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Supplementary Environmental and Social Impact Assessment Report

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RESPONSIBLE ENGINEER: Ed Oldmeadow	**DATE:**
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ALBA Potline 6 and Power Plant 5 Expansion

Supplementary Environmental and Social Impact Assessment Report

Final Report

Prepared by:
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October 2017

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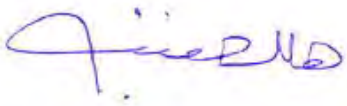
Initials/Date		06.10.17

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Appendix 4B	Copies of Communications with Stakeholders
Appendix 6A	ALBA Code of Practice for Construction Phase (ACOPC No. C001)
Appendix 10A	Phase I Soil and Groundwater Site Assessment Report
Appendix 10B	Phase II Soil and Groundwater Site Assessment Report

Table of Abbreviations

ADMS	Advanced Dispersion Modelling System
AEWRD	Agriculture, Engineering & Water Resources Directorate
ALBA	Aluminium Bahrain
AOI	Area of Influence
AQMS	Air Quality Monitoring Station
BACA	Bahrain Authority for Culture & Antiquities
Bapco	Bahrain Petroleum Company
BAT	Best Available Techniques
BBL	US Barrel
bgl	Below Ground Level
BMP	Bapco Modernization Programme
CEM	Continuous Emissions Monitoring
CESMP	Construction Environmental and Social Management Plan
CLA	Construction Laydown Area
dB(A)	Decibel A-Weighted
DQRA	Detailed Quantitative Risk Assessment
EACS	Environment Arabia Consultancy Services
EBRD	European Bank of Reconstruction & Development
ECA	Export Credit Agencies
EEE	Environmental Effects Evaluation
EER	Environmental Evaluation Report
EHS	Environmental Health and Safety
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EMS	Environmental Management System
EPC	Engineering Procurement Construction
EPCM	Engineering Procurement and Construction Management
ESAP	Environmental and Social Action Plan
ESDD	Environmental and Social Due Diligence
ESIA	Environmental and Social Impact Assessment
ESMS	Environmental and Social Management System
EU	European Union
EWA	Electricity and Water Authority
FEED	Front End Engineering Design
GHG	Greenhouse Gas
GIIP	Good International Industry Practice
GIS	Geographic Information System
GPIC	Gulf Petrochemical Industries Company
H&S	Health and Safety
HSE	Health, Safety and Environment
HAZID	Hazard Identification Study
HAZOP	Hazard Operability Study
HGV	Heavy Goods Vehicle
HF	Hydrogen Fluoride
IAQM	Institute of Air Quality Management
IFC	International Finance Corporation
IFC PS	International Finance Corporation Performance Standard
ILO	International Labour Organisation

ISO	International Organisation for Standardisation
KBSP	Khalifa Bin Salman Port
KPI	Key Performance Indicators
L_{Aeq}	Equivalent Continuous Noise Level
L_{max}	Maximum Noise Level
L_{10}	Noise level exceeded for 10% of the time of the measurement duration
L_{90}	Noise level exceeded for 90% of the time of the measurement duration
LPG	Liquefied Petroleum Gas
MOI	Ministry of Interior
MSDS	Material Safety Data Sheet
MWPS	Migrant Workers Protection Society
NO	Nitrogen Oxide
NOx	Nitrogen Oxides
NOGA	National Oil and Gas Authority
NPDS	National Planning Development Strategy
NRMM	Non Road Mobile Machinery
OECD	Organisation for Economic Cooperation and Development
OESMP	Operation Environmental and Social Management Plan
OHSAS	Occupational Health and Safety Assessment Series
PCBs	Polychlorinated Biphenyls
PDS	Power Distribution System
PEC	Predicted Environmental Concentration
$PM_{2.5}$	Particulate Matter up to 2.5 Micrometres in Size
PM_{10}	Particulate Matter up to 10 Micrometres in Size
PM	Particulate Matter
PPE	Personal Protective Equipment
PPV	Peak Particle Velocity
PS	(International Finance Corporation) Performance Standard
PS5	Power Station 5
RPDM	Roads Project and Maintenance Directorate
RZIA	Raz Zuwayed Industrial Area
QRA	Quantitative Risk Assessment
SAI	Social Accountability International
SAIE	South ALBA Industrial Estate
SCE	Supreme Council for Environment, Kingdom of Bahrain
SEP	Stakeholder Engagement Plan
SPL	Sound Pressure Level
SPL	Spent Pot Lining
STP	Sewage Treatment Plant
TLV	Threshold Limit Value
TMP	Traffic Management Plan
TSS	Total Suspended Solids
TWA	Time Weighted Average
UER	*Rus-Umm Er Radhuma*
US EPA	United States Environment Protection Agency
VDV	Vibration Dose Values
VOC	Volatile Organic Compound
WBG	World Bank Guidelines
WHO	World Health Organisation

1 INTRODUCTION

1.1 Background

Environment Arabia Consultancy Services WLL (EACS) has been appointed by Aluminium Bahrain B.S.C. (ALBA) to prepare a Supplementary Environmental and Social Impact Assessment (ESIA) for the expansion of the ALBA aluminium smelter, Bahrain. The project comprises the construction of an additional potline (Potline 6) together with additional, on-site electrical generation (Power Station 5 or PS5).

An ESIA for the project was prepared by Tebodin Middle East Ltd. in June 2014. Following changes to the project design, an Addendum to the ESIA was issued in October 2014. Based on these submissions the project obtained an environmental permit from the national environmental regulator, the Supreme Council for Environment (SCE) on the 9th of June 2015.

Since the preparation of the ESIA there have been further changes to the design of the Line 6 Expansion project and the main elements of the design are now finalized. In addition, Environmental and Social Due Diligence (ESDD) advisors to the project lenders have requested additional environmental and social impact assessment studies to be undertaken.

This report provides an updated ESIA to reflect the changes to the project design, and addresses the requirements for additional ESIA studies.

1.2 Previous Reports

The following reports comprise the previous work submitted to the SCE in respect of obtaining an environmental permit for the project:

i. Environmental and Social Impact Assessment Report ALBA Potline (6) and Power Plant (PS 5) Expansion. Tebodin Middle East Ltd. June 09, 2014. Document number: 3311002, Revision: C. Including an Executive Summary [referred to in this report as the 2014 ESIA Report].

ii. A translation of the project ESIA Executive Summary in Arabic, June 2014.

iii. Addendum to Environmental and Social Impact Assessment Report. Tebodin Middle East Ltd. October 12th, 2014. Document number: 3311003, Revision: C [referred to in this report collectively as the 2014 ESIA Report with item (i) or individually as the 2014 ESIA Addendum Report].

iv. Construction Environmental Management Plans for:

   a. Power Station 5. Tebodin Middle East Ltd. January 12th 2017. Document number: 3311001, Revision: 2.
   b. Power Distribution System. Tebodin Middle East Ltd. January 26th 2017. Document number: 3311001, Revision: 0.
   c. ALBA Line 6 Expansion Project. International Bechtel Company Ltd. 16th August 2016. Document number: 26096-6000-GPP-GHE-0001, Revision 000.

1.3 Scope of the Supplementary ESIA

This report identifies changes to the capacity and design of the project and addresses these where they have potential environmental and social impacts and provides an assessment of these impacts. It also provides an assessment of potential environmental and social impacts that have been identified by the Lender's ESDD advisors to bring the project into full compliance with the International Finance Corporation (IFC) Environmental and Social Sustainability Performance Standards 2012, the Equator Principles III 2013, and the Organization for Economic Co-operation and Development (OECD) Common Approaches 2012 requirements.

The scope is based upon an Environmental and Social Action Plan (ESAP) developed by ERM in 2016 and updated to reflect additional requirements of the Export Credit Agency Facility Lender Group in March 2017. A copy of the latest ESAP version from August 2017 is included as **Appendix 1A** which shows progress against ESAP completion indicators up to that time.

The scope of the supplementary ESIA is summarized in **Table 1.1** with reference to the relevant ESAP sections.

Table 1.1 Scope of the Supplementary ESIA

Supplementary ESIA Section	Activities	ESAP Ref No.
Introduction	Prepare an introductory section identifying: • The project. • Purpose of the Supplementary ESIA. • Relationship of the Supplementary ESIA to other documents. • Introduction to the project team. • Document structure.	2
Project Description	Update the project description to include changes to the project scope including: • Changes to Potline technology and capacity. • Changes to power station turbines. • Change in location of the Construction Laydown Area and off site construction traffic routing. • Inclusion of power distribution system and ALBA gas metering station. • Revisions to sewage treatment plant design. • Updates to project schedule.	2, 2.4
Policy and Planning Context	• Include the latest iteration of the Bahrain National Plan 2030. • Undertake a land use survey to identify potentially sensitive environmental and social receptors. • Identify the project Areas of Influence (AOIs).	2.5
Stakeholder Engagement	A Stakeholder Engagement Management group will be established between ALBA, Bechtel and EACS to conduct	2, 6

Supplementary ESIA Section	Activities	ESAP Ref No.

	the stakeholder consultations as part of the ESIA. As part of phase 3 outlined below, a stakeholder engagement plan will be drawn up which will include follow-up with the identified ESIA consultees, and identify the needs for ALBA's future stakeholder engagement programme.
	
	The stakeholder engagement plan would be undertaken in three main phases:
	
	• Phase 1 – Identify Stakeholder Groups:
	  ○ Identify key stakeholder groups based on potential impacts, e.g. labour/social, traffic and environment (based on ESIA findings).
	  ○ Prepare 'frequently asked questions' sheet in English and Arabic.
	  ○ Prepare project contact sheet.
	  ○ Identify mechanisms for consultations which would include meetings, presentations and mail shots.
	  ○ Prepare plan for engagement.
	  ○ Prioritise and begin consultations in respect of traffic and access as an immediate requirement.
	• Phase 2 – Conduct Initial Engagement:
	  ○ Organise and attend meetings and presentations.
	  ○ Prepare meeting minutes.
	  ○ Prepare stakeholder engagement chapter for supplementary ESIA.
	• Phase 3 – Prepare Plans for Follow-up Engagement:
	  ○ Identify requirements for further stakeholder engagement to link in with ALBA's Stakeholder Engagement Plan.	

Air Quality	• Review changes in emissions from ESIA case to latest design. • Present changes in mass emission rates. • Confirm process emission rates of pollutants will meet Bahrain National Emission Standards and IFC/WHO standards. • Identify whether changes in emissions will result in significant changes to air quality impacts in respect of location of impacts, concentrations of pollutants and percentage contributions to air quality standards (Bahrain National Standards and IFC standards). • Determine whether additional air quality dispersion modelling and assessment is scoped in or scoped out.	2.2, 2.4

Supplementary ESIA Section	Activities	ESAP Ref No.
	• Audit existing data set and procedures for ambient HF monitoring and determine whether the data set is robust. • Update the Greenhouse Gas (GHG) Emissions inventory. • Provide an inventory of construction equipment. • Provide a quantitative assessment of construction site emissions including an assessment of ambient hydrogen fluoride (HF) and dust mitigation/monitoring arrangements.	
Commissioning and Decommissioning Impacts	Description of commissioning and decommissioning/demolition requirements. This will include: • Decommissioning and demolition associated with construction of Line 6; • Decommissioning and demolition as a consequence of the construction of Line 6 (future of Power Stations 1 and 2); • Commissioning of Line 6; • Proposals for the decommissioning and demolition of Line 6 itself at the end of its life. For each of these the environmental and social impacts and risks will be identified, including a retrospective assessment of those activities that have already been undertaken as part of the Potline 6 construction. Where the impacts have not been assessed previously in the existing ESIA, an impact assessment will be included.	2.4
Surface Water	• Assess the potential for emissions to surface water (Arabian Gulf) both as peak and average flows and effluent quality. • Provide a baseline assessment of water quality in the vicinity of the outfall using existing secondary data on marine ecology, water and sediment quality. • Determine if the effluent flow is significant and whether it may require further impact assessment.	2.4, 2.7
Waste	• Review the changes in waste quantities and types as a result of the project changes. • Determine whether the changes are significant and if additional assessment or waste planning is required.	N/A
Vibration	• Prepare a vibration assessment for the construction and operation of the project. • Identify potential sources of vibration; identify their potential impact on sensitive environmental receptors, if any.	2.3
Geology and Hydrogeology	• We shall provide Phase I and Phase II Environmental Site Assessment Reports for the	2.1, 2.4, 2.6

Supplementary ESIA Section	Activities	ESAP Ref No.
	Jawed, Sewage Treatment Plant site and Construction Laydown Area. • These will be provided as Appendices and will be summarised in the Supplementary ESIA. The reports will include assessment of risks to human health in respect of sulphur and boron in soil. • Identify and assess the potential impacts of dewatering and identify how dewatering water will be managed. • The results of the ALBA groundwater monitoring program will be reviewed and the impacts of fluorine emissions on groundwater quality will be assessed. • Recommendations for any requirement for further monitoring and mitigation will be made including specification of a groundwater monitoring plan.	
Occupational Health and Safety (H&S)	• Prepare a summary assessment of occupational H&S for construction and operation. • Include a baseline occupational health assessment using existing ALBA data to identify accident and illness rates and root causes including incidence of chronic occupational diseases. • Include an overview of key construction H&S risks and how these will be managed. • Include an overview of key operational H&S risks and how these will be managed in line with the findings of the baseline assessment. • Identify specific health risks to women and how these will be managed. • Identify industry benchmarks and propose key performance indicators (KPIs) for management of H&S.	2.4, 6
Community Health, Safety and Security	• Include a review of available Quantitative Risk Assessment (QRA) data or emergency plans regarding potential impact of major accident hazards on the community and how these will be mitigated and managed. • Identify how dross is managed and transported by recyclers to determine that emissions and hazards are controlled. • Identify specific security risks to those within and outside the project site (local community) associated with the acts of security personnel and how these will be managed. Identify the training provided to security personnel to determine they meet the requirements of the Voluntary Principles. Identify if security staff will be armed and how this is licenced and controlled.	6
Traffic	• Include an assessment of traffic hazards.	6

Supplementary ESIA Section	Activities	ESAP Ref No.
Labour and Working Conditions	• Identify proposals for accommodation and management of construction labour force. • Identify minimum standards to be included in relevant contracts to meet Ministry of Labour requirements and IFC/EBRD guidelines. • Identify project standards that third parties and contractors are required to work to and how ALBA project standards are implemented by the EPC/EPCM contractors (e.g. contractor qualification and selection criteria, contract requirements, HSE performance reporting requirements, supplier audits, training and education of suppliers regarding project standards, methods for rectifying poor performance).	6

1.4 ESIA Consultants

1.4.1 Environment Arabia Consultancy Services

EACS is an Environmental Consultancy based in Bahrain offering a full range of environmental consultancy services to clients in sectors including: mixed use development; oil and gas; petrochemicals; ports and maritime; power generation; reclamation and dredging; sewage treatment; steel and aluminum manufacture; transport and waste to energy. These services have been provided across the Arabian Gulf including: Bahrain, Kuwait, Oman, Saudi Arabia, Dubai, Abu Dhabi, Sharjah, Ajman, Qatar and Jordan.

The company has been established since the year 2000 and was the first registered environmental consultancy with the SCE under Ministerial Order No. 3 with respect to the Environment Authority's recognition of consulting firms involved in the field of environmental evaluation of projects and environmental studies.

The team of specialists from EACS is presented in **Table 1.2**.

Table 1.2 EACS's ESIA Project Team

Name	Role Within Project
Halel Engineer	Project Director
Andy Booth	Project Manager
Kate Elsworth	Principal ESIA Specialist
Rafaela Konialidis	Senior ESIA Specialist
Eman Rafea	ESIA Specialist
Christopher Nacional	GIS/Mapping Specialist

1.4.2 Subconsultants

EACS has been supported by the following external specialists.

Royal Haskoning DHV UK - Air Quality, Health and Safety, Social Impact

Royal Haskoning DHV is an independent, international engineering and project management consultancy with over 130 years of experience. There is a well-established and historical relationship between RHDHV and EACS and several projects have been undertaken in partnership in the past in Bahrain and within the Arabian Gulf: including air quality assessments, H&S assessments and soil and groundwater assessments. Royal Haskoning are familiar with working to IFC requirements for the preparation of ESIAs.

Tree Environmental - Vibration Assessment

Tree Environmental are noise, vibration and air quality consultants based in the UK led by Rob Pierce. He has over 26 years experience in noise and vibration, the last 23 as an acoustics consultant. Rob has provided noise and vibration advice on many major UK schemes such as the Channel Tunnel Rail Link (CTRL), Wembley Stadium, Liverpool Airport Expansion and Leeds Supertram. Rob has provided evidence at Public Inquiries for many of these schemes.

International projects include the design of acoustic aspects of an Auditorium, Training Centre, Executive offices and conference rooms for the SABIC HQ in Saudi Arabia, noise and vibration measurements and modelling from the Abu Dhabi Grand Prix circuit and environmental projects including noise assessments for: the N-Road and Al Fateh Highway, Bahrain; Bapco refinery redevelopment, Bahrain; and a petrochemical plant noise assessment, Bahrain.

1.5 ESIA Report Structure

This report, contains the following sections in accordance with the scope of the supplementary ESIA set out in **Table 1.1**:

1. Introduction;
2. Project Description;
3. Policy and Planning Context;
4. Stakeholder Engagement;
5. Air Quality;
6. Commissioning and Decommissioning Impacts;
7. Surface Water;
8. Waste;
9. Vibration;
10. Geology and Hydrogeology;
11. Occupational Health and Safety;
12. Community Health, Safety and Security;
13. Labour and Working Conditions;
14. Management and Mitigation.

The management and mitigation section provides a summary of the findings of the ESIA as tables identifying significant potential impacts and how these will be mitigated and managed. Any residual impacts are also identified within the management and mitigation section.

1.6 Impact Assessment Methodology

The method to describe impacts has been set out in each section of the ESIA. Where possible the predicted impacts and effects are classified according to whether they are beneficial, adverse or negligible and further categorized as minor, moderate or major as presented in **Table 1.3**.

Table 1.3 Impact Significance Descriptions

Impact Significance	Impact Characteristic
Major Beneficial	The impact is large scale, giving rise to a significant gain to the environment.
Moderate Beneficial	The impact would provide a positive gain to the environment.
Minor Beneficial	The impact is small and would have a slight benefit to the environment.
Negligible	Either no impact or the impact is neutral (neither adverse nor beneficial).
Minor Adverse	The impact is small and of little concern; it is undesirable but acceptable.
Moderate Adverse	The impact gives rise to some concern but is likely to be tolerable in the short-term (e.g. during the construction phase) or would require a value judgement as to its acceptability.
Major Adverse	The impact is large-scale, giving rise to great concern; it should be considered unacceptable and requires mitigating, compensating or a significant change to the development if no alternative is available. If no mitigation is possible, then the impact would require a value judgement as to its acceptability.

Effects deemed to be significant are evaluated against recognised Bahraini and International standards and accepted criteria for each topic. Where no recognised standards or criteria exist, professional judgment is used, taking into account factors such as:

- Spatial extent;
- Magnitude;
- Duration (short, medium, long-term);
- Frequency of occurrence;
- Nature of effect (direct, indirect, permanent or reversible);
- Whether it is cumulative;
- Sensitivity and numbers of receptors affected;
- Performance against environmental quality standards; and
- Compatibility with environmental policies.

For some of the ESIA sections the impact significance scale shown in **Table 1.3** is not used or has been modified. This is because some of the work comprises only a review of the changes to the project arising since the 2014 ESIA Report was completed, to determine whether further assessment is required or not. Also in some cases there is no widely accepted method of assessing the impact significance. Each section of the Supplementary ESIA Report includes a section on the impact assessment methodology used for that particular topic where appropriate.

2 PROJECT DESCRIPTION

2.1 Process Description

2.1.1 Project Location

The ALBA Smelter is located at the junction of King Hamad Highway and Highway 96 close to the east coast of Bahrain. As well as the main smelter site, ALBA facilities include importation and processing facilities at its marine terminal in Sitra. The location of the smelter and marine terminal sites is shown in **Figure 2.1**.

2.1.2 ALBA Process Overview

Figure 2.2 shows a schematic overview of the ALBA manufacturing process.

Alumina is imported via a marine terminal in Sitra where it is stored in silos. The alumina is then transported to the ALBA smelter via road tankers using both public and private roads. The alumina is then smelted in "pots". The smelting process is actually an electrolysis process. Aluminium hexafluoride is mixed with the alumina and the mixture is subject a high electrical charge (460kA) via carbon electrodes. Over time liquid aluminium forms as oxygen is removed from the alumina (Al_2O_3) and combines with carbon anode to form carbon monoxide (CO) and carbon dioxide (CO_2). The carbon anode is slowly consumed in the reaction.

The carbon anodes are made from calcined petroleum coke (pet coke) and pitch in the Carbon Plant. ALBA has its own pet coke calciner located at the Sitra marine terminal facility. The calcining process utilises gas to heat the pet coke. The heat removes excess moisture, extracts any residual volatile hydrocarbons and modifies the crystalline structure of the coke, resulting in a denser more electrically conductive product. The calcining process also produces desalinated water from waste heat. The desalinated water is used to supply process requirements and spare capacity is sent to municipal supply.

To make the carbon anodes the calcinated pet coke and pitch are mixed to form a paste which is pressed into moulds to form "green" anodes. These are then baked in a kiln to improve their chemical and physical properties before being used in the smelting process.

Liquid aluminium from the smelting process is sold directly to local businesses within South ALBA Industrial Estate or is sent to the Casthouse where it is cast into various forms such as slabs, billets and ingots.

Electrical power for the smelting process is mainly provided from on-site, gas-fired power stations but may be supplemented by the national electrical grid supply.

After several years of operation the pots need to be replaced as the carbon electrodes become exhausted. The pots are removed from the production line and the pot is cleaned out. This produces two wastes steams – "Bath" and Spent Pot Lining (SPL). Bath is recycled into the process. SPL is partly recycled but some SPL requires disposal as hazardous waste.

Title: **Project Location**		Client:
Project: ALBA Potline 6 Supplementary ESIA		
Date: July 2017	Figure No.: 2.1	Consultant: Environment Arabia
Datum: WGS 84 - UTM 39N	Scale: 1:50,000 (A4)	

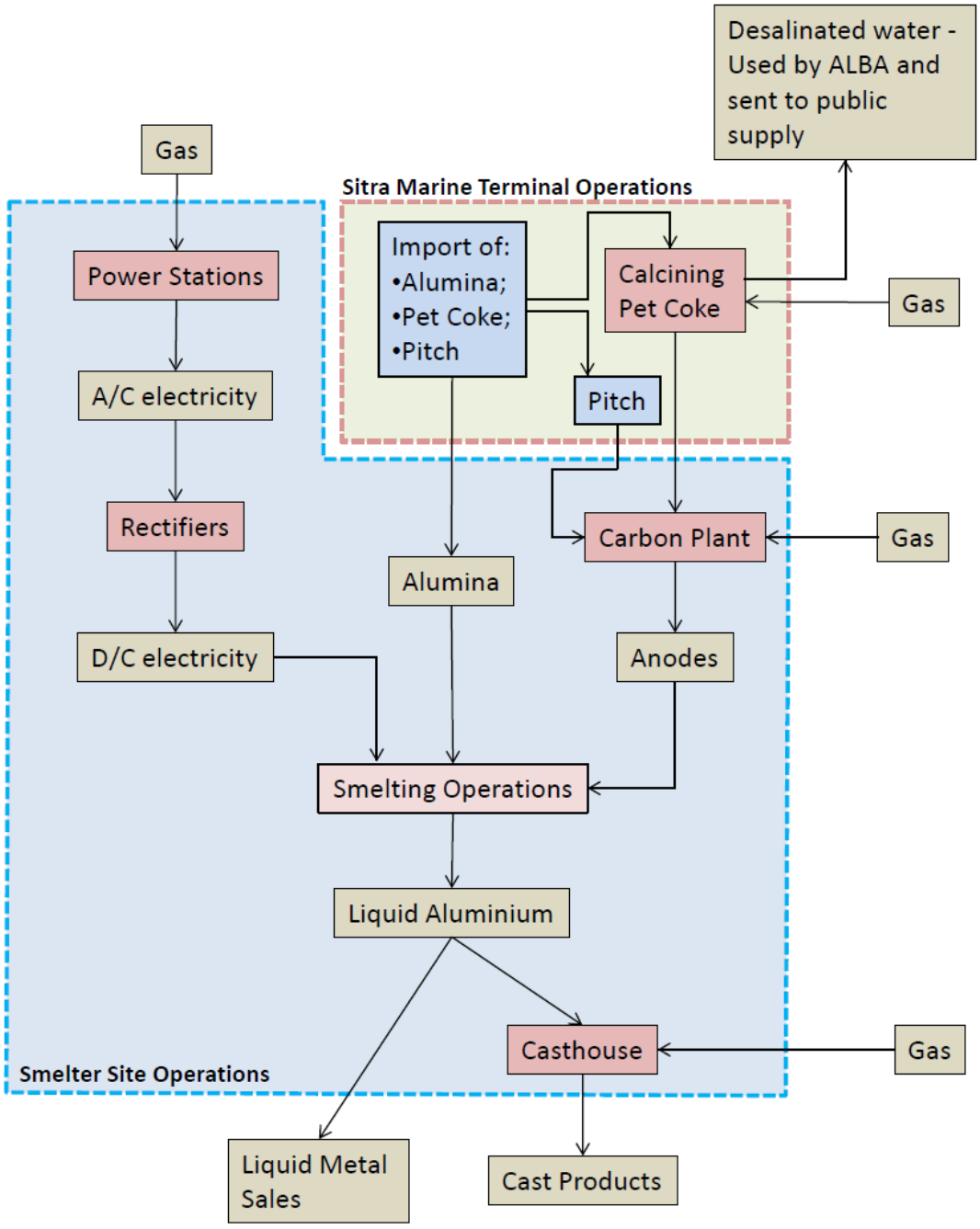
CN:\Alba Potline 6 Supplementary ESIA\mxd\Projectlocation.mxd

2.1.3 Existing Facilities

The existing smelter site comprises five potlines and four gas-fired electrical power stations with a combined capacity of 2249MW. In 2016 total production of aluminium was 971,420 metric tonnes.

The facilities at the ALBA Marine Terminal include a port with a capacity to handle 3.5 million tonnes per annum of materials and the calciner which can produce up to 550,000 tonnes per year of calcined pet coke and 41,000m^3 per day of desalinated water.

Figure 2.2 Schematic Overview of the ALBA Manufacturing Operations



2.2 Proposed Development

2.2.1 Overview

It is proposed to further develop the smelter to increase aluminium production to around 1.5 million tonnes per annum. This will comprise construction of a new potline - Potline 6 and a new power station - PS5. A plan of the ALBA smelter site is included as **Figure 2.3** which shows the key elements of the existing smelter and Potline 6 expansion.

The proposed scope of the development is described in the 2014 ESIA Report. Since that time there have been revisions to the scheme to optimise its design. The changes are summarised in **Table 2.1** which also provides a summary of the potential environmental impact of each change. Key changes are discussed in the following sections.

Table 2.1 Summary of Changes to Design and Potential Environmental Impacts

Aspect	Original Design	Updated Design	Potential Environmental Impacts
Potline technology type and capacity change.	404 Pots DX+ Technology Capacity – 514,197 tpa.	424 Pots DX Ultra+ Technology Capacity – 540,035 tpa.	• Small changes in emissions to air. • Reduction in waste quantities.
Casthouse scope and capacity change.	Rolling Slab processing facility and Batch homogenizing furnace facility.	Additional Vertical Direct Chill (VDC) casting pit for casting slabs and T-bars and additional batch homogenizing furnace for casting billet. Additional associated facilities like slab/T-bar sawing facility, process water cooling plant and cranes.	Increase in casting production capacity will lead to: • Likely increase in emissions to air. • Likely increase in dross production.
Power Station 5 Capacity and specification.	1350MW Nitrogen oxide emissions limited to 100mg/Nm^3 in specification.	1800MW Nitrogen oxide emissions limited to 51mg/Nm^3 in specification.	Changes in power stations will lead to a slight changes in emissions to air.
Power Station 3/4 operation.	Operating at full capacity	Will operate at partial load factors -30%, Power Station 3 and 82% Power Station 4.	
Black Start Generator	Black start diesel generator.	Power Station 2 will provide black start and emergency generation functions.	No significant changes in emissions.

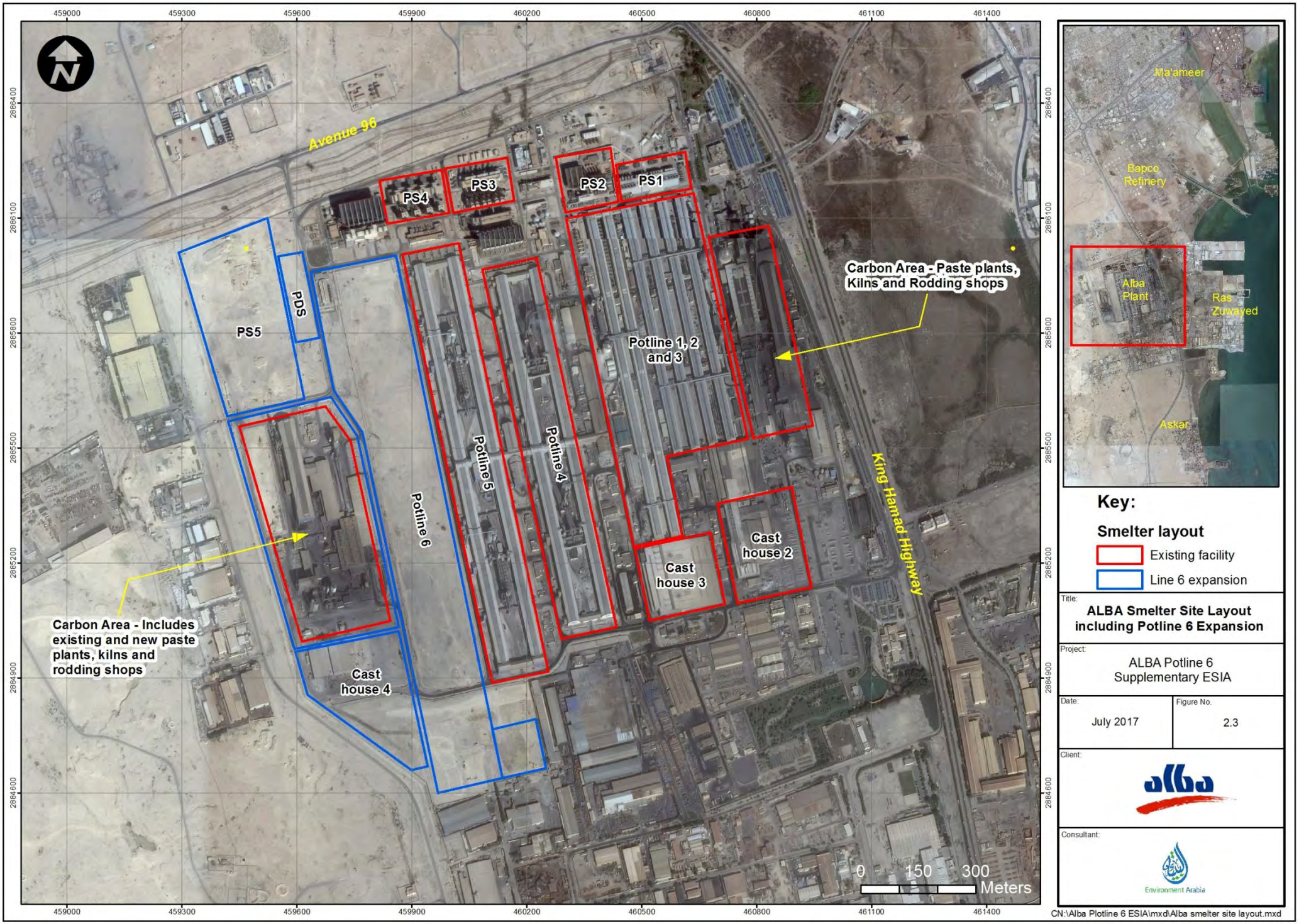

459000
459300
459600
459900
460200
460500
460800
461100
461400
2886400
2886100
2885800
2885500
2885200
2884900
2884600
Avenue 96
PS4
PS3
PS2
PS1
PS5
PDS
Potline 1, 2 and 3
Potline 5
Potline 4
Potline 6
Carbon Area - Paste plants, Kilns and Rodding shops
Carbon Area - Includes existing and new paste plants, kilns and rodding shops
Cast house 4
Cast house 3
Cast house 2
King Hamad Highway
0
150
300
Meters
Ma'ameer
Bapco Refinery
Alba Plant
Ras Zuwayed
Askar
Key:
Smelter layout
Existing facility
Line 6 expansion
Title:
ALBA Smelter Site Layout including Potline 6 Expansion
Project:
ALBA Potline 6 Supplementary ESIA
Date:
July 2017
Figure No.
2.3
Client:
alba
Consultant:
Environment Arabia
CN:\Alba Plotline 6 ESIA\mxd\Alba smelter site layout.mxd

Table 2.1(cont) Summary of Changes to Design and Potential Environmental Impacts

Aspect	Original Design	Updated Design	Potential Environmental Impacts
Power distribution system project	Previously not included.	New 220 kV substation New 33 kV substation New 3 x No. 315 MVA transformers New 4 x No. 60 MVA transformers New 4 x 450 MVA reactors New 3 x 120 MVA transformers All associated 220 kV, 33 kV & 11 kV cable run installations SCADA system replacement	The works are all within the ALBA smelter. The changes are not expected to significantly change the environmental impact of the project.
ALBA gas station (Bapco)	Previously not included.	New fuel gas metering station consisting of: Fuel gas emergency shutdown valves; Fuel gas condensate knock out drums; Fuel gas condensate collection drums; Fuel gas metering stations; All associated piping, valves and fitments; SCADA control room; Telecommunication mast.	The works are all within the ALBA smelter. The changes are not expected to significantly change the environmental impact of the project.
Sewerage Treatment	Additional Sewerage Treatment Plant (STP 3) for domestic type wastewater.	STP3 has been removed from the Line 6 Project. ALBA are undertaking improvements to the smelter sewage treatment system as an independent project.	There will be no overall material change. The upgraded sewage system will have the capacity to treat domestic type wastewater from Line 6 expansion.
Construction Footprint	Material Laydown Areas to be located on land to the west of ALBA.	Construction Laydown Area (CLA) located on land to the South of South ALBA Industrial Estate.	The project Area of Influence (AOI) will change. There will be possible ecological, archaeological, traffic, noise, air and

Aspect	Original Design	Updated Design	Potential Environmental Impacts
			community impacts associated with the CLA relocation.
	Previously not included.	Additional alumina road tanker loading facility and ship unloading facilities at Sitra Marine Terminal.	The project Area of Influence (AOI) will change. There are likely to be potential environmental impacts during construction but unlikely to be significant operational impacts.

2.2.2 Potline Technology and Capacity Change

The Dubal DX Ultra+ Technology that has been adopted in the final design is the latest iteration of Dubal DX aluminium smelting technology and offers improved energy efficiency and allows for shorter pot-to-pot distances which allows a greater number of pots to be used within the same footprint. Hence, the final design for Potline 6 has an increased production capacity from an increased number of pots within the same building footprint.

Also with respect to Dubal DX Ultra+ Technology, the pots have an increased operating life of 6 years compared to 4.9 years for Dubal DX Technology. Hence there is less waste created including spent pot lining (SPL) waste.

2.2.3 Changes to Power Stations

Within the final design for Potline 6 expansion the capacity of PS5 has increased from 1350MW to 1800MW. As a result there will be a reduction in the requirement to operate Power Stations 3 and 4. The baseline operating scenario is shown in **Table 2.2**.

Table 2.2 Baseline Operating Scenario for ALBA Power Stations

Power Station	No. of Units	Total Capacity (MW)	Operating Load (MW)	Load Factor (%)
PS1	16 GTs	0	0	-
PS2	5 GTs, 0 ST	0	0	-
PS3	6 GTs, 2 STs	794	260	30
PS4	4 GTs, 2 STs	888	770	82
PS5	3 GTs, 3 STs	1800	1800	100
Total		3482	2830	-

Following completion of the Line 6 Expansion Project, Power Station 1 will be largely decommissioned. As of July 2017, six of the original nineteen gas turbines have already been electrically disconnected from the electrical system and are no longer available for

generation purposes. Between July 2017 and July 2018 a further nine of the Power Station 1 gas turbines are scheduled to be electrically disconnected. These disconnections are required for the new equipment being installed as part of the power distribution system modifications. On completion of the Potline 6 Expansion Project only four of the newest Power Station 1 turbines will remain physically available for possible future use as a black start and emergency reserve. ALBA will undertake a power requirement review in 2019 in conjunction with its insurance company to determine whether it is required to retain these last four Power Station 1 units in the longer term.

Power Station 2 will remain in a black start and emergency reserve capacity. The 2014 ESIA Addendum identified that a separate diesel generator would be installed as part of Power Station 5 construction to provide a black start capability. Power Station 2 (and Power Station 1) will now fulfil this function and the new black start diesel generator will not be constructed. It is possible the Power Station 2 steam generator may be decommissioned and disposed of following the 2019 power requirement review, as an alternative to the decommissioning of the remain four Power Station 1 units, as it is a slower starting unit and so is not well-suited to emergency start-up functions.

Once the review process has identified the optimum power requirement for the future of the ALBA business, the redundant units comprising the 15 Power Station 1 units and other redundant units and equipment identified will be disposed of through an equipment disposal contract.

2.2.4 Construction Laydown Area (CLA)

The location of the CLA has been changed from land to the east of the ALBA smelter site to land to south of South ALBA Industrial Estate. The site of the CLA comprises open, previously undeveloped land. Construction of the CLA will require levelling and infilling of the site, provision of fencing around the area, construction of temporary internal roads, improvements to site access. The CLA site will be used for the following purposes:

1. Provision of office, workshops and storage space for contractors;
2. Provision of training facilities for site induction and other training;
3. Provision of vehicle inspection facilities;
4. Truck parking and car parking.

2.2.5 Project Schedule

Construction of the Line 6 Expansion Project commenced in October 2016 and will be completed in April 2019.

3 POLICY AND PLANNING CONTEXT

3.1 Introduction

The consideration of existing land use and planning policies within environmental assessment is important to facilitate the assessment of impacts. This section presents the latest available iteration of the Bahrain National Plan 2030 and describes the Area of Influence (AOI) including land use for all of the project's facilities. These include the Potline 6 site, PS5, ALBA Marine Terminal and the Construction Laydown Area (CLA). The project facilities can be seen on **Figure 2.1**.

3.2 Key Features

The ALBA Potline 6 Expansion Project is located within an area designated as priority industry in the Bahrain 2030 National Plan (see section below). The land use surrounding ALBA is partly built-up and composed of heavy and light industrial sites namely; Bapco Refinery, SAIE, Ras Zuwayed Industrial Area (RZIA), Askar and Hafeera landfill sites and quarries and the Bahrain (Awali) Oil Field.

3.3 Bahrain 2030: The National Plan

In line with Bahrain 2030 National Planning and Development Strategy (NPDS), the General Directorate for Urban Planning (GDUP) has produced the National Detailed Land Use map[1] (NDLU). The NDLU map aims to have a coordinated and effective use of available land resources in the country. Comprehensive land use planning has also been included as one of the priority objectives in the shorter-term (4-year) National Development Strategy (2015-2018).

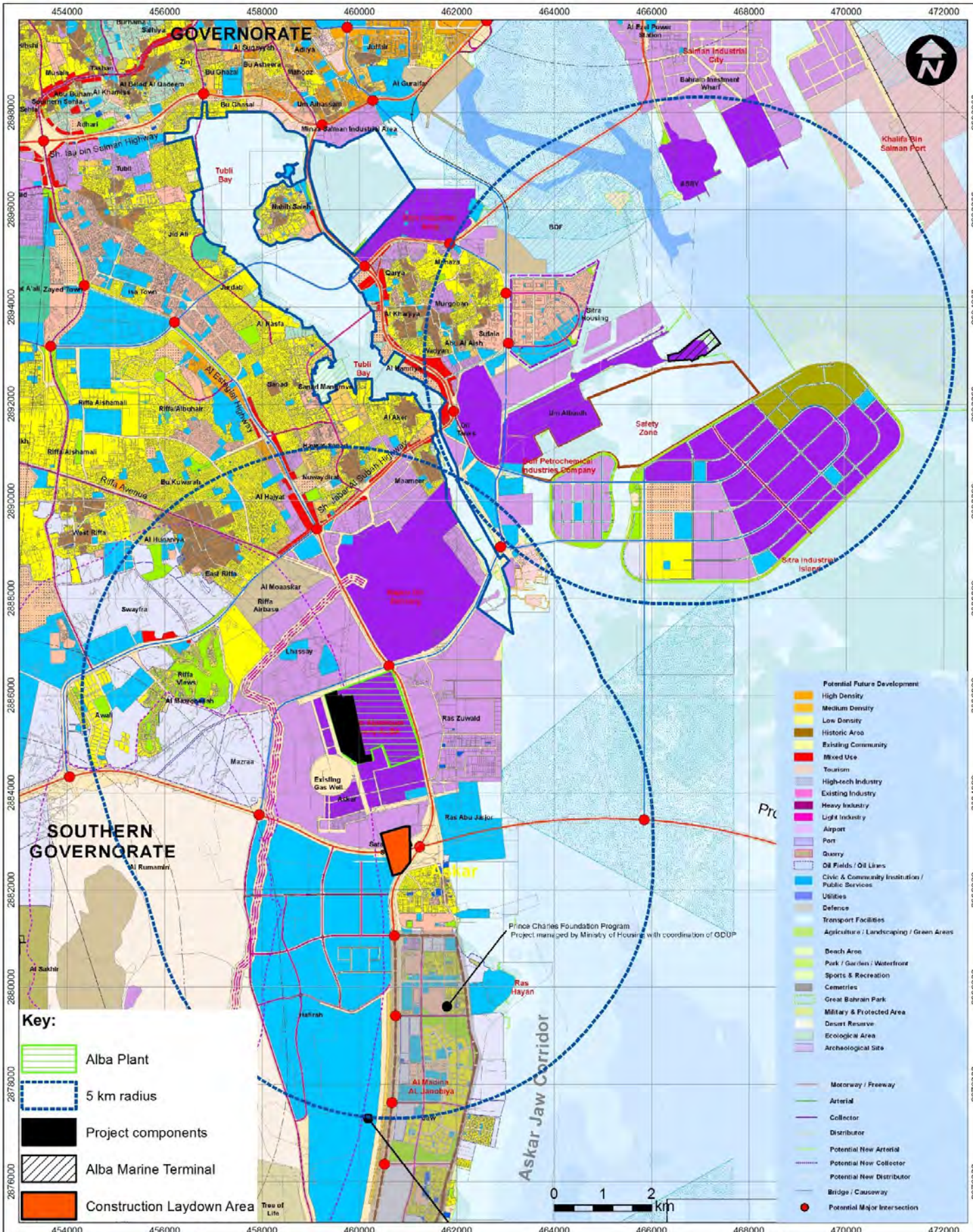
Figure 3.1 presents the 2030 National Plan land use designations falling within the 5 km zone of the project. It shows the clear demarcation of the heavy and light industrial areas with possible additional land reclamation for the same purpose. The vast land areas south of the project where the current open space and landfill sites are located are identified for public utility (community services) purposes. The southwest part remains exclusively for oil and gas facilities in the Bahrain (Awali) Field. The Arabia/Bahrain (A/B) pipeline is also shown and highlighted in **Figure 3.1**.

From Askar village south to Jaww there are areas identified for residential development with public utilities, mixed use and recreational facilities also provided. The villages to the north retain the current extent and land use designation and East Sitra, Nuwaidrat and Ma'ameer are highlighted as "historical core villages" in the NDLU map.

In addition to the existing roads, more arterial and connector roads are planned as shown in **Figure 3.1**. Highlights are the planned highway that would be connected to the proposed Bahrain-Qatar Causeway and the East Sitra Link Road which will connect the Mina Salman area with Shaikh Jaber Al Ahmed Al Subah Highway.

Apart from the planned residential expansions described above, no other potential receptors are identified on the NDLU map.

[1] Second version produced by GIS in GDUP, issue date: 5th February 2016.



Title: **ALBA Project Component in relation to Bahrain 2030 Plan**			Client:
Project: ALBA Potline 6 Supplementary ESIA			
Date: July 2017		Figure No.: 3.1	Consultant: Environment Arabia
Datum: WGS 84 - UTM 39N		Scale: 1:70,000 (A3)	

CN:\Alba Potline 6 Supplementary ESIA\mxd\landuse 2030.mxd

3.4 Existing Land Use and Area of Influence

3.4.1 Methodology

The project's AOI has been described based on a land use survey undertaken within a 5km radius of the Potline 6 project site, PS5, ALBA Marine Terminal and CLA. This radius includes part of the Awali Oil Field, East Riffa, Nuwaidrat, the Bapco Refinery, Ma'ameer, Ras Zuwayed, Askar, Jaww, and Hafira.

A 5km radius around the project sites is considered to be the maximum AOI for significant impacts. 5km was set as the maximum AOI radius following review of the 2014 ESIA, in particular the air quality impact section. Air quality impacts are expected to have the largest spatial influence and therefore have been used to set the maximum extent of the AOI.

The 2014 ESIA identifies that maximum impacts of emissions to air occur within 1.5km of the project site for all pollutants considered, well within the 5km AOI radius. The 2014 ESIA also identifies that air quality at sensitive receptors, which receive the highest impacts from the Line 6 Expansion Project, remains within health-based environmental standards. Air quality impacts reduce rapidly with distance from the facility and at 5km from the ALBA site the predicted concentration of pollutants due to emissions from the Line 6 Expansion Project are a fraction of their maximum values (approximately 25%). Therefore it can be expected with reasonable certainty that at greater than 5km from the ALBA site the impact of emissions from the Line 6 Expansion Project will be relatively minor and other, more local, emissions sources will be the dominant influence on air quality.

Within the 5km radius AOI, a range of land use types have been mapped and sensitive receptors highlighted. **Figures 3.2 & 3.3** present the land use mapping. The land use has been derived based on information gathered from a field survey conducted by EACS on the 26th of January 2017. Mapping was also supported with online Google Earth, local cadastral maps, and the Geographic Information System (GIS) database held by EACS.

3.4.2 ALBA Potline 6 and PS5 Land Use

Figure 3.2 indicates that the majority of land within a 5 km zone of ALBA is mainly utilised for oil & gas and various industrial services. Large tracts of open spaces still exist, but these have been earmarked for specific purposes under the National Land Use Plan as described above.

The surveyed radius extends westwards from ALBA over the coastal strip into the sea from the RZIA (which is mainly occupied by labour accommodation and light industry) down to the villages of Askar and Jaww. Much of the coastal strip is altered by reclamation development for industrial use and public utilities. Ras Abu Jarjur Desalination Plant, Askar Fishing Jetty, and Bahrain National Mariculture are located in this area and highlighted in **Figure 3.2**. The Ras Abu Jarjur Desalination Plant uses groundwater as opposed to seawater.

The area adjacent to the north of the Potline 6 and PS5 sites is largely an open area but has had encroaching development over recent years. This development has included a

variety of light industrial and commercial establishments. A labour accommodation block, a substation and gas dehydration units have been constructed within this area. Some oil and gas pipelines cross the area towards the direction of Bapco Refinery. The new A/B pipeline (Bapco) will run alongside these pipelines. Further to the north is a military base located beside the existing Riffa Power Station at Moaskar.

Bapco's Refinery lies further to the north of the open land. Bapco have permission to update and expand the Refinery; a project known as the Bapco Modernization Program (BMP). The main elements of the BMP will be located to the south and east of the existing process units and will utilise the 'pitch ponds' site which is an area historically used to dump pitch from the refining process in the south west corner of the Bapco Refinery. The BMP will also require changes and development of Sitra Tank Farm, Sitra Marine Terminal and the transfer pipelines between the Refinery and the Sitra facilities. The BMP will commence construction in Q2 2018 and so no significant overlap expected with the ALBA Line 6 Expansion Project.

Bapco abstracts groundwater from four boreholes within the Refinery.

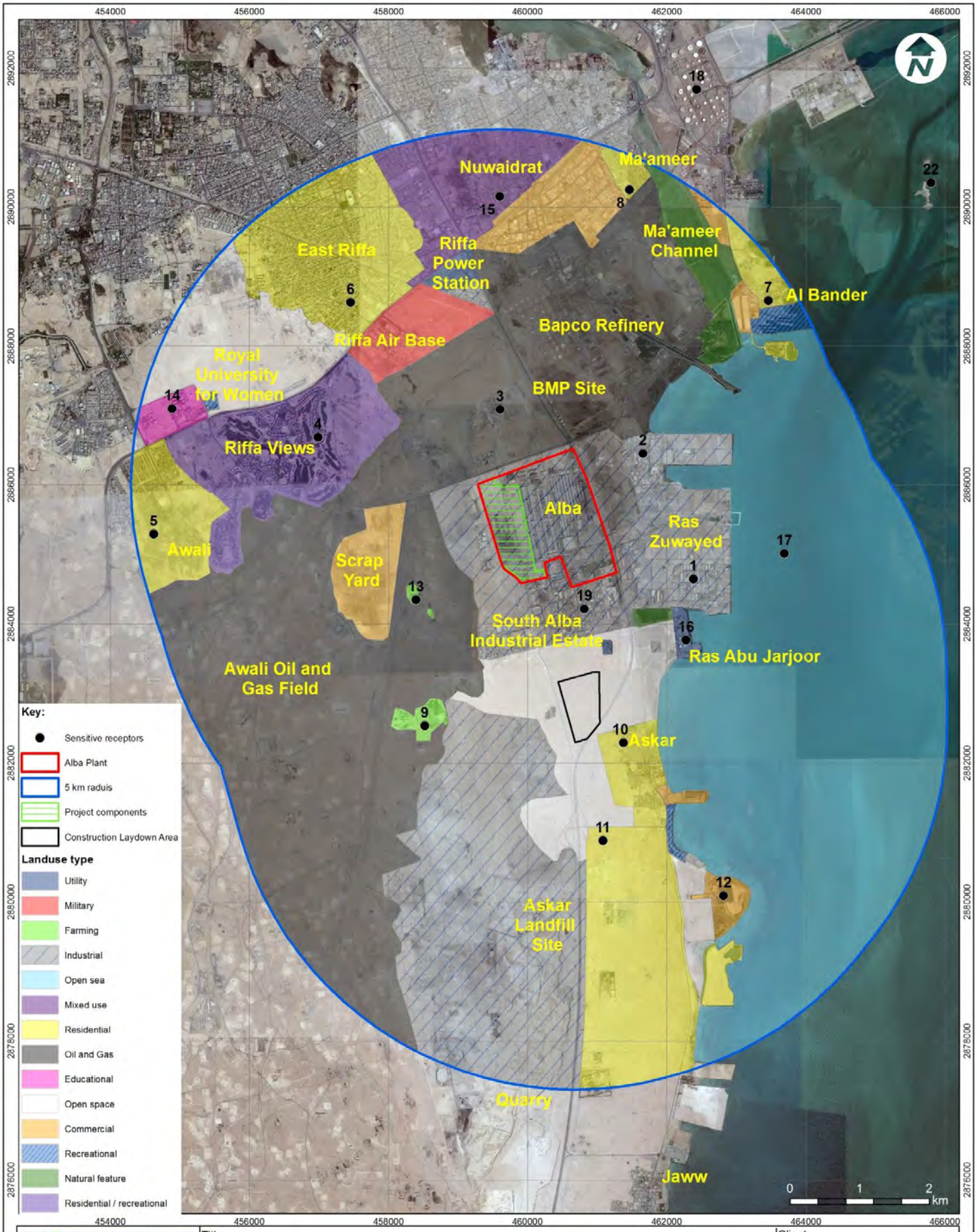
The nearest villages to the northwest are Awali and Riffa Views, whilst East Riffa, Nuwaidrat and Maameer village are situated to the north and northeast respectively. Average distance of these villages is about 3 km from the proposed PS5 site.

SAIE is located immediately south of the site. It comprises a wide range of industrial and commercial businesses which rely on the local road network for material deliveries and product distribution.

3.4.3 Construction Laydown Area Land Use

Askar village is the closest residential area to the CLA, located about 300 m to the southeast. Askar community has a public jetty and a newly developed recreational facility / public park with beach frontage. To the south of Askar village is an on-going residential development known as the Southern New Town.

To the west of the CLA, lie the quarries and landfill sites of Askar and Hafira. Further west is the Awali Oil Field. Some privately owned animal farms were identified in the Oil Field during the land use survey, the location of which are provided on **Figure 3.2**.



Title: **Land Uses within 5 km Radius from ALBA Project Components**		Client:
Project: ALBA Potline 6 Supplementary ESIA		
Date: July 2017	Figure No.: 3.2	Consultant: Environment Arabia
Datum: WGS 84 - UTM 39N	Scale: 1:50,000 (A3)	

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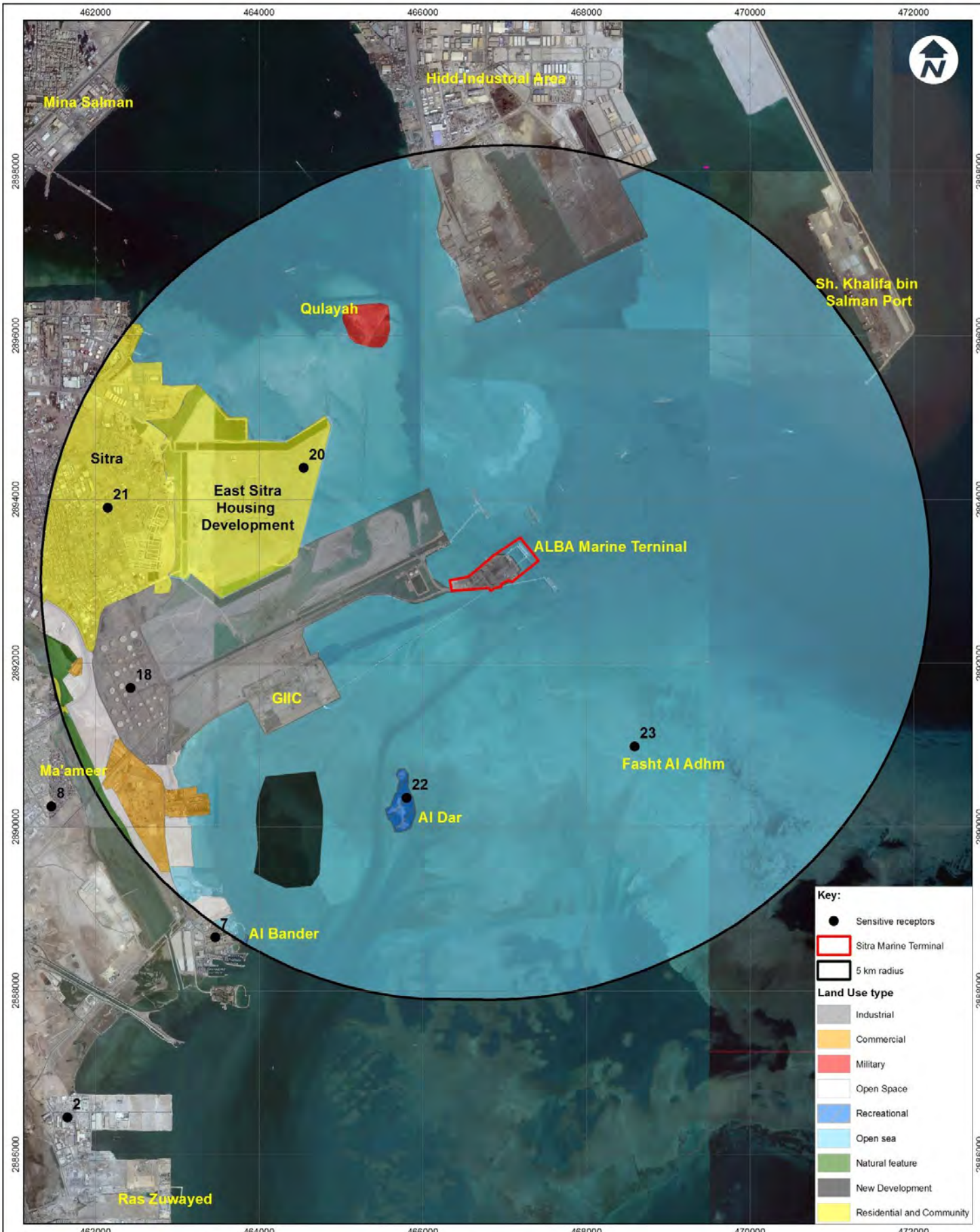
3.4.4 Sitra Marine Terminal Land Use

ALBA's facilities at Sitra Marine Terminal are located approximately 10 km from the Potline 6 site boundary. Sitra Marine Terminal is shared between ALBA, Bapco and Banagas. There are pipelines along the Terminal which transfer products from Bapco's Sitra Tank Farm to the Terminal for export. The Tank Farm is located approximately 4.5 km west of the Terminal. As part of their Central Gas Plant-III project, Banagas plans to expand its storage facilities on the Terminal.

To the north of Sitra Marine Terminal a new terminal is planned to be constructed on recently reclaimed land. This project is being led by the National Oil and Gas Authority (NOGA). Adjacent to the new terminal, there is a large reclamation plot for a new town known as the East Sitra Housing Development. This project is being led by the Ministry of Housing. Beyond the new town lies the residential area of Sitra which is a mixture of residential, commercial and industrial land uses. Within Sitra, there are two schools, the location of which are provided on **Figure 3.3**.

To the south west of the Sitra Marine Terminal there is further reclamation ongoing which is believed to be for industrial use in accordance with the Bahrain 2030 National Plan. Adjacent to the south west is the popular tourist resort of Al Dar Island.

Approximately 3.5 km to 4 km to the north lies the Arab Shipbuilding and Repair Yard (ASRY) and the SULB and Bahrain Steel plants.



Title: **Land Uses within 5 km Radius from ALBA Marine Terminal**		Client:
Project: ALBA Potline 6 Supplementary ESIA		
Date: July 2017	Figure No.: 3.3	Consultant: Environment Arabia
Datum: WGS 84 - UTM 39N	Scale: 1:40,000 (A4)	

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3.5 Identification of Potential Sensitive Receptors

Nineteen representative potential sensitive receptors have been identified within the 5 km study area for the Potline 6 site, PS5 and CLA as shown in **Figure 3.2**, and four for ALBA Marine Terminal as shown in **Figure 3.3**. These include nearest villages, residential areas, and housing accommodation for labourers, resorts and recreational facilities, farms and an educational institution. A description of the potential sensitive receptors and rationale for their selection is provided in **Table 3.1**. **Table 3.2** provides a matrix showing which of the sensitive receptors have the potential to be influenced by the project. The horizontal axis shows the environmental parameters and the vertical axis lists the sensitive receptors. Where ESIA parameters do not have a defined spatial impact, or spatial impact outside of the project site areas (e.g. occupational health and safety), they have not been included in **Table 3.2**.

Table 3.1 Potential Sensitive Receptors

No.	Potential Sensitive Receptor	Type	Distance (km)
ALBA Potline 6, PS5 and CLA			
S1	Ras Zuwayed 1	Labour accommodation	2
S2	Ras Zuwayed 2	Labour accommodation	2
S3	Lhassay	Labour accommodation	1
S4	Riffa Views	Residential / recreational	2
S5	Awali	Residential	4
S6	East Riffa Village	Residential	3
S7	Al Bander / Bahrain Yacht Club	Recreational	4.5
S8	Ma'ameer Village	Residential	4.5
S9	Awali Oil Field 1	Farm	1.6
S10	Askar Village	Residential	0.3
S11	Southern New Town	Residential	1.3
S12	Mariculture Centre	Farm (aquaculture) / commercial	2.6
S13	Awali Oil Field 2	Farm	1.5
S14	Royal University for Women	Educational	4
S15	Nuwaidrat Village	Residential	4
S16	Ras Abu Jarjur Desalination Plant	Groundwater abstraction	2.8
S17	Marine Environment	Water quality and ecology	1.8
S18	Bapco	Groundwater abstraction	2.5
S19	South ALBA Industrial Estate	Traffic	0.1
Sitra Marine Terminal			
S20	East Sitra Development	Residential	4
S21	Sitra residential and community	Residential	4
S22	Al Dar Island	Recreational	3
S23	Fasht Al Adhm	Ecological	2

Table 3.2 Matrix of AOI Against ESIA Parameters

No.	Name	ESIA Parameter					
		Air	Surface Water	Vibration	Geology and Hydrogeology	Community, Health Safety and Security	Traffic and Access
S1	Ras Zuwayed 1	√				√	√
S2	Ras Zuwayed 2	√				√	√
S3	Lhassay	√				√	√
S4	Riffa Views	√				√	√
S5	Awali	√				√	√
S6	East Riffa Village	√				√	√
S7	Al Bander / Bahrain Yacht Club	√				√	√
S8	Ma'ameer Village	√				√	√
S9	Awali Oil Field Farm 1	√					
S10	Askar Village	√				√	√
S11	Southern New Town	√				√	√
S12	Mariculture Centre	√	√				
S13	Awali Oil Field Farm 2	√					
S14	Royal University for Women	√					
S15	Nuwaidrat Village	√				√	√
S16	Ras Abu Jarjur Desalination Plant				√		
S17	Marine Environment		√				
S18	Bapco Groundwater Usage				√		
S19	South Alba Industrial Estate	√		√		√	√
S20	East Sitra Development	√				√	√
S21	Sitra residential and community	√				√	√
S22	Al Dar Island	√				√	
S23	Fasht Al Adhm		√				

4 STAKEHOLDER ENGAGEMENT

4.1 Introduction

The objectives of stakeholder engagement are to ensure that the impacts of developments are understood by all those who could be affected (the stakeholders). This allows for improved planning of developments and affords the opportunity to anticipate and avoid or manage unacceptable environmental and social impacts.

This section of the Supplementary ESIA details the process followed for managing stakeholder engagement and provides a record of the key stakeholder consultations that have been undertaken since the completion of the 2014 ESIA Report.

4.2 Legislation and Guidance

4.2.1 International Finance Corporation Performance Standards (IFC PS) on Environmental and Social Sustainability

IFC PS1 sets out requirements for on-going stakeholder engagement as part of an effective project Environmental and Social Management System (ESMS). The standard requires that local communities directly affected by the project (Affected Communities) are informed regarding:

i. The purpose, nature, and scale of the project;
ii. The duration of proposed project activities;
iii. Any risks to and potential impacts on such communities and relevant mitigation measures;
iv. The envisaged stakeholder engagement process; and
v. The grievance mechanism.

PS1 requires that a Stakeholder Engagement Plan (SEP) is developed for the project and that the extent of stakeholder engagement is proportional to the expected impact on local communities directly affected by the project (Affected Communities) and other stakeholder groups. PS1 also identifies that information should be disclosed to Affected Communities in a way that is accessible and includes information on emergency planning as it impacts Affected Communities. Periodic reports should be provided to Affected Communities at least one per year.

PS1 also requires that a grievance mechanism is established to receive and facilitate resolution of Affected Communities' concerns and grievances about the project environmental and social performance. PS4 identifies that the grievance mechanism should allow Affected Communities to express concerns about community health, safety and security.

4.2.2 Equator Principles III

Principle 5 requires project sponsors to undertake stakeholder engagement for all significant development projects. Principle 6 requires the establishment of a grievance mechanism for Affected Communities and other stakeholders. The specific requirements are equivalent to those set out in IFC PS1 in both cases.

Principle 10 requires information regarding the environmental and social impact of the project to be disclosed to stakeholders. As a minimum, a summary of the ESIA should be made accessible and available online. Principle 10 also states that where projects have greenhouse gas (GHG) emissions in excess of 100,000 tonnes per year, these should be reported publically.

4.3 Stakeholder Engagement Process

ALBA has established a Stakeholder Management Group with Bechtel and EACS to plan and implement the stakeholder engagement process.

The stakeholder engagement process has been divided into three main phases:

- Phase 1: Identification of Stakeholder Groups;
- Phase 2: Project Exhibition/ ESIA publication;
- Phase 3: Follow up Engagement.

These are described further below. These phases are for the describing the stakeholder engagement in the Supplementary ESIA only, not for ALBA's stakeholder engagement in general, for which ALBA is developing a SEP. The ALBA SEP will be finalized following completion and publication of this Supplementary ESIA.

4.4 Identification of Stakeholder Groups

The process to identify stakeholders has been informed by the following factors:

- The findings of the 2014 ESIA Report;
- The project Areas of Influence identified;
- Existing contacts established by ALBA;
- IFC Performance Standard 1 requirements to undertake consultation with Affected Communities.

On this basis the following groups of stakeholders have been identified:

vi. Supreme Council for Environment;
vii. Government Ministries – technical officers and policy makers;
viii. National and Local Government;
ix. Businesses with SAIE and surrounding area;
x. Civil Society Representatives;
xi. General Public.

Further information on each of these stakeholder groups and consultations and communications since submission of the 2014 ESIA Report are detailed in the following sections.

4.4.1 Supreme Council for Environment (SCE)

The SCE are directly responsible for the environmental permitting and regulation of the ALBA Line 6 Expansion Project. **Table 4.1** provides a summary of written communications with the SCE since submission of the 2014 ESIA Report and includes letters from the SCE permitting development to commence. Copies of all letters are included in **Appendix 4A**.

Table 4.1 Communications with SCE

Activity	Topic	Summary
09/08/2016 Letter from the SCE to ALBA	Commencement of construction activities for Line 6	States that there is no objection to start excavation activities for Line 6. However, any further construction operations must be postponed until Construction and Operational Environmental Management Plans are submitted and approved by the SCE.
21/08/2016 Letter from the SCE to ALBA	Dewatering activities procedures	States that adherence to Ministerial Order 3 of 2005 is required regarding environmental conditions in the workplace. Refrains from waste disposal in the terrestrial and marine environment. Provides the de-watering specifications of the SCE.
26/09/2016 Letter from ALBA to the SCE	Submission of the OESMP and CESMP to the SCE	
21/11/2016 Letter from the SCE to ALBA	CESMP (Ref EL-090-14: Environmental Permit issued by SCE on 9th June with conditions)	Refers to CESMP dated 16/08/2016. The CESMP has been reviewed and found to be satisfactory. Provides a number of parameters to be adhered to during construction phase. States that the OESMP is being reviewed and the SCE will respond on this as soon as possible.

Audit reports regarding the implementation of the CESMPs are provided to the SCE on a monthly basis by the project's independent environmental consultant, EACS. This will continue for the whole of the construction phase and the implementation of OESMPs will be audited and reported to the SCE for the first year of operation.

4.4.2 Government Ministries

Effective engagement with government ministries is an essential part of the project success so that engineering designs can be co-ordinated, e.g. connections to utility services. In terms of management of environmental and social impacts, now that the planning and design of the development is mostly complete, there are a few further decision-making requirements left that require co-ordination at ministry level. However, there will be a need for continued engagement and consultation with the Ministry of Interior (MoI) in respect of management of traffic in SAIE and planning and management of the transportation of oversized loads.

4.4.3 National and Local Government

ALBA is located with the Southern Governorate which includes a Municipal Council comprised of locally elected representatives. There are also elected representatives from the Southern Governorate area within the national government Council of Representatives and appointed representatives within the national government Shura Council.

The Southern Governorate was written to by ALBA on 27th July 2017 to invite them to a stakeholder meeting with ALBA and Ministry of Works to advise them of the traffic management plans that ALBA have put in place for construction of Line 6 Expansion Project. A presentation on traffic management was given to Southern Governorate

representatives and Ministry of Works on 6th July 2017 by ALBA. A copy of the letter and presentation are included in **Appendix 4A**.

4.4.4 Businesses within SAIE and Surrounding Area

Businesses within SAIE comprise one of the most important stakeholder groups as they are nearest neighbours to the development site. During the construction phase access to the site will be obtained through SAIE, and hence traffic will be of particular concern. Some businesses to the east of the ALBA smelter across King Hamad Highway in RZIA are included in this group as there will be a need to transfer abnormal loads from Muharraq Engineering Jetty and there are also some sub-contractor's yards in this area.

This group has been identified as a key stakeholder group and consultations and engagement have been prioritized for them. All businesses in SAIE and in the surrounding area have been contacted by representatives of ALBA and a contacts database has been set up. The database contains the contact details for approximately 95 contacts for SAIE; and approximately 17 contacts for RZIA. All of these businesses have been provided with a copy of a letter dated 14th May 2017 providing a summary of the construction programme and advising them that there will be increased levels of traffic in the area. The letter also invites the recipients to make any comments or complaints via the ALBA Integrity Hotline (see **Section 4.6**) and confirms that an exhibition on the Line 6 Expansion project will be held and the recipients of the letters will be invited. A copy of the letter is included in **Appendix 4B**.

Bechtel, the Line 6 Engineering Procurement and Construction Management (EPCM) contractor, has also consulted individual businesses within SAIE with regard to clearance of items of equipment and scrap from road verges to improve road safety. Copies of these letters are also included in **Appendix 4B**.

4.4.5 Civil Society Representatives

There are a number of active civil society groups that have an interest in environmental and social welfare issues. These include the Bahrain Environment Society and The Migrant Workers Protection Society (MWPS).

A consultation meeting has already taken place between the MWPS and Bechtel the on 28th May 2017 regarding management of workers welfare. A copy of the meeting notes is included in **Appendix 4B.**

4.4.6 General Public

Comprises any other individuals within Bahrain who have a interest in the Line 6 Expansion Project.

4.5 Project Exhibition

Following identification of stakeholder groups it is planned to hold an exhibition regarding the environmental and social impacts of the project and how ALBA intend to mitigate and manage these. Invitees to the exhibition will have the opportunity to provide direct feedback to ALBA representatives and its environmental consultant.

Traffic Management within SAIE will be given a special focus as it has the potential to impact neighbouring businesses and will require on-going interaction with SAIE occupants throughout the construction phase to be effectively managed.

The exhibition will present simplified summaries of key aspects of the ESIA that can be understood by a layman. These will be presented in graphics form as far as possible and will be presented in English and Arabic. Full copies of all ESIA documentation will be available at the exhibition to refer to.

Provisionally topics to be addressed will be:

i. History of ALBA and importance of the Line 6 Expansion to ALBA's future including the economic and developmental benefits of the project;
ii. Outline of the aluminium smelting process;
iii. Key environmental impacts of Line 6 and PS5 operation – air quality impacts, waste;
iv. Construction impacts – traffic; and construction workforce management;
v. Details of external grievance mechanism that can be used by community stakeholders to raise concerns about the project.

Project personnel will be on hand to guide visitors around the exhibition and to answer questions. All visitors will be given an opportunity to provide written and verbal feedback which they will be able to be give anonymously if required.

The exhibition will be open in several separate sessions:

1) Government and civil society;
2) Press and media;
3) SAIE and neighbours;
4) General public.

The opening times of the exhibition will be advertised in the press. Invitees within the project stakeholder database will be sent invitation letters and a frequently asked question sheet. The exhibition is scheduled for late October 2017. The feedback from the exhibition will be captured in the ALBA SEP.

4.6 External Grievance Mechanism

ALBA have developed an external grievance mechanism to provide a structured means of receiving and resolving concerns and complaints made by individuals or groups affected by ALBAs activities. Issues can be raised using the dedicated ALBA Integrity Line phone number (800-000-00) or via the company website. All issues raised will be investigated by relevant staff and the outcome will be reported to the complainant.

4.7 Publication of the ESIA

The 2014 ESIA Report has been published on the ALBA website and is available at the following location:
http://www.albasmelter.com/Corporate%20Responsibility/CSR/Pages/default.aspx

4.8 Follow up Engagement

The type and focus of follow up engagement will depend upon the outcome of the exhibition and other consultations. The feedback from these will be analysed to identify if there are any concerns that have been raised that are not adequately addressed by the ESIA process. If this is the case, additional mitigation and management measures will be considered to address these concerns. The feedback will also be used to identify what aspects of the stakeholder engagement programme should continue and what form it will take.

The ALBA SEP will be updated in light of the feedback and outcomes from the exhibition and other consultations.

4.9 Summary

A summary of management actions for stakeholder engagement are shown in **Table 4.2**.

Table 4.2 Summary of Required Actions for Stakeholder Engagement

Issue / Impact	Mitigation / Monitoring / Enhancement Measures
Stakeholder Engagement Plan	• Development of a project-wide Stakeholder Engagement Plan.
Grievance Mechanism	• Development and implementation of a project-wide external grievance mechanism.
Exhibition	• Undertake an exhibition inviting feedback on the environmental and social impact of the project from identified stakeholder groups.
Follow up Engagement	• Analyse the feedback from the exhibition and other consultations. • Revise mitigation and management plans where appropriate. Identify what aspects of stakeholder engagement it is appropriate to continue. • Update SEP to include feedback and outcomes of exhibition and other consultations.

5 AIR QUALITY

5.1 Introduction

This section of the Supplementary ESIA describes the revisions to the Line 6 Expansion Project compared with the 2014 ESIA Report, in the context of air emissions and their likely effects. The section takes account of the ESAP, which describes Alba's commitments to its Lenders to bring its activities in line with Lender Environmental and Social requirements.

In respect of air quality, the key information gaps identified in the 2014 ESIA Report, together with consideration of the subsequent revisions to the development, led to a requirement for the following summary assessments:

- A review of changes in emissions from ESIA case to latest design;
- Presentation of changes in mass emission rates;
- Confirmation that process pollutant emission rates will meet Bahrain National Emission Standards and IFC/WHO standards;
- Assessment of material changes in impacts at receptor locations, in respect of Bahrain National and IFC/WHO ambient air quality standards;
- Update the Greenhouse Gas (GHG) Emissions inventory; and
- Assessment of the revised scheme construction phase air quality impacts.

5.2 Legislation and Guidance

5.2.1 Ambient Air Quality

Air quality standards are established to protect human health and the environment. International Finance Corporation (IFC) Performance Standards and World Bank Environmental, Health, and Safety (EHS) Guidelines provide environmental assessment methods and significance criteria for international projects.

IFC Performance Standard 3 (2012)[2] states that where national regulations differ from the levels and measures presented in the EHS Guidelines, the more stringent is required to be demonstrated, or a justification provided for proposed alternatives. The World Bank EHS Guidelines specific to Air Emissions and Ambient Air Quality[3] indicate that national standards should be used, but in their absence, ambient air quality guidelines recommended by the World Health Organisation[4] (WHO) should be adopted. Overall the later principle contained in IFC Performance Standard 3 has been used to define the assessment criteria and thereby the Project Standards for this study. Therefore the applicable Project Standard is the lowest of the national standard or IFC/WHO standard except where a derogation is justified.

Table 5.1 shows a summary of ambient air quality standards applicable to the project that are taken from Bahrain legislation[5] and WHO guidelines. The table also shows the

[2] International Finance Corporation (2012) Performance Standard 3 Resource Efficiency and Pollution Prevention, 1 January 2012.

[3] World Bank General EHS Guidelines: Environmental – Air Emissions and Ambient Air Quality, 30 April 2007

[4] WHO Air quality guidelines for particulate matter, ozone, nitrogen dioxide and sulfur dioxide, Global Update 2005.

[5] Ministerial Order No. 10 of 1999 with Respect ot Enviromental Standards (Air and Water)

Project Standards based on the above criteria in bold type and shaded boxes.

Table 5.1 Ambient Air Quality Standards and Guidelines – Project Standards

Pollutant	Averaging Period	Bahrain ($\mu g.m^{-3}$)	WHO Guidelines ($\mu g.m^{-3}$)	WHO Interim Targets (IT) ($\mu g.m^{-3}$)
SO_2	10 minutes	-	**500**	
	Hourly	**350**(1)	-	
	Daily	125	**20**	125 (IT 1) 50 (IT 2)
	annual	**50**	-	
NO_2	Hourly	**200**	200	
	Daily	**150**	-	
	Annual	**40**	40	
CO	8-hourly	**10 000**	-	
PM_{10}	Daily	**340**	50	150 (IT 1) 100 (IT 2) 75 (IT 3)
	Annual	-	20	70 (IT 1) 50 (IT 2) 30 (IT 3)
HF	"less than"		**1**(2)	

Notes:
Project Standards are shown in Bold Type and Shaded Boxes.
(1) Not to be exceeded more than twice in any 30-day period at a given location.
(2) From WHO Air Quality Guidelines for Europe 2nd Ed. 2000

For some pollutants the WHO air quality guideline values are set out against Interim Targets, which are "*provided in recognition of the need for a staged approach to achieving the recommended guidelines*[3]*.*

In the case of daily SO_2 concentrations the Interim Target is equal to the Bahraini national standard, and is the former WHO guideline value (WHO, 2000), For NO_2, the annual mean and daily mean national standards are the same as the WHO Guidelines.

The Bahrain national standards relating to PM_{10} particulate matter are less stringent than those advised by WHO. The national standards are tailored to specific conditions in Bahrain, where background particulate concentrations routinely exceed the WHO guideline and Interim Target values, due to the natural arid, sandy and periodically windy environmental conditions.

Table 5.2 shows PM_{10} monitoring data for 2011 (the latest full year of data available) for the government air quality monitoring station located in the Central Governorate in Ma'ameer village. This is the site closest to ALBA.

Table 5.2 Ambient Air Quality Monitoring Results for PM_{10} for Central Governorate for 2011

Month	Average Daily Value	Maximum Daily Value	No. of Exceedences of Standard
January	-	-	-
February	184.89	398.66	3
March	213.75	1335.12	2
April	264.13	934.26	8
May	218.55	416.7	1
June	406.38	1399.18	13
July	348.00	1697.46	7
August	236.32	621.05	3
September	155.48	216.22	0
October	173.18	414.58	1
November	122.03	248.8	0
December	142.36	374.62	1

The results show that the average daily values all exceed the WHO guideline value and the Bahrain national standard was exceeded on numerous occasions with the highest maximum values and numbers of exceedences in the drier summer months. Article 12 of Ministerial Order No.10, 1999 with Respect to Environmental Standards (Air and Water) allows for exceedence of the national standard for PM10 if the breach is due to "extraordinary concentrations with natural origins"

Based on this evidence the Project Standard for PM_{10} is identified to be the Bahrain National Standard rather than the WHO guideline values which are unachievable due to natural conditions.

5.2.2 Emission Sources

World Bank Environmental, Health, and Safety Guidelines for Thermal Power Plants, 2008 and World Bank EHS Guidelines for Base Metal Smelting and Refining, 2007 set out emission standards for relevant plant. In national legislation emission standards are set out in Ministerial Order No. 3 of 2001[6]. The standards are summarised in **Table 5.3**.

Table 5.3 Project Standards for Emission Sources based on National Standards and World Bank EHS Guidelines

Industry	Source	Pollutant	Unit	Project Standard
Bahrain MO No. 3, 2001				
Combustion Processes[1]	Fuel combustion units, Commercial, furnaces, Industrial[1,2,3]	CO	mg/m^3	100
Aluminium smelting	Reduction cells	PM	mg/m^3	30 Total emissions not to exceed 3 kg/ton Al

[6] Ministerial Order No. 3 of 2001 with Respect to Amending Certain Schedules Attached to Ministerial Order No. 10 of 1999 with Respect to Environmental Standards (Air and Water) as Amended by Ministerial Order no. 2 of 2001.

Industry	Source	Pollutant	Unit	Project Standard
		HF	mg/m^3	1
		Total fluorides	mg/m^3	2 Total emissions not to exceed 1.25 kg/ton Al
		SO_2	kg/ton Al	32
		VOC	mg/m^3	20
	All other processes consisting of positive electrodes (anodes)	PM	mg/m^3	30
		SO_2	mg/m^3	500
		NO_x	mg/m^3	400
		Total fluorides	kg/ton Al	0.05
		VOC	mg/m^3	20
World Bank EHS Guideline Thermal Power Plants				
Combustion Turbines – Gas-fired >50MW		NO_x	mg/m^3	51
World Bank EHS Guideline Base Metal Smelting and Refining				
Aluminium: Primary aluminum electrolysis, materials pre-treatment, and from melting and smelting of secondary aluminum		Hydrogen Fluoride	mg/Nm^3	0.5[1,2]
		Total Fluoride	mg/Nm^3	0.8[1,3]
1 Fabric filter 2 Alumina scrubber 3 Emissions of metals are dependent on the composition of the dust produced by the processes. The composition varies and is influenced by the process source of dust and by the raw materials that are being processed.				

5.2.3 Greenhouse Gas (GHG) Emissions

Bahrain ratified the Kyoto Protocol in 2006 and is considered in Resolution Number 51 of 2007 'Establishing the Joint Committee on Climate Change', and Resolution Number 57 of 2015 'Amending the first article of Resolution No. 51 of 2007 Establishing the Joint Committee on Climate Change'. The Kyoto Protocol commits State Parties to reduce GHGs through a series of emissions targets and GHG reduction measures.

An International benchmark for comparison of GHG emissions is the International Finance Corporation (IFC) Performance Standard 3, *'Resource Efficiency and Pollution Prevention'*[7]. The Standard provides a reporting threshold of 25,000 tonnes of CO_2e per year, above which organisations should formally report annual GHG emissions. The Equator Principles III require organizations which emit over 100,000tpa of GHGs to report emissions publically on an annual basis.

5.3 Other References

Other relevant project documents used in the assessment are:

- ALBA Line 6 Expansion Power Distribution System (PDS) Construction Environmental Management Plan (CEMP). Siemens Document Reference ALBA PDS SH9 & SH7 L6-PDS-01-H-0030-00103, 26.01.2017

[7] International Finance Corporation (2012); Performance Standard 3, Resource Efficiency and Pollution Prevention.

- ALBA Line 6 Project Construction Environmental Management Plan. Bechtel Document Reference 26096-6000-GPP-GHE-001, 16.08.2016.

- ALBA Line 6 Project Construction Traffic Management Plan. Bechtel Document Reference 26096-6000-GPP-GPT-001, Rev 00D, 25.01.2017.

- ALBA General Clarifications_GEGA-EPC-011, 617. Guarantees for Combined-Cycle Operation (including emission guarantees); also Returnable Schedule 2B Performance Guarantees, Gas Turbine.

- ALBA PS5 Health, Safety, Environment and Community Management Plan. Document Reference ALBA-00-YYY-HS-PR-GPS-0001, Revision 2, 05.01.2017.

- ALBA PS5 Construction Environmental Management Plan. Reference ALBA-00-YYY-GN-RP-GPS-0530, Revision 1, 23.01.2017

5.4 Baseline

5.4.1 Construction Phase Baseline Monitoring

The 2014 ESIA provided an overview of existing air quality, although particulate monitoring specific to the ALBA site was not undertaken. The EPCM Contractor for the Line 6 project, Bechtel, therefore implemented a site baseline particulate survey on commencement of activities on site. Two Aeroqual Dust Sentry automatic real time monitors[8] were located (nominally) south, downwind and north, upwind of the main construction site, to provide continuous measurement of PM_{10} particulate matter, wind speed and direction

Bechtel provided summary measured PM_{10} data for the northern dust monitoring site between 14 March and 26 June 2017, when the recorded wind direction was between $315^0 \geq x \leq 45^0$, thereby representative of off-site dust sources, and the mean PM_{10} concentration during that period was 155µg.m^{-3}. This value is well below the Bahrain national ambient air quality standard for PM_{10} of 340µg.m^{-3} as a daily mean, although it is considered to be elevated compared to locations outside the GCC region, and reflects the arid and wind dispersion conditions in the region and in the industrial locality at and around the site. The measured value also characterizes ambient conditions across Bahrain, which are influenced by seasonal meteorology and natural sources of airborne particulates.

5.4.2 Operational Phase

5.4.2.1 Hydrogen Fluoride

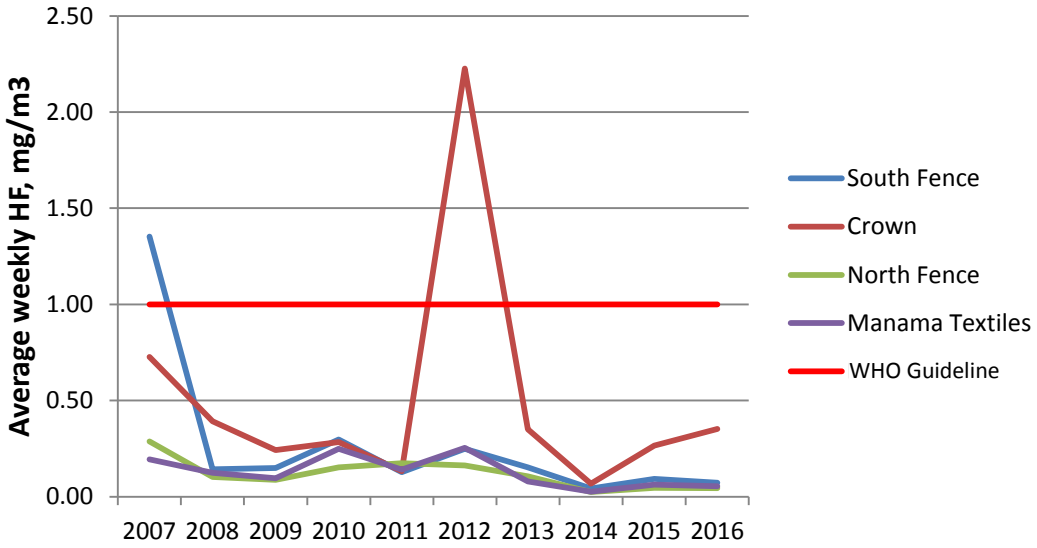
ALBA has undertaken site boundary and off-site measurements of HF for many years, in order to monitor long-term ground-level concentrations and provide assurance that stack emissions are adequately controlled and are not giving rise to elevated levels in the ambient environment, where its own staff may be exposed. The technique employs the high volume sampler methodology to collect sample air across impregnated (alkaline

[8] Aeroqual Serial Numbers DS 07102016-442 (South Location) and DS 07102016-443 (North Location)

treated) filters, with subsequent laboratory analysis by the specific ion electrode technique.

A 10-year summary of the data is provided in **Figure 5.1** below.

Figure 5.1 10-year Summary of Ambient HF Measurements, ALBA Site and Off Site



The distinct peak in 2012 is shown only at the off-site Crown facility, and was not associated with ALBA activities or emissions. A further version of the same data plotted only for the two ALBA site measurement locations from 2008 is shown in **Figure 5.2**.

Figure 5.2 Summary of Ambient HF Measurements at two ALBA Site Boundary Locations

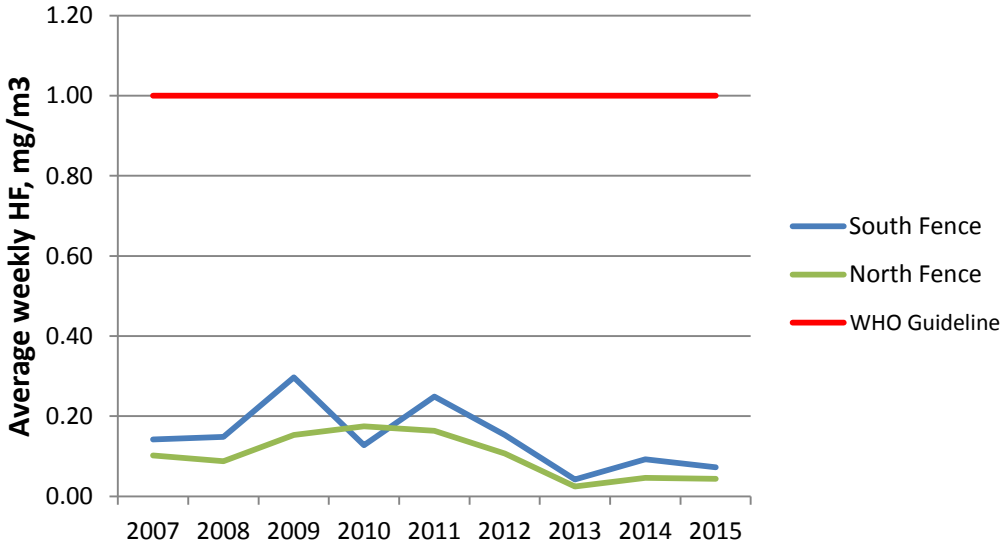


Figure 5.2 shows that the long-term ambient HF concentrations have been well below the WHO guideline value.

5.5 Significance Criteria

This Supplementary ESIA describes the revisions to the Line 6 Expansion Project compared with the 2014 ESIA Report in the context of air emissions and their likely effects. Therefore, the significance criteria applied to the impact assessment are based on changes in emissions since the 2014 ESIA due to changes in the plant design or capacity. Where those revisions do not give rise to material changes in emissions of likely ambient air quality, there are be no significant additional effect, and the conclusions of the original ESIA (for the consented development) remain applicable. Where the additional effects on local air quality due to the revised scheme would be likely to be significant, additional assessment and mitigation measures would be required.

The assessment criteria set out in **Table 5.4** have been used for the assessment of the construction and operational phases.

Table 5.4 Air Quality Assessment Criteria

Impact Significance	Impact Characteristic	
	Construction Phase	**Operational Phase**
Major Adverse	Risk based assessment concludes significant off-site effects, with revisions required to the project existing CEMP	The revised project gives rise to significant changes in primary pollutant emissions, and/or breaches of relevant IFC emission limits which would require a further detailed dispersion modelling study to determine effects at receptor locations.
Moderate Adverse	Risk based assessment concludes some off-site effects, with revisions required to the project existing CEMP	The revised project gives rise to some changes in primary pollutant emissions, and/or breaches of relevant IFC emission limits, which would require consideration of potential dispersion and effects at receptor locations.
Minor Adverse	Risk based assessment concludes minor off-site effects, with minor revisions required to the project existing CEMP	The revised project gives rise to minor changes in primary pollutant emissions, but IFC emission limits would be met and there would be no material change in effects at receptor locations.
Negligible	Risk based assessment concludes no significant off-site effects, and that the project existing CEMP will provide adequate controls	The revised project gives rise to no changes in primary pollutant emissions, with IFC emission limits met, and no difference in effects.

5.6 Assessment Methodology

5.6.1 Construction Phase

5.6.1.1 Construction Dust

An assessment of potential impacts associated with the construction phase was undertaken using a risk-based approach, based on the scale of likely activities and the proximity to sensitive receptors. In the absence of Bahraini national technical guidance on the assessment of construction effects on air quality, the assessment is based in the methodology contained in provided by the UK Institute for Air Quality Management (IAQM)[9].

The IAQM approach uses the following general steps:

i.	Risk Assessment	Separately for demolition, earthworks, construction and trackout (that is, as the transport of dust and dirt from the construction site onto the public road network): A. determine potential dust emission *magnitude*; B. determine *sensitivity* of the area; and C. establish the *risk* of dust impacts.
ii.	Mitigation	Identify site-specific mitigation; and
iii.	Residual Impacts	Examine the residual effects to determine whether or not additional mitigation is required.

5.6.1.2 Exhaust Emissions from Construction Road Traffic

A screening / qualitative consideration of any changes to off-site construction vehicle movements was undertaken, utilizing the road traffic emission model within the UK Design Manual for Roads and Bridges (DMRB)[10]. The DMRB provides guidance on the assessment of the impact that road projects may have on local air quality. The method has been applied in the assessment of significant infrastructure construction activities, and was considered to be appropriate for the assessment of air quality impacts associated with changes in traffic on roads within the wider off-site study area.

5.6.2 Operational Phase

5.6.2.1 Changes in Emissions and Air Quality Impact

For the operational phase, the assessment was based on the consideration of changes in emissions associated with the project revisions, and whether an additional detailed dispersion modelling study would be required to be undertaken. The approach was to focus on review of emissions data and the relative changes in emissions from the

[9] Institute of Air Quality Management (2014) Guidance on the Assessment of Dust from Demolition and Construction v1.1

[10] Highways Agency DMRB Volume 11, Section 3, Part 1 – HA207/07 Air Quality; applied with Highways Agency's IAN 174/13 Updated Advice for evaluating significant air quality effects for users of DMRB HA2017/07

consented development, on the basis that insignificant changes in primary emissions would have no material effect on ground level air quality at receptor locations.

5.6.2.2 Impact of Emissions of HF

This Supplementary ESIA considered existing HF emissions data and the potential impact of the Line 6 Expansion Project design changes on HF emissions and off-site effects. This approach also addressed matters raised by Lender advisors.

5.7 Impact Assessment

5.7.1 Assessment of Construction Dust Emissions

5.7.1.1 Magnitude of Dust Emissions

Firstly the magnitude of likely dust emissions for the Line 6 Expansion Project are established using criteria listed in **Table 5.5** below. The respective allocated categories which apply to the Line 6 Expansion Project are shown in **bold text** and grey shading.

Table 5.5 Dust Emission Magnitude Criteria

Activity	Criteria used to Determine Dust Emission Category		
	Small	**Medium**	**Large**
Demolition	• Total building volume <20,000m^2; • Material with low potential for dust release	• **Total building volume 20,000 – 50,000m^2;** • **Potentially dusty material.**	• Total building volume >50,000m^2; • Potentially dusty material.
Earthworks	• Total site area <2,500m^2; • <5 heavy moving earth vehicles active at any one time.	• Total site area 2,500 – 10,000m^2; • 5 – 10 heavy moving earth moving vehicles active at any one time.	• **Total site area >10,000m^2,** • **>10 heavy earth moving vehicles active at any one time.**
Construction	• Total building volume <25,000m^3; • Construction material with low potential for dust release.	• Total building volume 25,000 – 100,000m^3; • Potentially dusty construction material (e.g. concrete).	• **Total building volume >100,000m^3;** • **On site concrete batching.**
Trackout	• <10 outward HGV trips in any one day; • Unpaved road length <50m.	• 10 – 50 outward HGV trips in any one day. • Unpaved road length 50 – 100m.	• **>50 outward HGV trips in any one day;** • **Unpaved road length >100m.**

For the Line 6 Expansion Project, in respect of demolition activities, the dust emission magnitude was determined to be '**medium**', and for earthworks, construction and trackout was defined as '**large**'.

5.7.1.2 Determination of the Sensitivity of Environmental Receptors

The sensitivity of environmental receptors has been determined using **Table 5.6** which provides sensitivity criteria based on the type of land use.

Table 5.6 Criteria for Determining Sensitivity of Receptors

Sensitivity of Receptor	Criteria for Determining Sensitivity	
	Dust Soiling Effects	Health Effects of PM_{10}
High	Dwellings, museums and other culturally important collections, medium and long-term car parks and car showrooms	Residential properties, hospitals, schools and residential care homes
Medium	Parks, places of work	Office and shop workers not occupationally exposed to PM_{10}
Low	Playing fields, farmland, footpaths, short-term car parks and roads	Public footpaths, playing fields, parks and shopping streets

The criteria detailed in **Tables 5.7 and 5.8** are used to determine the sensitivity of the receptors to dust soiling effects and human health impacts.

Table 5.7 Sensitivity of the Area to Dust Soiling Effects on People and Property

Receptor Sensitivity	Number of Receptors	Distance from Source (m)			
		<20	<50	<100	<350
High	>100	High	High	Medium	Low
	10-100	High	Medium	Low	Low
	1-10	Medium	Low	Low	Low
Medium	>1	Medium	Low	Low	Low
Low	>1	Low	Low	Low	Low

Table 5.8 Sensitivity of the Area to Human Health Impacts

Receptor Sensitivity	Annual Mean PM_{10} Concentrations	Number of Receptors	Distance from the Source (m)				
			<20	<50	<100	<200	<350
High	>32µg.m^{-3}	>100	High	High	High	Medium	Low
		10-100	High	High	Medium	Low	Low
		1-10	High	Medium	Low	Low	Low
	>28-32µg.m^{-3}	>100	High	High	Medium	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	High	Medium	Low	Low	Low
	>24-28µg.m^{-3}	>100	High	Medium	Low	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
	<24µg.m^{-3}	>100	Medium	Low	Low	Low	Low
		10-100	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
Medium	>32µg.m^{-3}	>10	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
	>28-32µg.m^{-3}	>10	Medium	Low	Low	Low	Low

Receptor Sensitivity	Annual Mean PM_{10} Concentrations	Number of Receptors	Distance from the Source (m)				
			<20	<50	<100	<200	<350
		1-10	Low	Low	Low	Low	Low
	>24-28µg.m^{-3}	>10	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
	<24µg.m^{-3}	>10	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
Low	-	>1	Low	Low	Low	Low	Low

In this case, irrespective of a potentially high sensitivity to population dust and PM_{10} exposure, the distance to all residential and sensitive ecological receptors is beyond 350m from site activities. Therefore the sensitivity of the surrounding area is defined as low for both dust soiling and human health. The assessment is summarised in **Table 5.9**.

Table 5.9 Outcome of Defining the Sensitivity of the Area

Potential Impact	Sensitivity of the Surrounding Area			
	Demolition	Earthworks	Construction	Trackout
Dust Soiling	Low	Low	Low	Low
Human Health	Low	Low	Low	Low

5.7.1.3 Assessment of Risks of Dust Impacts

Finally, the dust emission magnitude and receptor sensitivity estimations are combined and the risk of impacts from each activity (demolition, earthworks, construction and trackout) are determined using the criteria detailed in **Tables 5.10** and **5.11**.

Table 5.10 Risk of Dust Impacts – Demolition, Earthworks and Construction

Potential Impact	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible

Table 5.11 Risk of Dust Impacts- Trackout

Potential Impact	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Low Risk	Low Risk
Low	Low Risk	Low Risk	Negligible

The risks for dust soiling and human health from the Line 6 Expansion Project were determined using **Tables 5.10 and 5.11** and are summarised in **Table 5.12.**

Table 5.12 Summary Dust Risk Table to Define Site-specific Mitigation

Potential Impact	Risk			
	Demolition	Earthworks	Construction	Trackout
Dust Soiling	Low risk	Low risk	Low risk	Low risk
Human Health	Low risk	Low risk	Low risk	Low risk

The risk assessment therefore concludes a low risk of both dust soiling and human health impacts for each construction activity category, and in accordance with the criteria set out in **Table 5.4**, there is a **Negligible** impact.

5.7.1.4 Mitigation of Dust Emissions

The assessment shows that the distance to sensitive receptors means that dust emissions from construction are unlikely to give rise to significant environmental effects. Nevertheless good international industry practice measures to control dust emissions at source should be implemented to minimise the exposure of construction personnel. Proposed mitigation measures are set out in **Section 5.9**. These measures are in line with the dust management measures identified in the project CEMPs and no further measures are required.

5.7.1.5 Residual Impacts

In this case as the impact is assessed as negligible, there are no residual impacts to be considered.

5.7.2 Off-Site Construction Traffic Emissions

The Construction Traffic Management Plan (CTMP)[11] for the project provides detailed profiles of the combined construction activity, by month, from the beginning of 2017 through to the end of 2018. The data are divided into vehicle classifications of enabling earthwork activities, the bussing of operatives (all direct contractors + 30% indirect), light vehicles, and raw material trucks. Given that the peak of truck movements in the initial earthwork excavation was in the early months of 2017 and has now passed, the CTMP shows that peak vehicle movements will occur in November 2017 (where the peak monthly truck loads will be 262, and in January 2018, when the total vehicle movement number will peak at 958. The CTMP further states that 'the current local traffic into the area is 3500 movements through the main traffic lights entering the industrial area', and that a combined L6 and PS5 project average of 1948 vehicles per day would be generated, (comprising 968 heavy and 980 light vehicles), and that a peak estimate would be 3,510 total vehicles/day.

[11] ALBA Line 6 Project Construction Traffic Management Plan. Bechtel Document Reference 26096-6000-GPP-GPT-001, Rev 00D, 25.01.2017

A conservative assessment was undertaken using these peak values and assumed average vehicle speeds on road links of 20km/h, at a range of nominal receptor locations at 50m intervals from 50m from the centre of the road to 300m, (which is the distance from Askar village to the construction laydown area, and the closest distance from any project construction activity to a residential receptor location.

The contribution of the key vehicle emission pollutants, nitrogen oxides (NO_x) and fine particulate matter (PM_{10}) at the 50m and 300m receptor distances, are given in **Table 5.13**.

Table 5.13 Construction Vehicle Emission Pollutant Receptor Concentrations

Location / Standard	NOx contribution, $\mu g.m^{-3}$	PM_{10} contribution, $\mu g.m^{-3}$
50m (nominal receptor distance)	0.3	0.07
300m (Askar Village)	<0.1	<0.01
Relevant Bahrain ambient air quality standard	40 $\mu g.m^{-3}$ annual mean 150 $\mu g.m^{-3}$ daily mean 200 $\mu g.m^{-3}$ hourly mean	340 $\mu g.m^{-3}$ daily mean
IFC (WHO) Guidelines	40 $\mu g.m^{-3}$ annual mean 200 $\mu g.m^{-3}$ hourly mean	20 $\mu g.m^{-3}$ annual mean 50 $\mu g.m^{-3}$ daily mean

Table 5.13 shows that the contribution of construction vehicle exhaust emissions at the most proximate receptor, Askar Village, is minimal and will not lead to exceedence of the ambient air quality Project Standards and as such the impact is assessed as **Negligible** in accordance with the criteria set out in **Table 5.4**.

5.8 Operational Phase Emissions

The 2014 ESIA Report provided a comprehensive baseline and operational phase air quality impact assessment based on a detailed atmospheric dispersion modelling study, with conclusions that air quality impacts would not be significant and that process emissions would be compliant with Bahraini national standards and the sector principles laid down in World Bank EHS Guidelines.

The changes to emissions associated with the revision of the project since the 2014 ESIA Report are set out below.

5.8.1 Changes in Stack and Potline Emissions

The 2014 ESIA Report stated a crept aluminium production of 924,654 tpa (tonnes per annum), and assessed an increased L6 production of 521,667 tpa. The revised final design scenario is an expanded production of 540,034 tpa. This is set out in **Table 5.14**.

Table 5.14 ESIA Assessment and Revised Design Criteria – Al Production

Scenario	Al Production (tpa)		Total Al production (tpa)
	Existing	L6	
Production figures from ESIA Table 30 applicable to ESIA Future Operations, Scenario A Option A	924654	521667	1446321
Final Design Scenario	924654	540034	1464688
% change			1.27

With the increase in the capacity of PS5 from 1350 to 1800MW, the normal operating loads of the power stations have changed from the scenario presented in the 2014 ESIA. The operating scenario for the final design including PS5 at 1800MW is summarized in **Table 5.15** alongside the normal operating scenario from the 2014 ESIA.

Table 5.15 ESIA Assessment and Revised Design Criteria – Power Station

Power Station	Normal Operations, Scenario A Option A Table 5 2014 ESIA Addendum ESIA (MW)	Final Design (MW)
PS3	794	260
PS4	888	770
PS5	1350	1800
Total Capacity	**3032**	**2830**

Note: Normal Operations, Scenario A Option A Table 5 2014 ESIA Addendum assumes PS3, 4 and 5 are on full load. Power station capacities obtained from 2014 ESIA Report Table 13 and 2014 ESIA Addendum Table 1. The Final Design scenario assumes an average operating load on PS3 of 260MW at 30% load factor; of 770MW on PS4 at 82% load factor, and 1800MW on PS5 at 100% load factor.

The associated changes in emissions of NO_x and SO_2 as a result of the changes to PS5 design and the operating scenario are shown in **Table 5.16**.

Table 5.16 Changes in Power Station NOx and SO_2 Emissions

Emission Scenario	NOx, t/day	SO2, t/day
Normal Operations, Scenario A Option A Table 5 2014 ESIA Addendum	34.97	16.87
Final Design	32.65	15.75

When these emission rates for the power stations are included with the emission rates from the smelter plant, the overall change in emission rates from the whole site can be estimated, as shown in **Table 5.17**. The table shows that the final design will give rise to

reduced total NOx, HF, PM_{10} and SO_2 emissions compared to those assessed in the 2014 ESIA.

Table 5.17 Summary of Final Design Implications on Pollutant Emissions

Aspect	Pollutant Emissions (t/day)			
	SO_2	HF	PM_{10}	NOx
Future Operations – Normal Operations (Inclusion of 3-PS5 and Discontinuing PS1 & PS2) Scenario A- Option A 2014 ESIA Addendum Table 5				
Stack Emissions[1]	103.1	0.26	1.72	0.48
Potline Emissions[2]	1.98	1.67	5.69	0
Power Station Emissions[3]	16.87	-	-	34.97
Total Emissions	**121.95**	**1.93**	**7.41**	**35.45**
Final Design Scenario - Increase in Capacity of Line 6 and PS5				
Stack Emissions[1]	104.44	0.26	1.74	0.51
Potline Emissions[2]	2.01	1.69	5.76	0.00
Power Station Emissions[3]	15.75	-	-	32.65
Total Emissions	**122.20**	**1.96**	**7.51**	**33.16**
Percentage change in total emissions (%)	**0.2**	**1.3**	**1.3**	**-6.5**

Notes:

1. Stack Emissions: include emissions from stack located at Reduction Area, Carbon Area and Casthouses; includes contribution of emissions from new Casthouse 4, expected to use 8.5mNm^3 gas per annum.
2. Potline Emissions: include emission from roof vents of the potlines.
3. Power Station Emissions: Emissions were calculated based on operation of all stack emission points at the power station (power stations operate intermittently on a monthly basis).

Fugitive HF emissions from Potlines are measured at the Potline roof vents. A summary of 2016 monitoring data is provided in **Table 5.18**.

Table 5.18 Summary of 2016 Measured HF Roof Vent Emissions

Roof Vent Pot Line	Monthly minimum, mg/m^3	Monthly Maximum mg/m^3	Annual Average mg/m^3
3	0.21	0.38	0.31
4	0.30	0.58	0.46
5	0.16	0.49	0.37
Average			0.38
Project Standard	**1 mg/m^3**		

The roof vent average HF emission concentration measurements show reasonable consistency and are below the Project Standard (the WHO guideline for ambient air quality). The Line 6 Expansion Project would be expected to increase total mass releases, but emissions would be expected to continue to be within the concentration limit.

The 2014 ESIA showed baseline ambient SO_2 concentrations already exceed WHO limits. The 2014 ESIA Addendum predicted that SO_2 concentrations at sensitive receptors would be within Bahraini limits (see Table 9, p33). The revisions to the selected gas turbines for PS5 are predicted to increase SO_2 emissions marginally (by less than 2%) and it is expected that ground level concentrations at the identified receptors will remain within Bahraini limits (in the 2014 ESIA concentrations were predicted to be significantly under Bahraini limits at 10-40% of the limit).

The 2014 ESIA Addendum predicted that NO_2 concentrations at sensitive receptors would be within Bahraini limits and WHO Guideline, with the exception of Ma'ameer where exceedances of the 1 hour averaged limit were anticipated. The existing 1 hour NO_2 concentrations are 9% above the limit, and the impact of the Line 6 Expansion Project would have brought about an additional contribution of less than 2% of the limit (for the Future-1 and Scenario A options). The revisions to the selected gas turbines for PS5 are predicted to decrease NO_x emissions by approximately 6.5%. Given the decrease in NO_x emissions, it is considered likely that ground level concentrations at the identified receptors will be less than those predicted in the 2014 ESIA Addendum, although they may still marginally exceed the 1 hour NO_2 standard at Ma'ameer on occasion.

As shown above, the final design project would generate an increase in stack and potline emissions of 1.3%, and a decrease in power station emissions of 6.5%. The revisions to the Line 6 Expansion Project would thereby give rise to a net reduction in NO_x emissions, and minor increases in other pollutants releases. Total HF emissions will increase but roof vent emission concentrations will be expected to remain well below the Project Standard. In accordance with the impact assessment criteria in **Table 5.4**, the effect of changes in plant capacity and design, on local air quality on site and at the most proximate off-site receptors, will be of **Negligible** significance. The minor changes in emissions do not affect the outcome and conclusions of the 2014 ESIA with respect to air quality impacts.

5.8.2 Changes in GHG Emissions

A GHG inventory estimation was carried out in the 2014 ESIA which considered emissions from gas and electricity consumption from the proposed Line 6 and PS5 expansion project. The conclusions were that some 17.2mtpa of CO_2 would be released from the expanded ALBA plant, with an increase associated with Line 6 of some 6.2mtpa. The Final Design scenario accounting for revisions to the expansion project will bring about approximately 1.3% increase in total aluminium production, and a slight reduction in power station emissions. These revisions would be expected to change the total annual CO_2 emissions, but not to a significant degree in the context of this large energy utilisation and associated CO_2 releases. Changes to GHG emissions will be **Negligible**.

The project will clearly exceed the IFC threshold of 25,000 tonnes of CO_2e per year, above which organisations should formally report annual GHG emissions. The Equator Principles III require that any project with annual emissions of GHGs in excess of 100,000 tonnes should report its GHG emissions publically on an annual basis and this will be required.

5.9 Mitigation and Monitoring

5.9.1 Construction Phase Emissions Management

The IAQM Guidance provides the following good practice guidance for management of emissions to air from construction work which are consistent with Good International Industry Practice. These measures are consistent with the dust control measures within the existing project CEMPs.

Dust Management

- Develop and implement a Dust Management Plan (DMP), which may include measures to control other emissions, approved by the relevant authority.
- Record all dust and air quality complaints, identify cause(s), take appropriate measures to reduce emissions in a timely manner, and record the measures taken.
- Make the complaints log available to the relevant authority when requested.
- Record any exceptional incidents that cause dust and/or air emissions, either on- or offsite, and the action taken to resolve the situation in the log book.
- Undertake daily on-site and off-site inspection, where receptors (including roads) are nearby, to note any dust deposition, record inspection results, and make the log available to the relevant authority when asked.
- Plan site layout so that machinery and dust causing activities are located away from receptors, as far as is practicable.
- Erect solid screens or barriers around dusty activities or the site boundary that are at least as high as any stockpiles on site.
- Consider enclosure of site or specific operations where there is a high potential for dust production and the site is active for an extensive period.
- Keep site fencing, barriers and scaffolding clean using wet methods.
- Remove materials that have a potential to produce dust from site as soon as possible.
- Cover, seed or fence stockpiles to prevent wind whipping.
- Ensure all vehicles switch off engines when stationary - no idling vehicles.
- Impose and signpost a maximum-speed-limit of 20 km/h on surfaced, and 15 km/h on unsurfaced, haul roads and work areas
- Use enclosed chutes and conveyors and covered skips.
- Minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use fine water sprays on such equipment wherever appropriate.
- The burning of waste materials should not be permitted.

Measures Specific to Demolition.

- Avoid explosive blasting, using appropriate manual or mechanical alternatives.

- Bag and remove any biological debris or damp down such material before demolition.

Measures Specific to Construction

- Ensure sand and other aggregates are stored in silos, bunded areas or in a controlled and well-managed manner.
- Ensure bulk cement and other fine powder materials are delivered in enclosed tankers and stored in silos with suitable emission control systems to prevent escape of material and overfilling during delivery.
- For smaller supplies of fine power materials ensure bags are sealed after use and stored appropriately to prevent dust release.

Measures Specific to Trackout

- Avoid dry sweeping of large areas.
- Ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport.
- Record all inspections of haul routes and any subsequent action in a site log book.

Measures Specific to Non Road Mobile Machinery (NRMM)

Non Road Mobile Machinery (NRMM) and plant would be well maintained. If any emissions of dark smoke occur then the relevant machinery should stop immediately and any problem rectified. In addition, the following controls should apply to NRMM:

- All NRMM should comply with relevant national Emission Standards.
- Implementation of energy conservation measures including instructions to throttle down or switch off idle construction equipment; switch off the engines of trucks while they are waiting to access the site and while they are being loaded or unloaded, ensure equipment is properly maintained to ensure efficient energy consumption.

5.9.2 Operation Emissions Management and Monitoring

The existing operational monitoring arrangements should continue. This includes HF monitoring and stack emission monitoring and reporting to the SCE. The SCE require emission monitoring on a quarterly basis and reporting every six notified . The applicable emission limits are the Project Standards identified in **Table 5.3**.

GHG emissions should be calculated and reported publically on an annual basis in accordance with IFC and Equator Principles requirements.

5.10 Impact Summary

Table 5.18 shows a summary of air quality issues addressed by the Supplementary ESIA for the ALBA Line 6 Expansion project.

Table 5.19 Summary of Air Quality Impacts

Impact/ Activity	Potential Significance (Minor/Moderate/Major) (Beneficial/Adverse/Negligible)	Mitigation / Monitoring / Enhancement Measures	Residual Impacts (Minor/Moderate/Major) (Beneficial/Adverse/Negligible)
Construction			
Construction – Dust emissions	Negligible	• IAQM Construction Dust Guidance mitigation measures, all of which are best practice measures for large scale international construction projects and are contained within the Potline 6 and PS5 CESMPs.	Negligible
Construction – off-site traffic emissions	Negligible	• Off-site vehicle movements associated with materials deliveries and construction worker transportation are all sufficiently distant from residential settlements, that emissions will not have a material effect on ambient air quality at receptor locations.	Negligible
Operation			
Operation – changes in combustion-related emissions	Negligible. Revisions to the expansion project will not give rise to significant changes in overall NOx, SO_2, CO, PM and other pollutant emissions.	• SCE require emission monitoring on a quarterly basis and reporting every six months.	Negligible
Operation – changes in fugitive HF emissions	Negligible. Concentration of fugitive HF emissions from roof vents will not change.	• Current Potline HF emissions from roof vents comply with the Bahraini emission standard and would be expected to do so for the Potline 6 plant. • Measurements of roof vent emissions and ambient ground level concentrations will continue.	Negligible
Operation – changes in GHG emissions	Negligible. Revisions to the Line 6	• The existing ALBA facility is an energy-intensive plant and the expansion in production will give	Negligible

Impact/ Activity	Potential Significance (Minor/Moderate/Major) (Beneficial/Adverse/Negligible)	Mitigation / Monitoring / Enhancement Measures	Residual Impacts (Minor/Moderate/Major) (Beneficial/Adverse/Negligible)
	Expansion Project will not result in significant changes to GHG emissions.	rise to greater CO_2e emissions. • Energy efficiency considerations are part of the design and operation philosophy. • GHG emissions should be calculated and publically reported annually in accordance with IFC requirements.	

6 COMMISSIONING AND DECOMMISSIONING IMPACTS

6.1 Introduction

Construction of the Line 6 Expansion Project will require the new operational plant to be commissioned. This will require a methodical approach to the testing of equipment and undertaking of acceptance testing until the plant is considered fully operational within the agreed engineering design specification. The plant will then be handed over to ALBA for operation. During this process there is the potential for environmental emissions from cleaning and testing of equipment that were not assessed as part of the 2014 ESIA Report.

Also the Line 6 Expansion Project will lead to the closure of redundant plant, most notably Power Station 1 units (specific proposals are described in **Section 2.2.3**). These will require decommissioning and removal / demolition after PS5 is demonstrated to be stably operating. Although this is not part of the existing Line 6 Expansion contracts, it is a direct consequence of the new development and so is included in this ESIA.

Finally, Potline 6 and PS5 themselves will ultimately be decommissioned and demolished and the potential environmental impacts of these activities in the long term are also considered.

Management of potential health and safety impacts of commissioning and decommissioning are considered in **Section 11, Occupational Health and Safety**.

6.2 Legislation and Guidance

6.2.1 World Bank Environmental Health and Safety General Guidelines, 2007

Section 4 provides advice on the potential impacts of construction and decommissioning. It specifically identifies noise and vibration, soil erosion, air quality, solid waste, hazardous materials, wastewater discharges, contaminated land as potential environmental issues related to construction and decommissioning phases.

6.2.2 ALBA Code of Practice for the Construction Phase (ACOPC No. C001)

The ALBA code of practice includes all relevant environmental and health and safety Project Standards that apply to the project construction phase. They will also apply to commissioning and decommissioning. A copy of the ACOPC is included as **Appendix 6A**.

6.3 Impact Assessment Methodology

There is no environmental baseline for assessment of potential impacts other than compliance with environmental emission Project Standards. By their nature impacts from commissioning, decommissioning and demolition are likely to be short term. For the assessment, impacts have been considered as Significant or Negligible depending on the need to comply with Project Standards and the potential impacts of uncontrolled emissions.

6.4 Commissioning Impacts

6.4.1 Effluent Discharges

During commissioning it is common practice to clean out pipe work with steam or water and pressure test systems with water. Wash water sometimes has additives such as biocides or cleaning agents. These wash waters will be discharged to surface water via the ALBA process water drainage system. To control their impacts the discharges will need to be tested regularly to confirm they meet Project Standards. Where needed effluent may need to be stored and / or pre-treated to achieve these standards, e.g. neutralisation of acids or alkalis.

Impact of discharges to surface water during commissioning is considered a Significant issue which can be rendered Negligible through control of discharges and appropriate testing.

6.4.2 Emissions to Air

During commissioning it is likely to be necessary to operate Power Stations 3, 4 and 5 whilst Power Station 2 is operating or Power Station 3 is operating at a higher load than assumed in the air quality assessment (Power Station 1 is not expected to be operated under any realistic circumstances). In this case the total emissions rates of pollutants will be temporarily higher than modelled and assessed. This will lead to a temporary reduction in air quality. Operating old and new power station units side by side may be unavoidable until the new PS5 units are tested and operating stably. However, by careful planning the period of simultaneous operation can be minimised.

The impact of emissions to air during commissioning is considered a Significant issue which can be rendered Negligible through effective planning to minimise simultaneous operating periods. ALBA are required to develop proposals for the management of air quality during commissioning to avoid or minimise excess emissions from undertaking commissioning of Power Station 5 alongside power generation for normal operations (from Power Stations 2, 3 and 4).

6.4.3 Solid Wastes

Whilst it is possible that off specification materials will be produced during the commissioning process, it is expected that most of these will be able to be recycled into the process, e.g. off-specification carbon electrodes. It is not expected that there will be a need to dispose of significant quantities of waste materials beyond those already detailed in the 2014 ESIA Report and **Section 8, Waste** of this Supplementary ESIA.

The potential impact of additional waste from commissioning is therefore considered Negligible.

6.5 Decommissioning

Power Station 1 and potentially elements of Power Station 2 and associated equipment will be decommissioned and demolished. Decommissioning plans should include:

i. Disconnection and isolation of services;

ii. Removal of hazardous materials;
iii. Emptying, cleaning and venting of pipes and vessels;
iv. Removal of valuable or reusable or economically recyclable materials.

Where there are potential environmental impacts of these activities they are described below.

6.5.1 Disconnection and Isolation of Services

Services should be disconnected as part of the decommissioning process. Of particular interest to environmental protection is the disconnection of drains that can form pathways for the accidental, uncontrolled release of wash waters or chemicals, fuels or oils from decommissioning work. These should be identified and either permanently or temporarily blocked off as needed.

The potential for uncontrolled releases from decommissioning (and demolition) is considered Significant and can be rendered Negligible through identification and blocking of drainage routes and by maintaining spill kits on site during the work and training staff in spill response procedures.

6.5.2 Removal of Hazardous Materials

Parts of the ALBA facility date back to 1971 and therefore there is the potential for buildings and equipment to contain asbestos or other hazardous materials, and for electrical equipment to contain polychlorinated biphenyls (PCBs). Such hazardous materials will require to be managed as part of the decommissioning process (asbestos was banned in Bahrain in 1996 and for PCB use in electrical equipment, EACS has been advised by the Electricity and Water Authority that PCBs are unlikely to be present in equipment supplied after 1990). In addition to PCBs and asbestos the plant will contain chemicals, fuels, oils and waste materials that will require to be removed prior to demolition.

The buildings should be subject to hazardous material surveys including sampling for hazardous materials such as asbestos and PCBs where appropriate based on the age of the equipment. All hazardous materials should be located and removed by appropriately trained contractors or staff. Materials should be disposed of in accordance with the law or reused /recycled as appropriate.

Removal of hazardous materials during decommissioning is considered a Significant issue that can be rendered Negligible through appropriate surveys, planning, use of appropriately trained contractors and management controls.

6.5.3 Demolition

Demolition may give rise to dust, this can be controlled through the use of water sprays to damp materials down. The discharge of any drainage water may need to be controlled during this process. The main waste materials will include scrap steel, copper and aluminium which can be recycled, and brick and block work which can also be recycled.

Dust emissions from demolition are considered a Significant issue. The emissions can be controlled by water sprays to render them Negligible.

Waste from demolition is considered a Significant issue that can be rendered Negligible through maximisation of recycling. This is best achieved through development of a waste management plan.

6.6 Decommissioning and Demolition of Line 6 Expansion Project

It is expected that when the Line 6 Expansion Project is decommissioned the land will remain in industrial use. The decommissioning and demolition will follow a similar set of procedures as those set out above for Power Station 1 and 2. Following demolition the land may require remediation to remove contamination. This aspect of the project has not been further assessed.

6.7 Summary

Table 6.1 provides a summary of the potential impacts of decommissioning and demolition and mitigation and management requirements.

Table 6.1 Summary of Required Mitigation and Management Actions for Commissioning, Decommissioning and Demolition

Issue / Impact	Potential Significance (Minor/Moderate/Major) (Beneficial/Adverse/Negligible)	Mitigation / Monitoring / Enhancement Measures	Residual Impacts (Slightly/Moderate/Major) (Beneficial/Adverse/Negligible)
Commissioning			
Discharges to Surface Water.	Significant	• Control of discharges – storage, neutralization etc. • Appropriate testing to demonstrate compliance with Project Standards.	Negligible
Simultaneous Operation of New and Old Power Stations. Operation of Power Station 2 and additional units of Power Station 3 alongside Power Station 4 and 5 will lead to additional mass emissions to air that will impact air quality.	Significant	• ALBA to develop a plan to minimize simultaneous operation of new and old power stations during commissioning	Negligible
Solid Wastes (in excess of those already identified).	Negligible		Negligible
Decommissioning			
Disconnection and Isolation of Services (uncontrolled releases to drains)	Significant	• Survey and block off possible drainage routes. • Maintain spill kits on site and train staff in spill response	Negligible

Issue / Impact	Potential Significance (Minor/Moderate/Major) (Beneficial/Adverse/Negligible)	Mitigation / Monitoring / Enhancement Measures	Residual Impacts (Slightly/Moderate/Major) (Beneficial/Adverse/Negligible)
		procedures.	
Removal of hazardous materials	Significant	• Appropriate surveys and planning of work. • Use of appropriately trained contractors. • Management controls (e.g. limiting access, controlled removal).	Negligible
Demolition			
Dust emissions from demolition	Significant	• The emissions can be controlled by water sprays.	Negligible
Demolition Waste	Significant	• Development of a waste management plan to maximise reuse and recycling of wastes.	Negligible

7 SURFACE WATER

7.1 Introduction

ALBA has a marine outfall associated with its smelter site. This section provides a description of the marine outfall and the marine environment and considers the impact of the outfall. This is provided to meet the requirements of the ESAP. The discharge from the calciner at ALBA Marine Terminal is not considered as it will not materially change as a result of the Line 6 Expansion Project.

7.2 Legislation and Guidance

7.2.1 National

7.2.1.1 Ministerial Order No. 3 of 2001 Amending Certain Tables Attached to Ministerial Order No. 10 of 1999 with Respect to Environmental Standards (air and water) as amended by Ministerial Order No. 2 of 2001

This regulation includes a table of standards for industrial effluents which is reproduced as **Table 7.1**.

Table 7.1 Bahrain Industrial Effluent Standards

Determinand	Units	Monthly Average*	Maximum
Floating Particles	mg/l	Nil	-
pH		6.0-9.0	-
Total Suspended Solids	mg/l	20	35
Temperature	Deg. C	ΔT 3ºC	--
Turbidity	NTU	25	75
Biochemical Oxygen Demand	mg/l	25	50
Chemical Oxygen Demand	mg/l	150	<350
Total Organic Carbon	mg/l	50	-
Total Kjeldahl Nitrogen	mg/l	5	10
Oil and Grease	mg/l	8	15
Fluorescent Petroleum Matter	mg/l	0.1	0.1
Phenols	mg/l	0.5	1
Ammoniacal Nitrogen	mg/l	1	3
Residual Chlorine	mg/l	0.5	2
Total Cyanide	mg/l	0.05	0.1
Nitrites	mg/l	-	1
Nitrates	mg/l	-	10
Sulphides as H2S	mg/l	0.5	1
Total Phosphorous	mg/l	1	2
Arsenic	mg/l	0.1	0.5
Cadmium	mg/l	0.01	0.05

Determinand	Units	Monthly Average*	Maximum
Total Chromium	mg/l	0.1	1
Copper	mg/l	0.2	1
Lead	mg/l	0.2	1
Mercury	mg/l	0.001	0.005
Nickel	mg/l	0.2	0.5
Aluminium	mg/l	15	25
Iron	mg/l	5	10
Zinc	mg/l	2	5
Total Coliforms	MPN	1000	10000
* = Average reading during 30 days NTU = Nephlometric Turbidity Units MPN = Most Probable Number / 100ml			

7.2.1.2 Ministerial Order No. 10 of 1999 with Respect to Environmental Standards (Air and Water)

The regulation includes the requirement to sample and test effluents on a quarterly basis against the standards for industrial effluents and report the results to the SCE.

7.2.2 International Guidance

7.2.2.1 World Bank Environmental, Health, and Safety Guidelines for Base Metal Smelting and Refining 2007 and World Bank Environmental, Health, and Safety Guidelines for Thermal Power Plants, 2008

Both of these guidelines include effluent discharge standards applicable to the relevant sectors and these are shown in **Table 7.2**.

Table 7.2 IFC Guideline Values for Effluent Discharges

Determinands	Units	Aluminium Smelting	Thermal Power Plant
pH		6.0-9.0	6.0-9.0
Total Suspended Solids	mg/l	20	50
Temperature	Deg. C	ΔT 3ºC	
Chemical Oxygen Demand	mg/l	50	
Oil and Grease	mg/l		10
Hydrocarbons	mg/l	5	
Residual Chlorine	mg/l		0.2
Arsenic	mg/l		0.5
Cadmium	mg/l		0.1
Total Chromium	mg/l		0.5
Copper	mg/l		0.5
Lead	mg/l		0.5

Determinands	Units	Aluminium Smelting	Thermal Power Plant
Mercury	mg/l	0.01	0.005
Aluminium	mg/l	0.2	
Iron	mg/l		1.0
Zinc	mg/l		1.0
Fluorides	mg/l	5	

7.2.2.2 World Bank Environmental, Health, and Safety General Guidelines Wastewater and Ambient Water Quality, 2007

The general guidelines provide standards for effluent discharges from sewage treatment plants. These are shown in **Table 7.3**.

Table 7.3 Treated Sanitary Sewage Discharges

Determinand	Unit	Guideline Value
pH		6-9
Biological Oxygen Demand	mg/l	30
Chemical Oxygen Demand	mg/l	125
Total Nitrogen	mg/l	10
Total Phosphate	mg/l	2
Oil and Grease	mg/l	10
Total Suspended Solids	mg/l	50
Total Coliforms	MPN / 100ml	400

7.3 Methodology

The assessment is based on a quantitative review of existing effluent discharge quality and quantity, and a qualitative assessment of the condition of the receiving marine environment and the likely impact of the discharge.

The sensitivity of the marine environment has been defined using the criteria in **Table 7.4** below.

Table 7.4 Sensitivity Criteria for Marine Environment

Importance	Description
High	Coastal waters designated as locally, nationally or internationally protected areas by any Concerned Agency (e.g. National - SCE, International (e.g. RAMSAR). Furthermore, waters which serve industrial/utilities (e.g. power station intake) fall within this category or host exceptionally sensitive ecological receptors (e.g. coral reefs).
Medium	National marine waters which do not conform to either high or low classified waters. These may be indicative of open sea areas not holding exceptionally sensitive receptors/habitats.
Low	Waters adjacent to areas (either marine or terrestrial) which are classified as industrial through local or national planning regulation. The extent of these waters do not impinge upon higher classification of water bodies.

The magnitude of the impact of the discharge has been defined using the criteria in **Table 7.5** below. The criteria for extent and duration of the impact are added together and used in **Table 7.6** to identify the magnitude of the impact.

Table 7.5 Impact Magnitude Criteria

Feature	**Scale of Magnitude**			
Impact Extent	Limited	Local	National	International
Score	1	2	3	4
Impact Duration	Short term	Medium term	Long term	Permanent
Score	1	2	3	4

Table 7.6 Scale of Impact Magnitude

	Magnitude of Impact			
	High	**Medium**	**Low**	**Negligible**
Magnitude Score	8	6	4	≤2

The significance of environmental impacts is determined by a combination of the sensitivity of the marine environment and impact magnitude. **Table 7.7** shows the impact significance classification used.

Table 7.7 Calculation of Impact Significance

MAGNITUDE	**High**	Moderate	Moderate/Major	Major
	Medium	Minor/Moderate	Moderate	Moderate/Major
	Low	Minor	Minor/Moderate	Moderate
	Negligible	Negligible	Negligible/Minor	Minor/Moderate
		Low	**Medium**	**High**
		SENSITIVITY		

7.4 Baseline

7.4.1 Coastal Geomorphology

The ALBA smelter site outfall is located in Ras Zuwayed Industrial Area. The seawater is shallow in this area and as a result a series of land reclamation works have been undertaken in recent years to create industrial land. Snapshots of land profiles from 2009 to 2017 are shown below as **Figures 7.1** to **7.4**.

Figure 7.1 Ras Zuwayed Industrial Area Land Profile 23rd May 2004

Figure 7.2 Ras Zuwayed Industrial Area Land Profile 7th April 2011

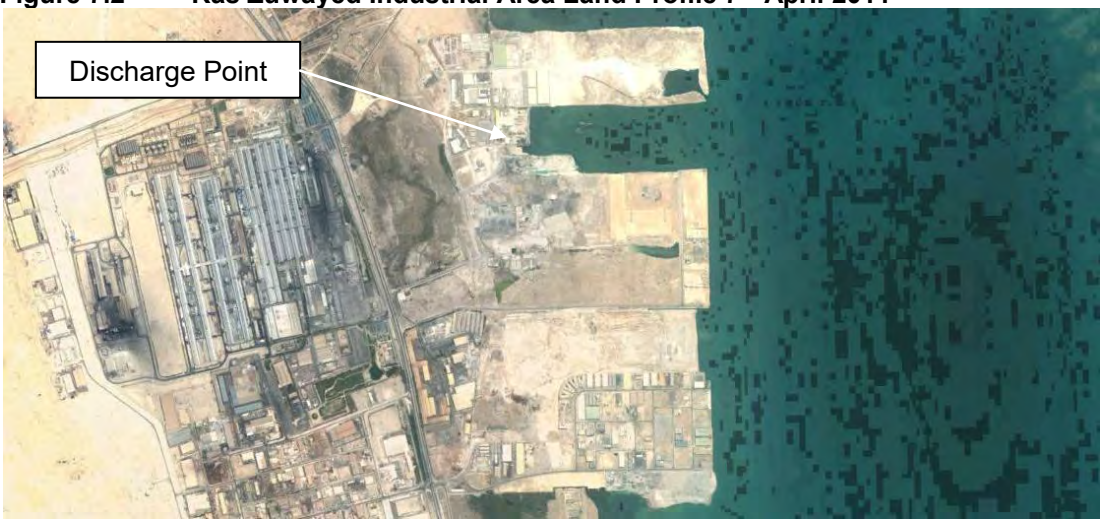
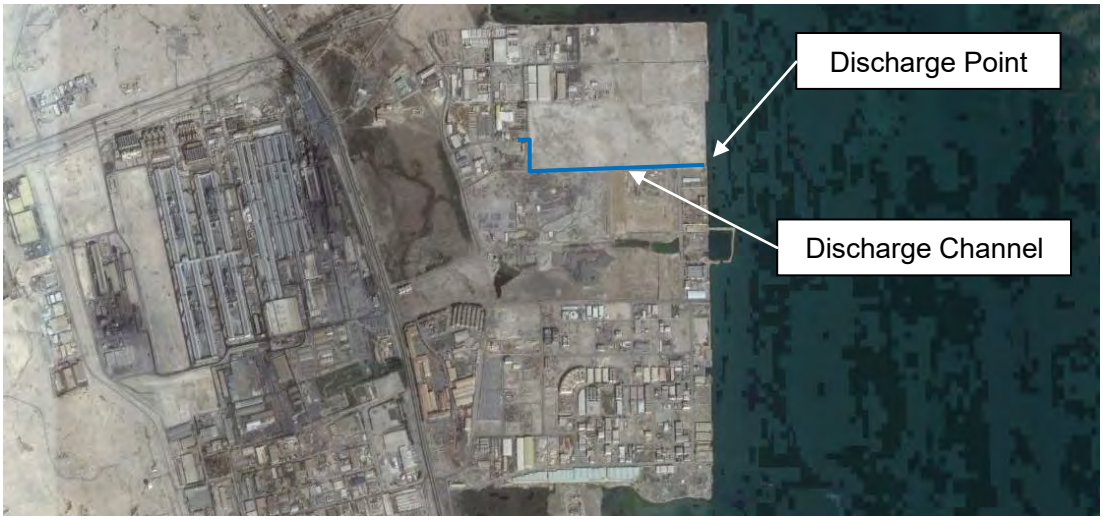


Figure 7.3 Ras Zuwayed Industrial Area Land Profile 10th December 2014

Figure 7.4 Ras Zuwayed Industrial Area Land Profile 1st March 2017



The ALBA discharge has been maintained by the creation of a channel from the discharge point to the sea by the reclamation contractors. ALBA are currently planning to install a pipeline to formalise the arrangement and are in consultation with the SCE regarding the matter.

7.4.2 Marine Environment

The distribution of subtidal habitats within Bahrain waters has been mapped by GEOMATEC, 2006 (MARGIS II survey)[12]. The distribution of habitat types in the vicinity of the outfall is described as mixed (rock/sand, algae/rock/sand, sand, mud/sand). Surveys by EACS in 2015 indicate that the habitat type in the vicinity of the outfall is mainly sand.

The coastal area around the outfall is not subject to any protected status and does not have a significant economic use (i.e. it is not used for commercial fishing). Fasht Al Adhm, a coral reef and commercial fishing area is located 2km east of the outfall.

To the north of the ALBA outfall there are two outfalls from the Bapco Refinery which discharge a total of around 700,000m^3 of cooling water and effluent per day.

Due to the land reclamation around the ALBA outfall, the habitat in the immediate vicinity of the coast is expected to have been impacted by development.

7.4.3 ALBA Outfall

The ALBA outfall exits the site from ALBA lake located in the south east corner of the site. The ALBA process has a relatively small water footprint and, under normal operation, water requirements are supplied by pipeline from the calciner located at ALBA Marine Terminal. Water is used for cooling and is further purified to create boiler feed water. New water storage tanks will be constructed as part of the Line 6 Expansion

[12] GEOMATEC, 2006. Marine Environmental Geographic Information System (MARGIS II). Report submitted to the Government of Bahrain, GEOMATEC, BCSR, August 2006.

Project and will store potable water from the calciner to provide a reserve supply when the calciner is shut down for maintenance.

Waste water from ALBA operations comprises: boiler blowdown, cooling water blowdown; treated sewage effluent and stormwater. The volume of wastewater discharged is estimated to be 1227m^3 per day in the 2014 ESIA Report. The effluent is sampled and tested on a monthly basis. The results are provided to the SCE in compliance with regulatory requirements.

7.5 Impact Assessment

7.5.1 Effluent Quality

Copies of effluent quality results for the last 3 years are summarised in **Table 7.8**. The results are compared to Project Standards which are derived from Bahrain Industrial Effluent Standards and World Bank EHS guideline values applicable to aluminium smelters, thermal power plants and treated sewage effluent. In each case the lowest value has been taken as the Project Standard. It should be stressed that the comparison is undertaken to provide a benchmark of the present ALBA effluent discharge quality only. The existing ALBA smelter and power plants were not designed to meet current IFC standards but were designed to meet environmental standards applicable at the time of their construction.

Table 7.8 shows that the effluent is in compliance with all Bahraini Industrial Effluent standards except for multiple instances where the monthly average values for Total Coliforms was exceeded and the value for nitrite was exceeded on one occasion. The results for Total Coliforms are not actual “average” values as only one sample was taken each month, but the results do indicate that Total Coliforms are present at a slightly elevated concentration in the effluent on a regular basis. The maximum value for Total Coliforms was not exceeded. The results have all been provided to the SCE as part of normal emissions reporting requirements.

In comparison with the relevant IFC guideline value, the concentration of Total Coliforms exceeds the Project Standard in every sample. There were several other sporadic exceedences of Project Standards comprising total suspended solids, chemical oxygen demand, nitrites, aluminium and fluorides. The regular elevated results for Total Coliforms may indicate that one or more of the sewage treatment plants on site are not functioning to the required standard. The reasons for the other sporadic exceedences are unclear.

The temperature results in **Table 7.8** are expressed as a discharge temperature, not a change in temperature in respect of the ambient temperature (as in the Project Standard). However, the temperatures measured are consistent with ambient seasonal temperatures for seawater in Bahrain (around 35°C summer and 19°C in winter - based on EAC’s experience) and excess discharge temperatures is not expected to be an issue.

7.5.2 Impact of Line 6 Expansion Project

The ESAP specifically required an assessment of the effluent discharge on the marine ecology to ensure that the marine discharge will have no impact on flora and fauna.

As the Line 6 Expansion Project is not expected to significantly change the volume or the composition of the effluent, the existing effluent volume and quality provides a direct index of the future environmental impacts and has been used for the assessment.

The marine environment in the immediate vicinity of the smelter outfall is expected to be poor quality due to recent disturbance by land reclamation and on-going industrial use of the land. The sensitivity of the marine environment has therefore been classified as Low in accordance with the criteria in **Table 7.4.**

The low volume of the effluent and its general compliance with discharge standards indicates that the discharge is unlikely to significantly impact the marine environment. However, the discharge does exceed the Project Standards as described including regular exceedences of the Total Coliform standard and other sporadic exceedences. Due to the relatively low discharge rate the extent of the discharge impact is considered to be limited and the duration is permanent. Using the criteria in **Tables 7.5** and **7.6**, the impact magnitude is therefore classified as Low.

As the receptor sensitivity is classified as Low and impact magnitude is classified as Low, the impact significance is classified as **Minor Adverse** using the criteria in **Table 7.7**.

7.6 Mitigation and Monitoring

Whilst the impact of the discharge is classified as minor adverse, the discharge is non-compliant with Project Standards based on IFC guidance. The effluent discharge will need to be compliant with the Project Standards from 2019 when the operation of the Line 6 and Power Station 5 commences. Therefore ALBA should undertake a program of investigation and corrective actions to ensure that the smelter site effluent is compliant with Project Standards from the commencement of Line 6 and Power Station 5 operation. This will reduce the impact of the discharge to **Negligible**.

7.7 Impact Summary

Table 7.9 shows a summary of the impact assessment.

Environment Arabia

Table 7.8 Review of ALBA Effluent Discharge Results June 2015 to June 2017

Determinand	Unit	Bahrain Industrial Effluent Standard		IFC Guideline Value[+]			Project Standard		Jun-15	Jul-15	Aug-15	Sep-15	Oct-15	Nov-15	Dec-15	Jan-16	Feb-16	Mar-16	Apr-16	May-16	Jun-16	Jul-16	Aug-16	Sep-16	Oct-16
		Monthly Average[++]	Max	Aluminium Smelting	Thermal Power Plant	Treated Sewage Discharge	Monthly Average	Maximum**																	
Floating Particles	mg/l	Nil					Nil	-	<3	<3	<3	<3	<3	<3	<3				<3	<3	<3	<3	<3	<3	
pH		6.0-9.0		6.0-9.0	6.0-9.0	6.0-9.0	6.0-9.0	6.0-9.0	7.3	7.3	7.1	6.8	7.4	6.7	7.1				7.1	7.0	7.0	6.9	7.2	7.0	7.2
Total Suspended Solids	mg/l	20	35	20	50	50	20	20	22.0	17.0	24.0	20.0	18.0	8.0	9.0				10.2	5.6	3.8	3.2	5.0	13.0	9.0
Temperature	Deg. C	ΔT 3ºC		ΔT 3ºC			ΔT 3ºC	ΔT 3ºC	30.5	34.4	36.4	34.4	34.5	33.0	28.3				29.1	33.4	34.5	33.8	34.1	36.5	33.0
Turbidity	NTU	25	75				25	75	5.6	7.8	9.6	9.3	8.0	3.6	4.2				4.3	1.5	1.5	1.4	2.0	2.4	2.1
Biochemical Oxygen Demand	mg/l	25	50			30	25	50	9	25	15	5	12	7	6				5	6	7	6	5	9	12
Chemical Oxygen Demand	mg/l	150	<350	50		125	-	50	40	90	75	17	40	40	20				26	30	37	15	20	35	46
Total Organic Carbon	mg/l	50					50	-	2.1	7.6	2.9	3.8	2.2	2.4	3.2				2.2	0.9	0.9	2.2	1.2	1.2	
Total Kjeldahl Nitrogen	mg/l	5	10			10	5	10	5.7	5.1	4.8	4.2	4.5	2.4	3.6				0.6	0.9	0.6	5.1	4.2	4.5	
Oil and Grease	mg/l	8	15		10	10	8	10	<1	<1	<1	<1	<1	<1	<1				<1	<1	<1	<1	<1	<1	<1
Fluorescent Petroleum Matter / hydrocarbons	mg/l	0.1	0.1	5			0.1	0.1	0.03	0.03	0.03	0.04	0.04	0.04	0.04				0.04	0.06	0.05	0.06	0.04	0.04	
Phenols	mg/l	0.5	1				0.5	1	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002				<0.002	<0.002	<0.002	<0.002	<0.01	<0.002	
Ammoniacal Nitrogen	mg/l	1	3				1	3	1.20	2.30	2.30	2.00	1.90	0.50	1.70				0.17	0.40	0.30	2.50	2.10	0.11	0.19
Residual Chlorine	mg/l	0.5	2		0.2			0.2	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05				<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.02
Total Cyanide	mg/l	0.05	0.1				0.05	0.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01				<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.005
Nitrites	mg/l		1				-	1	0.83	0.83	0.60	0.63	0.42	0.30	0.20				3.80	0.60	0.40	0.40	0.12	0.09	
Nitrates	mg/l		10				-	10	4.4	3.6	4.5	4.8	3.5	3.5	2.8				2.0	1.8	2.0	2.4	1.7	2.2	
Sulphides as H2S	mg/l	0.5	1				0.5	1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Total Phosphorous	mg/l	1	2			2	1	2	1.10	0.40	0.90	1.00	0.23	0.50	0.30				0.23	0.20	0.20	0.30	0.06	0.09	0.10
Arsenic	mg/l	0.1	0.5		0.5		0.1	0.5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005				<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	
Cadmium	mg/l	0.01	0.05		0.1		0.01	0.05	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005				<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
Total Chromium	mg/l	0.1	1		0.5		0.1	0.5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005				<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
Copper	mg/l	0.2	1		0.5		0.2	0.5	0.04	0.04	<0.01	<0.01	<0.01	<0.01	<0.01				<0.01	0.02	0.03	0.06	<0.005	0.03	
Lead	mg/l	0.2	1		0.5		0.2	0.5	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05				<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	
Mercury	mg/l	0.001	0.005	0.01	0.005		0.001	0.005	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002				<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	
Nickel	mg/l	0.2	0.5				0.2	0.5	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01				<0.01	<0.01	<0.01	<0.01	<0.005	<0.005	
Aluminium	mg/l	15	25	0.2				0.2	0.02	0.02	0.74	<0.01	0.18	0.01	0.42				0.10	0.26	0.31	0.64	<0.01	0.01	
Iron	mg/l	5	10		1.0			1.0	<0.01	0.05	0.02	0.03	0.05	0.04	0.03				0.07	0.15	0.17	0.37	0.03	0.11	0.02
Zinc	mg/l	2	5		1.0			1.0											0.03	<0.01	0.02	0.05	<0.01	<0.01	
Chloride	mg/l								8986	4369	5356	99	14447	3970	9430				10281	7352	7444	5247	10706	9217	9526
Fluorides	mg/l			5				5	1.8	1.8	1.8	1.1	1.9	1.2	1.8				1.9	1.8	1.4	1.2	1.9	1.5	1.8
E. Coli	MPN								270	170	330	220	350	140	220				270	210	260	210	220	170	
Total Coliforms	MPN	1000	10000			400		400	1400	1100	1700	1300	2200	1100	1700				1500	1400	1100	1300	940	790	

Key:

NTU = Nephlometric Turbidity Units

MPN = Most Probable Number / 100ml

** = maximum includes IFC 95%ile values

[+] = 95 percentile value

[++] = Average reading during 30 days

Values highlighted in yellow boxes indicate the project standard was exceeded

Bahrain industrial effluent standards taken from - Ministerial Order No. 3 of 2001 amending certain Tables attached to Ministerial Order No. 10 of 1999 with respect to environmental standards (air and water) as amended by Ministerial Order No. 2 of 2001

IFC guideline values taken from - World Bank Environmental, Health, and Safety Guidelines Base Metal Smelting and Refining 2007 and World Bank Environmental, Health, and Safety Guidelines for Thermal Power Plants, 2008

Table 7.4 continued

Determinand	Unit	Bahrain Industrial Effluent Standard		IFC Guideline Value+			Project Standard		Nov-16	Dec-16	Jan-17	Feb-17	Mar-17	Apr-17	May-17	Jun-17	Average Value	Maximum Value	Exceedence (Y/N & number of occasions)				
		Monthly Average++	Max	Aluminium Smelting	Thermal Power Plant	Treated Sewage Discharge	Monthly Average	Maximum**											BIE Monthly Average	BIE Maximum Value	IFC Guideline Aluminium Smelters	IFC Guideline Thermal Power Plant	IFC Treated Sewage Discharge
Floating Particles	mg/l	Nil					Nil	-				<3	<3	<3	<3	<3	<3	<3	No	-	-	-	-
pH		6.0-9.0		6.0-9.0	6.0-9.0	6.0-9.0	6.0-9.0	6.0-9.0	6.8		7.2	7.1	6.8	7.1	7.1	7.0	7.0	7.2	No	-	No	No	No
Total Suspended Solids	mg/l	20	35	20	50	50	20	20	8.5		5.3	11.0	7.0	26.0	18.0	15.0	13.0	26	No	0	Yes- 3	No	No
Temperature	Deg. C	ΔT 3ºC		ΔT 3ºC			ΔT 3ºC	ΔT 3ºC	33.0		30.0	21.6	27.3	31.5	33.7	35.1	30.3	35.1	-	-	-	-	-
Turbidity	NTU	25	75				25	75	2.5		2.8	5.4	3.2	5.9	8.4	7.2	5.1	8.4	No	No	-	-	-
Biochemical Oxygen Demand	mg/l	25	50			30	25	50	9			7	8	10	9	4	8	10	No	No	-	-	No
Chemical Oxygen Demand	mg/l	150	<350	50		125	-	50	42		52	23	32	44	32	22	35	52	No	No	Yes- 3	-	No
Total Organic Carbon	mg/l	50					50	-				1.5	4.9	1.3	5.0	2.3	3.0	5	No	-	-	-	-
Total Kjeldahl Nitrogen	mg/l	5	10			10	5	10				4.8	2.1	3.0	4.8	5.4	4.0	5.4	No	No	-	-	No
Oil and Grease	mg/l	8	15		10	10	8	10	<1		<1	<1	<1	<1	<1	<1	<1	<1	No	No	-	No	No
Fluorescent Petroleum Matter / hydrocarbons	mg/l	0.1	0.1	5			0.1	0.1				0.06	0.06	0.05	0.05	0.05	0.05	0.06	No	No	No	-	-
Phenols	mg/l	0.5	1				0.5	1				<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	No	No	-	-	-
Ammoniacal Nitrogen	mg/l	1	3				1	3	0.12		0.15	2.30	1.60	2.10	2.40	2.60	1.61	2.6	No	No	-	-	-
Residual Chlorine	mg/l	0.5	2		0.2			0.2	<0.01		0.01	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.01	No	No	-	No	-
Total Cyanide	mg/l	0.05	0.1				0.05	0.1	<0.005		<0.005	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	No	No	-	-	-
Nitrites	mg/l		1				-	1				0.04	0.02	<0.01	0.04	0.20	0.075	0.2	-	Yes	-	-	-
Nitrates	mg/l		10				-	10				0.4	0.5	0.5	0.4	0.9	0.5	0.9	-	No	-	-	-
Sulphides as H2S	mg/l	0.5	1				0.5	1	<0.1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	No	No	-	-	-
Total Phosphorous	mg/l	1	2			2	1	2	0.11		0.14	0.14	0.40	0.10	0.80	0.50	0.31	0.8	No	No	-	-	No
Arsenic	mg/l	0.1	0.5		0.5		0.1	0.5				<0.005	<0.005	<0.005	<0.01	<0.01	<0.01	<0.01	No	No	-	No	-
Cadmium	mg/l	0.01	0.05		0.1		0.01	0.05				<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	No	No	-	No	-
Total Chromium	mg/l	0.1	1		0.5		0.1	0.5				<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	No	No	-	No	-
Copper	mg/l	0.2	1		0.5		0.2	0.5				0.02	<0.01	<0.01	0.03	0.09	0.02	0.09	No	No	-	-	-
Lead	mg/l	0.2	1		0.5		0.2	0.5				<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.02	No	No	-	No	-
Mercury	mg/l	0.001	0.005	0.01	0.005		0.001	0.005				<0.001	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	No	No	No	No	-
Nickel	mg/l	0.2	0.5				0.2	0.5				<0.01	<0.01	<0.01	<0.01	0.02	0.02	0.02	No	No	-	-	-
Aluminium	mg/l	15	25	0.2				0.2				0.13	0.19	0.1	0.16	0.16	0.20	0.19	No	No	Yes-5	-	-
Iron	mg/l	5	10		1.0			1.0	0.10		0.13	0.27	0.19	0.06	0.94	0.54	0.15	0.94	No	No	-	No	-
Zinc	mg/l	2	5		1.0			1.0				0.03	0.02	<0.01	0.13	0.08	0.03	0.13	No	No	-	No	-
Chloride	mg/l								9656		9785	7303	2588	7232	7657	5743	7138	9785	-	-	-	-	-
Fluorides	mg/l			5				5	1.3		1.2	1.6	10.0	2.2	1.8	1.7	2.8	10	-	-	Yes -1	-	-
E. Coli	MPN											200	170	350	220	110	210	350	-	-	-	-	-
Total Coliforms	MPN	1000	10000			400		400				790	940	1100	1700	840	1074	1700	Yes-13	No	-	-	Yes- 18

Table 7.9 Surface Water Impact Assessment Summary

Issue / Impact	Potential Significance (Minor/Moderate/Major) (Beneficial/Adverse/Negligible)	Mitigation / Monitoring / Enhancement Measures	Residual Impacts (Slightly/Moderate/Major) (Beneficial/Adverse/Negligible)
Operation			
Discharges to Surface Water.	Minor Adverse	• ALBA should undertake a program of investigation and corrective actions to ensure that the smelter site effluent is fully compliant with Project Standards from the commencement of Line 6 and Power Station 5 operation.	Negligible

8 WASTE

8.1 Introduction

This section briefly addresses the changes in operational phase waste quantities and types as a result of the changes in the Line 6 Expansion Project design.

There is no change in the predicted quantities and types of construction wastes and these are therefore not assessed.

8.2 Legislation and Guidance

8.2.1 National

8.2.1.1 Public Commission for the Protection of Marine Resources, Environment and Wildlife, Resolution No. 3 of 2006 with Respect to the Management of Hazardous Wastes

Resolution No. 3 of 2006 highlights the acceptable methods of waste collection, storage, handling, transportation, treatment, disposal, recycling and reuse. The purpose of the Order is to implement a scheme to supervise the generation, transport, storage, treatment and disposal of hazardous wastes, to ensure the protection of human health and the environment. Amongst others, the Order applies to producers of hazardous wastes.

8.2.1.2 Ministerial Order No.10 of 1998 with Respect to Fees for Licences Issued by the Environment Affairs Authority and the Services it Provides

This legislation sets out fees for disposal of hazardous and semi-hazardous waste and also requires companies transporting these types of waste to obtain an annual licence.

8.2.1.3 Public Commission for the Protection of Marine Resources, Environment and Wildlife Resolution No 3 of 2005 with Respect to Environmental Standards in Workplaces

Amongst other things, the Resolution requires an employer to separate industrial wastes from other types of waste and to approach the Waste Management Section of the SCE to be advised as to how to properly dispose of industrial wastes.

8.2.1.4 Public Commission for the Protection of Marine Resources, Environment and Wildlife Resolution No 4 of 2005 with Respect to Used Oils Management

The resolution introduced a supervision and control scheme for storage, transportation and processing of used oils and disposal thereof.

8.2.1.5 Law No 11 of 1992 ratifying the 1989 Basel Convention regarding the Control of Transboundary Movements and Disposal of Hazardous Waste

The Basel Convention is principally devoted to establishing a framework to control the movement of hazardous wastes across international borders.

8.2.2 International Guidance

8.2.2.1 IFC Performance Standard 3 - Resource Efficiency and Pollution Prevention, 2012

IFC Performance Standard 3 states that the client (the party responsible for implementing the project) should avoid the generation of hazardous and non-hazardous waste materials. Where waste generation cannot be avoided, the client should reduce the generation of waste, and recover and reuse waste in a manner that is safe for human health and the environment.

Where waste cannot be recovered or reused, the client should treat, destroy, or dispose of it in an environmentally sound manner that includes the appropriate control of resulting emissions.

8.2.2.2 World Bank General Environmental Health and Safety Guidelines, 2007

Section 1.6 addresses waste management and sets out Good International Industry Practice measures for the management of waste including use of the waste hierarchy and duty of care principles.

8.3 Methodology

The impact assessment will use the same criteria for the assessment of waste impacts as described in the 2014 ESIA Report.

8.4 Baseline

The baseline for the operational phase waste assessment is the waste types and quantities described in the 2014 ESIA Report. The 2014 ESIA Report assumes a baseline capacity for the ALBA smelter of 924,652 tpa aluminium production and waste predictions are based upon proportionate increases in waste stream quantities with increased aluminium production.

8.5 Impact Assessment

The final design for the Line 6 Expansion Project uses the more efficient Dubal DX Ultra+ Technology for the potline (rather than DX+) which increases the number of pots in the Reduction Rooms to 424 Pots from 404 and increases Potline 6 capacity from 514,197 to 540,035 tpa. DX Ultra+ Technology is a more efficient smelting process and has a longer pot life which increases the pot life from around 4.9 years to around 6 years. This will reduce the amount of SPL waste produced.

When the changes in pot life and plant capacity are taken into account it is expected that the total predicted amount of SPL produced by ALBA (with Line 6) will reduce from 7962 tpa to 7402 tpa or a reduction of around 7% from the total SPL waste predicted in the 2014 ESIA Report (total predicted SPL waste will increase from 5090 tpa to 7402 tpa, rather than to 7962 tpa as stated in the 2014 ESIA Report). This is as a result of the improved efficiency of the DX Ultra+ Technology.

The improved process efficiency introduced by the use of DX Ultra+ Technology produces a definite benefit through the reduction of the quantity of SPL, which is a hazardous waste. However, overall the changes in waste quantities and types do not significantly change the impact assessment and significance of the impacts and the mitigation and management measures identified in the 2014 ESIA Report remain valid - waste is classified as having a “low to moderate” impact.

The predicted quantities of other wastes is expected to increase slightly as a results of the slight increase in capacity of the Line 6 Expansion Project which will increase total predicted aluminium production by ALBA from around 1,446,321 tpa (in 2014 ESIA Report) to around 1,464,689 tpa including for the new Potline 6 design using DX Ultra+ Technology. This is a total increase in production of around 1%. Using the same approach as used in the ESIA Report of increasing the predicted quantity of waste produced in proportion with the increase in aluminium production, then the total amount of waste produced (other than SPL) will also increase by around 1%. This is a negligible change in waste quantities and has been assessed as such. The 2014 ESIA report did not provide a formal assessment of the potential impacts of operational waste (other than SPL), it is therefore assumed the impact was considered negligible and remains as negligible following the 1% increase in quantity.

8.6 Mitigation and Management

There are no additional mitigation and management proposals. Those identified in the 2014 ESIA Report and CESMPs remain fully applicable.

8.7 Impact Assessment Summary

The change in potline technology has introduced efficiency improvements that reduce the amount of SPL that will need to be disposed of to landfill. The quantities and type of other wastes remain relatively unchanged from those identified in the 2014 ESIA Report therefore the impact assessment outcomes remain unchanged.

Table 8.1 provides a summary of the impact assessment.

Table 8.1 Summary of Waste Impacts

Issue / Impact	Potential Significance (Minor/Moderate/Major) (Beneficial/Adverse/Negligible)	Mitigation / Monitoring / Enhancement Measures	Residual Impacts (Slightly/Moderate/Major) (Beneficial/Adverse/Negligible)
Construction			
Management of construction wastes	Not described in 2014 ESIA	• As described in 2014 ESIA Report and CESMPs.	Low / Moderate (as described in 2014 ESIA)
Operations			
Spent Pot Lining waste	Not described in 2014 ESIA	• As described in 2014 ESIA Report and OESMP.	Low / Moderate (as described in 2014 ESIA)
Other operational wastes	Negligible	• 1% increase in expected quantities over 2014 ESIA.	Negligible

9 VIBRATION

9.1 Introduction

This section considers the potential for ground-borne vibration from construction and operational phases of the project to cause a nuisance to environmental receptors or structural damage to neighbouring buildings. It does not consider occupational health impacts of vibration. Occupational health and safety is addressed in **Section 11**.

The construction works will require significant excavation work using hydraulic breakers and surface mining equipment, and civil engineering works will require piling and construction of excavations up to 18m deep within the Casthouse 4 plot. These activities in particular, as well as general construction works, have the potential to give rise to ground-borne vibration. During operations, transportation and handling of heavy loads and operation of large pieces of equipment and rotating plant has the potential to create ground-borne vibration.

Impacts of vibration were not addressed in the 2014 ESIA Report and therefore the ESAP has identified the need for an assessment to be undertaken as part of this supplementary ESIA.

9.2 Legislation and Guidance

9.2.1 Construction Vibration Criteria

Vibration may be impulsive, such as that due to hammer-driven piling; transient, such as that due to vehicle movements along a railway; or continuous, such as that due to vibratory driven piling. The primary cause of community concern generally relates to building damage, although, the human body can perceive vibration at levels which are substantially lower than those required to cause building damage.

Damage to buildings associated solely with ground-borne vibration is not common and although vibration may be noticeable, there is little evidence to suggest that it produces cosmetic damage such as a crack in plaster unless the magnitude of the vibration is excessively high. The most likely impact, where elevated levels of vibration do occur during the construction phase, is associated with perceptibility.

BS 5228-2:2009+A1:2014 ‘Code of practice for noise and vibration control on construction and open sites, Vibration’ indicates that the threshold of human perception to vibration is around 0.15mm/s, although it is generally accepted that for the majority of people vibration levels in excess of between 0.15 and 0.3 mm/s peak particle velocity (PPV) are just perceptible.

9.2.2 Operational Vibration Criteria

The assessment of potential vibration impacts has considered British Standard 6472-1:2008 ‘Guide to evaluation of human exposure to vibration in buildings. Vibration sources other than blasting’ (BS6472), which provides guidance over the frequency range 0.5 Hz to 80 Hz.

BS 6472 describes how to determine the vibration dose value (VDV) from frequency-weighted vibration measurements. The vibration dose value is used to estimate the probability of adverse comment, which might be expected from human beings experiencing vibration in buildings.

Consideration is given to the time of day and use made of occupied space in buildings, whether residential, office or workshop. BS 6472 states that in homes, adverse comment about building vibrations is likely when the vibration levels to which occupants are exposed are only slightly above thresholds of perception.

BS 6472 contains a methodology for assessing the human response to vibration in terms of either the VDV, or in terms of the acceleration or the peak velocity of the vibration, which is also referred to as peak particle velocity.

9.3 Assessment Methodology

9.3.1 Construction Phase

1 mm/s ppv has been selected as the Project Standard to control the impact of construction vibration, with the criteria for assessing the magnitude of vibration impacts according to the margin by which the Project Standard criterion is achieved or exceeded presented in **Table 9.1** below. This Project Standard is based on the guidance contained within BS 5228, experience from previous sites and accepted vibration policy criteria across a range of enforcing authorities within the UK. The limits are presented in terms of peak particle velocity (PPV) as it is the simplest indicator for both perceptibility and building damage.

Table 9.1 Ground Vibration Effect Levels for Permanent Residential Buildings

Significance Criteria	Units	Project Standard
Lowest Observed Adverse Effect Level	PPV mm/s	1
Significant Observed Adverse Effect Level	PPV mm/s	10

It should be noted that the purpose of the construction vibration Project Standard is to control the impact of construction vibration insofar as is reasonably practicable and is entirely based on the likelihood of the vibration being perceptible, rather than causing damage to property. Hence, although vibration levels in excess of 1 mm/s ppv would be considered an adverse impact in respect of the likelihood of perceptibility, they would not be considered significant in terms of the potential for building damage, which would require levels of at least 15 mm/s ppv to result in minor cosmetic damage in light / unreinforced buildings.

9.3.2 Operational Phase

The recommendations and guidance presented in BS 6472 have been used to derive criteria for assessing the impact of development generated vibration on nearby residential dwellings, as set out in **Table 9.2**. The Project Standards are therefore $<0.1 m.s^{-1.75}$ for night-time vibration and $<0.2 m.s^{-1.75}$ for daytime vibration.

Table 9.2 Residential Use Buildings, Vibration Magnitude Description, m $s^{-1.75}$

Night-time Vibration Level VDV	Daytime Vibration Level VDV	Impact Significance Description
>0.4	>0.8	Major Negative
0.2 - 0.4	0.4 - 0.8	Moderate Negative
0.1 - 0.2	0.2 - 0.4	Minor Negative
<0.1	<0.2	Negligible

9.4 Impact Assessment

9.4.1 Construction Phase

Table 9.3 below details the distances at which certain construction activities could give rise to a just perceptible level of vibration. These figures are based on historical field measurements.

Table 9.3 Distances at which Vibration may be Just Perceptible

Construction Activity	Distance (m)
Excavation	10-15
Heavy Vehicles (e.g. dump trucks, cranes, loaders, dozers, graders)	5-10
Hydraulic Breakers	15-20
Large Rotary Piling Rig	20-30
Driven Piling Rig (if required)	10-20

The nearest residential properties to the construction works are located much further from the site than the distances at which vibration from construction will be perceptible as identified in **Table 9.3**. The residential properties will therefore not be affected by construction vibration and the effects are considered to be negligible.

9.4.2 Operational Phase

The inventory of operational site equipment is shown in Appendix 3, Noise Modelling Methodology of the 2014 ESIA Addendum Report. Appendix 3 lists the various noise generating sources identified at GTC and FTC in Table 2 and Major Noise Emission Sources for Normal Steady State Operation of Power Block PS-5 in Table 3.

Based on the distance between the plant/machinery to the nearest residential properties at Askar Village, located 500m away, the vibration effects of the operational plant will not be perceptible and would be well below the Project Standard Vibration Dose Values of 0.2 m $s^{-1.75}$ in the daytime and 0.1 m $s^{-1.75}$ at night, which provides a negligible operational vibration impact.

9.5 Summary

Table 9.4 provides a summary of the vibration impact assessment.

Table 9.4 Summary of Vibration Impacts

Issue / Impact	Potential Significance (Minor/Moderate/Major) (Beneficial/Adverse/Negligible)	Mitigation / Monitoring / Enhancement Measures	Residual Impacts (Slightly/Moderate/Major) (Beneficial/Adverse/Negligible)
Construction			
Vibration Impact on sensitive environmental receptors.	Negligible	• None required	Negligible
Operations			
Vibration Impact on sensitive environmental receptors.	Negligible	• None required	Negligible

10 GEOLOGY AND HYDROGEOLOGY

10.1 Introduction

This section addresses the geological and hydrogeological setting of the site and includes an assessment of the impact of pre-existing contamination on the development. The section provides an update on the 2014 ESIA Report to include further details of the assessment and management of pre-existing soil and groundwater contamination within the site, and to include changes to the scheme including the relocation of the Construction Laydown Area from the east to the south of the ALBA site. It also provides further assessment of the significance of elevated levels of elemental sulphur and boron in soil identified in 2014 ESIA Report.

This ESIA section provides a summary of the assessment work undertaken and is based on the following reports which are contained in **Appendix 10A** and **10B**, respectively:

i. Phase I Soil and Groundwater Site Assessment Report, ALBA Potline 6, January 2017. Environment Arabia Consultancy Services.

ii. Phase II Soil and Groundwater Site Assessment Report: Jawed Area, Construction Laydown Area, Sewage Treatment Plant, May 2017. Environment Arabia Consultancy Services.

10.2 Legislation and Guidance

10.2.1 Legislation

There are no specific environmental regulations in Bahrain in respect of land contamination; however, environmental issues in Bahrain are mainly dealt with under Legislative Decree No. 21 of 1996 in Respect of the Environment (Law No. 21).

The main objective of Law No. 21 is set out in Article 1, which provides for the following:

"….protecting the environment from sources and causes of pollution and curbing its deterioration through the formation of the required plans and policies for its protection against harmful effects….which may result in causing damage to human health, agricultural products, marine and wildlife, other natural resources, the climate, etc."

Hence there is a general requirement for protection of the environment including soil, geology and groundwater resources.

10.2.2 Guidance

10.2.2.1 Model Procedures for the Management of Contaminated Land (CLR 11), UK Environment Agency 2005

The main guidance used to formulate the assessment is Model Procedures for the Management of Contaminated Land (CLR 11) UK Environment Agency 2005. The document provides an overview of the approach for the management of contaminated land using a phased approach.

Three phases of increasing detailed analysis are identified:

i. Phase 1 – review of desk based information, e.g. historic maps, etc.;
ii. Phase 2 – Assessment of site investigation results against international standards for land quality;
iii. Phase 3 – Detailed Quantitative Risk Assessment (DQRA) use of site specific modelling to develop more realistic models of source – pathways – Targets.

Each phase is progressed from one to the other until the contamination is identified as not significant (i.e. it is risked out) or the contamination is identified as significant and remediation is required.

The document also recommends the use of the Source – Pathway – Target (S-P-T) methodology to analyze contaminated land where:

i. Sources – contamination that may be present based on the previous site investigations or new contamination that may be introduced by the proposed project or its construction.
ii. Pathways – the means by which contamination may migrate.
iii. Targets – environmental receptors including occupants, workers, geological and hydrogeological receptors.

Where a source – pathway-target linkage is present then it is likely that contamination is having a significant environmental impact.

Where a source – pathway – target linkage is not present any contamination is not considered to be having a significant environmental impact.

10.2.2.1.1 World Bank, Environmental Health and Safety (EHS) Guidelines, 2007 (World Bank 2007)

Section 1.8 of the general EHS guidelines addresses contaminated land. The document identifies an approach to the management of contaminated land that is very similar to that identified by the UK Environment Agency. It recommends development of a source-pathway-target model and a phased approach to risk assessment and remediation. It also identifies risk reduction measures (remediation) as interim for situations where there are immediate EHS risks and permanent as a longer term approach where there are no immediate EHS concerns.

10.3 Baseline

There are several areas of the Line 6 Expansion Project sites that have been exposed to potentially contaminative historic uses or require further contamination assessment. These are shown in **Figure 10.1** and are described further below. The remainder of the land for the Line 6 Expansion Project is undeveloped open land with no evidence of significant contamination.

Title: **Location of Sites**		Client:
Project: Alba Plot Line 6 ESIA		
Date: August 2017	Figure No.: 10.1	Consultant: Environment Arabia
Datum: WGS 84 - UTM 39N	Scale: 1:15,000 (A4)	

CN:\Alba Plotline 6 ESIA\mxd\locsites 10.1.mxd

10.3.1 Jawed Area

The Jawed area is adjacent to the existing ALBA works. It formerly comprised open land within the ALBA facility and a textile factory that has recently been demolished. The site forms the southern part of the Potline 6 project.

The site has been largely cleared and was vacant except for small piles of commercial waste which were being cleared at the time of the site visit. The waste comprised brick, concrete, gravel, scrap metal, wool and cardboard tubes used to wind textiles. In two locations there was evidence of localised surface staining with hydrocarbons (probably diesel from use of temporary generators).

10.3.2 STP Site

The site comprises a small sewage treatment plant (STP) which appears to be no longer fully in service. The STP plant occupies the western end of the site and includes a plant building, a small, empty hypocholite storage tank, a below ground water tank / sump and an operational rotating screen to remove large solids (grit) from the incoming sewer flow. Across open land, in the centre of the site there is a water storage tank, another administrative type building and an above ground fuel storage tank (probably diesel) mounted on an elevated structure. There was no evidence of staining or spills around the tank. South of this building is more open land. On the north boundary of the site there are a series of pipe runs at the ground surface.

The soil comprises thin sand and gravel with made ground and sparse vegetation. Limestone bedrock outcrops in several locations. In places particularly along the northern boundary the soil includes black carbon deposits which appear to be small amounts of waste from the anode manufacturing process which is present on the adjacent plot to the north of the site. There is also evidence of grey staining of the soil in places which is likely to comprise dust from the SPL area which is located on the plot immediately south of the site.

10.3.3 Construction Laydown Area

The CLA site is located south of South ALBA Industrial estate. The site is comprised of undeveloped, open desert land that will be used for storage of construction materials and workshops associated with the project. The site area is approximately 50 hectares and includes land designated for Potline 6 and PS5 / PDS.

The site comprises open land sloping west to east with few signs on any previous development. The ground comprises mainly natural sand and gravel with frequent outcropping limestone bedrock. In places there are pits 2-5m deep which is evidence that the limestone has been quarried by artisans.

10.3.4 Groundwater Quality

As detailed in the 2014 ESIA Report, ALBA has carried out a groundwater quality monitoring at its smelter site between 2007 and 2012. The results show that groundwater contained elevated concentrations of fluoride and increasing concentrations of ammonicial nitrogen over time.

10.4 Assessment Methodology

10.4.1 ESIA Significance Criteria

The findings of the contamination assessment have been classified using the following impact assessment five point scale:(i) Major Beneficial, (ii) Minor Beneficial (iii) Negligible, (iv) Minor Adverse, (v) Major Adverse. These classifications have been applied both pre and post mitigation. The significance criteria have also been applied to both construction and operational scenarios.

Table 10.1 shows descriptions of risk impact significance classifications for each scenario given above. **Table 10.1** refers to the amenity value of a resource. The amenity value of a natural resource is its capability to be used for a certain purpose, e.g. groundwater being used for abstraction of a drinking water supply, use of land for agriculture. Should the project reduce the amenity value of a resource this will be considered a major adverse impact. For example, contamination of groundwater so that it is no longer suitable for use as drinking water. Where the project is expected to release pollution to a resource but it does not affect its amenity value the impact will be considered a minor adverse impact.

Table 10.1 Soil and Groundwater Impact Assessment Significance Criteria

Scenario	Major Adverse	Minor Adverse	Negligible	Minor Beneficial	Major Beneficial
Construction impacts	Construction workers will be exposed to unacceptably high concentrations of contamination. Construction work may introduce new pathways which would expose environmental targets to unacceptably high concentrations of contamination causing pollution (exceedance of environmental standards).	Construction workers may be exposed to elevated concentrations of contamination. Construction work may introduce new temporary pathways which could expose environmental targets to increased concentrations of contamination.	Adverse environmental impacts to construction workers mitigated through the use of appropriate personal protective equipment. Use of mitigation measures to eliminate potential introduction of contamination exposure pathways. Appropriate environmental management and monitoring to mitigate contamination impacts.	Remediation of contamination.	Remediation of significant contamination.
Impacts of development	The development is likely to impact the quality of soil and groundwater through the release of pollutants and this would reduce the amenity value of a natural resource (e.g. aquifer) and prevent it being used for its intended or suitable purpose.	The development may impact the quality of soil and groundwater through minor pollution but would not reduce the amenity value of a natural resource.	The development is not expected to reduce the amenity value of a natural resource through the release of pollutants to soil or groundwater.	n/a	n/a

10.5 Impact Assessment

10.5.1 Jawed Area

Waste materials were removed from the Jawed area prior to commencement of construction. This included all stockpiled wastes and areas where soil was stained with small hydrocarbon spills. All material was disposed of as waste to appropriate landfills.

The Jawed Area was then subject to contamination sampling for a wide range of common industrial contaminants. The results showed evidence of contamination with boron and iron and slight contamination with nickel. The boron contamination is considered to be a natural feature of the local soil and limestone bedrock. This is because soils from the CLA site, which shows no signs of any significant previous development, also contained elevated boron (and sulphur) which provides good evidence that the contamination is a natural phenomenon. Both the iron and nickel contamination were likely to have been associated with previous industrial use of the land. The contamination was restricted to the thin layer of made ground which was a maximum of 20cm thick.

The majority of the made ground has been removed and the site levelled as part of the site preparation. The made ground was disposed of a waste material. Any residual made ground will be largely covered with buildings and hardstanding as part of the Line 6 development. This will effectively cap any residual contamination, preventing water ingress and leaching of contamination into groundwater.

The overall impact is assessed to be minor beneficial as the project has led to the remediation of soil contamination so that the land is suitable for it intended use. Without the assessment and remediation work undertaken, development of the site could have led to the spreading of contamination and exposure of workers to contaminated soils resulting in a minor adverse impact.

10.5.2 STP Site

The soil testing results indicated that the blackened soil was associated with PAH and TPH contamination and required remediation to reduce the mass of contamination present and to lower contaminant concentrations to acceptable levels.

Subsequently in June 2017 the blackened soil was removed by scraping it off the site surface. The material has been placed within skips and stored on site prior to disposal to landfill. As of early August 2017 ALBA are waiting for formal advice from the SCE regarding its waste classification and disposal route. This work will be reported by EACS when complete.

The residual impact is to be determined following completion of reporting on this element of the work.

10.5.3 Construction Laydown Area

Within the CLA the shallow soils are natural and show no evidence of previous industrial use. The soil samples show high concentrations of sulphur and boron which is considered to be naturally occurring due to the absence of significant industrial sources.

The CLA site has been levelled and capped with clean granular fill isolating the sulphur and boron contamination from site occupants. Pre-existing contamination is therefore considered to be a Negligible issue. Operation of the CLA during construction is expected to be a potentially Minor Adverse impact due to the storage of construction materials and fabrication work on site. This can be effectively mitigated to a Negligible impact through the adoption of good international industrial practice as identified in the 2014 ESIA Report.

10.5.4 Groundwater

Groundwater samples from the ALBA site contained fluoride in excess of the World Health Organization provisional guideline value for drinking water of 1.5mg/l[13]. It is therefore concluded that it is likely the ALBA smelter is impacting groundwater quality locally. Groundwater within the impacted aquifer is not used within the vicinity of the site. The impact is classified as minor adverse as the site is located in an industrial area and the fluoride contamination is not expected to prevent use of shallow groundwater for industrial purposes. It is recommended that further monitoring of the impact of ALBA operations on groundwater quality is undertaken.

A limited amount of dewatering may be required as part of the construction of Casthouse 4 which will require excavation of a pit 18m deep. This will intersect the groundwater level. The results for groundwater quality from Well 2 close to the location Casthouse 4 shows that groundwater meets the Project Standards for effluent discharge to surface water contained in the ALBA Code of Practice for Construction Phase (ACOPC No.C001) with the exception of floating solids and total suspended solids. These standards are based on IFC requirements. Removal of solids can be addressed by use of a settlement tank, if needed or the groundwater may be tankered off-site for treatment, or may be used for dust suppression on site without treatment.

10.6 Mitigation and Monitoring Requirements

There are no changes to the good international industry practice measures identified in the 2014 ESIA Report to manage contamination risks from the operation of the Line 6 Expansion project. However, the recommended site investigations were amended to match the changes in the project layout and completed. Pre-existing contamination issues in respect of the Line 6 Expansion Project have all been addressed at this stage in the project.

Soil contamination remediation with the Jawed Area and STP Area require further validation reporting to fully close out.

Further groundwater monitoring is recommended to monitor the impact of the ALBA smelter operations on local groundwater quality. The groundwater monitoring programme at the site should be reinstated and updated. A new groundwater monitoring plan should be developed to identify:

i. the location and number of groundwater monitoring wells required,
ii. frequency and scope of sampling and analysis;
iii. The sampling methods;

[13] WHO Guidelines for Drinking Water 4th Edition, 2011.

iv. Quality control and reporting requirements.

The SCE in their letter of the 13th of November 2016 (see **Appendix 4A**) set out requirements for disposal of dewatering water including:

- Agreeing the discharge point with SCE;
- Testing the discharge groundwater prior to discharge for Ammoniacal nitrogen; Biological Oxygen Demand, Chemical Oxygen Demand, Total Phosphate, Sulphide; Nitrate and Nitrite;
- Use of settlement tanks to reduce Total Suspended Solids (TSS) concentration to <35mg/l; and
- Periodic sampling to monitor TSS concentrations in the discharge to be agreed with SCE.

10.7 Summary

Table 10.2 shows a summary of the soil and groundwater issues. In most cases, suitable management and a precautionary approach can reduce the predicted impacts to a negligible level.

Table 10.2 Summary of Soil and Groundwater Impacts

Issue / Impact	Significance (Minor, Major Beneficial / Adverse or Negligible)	Mitigation Measures	Residual Impacts (Minor, Major Beneficial / Adverse or Negligible)
Construction			
Jawed and Surrounds - waste materials and contaminated soil causing on-going contamination of soil or groundwater if left in place during development.	Minor Adverse	• Removal of waste material, site investigation and assessment.	Minor Beneficial
STP Site – Contaminated soil causing on-going contamination of soil or groundwater if left in place during development.	Minor Adverse	• Site investigation and remediation by removal of contaminated soil.	Minor Beneficial - Remediation Validation Report to be completed
CLA - Contaminated soil causing on-going contamination of soil or groundwater if left in place during development.	Negligible	Not required.	Negligible
Casthouse 4 - Dewatering groundwater disposal.	Minor Adverse	For discharge to surface water: • Agree the discharge point with SCE. • Test the discharge groundwater prior to discharge against Project Standards for effluents in ACOPC C001 • Use of settlement tanks to reduce Floating particles and Total Suspended Solids (TSS) to Project Standards Or tanker away or discharge to sewer. Or use for dust suppression on site.	Negligible

Issue / Impact	Significance (Minor, Major Beneficial / Adverse or Negligible)	Mitigation Measures	Residual Impacts (Minor, Major Beneficial / Adverse or Negligible)
Operation			
Groundwater contamination – impact of contaminants from smelter operations on groundwater quality.	Minor Adverse	• Groundwater monitoring – Develop and implement an updated groundwater monitoring plan.	Minor Adverse

11 OCCUPATIONAL HEALTH AND SAFETY

11.1 Introduction

The nature of any large scale construction and/or industrial operation is such that personnel will be exposed to the risk of injuries and it is the duty of the employer and workers to ensure that working conditions are safe and such risks are minimised.

This section discusses the potential occupational H&S hazards associated with the project and provides an overview of the control and mitigation measures that will be put in place. For descriptive purposes, H&S aspects have been grouped according to the type of activity, i.e. construction (including commissioning), operation, emergency situations and decommissioning / demolition. This section is not a comprehensive H&S assessment or H&S plan for the project, but It provides an overview of key H&S issues and management requirements.

The section expands on the H&S assessment undertaken in the 2014 ESIA Report and also addresses the requirement for a H&S assessment of the project identified in the ESAP.

11.2 Relationship to other Sections of the ESIA

The ESAP sets out a number of specific H&S issues to be addressed. Most are addressed in this section but some are addressed by other sections of this supplementary ESIA. **Table 11.1** below summarises how specific ESAP H&S items are addressed.

Table 11.1 Specific ESAP H&S Issues Addressed within Supplementary ESIA

ESAP H&S Assessment Requirement	ESIA Section
Detailed H&S risk assessment of occupational diseases.	11. Occupational Health and Safety
Detailed H&S risk assessment of offsite risks such as road transportation, dross management.	13. Traffic and Access 12. Community Health, Safety and Security (dross management).
Detailed H&S risk assessment of specific threats to women.	14. Labour and Working Conditions
Conduct risk and health impact assessment related to: • higher concentration of Boron and Sulphur in soil; • higher concentration of fluoride in groundwater contaminated soil.	10. Geology and Hydrogeology
Conduct risk and health impact assessment related to: • Worker accommodation; • Supply chain; • Third parties and contractors.	14. Labour and Working Conditions (addresses worker welfare issues. H&S issues are addressed in this section for supply chain, third parties and contractors)
Conduct risk and health impact assessment related to: • Security personnel.	12. Community Health, Safety and Security (security personnel).

ESAP H&S Assessment Requirement	ESIA Section
Conduct risk and health impact assessment related to: • Health impacts on personnel and community including unplanned releases, emergencies, transportation, etc.	5.Air Quality (impact of construction phase transportation on air quality). 12.Community Health, Safety and Security (unplanned releases and emergencies).

11.3 Legislation and Guidance

11.3.1 International

11.3.1.1 World Bank General Environmental Health and Safety (EHS) Guidelines, 2007: 2. Occupational Health and Safety

These guidelines require that employers and supervisors are obliged to implement all reasonable precautions to protect the H&S of workers. They provide guidance and examples of reasonable precautions to implement in managing principal risks to occupational H&S during construction, operation and decommissioning.

The guidelines also identify that companies should hire contractors that have the technical capability to manage the occupational H&S issues of their employees, extending the application of the hazard management activities through formal procurement agreements.

The guidance also provides a hierarchy of preventative and protective measures to eliminate hazards according to the following order of priority:

- eliminating the hazard by removing the activity from the work process;
- controlling the hazard at its source through use of engineering controls;
- minimising the hazard through design of safe work systems and administrative or institutional control measures; and
- providing appropriate personal protective equipment (PPE) in conjunction with training, use and maintenance of the PPE.

Furthermore, the guidelines state that the application of prevention and control measures to occupational hazards should be based on comprehensive job safety or job hazard analyses.

11.3.1.2 World Bank Environmental, Health, and Safety (EHS) Guidelines, Base Metal Smelting and Refining, 2007

The guidelines provide advice on specific H&S requirements for smelters in their design and operation. The requirement for preparation of risk assessment studies such as Hazard Identification Studies (HAZID) and Hazard and Operability Studies (HAZOP) to inform the project design is identified. Requirements to address the following operational H&S issues are also addressed:

- Chemical exposure e.g. exposure to metal fumes;
- Physical hazards – e.g. potential for exposure to hot metal and hot; environments;

- Noise;
- Radiation;
- Confined space entry.

11.3.1.3 World Bank Environmental, Health, and Safety (EHS) Guidelines, Thermal Power Plants, 2008

The guidelines provide advice on specific H&S requirements for thermal power stations in their design and operation. Requirements to address the following operational H&S issues are addressed:

- Non-ionizing radiation e.g. electric and magnetic fields (EMF);
- Heat;
- Noise;
- Confined spaces;
- Electrical hazards;
- Fire and explosion hazards;
- Chemical hazards;
- Dust.

11.3.1.4 International Labour Organization (ILO) C155 - Occupational Safety and Health Convention, 1981

The convention places general requirements on businesses to adopt good practice measures in respect of H&S and to develop and maintain systems of communication between the employer and workforce in respect of H&S matters. Amongst other things the convention requires employers to ensure as far as reasonably practicable that they provide a safe environment for employees to work in and to provide H&S training and PPE to employees.

In Bahrain the convention is implemented by - Law No (25) of 2009 with respect to approving the accession of the kingdom of Bahrain to the international labour convention no. (155) of 1981 with respect to occupational safety and health, and work environment.

11.3.2 National

Occupational H&S matters in Bahrain are regulated by the SCE's Directorate of Environmental Assessment and Control and by the Ministry of Labour and Social Development in conjunction with the Ministry of Health.

Relevant H&S legislation in Bahrain is covered within key documentation as follows:

- Ministerial Order No. 1 of 1977 Respecting the Definition and Organisation of Primary Health Care for Workers in Establishments Employing More Than 50 Workers and subsequent amendments.
- Ministerial Order No. (3) of 2005 with Respect to Environmental Regulations and Standards in the Work Place.
- Ministerial Order No. 8 of 2013 with Respect to Regulating Occupational Safety and Health in Establishments.

- Ministerial Order No. 6 of 2013 with respect to Protection of Workers from the Hazards of Fire in Establishments and Work Sites.

Additional legislation is provided on specific H&S issues:

- Ministerial Order No 4 of 1996 regarding Maintenance of Thermal Insulators which Contain Asbestos Material and Disposal Thereof.
- Ministerial Order No 4 of 1999 regarding Licensing Work in Maintaining Equipment and Buildings that Contain Asbestos, Removal and Transportation of this Material and Disposal of its Waste.
- Ministerial Order No 3 of 2013 with respect to Banning Work during Noon Time.
- Ministerial Order No 12 of 2013 with respect to Procedures Required to Report Occupational Injuries and Diseases.
- Ministerial Order No 4 of 2014 with respect to Determining the Required Conditions and Precautionary Measures for the Protection of Workers Engaged in Building Works, Construction and Civil Engineering.
- Ministerial Order No 5 of 2014 with respect to Determining the Required Conditions and Precautionary Measures for the Protection of Workers from the Hazards of Work on Lifting Equipment.
- Ministerial Order No.9 of 2014 with respect to Protecting Workers from Natural (physical) Hazards at Establishments and Worksites.
- Ministerial Order No.15 of 2014 with respect to Protecting Workers from the Hazards of Highly Flammable Liquids and Liquefied Petroleum Gases at Establishments and Worksites.
- Minister Order No 28 of 2014 with respect to Determining the Services and Conditions Required for the Protection of Workers from the Hazards of Boilers, Steam Recovery Tanks and Air Receiver Tanks.
- Ministerial Order No 38 of 2014 with respect to Determining the Required Conditions and Precautionary Measures for the Protection of Workers from Mechanical and Environmental Hazards.

These set out the legal requirements and specify actions and considerations that are required to be addressed in the workplace.

With respect to the construction, commissioning and decommissioning phases, the contractors and sub-contractors on-site must also adhere to the Labour Law for the Private Sector 2012 and legislation relating thereto, and the legal duties on the employer and contractors must be complied with.

11.4 Assessment Methodology

A qualitative H&S assessment has been carried out on the likely activities during construction (including commissioning), operation, emergency situations and decommissioning / demolition. Likely hazards and risks, mitigation measures to be implemented and the residual impacts of these activities are presented in the following sections. A summary of the main H&S risks is provided together with the means by which ALBA and their contractors intend to manage and mitigate these issues.

The following characteristics (**Table 11.2**) have been used to attribute significance to potential impacts to H&S from the proposed development.

Table 11.2 Criteria for Impact Significance for Occupational Health and Safety

Impact Significance	Impact Characteristic
Major Adverse	Accident or incident resulting in loss of life or major injury.
Moderate Adverse	Accident or incident resulting in operational lost time and /or off site treatment of personnel is required.
Minor Adverse	Minor accident or incident.
Negligible	No impact.

11.5 Baseline

11.5.1 Construction Phase

The Line 6 Expansion project will be generally constructed within the ALBA smelter fence line alongside existing plant. Offsite, construction support activities will take place at the CLA. There will also be limited construction required within the ALBA Marine Terminal. The construction works will require the commissioning of new plant and equipment and the decommissioning and demolition of plant and equipment that is no longer required.

11.5.2 Operational Phase

11.5.2.1 Occupational Health and Safety Management

The ALBA Safety Health and Environment, Security and Fire Department is headed by the departmental Senior Manager and its organizational structure (in 2017) is divided into responsibilities for safety, security & fire, environment and industrial hygiene.

The department produces monthly SHE statistics which are reported to Executive meetings, and annual summary statistics. The health, safety and environmental management systems are certified to OHSAS 18001:2007 and to ISO14001:2004, and externally audited by Bureau Veritas. All aspects of the L6 Expansion Project will be covered by these systems. The systems are underpinned by Codes of Practice (COP), which apply to all procedures on site. The Job Safety Practice (JSP) within the COP identify a training needs analysis, which in turn informs the individual employee training plan and links to internal, and where applicable, external training provision.

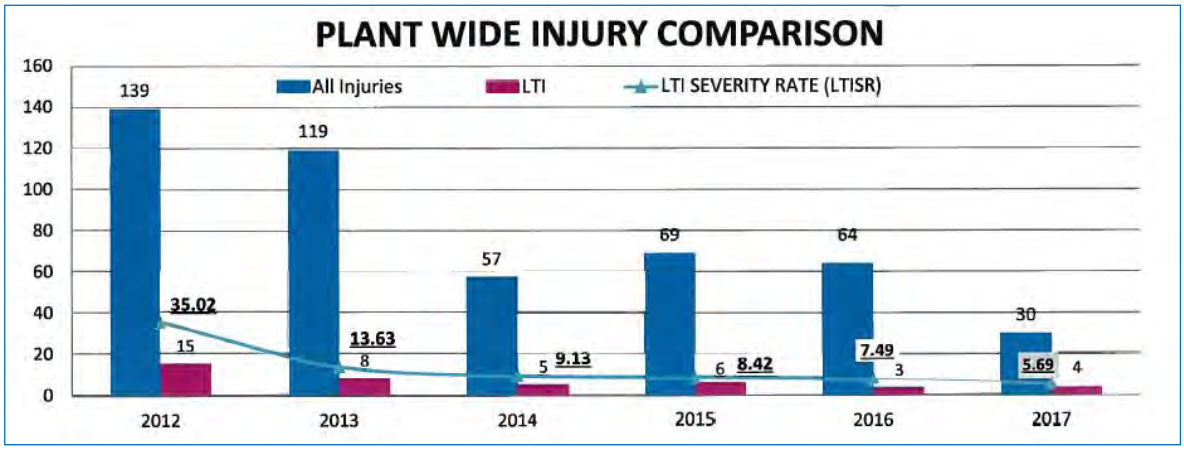
11.5.2.2 Accident and Incident Statistics

Summaries of the latest year to date statistics and a 5-year trend are provided in **Table 11.3** and **Figure 11.1**.

Table 11.3 2017 Incident Reporting

No.	Incident Category	Total 2016	YTD 2017 to 31/5/17
1	Fatality (FAT)	0	0
2	Lost time Injury (LTI)	3	4
3	Restricted Work Cases (RWC)	21	15
4	Minor Injury (MI)	40	11
5	First Aid (FA)	38	18
Total Injuries		**102**	**48**
Total Injuries (excluding First Aid)		**64**	**30**

Figure 11.1 Summary Incident Statistics 2012-2017[14]



The continuing improvement cycle required of certified management systems has led to an increased reporting of near misses, which are all investigated to determine opportunities for improvement. **Figure 11.1** indicates the reducing long-term trend in injury incidents.

The ALBA incident statistics can be compared with international standards which are reported within the industry.

Table 11.4 shows data published by the International Aluminium Institute and European Aluminium, collected from the major operators across the world and regionally.

[14] ALBA Safety Health and Environment Department, Statistics and Performance Reporting (five years to May 2017)

Table 11.4 2017 Incident Reporting and Comparison Statistics

Year	International Aluminium Institute		ALBA	European Aluminium	International Aluminium Institute		ALBA
	Smelters	Refining			Smelters	Refining	
	LTI, per MHW*			Total, per MHW*			
2016	-	-	0.34	-	-	-	7.17
2015	-	-	0.66	7.3	-	-	7.64
2014	1.10	1.30	0.54	9.2	3.8	4.9	6.20
2013	1.80	1.50	0.87	7.8	5.5	6.4	12.95
** Lost Time Incidents (LTI) and Total (IAI as 'restricted work / medical treatment'), reported per million hours worked.*							

The data are reported in terms of Lost Time Incidents (LTI) and total injuries frequency rates per million hours worked. ALBA's LTI data are shown to compare well with international reporting, at around half of the reported statistic for the most recent years when data are available. ALBA's total injuries data is shown to be higher than international reporting, but this may reflect a higher reporting culture within ALBA workforce, and possible differences in the extent of manufacturing activities and personnel included in the global dataset.

ALBA's own internal reporting, incident investigation, training and open reporting culture will continue to drive its safety philosophy and this approach will be incorporated into the expanded site operations.

11.5.2.3 Industrial Hygiene at ALBA

There is a comprehensive Industrial Hygiene (IH) management, monitoring and health surveillance program undertaken at the ALBA site. The program for all (approximately) 2,700 staff includes:

- Pre-employment medical checks carried out by the company medical staff of 2 doctors and 3 nurses. These include lung function, blood and urine tests, general physical and health (blood pressure, ECG, weight, smoking history) checks, baseline audiometry;
- Personal exposure, workplace environment and biological monitoring;
- Continuous review of raw materials substance Material Safety Data Sheets (MSDSs), controls and Personal Protective Equipment (PPE);
- Induction and ongoing training (via a feedback loop associated with monitoring data in specific departments, work areas or individual tasks).

The IH monitoring program covers all the key risks associated with the site and its manufacturing operations, including HF, Coal Tar Pitch Volatiles (CTPV), welding fume, the thermal environment, noise and specific risks to women workers.

Hydrogen Fluoride

HF is released in its particulate and gaseous form from the electrolytic process, due to the addition of aluminium fluoride. Most of the fluoride is captured by the fume abatement system, but some is released to atmosphere via exhaust stacks and potroom roof vents. HF exposure in the workforce therefore occurs by inhalation of the gas or aerosol, and potentially via dermal absorption from contact with dissolved fluid.

Inhalation of air containing hydrogen fluoride can cause irritation of the eyes, nose and upper respiratory tract. Exposure to high levels may cause muscle spasms and can damage the lungs and heart, and in extreme cases can result in death. Dermal contact with hydrofluoric acid can cause severe skin burns. Long term elevated exposure and retention of fluorides can give rise to 'skeletal fluorosis' or osteosclerosis (increased bone density).

HF gas is highly soluble and corrosive and its presence in the atmosphere will damage metal structures and buildings. Deposition and dissolution of HF into water bodies and soils will lower the pH and cause harm to aquatic organisms.

Coal Tar Pitch Volatiles

Work in the carbon plant, particularly the kiln areas can expose workers to fume which includes pitch vapour which can contain toxic materials collectively referred to as Coal Tar Pitch Volatiles (CTPV). ALBA undertake routine sampling and measurement of CTPVs in the kiln, paste plant and rodding areas within the carbon department, with typically around 80 samples collected per year. The samples are submitted to Scientific Analysis Laboratories Ltd., UK for benzene-soluble fraction and sweep of the PAH species analysis. In 2015 there was a change from hot to cold pasting in ALBA and throughout the industry sector, which led to significant reductions in CTPV exposures.

11.5.2.4 Standards and Guidelines

The IFC EHS Guidelines for OHS refer to *'maintaining levels of contaminant dusts, vapors and gases in the work environment at concentrations below those recommended by the ACGIH[68] as TWA-TLV's (Time Weighted Average - Threshold Limit Value) - concentrations to which most workers can be exposed repeatedly (8 hours/day, 40 hrs/week, week-after week), without sustaining adverse health effects'.*

The key Project Standards for HF and CTPV derived from ACGIH TWA-TLV are shown in **Table 11.5**.

Table 11.5 Occupational Exposure Limits, Project Standards

	Hydrogen Fluoride, HF	**Coal Tar Pitch Volatiles, CTPV1,**
	8-hour TWA ($mg.m^{-3}$)	**8-hour TWA (mg.m-3)**
ACGIH TLV	2.5	0.2[1]
Notes: ACGIH TLV - American Conference of Governmental Industrial Hygienists, Threshold Limit Value CTPV Note 1 - As the benzene-soluble fraction		

Hydrogen Fluoride Monitoring

Hydrogen fluoride emissions are measured at the roof ventilation exhausts of potlines 3,4 and 5, and at two ground level site boundary and one off-site locations (see **Section 5, Air Quality**).

Personal exposure measurements are also collected within the workplace, and 2016 data are reported in **Table 11.6**.

Table 11.6 2016 HF Personal Exposure Monitoring Results

Job Title	HF, mg/m^3 time-weighted average
Potlines 1-3	
Anode Changer	0.30
Anode Changer Helper	0.30
Set Operator	0.27
Set Operator helper	0.25
Tapping Operator	0.22
Tapping Helper	0.18
Crusher Driver	0.12
Start up Operator	0.05
Set Operator Leader	0.03
Potline 4-5	
Pot Maintenance	0.35
House Keeping contractor	0.32
Anode Changer Helper	0.25
Leadman	0.20
PTA Helper	0.19
Mecillinuos	0.13
Tapping Operator	0.10
Anode Changer	0.07
Crane Operator	0.05
Project Standard – ACGIH TLV 8-hour TWA (mg.m^{-3})	**2.5**

The sampling periods represent full or part-shift exposures and therefore should be compared with long-term (8-hour) limits. The monitoring results compare well with the standard and demonstrate that the Project Standard is not being exceeded.

The Line 6 expansion will incorporate new plant and associated exhaust ventilation systems and would be expected to give rise to equivalent or better exposure monitoring data. Hence the project is expected to comply with IFC requirements in this regard.

Exposure to Pitch Vapour

Three further specific improvement modifications have recently been undertaken:

- an overall reconstruction of Carbon 1-2 Kilns 3, which is expected to have a major impact on the level of CTPV exposure;
- major maintenance in Fume Treatment Plant 5; and
- substitution of ramming paste in the cathode ceiling section to an odourless cold paste which contains no PAH.

The current exposure profile is subject to an ongoing re-evaluation, with population exposure data expected to be available in Q4/2017.

Noise

All areas within the site are divided into 3 categories of noise environment, 'green' (<85dB(A)); 'orange' (85-105 dB(A)), and 'red' (<105 dB(A)), and hearing protection is provided on this basis, with associated training and periodic personal dosimetry measurements.

Cases of potential noise-induced hearing loss (NIHL) identified by the audiometry program are reported, as required, to the Social Insurance Organization. In the five years 2012-2017 an average of 30 cases were reported per year, and although in 2016 there were 47, ALBA has reported that the increase was mainly due to the ERS scheme introduced by the company, and around half of the cases proceeded to a claim for medical retirement and left the company. The audiometry, personal dosimetry and area noise monitoring data inform continuous review of acoustic engineering controls and ear protection compliance checks.

Heat Stress

Heat stress incidence is recorded and in 2017 a program on Wet Bulb Globe Temperature (WBGT) monitoring commenced, to provide an ambient workplace temperature, humidity, radiation and ventilation index for comparison with recommended ACGIA work/rest regimes and drinking water advice. Incident statistics within the sector and the region were reported to be good, with a 2012-2016 5-year average of 3 ALBA staff and 4 contractors per year.

11.6 Impact Assessment

Throughout the project's lifetime from site preparation to operation, the workforce will be exposed to a number of different hazards and associated risks by the nature of the activities that are required for a project of this scale. If no risk controls or ineffective risk controls are implemented, injuries and fatalities could possibly occur during the site preparation and construction process, and injuries could also occur during the inspection and maintenance activities that are necessary during operation.

The following sections discuss the risks associated with the main stages of the project, i.e. construction, commissioning, operation and decommissioning and demolition.

11.6.1 Construction Phase

There are five main sites where construction activities will be taking place. These are: Line 6, PS5, PDS, the marine terminal, CLA and Power Station 1 and 2 (decommissioning). Due to the varying nature of these five sites, a wide range of occupational H&S risks exist, although there are considerable overlaps in the issues likely to be faced by construction workers.

There are common general activities associated with each construction site such as the storage of materials and fuels, storage and removal of wastes, use of mobile equipment, excavation, erection of structures and civil engineering works, lifting and working at height and the installation of electrical and mechanical systems. The impacts associated with general activities are presented in **Table 11.7**.

In procurement ALBA assesses the H&S performance of contractors as part of its prequalification procedures and a poor H&S record may lead to disqualification. ALBA manage construction H&S risks through requiring contractors to prepare comprehensive H&S management plans before starting work. The H&S plans must be in alignment with ALBA project procedures and are approved by ALBA.

The key features that are common to all contractor H&S management plans are:

- Provision of top management commitment to H&S;
- Provision of resources to manage H&S;
- Provision of qualified and experienced H&S management professionals;
- Provision of H&S training to staff;
- Undertaking H&S risk assessments and implementing safe systems of work and permit to work where these are appropriate;
- Management of sub-contractors including H&S assessment during procurement;
- Preparation of construction phase Emergency Response Plans (ERP);
- Auditing and inspection of H&S performance;
- Regular reporting and review of H&S performance;
- Provision of occupational health services.

These requirements are passed down the supply chain so that all sub-contractors are required to comply with the project H&S requirements.

Table 11.7 Occupational Health and Safety Impacts Associated with Construction Activities

Description of Impact	Risk of occupational H&S incidents on site (e.g. accidents, injury, falling, falling equipment, hot-work, electrical exposure, confined spaces, heat stress (during summer), risk of injury from working in close proximity to existing process units, exposure to contaminated soils.
Receptor(s)	Site workers.
Features of Impact	Local, avoidable risk but impact could be long-term or permanent (or could even result in death) if safety measures are

	breached; very high sensitivity of receptor, national legislation relating to occupational H&S including Ministerial Orders 8 of 2013 and No. 3 of 2005.
Significance of Impact	**Minor to Moderate Adverse** depending on type of accident/injury. **Major Adverse** significance if serious accidents or fatalities occur.
Mitigation	• Assessment of H&S competence during contractor procurement. • Inclusion of H&S management requirements into formal contract documents. • Provision of H&S professionals. • Preparation of written H&S management plans including commissioning. • Development and documentation of safe systems of work and use of Permits to Work for higher risk activities. • Training and awareness of workers regarding occupational safety issues on site. • Provision of safety facilities, emergency equipment, and first aid facilities together with personnel trained in its use. • Provision of Personal Protective Equipment (PPE) as appropriate for tasks undertaken. • Ensure the contractor specification adequately covers the assessment of risk of their employees for all construction activities, such as in a Construction Code of Practice (e.g. safe use of vehicles on construction sites). • Continuous provision of drinks and sheltered/shaded areas for labourers , especially during the summer months to avoid heat stress. • Preparation of Emergency Response Plan to include working in close proximity to existing process units. • Routine inspections, auditing, near-miss reporting and investigation with opportunities for improvement identified and implemented. The above measures are incorporated into ALBA's existing HSE Management System and will therefore be in place during the project construction activities.
Residual Impact	**Negligible impact**. Robust management and control of all aspects of H&S, including appropriate training for staff and contractors, during the construction activities should provide a safe working environment.

11.6.2 Operational Phase

ALBA facility activities require operation of the marine terminal, electricity generation from gas, smelting of aluminium, casting and distribution of products. H&S hazards include: exposure to CTPV vapours, exposure to HF, exposure to molten metal and high temperatures, exposure to high voltage electricity, and physical hazards associated with transportation, lifting operations and exposure to high noise levels.

During operation, there will be approximately 550 additional ALBA employees including managers, engineers, technicians, laboratory staff and maintenance staff on site as well as additional contractor personnel.

The plant and equipment for the Line 6 expansion will be modern, largely automatic and designed to the latest H&S standards. During process design, H&S hazards should be eliminated or reduced through the use of safety in design processes such as HAZOP studies. As such, routine operations of the processes will generally present a low or negligible H&S hazard when adequate maintenance is carried out and proper industry standards and systems for construction and operation have been followed.

The potential for hazardous exposures for the workforce will still exist, however, and continuous application of controls and management will be required.

As well as routine operations there will be a requirement for maintenance. The risk of exposure to hazardous substances or circumstances can occur during shutdown or maintenance work, since these are a deviation from routine operations, and often involve confined space entry and potential exposure to used substances and contaminated waste materials. Maintenance work requires careful planning, scheduling and development of safe systems of work to make sure that unanticipated exposures do not occur. Any plant shutdown requires a complete plan in writing to cover all activities, the impact on other operations, and emergency planning.

Table 11.8 presents the potential impacts and provides information on safe work practices and procedures that should be followed.

Table 11.8 Occupational Health and Safety Impacts during Operation

Description of Impact	Risk of injury, disability or chronic illness resulting from workplace exposure to hazards such as: fire, explosion, hazardous substances, noise, toxic vapours and gases, high thermal environment, high voltage electricity, etc.
Receptor(s)	Site workers.
Features of Impact	Temporary for injury, permanent if death results, local, very high sensitivity of receptor, national legislation relating to occupational health and safety including Ministerial Orders 8 of 2013 and No. 3 of 2005.
Significance of Impact	**Minor to Moderate Adverse** for injury, **Major Adverse** for chronic occupational disease or accidents which result in serious injury or death.
Mitigation	• Use safety in design processes (e.g. HAZID / HAZOP) to identify and eliminate or minimize H&S hazards. • Prequalify contractors and subcontractors on criteria including H&S performance. • Work to an accredited documented H&S Management System and integration of L6 expansion into the existing ISO 18001 system. • Employment of H&S professionals and adequate company resources to implement H&S management system. • Prepare H&S risk assessments for all activities. • Use of safe systems of work.

	• Operate a permit-to-work system for higher risk activities. • Operate a vehicle permit system. • Training and awareness of workers regarding occupational safety issues on site. Provide appropriate PPE, e.g. hearing protection, safety glasses, respiratory protection, protective (non-flammable) clothing, rubber boots. • Provision of first aid facilities together with personnel trained in its use. • Inspections, audits, reporting and feedback. • Occupational exposure monitoring, pre-employment checks and health surveillance. The above measures are incorporated into ALBA's existing HSE Management System and will therefore be in place during the operational activities of the Line 6 project.
Residual Impact	**Negligible impact.** Robust management and control of all aspects of H&S, including appropriate training for staff and contractors, during operation should provide a safe working environment.

11.6.3 Emergency Situations and Response

Operation of large industrial facilities poses the risk of health, safety or environmental incidents. For ALBA credible emergency scenarios would include fires, metal explosions, electrical incidents, environmental releases, etc. The management and minimization of the consequences of such incidents are addressed through the development of Emergency Response Plans and provision of specialist equipment, facilities and training. The operation of the Line 6 Expansion project will require that existing emergency response plans, equipment, facilities and training are reviewed to include Line 6 expansion within the existing systems.

Table 11.9 presents the potential H&S impacts of health, safety or environmental incidents and identifies the expected mitigation and management measures.

Table 11.9 Emergency Situations Potential Impacts and Mitigation

Description of Impact	Risk of major accident hazards – fire, explosion, electrical incidents, environmental releases etc.
Receptor(s)	Site workers.
Features of Impact	Highly unlikely but has potential for significant loss of life, significant environmental damage, significant economic damage.
Significance of Impact	**Moderate Adverse to Major Adverse** depending on the scale of the type and scale of the incident.
Mitigation	• General safety in design practice studies e.g. HAZOP. • Operating and maintaining the equipment in accordance with operation and maintenance manuals and approved procedures. • Updating the site Safety Plan and Emergency Response Plan, equipment, facilities and training requirements to account for operation of Line 6 expansion. • Communicating the Plans to regulatory authorities,

	emergency services and the community.
Residual Impact	**Negligible impact**. Good design and operation practice and adequate emergency response planning should significantly reduce the risk of and consequences of emergency situations.

11.6.4 Decommissioning and Demolition

The Line 6 expansion project will render some existing equipment redundant and this will require decommissioning and demolition. This includes Power Station 1 and 2. Parts of ALBA facility date back to 1971 and therefore there is the potential for buildings and equipment to contain asbestos or other hazardous materials and for electrical equipment to contain poly-chlorinated biphenyls (PCBs). Such hazardous materials will require to be managed as part of the decommissioning process. (Asbestos was banned in Bahrain in 1996 and for PCB use in electrical equipment, EACS has been advised by the Electricity and Water Authority that PCBs are unlikely to be present in equipment supplied after 1990).

Demolition itself is a potentially high risk activity and presents particular hazards from the unexpected collapse of buildings and structures, lifting of large items of equipment and working in reduced lighting environments with reduced access and egress arrangements.

Decommissioning and demolition work should be planned to avoid exposure of workers to hazardous materials, to prevent environmental incidents and to ensure the sequencing of work is designed to eliminate safety risks to workers. Decommissioning plans should include: disconnection and isolation of services, surveying and removal of hazardous materials, emptying, cleaning and venting of pipes and vessels, removal of valuable or reusable or economically recyclable materials. Demolition plans should determine a safe sequence for the demolition process and safe demolition techniques taking into account the constraints of the site. Where possible remote demolition techniques should be used.

Table 11.10 presents the potential impacts and provides information on safe work practices and procedures that should be followed.

Table 11.10 Occupational Health and Safety Impacts during Decommissioning and Demolition

Description of Impact	Risk of exposure to hazardous materials, risk of environmental incidents from spills, risk of damage to services or surrounding equipment, risk of structural collapse, risks from heavy lifts, risks from reduced access and egress and reduced lighting workplaces.
Receptor(s)	Site workers.
Features of Impact	Temporary for injury, permanent if death results, local, very high sensitivity of receptor, national legislation relating to occupational H&S including Ministerial Orders 8 of 2013 and No. 3 of 2005.
Significance of Impact	**Minor to Moderate Adverse** for injury, **Major Adverse** if accident results in death.
Mitigation	• Prequalify contractors and subcontractors on criteria

	including H&S performance. • Use contractors experienced in decommissioning and demolition work. • Develop a written decommissioning and demolition plan. • Undertake hazardous materials surveys to include asbestos and PCBs as applicable. • Remove hazardous materials under controlled conditions prior to commencing general demolition. • Isolate all services. • Drain down, clean and vent pipes and tanks as needed. • Remove economically recoverable materials prior to demolition. • Plan the demolition sequence to ensure stability of buildings and obtain advice of a structural engineer as needed. • Use remote demolition techniques if possible. • Use of safe systems of work. • Operate a permit-to-work system for decommissioning and demolition. • Training and awareness of workers regarding occupational safety issues on site. Provide appropriate PPE.
Residual Impact	**Negligible impact**. Robust management and control of all aspects of H&S, including appropriate training for staff and contractors, during the decommissioning and demolition activities should provide a safe working environment.

11.7 Mitigation and Monitoring

Mitigation and monitoring measures are generally set out in the sections above, but several points should be highlighted:

1) Auditing of the CESMP and OESMP implementation by the independent environmental consultant (as required by the SCE) will include confirmation that the main H&S requirements are implemented. Hence these will provide a high level check on implementation.
2) ALBA will need to accommodate the operation of the Line 6 expansion within its existing management systems including ISO18001 and Emergency Response Plans.
3) ALBA should report H&S statistics in a form that can be easily benchmarked stating accident and incident rates per 1,000,000 hours worked. This would allow for continuous benchmarking within the aluminium industry sector and against the best performing industry sectors.

11.8 Summary

Table 11.11 shows a summary of occupational health and safety issues for the ALBA Line 6 Expansion Project.

Table 11.11 Summary of Occupational Health and Safety Impacts

Impact/ Activity	Potential Significance (Minor/Moderate/Major) (Beneficial/Adverse/Negligible)	Mitigation / Monitoring / Enhancement Measures	Residual Impacts (Minor/Moderate/Major) (Beneficial/Adverse/Negligible)
Construction Phase			
Construction work	Major - Minor	• H&S assessment of contractors and during pre-qualification and qualification stages. • Inclusion of H&S management requirements into formal contract documents. • Development of a H&S control plan (including method statements, standard operating procedures and risk assessments). • Speed limits and warning signs should be respected at all times on the local road network. • All traffic should stay within road corridors. • On busy roads, consideration should be given to the use of flag-men for vehicles with large loads entering the road network. • Maintenance of roads should be implemented at all times to ensure that they are kept clear of any sand and debris. • A permit to work system should be implemented for higher risk activities. • Induction training and awareness training of workers regarding occupational safety issues on-site. • Provision of safety facilities.	Negligible

Impact/ Activity	Potential Significance (Minor/Moderate/Major) (Beneficial/Adverse/Negligible)	Mitigation / Monitoring / Enhancement Measures	Residual Impacts (Minor/Moderate/Major) (Beneficial/Adverse/Negligible)
		• Provision of safety tools and clothing (i.e. PPE) such as hard hats, safety boots, eye protection, ear protectors, respiratory protection against emissions and fumes, gloves for handling certain types of materials and waste, etc. • Provision of emergency response equipment such as first aid boxes (which need to be checked frequently), adequate water supply, and eye wash stations and emergency showers if appropriate. • Correct storage and handling of hazardous materials. • Continuous provision of drinks and sheltered/shaded areas for laborers, especially during the summer months to avoid heat stress. • Supervisors should provide frequent breaks for employees, air conditioned refuges for breaks where practicable, and electrolyte solutions to maintain body chemistry in order to minimize the effects of heat stroke. • Emergency Response Plan for construction phase. • Routine inspections, auditing, near-miss reporting and investigation with implementation of improvements.	
Operational Phase			
Operations	Major - Minor	• Use safety in design processes (e.g. HAZID / HAZOP) to identify and eliminate or minimize H&S hazards. • Prequalify contractors and subcontractors on	Negligible

Impact/ Activity	Potential Significance (Minor/Moderate/Major) (Beneficial/Adverse/Negligible)	Mitigation / Monitoring / Enhancement Measures	Residual Impacts (Minor/Moderate/Major) (Beneficial/Adverse/Negligible)
		criteria including H&S performance. • Work to an accredited documented H&S Management System and integration of L6 expansion into the existing ISO 18001 system. • Employment of H&S professionals and adequate company resources to implement H&S management system. • Prepare H&S risk assessments for all activities. • Use of safe systems of work. • Operate a permit-to-work system for higher risk activities. • Operate a vehicle permit system. • Training and awareness of workers regarding occupational safety issues on site. Provide appropriate PPE, e.g. hearing protection, safety glasses, respiratory protection, protective (non-flammable) clothing, rubber boots. • Provision of first aid facilities together with personnel trained in its use. • Inspections, audits, reporting and feedback. • Occupational exposure monitoring, pre-employment checks and health surveillance.	
Emergency Situations and Response	Major - Moderate	• General safety in design practice studies e.g. HAZID / HAZOP. • Operating and maintaining the equipment in accordance with operation and maintenance manuals and approved procedures.	Negligible

Impact/ Activity	Potential Significance (Minor/Moderate/Major) (Beneficial/Adverse/Negligible)	Mitigation / Monitoring / Enhancement Measures	Residual Impacts (Minor/Moderate/Major) (Beneficial/Adverse/Negligible)
		• Updating the site Safety Plan and Emergency Response Plan, equipment, facilities and training requirements to account for operation of Line 6 expansion. • Communicating the Plans to regulatory authorities, emergency services and the community.	
Decommissioning and Demolition Work	Major - Minor	• Prequalify contractors and subcontractors on criteria including H&S performance. • Use contractors experienced in decommissioning and demolition work. • Develop a written decommissioning and demolition plan. • Undertake hazardous materials surveys to include asbestos and PCBs as applicable. • Remove hazardous materials under controlled conditions prior to commencing general demolition. • Isolate all services. • Drain down, clean and vent pipes and tanks as needed. • Remove economically recoverable materials prior to demolition. • Plan the demolition sequence to ensure stability of buildings and obtain advice of a structural engineer as needed. • Use remote demolition techniques if possible.	Negligible

Impact/ Activity	Potential Significance (Minor/Moderate/Major) (Beneficial/Adverse/Negligible)	Mitigation / Monitoring / Enhancement Measures	Residual Impacts (Minor/Moderate/Major) (Beneficial/Adverse/Negligible)
		• Use of safe systems of work. • Operate a permit-to-work system for decommissioning and demolition. • Training and awareness of workers regarding occupational safety issues on site. Provide appropriate PPE.	

12 COMMUNITY HEALTH, SAFETY AND SECURITY

12.1 Introduction

This section identifies potential impacts of the ALBA Line 6 Expansion Project construction and operation on site neighbours and the wider community. In particular specific issues identified in the ESAP are:

i. Hazards associated with the transportation of dross during operation;
ii. Management of security personnel;
iii. Impact of emergency situations on the community during operation;
iv. Hazards associated with transportation for construction and operation;
v. Specific threats to women during operation.

Hazards associated the transportation of dross, management of security personnel and the impact of emergency situations on the community are addressed in this section. Management of traffic is described in **Section 13, Traffic and Access** and management of threats to women is described in **Section 14, Labour and Working Conditions**. Consultations and communications with the community are described in **Section 4, Stakeholder Engagement**.

12.2 Legislation and Guidance

12.2.1 International Guidance

12.2.1.1 International Finance Corporation, International Performance Standards on Environmental and Social Sustainability, 2012. Performance Standard 4, Community Health, Safety and Security (IFC PS4)

IFC PS4 provides guidance on the potential risks and impacts to Affected Communities from project activities and provides guidance on the assessment and management of potential adverse impacts. IFC PS4 is backed by technical guidance contained in the World Bank Guidelines described below.

12.2.1.2 World Bank General Environmental Health and Safety (EHS) Guidelines, 2007: 3 Community Health and Safety (World Bank, 2007a)

Provides guidance protection of the public in respect of impacts that may arise outside of the physical project boundaries. The guidance provides guidance on management of water quality, building safety, traffic safety, transportation of hazardous materials, disease prevention and emergency preparedness and response.

12.2.2 National Legislation

12.2.2.1 Law No. 24 of 2006 On Private Security and Guard Companies, Ministerial Order No. 36 of 2007 Authorising the General Directorate of Guards to Regulate the Security industry

These legal instruments set out the requirement for the regulation of private security companies and security guard qualification and training in Bahrain.

12.3 Methodology

The impact assessment provides a qualitative assessment of impacts based on expert judgment taking into account the magnitude and duration of any potential impacts. Impacts are classified using the impact significance descriptions in **Table 1.3**. Where needed, required management and mitigation measures to eliminate or reduce impacts to acceptable levels are described.

12.4 Baseline

The baseline for each issue is described below:

1. Transportation of hot dross on public roads – In the ESAP it was identified that hot dross is removed from site by a contractor for processing elsewhere. The dross is transported hot on public roads. Hot dross may contain molten aluminium and can react with water to produce ammonia. It presents an evident H&S hazard to members of the public in the event of a road traffic incident.

2. Potential for emergency situations at ALBA sites to impact the community – ALBA has an Emergency Response Plan for its existing operations which includes consideration of potential for offsite incidents of offsite effects of incidents.

3. ALBA has its own security team who and control access to ALBA premises. They do not possess firearms and are permanent ALBA employees.

12.5 Impact Assessment

12.5.1 Transportation of Dross

ALBA has revised its processes for managing dross since the 2014 ESIA Report and ESAP were prepared. Dross is now handled by a company called Taha. The company has a facility on the ALBA smelter site and use it to process hot dross to remove liquid aluminium. Once the processed dross is cooled it is transported by Taha in covered containers to their facility in Ma'ameer Industrial Estate. Approximately 6 trucks of dross a day are transported off site. At the Taha facility, the dross is processed to produce a fertilizer. This arrangement is planned to continue for the future and will be applied to dross from Line 6.

As the dross is transported cold and in weather-proof packaging, the risks identified in the ESAP have been eliminated and the potential impact is considered Negligible.

12.5.2 Emergency Situations

As part of the design process for Potline 6 and PS5, safety in design studies such as hazard identification and Hazard and Operability Studies (HAZOP) have been undertaken. These have not identified any events where there could be: an explosion hazard with the pressure wave extending off-site; a major fire / explosion with a significant thermal radiation hazard extending off-site or a release of a toxic gas cloud or explosive vapour cloud off-site. Therefore there are no scenarios where there is a need to formulate an emergency response plan in co-ordination with neighbours or off-site communities for their protection. There will of course be a need to co-ordinate and

obtain support from Civil Defence in case of a major fire on site which may result in temporary inconvenience to site neighbours. The issue is therefore considered Negligible.

12.5.3 Management of Security Personnel

12.5.3.1 Construction Phase

Security Planning

For the construction phase, security of construction premises will be controlled by private security companies employed by the contractors. Security policy is controlled by ALBA and ALBA have produced a Security Capping Document; a Security Services Plan and a Security Incident Response Plan to set the standards and requirements for management of security. This suite of documents has been approved by the Ministry of Interior and the scope of these documents has been included into the scope of security services contracts for the Line 6 Expansion Project. The documents address:

- Roles and responsibilities;
- Co-ordination with other entities, e.g. ALBA HSE department;
- Security manpower;
- Security systems;
- Security alerts and response levels;
- Incident response plan.

The private security industry in Bahrain is regulated by the Ministry of Interior, Directorate of Guards who licence private security companies. They also require background checks and training for all guards.

Training of Security Personnel

For all security guards the following is required / undertaken:

i. Checking and clearance of personal records with Bahrain police, concerned competent authorities and police records in the persons country of origin;

ii. All guards must attend training at the Guard Training School, operated by the General Directorate of Guards, Ministry of Interior. The training comprises:

- Introduction to security;
- Role and responsibilities of security guards;
- Customer care;
- Equality and diversity;
- Security patrolling;
- Access control;
- Inspection;
- Security and emergency situations;
- Fire;
- First aid, H&S;
- Emergency situations;
- Communications and report writing; and

- Parade training.

Security guards do not carry firearms.

Overall the safety risks associated with security personnel is considered to be Negligible. Security arrangements are well planned using licenced businesses, background checked and trained personnel.

12.5.3.2 Operational Phase

For the operational phase of the Line 6 Expansion Project, ALBA will take over security of the site directly. The same standards of security operational planning and training of personnel will apply. ALBA security guards do not carry firearms.

Overall the safety risks associated with security personnel is considered to be Negligible. Security arrangements will be well planned using background checked and trained personnel.

12.6 Mitigation and Management

12.6.1 Transportation of Dross

Dross should be transported off site only when cold and in weather-proof packaging.

12.6.2 Emergency Situations

Other than safety in design studies (e.g. HAZOP) there are no further requirements.

12.6.3 Management of Security Personnel (Construction and Operation)

Use of licenced/ background checked and trained security personnel.

12.7 Summary

Table 12.1 provides a summary of impacts.

Table 12.1 Community Health and Safety - Summary of Required Mitigation and Management Actions

Impact	Significant	Mitigation/ Enhancement Measures	Residual Impact
Construction Phase			
Management of Security Personnel	Minor Adverse	• Use of licenced, background checked and trained security personnel.	Negligible
Operational Phase			
Transportation of Dross	Significant	• Dross should be transported off site only when cold and in weather-proof packaging.	Negligible
Off site risks from Emergency Situations	Negligible	• Safety in design studies confirm there are no applicable hazard scenarios that could have off-site consequence requiring a planned emergency response with site neighbours.	Negligible

13 TRAFFIC AND ACCESS

13.1 Introduction

The Line 6 Expansion Project will require a significant number of vehicle movements during construction to transport materials, equipment and the workforce. Construction workers will need to be transported to and from site at the beginning and end of each shift. Construction materials and equipment will also need to be brought to site; this will include a number of oversized or abnormal loads. During operation there will be a requirement for a larger workforce, an increase in the quantity of supplies bought to site, and an increase in the amount of aluminium exported.

Whilst the ALBA smelter is located on an established main road network there remains the potential for traffic hazards due to the scale of the project, particularly during the construction phase.

The purpose of this section of the Supplementary ESIA is to provide an assessment of the traffic and access arrangements and potential traffic hazards associated with the construction phase of the project. The assessment is based on information available from both the EPCM for Potline 6 (Bechtel) and the EPC contractors for PS5 and PDS (GE-GAMA and Siemens, respectively).

For the operation phase, the operational conditions described in the 2014 ESIA Report have not significantly changed and hence are not considered. With regard to the transportation of dross, this activity is addressed further in **Section 12, Community Health and Safety**.

13.2 Legislation and Guidance

13.2.1 World Bank Group General Environmental Health and Safety Guidelines, 2007

Section 3 regarding Community Health and Safety contains a section on Traffic Safety that includes general good practice H&S measures, e.g. limiting vehicle speeds, maintaining vehicles, providing driver training, etc.

13.2.2 Transportation of Abnormal Loads

Transportation of abnormal or indivisible loads is regulated by the Ministry of Works, Roads Projects and Maintenance Directorate (RPMD). A load is considered an Abnormal Load when the total (trailer plus load) exceeds the following criteria:

i. Gross weight - 40 tons.
ii. Length - 18 meters.
iii. Height - 4 meters.
iv. Width - 2.5 meters.

For loads exceeding these criteria, an application form must be completed and the approval obtained. The load must be accompanied by the police and transportation is usually authorized for night-time to avoid day-time traffic.

13.3 Assessment Methodology

Potential hazards relating to traffic have been assessed qualitatively and are based on: visits to the study area to identify traffic conditions; a review of the 2014 ESIA Report; interviews with the main construction contractors to identify traffic routes and proposed management measures; and a review of predicted traffic movements during construction and operation.

In this assessment, impact significance is considered to fall into one of only two categories: Significant or Negligible. In the absence of established significance criteria for traffic and access impacts, professional judgment has been used to assess whether the impacts on traffic and access are considered to be significant or not. Professional judgment has considered the magnitude and duration of the impact.

Mitigation and monitoring measures proposed include any specific measures indicated by the assessment as well good international industry practice measures in respect of traffic management and road safety.

The receptors considered in this assessment are the users of local roads. There are no residential communities that are considered receptors in context of traffic impacts. The impact considered is purely the contribution of the project to local traffic volumes, congestion and road safety.

The assessment has not considered construction work or operational changes at ALBA Marine Terminal. This is because the proposed construction work and operational changes at the Wharf are relatively minor requiring very limited vehicle movements.

13.4 Baseline

13.4.1 Road Infrastructure and Existing ALBA Access

Figure 13.1 presents an overview of the current road layout in the vicinity of the Expansion Project.

The main access point to the ALBA smelter is off the King Hamad Highway, known as the Main Gate. There is also a South Gate but this can only be accessed off an internal road leading from the Main Gate. The North Gate for access to the PDS site only. The King Hamad Highway is a main arterial route extending from the ALBA roundabout to the very south of Bahrain island to the Durrat Al Bahrain development. King Hamad Highway is dual carriageway from the ALBA roundabout to Road 5156 at the southern end of the SAIE. From this point south, King Hamad Highway becomes a three lane highway.

On the northern boundary of the smelter is Avenue 96 which has an intersection with King Hamad Highway. Avenue 96 provides access to the northern part of the Awali Oil Field and the residential area of Awali, connecting to Al Muaskar Highway. There is an access into the smelter from Avenue 96 - North Gate (**Figure 13.1**).

Title: **Project Location**			Client:
Project: Alba Potline 6 Supplementary ESIA			
Date: July 2017	Figure No.: 13.1		Consultant: Environment Arabia
Datum: WGS 84 - UTM 39N	Scale: 1:50,000 (A4)		

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Furthermore, there is an access point on the west side of ALBA known as the West Gate providing access to the Carbon area.

Alumina is delivered to the smelter from ALBA Marine Terminal Wharf. From the Terminal, specialist trucks use the private Sitra Wharf access road, then join the public road network along Um Al Saad Avenue, before connecting with a private road south of Bapco Refinery known locally as the ALBA Road (see **Figure 13.1**). The ALBA Road extends to King Hamad Highway at a signalised junction, allowing access to the ALBA Main Gate.

13.4.2 Traffic Volumes

In early 2016, road improvement construction work commenced on the ALBA roundabout. When complete, it will consist of a 3-level interchange. The works are expected to be completed in 2018 and are expected to greatly reduce congestion in the area (**Figure 13.2**). There are also plans to make road and junction improvements along King Hamad Highway as presented in the 2014 ESIA Report.

Figure 13.2 Proposed Interchange at ALBA Roundabout

13.4.2.1 Traffic Volumes on King Hamad Highway

Traffic volumes for 2010, 2016 and 2020 are available from the MWMAUP National Planning and Development Strategy 2030 (NPDS) Model created by W.S Atkins for the section of King Hamad Highway which adjoins the ALBA roundabout and passes the ALBA smelter site. The volumes are presented in **Table 13.1**.

Table 13.1 Traffic Flows on King Hamad Highway

Duration	2010 (measured)		2016 (measured)		2020 (predicted)	
	From ALBA R/A	To ALBA R/A	From ALBA R/A	To ALBA R/A	From ALBA R/A	To ALBA R/A
	Numbers of Vehicles					
24 hrs	19,737	22,462	35,662	38,607	46,279	49,370
Morning 06.30-07.30	1,487	1,173	3,475	2,186	4,800	2,861
Afternoon 13.00-14.00	1,448	1,345	2,129	2,738	2,583	3,667
Evening 16.30-17.30	1,357	1,391	2,061	2,868	2,531	3,852

Traffic volumes on King Hamad Highway are relatively high and averaged 160 vehicles per hour in 2016. Given the industrial nature of the area, the traffic comprises a large proportion of HGVs and worker transportation (minibuses, coaches).

13.4.2.2 Traffic Volumes in South ALBA Industrial Estate and Surrounding Area

A brief traffic survey was undertaken by Tebodin in December 2016 for roads within SAIE and the surrounding area. Total vehicle movements were recorded as 8,368 per day and 1,683 per hour during peak periods (05:30- 07:30 and 16:30 to 18:30).

13.5 Impact Assessment

13.5.1 Increase in Traffic during the Construction Phase

The transport requirements of the Line 6 Expansion Project include: movement of equipment (cranes, bulldozers, etc); movement of spoil generated by earthworks; movement of building materials; delivery of fabricated components and equipment; and the transport of construction workers. The additional traffic fleet will be made up of heavy vehicles such as large trucks (including abnormal load vehicles), buses, mid-sized trucks, light delivery vehicles and private cars. Total predicted traffic volume for the construction phase is shown in **Figure 13.3**.

Figure 13.3 shows monthly traffic movements (one movement to site and one movement from site, per trip) for Line 6, PS5 and PDS combined. There is a large peak at the start of the project associated with site preparation earthworks and the removal of spoil from site. Total vehicle movements for the remainder of the construction works are shown in **Figure 13.4** which shows peak vehicle movements in early 2018.

Figure 13.3 Total Traffic Movements for ALBA Line 6 and PS 5

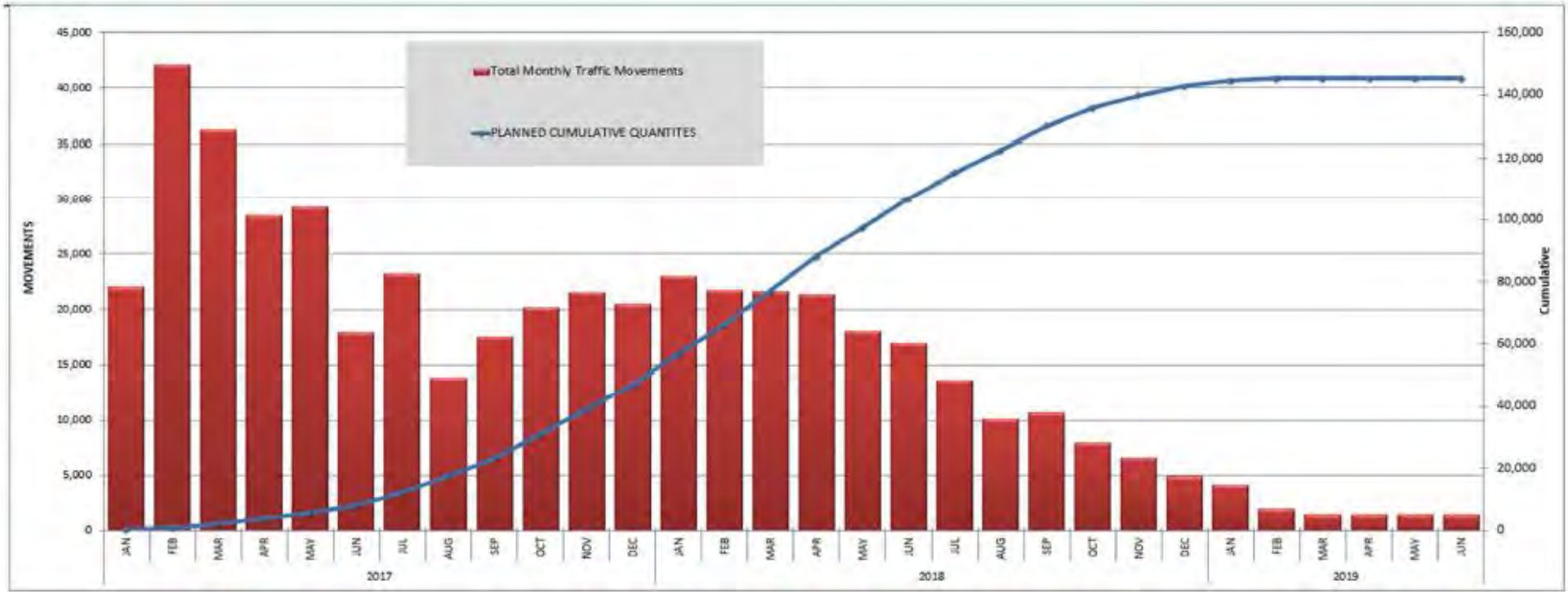
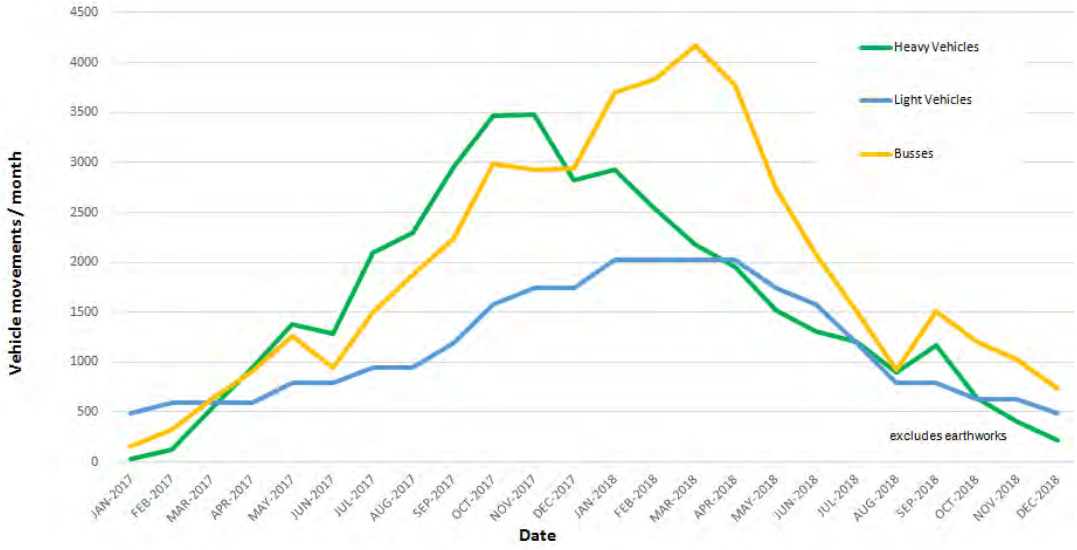


Figure 13.4 Construction Phase Vehicle Movements Excluding Earthworks



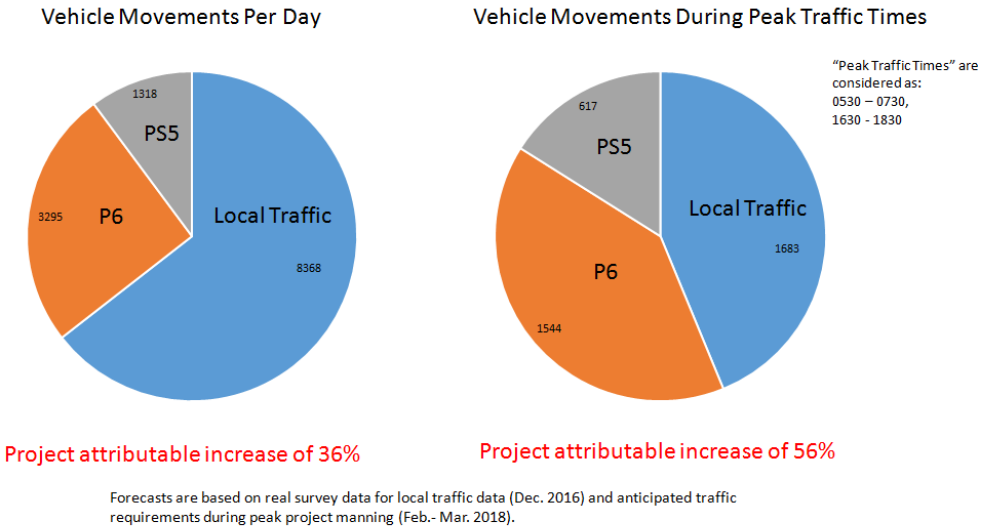
13.5.2 Impact of Construction Traffic on King Hamad Highway

In order to identify the project impact on King Hamad Highway a comparison can be undertaken using **Table 13.1** which provides the 2016 traffic volumes for King Hamad Highway. The calculated traffic volumes of 2016 are 35,662 and 38,607 for the number of vehicles to and from ALBA Roundabout in 24 hours. There are therefore a total of 74,269 vehicles per day going through ALBA Roundabout. This figure can then be compared to the project predicted traffic movements per day utilising **Figure 13.3**. Taking the worst case scenario of 42,000 traffic movements per month, this is equivalent to approximately 1,600 vehicle movements per day. Utilising these figures it is expected that the project would contribute to a maximum worst case scenario of around a 2.2% increase in vehicle traffic movements on King Hamad Highway. This impact is considered as Negligible.

13.5.3 Impact on South ALBA Industrial Estate

A comparison of the expected project vehicle movements per day and the predicted local area vehicle movements - the South ALBA Industrial Estate (SAIE), Avenue 96, Road 4145 and King Hamad Highway - is provided in **Figure 13.5.** The traffic movement forecasts are based on anticipated traffic requirements during peak project manning (from February to March 2018). It is anticipated that the project will contribute to an overall 36% increase in vehicle movements per day and a 57% increase in vehicle movements per day during peak hours on local roads.

Figure 13.5 Expected Vehicle Movements Per Day



This impact is considered Significant and mitigation and management measures will be need to eliminate or minimise the impact to an acceptable level. Proposed mitigation measures are outlined in **Section 13.6**.

13.5.4 Abnormal Loads

There will be a predicted total of 5,074 abnormal loads to be delivered to site during the construction phase. As there is a high number of abnormal loads and these all require permitting, transportation of abnormal loads is considered as a Significant impact and therefore requires mitigation and management to minimize impacts to an acceptable level.

13.6 Mitigation and Management

13.6.1 Requirement for a Traffic Management Plan

The project will lead to a large increase in traffic volumes on local roads within and around SAIE and there will also be a large number of abnormal loads that will require transportation to site. A Traffic Management Plan (TMP) will be required that is designed to achieve the following:

i. Ensure road safety;
ii. Minimise congestion on roads;
iii. Comply with requirements to transport abnormal loads;
iv. Ensures the transport of people, equipment and materials to site with the minimum of delays.

Bechtel, PS5 and PDS have all developed TMPs to achieve these objectives that are co-ordinated by ALBA. The key common elements of these are described in the following sections.

13.6.1.1 Transport Manager

All transportation to site will be controlled by a Transport Manager who will be responsible for implementation of the TMP. There will be separate Transport Manager and TMPs for Potline 6 and PS5/PDS as they will have separate allocated entrances and CLA areas. Overall co-ordination will be the responsibility of ALBA who will need to ensure continued liaison and co-operation between contractors on transport matters.

13.6.1.2 Transportation Routes

Proposed transportation routes to site are shown in **Figure 13.6**. Goods imported to Bahrain will enter by road via the King Fahd Causeway from Saudi Arabia or by ship via Khalifa Bin Salman Port (KBSP) in Hidd. Facilities at ASRY may also be used for the landing of loads by sea. Transportation of goods to site by road will then follow the routes shown in **Figure 13.6**.

Figure 13.6 also identifies routes for abnormal loads. Abnormal loads from Khalifa Bin Salman Port (KBSP) or ASRY will be driven via Prince Khalifa Bin Salman Causeway through Sitra and on to the project site. There is also an alternate route through Muharraq and Manama and then through the centre of Bahrain. The route taken will depend upon the size and weight of the load as the bridges between Muharraq and Sitra and the main island of Bahrain have different weight and size limits. This will be controlled by the Ministry of Works officials.

In **Figure 13.6** some loads are shown as originating from points with the main island of Bahrain. In these locations civil or mechanical structures will be fabricated off-site at contractor facilities and transported to site when partly or full assembled.

As a general rule, all loads greater than 200 metric tons, 6m wide and 4.1 m high will be barged to Muharraq Engineering Jetty in Ras Zuwayed Industrial Area from its port of arrival. The abnormal loads will then require road transportation for the short distance from Muharraq Engineering Jetty to ALBA. This will minimize the impact on road traffic. Abnormal loads will also be transported at night under the supervision of the Police. Routes to site for abnormal loads need to planned in advance and the route cleared of any obstructions.

Within SAIE the roads for access for construction transportation have been surveyed to confirm they can accept the planned abnormal load dimensions and weights. There is on-going liaison with occupants of SAIE, Southern Governorate and Ministry of Works to ensure the roads are maintained and cleared of roadside obstructions such as waste materials (see **Section 4, Stakeholder Engagement**).

There is also a proposal to widen the road at the entrance to the CLA to create a slip road to improve road safety.

There are two culverts located on Road 5156 leading from the CLA toward the ALBA and these will require strengthening to support abnormal loads.

Access from King Hamad Highway to the site through SAIE will be controlled by using the three junctions from the Highway into SAIE for different purposes, as follows (see **Figure 13.7**):

- Entry Point 2 – access for ALBA / EPCM site vehicles;
- Entry Point 3 – access for contractor buses and light vehicles travelling to site;
- Entry Point 4 – access for staff and visitors for Potline 6. Will travel along Road number 5156 to the CLA and will transfer to a bus service to site that will run every 10 minutes and enter via Charlie Gate.

The segregation of vehicle types and use of separate routes through SAIE will help minimize any congestion.

13.6.1.3 Access to Site

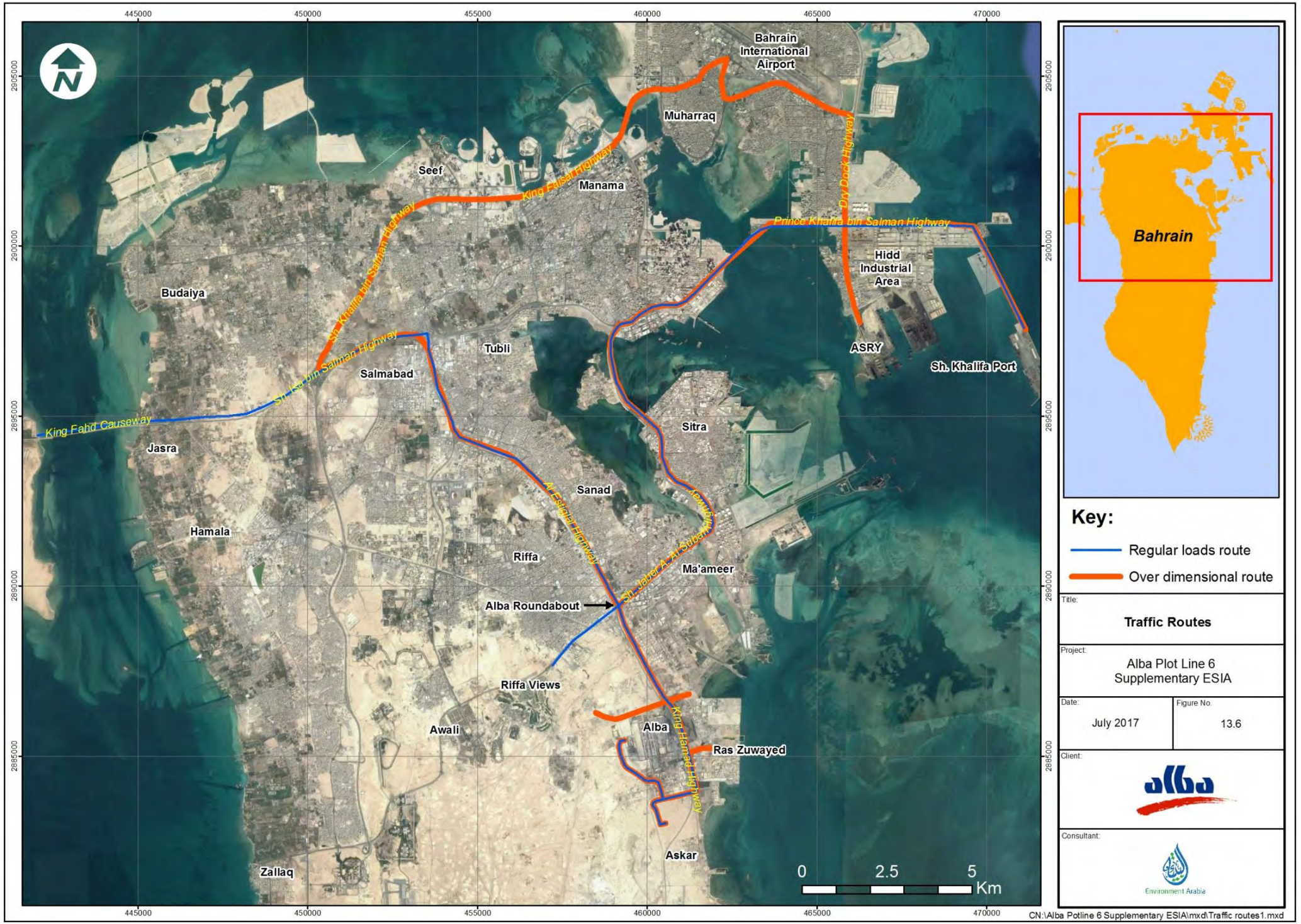
There are 5 access points to site which are shown on **Figure 13.7** – PS5, West Gate, South West Gate, North Gate and Charlie Gate. These are all controlled by security checkpoints.

Times for deliveries of materials to site are:

- 06:45 hrs to 11:30hrs
- 12:30hrs to 16:30hrs
- 17:30hrs to 06:00hrs

Deliveries are pre-arranged at least 24 hours in advance with the relevant Transport Manager.

Outside of these hours buses will deliver workers to site. Workers will access the site through turnstiles and pedestrian access points close to West Gate and South West Gate for Potline 6 and at the west of the PS5 site for PS5/PDS. Buses will park in demarcated and barriered laybys, off the highway outside the ALBA fence line. Workers will walk through the access gate/ turnstile and will directly access their work site or will be taken to their work site by internally circulating buses. At the peak up to 300 buses may need to access the site at the start and end of shifts. The start and finish times for sub-contractor shifts will be staggered to avoid congestion and to maximize the traffic flow.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Hidd Industrial Area
Tubli
ASRY
Sh. Khalifa Port
Salmabad
Sh. Isa bin Salman Highway
King Fahd Causeway
Jasra
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Sanad
Al Esteqlal Highway
Hamala
Riffa
Ma'ameer
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Project:
Alba Plot Line 6
Supplementary ESIA
Date:
July 2017
Figure No.
13.6
Client:
Consultant:
Environment Arabia
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Title: **Traffic Access Points**		Client:
Project: Alba Plotline 6 Supplementary ESIA		
Date: July 2017	Figure No.: 13.7	Consultant: Environment Arabia
Datum: WGS 84 - UTM 39N	Scale: 1:50,000 (A4)	

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13.6.2 Stakeholder Engagement

There will be need a need for on-going stakeholder engagement and liaison with occupants of the SAIE and the relevant regulators – Southern Governorate, Ministry of Works and Transport Police to ensure that if any traffic issues arise, they are effectively managed. Occupants of SAIE have been identified as a key stakeholder and further information on planned stakeholder engagement is contained in **Section 4**.

13.6.3 Monitoring

Implementation and co-ordination of the TMPs will be reviewed as part of the monthly CESMP implementation audits by the independent environmental consultant.

13.7 Summary

A summary of the predicted impacts for traffic and access are provided in **Table 13.2**. These measures are likely to minimize traffic impacts but there is still likely to be a lesser, but still significant impact after mitigation that will require day-to-day management throughout the construction phase.

Table 13.2 Summary of Required Mitigation and Management Actions

Impact	Significant	Mitigation/ Enhancement Measures	Residual Impact
Construction Phase			

Access to Site Through South ALBA Industrial Estate	Significant	• ALBA to maintain overall control of traffic management and ensure that Potline 6 and PS5 TMPs are co-ordinated.
		• Implement TMPs for Potline 6 and PS5/PDS sites to be followed by all contractors and suppliers. TMPs have the following key features:
		  • Transport Manager appointed and responsible for TMP implementation;
		  • On-going liaison with SAIE occupants;
		  • Access points to SAIE limited to the vehicle types and uses described;
		  • Deliveries to be managed to avoid peak periods and shift changes;
		  • Road improvements to create a slip road into the CLA; and
		  • Strengthening of culverts to be implemented.
			Significant but minimized as far as reasonably practicable.

Transportation of Abnormal Loads	Significant	• Transportation of abnormal loads to be co-ordinated with authorities.	Negligible

14 LABOUR AND WORKING CONDITIONS

14.1 Introduction

For any business, the workforce is a valuable asset, and a sound worker-management relationship is a key ingredient to the successful implementation of a project. Failure to establish and foster a sound relationship can undermine worker commitment and retention and can jeopardise the delivery of a project. Conversely, through a constructive worker-management relationship, and by treating workers fairly and providing them with safe and healthy working conditions, project proponents can create tangible benefits, such as enhancement of the efficiency and productivity of their operations.

The construction of the ALBA Line 6 Expansion Project will require a large workforce, and ALBA will need to employ additional workers for the Project's operation.

The way the contracts have been set up for the construction of the various elements differs between Potline 6 and PS5 & PDS. For Potline 6, Bechtel is the EPCM Contractor. In this role, Bechtel is responsible for the design, procurement of contractors and construction work, and ensuring that the project is completed as required and in time. Bechtel has sub-contracted a number of construction contractors.

For both PS5 and the PDS, ESBI are the Owner's Engineer subcontracted to ALBA to protect their interest by ensuring that the contractors are on programme, budget and project specification. The EPC Contractor for PS5 is the GE-GAMA Consortium, a partnership of General Electric Bahrain Company WLL and Gama Power Systems Engineering and Contracting Inc. The consortium has also employed a number of sub-contractors to undertake specific construction tasks for PS5. The EPC contractor for PDS is Siemens. Siemens has also employed a number of sub-contractors to undertake specific construction tasks for the PDS.

14.2 Scope of Assessment

This section of the supplementary ESIA addresses the following:

- Identification of Project Standards that contractors and third parties are required to work to;
- Identification of the minimum standards to be included in relevant contracts to meet Ministry of Labour requirements and IFC/EBRD guidelines;
- Identification of the requirements for provision and management of labour accommodation.
- Identification of issues associated with management of a large, expatriate construction workforce and how these will be managed.

This section does not address occupational health and safety (see **Section 11**).

14.3 Legislation and Guidance

14.3.1 National Legislation

14.3.1.1 Law No. 36 of 2012 (the Labour Law)

Law No. 36 of 2012, the Promulgation of the Labour Law in the Private Sector and associated legislation sets out employment requirements for Bahraini nationals and migrant workers.

The law sets out employees rights with respect to conditions of employment such as: annual leave, maternity leave, sick leave entitlement, labour disputes resolution and other topics. It also sets out measures to prevent human trafficking and prohibition of discrimination practices such as discrimination in the payment of wages based on sex, ethnic origin, language, religion or beliefs.

14.3.1.2 Order No. 79 of 2009 Respecting the Procedures of Foreign Worker Transfer to Another Employer

This Order from the Ministry of Labour grants the right of foreign workers to transfer to work with another employer without obtaining consent of the existing employer and without prejudice to the rights of the worker. A worker can leave employment if he/she is not paid.

14.3.1.3 Ministerial Order No. 16 of 2013 Specifying the Circumstances, Occasions and Works in Which Women are not Permitted to Work During the Night

This Order states that women are not allowed to work in industrial facilities or any of their branches between 7pm and 7am. An industrial facility means:

- Facilities in which material is produced, modified, cleaned, repaired, decorated, assembled and unassembled, destroyed or transformed including facilities that involve ship building, electric generation, transmittal and connection;
- Civil engineering, contracting, maintenance, construction and demolition facilities;
- Any other facility specified by a Ministerial Order.

This law does not apply in emergency situations which could cause operations to cease, and if the work involved was necessary to prevent loss or damage of material. Nor does it apply to women working in administrative, technical or supervisory positions.

14.3.1.4 Ministerial Order No. 23 of 2013 Regarding Specifying the Conditions, Circumstances and Events for the Purposes of Regulating Employment of Minors, as well as the Works, Industries and Crafts Considered Hazardous to their Health and Safety in which it is not Permitted to Employ Minors

This Order specifies the industries in which it is not permitted to employ anyone under the age of 18. It also states employment that is banned for minors under the age of 12. The conditions for employing minors are also set out.

14.3.1.5 Ministerial Order No. 40 of 2014 With Respect to the Requirements and Specification of Workers' Accommodation

Ministerial Order No.40 of 2014 sets out minimum standards for labour accommodation including:

- space requirements;
- health and safety;
- kitchen facilities;
- dining facilities; and
- maintenance requirements.

14.3.2 International Guidance

14.3.2.1 International Finance Corporation Performance Standard 2 (IFC PS2) Labour and Working Conditions, 2012

IFC PS2 sets out requirements for labour and working conditions. The key objectives of IFC PS2 are:

- To promote the fair treatment, non-discrimination, and equal opportunity of workers;
- To establish, maintain, and improve the worker-management relationship;
- To promote compliance with national employment and labour laws;
- To protect workers, including vulnerable categories of workers such as children, migrant workers, workers engaged by third parties, and workers in the client's supply chain;
- To promote safe and healthy working conditions, and the health of workers; and
- To avoid the use of forced labour.

14.3.2.2 Acceptable Standards and Management of Workers' Accommodation

Workers' Accommodation: Processes and Standards, 2009 has been developed jointly by IFC and the European Bank of Reconstruction and Development (EBRD) (IFC & EBRD, 2009) and provides guidance on the establishment and management of workers accommodation.

Bahrain law regarding the specification of labour accommodation provides a number of minimum facility design standards which are in line with the recommendations made in IFC/ EBRD guidance. Generally the IFC/ EBRD guidance is more detailed. It also includes additional requirements in respect of canteens, security, leisure and medical facilities, workers' rights, consultation and grievance mechanisms and management of community relations.

14.4 Assessment Methodology

In this instance there is no baseline for the assessment other than Bahraini employment law as it applies to ALBA employees. Also the main impacts to be considered will be during the construction period when contractors and sub-contractors will be responsible for employing large numbers of largely migrant workers. Therefore, this assessment is based on a review of the applicable laws and guidance and identification of mitigation

and management measures to be adopted during the construction and operational phases to ensure the ALBA Line 6 Expansion Project complies with relevant laws and guidance.

The classification of impact significance used in this assessment is qualitative. The impact assessment significance descriptions set out in **Table 1.3** have been used. Where there is a requirement to adopt a measure to meet legal obligations then a minor, moderate or major adverse impact has been selected, depending on the likelihood and consequences of any non-compliance in the absence of mitigation. Where suitable mitigation and management measures are identified that would lead to routine compliance, then the residual impact has been assessed as negligible.

14.4.1 Background to Assessment of Impacts on Migrant Construction Workforce

The construction phase of the Line 6 Expansion Project will require the employment of a large workforce of up to 15,000 persons. The majority will be expatriate male workers from the Indian sub-continent who will be employed on relatively low wages with accommodation provided in labour camps by their employer.

There have been numerous reports from the Middle East region concerning poor treatment of such migrant workers including: poor health and safety standards, poor accommodation standards and non payment of wages[15,16]. Hence these are key issues for the assessment and management of the Line 6 construction phase. As noted earlier, health and safety is addressed in a separate section but labour accommodation and payment of wages will both be addressed in this section.

14.5 Impact Assessment

14.5.1 Workforce Numbers

14.5.1.1 Construction Workforce

Table 14.1 and **Figure 14.1** shows the estimated numbers of workforce required for the Expansion Project during the construction phase. These numbers consist of staff from the main contractors and all anticipated sub-contractors.

Table 14.1 Estimated Workforce Numbers for Construction Phase

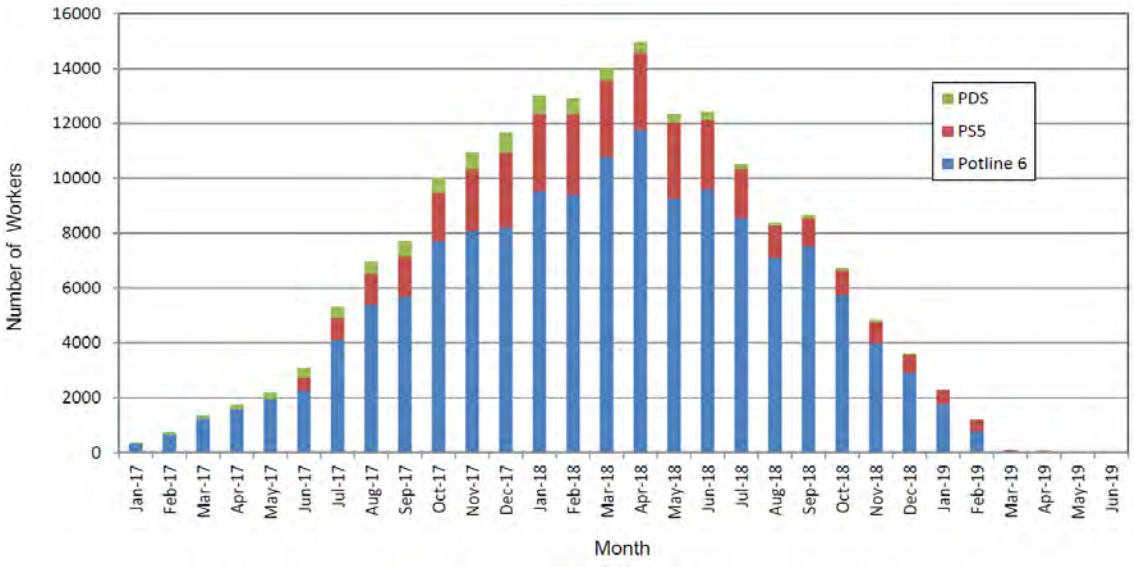
Month	Potline 6	Power Station 5	Power Distribution System	Total Workforce
Jan-17	318	0	45	363
Feb-17	664	0	90	754
Mar-17	1256	0	115	1371
Apr-17	1592	0	160	1752
May-17	1954	0	250	2204
Jun-17	2269	472	335	3076
Jul-17	4105	795	420	5320

[15] For A Better Life: Migrant Worker Abuse in Bahrain and the Government Reform Agenda. Human Rights Watch, 2012

[16] India: Exploited dreams: Dispatches from Indian migrant workers in Saudi Arabia, Amnesty International, 2014

Month	Potline 6	Power Station 5	Power Distribution System	Total Workforce
Aug-17	5400	1126	450	6976
Sept-17	5685	1482	535	7702
Oct-17	7702	1758	560	10020
Nov-17	8084	2257	615	10956
Dec-17	8195	2764	715	11674
Jan-18	9537	2824	655	13016
Feb-18	9410	2948	575	12933
Mar-18	10777	2800	435	14012
Apr-18	11777	2796	405	14978
May-18	9246	2762	355	12363
Jun-18	9593	2552	280	12425
Jul-18	8552	1793	185	10530
Aug-18	7089	1183	125	8397
Sep-18	7524	1031	105	8660
Oct-18	5757	889	85	6731
Nov-18	3984	786	65	4835
Dec-18	2899	668	55	3622
Jan-19	1759	515	0	2274
Feb-19	789	431	0	1220
Mar-19	0	87	0	87
Apr-19	0	59	0	59
May-19	0	30	0	30
Jun-19	0	30	0	30

Figure 14.1 Estimated Workforce Numbers for Construction Phase



14.5.1.2 Operation Workforce

ALBA employs approximately 2650 staff. There will be a requirement for approximately 550 additional staff for the operation of Line 6 and PS5.

14.5.2 Comparison of Bahrain Labour Law and International Guidance

Table 14.2 presents a comparison of Bahrain law and international guidance with respect to labour law. The information presented is an overview of the main legal points and is not intended to be a legal interpretation of the law. The comparison presented indicates that there are some gaps between Bahrain law and IFC PS2. These gaps are in the areas of:

- Human resources policy and procedures;
- Grievance mechanism;
- Workers engaged by third parties; and
- Management of supply chain.

In all other respects, existing Bahrain law appears to be sufficient to implement IFC requirements on labour and working conditions.

Table 14.2 Comparison of Bahrain Labour Law and IFC PS2

Summary of PS2 Provision	Key Points of Bahrain Law
Human Resources Policy and Procedures The client will adopt and implement human resources policies and procedures appropriate to its size and workforce that set out its approach to managing workers consistent with the requirements of this Performance Standard and national law. The client will provide workers with documented information that is clear and understandable, regarding their rights under national labour and employment law and any applicable collective agreements, including their rights related to hours of work, wages, overtime, compensation and benefits upon beginning the working relationship and when any material changes occur.	No provisions in Bahrain Law.
Working Conditions and Terms of Employment Where the client is a party to a collective bargaining agreement with a workers' organisation, such agreement will be respected. Where such agreements do not exist, or do not address working conditions and terms of employment, the client will provide reasonable working conditions and terms of employment. The client will identify migrant workers and ensure that they are engaged on substantially equivalent terms and conditions to non-migrant workers carrying out similar work. Where accommodation services are provided to workers covered by the scope of this PS, the client will put in place and implement policies on the quality and management of the accommodation and provision of basic services. The accommodation services will be provided in a manner consistent with the principles of non-discrimination and equal opportunity. Workers' accommodation arrangements should not restrict workers' freedom of movement or of association.	*Labour Law 2012, Article 19* States that the employment contract should include the terms of employment agreed by the parties, and may be entered into for a fixed term, or for an indefinite duration, which can be terminated on notice, or for execution of a specific project. The contract should be in writing in both English and Arabic and both parties should be given a copy. *Labour Law 2012, Article 39* Discrimination in wages based on sex, origin, language, religion or ideology shall be prohibited. *Ministerial Order No.40 of 2014 with respect to the requirements and specifications of workers' accommodation* Sets out minimum physical requirements for accommodation.
Workers' Organisation In countries where national law recognises workers' rights to form and to join workers'	*Workers Trade Union Law, 2002* This recognises the right of workers to organise collectively without discrimination in

Summary of PS2 Provision	Key Points of Bahrain Law
organisations of their choosing without interference and to bargain collectively, the client will comply with national law. Where national law substantially restricts workers' organisations, the client will not restrict workers from developing alternative mechanisms to express their grievances and protect their rights regarding working conditions and terms of employment. The client should not seek to influence or control these mechanisms. In either case described above, and where national law is silent, the client will not discourage workers from electing worker representatives, forming or joining workers' organisations of their choosing, or from bargaining collectively, and will not discriminate or retaliate against workers who participate, or seek to participate, in such organisations and collective bargaining. The client will engage with such workers' representatives and workers' organisations, and provide them with information needed for meaningful negotiation in a timely manner. Workers' organisations are expected to fairly represent the workers in the workforce.	employment. Article 10 states that: 'the workers of any establishment, of any particular sector, of any particular activity or of similar or associate industries or professions may establish their own trade union subject to the provision of this law'. Article 11 concerns the procedure for the formation of a trade union and states: 'The procedure for the formation of a trade union shall be by submitting to the Ministry its Constitution and the names of the founding members, provided that the Constitution shall not conflict with the provisions of the applicable laws and regulations in the Kingdom'.
Non-Discrimination and Equal Opportunity The client will not make employment decisions on the basis of personal characteristics[17] unrelated to inherent job requirements. The client will base the employment relationship on the principle of equal opportunity and fair treatment, and will not discriminate with respect to any aspects of the employment relationship, such as recruitment and hiring, compensation (including wages and benefits), working conditions and terms of employment, access to training, job assignment, promotion, termination of employment or retirement, and disciplinary practices. The client will take measures to prevent and address harassment, intimidation, and/or exploitation, especially in regard to women. The principles of non-discrimination apply to migrant workers. In countries where national law provides for non-discrimination in employment, the	*Labour Law 2012, Wages - Article 39* Discrimination in wages based on sex, origin, language, religion or ideology shall be prohibited.

[17] Such as gender, race, nationality, ethnic, social and indigenous origin, religion or belief, disability, age or sexual orientation.

Summary of PS2 Provision	Key Points of Bahrain Law
client will comply with national law. When national laws are silent on non-discrimination in employment, the client will meet this Performance Standard. In circumstances where national law is inconsistent with this Performance Standard, the client is encouraged to carry out its operations consistent with the intent of the above without contravening applicable laws. Special measures of protection or assistance to remedy past discrimination or selection for a particular job based on the inherent requirements of the job will not be deemed as discrimination, provided they are consistent with national law.	
Retrenchment Prior to implementing any collective dismissals, the client will carry out an analysis of alternatives to retrenchment. If the analysis does not identify viable alternatives to retrenchment, a retrenchment plan will be developed and implemented to reduce the adverse impacts of retrenchment on workers. The retrenchment plan will be based on the principle of non-discrimination and will reflect the client's consultation with workers, their organisations, and, where appropriate, the government, and comply with collective bargaining agreements if they exist. The client will comply will all legal and contractual requirements related to notification of public authorities, and provision of information to, and consultation with workers and their organisations. The client should ensure that all workers receive notice of dismissal and severance payments mandated by law and collective agreements in a timely manner. All outstanding back pay and social security benefits and pension contributions and benefits will be paid (i) on or before termination of the working relationship to the workers, (ii) where appropriate, for the benefit of the workers, or (iii) payment will be made in accordance with a timeline agreed through a collective agreement. Where payments are made for the benefit of workers, workers will be provided with evidence of such payments.	*Labour Law 2012, Article 101* States that the worker shall be entitled to compensation for termination by the employer unless the termination of the contract is for a legitimate reason. The burden of proof of the legitimacy of termination of the contract shall be borne by the employer. *Labour Law 2012, Article 111* Determines what compensation employees are entitled to under different circumstances of dismissal by the employer.
Grievance Mechanism The client will provide a grievance mechanism for workers (and their organisations,	No specific provisions in Bahrain law.

Summary of PS2 Provision	Key Points of Bahrain Law
where they exist) to raise workplace concerns. The client will inform the workers of the grievance mechanism at the time of recruitment and make it easily accessible to them. The mechanism should involve an appropriate level of management and address concerns promptly, using an understandable and transparent process that provides timely feedback to those concerned, without any retribution. The mechanism should also allow for anonymous complaints to be raised and address. The mechanism should not impede access to other judicial or administrative remedies that might be available under the law or through existing arbitration procedures, or substitute for grievance mechanisms provided through collective agreements.	
Child Labour The client will not employ children in any manner that is economically exploitative, or is likely to be hazardous to or interfere with the child's education, or to be harmful to the child's health or physical, mental, spiritual, moral or social development. The client will identify the presence of all persons under the age of 18. Where national laws have provisions for the employment of minors, the client will follow those laws applicable to the client. Children under the age of 18 will not be employed in hazardous work. All work of persons under the age of 18 will be subject to an appropriate risk assessment and regular monitoring of health, working conditions and hours of work.	*Labour Law 2012, Employment of Minors, Articles 23 - 28* It is prohibited to employ any minor who is not yet 15. Minors should not be employed for more than 6 hours a day. They should be given one or more breaks, the total of which should not be less than 1 hour for a rest and a meal. They should not work more than 4 consecutive hours. They should not be employed at night or on weekly rest days or official holidays. Prior to appointment, the employer must verify: • the custodian or guardian approve the minor's employment; • the minor has undergone a medical examination to determine his physical fitness; • the minor is not engaged in hazardous work; • the Ministry is notified of al data related to the minor. Following the employment of the minor, an employer shall: • post in an apparent location the provisions on the employment of minors; • draft a statement clarifying the names of minors working, their age, the works entrusted to them and the date of their employment; • subject the minor to a periodic medical examination to verify his physical fitness.
Forced Labour The client will not employ forced labour, which consists of any work or service not voluntarily performed that is exacted form an individual under threat of force or penalty. This covers any kind of involuntary or compulsory labour, bonded labour, or similar labour-contracting arrangements. The client will not employ trafficked persons.	*Order No. 79 of 2009 Respecting the Procedures of Foreign Worker Transfer to Another Employer, Article 2* This states that a foreign worker has the right to transfer to work with another employer without obtaining consent of the existing employer, without prejudice to the rights of the worker. A worker can leave employment if he/she is not paid.

Summary of PS2 Provision	Key Points of Bahrain Law
Occupational Health and Safety The client will provide a safe and healthy work environment, taking into account inherent risks in its particular sector and specific classes of hazards in the client's work areas, including physical, chemical, biological, and radiological hazards, and specific threats to women. The client will take steps to prevent accidents, injury, and disease arising from, associated with, or occurring in the course of work by minimising, as far as reasonably practicable, the causes of hazards. In a manner consistent with good international best practice, as reflected in various internationally recognised sources including the World Bank Group EHS Guidelines, the client will address areas that include the (i) identification of potential hazards to workers, particularly those that may be life-threatening, (ii) provision of preventative and protective measures, including modification, substitution, or elimination of hazardous conditions or substances, (iii) training or workers, (iv) documentation and reporting of occupational accidents, diseases, and incidents, and (v) emergency prevention, preparedness, and response arrangements. For additional information related to emergency preparedness and response to Performance Standard 1.	*Labour Law 2012, Title VX Occupational Safety and Health and Working Environment, Article 166* The employer must provide a safe and healthy work environment and take measures to protect workers from the following hazards: • mechanical hazards arising as a result of a collision or contact between the worker's body and a solid object; • hazards arising from handling solid, liquid or gas chemical substances or arising from the leakage of such substances to the working environment; • Natural hazards affecting the worker's safety and health as a result of a natural hazard or damage such as heat, humidity, cold, noise, dangerous and harmful radiations, quakes or the high or low atmospheric pressure in the workplace; • Hazards arising from the unavailability of means of safety, rescue, first aid and hygiene or the like and hazards arising from nutrition in cases where the employer is bound by virtue of the law to provide nutrition; • Fire hazards and hazards arising from electricity and lighting. Employers should prepare emergency plans which are tested to ascertain the adequacy and workers are trained in executing them. Employers should also inform workers' of potential hazards, provide them with free protective equipment and train them in its use.
Workers Engaged by Third Parties With respect to contracted workers the client will take commercially reasonable efforts to ascertain that the third parties who engage these workers are reputable and legitimate enterprises and have an appropriate ESMS that will allow them to operate in a manner consistent with the requirements of this Performance Standard (apartment from retrenchment & supply chain requirements). The client will establish policies and procedures for managing and monitoring the performance of such third party employers in relation to the requirements of this Performance Standard. In addition, the client will use commercially reasonable efforts to incorporate these requirements in contractual agreements with such third party	No specific provisions in Bahrain Law.

Summary of PS2 Provision	Key Points of Bahrain Law
employers. The client will ensure that contracted workers have access to a grievance mechanism. In cases where the third party is not able to provide a grievance mechanism, the client will extend its own grievance mechanism to serve workers engaged by the third party.	
Supply Chain Where there is a high risk of child labour or forced labour in the primary supply chain, the client will identify those risks consistent with the above requirements. If child labour or forced labour cases are identified, the client will take appropriate steps to remedy them. The client will monitor its primary supply chain on an ongoing basis in order to identify any significant changes in its supply chain and if new risks or incidents of child and/or forced labour are identified, the client will take appropriate steps to remedy them. Additionally, where there is a high risk of significant safety issues related to supply chain workers, the client will introduce procedures and mitigation measures to ensure that primary suppliers within the supply chain are taking steps to prevent or to correct life-threatening situations. The ability of the client to fully address these risks will depend upon the client's level of management control or influence over its primary suppliers. Where remedy is not possible, the client will shift the project's primary supply chain over time to suppliers that can demonstrate that they are complying with this Performance Standard.	No specific provisions in Bahrain law.

14.6 Forced Labour

There are potential risks of forced labour within the supply chain within Bahrain particularly as the construction work force will comprise up to 15,000 migrant workers. Whilst forced labour is banned under law in Bahrain, working under poor conditions of health and safety or living in sub-standard accommodation facilities or working without regular pay can comprise forced labour to one extent or another. Whilst there are legal safe guards these may rely on the courts to implement them which may be slow to respond and be beyond the financial reach and knowledge of migrant workers. Overall the potential for forced labour is classified as a potentially Major Adverse impact, as if it is not actively managed and mitigated, failure to respect migrant workers rights is likely to occur in some cases.

The responsibility falls to the project owner, ALBA, to ensure that the supply chain acts responsibly and meet its duties to protect workers' rights including implementation of labour contracts, provision of information regarding workers' rights, provision of suitable labour accommodation, payment of wages and implementation of a grievance mechanism.

14.7 Payment of Wages

This is related to the issue of forced labour , but is also discussed separately to highlight the issue.

The non-payment of wages can come about through poor financial management by contractors. So even if a contractor is paid by the client, the workers may not get paid. This can lead to non performance by the contractor, industrial action by workers and social unrest. As such this is identified as a potential Major Adverse impact and must be actively managed to mitigate its potential impacts.

14.8 Labour Accommodation

The provision of labour accommodation is also related to the issue of forced labour, but as above, it is discussed separately to highlight the issue.

Labour accommodation for migrant workers will be provided by individual contractors. A project specific labour camp for construction workers is not proposed. This means that the standard of labour accommodation is likely to be variable. At its worst sub-standard labour accommodation can be unhygienic, and a potential source of disease or illness, or dangerous (e.g. fire hazard). Therefore the standard of labour accommodation is a key issue for the project and a potential Major Adverse issue that will require active management to mitigate its potential impacts.

14.9 Child Labour

Child labour is banned in Bahrain. Child labour is considered to be a Negligible impact for the project. This is because the majority of the work force comprises expatriate workers who must meet national legal requirements to qualify for work and also because child labour is unlikely to go unnoticed on site or at contractor yards.

14.10 Public Health

The employment of a large, male, expatriate work force has the potential to cause an increase in prostitution, alcohol and drug abuse and violence particularly in the vicinity of labour accommodation camps. Many of these potential impacts are mitigated by the particular project circumstances.

Contractors labour camps are typically sited in commercial or industrial areas not near centres of population or in suburban areas. Thus the potential for workers to congregate in local populated areas and cause unrest is low. Also as individual contractors are providing labour accommodation from the existing stock, the accommodation facilities are spread across the surrounding area and are not concentrated in one place. Thus their impact is dispersed.

Contractor's also have prevention and control measures regarding the use of drugs and alcohol within accommodation facilities. Contractors ban the use of drugs by employees and within the labour accommodation facilities, and being drunk at a labour accommodation facility can result in dismissal.

Workers do have the right to leave the accommodation facilities during their free-time and are likely to do so, particularly at the weekends. It is likely that some will engage with prostitutes and so there is a risk of spreading Sexually Transmitted Diseases (STDs). This is considered to be a potentially Minor Adverse impact.

14.11 Management and Mitigation

14.11.1 Forced Labour

14.11.1.1 Human Resources Policy and Procedures

It is recommended that ALBA should prepare a specific employment policy and procedures to be implemented on the project to ensure it is compliant with Bahraini law and IFC PS2 requirements. The requirements should be applicable to direct employees, main contractors and sub-contractors.

ALBA should ensure that all direct employees, contractor and sub-contractor employees are provided with a clear and understandable written statement of their rights under national labour and employment law, and any applicable collective agreements including their rights to hours of work, wages, overtime, compensation and benefits upon beginning the working relationship and when any material changes occur. Educational campaigns should be run to raise awareness of workers' rights.

Compliance with the policy and procedures should be audited for all (sub) contractors prior to their mobilisation. Thereafter compliance should be audited annually.

The mitigation measures detailed in the following sections should be addressed in the policy and procedures.

14.11.1.2 Contracts with Suppliers

ALBA should ensure that all (sub) contracts with suppliers include clauses:

- Banning forced labour.
- To only use recruitment companies, in the workers country of origin, that are accredited.
- Banning payment of recruitment or other fees by the worker (e.g. for accommodation or transport).
- Allowing workers to retain access to their passports.

14.11.1.3 Minimum Requirements for Individual Employment Contracts

All employees working on the Line 6 Expansion Project should be provided with a Contract of Employment which meets the requirements of Bahrain's Labour Law 2012. ALBA should ensure that the items in **Table 14.3** are included in all worker contracts.

Table 14.3 Minimum Requirements for Worker Contracts

Subject	Requirements from Bahrain Labour Law (with Article No.)

Employment Contract	• Article 19: A contract of employment shall be signed by both parties;
	• Article 20: The contract of employment shall contain:
	  ○ Parties to the contract;
	  ○ Type of employment;
	  ○ Nature of the job;
	  ○ Agreed wage;
	  ○ Method and time of payment;
	  ○ Benefits agreed upon.
	• Article 21: A probation period shall be no more than 3 months. 1 days' notice of termination by either party is required during this time.

Wages	• Article 40: Wages shall be paid at least once per month. • Article 44: An employer shall not deduct more than 10% of a workers' wages in repayment of any loans (unless the loan for the building of houses). An employer is not permitted to charge interest on any such loans.
Working Hours	• Article 50: Workers engaged on a night shift basis shall receive compensation for the nature of their job. • Article 51: The maximum working hours per week is 48 (excluding Ramadan for Muslim workers). • Article 52: A worker may not work more than 6 hours without a break. • Article 54: Any hours worked in excess of 48 hours per week is to be paid at 125% of the worker's wage entitlement. • Article 57: Friday is deemed the weekly day of rest. No employee shall work the weekly day for rest more than 2 successive times without his written consent. • Article 64: An employee required to work on official occasions issued by the Council of Ministers (public holidays) are entitled to his/her wage for such day in addition to overtime wages of 150%, or another day off in lieu as elected by the worker.
Leave	• Article 58: A worker who has completed at least 1 years' service shall be entitled to annual leave of no less than 30

Subject	Requirements from Bahrain Labour Law (with Article No.)
	days. • Article 65: A worker who has completed 3 months of service, shall be granted 15 days sickness per year on full pay.
Notice of Termination	• Article 40: If a worker leaves employment, all wages and entitlements must be paid within 7 days. • Article 96: A contract of employment for a specified period ends at the end of its stated duration. • Article 105: Outside of probation and serious misconduct, either party may terminate a contract of employment with 30 days' notice.
Dismissal	• Article 104: A dismissal shall be deemed as unfair if for any of the following reasons: o Sex, colour, religion, belief, social status, family responsibility, pregnancy, child birth, suckling an infant; o Membership of our representation in a trade union or participation in its activities as prescribed by relevant laws; o Filing complaint, report or court case against the employer unless it is of a vexatious nature; o Placement of an attachment upon the workers entitlements held by employer.
Discrimination	• Article 29: Discrimination on the basis of gender is prohibited. • Article 39: It is prohibited to discriminate in the payment of wages on basis of sex, ethnic origin, language, religion or belief.
Workplace Injuries	• Article 87: A worker injured at the workplace is entitled to receive treatment in a government medical institution or other appropriate care facility at the employers cost. Unless the injury is self-inflicted, caused by deliberate misbehaviour or violation of employers instructions.

14.11.1.4 Payment of Wages

ALBA should put in place payroll audits for construction contractors and the supply chain to provide evidence on a monthly basis that all workers have been paid in accordance with their contracts and no illegal fees are deducted from salaries. Auditing should include the should include provision of terms and conditions of employment for all workers for auditing, as needed. This will reduce the potential impact of this issue to Negligible.

14.11.1.5 Grievance Mechanism

All workers, and migrant workers in particular, should have access to grievance mechanisms that allow them to voice concerns without fear of punishment or retribution. ALBA will develop a specific workers' grievance mechanism for the project to provide a transparent and easily accessible way for workers to raise and address grievances. The mechanism should include procedures for the following:

- Registering the grievance;
- Screening and assessing the complaint;
- Formulating a response and settling the issue;
- Evaluate and monitor the results; and
- Sharing results for the purpose of 'lessons learnt'.

The grievance mechanism should be available in a language understandable to the workers and awareness campaigns should be implemented to raise awareness of the worker grievance mechanism. Contractors and sub contractors should report regularly to ALBA regarding any grievances raised and if/how these were resolved.

14.11.1.6 Labour Accommodation

All immigrant construction workers should be housed in accommodation which meets in full the requirements of *Ministerial Order No. 40 of 2014 with respect to the requirements and specification of workers' accommodation*.

Workers should also have access to the following:

- medical and dental facilities;
- places of worship;
- a range of sports and leisure facilities including indoor and outdoor facilities;
- shops and banking facilities;
- internet and telecommunications;
- organised transportation to allow them to leave the accommodation and have access to Manama centre and major shopping centres, on non-working days.

Worker accommodation should be inspected and approved before contractor mobilisation to site. Thereafter the labour camps should be audited every three months to ensure they meet legal and guidance requirements. These measures should reduce the potential impacts to Negligible.

14.11.2 Public Health

It is recommended that ALBA require all construction contractors to provide health education campaigns to their workers to provide information on the policies regarding STDs, their impacts, symptoms and prevention measures.

14.11.3 Child Labour

Child labour is not likely to be a significant issue for the project, but ALBA should ensure that the project HR policy and procedures should have specific requirements banning child labour and these are incorporated into supplier contracts and they are obligated to apply these to their sub contractors. Contractors and sub contractors should be audited prior to mobilisation and annually to ensure compliance.

14.12 Summary

Table 14.4 shows a summary of the potential impacts and identified mitigation and monitoring requirements.

Table 14.4 Summary of Impacts for Labour and Working Conditions

Issue / Impact	Potential Significance (Minor/Moderate/Major) (Beneficial/Adverse/Negligible)	Mitigation / Monitoring / Enhancement Measures	Residual Impacts (Slightly/Moderate/Major) (Beneficial/Adverse/Negligible)
The use of forced labour	Major Adverse	• Establishing HR policy and procedures for Expansion Project in compliance with IFC PS2 requirements, including provision of a clear and understandable written statement of rights to each employee. • Application of mitigation in respect of human resource policy and procedures to employees of all (sub) contractors. • Ensuring all procurement contracts contain clauses banning forced labour. • Ensure (sub) contractors only use accredited local recruitment companies (in country of worker origin) to recruit workers. • Forbid the use of recruitment and other fees (such as payment for accommodation and transportation to/from home country). • Workers to retain access to their passport. • Run campaigns to raise awareness of worker rights, particularly in the context of forced labour; • Provide all employees with a Contract of Employment which contains all the items in **Table 14.3**. • Establishment of a grievance mechanism	Negligible

Issue / Impact	Potential Significance (Minor/Moderate/Major) (Beneficial/Adverse/Negligible)	Mitigation / Monitoring / Enhancement Measures	Residual Impacts (Slightly/Moderate/Major) (Beneficial/Adverse/Negligible)
		for employees of all (sub) contractors. • Make the grievance mechanism available in a language understandable to the worker. • Run campaigns to raise awareness of the worker grievance mechanism. • (sub) contractors to report regularly on grievances raised through the grievance mechanism and if/how these were resolved. • ALBA to put in place requirements to conduct payroll audits on a monthly basis to ensure that (sub) contractors pay workers wages in full and no illegal fees are deducted from workers salaries. Payroll audits should include an audit of worker contracts to determine if they meet the required terms and conditions of employment. • Auditing of (sub) contractor to ensure relevant policy, procedures and contract requirements are in place prior to mobilization. • Auditing of (sub) contractors annually to ensure relevant policy procedures and contract requirements remain in force. • Labour accommodation should be inspected and approved to ensure labour camps meet Bahraini law and IFC / EBRD guidelines	

Issue / Impact	Potential Significance (Minor/Moderate/Major) (Beneficial/Adverse/Negligible)	Mitigation / Monitoring / Enhancement Measures	Residual Impacts (Slightly/Moderate/Major) (Beneficial/Adverse/Negligible)
		before (sub) contractor mobilization. • Labour accommodation should continue to be audited every three months to confirm continued compliance with Bahraini law and IFC / EBRD guidelines.	
The use of child labour	Negligible	• Establishing HR policy and procedures for Expansion Project in compliance with IFC PS2 requirements, including provisions banning child labour • Ensuring all procurement contracts contain clauses banning child labour. • Auditing of (sub) contractors to ensure relevant policy, procedures and contract requirements are in place prior to mobilization. • Auditing of documents annually to confirm continued compliance with relevant policy, procedures and contract requirements.	Negligible
An increase in STDs amongst workers and the local communities	Minor Adverse	• ALBA to require contractors to implement public health campaigns on STD impacts, symptoms and prevention.	Negligible

15 MANAGEMENT AND MITIGATION

15.1 Introduction

This section provides a tabulated summary of the mitigation and management measures identified within each supplementary ESIA section. It does not include mitigation and management measures identified in the 2014 ESIA Report and already included in project CEMPs and OEMPs. It only addresses any additional requirements identified as a result of the Supplementary ESIA.

15.2 Stakeholder Engagement

The Supplementary ESIA has identified requirements for development of project wide Stakeholder Management Plan and undertaking additional stakeholder engagement in the form of an exhibition regarding the environmental and social impacts of the project. The outcomes of the exhibition will need to be analysed and used to formulate further stakeholder engagement activities where this will be appropriate.

ALBA has formed a Stakeholder Engagement Management Group which will organize the exhibition and take this activity forward. **Table 15.1** summarises the management actions required.

15.3 Construction Phase

Traffic management, HSE management of contractors and social welfare of workers remain key topics for the construction phase and activities for ALBA to implement through its contractors and supply chain are identified.

Monitoring of implementation of these measures will be undertaken by the independent environmental consultant and reported monthly to ALBA, relevant contractors and the SCE.

The changes to the project design have not had any significant impact on the construction phase mitigation and management requirements.

Table 15.2 shows as summary of management actions required for the construction phase. Management of impacts from commissioning have been included in the construction phase table as they will be the responsibility of the construction contractors.

15.4 Operational Phase

Additional mitigation measures identified are included in **Table 15.3**. In general operational phase requirements have already been addressed by current ALBA practices and the findings of the 2014 ESIA Report. However, there are additional requirements to undertake improvements in the surface water discharge quality, implement groundwater monitoring and make improvements to human resources procedures to meet full compliance with IFC Performance Standards.

15.5 Decommissioning and Demolition

Mitigation measures specific to decommissioning and demolition are shown in **Table 15.4**. Decommissioning and demolition will require development of written plans and method statements to include measures to protect health and safety, survey and remove hazardous materials and manage wastes.

Table 15.1 Summary of Required Actions for Stakeholder Engagement

Issue / Impact	Mitigation / Monitoring / Enhancement Measures
Stakeholder Engagement Plan	• Development of a project-wide Stakeholder Engagement Plan
Grievance Mechanism	• Development and implementation of a project-wide external grievance mechanism
Exhibition	• Undertake an exhibition inviting feedback on the environmental and social impact of the project from identified stakeholder groups.
Follow up Engagement	• Analyse the feedback from the exhibition and other consultations. • Revise mitigation and management plans where appropriate. Identify what aspects of stakeholder engagement it is appropriate to continue. • Update SEP to include feedback and outcomes of exhibition and other consultations.

Table 15.2 Construction Phase Management and Mitigation Requirements

Construction Phase Impact	Impact Significance	Mitigation Summary	Residual Impact
Air Quality			
Construction – Dust emissions	Negligible	• IAQM Construction Dust Guidance mitigation measures, all of which are best practice measures for large scale international construction projects and are contained within the Potline 6 and PS5 CEMPs.	Negligible
Construction – off-site traffic emissions	Negligible	• Off-site vehicle movements associated with materials deliveries and construction worker transportation are all sufficiently distant from residential settlements, that emissions will not have a material effect on ambient air quality at receptor locations.	Negligible
Commissioning			
Discharges to Surface Water	Significant	• Control of discharges – storage, neutralization etc. • Appropriate testing to demonstrate compliance with Project Standards.	Negligible
Simultaneous Operation of New and Old Power Stations. Operation of Power Station 2 and additional units of Power Station 3 alongside Power Station 4 and 5 will lead to additional mass emissions to air that will impact air quality.	Significant	• ALBA to develop a plan to minimize simultaneous operation of new and old power stations during commissioning	Negligible
Solid Wastes (in excess of those already identified).	Negligible	• No additional mitigation required.	Negligible

Construction Phase Impact	Impact Significance	Mitigation Summary	Residual Impact
Waste			
Management of construction wastes	Not described in 2014 ESIA	• As described in 2014 ESIA Report and CESMPs.	Low / Moderate (as described in 2014 ESIA)
Vibration			
Vibration Impact on sensitive environmental receptors.	Negligible	• None required.	Negligible
Geology and Hydrogeology			
Jawed and Surrounds - waste materials and contaminated soil causing on-going contamination of soil or groundwater if left in place during development.	Minor Adverse	• Removal of waste material, site investigation and assessment.	Minor Beneficial
STP Site – Contaminated soil causing on-going contamination of soil or groundwater if left in place during development.	Minor Adverse	• Site investigation and remediation by removal of contaminated soil.	Minor Beneficial - Remediation Validation Report to be completed
CLA - Contaminated soil causing on-going contamination of soil or groundwater if left in place during development.	Negligible	• Not required.	Negligible
Casthouse 4 - Dewatering groundwater disposal.	Minor Adverse	For discharge to surface water: • Agree the discharge point with SCE. • Test the discharge groundwater prior to discharge against Project Standards for effluents in ACOPC C001 • Use of settlement tanks to reduce Floating particles and Total	Negligible

Construction Phase Impact	Impact Significance	Mitigation Summary	Residual Impact
		Suspended Solids (TSS) to Project Standards Or tanker away or discharge to sewer. Or use for dust suppression on site.	
Occupational Health and Safety			
Construction work	Major - Minor	• H&S assessment of contractors and during pre-qualification and qualification stages. • Inclusion of H&S management requirements into formal contract documents. • Development of a H&S control plan (including method statements, standard operating procedures and risk assessments). • Speed limits and warning signs should be respected at all times on the local road network. • All traffic should stay within road corridors. • On busy roads, consideration should be given to the use of flag-men for vehicles with large loads entering the road network. • Maintenance of roads should be implemented at all times to ensure that they are kept clear of any sand and debris. • A permit to work system should be implemented for higher risk activities. • Induction training and awareness training of workers regarding occupational safety issues on-site. • Provision of safety facilities. • Provision of safety tools and clothing (i.e. PPE) such as hard hats,	Negligible

Construction Phase Impact	Impact Significance	Mitigation Summary	Residual Impact
		safety boots, eye protection, ear protectors, respiratory protection against emissions and fumes, gloves for handling certain types of materials and waste, etc. • Provision of emergency response equipment such as first aid boxes (which need to be checked frequently), adequate water supply, and eye wash stations and emergency showers if appropriate. • Correct storage and handling of hazardous materials. • Continuous provision of drinks and sheltered/shaded areas for laborers, especially during the summer months to avoid heat stress. • Supervisors should provide frequent breaks for employees, air conditioned refuges for breaks where practicable, and electrolyte solutions to maintain body chemistry in order to minimize the effects of heat stroke. • Emergency Response Plan for construction phase. • Routine inspections, auditing, near-miss reporting and investigation with implementation of improvements.	
Community Health and Safety			
Management of Security Personnel	Minor Adverse.	• Use of licenced, background checked and trained security personnel.	Negligible
Traffic and Access			
Access to Site Through South ALBA Industrial Estate	Significant	• ALBA to maintain overall control of traffic management and ensure that Potline 6 and PS5 TMPs are co-ordinated. • Implement TMPs for Potline 6 and PS5/PDS sites to be followed by all contractors and suppliers. TMPs have the following key features: • Transport Manager appointed and responsible for TMP	Significant but minimized as far as reasonably practicable.

Construction Phase Impact	Impact Significance	Mitigation Summary	Residual Impact
		implementation; • On-going liaison with SAIE occupants; • Access points to SAIE limited to the vehicle types and uses described; • Deliveries to be managed to avoid peak periods and shift changes; • Road improvements to create a slip road into the CLA; and • Strengthening of culverts to be implemented.	
Transportation of Abnormal Loads	Significant	• Transportation of abnormal loads to be co-ordinated with authorities.	Negligible
Labour and Working Conditions			
The use of forced labour	Major Adverse	• Establishing HR policy and procedures for Expansion Project in compliance with IFC PS2 requirements, including provision of a clear and understandable written statement of rights to each employee. • Application of mitigation in respect of human resource policy and procedures to employees of all (sub) contractors. • Ensuring all procurement contracts contain clauses banning forced labour. • Ensure (sub) contractors only use accredited local recruitment companies (in country of worker origin) to recruit workers. • Forbid the use of recruitment and other fees (such as payment for accommodation and transportation to/from home country). • Workers to retain access to their passport.	Negligible

Construction Phase Impact	Impact Significance	Mitigation Summary	Residual Impact
		• Run campaigns to raise awareness of worker rights, particularly in the context of forced labour; • Provide all employees with a Contract of Employment which contains all the items in **Table 14.3**. • Establishment of a grievance mechanism for employees of all (sub) contractors. • Make the grievance mechanism available in a language understandable to the worker. • Run campaigns to raise awareness of the worker grievance mechanism. • (sub) contractors to report regularly on grievances raised through the grievance mechanism and if/how these were resolved. • ALBA to put in place requirements to conduct payroll audits on a monthly basis to ensure that (sub) contractors pay workers wages in full and no illegal fees are deducted from workers salaries. Payroll audits should include an audit of worker contracts to determine if they meet the required terms and conditions of employment. • Auditing of (sub) contractor to ensure relevant policy, procedures and contract requirements are in place prior to mobilization. • Auditing of (sub) contractors annually to ensure relevant policy procedures and contract requirements remain in force. • Labour accommodation should be inspected and approved to ensure labour camps meet Bahraini law and IFC / EBRD guidelines before (sub) contractor mobilization. • Labour accommodation should continue to be audited every three months to confirm continued compliance with Bahraini law and IFC /	

Construction Phase Impact	Impact Significance	Mitigation Summary	Residual Impact
		EBRD guidelines.	
The use of child labour	Negligible	• Establishing HR policy and procedures for Expansion Project in compliance with IFC PS2 requirements, including provisions banning child labour • Ensuring all procurement contracts contain clauses banning child labour. • Auditing of (sub) contractors to ensure relevant policy, procedures and contract requirements are in place prior to mobilization. • Auditing of documents annually to confirm continued compliance with relevant policy, procedures and contract requirements.	Negligible
An increase in STDs amongst workers and the local communities	Minor Adverse	• ALBA to require contractors to implement public health campaigns on STD impacts, symptoms and prevention.	Negligible

Table 15.3 Operational Phase Management and Mitigation Requirements

Operational Phase Impact	Impact Significance	Mitigation Summary	Residual Impact
Air Quality			
Operation – changes in combustion-related emissions	Negligible. Revisions to the expansion project will not give rise to significant changes in overall NOx, SO_2, CO, PM and other pollutant emissions.	• SCE require emission monitoring on a quarterly basis and reporting every six months.	Negligible
Operation – changes in fugitive HF emissions	Negligible. Concentration of fugitive HF emissions from roof vents will not change.	• Current Potline HF emissions from roof vents comply with the Bahraini emission standard and would be expected to do so for the Potline 6 plant. • Measurements of roof vent emissions and ambient ground level concentrations will continue.	Negligible
Operation – changes in GHG emissions	Negligible. Revisions to the Line 6 Expansion Project will not result in significant changes to GHG emissions.	• The existing ALBA facility is an energy-intensive plant and the expansion in production will give rise to greater CO_2e emissions. • Energy efficiency considerations are part of the design and operation philosophy. • GHG emissions should be calculated and publically reported annually in accordance with IFC requirements.	Negligible
Vibration			
Vibration Impact on sensitive environmental receptors.	Negligible	• None required.	Negligible

Operational Phase Impact	Impact Significance	Mitigation Summary	Residual Impact
Surface Water			
Discharges to Surface Water.	Minor Adverse	• ALBA should undertake a program of investigation and corrective actions to ensure that the smelter site effluent is fully compliant with Project Standards from the commencement of Line 6 and Power Station 5 operation.	Negligible
Waste			
Spent Pot Lining waste	Not described in 2014 ESIA	• As described in 2014 ESIA Report and OESMP.	Low / Moderate (as described in 2014 ESIA)
Other operational wastes	Negligible	• 1% increase in expected quantities over 2014 ESIA.	Negligible
Vibration			
Vibration Impact on sensitive environmental receptors.	Negligible	• None required	Negligible
Geology and Hydrogeology			
Groundwater contamination – impact of contaminants from smelter operations on groundwater quality.	Minor Adverse	• Groundwater monitoring – Develop and implement an updated groundwater monitoring plan.	Minor Adverse
Occupational Health and Safety			
Operations	Major - Minor	• Use safety in design processes (e.g. HAZID / HAZOP) to identify and eliminate or minimize H&S hazards. • Prequalify contractors and subcontractors on criteria including H&S performance. • Work to an accredited documented H&S Management System and	Negligible

Operational Phase Impact	Impact Significance	Mitigation Summary	Residual Impact
		integration of L6 expansion into the existing ISO 18001 system. • Employment of H&S professionals and adequate company resources to implement H&S management system. • Prepare H&S risk assessments for all activities. • Use of safe systems of work. • Operate a permit-to-work system for higher risk activities. • Operate a vehicle permit system. • Training and awareness of workers regarding occupational safety issues on site. Provide appropriate PPE, e.g. hearing protection, safety glasses, respiratory protection, protective (non-flammable) clothing, rubber boots. • Provision of first aid facilities together with personnel trained in its use. • Inspections, audits, reporting and feedback. • Occupational exposure monitoring, pre-employment checks and health surveillance..	
Emergency Situations and Response	Major - Moderate	• General safety in design practice studies e.g. HAZID / HAZOP. • Operating and maintaining the equipment in accordance with operation and maintenance manuals and approved procedures; • Updating the site Safety Plan and Emergency Response Plan, equipment, facilities and training requirements to account for operation of Line 6 expansion. • Communicating the Plans to regulatory authorities, emergency services and the community.	Negligible
Community Health and Safety			

Operational Phase Impact	Impact Significance	Mitigation Summary	Residual Impact
Transportation of Dross	Significant	• Dross should be transported off site only when cold and in weather-proof packaging.	Negligible
Off site risks from Emergency Situations	Negligible	• Safety in design studies confirm there are no applicable hazard scenarios that could have off-site consequence requiring a planned emergency response with site neighbours.	Negligible
Labour and Working Conditions			
The use of forced labour	Major Adverse	• Establishing HR policy and procedures for Expansion Project in compliance with IFC PS2 requirements, including provision of a clear and understandable written statement of rights to each employee. • Application of mitigation in respect of human resource policy and procedures to employees of all (sub) contractors. • Ensuring all procurement contracts contain clauses banning forced labour. • Ensure (sub) contractors only use accredited local recruitment companies (in country of worker origin) to recruit workers. • Forbid the use of recruitment and other fees (such as payment for accommodation and transportation to/from home country). • Workers to retain access to their passport. • Run campaigns to raise awareness of worker rights, particularly in the context of forced labour; • Provide all employees with a Contract of Employment which contains all the items in **Table 14.3**. • Establishment of a grievance mechanism for employees of all (sub) contractors.	Negligible

Operational Phase Impact	Impact Significance	Mitigation Summary	Residual Impact
		• Make the grievance mechanism available in a language understandable to the worker. • Run campaigns to raise awareness of the worker grievance mechanism. • (sub) contractors to report regularly on grievances raised through the grievance mechanism and if/how these were resolved. • ALBA to put in place requirements to conduct payroll audits on a monthly basis to ensure that (sub) contractors pay workers wages in full and no illegal fees are deducted from workers salaries. Payroll audits should include an audit of worker contracts to determine if they meet the required terms and conditions of employment. • Auditing of (sub) contractor to ensure relevant policy, procedures and contract requirements are in place prior to mobilization. • Auditing of (sub) contractors annually to ensure relevant policy procedures and contract requirements remain in force. • Labour accommodation should be inspected and approved to ensure labour camps meet Bahraini law and IFC / EBRD guidelines before (sub) contractor mobilization. • Labour accommodation should continue to be audited every three months to confirm continued compliance with Bahraini law and IFC / EBRD guidelines.	
The use of child labour	Negligible	• Establishing HR policy and procedures for Expansion Project in compliance with IFC PS2 requirements, including provisions banning child labour • Ensuring all procurement contracts contain clauses banning child labour.	Negligible

Operational Phase Impact	Impact Significance	Mitigation Summary	Residual Impact
		• Auditing of (sub) contractors to ensure relevant policy, procedures and contract requirements are in place prior to mobilization. • Auditing of documents annually to confirm continued compliance with relevant policy, procedures and contract requirements.	
An increase in STDs amongst workers and the local communities	Minor Adverse	• ALBA to require contractors to implement public health campaigns on STD impacts, symptoms and prevention.	Negligible

Table 15.4 Decommissioning and Demolition Management and Mitigation Requirements

Decommissioning and Demolition Phase Impact	Impact Significance	Mitigation Summary	Residual Impact
Decommissioning and Demolition Work	Major - Minor	• Prequalify contractors and subcontractors on criteria including H&S performance. • Use contractors experienced in decommissioning and demolition work. • Develop a written decommissioning and demolition plan. • Undertake hazardous materials surveys to include asbestos and PCBs as applicable. • Remove hazardous materials under controlled conditions prior to commencing general demolition. • Isolate all services. • Drain down, clean and vent pipes and tanks as needed. • Remove economically recoverable materials prior to demolition. • Plan the demolition sequence to ensure stability of buildings and obtain advice of a structural engineer as needed. • Use remote demolition techniques if possible. • Use of safe systems of work. • Operate a permit-to-work system for decommissioning and demolition. • Training and awareness of workers regarding occupational safety issues on site. Provide appropriate PPE.	Negligible
Disconnection and Isolation of Services (uncontrolled releases to	Significant	• Survey and block off possible drainage routes.	Negligible

Decommissioning and Demolition Phase Impact	Impact Significance	Mitigation Summary	Residual Impact
drains)		• Maintain spill kits on site and train staff in spill response procedures.	
Removal of hazardous materials	Significant	• Appropriate surveys and planning of work. • Use of appropriately trained contractors. • Management controls (e.g. limiting access, controlled removal).	Negligible
Dust emissions from demolition	Significant	• The emissions can be controlled by water sprays.	Negligible
Demolition Waste	Significant	• Development of a waste management plan to maximise reuse and recycling of wastes.	Negligible

Environment Arabia

APPENDIX 1A

August 2017 ESAP

APPENDIX 4A

Copies of Communications with SCE

The following items are included:

- Letter from SCE: Commencement of Construction Activities for Line 6 (dated 9th August 2016)
- Letter from SCE on Dewatering Activities (dated 15th November 2016)
- Letter to submit CEMP and OEMP to SCE (dated 26th of September 2016)
- Letter from SCE on CEMP (dated 21st November 2016)

APPENDIX 4A

Copies of Communications with Stakeholders

The following items are included:

- Letter from alba to all businesses (dated 14th May 2017)
- Letter from ALBA to Southern Governorate (23rd July 2017)
- Stakeholder Meeting Presentation to South ALBA Governorate
- Migrant Workers Protection Society Meeting Notes (28th May 2017)

Environment Arabia

APPENDIX 6A

ALBA Code of Practice for Construction Phase (ACOPC No. C001)

Environment Arabia

APPENDIX 10A

Phase I Soil and Groundwater Site Assessment Report

Environment Arabia

APPENDIX 10B

Phase II Soil and Groundwater Site Assessment Report