noise.

To demonstrate how this scale works, the following points give an indication of how the noise levels and differences are perceived by an average person:

- 0 dB - represents the threshold of human hearing (for a young person with ears in good condition).
- 50 dB – represents average conversation.
- 70 dB – represents average street noise, local traffic etc.
- 90 dB – represents the noise inside an industrial premises or factory.
- 140 dB - represents the threshold of pain – the point at which permanent hearing damage may occur.

A.1.4 Human Response to Changes in Noise Levels

The following concepts offer qualitative guidance in respect of the average response to changes in noise levels:

- Differences in noise levels of less than approximately 2 dBA are generally imperceptible in practice; an increase of 2 dB is hardly perceivable.
- Differences in noise levels of around 5 dBA are considered to be significant.
- Differences in noise levels of around 10 dBA are generally perceived to be a doubling (or halving) of the perceived loudness of the noise. An increase of 10 dB is perceived as twice as loud. Therefore an increase of 20 dB is four times as loud and an increase of 30 dB is eight times as loud etc.
- The addition of two identical noise levels will increase the dB level by about 3 dB. For example, if one car is idling at 40 dB and then another identical car starts idling next to it, the total dB level will be about 43 dB.
- The addition of a second noise level of similar character which is at least 8 dB lower than the existing noise level will not add significantly to the overall dB level.
- A doubling of the distance between a noise source and a receiver results approximately in a 3 dB decrease for a line source (for example, vehicles travelling on a road); and a 6 dB decrease for a point source (for example, the idling car discussed above). A doubling of traffic volume for a line source results approximately in a 3 dB increase in noise, halving the traffic volume for a line source results approximately in a 3 dB decrease in noise.

A.1.5 Terms to Describe the Perception of Noise

The following terms offer quantitative and qualitative guidance in respect of the audibility of a noise source:

- **Inaudible / Not Audible** - the noise source and/or event could not be heard by the operator, masked by extraneous noise sources not associated with the source. If a noise source is 'inaudible' its noise level may be quantified as being less than the measured L_{A90} background noise level, potentially by 10 dB or greater.

- **Barely Audible –** the noise source and/or event are difficult to define by the operator, typically masked by extraneous noise sources not associated with the source. If a source is 'barely audible' its noise level may be quantified as being 5 - 7 dB below the measured L_{A90} or L_{Aeq} noise level, depending on the nature of the source e.g. constant or intermittent.

- **Just Audible** – the noise source and/or event may be defined by the operator. However there are a number of extraneous noise sources contributing to the measurement. The noise level should be quantified based on instantaneous noise level contributions, noted by the operator;

- **Audible** - the noise source and/or event may be easily defined by the operator. There may be a number of extraneous noise sources contributing to the measurement. The noise level should be quantified based on instantaneous noise level contributions, noted by the operator.

- **Dominant –** the noise source and/or event are noted by the operator to be significantly 'louder' than all other noise sources. The noise level should be quantified based on instantaneous noise level contributions, noted by the operator.

The following terms offer qualitative guidance in respect of acoustic terms used to describe the frequency of occurrence of a noise source during an operator attended environmental noise measurements:

- **Constant –** this indicates that the operator has noted the noise source(s) and/or event to be constantly audible for the duration of the noise measurement e.g. an air-conditioner that runs constantly during the measurement.

- **Intermittent** – this indicates that the operator has noted the noise source(s) and/or event to be audible, stopping and starting intervals for the duration of the noise measurement e.g. car pass-bys.

- **Infrequent** – this indicates that the operator has noted the noise source(s) and/or event to be constantly audible, however; not occurring regularly or at intervals for the duration of the noise measurement e.g. a small number of aircraft are noted during the measurement.

A.1.6 How to Calculate or Model Noise Levels?

There are two recognised methods which are commonly adopted to determine the noise at particular location from a proposed activity. The first is to undertake noise measurements whilst the activity is in progress and measure the noise, the second is to calculate the noise based on known noise emission data for the activity in question.

The second option is preferred as the first option is largely impractical in terms of cost and time constraints, notwithstanding the meteorological factors that may also influence its quantification. Furthermore, it is also generally considered unacceptable to create an environmental impact simply to measure it. In addition, the most effective mitigation measures are determined and implemented during the design phase and often cannot be readily applied during or after the implementation phase of a project.

Because a number of factors can affect how 'loud' a noise is at a certain location, the calculations can be very complex. The influence of other ambient sources and the contribution from a particular source in question can be difficult to ascertain. To avoid these issues, and to quantify the direct noise contribution from a source/site in question, the noise level is often calculated using noise modelling software packages. The noise emission data used in may be obtained from the manufacturer or from ERM's database of measured noise emissions.

A.1.7 Acoustic Terminology & Statistical Noise Descriptors

Environmental noise levels such as noise generated by industry, construction and road traffic are commonly expressed in dBA. The A-weighting scale follows the average human hearing response and enables comparison of the intensity of noise with different frequency characteristics. Time varying noise sources are often described in terms of statistical noise descriptors. The following descriptors are commonly used when assessing noise and are referred to throughout this acoustic assessment:

- **Decibel (dB is the adopted abbreviation for the decibel) –** The unit used to describe sound levels and noise exposure. It is equivalent to 10 times the logarithm (to base 10) of the ratio of a given sound pressure to a reference pressure.

- **dBA** - unit used to measure 'A-weighted' sound pressure levels. A-weighting is an adjustment made to sound-level measurement to approximate the response of the human ear.

- **dBC** – unit used to measure 'C-weighted' sound pressure levels. C-weighting is an adjustment made to sound-level measurements which takes account of low-frequency components of noise within the audibility range of humans.

- **dBZ or dBL –** unit used to measure 'Z-weighted' sound pressure levels with no weighting applied, linear.

- **Hertz (Hz)** - the measure of frequency of sound wave oscillations per second. 1 oscillation per second equals 1 hertz.

- **Octave –** a division of the frequency range into bands, the upper frequency limit.

- **1/3 Octave –** single octave bands divided into three parts.

- **Leq** - this level represents the equivalent or average noise energy during a measurement period. The $L_{eq, 15min}$ noise descriptor simply refers to the L_{eq} noise level calculated over a 15 minute period. Indeed, any of the below noise descriptors may be defined in this way, with an accompanying time period (e.g. $L_{10, 15\ minute}$) as required.

- **Lmax** - the absolute maximum noise level in a noise sample.

- **LN -** the percentile sound pressure level exceeded for N% of the measurement period calculated by statistical analysis.

- **L10 -** the noise level exceeded for 10 per cent of the time and is approximately the average of the maximum noise levels.

- **L90** - the noise level exceeded for 90 per cent of the time and is approximately the average of the minimum noise levels.

- **Sound Power Level (LW)** - this is a measure of the total power radiated by a source. The Sound Power of a source is a fundamental property of the source and is independent of the surrounding environment.

- **Sound Pressure Level (LP)** - the level of sound pressure; as measured at a distance by a standard sound level meter with a microphone. This differs from LW in that this is the received sound as opposed to the sound 'intensity' at the source.

- **Background noise –** the underlying level of noise present in the ambient noise, excluding the noise source under investigation, when extraneous noise is removed.

- **Ambient noise –** the all-encompassing noise associated within a given environment. It is the composite of sounds from many sources, both near and far.

- **Cognitive noise –** noise in which the source is recognised as being annoying.

- **Masking –** the phenomenon of one sound interfering with the perception of another sound. For example, the interference of traffic noise with use of a public telephone on a busy street.

- **Extraneous noise –** noise resulting from activities that are not typical of the area. Atypical activities may include construction, and traffic generated by holiday periods and by special events such as concerts or sporting events. Normal daily traffic is not considered to be extraneous.

- **Most affected location(s) –** locations that experience (or will experience) the greatest noise impact from the noise source under consideration. In determining these locations, one needs to consider existing background levels, exact noise source location(s), distance from source (or proposed source) to receiver, and any shielding between source and receiver.

- **Noise criteria –** the general set of non-mandatory noise level targets for protecting against intrusive noise (for example, background noise plus 5 dB) and loss of amenity (for example, noise levels for various land uses).

- **Noise limits –** enforceable noise levels that appear in conditions on consents and licences. The noise limits are based on achievable noise levels which the proponent has predicted can be met during the environmental assessment. Exceedance of the noise limits can result in the requirement for either the development of noise management plans or legal action.

- **Compliance –** the process of checking that source noise levels meet with the noise limits in a statutory context.

- **Feasible and Reasonable measures –** feasibility relates to engineering considerations and what is practical to build; reasonableness relates to the application of judgement in arriving at a decision, taking into account the following factors:

  - Noise mitigation benefits (amount of noise reduction provided, number of people protected);

  - Cost of mitigation (cost of mitigation versus benefit provided);

  - Community views (aesthetic impacts and community wishes); and

  - Noise levels for affected land uses (existing and future levels, and changes in noise levels).

- **Meteorological Conditions –** wind and temperature inversion conditions.

- **Temperature Inversion –** an atmospheric condition in which temperature increases with height above the ground.

- **Adverse Weather –** weather effects that enhance noise (that is, wind and temperature inversions) that occur at a site for a significant period of time (that is, wind occurring more than 30% of the time in any assessment period in any season and/or temperature inversions occurring more than 30% of the nights in winter).

A.1.8 Operator Attended Noise Measurements

Table A.1 below presents typical abbreviations that are used to describe common noise sources that may be noted during environmental noise measurements.

Table A.1 General Field Note Abbreviations

Noise Source	Abbreviation
'Wind-blown vegetation'	WBV
'Car pass-by'	CP
'Operator Noise'	OP
'Animal Noise'	AN
'Distant Traffic'	DT
'Near Traffic'	NT
'Aircraft Noise'	AN
'Metal on Metal contact'	MMC

During operator attended noise measurements, the sound level meter will present the instantaneous noise level and record acoustical and statistical parameters. In certain acoustical environments, where a range of noise sources are audible and detectable, the sound level meter cannot measure a direct source noise level and it is often necessary to account for the contribution and duration of the sources.

Noted Percentile Contribution – *Table A.2* presents noise level deductions that are typically applied based on the percentage contribution of a noise source(s). **Noted Time Contribution –** *Table A.3* presents noise level deductions that may be applied based on the percentage of time that a noise source(s) is audible during a 15 minute measurement.

Where the noise emission from a source is clearly detectable and the contribution can be measured, these deductions are not necessary.

Table A.2 Noise Level Deductions – Noted Percentile Contribution

Percentage Contribution	Noise Level Adjustment, dBA
5%	-13.0
10%	-10.0
15%	-8.2
20%	-7.0
25%	-6.0
30%	-5.2
35%	-4.6
40%	-4.0
45%	-3.5
50%	-3.0
55%	-2.6
60%	-2.2

Percentage Contribution	Noise Level Adjustment, dBA
65%	-1.9
70%	-1.5
75%	-1.2
80%	-1.0
85%	-0.7
90%	-0.5
95%	-0.2
100%	0.0

1. **EXAMPLE:** the measured $L_{Aeq,\ 15\ minute}$ noise level is 49 dB and the site contribution was observed to be 10% of this level (extraneous noise sources were noted to dominate the measurement), therefore the $L_{Aeq,\ 15\ minute}$ noise level deduction is 10 dB, with a resultant noise level contribution of approximately 39 dB.

Table A.3 Noise Level Deductions – Noted Time Contribution

Event Duration (minutes)	Noise Level Adjustment, dBA
1	-11.8
2	-8.8
3	-7.0
4	-5.7
5	-4.8
6	-4.0
7	-3.3
8	-2.7
9	-2.2
10	-1.8
11	-1.3
12	-1.0
13	-0.6
14	-0.3
15	0.0

1. **EXAMPLE:** the measured $L_{Aeq,\ 15\ minute}$ noise level contribution of an excavator was noted to be 56 dB, however it was only audible for 6 minutes during the 15 minute measurement period, therefore the $L_{Aeq,\ 15\ minute}$ noise level deduction is 4 dB, with a resultant noise level contribution of approximately 52 dB.

A.2 VIBRATION - ACOUSTICAL CONCEPTS AND TERMINOLOGY

A.2.1 How to Measure and Control Vibration

Vibration refers to the oscillating movement of any object. In relation to construction projects, ground-borne vibration is the most likely outcome of works and potentially has three (3) effects on vibration sensitive receivers, these are:

- Ground-borne vibration that may cause annoyance;
- Ground-borne vibration that may have adverse effect on a structure e.g. a building; and
- Regenerated noise due to ground-borne vibration.

Each of these potential effects can be assessed with due regard to the relevant standard. Perceptible levels of vibration often create concern for the surrounding community at levels well below structural damage guideline values; this issue needs to be managed as part of the vibration monitoring program.

Vibration is typically measured using specific devices that record the velocity or acceleration at a designated receiver location – usually being the closest premises to works. Modern vibration monitoring devices will typically capture amplitude data for the three (3) orthogonal axes being, the transverse, longitudinal and vertical and also the frequency at which the measured vibration event occurs.

Monitoring of this level of detail enables analysis of significant vibration events to determine compliance with relevant guidelines such as the NSW Department of Environment and Conservation – NSW Environmental Noise Management – *Assessing Vibration: a Technical Guideline* (the NSW vibration guideline), February 2006 and the German Institute for Standardisation – DIN 4150 (1999-02) Part 3 (DIN4150-3) – *Structural Vibration - Effects of Vibration on Structures*.

Vibration propagates in a different manner to noise and can be difficult to control depending on the frequency of the source in question, although identifying the strategy best suited to controlling vibration follows a similar approach to that of noise. This includes elimination, control at the source, control along the propagation path and control at the receiver and/or a combination of these, such as no work/respite periods.

A.2.2 Vibration Descriptors

The following terms are often used to describe measured vibration levels.

- **Parameter** – an attribute with a value - for example, weighting.

- **Particle Velocity** – the instantaneous value of the distance travelled by a particle per unit time in a medium that is displaced from its equilibrium state by the passage of a sound or vibration wave.

- **Peak Component Particle Velocity (PCPV)** – is the highest (maximum or peak) particle velocity which is recorded during a particular vibration event over the three (3) axes. PCPV is measured in the unit, mm/s.

- **Phase** – the relative position of a sound wave to some reference point, the phase of a wave is given in radians, degrees, or fractions of a wavelength.

- **Acceleration** – the change in velocity over time. Acceleration is dependent on the velocity and the frequency of the vibration event (velocity is a vector), as such acceleration changes in two ways - magnitude and/or direction. Acceleration is measured in the unit; m/s^2.

- **Perceptible** – vibration levels that a receiver of building occupant may 'feel'. 0.2 mm/s is typically considered to be the human threshold for perception of vibration.

- **Geophone or accelerometer** – the transducer/device typically used to measure vibration.

- **Damage** – is defined in DIN 4150-3 to include minor non-structural effects such as cosmetic damage or superficial cracking in paint or cement render, the enlargement of cracks already present, and the separation of partitions or intermediate walls from load bearing walls.

- **Vibration Dose Value (VDV)** – a concept outlined in the DECC Guideline, which is a calculative approach to assessing the impact of intermittent vibration or extended periods of impulsive vibration. VDV require the measurement of the overall weighted RMS (Root Mean Square) acceleration levels over the frequency range 1Hz to 80Hz. To calculate VDV the following formula (refer Section 2.4.1 of the guideline) is used:

$$VDV = \left[\int_0^T a^4(t)dt \right]^{0.25}$$

  Where VDV is the vibration dose value in $m/s^{1.75}$, $a\ (t)$ is the frequency-weighted RMS of acceleration in m/s^2 and T is the total period of the day (in seconds) during which vibration may occur.

- **MIC** - Maximum Instantaneous Charge or explosive charge mass (kg) detonated per delay (any 8ms interval).

- **SD** (m) - The scaled distance for air-blast and ground vibration from the charge to the receiver.

Annex B

Samsung, 2016 Noise Study Review: Noise Limits (Section 1 and Section 2)

Source: *Samsung C&T – Engineering and Construction Group (Samsung) – Indonesia Jawa-1 Noise Study Review – Ver. 07 - Cooling Tower Re-location to East-Side* report, dated 2016.7.9 and prepared by Samsung - Quality Technology Division, Technical Team (Samsung, 2016 Noise Study Review)

1. ITB Review results (Noise Requirement review)

1) Near Field Noise Limits: below 85 dB(A)

2) Far Field Noise Limits: below 70 dB(A) (Industrial Area)

3) Noise requirement: IFC Guideline Limit

Receptor	IFC Guideline Limit One Hour LAeq (dBA)	
	Daytime 07:00 - 22:00	Nighttime 22:00 - 07:00
Residential; institutional; educational	55	45
Industrial; commercial	70	70

※ IFC Guideline Limit states that the noise impacts should not exceed the limits given in the table or result in a maximum increase in background levels of 3 dB at the nearest receptor location off-site.

2. Noise impacts in background level of 3dB at the off-site

※ IFC Guideline Limit states that the noise impacts should not exceed the limits given in the table or result in a maximum increase in background levels of 3 dB at the nearest receptor location off-site.

Table 3.2
Noise level results in five location measurement per hour

No	Location	Parameter	Unit	Result	Environmental Quality Standard	
1	Perumahan Karyawan Pertamina (Mess) Kec.Cilamaya Wetan Kabupaten Karawang S : 93 08896,65 E : 78 6166,45	L1 (Hour 06.00 – 09.00)	dBA	52,6		
		L2 (Hour 09.00 – 14.00)	dBA	55,0		
		L3 (Hour 14.00 – 17.00)	dBA	54,9		
		L4 (Hour 17.00 – 22.00)	dBA	56,2	55	
		L5 (Hour 22.00 – 24.00)	dBA	51,2		Leq_{8h}: 48.9 **Noise Limit : 51.9**
		L6 (Hour 24.00 – 03.00)	dBA	44,8		
		L7 (Hour 03.00 – 06.00)	dBA	48,6		
2	SDN Cilamaya VI Kec. Cilamaya Wetan Kab.Karawang S : 93 08736,57 E : 78 6376,42	L1 (Hour 06.00 – 09.00)	dBA	57,4		
		L2 (Hour 09.00 – 14.00)	dBA	65,7		
		L3 (Hour 14.00 – 17.00)	dBA	63,2		
		L4 (Hour 17.00 – 22.00)	dBA	59,0	55	
		L5 (Hour 22.00 – 24.00)	dBA	55,1		Leq_{8h}: 52.1 **Noise Limit : 55.1**
		L6 (Hour 24.00 – 03.00)	dBA	50,8		
		L7 (Hour 03.00 – 06.00)	dBA	46,5		
3	Kp Bunut Ageung Ds Cilamaya Kec.Cilamaya Weta Kab.Karawang S : 93 09098,72 E : 78 7389,57	L1 (Hour 06.00 – 09.00)	dBA	52,5		
		L2 (Hour 09.00 – 14.00)	dBA	54,9		
		L3 (Hour 14.00 – 17.00)	dBA	60,0		
		L4 (Hour 17.00 – 22.00)	dBA	61,2	55	
		L5 (Hour 22.00 – 24.00)	dBA	46,8		Leq_{8h} : 45.6 **Noise Limit : 48.6**
		L6 (Hour 24.00 – 03.00)	dBA	44,4		
		L7 (Hour 03.00 – 06.00)	dBA	45,3		
4	Area Jalur Ingasi Kec. Cilamaya Wetan Kab.Karawang S : 93 09368,53 E : 78 6369,98	L1 (Hour 06.00 – 09.00)	dBA	44,9		
		L2 (Hour 09.00 – 14.00)	dBA	59,9		
		L3 (Hour 14.00 – 17.00)	dBA	53,6		
		L4 (Hour 17.00 – 22.00)	dBA	60,9	55	
		L5 (Hour 22.00 – 24.00)	dBA	53,9		Leq8h : 52.0 **Noise Limit : 55.0**
		L6 (Hour 24.00 – 03.00)	dBA	46,0		
		L7 (Hour 03.00 – 06.00)	dBA	52,9		
5	Area Persawahan Desa Cilamaya Kec. Cilamaya Wetan Kab.Karawang S : 93 0991,07 E : 78 6997,16	L1 (Hour 06.00 – 09.00)	dBA	53,9		
		L2 (Hour 09.00 – 14.00)	dBA	56,1		
		L3 (Hour 14.00 – 17.00)	dBA	55,1		
		L4 (Hour 17.00 – 22.00)	dBA	53,8	55	
		L5 (Hour 22.00 – 24.00)	dBA	51,9		Leq8h : 51.5 **Noise Limit : 54.5**
		L6 (Hour 24.00 – 03.00)	dBA	51,2		
		L7 (Hour 03.00 – 06.00)	dBA	51,5		

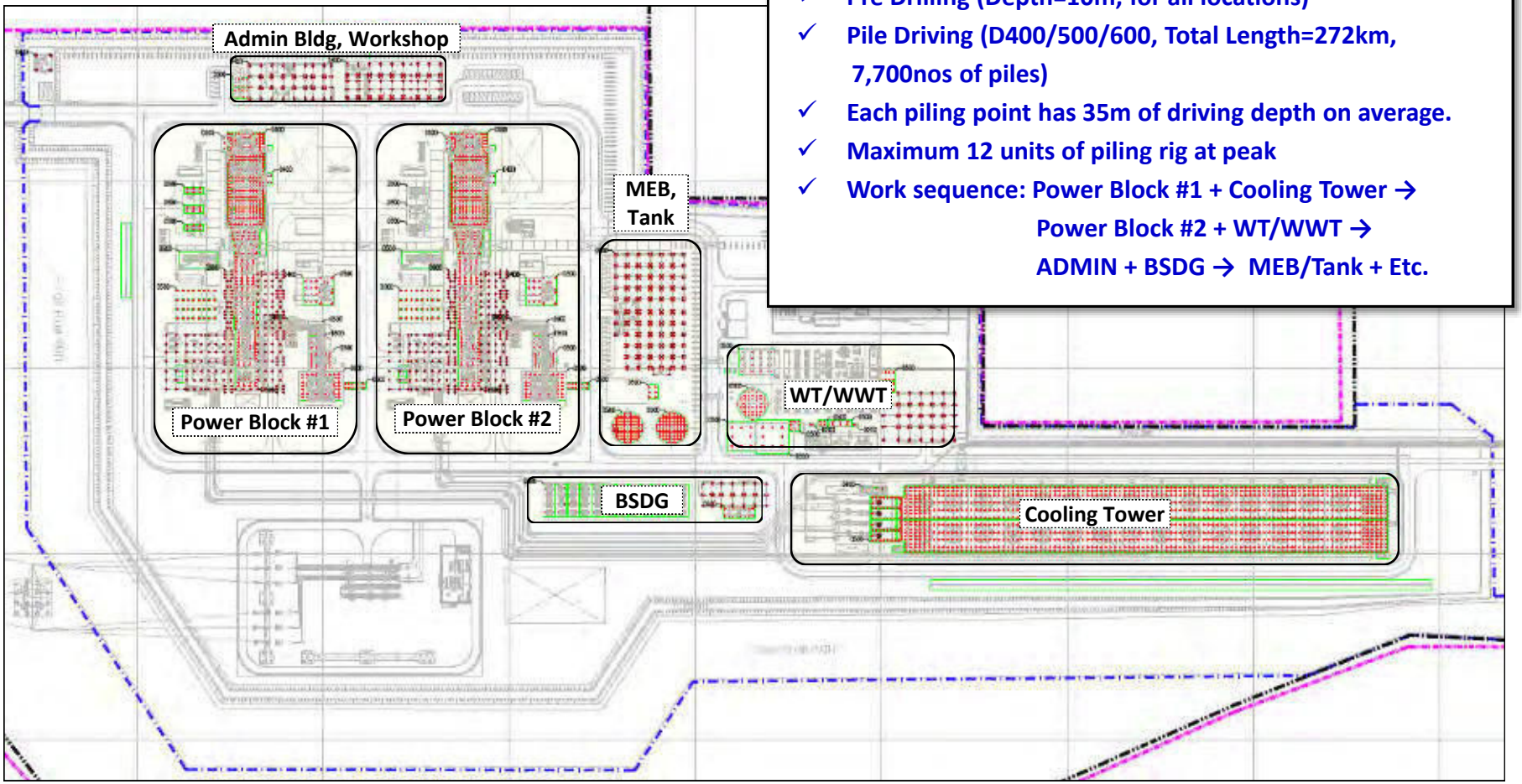
Annex C

Piling Method and Noise Reducing Mitigation

Noise & Vibration on Pile Driving

GE Power SAMSUNG C&T MEINDO ELANG INDAH

CCGT Piling Plan (Location)



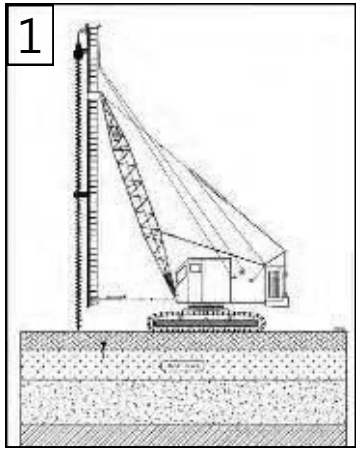
Work Description

- ✓ Pre Drilling (Depth=10m, for all locations)
- ✓ Pile Driving (D400/500/600, Total Length=272km, 7,700nos of piles)
- ✓ Each piling point has 35m of driving depth on average.
- ✓ Maximum 12 units of piling rig at peak
- ✓ Work sequence: Power Block #1 + Cooling Tower → Power Block #2 + WT/WWT → ADMIN + BSDG → MEB/Tank + Etc.

Noise & Vibration on Pile Driving

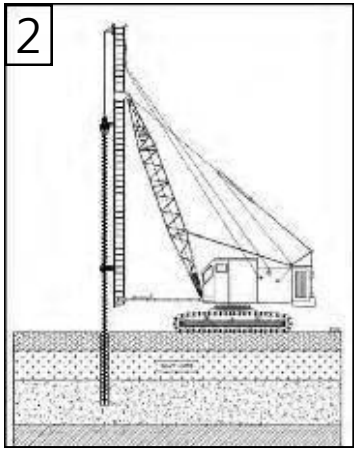
Piling Procedure

1



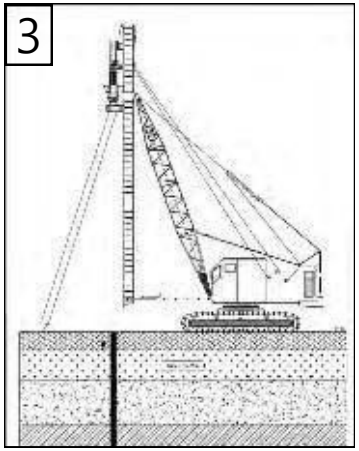
Equipment Setting

2



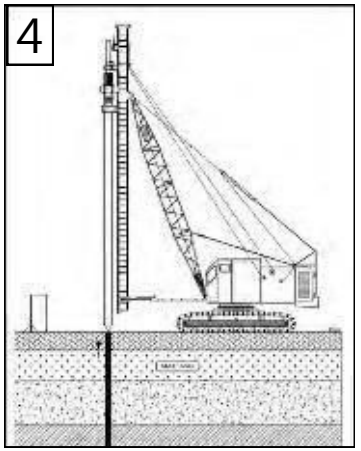
Pre-boring (10m)

3



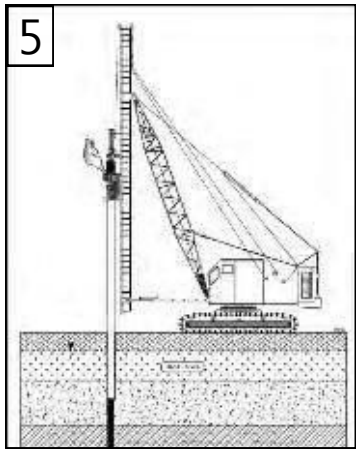
Pile Pitch-up to Rig

4



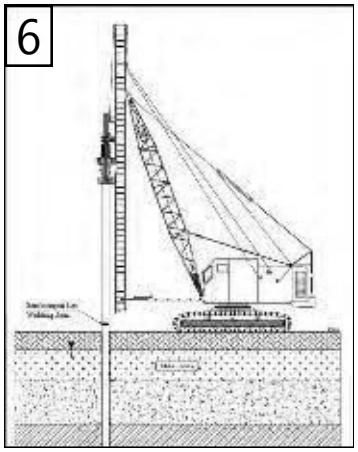
Confirm on Verticality

5



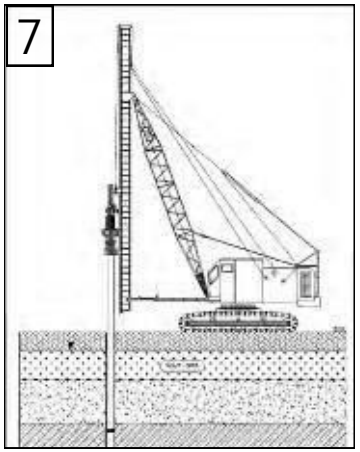
1st Driving (Bottom Part)

6



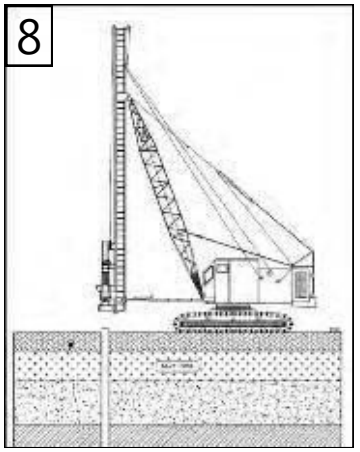
Welding

7



2nd Driving (Mid Part)

8

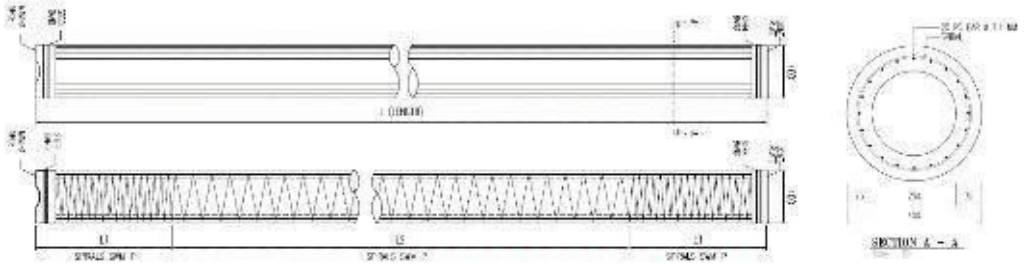
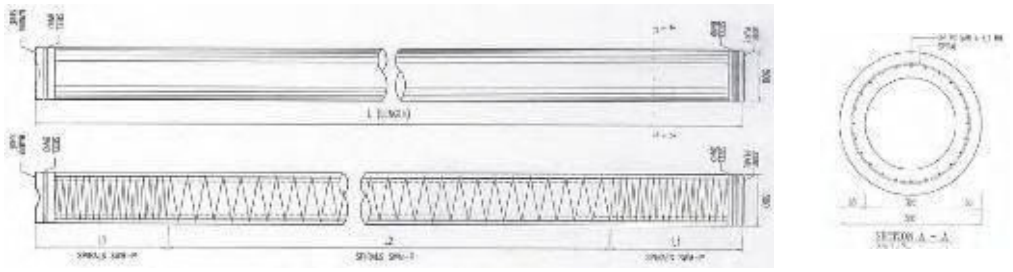
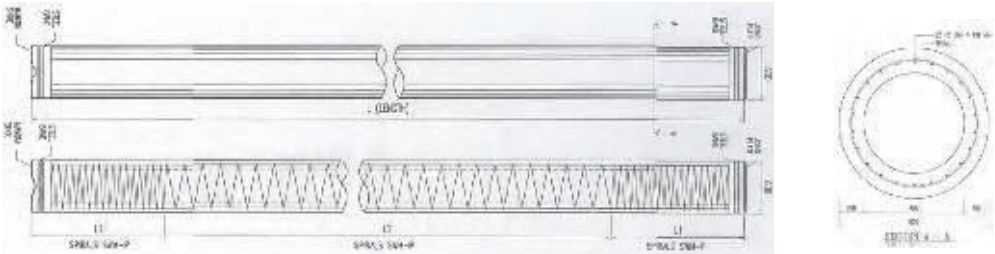


Driving Finished

Noise & Vibration on Pile Driving

GE Power SAMSUNG C&T MEINDO ELANG INDAH

Pile Dimension

Dia. (mm)	Wall THK. (mm)	Comp. Con'c Strength (MPa)	Rebar	Length (m)	Pile Drawing with Section
400	75	80	16 ϕ 7.1mm	6-16	
500	90	80	24 ϕ 7.1mm	6-18	
600	100	80	22 ϕ 9.0mm	6-20	

Noise & Vibration on Pile Driving

GE Power SAMSUNG C&T MEINDO ELANG INDAH

Noise from Pile Driving

Historic Sound Level Data on Piling from BS Code

Table D.4 Historic sound level data on piling: piling operations *(continued)*

Ref no.	Pile		Method	Energy, power rating	Dolly	Sound power level L_{WA}	Soil	Cycle time	On-time	Activity equivalent continuous sound pressure level L_{Aeq} at 10 m (one cycle)
	Depth	Width [a]								
	m	m				dB			%	dB
	Precast concrete piles									
29	10	0.535 dia.	Drop hammer	6 t, 0.5 m drop	Wood	124	Fill	5 min	30	91
30	25	0.285 sq.		5 t, 1.0 m drop	Wood	123	Clay/flint/chalk	2.5 h	80	87
31	20	0.275 sq.		4 t, 0.5 m drop	Wood	116	Chalk/clay	47 min	60	87
32	20	0.275 sq.		4 t, 0.5 m drop	Wood	116	Fill/clay/sand	67 min	30	82

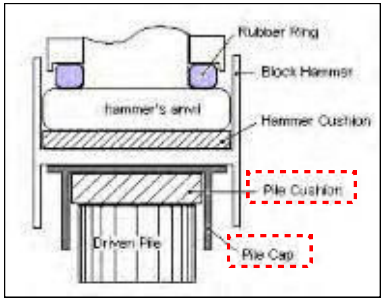
✓ **Noise from piling to be measured and monitored during test piling**

Noise & Vibration on Pile Driving

Noise from Pile Driving (Counter-measure)

Pre-boring (10m)

- ✓ To minimize noise & vibration during pile driving, EPC plans to do pre-boring(10m) for all piling locations.



Pile Cap and Cushion

- ✓ Transmitting hammer's energy properly to the pile, reducing noise and vibration.
  * Hammer cushion consists of 5 layers of high-strength multiflex board.

EGI Fence Installation (Adjacent to Villager Area Only)

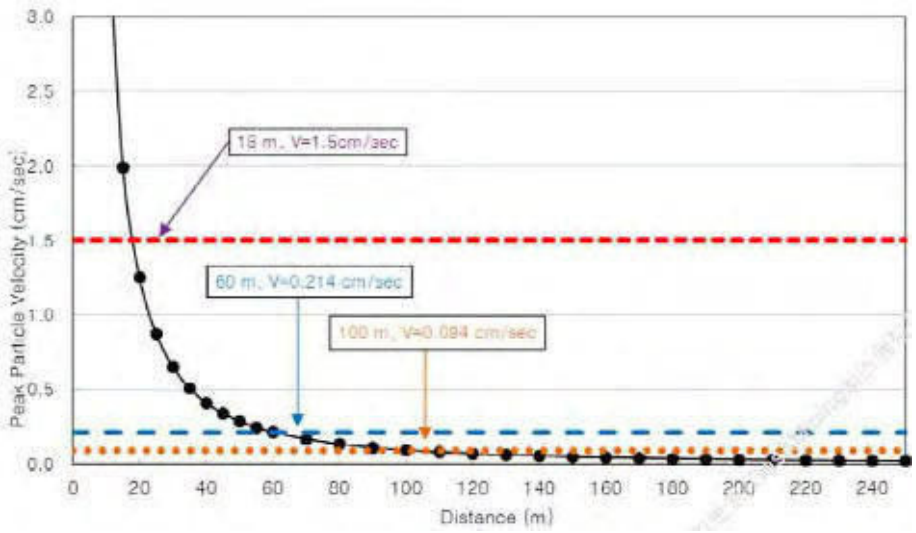
- ✓ To minimize the noise impact to villages close, EGI fence will be installed adjacent to village area.
- ✓ Height and specification shall be determined after EPC's test piling and noise monitoring.

Noise & Vibration on Pile Driving

Vibration Monitoring

Influence Range
a Vibration by Driv

Case of Vibration Effect Study from SAMSUNG's Previous Project (PC Pile Driving)



R (m)	10	17.9	20	40	60	80	100	120
V (mm/s)	38.23	14.97	12.52	4.10	2.14	1.34	0.94	0.70

- ✓ From Attewell & Farmer(1973) empirical prediction model for peak particle velocity, (Ram Weight 11tf with stroke height 1.2m) 18m of the minimum clearance shall be assured for no impact on existing facility.
- ✓ For Jawa-1 CCGT, min. 90m of clearance is guaranteed. Furthermore, Jawa-1 piling plans lower ram weight and stroke height than this case.

→ No vibration monitoring required.
(No impact on Pertamina facility or villages)
see page 7 and attached PDF

Noise & Vibration on Pile Driving

CCGT Piling Location ↔ Adjacent Area