Alba Power Station 5 Block 4
Supplementary ESIA
Construction Noise Risk Assessment

February 2023
1B0114203 – A
Rev. 01

Aluminium
for the world

Environment Arabia

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Table of abbreviations

ACOP	Alba Code of Practice
Alba	Aluminium Bahrain BSC
CCGT	Combined Cycle Gas Turbine
CESMP	Construction Environmental and Social Management Plan
Citrus	Citrus Advisors Ltd.
DMRB	Design Manual for Roads and Bridges
EACS	Environment Arabia Consultancy Services WLL
EPAP	Equator Principles Action Plan
EPC	Engineering Procurement and Construction
ESIA	Environmental and Social Impact Assessment
EWA	Electricity and Water Authority
GE	General Electric
IAQM	Institute of Air Quality Management
IWPP	Integrated Water and Power Project
KBSP	Khalifa Bin Salman Port
kV	Kilovolt
MPW	Mitsubishi Power Ltd.
MW	Mega Watts
SCE	Supreme Council for Environment
SEPCO III	SEPCO III Bahrain Construction Company W.L.L.
SHE	Safety Health and Environment
SOP	Standard Operating Procedure

1 INTRODUCTION

This Construction Noise Risk Assessment is the part of a suite of documents prepared as supplementary reports to the Environmental and Social Impact Assessment (ESIA) undertaken for the Alba Power Station 5 (PS5) Block 4 project.

1.1 Project description

Aluminium Bahrain B.S.C. (Alba) consistently ranks as one of the largest and most modern Aluminium smelters in the world. Known for its technological strength and innovative policies. Alba enforces strict environmental guidelines, maintains a high track record for safety, and is widely regarded as one of the top performers on a global scale.

Alba PS 5 Block 4 Combined Cycle Power Plant is an expansion of the existing Power Station 5, which was commissioned in 2019 – 2020 and consists of 3 x CCGT Blocks of 1:1:1 configuration, with H class gas turbine technology, GE A650 steam turbine, GE (Alstom legacy) heat recovery steam generator, GE Mark VIe distribute control system. PS5 power is exported to the Alba islanded grid through a recently completed (2019) Siemens 220kV indoor gas insulated switchgear Substation.

PS5 Block 4 Project is the addition of a fourth Block of similar 1:1:1 configuration with J-class gas turbine technology and with minimum nominal ISO rating of a 680.8 MW and it also includes tie into the existing 220kV Substation. A Consortium of Mitsubishi Power Ltd. (MPW) and SEPCO III Electric Power Construction Co. Ltd. (SEPCO III) will execute PS5 Block 4 as the Engineering, Procurement and Construction (EPC) Contractor for the Project.

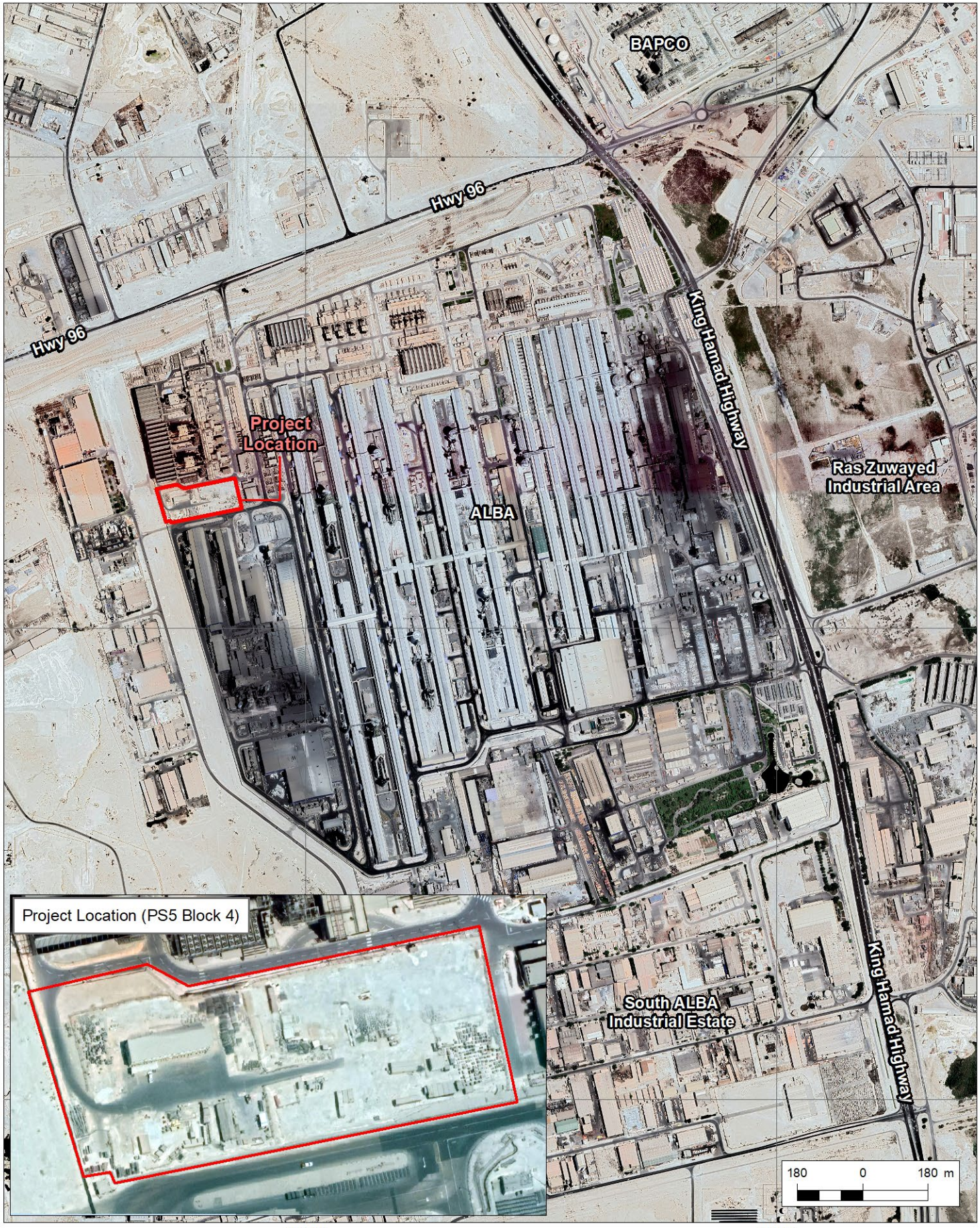
PS5 capacity will increase from 1,800 MW to 2,481 MW. Block 4 Gas turbine unit will have the capability to operate on 100% Khuff gas, 100% Residual will also have the capability to operate on any proportionate mixture of Khuff-residual gas. Generally, concept for the new Block 4 is like the existing Blocks 1 to 3, and the services will be provided from the common facilities from the existing PS5 or other plants within the Alba complex.

The rationale behind the expansion of PS5 Block 4 is that the efficiency of this combined cycle power plant is much higher than the combined cycle power plants of PS 3 and PS 4. Power Station 3, which is operating on a low load, will be shut down and will be kept as emergency standby. Power station 4 will be run partially.

Project location is presented in **Figure 1.1**.

An ESIA report was submitted to the Supreme Council for Environment on 06th January 2022 and environmental clearance was issued. Alba forwarded the approved ESIA report to BNP Paribas – the coordinator of project finance. BNP Paribas appointed Citrus advisors Ltd. (Citrus) to conduct a review on the report for compliance with Equator Principles 4. Citrus then prepared a report that highlighted some gaps and an Equator Principles Action Plan (EPAP) to address them.

Alba commissioned Environment Arabia Consultancy Services (EACS) to address the gaps in the ESIA and EPAP.



CLIENT: Aluminium for the world

CONSULTANT: Environment Arabia

LEGEND: Project location (PS5 Block 4)

NORTH ARROW: N

FIGURE TITLE: Figure 1.1 Project location

DATE: February 2023

DATUM: WGS 1984 (UTM Zone 39N)

PROJECT TITLE: Alba Power Station 5 Block 4 Supplementary ESIA

PREPARED BY: MS

SCALE (A4): 1:13,982

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1.2 Scope of the assessment

The overall objective of the assessment is to determine the nature and magnitude of risks due to construction noise, due to the gaps identified in the noise impact assessment presented in section 10 of the Power Station 5 Block 4 ESIA Report dated 06th January 2022. The assessment will:

- Identify any sensitive receptors (people/businesses) along the construction traffic route(s) and those who work near the SEPCO III site offices, gates to the Al Dur Construction Laydown Area and gates to the Block 4 project site.
- Using the information presented in the ESIA, consider how Block 4 construction noise pose specific risks to identified receptors.
- Evaluate whether existing Alba and EPC Contractor systems, procedures and requirements are specific enough and sufficient to manage and monitor these specific risks on sensitive receptors (including Construction Environment and Social Management Plan (CESMP) and management controls).
- Identify any additional project-specific mitigation or monitoring requirements required to be implemented by Alba and the EPC Contractor to manage these risks. Specifically consider publicizing and providing access to a direct grievance channel for the public.

1.3 Documents reviewed

Table 1.1 shows the list of documents reviewed during the preparation of this risk assessment.

Table 1.1 List if documents reviewed

Sl. No.	Document description
1	ACOP-006- Control of Physical Hazard and Ergonomics
2	ACOP-023-Noise Control and Hearing Protection
3	ACOP-052-Performance Measurement and Monitoring
4	ACOP-056-Environmental Monitoring
5	AGLC 001 Monthly Safety Health and Environment Report Guideline
6	PS5 Block 4 Health Safety Environmental Management Plan PS5-B4-01-YDC-GGP-SEP-00002
7	PS5 Block 4 Hearing Conservation Procedure PS5-B4-01-YDC-GGP-SEP-00011
8	PS5 Block 4 Traffic Management Plan PS5-B4-01-YDC-GGP-SEP-00034 V0.4
9	ESIA_Report_of_PS5_Block_4_Expansion_Project
10	Addendum to the ESIA study
11	1B0114201 Alba Power Station 5 Block 4 Construction Traffic Risk Assessment, Rev 01

2 NOISE STANDARDS AND GUIDELINES

2.1 International Guidelines

2.1.1 Traffic Noise Impacts

The Design Manual for Roads and Bridges (DMRB) published in May 2020 by Highways England, provides guidance on the impact of change to road traffic noise levels in Section LA 111 (Noise and Vibration). The guidance includes an impact significance matrix for assessing the magnitude of changes in noise level for the short and long term to be used as criteria for assessing the impact of any changes to road traffic noise levels. The magnitude criteria of noise level change for the short term is shown in **Table 2.1** and for the long term is shown in
Table 2.2:

Table 2.1 Magnitude of change – short term (Table 3.54a in DMRB)

Short term magnitude	Short term noise change (dB $L_{A10,18\ hr}$ or L_{night})
Major	Greater than or equal to 5.0
Moderate	3.0 to 4.9
Minor	1.0 to 2.0
Negligible	Less than 1.0

Table 2.2 Magnitude of change – long term (Table 3.54a in DMRB)

Long term magnitude	Long term noise change (dB $L_{A10,18\ hr}$ or L_{night})
Major	Greater than or equal to 10.0
Moderate	5.0 to 9.9
Minor	3.0 to 4.9
Negligible	Less than 3.0

2.1.2 British Standards Institute (BSI)

Predicted noise effects have also been assessed using the methodology within BS 5228-1&2:2009+A1:2014 Code of Practice for Noise and Vibration Control on Construction and Open Sites (BSI, 2014A and B). This standard represents the generally accepted industry best practice for controlling noise and vibration from works of construction, excavation and demolition. Annex F of this Standard contains a methodology for estimating noise levels that can arise from various construction techniques as well as recognised methods of mitigating excessive noise levels. BS 5228 gives several examples of acceptable limits for construction noise. The most simplistic being based upon the exceedance of fixed noise limits and states in paragraph E.2:

“Noise from construction and demolition sites should not exceed the level at which conversation in the nearest building would be difficult with the windows shut”.

Paragraph E.2 goes on to state:

“*Noise levels, between say 07.00 and 19.00 hours, outside the nearest window of the occupied room closest to the site boundary should not exceed: 70 decibels (dBA) in rural, suburban areas away from main road traffic and industrial noise or 75 decibels*

(dBA) in urban areas near main roads in heavy industrial areas. These limits are for daytime working outside living rooms and offices".

To provide variable noise limits for the day, evening and night-time periods the 'ABC method' from BS5228 has been informally adopted for Bahrain, the details of which are summarized in **Table 2.3** below. In order to place a receptor in category A, B or C, the existing noise level is rounded to the nearest 5 dB and compared to the levels in Category A.

Table 2.3 BSI Construction Noise Limits (Adapted for Bahrain)

Assessment Category and Threshold Value Period (L_{Aeq})	Threshold Value, dB		
	Category A [A)]	Category B [B)]	Category C [C)]
Night-time (23.00 to 07.00)	45	50	55
Evenings (19.00-23.00) and Daytime Friday	55	60	65
Daytime (07.00 – 19.00)	65	70	75

[A)] Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are less than these values.

[B)] Category B: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are the same as category A values.

[C)] Category C: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are higher than category A values.

It is worth noting that the purpose of the target construction noise criteria is to control the impact of construction noise insofar as is reasonably practicable, whilst recognising that it is unrealistic for developments of this nature to be constructed without causing some degree of disturbance in the locality.

2.1.3 IFC Guidelines

Section 1.7 "Noise" of the IFC Environment, Health and Safety General Guidelines, dated 30 April 2007 states that the guidelines address the impacts of noise beyond the property boundary of the facilities. The guidelines provide advice regarding the prevention and noise mitigation measures and noise level guidelines. The noise level limits that should not be exceeded at the nearest receptor location off-site (or result in a maximum noise increase background of 3 dB) are shown in **Table 2.4**.

Table 2.4 IFC Noise Level Guidelines

Receptor	One Hour L_{Aeq} (dBA)	
	Daytime 07:00 – 22:00	Night-time 22:00 - 0700
Residential; institutional; educational	55	45
Industrial; commercial	70	70

3 RISK ASSESSMENT

3.1 Summary of previous assessment in the ESIA, January 2022

3.1.1 Baseline

Section 10.2.1.1 of the Alba PS5 Block 4 ESIA describes six (6) Noise Monitoring Locations (NML) used to monitor background noise levels in the vicinity of the construction project location:

- NML 1: Adjacent to accommodation and recreational area located ~650 meters towards North of Block 4 (and considered to be residential);
- NML 2: Outside North-West fence line of existing Power Station 5 Blocks. Adjacent to gas metering station;
- NML 3: Block 4 site. ~50 meters away from existing PS 5 Block 3;
- NML 4: Adjacent to Princess Sabeeka Oasis within the Alba Complex, located ~1.8 Km towards South East of Block 4;
- NML 5: Adjacent to Alba Potline 6 fence line. Located at ~850 meters towards South West of Block 4; and
- NML 6: Outside West fence line of proposed Block 4 site.

The report concluded that the mean baseline LAeq noise levels are:

- Within the IFC guideline value of 70 dB(A) for industrial and commercial receptors at locations NML 4, NML 5 and NML 6 during the daytime and night time. Measurements at location NML 2 were also within 70 dB(A) during weekday daytime monitoring.
- Exceeded the IFC guidance value of 70 dB(A) at location NML 3 at the Block 4 site, some 50 m distance from the existing power station 5 at Block 3 during daytime and night time monitoring, and at location NML 2 outside the northwest fence line of existing power station 5 during weekday night time monitoring and weekend day time monitoring.
- Background noise levels at NML 1 located next to the accommodation and recreational area some 650 m north of Block 4 exceeded IFC guideline values for residential areas during day, night, and weekend day monitoring events.

3.1.2 ESIA January 2022 noise assessment

The construction noise assessment in the January 2022 ESIA for Alba PS5 Block 4 (Table 10-18), provides predicted construction noise levels at various distances for individual items of equipment. The construction noise assessment (Section 10.4.1.1) concludes that:

"The nearest sensitive receptor to the Block 4 Expansion Project is the accommodation and recreational area located 650 meters north from the site. From Table 10-18, it is evident that the noise levels are not exceeding the IFC guideline values during day time, except when jack hammers are used during construction.

Predicted noise levels are exceeding IFC guideline values while a number of equipment are operational. General construction activities shall be limited to day time working hours, where feasible and reasonable."

3.1.3 January 2022 ESIA noise assessment gap analysis

As described above, the construction noise assessment presented in the January 2022 ESIA for Alba PS5 Block 4 provides background noise levels at six locations in the vicinity of the construction site location and the predicted construction noise levels at various distances for individual items of equipment. However, the assessment did not consider additional noise sensitive receptors that are shown near Alba PS5 Block 4 as shown in **Figure 3.1** (site office, first aid center and the site entrance security cabin) and no noise mapping is provided in the ESIA for construction activities to enable the noise at these locations to be predicted.

Construction traffic routes and receptors close to Al Dur laydown yard entrance were also not considered in the January 2022 ESIA. A description of the construction traffic route and receptors near laydown entrance is presented in the subsequent sections.

Construction traffic routes

The construction laydown yard and accommodation of SEPCO III employees are located at Al Dur (**Figure 3.2**). Traffic route from Al Dur to the Project site is via King Hamad Highway, then through a series of internal dual lane roads (Road 5156, 5141, 5136 and 5146) (**Figure 3.3**). The smaller roads run through industrial areas and are considered access routes to the businesses and industries present in the area. Light to medium vehicles from Al Dur to Project site will also use the same route. The peak number of light/medium duty vehicles used for the purposes of this Project is expected to be 40 vehicles per day, including vehicles used by management and staff. It is expected that a total of 36 heavy-duty vehicles per day will be required during the construction phase of the Project. These will be transported from Al Dur laydown yard to Block 4 site via the route shown in **Figure 3.3**. This equipment will be transferred to site as needed from the Laydown area. Some will be kept on the Project site and others will be returned. The type of equipment and the frequency its transportation to site will be dependent on specific construction phases and activities and details of expected transportation movements were not available at the time of writing this report.

Large equipment and structures required for the Project will arrive via Khalifa Bin Salman Port (KBSP). Approximately 1500 of these shipments is expected over the course of construction work (83 of these shipments are considered abnormal load). In addition, 700 container shipments of smaller items such as tools, and spare parts are expected to arrive via KBSP over the course of the 29 month construction periods Transport of these shipments and containers from KBSP directly to the Project Site begins on the Prince Khalifa Bin Salman Causeway which links the Hidd Industrial Area to the Project as shown in **Figure 3.4**.

The transportation route for shipments which require transport from KBSP to the Al Dur Laydown area will be via the Prince Khalifa Bin Salman Causeway, then exiting to the Shaikh Jaber Al-Subah Highway via Route 34M and Route 80M, merging onto King Hamad Highway to Bridge no. 3 cross over, then turning right to the Laydown area. The length of the route from KBSP to the Al Dur Laydown area is approximately 45 km and is shown in **Figure 3.5**.

Abnormal loads arriving from KBSP will be transported to the Muharraq Engineering Port in Askar by sea to be later transferred to the Project site via King Hamad Highway. The Contractor has conducted a survey to preliminary identify the safest route to transport the abnormal loads from the Muharraq Engineering Jetty to the Project Site. This preliminary route requires removal a line of 14 concrete jerseys in the middle of the King Hamad Highway just in front of the South Gate of Alba. The preliminary route

indicates that Roads 5135 and 5156 shall be avoided and that route 5136 will be used to enter the industrial area turning then onto Road 5146 as indicated in **Figure 3.6**.

Due to the restrictions of space in the Project site, the Consortium has applied for a permit to use a land in the west side of the Project site, 150 meters long by 15 meters, affronting Road 5146. This parking space has the capacity for 100 lightweight vehicles. Parking of HGVs and delivery of equipment/shipment will be within a designated area inside the Project site boundaries.

Al Dur laydown area

Access to and exit from the Al Dur Laydown area is via the King Hamad Highway where there are no sensitive receptors within a 1-kilometre radius of the entrance and exit points. However, at the western boundary of the laydown area labour accommodation and SEPCO III site offices are present. The locations are shown in **Figure 3.7**.

CLIENT: alba Aluminium for the world

CONSULTANT: Environment Arabia

LEGEND: Noise sensitive receptors; PS5 Block 4 area

NORTH ARROW:

FIGURE TITLE: Figure 3.1 Noise sensitive receptors near Alba PS5 Block 4

DATE: February 2023

DATUM: WGS 1984 UTM Zone 39N

PROJECT TITLE: ALBA PS5 Block 4 - Noise and dust risk assessment

PREPARED BY: MS

SCALE (A4): 1:549

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CLIENT: Alba – Aluminium for the world

LEGEND: Accommodation; Laydown area; Site office; Sensitive receptor

NORTH ARROW: N

CONSULTANT: Environment Arabia

FIGURE TITLE: Figure 3.2 Al Dur Labour Accommodation and Laydown Area

DATE: February 2023

DATUM: WGS 1984 (UTM Zone 39N)

PROJECT TITLE: Alba Power Station 5 Block 4 Supplementary ESIA

PREPARED BY: CN

SCALE (A4): 1 cm = 140 m

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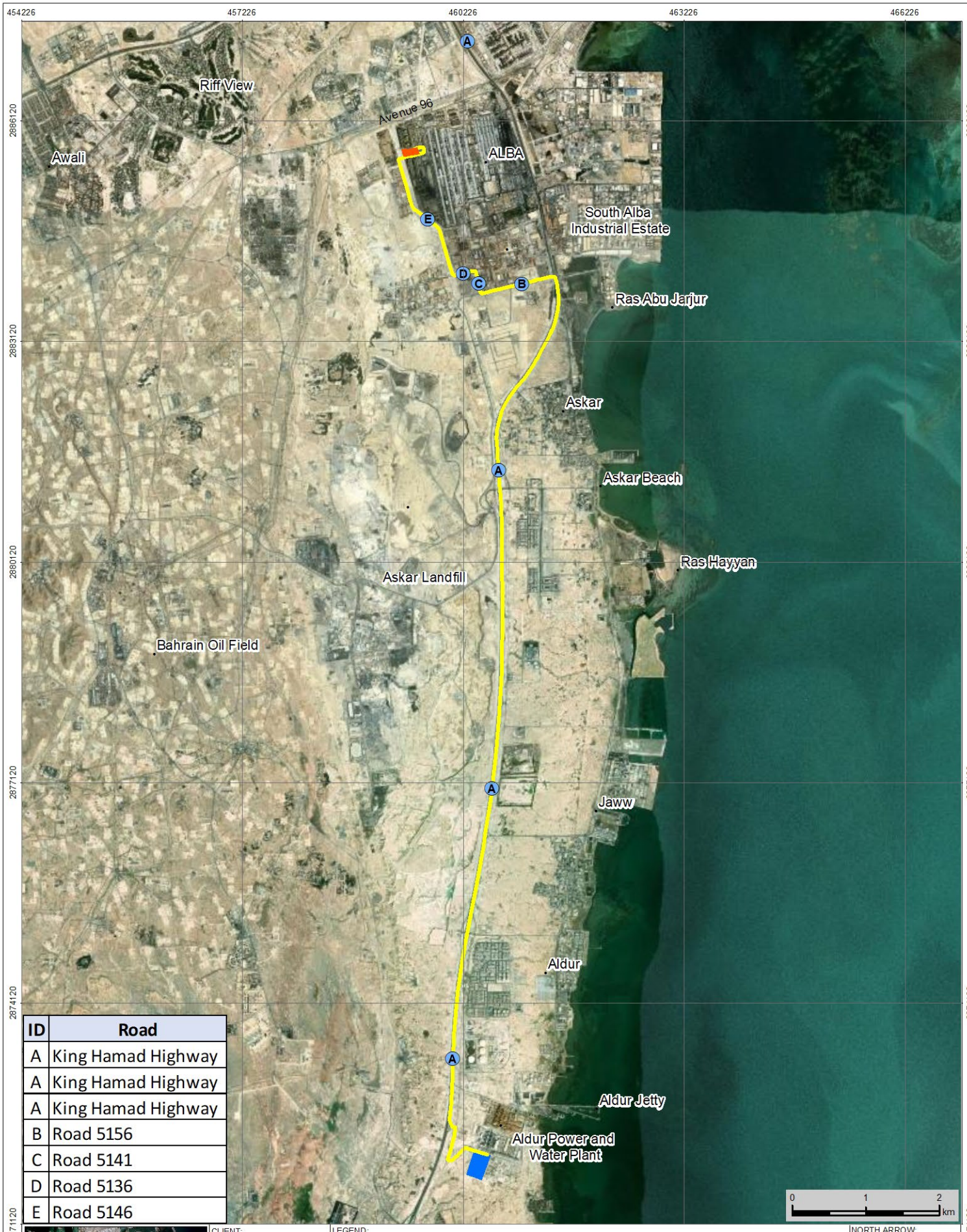

ID	Road
A	King Hamad Highway
A	King Hamad Highway
A	King Hamad Highway
B	Road 5156
C	Road 5141
D	Road 5136
E	Road 5146

CLIENT: Alba – Aluminium for the world

CONSULTANT: Environment Arabia

LEGEND: Project location (PS 5 Block 4) | Laydown area | Al to to PS5 traffic route

NORTH ARROW: N

FIGURE TITLE: Figure 3.3 Route from Al Dur to Alba PS 5 Block 4

DATE: February 2023

DATUM: WGS 1984 (UTM Zone 39N)

PROJECT TITLE: Alba Power Station (PS) 5 Block 4 Supplementary ESIA

PREPARED BY: CN

SCALE (A4): 1 cm = 670 m

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ID	Road
A	Sh. Khalifa bin Salman Highway
B	Sh. Isa Highway
C	Sh. Jaber Al Sabah Highway
D	King Hamad Highway
E	Road 5156
F	Road 5141
G	Road 5136
H	Road 5146

CLIENT: Aluminium for the world

CONSULTANT: Environment Arabia

LEGEND: Project location (PS 5 Block 4) — Al to to PS5 traffic route

NORTH ARROW: N

FIGURE TITLE: Figure 3.4 Route from KBSP to Alba PS 5 Block 4

DATE: February 2023

DATUM: WGS 1984 (UTM Zone 39N)

PROJECT TITLE: Alba Power Station (PS) 5 Block 4 Supplementary ESIA

PREPARED BY: CN

SCALE (A4): 1 cm = 820 m

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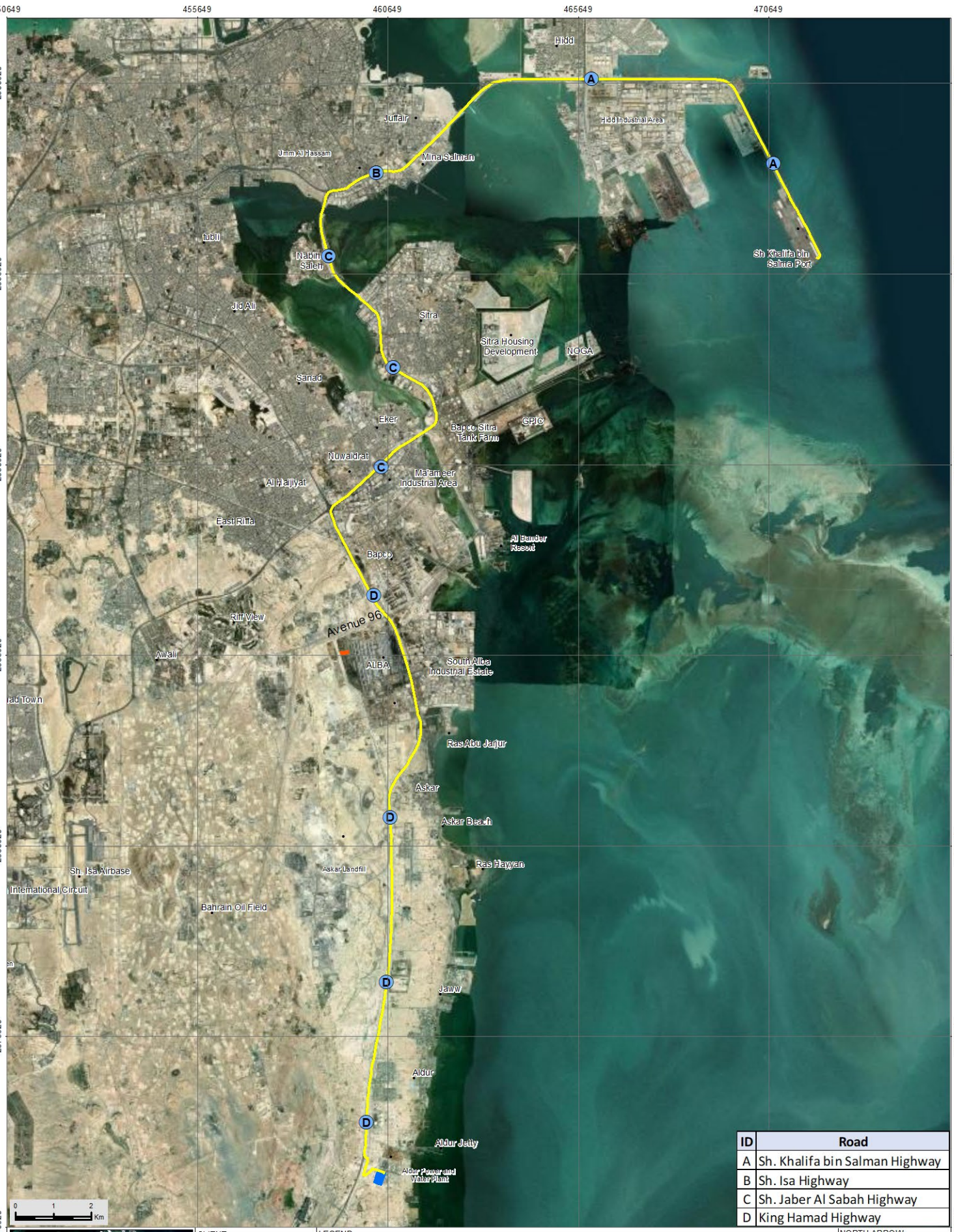

CLIENT: Aluminium for the world

CONSULTANT: Environment Arabia

LEGEND: Project location (PS 5 Block 4) | Al to PS5 traffic route | Laydown area

NORTH ARROW

FIGURE TITLE: Figure 3.5 Route from KBSP to Al Dur Laydown Area

DATE: February 2023

DATUM: WGS 1984 (UTM Zone 39N)

PROJECT TITLE: Alba Power Station (PS) 5 Block 4 Supplementary ESIA

PREPARED BY: CN

SCALE (A4): 1 cm = 1,300 m

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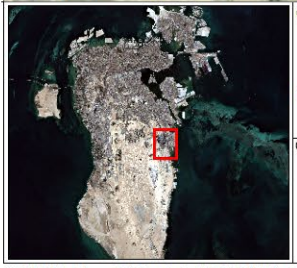
ID	Road
A	Road 5231
B	Road 5238
C	Road 5227
D	Road 94
E	Road 5156
F	Road 5141
G	Road 5136
H	Road 5146



CLIENT: Aluminium for the world

CONSULTANT: Environment Arabia

LEGEND: Project location (PS 5 Block 4); Al to to PS5 traffic route

NORTH ARROW: N

FIGURE TITLE: Figure 3.6 Route from Muharraq Jetty to Alba PS 5 Block 4

DATE: February 2023

DATUM: WGS 1984 (UTM Zone 39N)

PROJECT TITLE: Alba Power Station (PS) 5 Block 4 Supplementary ESIA

PREPARED BY: CN

SCALE (A4): 1 cm = 13,000 m

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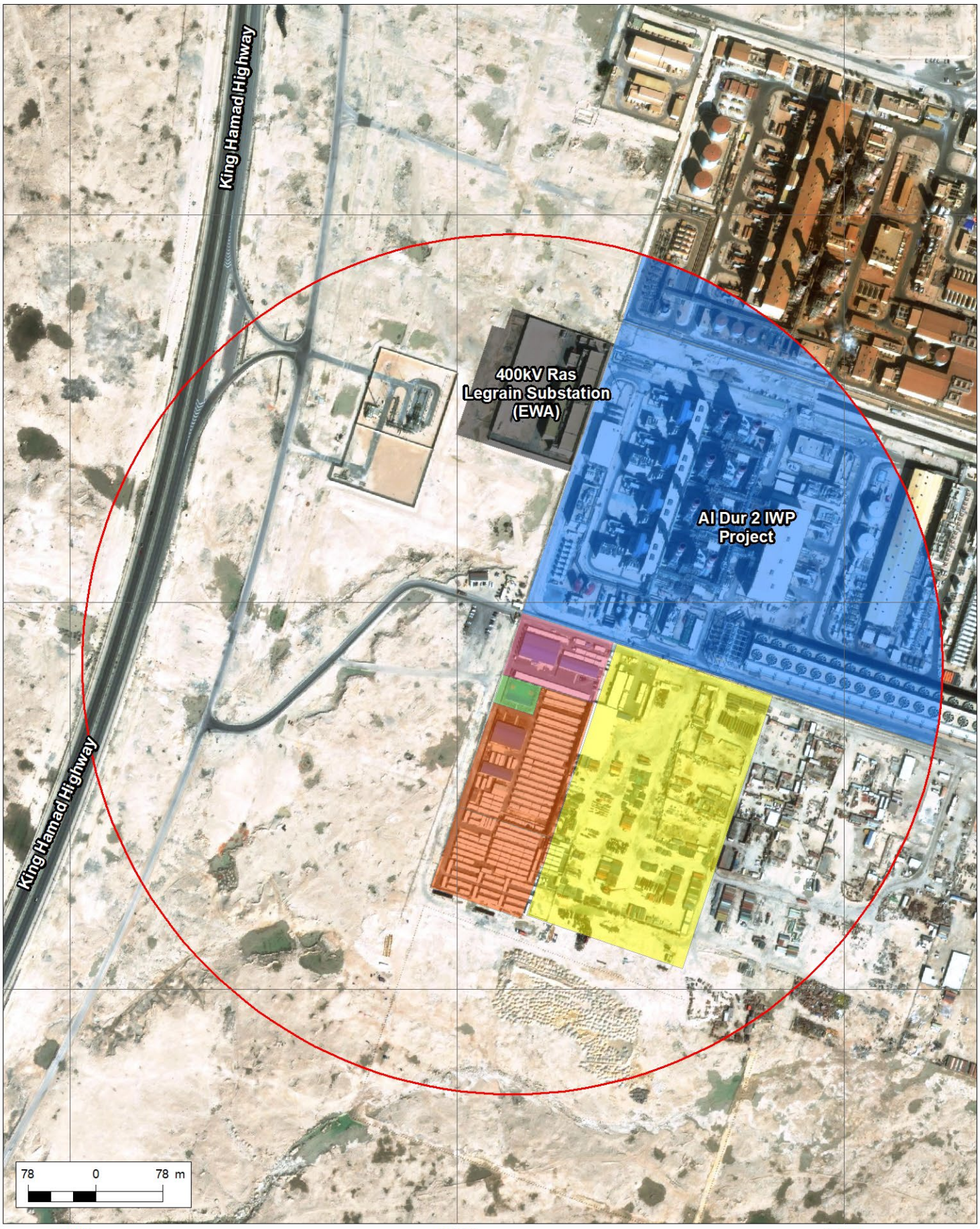

CLIENT: Aluminium for the world

CONSULTANT: Environment Arabia

LEGEND:
- 500m buffer (from the site entrance)
- Site office
- Industrial Facilities
- Recreational
- Residential
- Utilities
- Laydown aera

NORTH ARROW: N

FIGURE TITLE: Figure 3.8 Sensitive receptors and landuse adjacent to Al Dur laydown area (500m away from the entrance)

DATE: February 2023

DATUM: WGS 1984 UTM Zone 39N

PROJECT TITLE: ALBA PS5 Block 4 - Noise and dust risk assessment

PREPARED BY: MS

SCALE (A4): 1:5,894

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3.2 Construction noise risk assessment

The Alba PS5 Block 4 ESIA, January 2022 (section 10.4.1.1) identifies the following as the sources of construction noise:

The major noise sources during construction phase will include a range of construction activities such as:

- *Excavation and earth movement works;*
- *Rock breaking (including jack hammers);*
- *Compaction;*
- *Scaffolding works;*
- *Articulated vehicle (heavy and light) movement;*
- *Construction machinery; and*
- *Welding operations.*

As contained in the baseline noise monitoring report from the Block 4 ESIA (Ref. Section 10.3 - ENV-RJC-20-00070-PS5/ESIA-001), noise from existing industrial activities and road traffic are a major source of noise at the Project site. Vehicles accessing the site during delivery of materials and collection of waste, as well as transportation of workers will also generate noise.

It is considered likely that the noise from construction will exceed IFC guidance levels on site, although noise control and hearing protection for the construction workforce will be in place. It is expected that guidance levels will also be exceeded during the daytime at the site office, first aid centre and the site entrance security cabin as identified on **Figure 3.1**. These receptors are significantly closer to the construction works than 'the accommodation and recreational area located 650 meters north from the site' as identified in the January 2022ESIA. There is a risk that employees working in these locations will be exposed to construction noise above standards and noise attenuation at these locations should be further considered.

3.3 Construction traffic noise

The construction traffic noise assessment has considered the construction traffic flows on the construction route against the existing traffic flows on these roads. A brief description of the traffic routes to ferry workers and materials during construction phase is provided in **Section 3.1.3**.

3.3.1 Construction traffic noise risk assessment

Existing traffic data is provided for the morning, evening and lunchtime peaks hours on the construction traffic route in NPDS2 Model (Year 2020) . To enable a comparison to the change in the 18-hour daytime noise levels for each section of the route, as per Highway England's DMRB guidance on noise and vibration assessment, the three 1-hour peak flows have been converted to an estimated 18 hour flows as shown in **Table 3.1** for the individual sections of the route as shown on **Figure 3.3, Figure 3.4** and **Figure 3.5** and the traffic data for the spot locations (1 to 9) in **Table 3.1**.

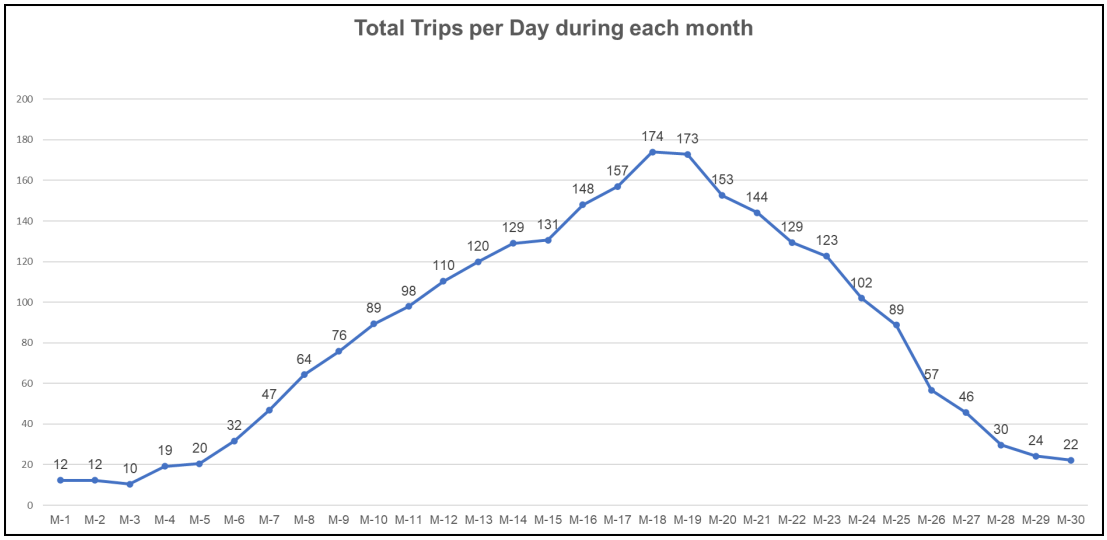
Table 3.1 Traffic Flow Data

Road Spot Location	3-hour Traffic based on morning, lunch and evening 1 hr peak flows	Estimated 18-hour daytime traffic flow *
Prince Khalifa Bin Salman Hwy (Sitra Interchange (IC) to Dry Dock Hwy)		

Road Spot Location	3-hour Traffic based on morning, lunch and evening 1 hr peak flows	Estimated 18-hour daytime traffic flow *
1	17768	63965
2	16704	60134
3	36154	130154
Sh. Jaber A Al Sabah Hwy (Sitra IC to near to Nuwaidrat		
4	35378	127361
5	23313	83927
6	28495	102582
Sh. Jaber A Al Sabah Hwy and King Hamad Hwy (Nuwaidrat IC to ALBA Power Station 5)		
7	19592	70531
8	15586	56110
King Hamad Hwy (ALBA to SEPCO3)		
9	6901	24844
Source: NPDS2 Model (Year 2020)		

The EPC contractor has forecasted the number of trips at any given day during each of the Project months based on the trip requirements in **Figure 3.8**.

Figure 3.8 Construction traffic forecast per day during construction months



The construction traffic noise assessment has been based on the highest number of construction trips per month, which is 174 in month 18 which represents a 'worst case' assumption regarding construction traffic movements.

Based on existing traffic flows and forecasted construction traffic flows, the predicted noise levels at 25m from each section of the construction route for the combined volume of both existing and 'worst case' construction traffic is shown in **Table 3.2**.

The traffic data clearly indicates that the number of construction traffic movements is insignificant when compared to the existing traffic flows on the construction route. To

provide an indication of the noise impact the traffic noise has been predicted at a nominal distance of 25m from the nearside kerb for road spot locations 1 to 9 to enable a comparison of the predicted noise from construction traffic when compared to the existing traffic noise. The traffic data does not provide the percentage of Heavy Goods Vehicles (HGV's) and so for the purpose of the noise assessment it has been assumed that there are 8% HGV's for the existing situation and 50% HGV's for the construction traffic. The noise predictions have assumed a traffic speed of 60 kph, except where stated otherwise.

Table 3.2 Predicted Traffic Noise Levels at 25m from Road

Road Section	Existing Noise Level $L_{A10,18\ hr}$ dB	Construction Traffic Noise Level $L_{A10,18\ hr}$ dB	Combined Existing + Construction Noise Level $L_{A10,18\ hr}$ dB	Change in Noise due to construction traffic dB
Prince Khalifa Bin Salman Hwy (Sitra Interchange (IC) to Dry Dock Hwy)				
1	71.8	50.3	71.8	0.0
2	71.5	50.3	71.5	0.0
3	74.6	50.3	74.6	0.0
Sh. Jaber A Al Sabah Hwy (Sitra IC to near to Nuwaidrat				
4	74.8	50.3	74.8	0.0
5	72.9	50.3	72.9	0.0
6	73.8	50.3	73.8	0.0
Sh. Jaber A Al Sabah Hwy and King Hamad Hwy (Nuwaidrat IC to ALBA Power Station 5)				
7	72.2	50.3	72.2	0.0
8	71.2	50.3	71.2	0.0
King Hamad Hwy (ALBA to SEPCO3)				
9	67.5	50.3	67.6	0.1

The predicted noise levels at 25m from the construction route indicate that the construction traffic provides no noise increase at the spot locations 1 to 8 and a 0.1 dB increase at spot location 9.

DMRB states that in the short term a change in traffic noise of less than 1.0 dB is negligible. At any noise sensitive receptor on the construction route the construction traffic noise will be negligible due to the high existing traffic noise levels.

The noise impact of construction traffic at noise sensitive receptors on the smaller roads leading to the Al Dur Laydown area and the Block 4 construction site entrance have been considered separately in Section 2.3 below.

3.3.2 Noise Receptors for Construction Traffic

The noise assessment has considered the construction traffic route to Alba PS5 Block 4 and the route to the Al Dur 2 laydown area. On the construction route there are multiple noise sensitive receptors from KBSP to Alba PS5 Block 4. The highway to Alba PS5 Block 4 from Al Dur has receptors at industrial sites and are therefore not considered to be noise sensitive. The noise effects on the construction routes have been considered

in terms of the change in noise level and as discussed above the noise effect is negligible.

Al Dur laydown area

The construction traffic at the Al Dur 2 laydown area passes the front of the site offices and for the purpose of the noise assessment it is assumed that the construction traffic will take a route down the centreline of the laydown area. The predicted construction traffic noise levels at the nearest noise sensitive receptor areas to the Al Dur 2 laydown are provided in **Table 3.3**.

Table 3.3 Predicted construction traffic noise levels at receptors close to Al Dur 2 laydown

Receptor Location and estimated traffic speed	Predicted Daytime Construction Traffic Noise Level $L_{Aeq,16\ hr}$ dB
Labour accommodation (30kph)	44.8
SEPCO III site offices – front (60 kph)	48.3
SEPCO III site offices – side facing laydown site (30kph)	44.8
Residential area approx. 700m to the south-east of the laydown site (30 kph)	33.9

The predicted construction traffic noise levels have been considered against the BSI Construction Noise Limits (**Table 2.3**). The predicted noise levels are below the daytime and evening noise thresholds at all receptor locations, however the night-time threshold would be exceeded at the front of the SEPCO III site offices. It is assumed that the offices would be mostly vacant during night time hours.

Block 4 construction site entrance

Noise receptors closest to construction traffic movements at the Block 4 site entrance are a site office, first aid centre and the site entrance security cabin. These locations are shown on **Figure 3.1**. It is understood that the site entrance security cabin is located 5 m from the site entrance road. The predicted construction traffic noise levels at these nearest noise receptor areas to Alba PS5 Block 4 are provided in **Table 3.4**.

The predicted construction traffic noise levels at the nearest noise receptor areas to Alba PS5 Block 4 are provided in **Table 3.4**.

Table 3.4 Predicted construction traffic noise levels at receptors close to Alba PS5 Block 4

Receptor Location and estimated traffic speed	Predicted Daytime Construction Traffic Noise Level $L_{Aeq,16\ hr}$ dB
Site Office (40 kph on Rd 5156 and 30kph on site access road)	46.2
First Aid Centre (40 kph on Rd 5156 and 30kph on site access road)	47.9
Site entrance security cabin (30kph)	56.4

The predicted construction traffic noise levels have been considered against the Construction Noise Limits (**Table 2.3**). The predicted noise levels are below the daytime noise thresholds at all receptor locations. The evening and the night-time threshold would be exceeded at the site entrance.

The EPC contractor has taken baseline day/night noise measurements at the site entrance. The noise levels were measured every day from 1st to 31st December 2022 and the log average value over the month is $L_{Aeq,T}$ 68.5 dB. The baseline noise level is significantly higher than the predicted daytime construction traffic noise level at this location and construction traffic would add 0.3 dB to the baseline noise level, which is considered to be a negligible noise increase.

Predicted construction traffic noise levels when compared against the IFC Guidelines are below the daytime guidance levels at the site office and the first aid centre. As the site entrance security cabin is considered as industrial use the noise levels also meet the higher daytime noise target. The night-time level guideline would just be exceeded at the site office and the first aid centre but these are unlikely to be in use during the night.

3.4 Review of Alba / EPC Contractor's management procedures

The following three documents provided by the Project team were reviewed to evaluate whether processes and procedure specific enough and sufficient to manage and monitor the construction noise risks on sensitive receptors:

- ACOP-023 Noise Control & Hearing Protection;
- Hearing Conservation Procedure; and
- Construction Environmental and Social Management Plan, Section 6.2 Noise Management Plan (CESMP).

3.4.1 ACOP – 023 noise control and hearing protection

ACOP – 023 is related to exposure of the workforce to excessive noise, noise control and hearing protection. It does not cover noise control in relation to external sensitive receptors who may be exposed to excessive noise or noise management for external receptors. However, the following review has been conducted to compare the document with internationally recognised standards and provide additional recommendations.

The noise exposure limits included in the ACOP - 023 Noise Control & Hearing Protection (NCHP) document have been compared to the action levels in the 'Control of Noise at Work Regulations, 2005', UK Statutory Instrument No.1643 (CNWR).

The three-exposure limit and action values in the CNWR have been compared to the 'action level' and 'noise exposure limit' values provided in Section 4 Definitions of the NCHP.

The 'action level' value in the NCHP is the same as the lower exposure action value for the daily personnel noise exposure of 80 and 85 dB(A) as provided in the CNWR. However, the CNWR also provide a peak sound pressure level of 135 dB (C-weighted) for the lower exposure action level whereas the 'action level' value in the NCHP does not provide a peak value.

The 'noise exposure limit' value in the NCHP is the same as the upper exposure action values for daily personnel noise exposure of 85 dB(A) as provided in the CNWR. However, the 'noise exposure limit' peak value in the NCHP is 140 dB whereas the

CNWR peak value is 137 dB (C-weighted). Furthermore, the NCHP does not specify how the peak value should be measured whereas the CNWR states that C-weighting should be applied. The NCHP should specify the setting on the noise meter for the peak value such as weighted or unweighted peak or a specific weighting such as C-weighting as used in the CNWR. The unspecified peak value could lead to discrepancies in peak noise measurements and should be specified to reduce any misunderstanding.

The CNWR provides a daily exposure limit value of 87 dB(A) and a peak value is 140 dB (C-weighted). This exposure limit is higher than that provided in the NCHP but provide the same peak value of 140 dB although this is specified differently in the two documents.

The CNWR apply to both daily and weekly personal exposure values whereas the NCHP only apply to daily values. Clearly the noise exposure of an employee that is exposed to high noise for 5 days a week should be considered differently than an employee that is only exposed to the same noise for 1 day a week. The CNWR states that where the exposure of an employee to noise varies markedly from day to day, an employer may use weekly personal noise exposure action values.

It is considered that the NCHP exposure and limit values should be amended such that they align with the CNWR.

In number 11 (ACOP – 23). Doubling Rate of 4. Definitions section of the NCHP the 'doubling rate' is stated as 5 dB. It is assumed that this is based on the Occupational Safety and Health Administration (OSHP) guidance for the USA. For the majority of countries including the UK the 'doubling rate' is 3 dB. The difference is due to the OSHP exchange rate taking into account for the times during a workday that the employee is not exposed to noise, like work breaks. The OSHP acknowledge that many global companies are using a 3-dB exchange rate, which is more stringent than the legal requirements in the United States. We recommend that a 3-dB exchange rate is used, which provides better protection for employees.

Section 6.4. Measurements states that: '*Measurements shall be made with a calibrated sound level meter (SLM) by a person trained and skilled in the use of acoustic measurement instruments. As a minimum, training should include classroom instruction and field measurements. A separate instrument called an acoustical calibrator is available from the instrument manufacturer and shall be used to check calibration before and after each day's SLM usage. Acoustical calibrators shall be recalibrated at least annually by the instrument manufacturer or an acoustical test laboratory qualified to perform the calibration*.' We recommend that the NCHP should also state that the sound level meter shall be Type 1 or 2 and it shall bear a valid calibration certificate.

In section 6.8.3 of the NCHP it states that '*an employee with an effective Noise Reduction Rating (NRR) can work for 8 hours in a 100dB area (100-15 = 85 dB)*'. This information has been provided as an example but still implies that 85 dB(A) at the ear is acceptable. The CNWR state in 7(4) that:

Any personal hearing protectors shall be selected by the employer so as to eliminate the risk to hearing or to reduce the risk to as low a level as is reasonably practical.

Hearing protection should be selected to reduce the risk to hearing to as low a level as is reasonably practical and not to the upper action level as implied by 6.8.3 of the NCHP.

In section 6.8.3 of the NCHP it also stated that in areas with noise level above 105 dB(A) a combination of earplugs and earmuffs is recommended for additional

attenuation. In this situation we would recommend specialist hearing protection is provided that not only reduces the risk to hearing to as low a level as is reasonably practical and must be below a level of 75 dB(A) but it is also comfortable and practical for the employee. This may involve a combination of earplugs and earmuffs as suggested in the NCHP but other specialised hearing protection options are available such as tuned ear plugs, which can reduce specific industrial sound frequencies but can allow speech frequencies to enable effective employee communication.

In conclusion the NCHP provides a hierarchy of noise control with practical options considered such as engineering controls, quieter equipment, silencer and enclosure options to reduce the noise as far as is reasonably practical. The NCHP then considers Hearing Protection Zones where appropriate signs are required and appropriate hearing protection is provided where the daily noise exposure exceeds 85 dB(A). It is considered that the action and exposure limit values in the NCHP should be aligned with those in the CNWR and the text revised for issues such as the 'doubling rate', weekly exposure and peak sound levels.

3.4.2 Hearing conservation procedure

The Hearing Conservation Procedure is related to workforce protection and does not cover noise control in relation to external sensitive receptors who may be exposed to excessive noise or noise management for external receptors. However, the following review has been conducted to compare the document with internationally recognised standards and provide additional recommendations.

The same issues that have been reviewed and commented on for the NCHP are repeated in the Hearing Conservation Procedure (HCP). In summary these are:

- Differences in the three-exposure limit and action values in the CNWR when compared to the 'action level' and 'noise exposure limit' values provided in Section 4 Definitions of the NCHP and the HCP.
- The doubling rate should be 3 dB to better protect employees. It is noted that on Page 11 of the HCP that it states that *'For every 3 dB(A) increase in sound levels, the 'allowed' exposure period or duration should be reduced by 50 percent'* .
- Hearing protection should be selected to reduce the risk to hearing to as low a level as is reasonably practical and not to the upper action level as implied by 6.8.3 of the NCHP.

In the Table in Section 6.3 under Health and Safety the HCP defines the peak level as 'a peak sound pressure level (instantaneous) of more than 140 dB(C)'. This C weighting is in agreement with the measurement methodology in the CNWR and it is recommended that this is adopted in the NCHP and the HCP.

The HCP states in the Table in Section 6.3 that '*The use of hearing protection should be enforced actively when the equivalent sound level over 8 hours reaches 85 dB(A), the peak sound levels reach 140 dB(C), or the average maximum sound level reaches 110dB(A). Hearing protective devices provided should be capable of reducing sound levels at the ear to at least 85 dB(A)*'. The recommendation of a 110 dB(A) maximum noise trigger for hearing protection is not in the CNWR but provides a sensible precaution and should be adopted in the NCHP and the HCP documents.

3.4.3 Construction environmental and social management plan (CESMP)

Section 6.2 – Noise Management Plan – of the CESMP for Alba PS5 Block 4 construction includes the regulatory requirements, potential impacts, noise sources, monitoring and responsible persons for construction noise. Noise mitigation options are also outlined including the selections and use of machinery, appropriate silencers and enclosures, working hours and vibration reduction measures.

The mitigation measures include:

- *Equipment and machinery should be switched off when not in use;*
- *Equipment such as generators, etc., should be fitted with appropriate silencers and acoustic enclosures (where practical) and be in good working order;*
- *Machines found to produce excessive noise compared to normal industry expectations should be removed from the site or stood down until repairs or modifications can be made;*
- *General construction activities should be limited to daytime (7am to 8pm) working hours, where feasible and reasonable;*
- *All mechanical plant and equipment should be checked regularly to avoid any unnecessary noise caused by lack of maintenance; and*
- *All engine covers should be kept closed when equipment is operating.*

Where predicted construction noise levels at Alba PS5 Block 4 are above the target values at noise sensitive receptors then additional measures such as site barriers/hoardings or revised construction methodology such as limited use of jack hammers (restriction on hours of use) should also be considered as well as the measures presented in the PS5 Block 4 CESMP.

3.4.4 Conclusions and recommendations

The January 2022 ESIA noise assessment concluded that the noise levels would not exceed guidance levels, except when jack hammers are in use during construction. However, it should be noted that baseline noise measurements carried out for the ESIA indicated noise levels above international guidance levels in the area.

External noise receptors in the vicinity of the construction site are mainly industry and local commercial businesses, although there is some labour camp accommodation at 650 m distance from the Project site.

Assessment of traffic construction noise impacts in this document predicted that cumulative noise impacts would be negligible on receptors along the transportation routes based on the insignificant increase on current traffic levels that will be added by Project related construction traffic.

It is expected that construction activities will result in exceedance of international noise guidance levels during the daytime at the site office, first aid centre and the site entrance security cabin. These receptors are close to the construction works and additional noise attenuation at these locations should be considered.

The January 2022 ESIA construction noise assessment, is based on distance from construction sources rather than predicted levels at noise sensitive receptors and the nearest noise sensitive receptors were not adequately considered. As such, the risk of adverse construction noise effects at the nearest noise sensitive receptors has not been adequately identified and as such noise controls in relation to attenuating noise levels at external receptors are not included in current Alba systems and procedures.

The ACOP-023 Noise Control & Hearing Protection and the Hearing Conservation Procedure documents consider issues and targets relating to hearing protection for the workforce and do not consider the effects at noise sensitive receptors outside the construction area and laydown yard.

A noise management plan is included in the CESMP which contains noise mitigation options to minimize the noise effects at noise sensitive receptors.

It is recommended that a noise monitoring programme is developed for construction. The programme should include procedures and locations to conduct regular noise measurements at the construction site fence line and at selected locations outside the fence line during construction, with an increased frequency of measurement during the noisiest operations (such as the use of the jack hammers). An outline of the program is provided in **Section 3.5**.

Noise complaints from external parties will be handled through the processes and procedures contained in the Project stakeholder engagement plan as well as Alba's and the EPC Contractor's grievance mechanisms. Alba's grievance mechanism should be reviewed to ensure that guidelines to record all noise related complaints are adequate in that the noise sources can be identified and appropriate measures to reduce noise levels can be taken.

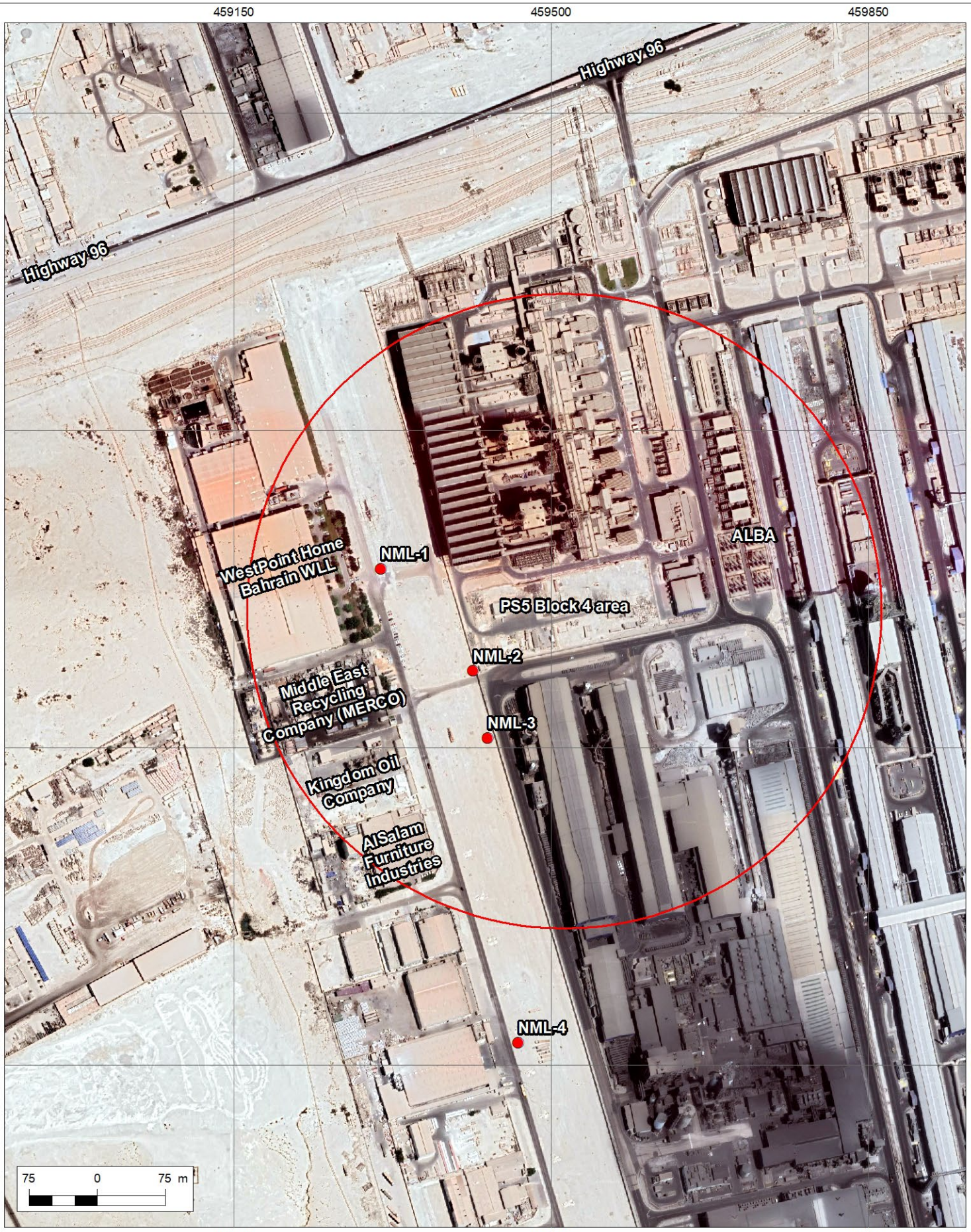
3.5 Noise Monitoring Program

The following monitoring plans were reviewed during the risk assessment process:

- ACOP-052-Performance Measurement and Monitoring;
- ACOP-056-Environmental Monitoring; and
- AGLC 001 Monthly Safety Health and Environment Report Guideline.

The EPC contractor has a noise monitoring program in place and undertaking regular noise monitoring at two (2) locations. Since the assessment predicted increase in noise levels during night-time near site office and site entrance, additional Noise Monitoring Locations are recommended (refer **Figure 3.9**) which includes these locations and adjacent businesses. Monitoring locations are as follows:

- NML 1 – adjacent to West Point Home entrance;
- NML 2 – adjacent to security cabin;
- NML 3 – adjacent to site office and first aid centre; and
- NML 4 – adjacent to Tylos Plastics.



CLIENT: Aluminium for the world

CONSULTANT: Environment Arabia

LEGEND: Noise monitoring locations; 350m buffer (from the site boundary)

NORTH ARROW: N

FIGURE TITLE: Figure 3.9 Noise monitoring locations

DATE: March 2023

DATUM: WGS 1984 UTM Zone 39N

PROJECT TITLE: ALBA PS5 Block 4 - Noise and dust risk assessment

PREPARED BY: MS

SCALE (A4): 1:5,524

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