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# 1.0 INTRODUCTION

## 1.1 Preamble

This Environmental Impact Assessment Report (EIAR) relates to a Planning Application by *Aughinish Alumina Limited*[1] [AAL] (the Applicant) for development at an existing alumina facility located in the townlands of Aughinish East, Aughinish West, Island Mac Teige, Glenbane West, and Fawnamore at or adjacent to Aughinish Island, Askeaton, Co. Limerick.

The alumina facility is operated in accordance with the Conditions of the Industrial Emissions Licence (IEL) P0035-07 issued by the Environmental Protection Agency (EPA).


**Figure 1.1:** Aerial view of the site and its surrounding context (source: www.myplan.ie 2021, Annotated by TPA).

The lands subject to this current application measure c. 222 ha and currently accommodate processes associated with the operation of the adjoining refinery plant located to the north west of the subject site. The overall landholding of the Applicant including the subject site, the refinery plant, nature trails and ancillary areas extends to c. 601 ha.

The proposed development comprises of:

- An expansion of the Bauxite Residue Disposal Area (BRDA) to increase its disposal capacity in order to accommodate additional bauxite residue resulting in a proposed increase in height of c.12m (to c. 44m OD) above the currently permitted levels. No increase to the existing footprint of the BRDA is proposed.

- An extension to the existing Salt Cake Disposal Cell (SCDC) to accommodate further disposal of salt cake resulting in an increase in height of the cell by c.2.25m. The SCDC is located within the BRDA area. A description of the existing SCDC and its function is provided in Chapter 2 of this EIAR.

[1] Aughinish Island, Askeaton, Co. Limerick

- An extension of the permitted borrow pit[2], located to the east of the BRDA, is also proposed. This extension proposes to increase the footprint of the borrow pit from c.4.5ha to c.8.4ha. This extension will provide an additional 380,000m$^3$ of rock fill material which is needed to satisfy the requirements of the construction and operation of the BRDA.

- The continued use of an existing stockpile area at the south east of the subject site to store topsoil in order to satisfy the additional restoration requirements of the extended BRDA.

- Upgrades to the existing water management infrastructure to accommodate the BRDA development to Stage 16 which will also allow for greater Inflow Design Flood (IDF) capacity for the entirety of the BRDA.

A description of the BRDA and its function in the alumina production process is provided in Chapter 2 of this EIAR.

As set out in Section 1.6 below, the proposed development is of a class that requires a mandatory *Environmental Impact Assessment (EIA)* and the preparation of an Environmental Impact Assessment Report (EIAR). A Non-Technical Summary has also been prepared which provides a concise outline of the main topics covered within this EIAR. In addition, given the proximity to River Shannon and River Fergus Estuaries and the Lower River Shannon, which are Natura 2000 sites, a Natura Impact Statement (NIS) is also submitted with the planning application.

It is further noted that a consultation meeting took place with An Bord Pleanála on 19th February 2021 in order to determine whether the proposed development constitutes strategic infrastructure development and falls within the criteria set out in section 37(A)(2) of the Planning and Development Acts, 2000 (as amended).

Further to this consultation meeting, the Board subsequently decided, by letter dated 1st April 2021, that it is of the opinion that the proposed development falls within the scope of paragraphs 37A(2) of the Acts, that the development would be strategic infrastructure development and that any application for permission for the proposed development must therefore be made directly to An Bord Pleanála, as a Strategic Infrastructure Development (SID) under Section 37E of the Acts. In accordance with this determination, the subject application (including this EIAR) is submitted to An Bord Pleanála under section 37E of the Planning and Development Acts, 2000 (as amended).

## 1.2 Need for Proposed Development

The existing alumina refinery at Aughinish is the largest of its kind in Europe and is thus of strategic national and continental importance. Aluminium, which is ultimately produced from alumina, is of increasing importance as economies transition towards a low carbon future. The metal's light-weight nature, corrosion resistant qualities, and recyclability are all characteristics which have resulted in its application in renewable technologies such as solar photovoltaic (PV) panels and electric vehicles.

[2] Limerick City and County Council (LCCC) Reg. Ref. 17/714; An Bord Pleanála (ABP) Ref. 301011-18

The production of alumina is thus critical to facilitating the production of renewable technologies and thereby ensuring that a low carbon and green economy centred on renewable energy production and electric transport modes can be delivered.

Alumina plants are capital intensive because of the nature and size of equipment employed in the process of refining bauxite. Such major start-up capital investments invariably present significant challenges for development at new greenfield locations. As a result, the efficient operation and expansion of existing facilities is of critical importance in ensuring that alumina supply is maintained to satisfy worldwide demand.

The maximum production level permitted at the refinery plant is and will remain at c.1.95 million tonnes of alumina per annum. This represents 30% of the alumina produced in Europe. In order to protect such production levels, future disposal capacity for bauxite residue is required. This application seeks to ensure that such disposal capacity is appropriately accommodated on site to secure the continued operation of the alumina facility.

## 1.3 The Applicant

Aughinish Alumina Limited (the Applicant) operates a long-established alumina facility, located on Aughinish Island on the southern side of the Shannon Estuary near the industrial port of Foynes, Co. Limerick. The landholding extends to c. 601 ha.

The industrial activity undertaken at the facility comprises the processing of bauxite in order to extract alumina (aluminium oxide) which is required for the production of aluminium as well as having a number of other industrial uses. The bauxite, which is transported by ship from South America and West Africa, is unloaded at a dedicated Marine Terminal located in the Shannon Estuary, and transferred by enclosed conveyor to the plant, where the bauxite is refined to produce alumina, an operation known as the 'Bayer Process'.

The 'Bayer Process' results in the production of alumina and a bauxite residue, which is deposited in the Bauxite Residue Disposal Area ('BRDA'). The alumina refinery plant is permitted[3] to produce up to 1.95 million tonnes of alumina per annum, which is exported to smelters where it is used to produce aluminium.

The alumina facility commenced operations in 1983, and has been the subject of considerable expansion and investment over the intervening years. The plant is now one of the most efficient alumina refineries in the world, and the state-of-the-art facilities provide a total of c. 482 jobs directly plus 385 maintenance and installation contractor employees, and considerable further employment for local service industries.

AAL is owned by RUSAL, a leading aluminium producer, with interests throughout the aluminium production process – from bauxite ore mines to alumina extraction plants to aluminium smelters.

[3] Planning Permission Limerick County Council (LCC) Reg. Ref. 05/1836 (ABP Ref. PL13.217976) refers.

## 1.4 Purpose of the Environmental Impact Assessment Report

In order to ensure that all potential impacts associated with the development proposal are identified and addressed, this EIAR provides a systematic and integrated evaluation of the direct, indirect and secondary effects (positive and negative) of the project on the natural and socio-economic environment.

The aim of the approach is to identify and predict (for a given proposed development) any impacts of consequence; to describe the means and extent by which they can be avoided in the first instance or reduced or ameliorated; to interpret and communicate information about the impacts; and to provide an input into the decision making and planning process.

The aim of the EIAR is to:

- Describe the proposed development using information on the site, design and size;
- Identify and predict any impacts on environmental features likely to be affected, having regard to the specific characteristics of the proposed development;
- Describe the measures envisaged in order to avoid, reduce and, where possible, mitigate significant adverse effects;
- Provide the data required to identify and assess the main effects which the proposed development is likely to have on the environment; and
- Provide a Non-Technical Study of the information.

The preparation of the *EIAR* has been co-ordinated by Tom Phillips + Associates, Town Planning Consultants,[4] in association with other members of the Project Team as identified in Section 1.8 below.

A copy of the full EIAR is available for reference/purchase at the offices of Limerick City and County Council, Dooradoyle, Limerick, at the offices of An Bord Pleanála and online at the dedicated website prepared in respect of this Strategic Infrastructure Development (SID) planning application – ***www.brdasid.ie.***

## 1.5 EIA Process

EIA requirements are governed by Directive 2011/92/EU as amended by Directive 2014/52/EU. The primary objective of the EIA Directive is to ensure that projects that are likely to have significant effects on the environment are subjected to an assessment of their likely impacts.

EIA forms part of the planning consent process and is carried out by the Competent Authority. An EIAR is prepared by / on behalf of a Developer in respect of the proposed development. The EIAR thus becomes an integral informing element in the Competent Authority's EIA. Directive 2014/52/EU introduced strict new requirements in respect of the competency of experts responsible for the preparation of the EIAR (see Table 1.1 below and Appendix 1.1 for details on the experts involved in the preparation of this document).

[4] Tom Phillips + Associates, Town Planning Consultants, 80 Harcourt Street, Dublin 2, D02 F449

## 1.6 Need for EIA

The proposed development is covered by the following classes of development in the EIA Directive.

- Schedule 5, Part 2 Class 11(b) of the *Planning and Development Regulations, 2001 (as amended),* an EIAR is a mandatory requirement for *"Installations for the disposal of waste with an annual intake greater than 25,000 tonnes not included in Part 1 of this Schedule".* The proposal seeks the disposal of c. 1.57 million tonnes of bauxite residue per annum which would exceed this threshold.

- Schedule 5, Part 2, 2(b) of the *Planning and Development Regulations, 2001 (as amended),* an EIAR is a mandatory requirement for the "*Extraction of stone, gravel, sand or clay, where the area of extraction would be greater than 5 hectares".* The proposal seeks to extend the permitted borrow pit by c. 3.9 hectares which would create an overall borrow pit of c. 8.4 hectares and thus exceed the threshold.

As noted in Section 1.1 of this chapter, consultation was undertaken with An Bord Pleanála in respect of the proposed development and correspondence was subsequently issued by the Board confirming that the development fell within the scope of paragraphs 37A(2) of the Acts and thus constituted Strategic Infrastructure Development. As such, the subject application is an SID application submitted directly to the Board and must therefore be accompanied by an EIAR.

As noted in the Preamble to the EIAR, a Non-Technical Summary of the EIAR has also been submitted.

A core objective of this EIAR is to provide the appropriate information and evaluation of the proposed development, having regard to the specific characteristics of the development, the scale of the development and the potential for significant effects arising from the development.

## 1.7 EIAR Methodology and Format

In addition to the EIA Directive, this EIAR has been prepared with reference to the following guidance documents:

- *Draft Guidelines On The Information To Be Contained In Environmental Impact Assessment Reports* (EPA, August 2017);

- *Advice Notes for Preparing Environmental Impact Statements,* Draft, (EPA September 2015);

- *Environmental Impact Assessment of Projects: Guidance on Screening* (European Commission, 2017);

- *Environmental Impact Assessment of Projects: Guidance on Scoping* (European Commission, 2017);

- *Environmental Impact Assessment of Projects: Guidance on the preparation of the Environmental Impact Assessment Report* (European Commission, 2017);

- *Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment* (Department of Housing, Local Government and Heritage, August 2018);

EIARs require the assimilation, co-ordination and presentation of a wide range of relevant information in order to allow for the overall assessment of proposed development. To allow for ease of presentation, and consistency when considering the various elements of the environment and the proposed development, a systematic structure is proposed for the main body of the statement.

The structure of the EIAR is outlined below.

### 1.7.1 Receiving Environment (Baseline Situation)

In outlining the receiving environment, the context of the proposed development is described and assessed.

### 1.7.2 Characteristics of the Proposed Development

A description of the location, nature and extent of the proposed development along with its construction and operational characteristics. The description includes estimates of any residues, emissions, or waste produced during the construction and operational stages.

Consideration of the 'Characteristics of the Proposed Development' allows for a projection of the 'level of impact' on any particular aspect of the environment that could arise.

### 1.7.3 Environmental Factors Affected

A list of the environmental factors impacted by the proposed development.

### 1.7.4 Potential Impact of the Proposed Development

A chapter related to each of the relevant environmental factors is contained within the EIAR. Within each chapter, a description of the direct and indirect impacts that the proposed development may have on aspects of the environment likely to be significantly affected is outlined. This is done with reference to both the *Receiving Environment* and *Characteristics of the Proposed Development* sections, while also referring to the magnitude, duration, consequences (including use of natural resources) and significance of the development.

Each chapter assesses the potential impacts on aspects of the environment in a 'Do Something' scenario where the proposed development proceeds and in a 'Do Nothing' scenario' where the proposed development does not proceed.

Given that the construction and operation of the BRDA, SCDC and Borrow Pit will take place in tandem, the traditional separation of construction and operational phases is not considered to be applicable in this instance. As such, it should be noted that whilst construction and operation impacts are identified, these will not take place at distinctly different time periods.

### 1.7.5 Assessment of Alternatives

Chapter 4 of the EIAR describes the reasonable alternatives considered and provides a rationale for the chosen option.

### 1.7.6 Interactions and Cumulative Impacts

Potential interactions and cumulative impacts between effects predicted as a result of the proposed development are referenced within chapters where relevant. Chapter 18 of the EIAR contains a summary of all potential interactions and cumulative impacts arising from the proposed development.

### 1.7.7 Avoidance, Remedial or Reductive Measures

A description of the measures envisaged to prevent, reduce and (where possible) offset any significant adverse effects on the environment that are practicable or reasonable, having regard to the potential impacts. These are summarised in Chapter

### 1.7.8 Residual Impact of the Proposal

Residual effects refer to those environmental effects predicted to remain after the application of mitigation measures and the likely significance of these residual effects are described.

### 1.7.9 Monitoring

This involves a description of monitoring required in a post-development phase, if required. It addresses the effects that require monitoring, in order to confirm the impacts predicted in the EIAR, along with the methodology and the agencies responsible for such monitoring.

### 1.7.10 Reinstatement

While not applicable to every aspect of the environment considered within this EIAR, certain measures need to be proposed to ensure that once operations / extractions are discontinued, an appropriate restoration plan can be implemented with minimal impact on the environment.

## 1.8 EIAR Study Team and Guarantee of Competency and Independence

The EIAR was completed by a project team coordinated by Tom Phillips + Associates, who also prepared a number of the chapters.

The members of the team and their respective inputs are outlined below in Table 1.1. The EIAR Chapters as set out in Table 1.1 are provided with Appendices for each section provided in separate volumes. A separate Non-Technical Summary of the EIAR is also enclosed within the inside cover.

In accordance with EIA Directive 2014/52/EU, we confirm that experts involved in the preparation of the EIAR are fully qualified and competent in their respective fields. Each has extensive proven expertise in the relevant field concerned, thus ensuring that the information provided herein is complete and of high quality. The professional competencies of the EIAR consultants involved in the preparation of each chapter are outlined in Appendix 1.1.

| EIAR Chapter Headings and Contributors | | |
|---|---|---|
| **CHAPTER** | **ASPECT OF THE ENVIRONMENT ASSESSED** | **CONTRIBUTOR** |
| Chapter 1 | Introduction | TOM PHILLIPS + ASSOCIATES |
| Chapter 2 | Site Location and Context | TOM PHILLIPS + ASSOCIATES, GOLDER ASSOCIATES, APPLICANT |
| Chapter 3 | Description of the Proposed Development | TOM PHILLIPS + ASSOCIATES, GOLDER ASSOCIATES, APPLICANT |
| Chapter 4 | Examination of Alternatives | TOM PHILLIPS + ASSOCIATES, APPLICANT |
| Chapter 5 | Archaeology, Architectural and Cultural Heritage | IRISH ARCHAEOLOGICAL CONSULTANCY LTD |
| Chapter 6 | Biodiversity | ECOLOGY IRELAND / RSK / IEH CONSULTING |
| Chapter 7 | Population, Human Health and Agriculture | TOM PHILLIPS + ASSOCIATES / AWN CONSULTING / WSP / Consult UCD |
| Chapter 8 | Land and Soils (Geology and Hydrogeology) | GOLDER ASSOCIATES |
| Chapter 9 | Landscape and Visual Impact | BRADY SHIPMAN MARTIN |
| Chapter 10 | Hydrology | GOLDER ASSOCIATES |
| Chapter 11 | Air Quality | AWN CONSULTING |
| Chapter 12 | Noise and Vibration | AWN CONSULTING |
| Chapter 13 | Material Assets – Waste | GOLDER ASSOCIATES |
| Chapter 14 | Traffic and Transportation | TRANSPORT INSIGHTS |
| Chapter 15 | Material Assets – Site Services | GOLDER ASSOCIATES |
| Chapter 16 | Major Accidents and Disasters | GOLDER ASSOCIATES |
| Chapter 17 | Climatic Factors | AWN CONSULTING |
| Chapter 18 | Interactions and Cumulative Impacts | TOM PHILLIPS + ASSOCIATES |
| Chapter 19 | Mitigation and Monitoring | TOM PHILLIPS + ASSOCIATES |
| Chapter 20 | Difficulties Encountered | TOM PHILLIPS + ASSOCIATES |

**Table 1.1:** EIAR Chapter Headings and Contributors

## 1.9 Stakeholder Consultation

The EPA's *Draft Guidelines on the Information to be Contained in an Environmental Impact Statements* (2017) highlight the importance to 'Facilitate Better Consultation' in the assessment process and it is noted that 'Consultation is a key element of each stage of the EIA process' in order to fully comply with the EIA Directive.

Accordingly, consultation in respect of the proposed development was undertaken with relevant stakeholders. The details of this consultation process are outlined below.

### 1.9.1 Statutory Consultation

As outlined in Section 1.1 of this chapter, a pre-application SID consultation meeting took place between the applicant and An Bord Pleanála on 19th February 2021 in order to determine whether the proposed development constitutes strategic infrastructure and falls within the criteria set out in section 37(A)(2) of the Planning and Development Acts, 2000 (as amended).

Further to that consultation meeting, the Board subsequently decided, by letter dated 1st April 2021, that it was of the opinion that the proposed development falls within the scope of paragraphs 37A(2)(a) and (b) of the Acts, that the development would be strategic infrastructure and that any application for permission for the proposed development should therefore be made directly to An Bord Pleanála, as a Strategic Infrastructure Development (SID) under Section 37E of the Acts.

Arising from the consultation process with ABP, a list of prescribed bodies was issued to the applicant with whom consultation was required. The list of these 16 no. prescribed bodies and the consultation procedure initiated with each body is outlined in Table 1.2 below. A copy of the letter issued to each prescribed body is contained in Appendix 1.2.

| PRESCRIBED BODY | TPA ACTION | RESPONSE DETAILS |
|---|---|---|
| Minister for Housing, Local Government and Heritage | Letter Requesting Consultation Feedback, dated 14th June 2021. | No Response Received |
| **Minister for Environment, Climate and Communications** | **Letter Requesting Consultation Feedback, dated 14th June 2021.** | **RESPONSE RECEIVED** |
| Minister for Tourism, Culture, Arts, Gaeltacht, Sport and Media | Letter Requesting Consultation Feedback, dated 14th June 2021. | No Response Received |
| Minister for Agriculture, Food and the Marine | Letter Requesting Consultation Feedback, dated 14th June 2021. | No Response Received |
| Limerick City and County Council | Letter Requesting Consultation Feedback, dated 14th June 2021. | **No Written Response Received.**<br>**Meeting Undertaken (details below).** |

| PRESCRIBED BODY | TPA ACTION | RESPONSE DETAILS |
|---|---|---|
| The Southern Regional Assembly | Letter Requesting Consultation Feedback, dated 14th June 2021. | No Response Received |
| Environmental Protection Agency | Letter Requesting Consultation Feedback, dated 14th June 2021. | No Response Received |
| **Transport Infrastructure Ireland** | **Letter Requesting Consultation Feedback, dated 14th June 2021.** | **RESPONSE RECEIVED** |
| Failte Ireland | Letter Requesting Consultation Feedback, dated 14th June 2021. | No Response Received |
| **An Taisce** | **Letter Requesting Consultation Feedback, dated 14th June 2021.** | **RESPONSE RECEIVED** |
| The Heritage Council | Letter Requesting Consultation Feedback, dated 14th June 2021. | No Response Received |
| **Inland Fisheries Ireland** | **Letter Requesting Consultation Feedback, dated 14th June 2021.** | **RESPONSE RECEIVED** Site Visit Undertaken (details below) |
| Irish Water | Letter Requesting Consultation Feedback, dated 14th June 2021. | No Response Received |
| Coras Iompair Eireann | Letter Requesting Consultation Feedback, dated 14th June 2021. | No Response Received |
| Commission for Railway Regulation | Letter Requesting Consultation Feedback, dated 14th June 2021. | No Response Received |
| Railway Safety Commission | Letter Requesting Consultation Feedback, dated 14th June 2021. | No Response Received |

**Table 1.2:** Details of Consultation with Prescribed Bodies

As evidenced in the table above, some 4 no. prescribed bodies responded to the consultation letters issued. A summary of each of these written responses is provided below.

***Department of Environment, Climate and Communications (DECC)***

A response, dated 1st July 2021, was received by the *Department of the Environment, Climate and Communications* and *Geological Survey Ireland*. This response included datasets which were considered to be of potential use for the environmental assessment. Also included within this response was additional guidance in relation to geological issues.

This EIAR has had regard to the commentary provided by the Geological Survey Ireland / Department of Environment, Climate and Communications.

***Transport Infrastructure Ireland (TII)***

An email response was received from TII providing general guidance for the preparation of an EIAR, which may affect the national road network.

This EIAR has had regard to the commentary provided by TII.

***An Taisce***

An email response was received from An Taisce, dated 12th July 2021. This response requested that consideration be given groundwater conditions, flooding, cumulative impacts on the Shannon Estuary, potential dust impacts and impacts to relevant buffer zones.

Regard has been had to the above considerations and the EIAR fully addresses any concerns in relation to these items.

***Inland Fisheries Ireland (IFI)***

An email response from Inland Fisheries Ireland was received on 21st June 2021 requesting a site visit to be arranged in order to better inform their comments on the SID application. Further to a site visit, a letter, dated 26th July 2021, was subsequently issued by the IFI seeking clarification on the following items that:

- *the treatment plant downstream of the storm water pond and the storm water pond itself have sufficient capacity to cater for the extension to the BRDA with buffer capacity for future climate change-mediated heavy rainfall events*
- *capacity exists within the discharge flow limit value of 1250m3 to deal with the extension and heavy rainfall events*
- *the proposed borrow pit will not interact with groundwater and give detail as to any drainage and treatment of same associated with the operation of the borrow pit*
- *the integrity of the lining of the drainage channels and stormwater ponds is intact*
- *that silt trapping is adequately treating the clean water captured by the drainage system prior to discharge*

Regard has been had to the above commentary received from Inland Fisheries Ireland and is fully addressed within this EIAR.

***Limerick City and County Council (LCCC)***

In addition to the above written consultation, a pre-planning meeting was requested by the applicant with LCCC and duly undertaken on 27th September 2021.

At this meeting, a presentation outlining the details of the proposed development was delivered to LCCC and any feedback received was duly noted and relayed to the wider project team. Regard has been had to the commentary received from LCCC.

### 1.9.3 Community Consultation

In addition to the statutory consultation undertaken above, a pre-application consultation brochure was also prepared and circulated in June 2021 to members of the local community (see Appendix 1.3). This brochure provided an outline of the proposed development and noted that an EIAR and NIS would accompany the final SID planning application.

The distribution of this brochure ensured that local residents were kept fully informed of the proposed development. The brochure also informed recipients that any queries in relation to the proposal should be directed to AAL by email or letter.

Following the distribution of this brochure, one response was received from a local resident in the community. The resident in question voiced concerns in relation to visual impact and the long term restoration plans for the BRDA. The EIAR includes a Landscape and Visual Impact Assessment which fully addresses any concerns in relation to potential visual impacts from the surrounding area. In addition, details of the restoration proposals for the subject site are also included within this EIAR and wider application pack.

Local politicians were also informed of the proposed development by means of a letter issued 4th June 2021. A copy of this letter and a list of the politicians to whom it was issued is provided in Appendix 1.4.

## 2.0 SITE LOCATION AND CONTEXT

### 2.1 Location of the Subject Site

AAL operates a long-established alumina facility, located on Aughinish Island on the southern side of the Shannon Estuary near the industrial port of Foynes, Co. Limerick. The AAL facility is located c. 6 km north-west of Askeaton and c. 30 km west of Limerick City Centre.

The lands subject to this current application measure c.222ha and are referred to throughout this EIAR as the **'subject site'**. The alumina refinery processing plant located at the north west of the facility is located outside of the subject site and is referred to throughout as the **'refinery plant'**. The total AAL landholding including the subject site and the refinery plant is referred to as the **'AAL facility'** or the **'facility'.**


**Figure 2.1:** Site Context Map with subject site highlighted in red (source: www.myplan.ie 2021, Annotated by TPA).

The Limerick – Foynes railway line (closed in 2002) runs to the south of the island, as does the N69 National Secondary Route between Limerick and Tarbert. Aughinish Island is accessed via the L1234 Aughinish Road, which is a two way local road which connects with the N69.

As noted above the subject site measures c.222ha and is located at the western and south western portions of the wider AAL facility at Aughinish Island (see Figure 2.2). The subject site is bounded by grassland and vegetation to the north, beyond which lies the Shannon Estuary.

The refinery plant is located to the north east of the subject site with AAL Sports Complex, a Limerick City and County Council (LCCC) water treatment plant and main site access road all located to the east of the subject site.

The western boundary of the subject site runs parallel with the Robertstown River, the edge of which is defined by an existing flood tidal defence berm (FTDB) and drainage channel.

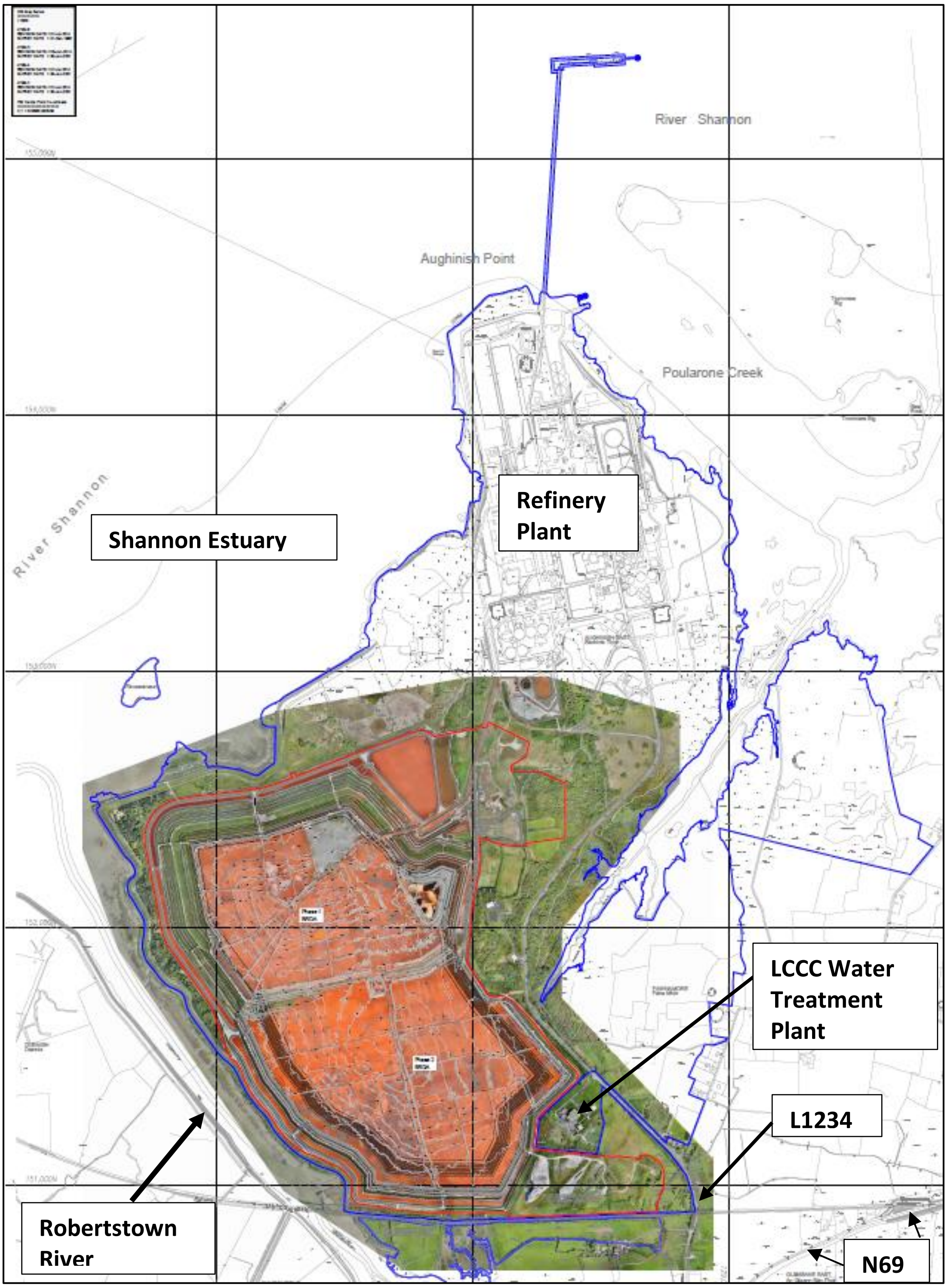



**Figure 2.2:** Aerial View of Subject Site and Wider AAL Facility (Source: Golder, 2021).

## 2.2 Processes Undertaken at Alumina Refinery Plant and Existing BRDA

The AAL facility, including the subject site area, operates in accordance with the Conditions of the Industrial Emissions Licence (IEL) P0035-07 issued by the Environmental Protection Agency (EPA).

At the refinery plant, alumina (also known as aluminium oxide) is extracted from bauxite raw material. The facility was principally constructed between 1978 and 1983. Plant production has been continually increased since the commissioning of the plant in 1983 up to its current maximum production of approximately 1.95 million tonnes of alumina per annum.

Bauxite, the raw material processed within the refinery plant, is a naturally dark red coloured earth which gets its colour from its iron content. It is imported by ship to the facility in bulk ore carriers from bauxite mines primarily located in West Africa and Brazil. The bauxite is then unloaded at the dedicated AAL marine terminal on the Shannon Estuary.

### 2.2.1 'Bayer Process'

Once the bauxite is received on site, the alumina is then extracted via what is known as the 'Bayer Process'. This five-step process is outlined below.

1. **Preparation:** The bauxite ore is crushed, ground and mixed with caustic soda solution and then pumped into digester pressure vessels.

2. **Digestion:** Under high pressure and heat, the alumina (within the bauxite slurry) is dissolved by and combines with the caustic soda to produce sodium aluminate.

3. **Clarification:** The solid residues (bauxite residue and process sand) in the digested bauxite slurry are separated by settling out of the sodium aluminate solution. The residues are then washed, and the bauxite residue is thickened by vacuum filtration and pumped to what is known as the Bauxite Residue Disposal Area (BRDA).

4. **Precipitation:** As the soluble sodium aluminate is cooled, it is agitated and seeded with aluminium hydroxide crystals. These form larger aluminium hydroxide crystals which gradually settle out of solution. Seed crystals and sodium aluminate remaining in solution are recirculated.

5. **Calcination:** The aluminium hydroxide crystals are calcined at over 1100 degrees Celsius to remove the water of crystallisation. A fine white powder, alumina (aluminium oxide), is produced and this product is exported by ship to overseas smelters.

### 2.2.2 Bauxite Residue Disposal Area (BRDA)

Bauxite residue from the above described process is pumped as a thickened residue to what is known as the Bauxite Residue Disposal Area (BRDA). Figure 2.3 outlines the location of this BRDA within the overall AAL facility. The bauxite residue can be directed into selected areas of the BRDA by valve operated piped discharge points. The bauxite residue is deposited to facilitate drying.

The placement and direction of movement of the bauxite residue is influenced by the level and distribution of the previously deposited material and position of residue berms.

As the bauxite residue dries, its moisture content and volume decreases while its density increases. The maturing of the bauxite residue is achieved by the following principal methods;

- Compaction of the residue by mechanical plant principally a series of amphirols and low ground pressure excavators,
- Air drying of the surface of the bauxite residue by evaporation
- Consolidation of the bauxite residue under its own weight.

Compaction of the residue by mechanical plant achieves the largest increase in density over a short period of time. Air drying by evaporation is the most important process in drying the bauxite residue and improving undrained shear strength. Self-weight consolidation of the residue achieves long term increases in density and strength.

The process sand, arising from the Bayer process, is transported from the plant by truck and is used to construct ramps and access roads within the BRDA. Other residues of the production process include salt cake, lime grits and process waste, which are deposited in the BRDA. The salt cake is stored within a separate specially engineered cell located within the BRDA (discussed further in Section 2.2.2.5.


**Figure 2.3:** Aerial View of part of Aughinish Alumina Site – BRDA (source: Golder Associates).

### 2.2.2.1 Characteristics of the Residue Deposits

As noted in Section 2.2.2 above, the residues deposited in the existing BRDA and those proposed to be deposited in the expanded BRDA include bauxite residue and salt cake.

***Bauxite Residue***

The farmed bauxite residue is classified as a solid non-hazardous material. There are 5 predominant compounds measured (Moisture, Aluminium Goethite, Hematite, Calcium Cancrinite, Bayer Sodalite) amounting to 75% of the overall content. A detailed description of all compounds identified in the bauxite residue and the classification of each is provided in Chapter 7 of this EIAR.

Mineral raw materials such as bauxite exhibit natural radioactivity slightly above the average level in the earth's crust. In bauxite, both thorium 232 and uranium 238 are present in measurable amounts. Material such as this is termed naturally occurring radioactive material (NORM).

The Radiological Protection Institute of Ireland (RPII) (merged into the EPA in 2014) is the competent Authority in Ireland with regulatory, monitoring and advisory responsibilities in matters pertaining to ionising radiation and radioactive contamination in the environment.

The RPII surveyed the Aughinish site and assessed the facility, raw materials (bauxite) and wastes (bauxite residue, process scales and effluent) for NORM properties. The RPII (2008) concluded that the (low) levels of NORM are in compliance with safe levels set out in S.I. No. 125/2000: Radiological Protection Act, 1991 (Ionising Radiation) Order, 2000 and are below the threshold at which the facility would come within the scope of the above Regulations. As such, the BRDA does not present a radiation hazard to either site operatives, visitors or the surrounding environment. Additional detail in this regard can be found in Chapter 8 of this EIAR.

***Salt Cake***

The salt cake is classified as hazardous according to the European Waste Catalogue, it is therefore deposited within a specially engineered cell (Salt Cake Disposal Cell, “SCDC”) within the BRDA.

The salt cake deposits consist of the organic degradation produced from naturally occurring humates in the bauxite.

#### 2.2.2.2 Development of Existing BRDA

The existing BRDA at the subject site was constructed in three phases and comprises two disposal areas which are currently merging (see Figure 2.3). The combined total size of these areas is 184ha.

- The Phase 1 BRDA is formed from two areas, the original Phase 1 BRDA constructed in the early 1980s, covering an area of 72 ha., and the Phase 1 BRDA extension, constructed in the mid-to-late 1990s, covering an area of 32 ha. The initial design for the Phase 1 BRDA was to provide a disposal area to the year 2009 based on the BRDA constructed to Stage 7 (elevation 18m OD), which equates to a central dome elevation of 27.5m OD or 26m above original ground level.
- The Phase 2 BRDA is a southern extension of the Phase 1 BRDA that was permitted in 2007 (*Limerick County Council Reg. Ref. 05/1836; ABP Ref. PL13.217976*) to Stage 10 with a maximum perimeter elevation of 24m OD and a maximum central elevation of 32m OD. The Phase 2 BRDA merges with the southern extent of the Phase 1 BRDA. The Phase 2 BRDA covers an area of approximately 80 ha. and was commissioned in 2011.
- The permitted BRDA provides a disposal area for Bauxite at the facility until c. 2030. The current level of the BRDA residue varies, from 22m OD to 32m OD in Phase 1 and from 11m OD to 20m OD in Phase 2.

#### 2.2.2.3 BRDA Structure

As noted above in Section 2.2.2.2, the BRDA is comprised of two disposal areas – Phase 1 to the north and Phase 2 to the south. The perimeter structure of the existing/permitted BRDA is shown in Figure 2.4, below. This demonstrates that the structure is characterised by external perimeter walls within which the bauxite residue is stored in a terraced nature known as stage raises.

The BRDA is surrounded by composite lined Perimeter Interceptor Channels (PIC) which are formed by constructing the Inner Perimeter Wall (IPW) and the Outer Perimeter Wall (OPW).

The OPW is constructed of either till or rock fill and is composite lined on the upstream slope to form the PIC. The downstream slope has been overlain with a wire mesh gabion mattress for the northern and western extents of the Phase 1 BRDA. The IPW is constructed of permeable rock fill and provides the starter dam for the BRDA.

The lining system for the BRDA basin is a mixture of natural and geosynthetic materials which have very low hydraulic conductivity. These lining systems provide the short-term containment as the BRDA basin is filled, the depth of deposited bauxite residue is increased, and consolidation occurs.

Once a sufficient depth of bauxite residue has been deposited above the basal lining system, then the bauxite residue itself becomes the controlling containment and long-term containment, owing to the following characteristics:

- Bauxite residue has a low hydraulic conductivity
- Bauxite residue is farmed, and the consolidation benefits are achieved directly.
- No free water is stored on the BRDA.

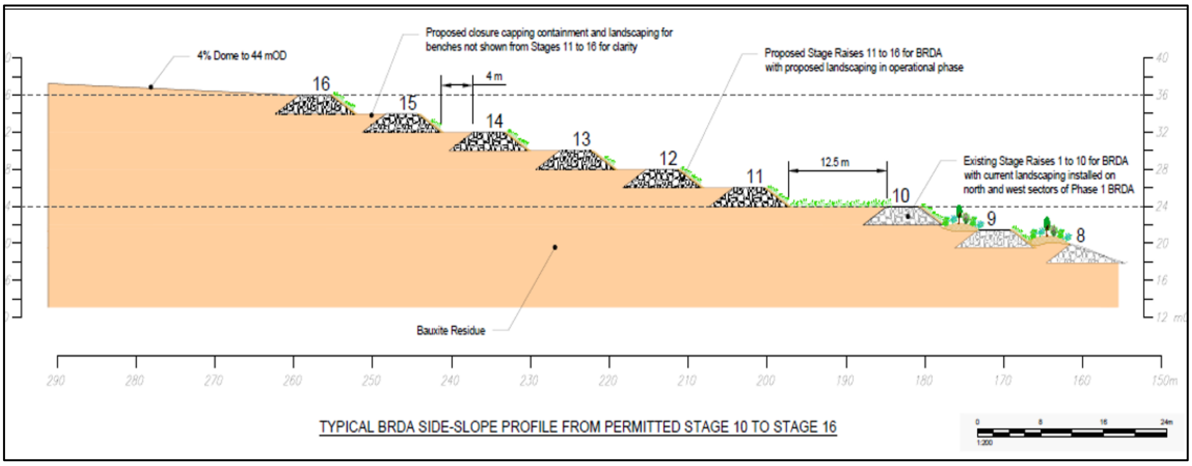



**Figure 2.4:** Typical BRDA Side-Slope Profile from Permitted Stage 10 to Stage 16

**Permitted Drainage Arrangement**

The BRDA is surrounded by the Perimeter Interceptor Channel (PIC) which collects water emerging from the BRDA (seepage, bleed water, sprinkler water and surface water runoff) and conveys it via pumps either to the Effluent Clarification System (ECS) located in the plant and/or to the Storm Water Pond (SWP).

The SWP is located in the north-east sector of the BRDA and its function is two-fold:

- To provide surge capacity for excess surface water prior to processing by the ECS; and
- To provide a continuous flow of water that is used for dilution or wash water within some parts of the processing plant.

Excess water from the SWP is pumped to the ECS via pumps. The SWP does not currently have an overflow spillway (during operation) but will be breached during the closure works for the post-closure period. Please refer to Chapter 10 of this EIAR for further detail.

The Liquid Waste Pond (LWP) is located adjacent to the SWP and receives treated water from the ECS and conditions this water (cooling and settlement) prior to discharging or re-use in the refinery.

**Distribution of Bauxite Deposits**

There are two discharge platforms located centrally in the Phase 1 and Phase 2 BRDA areas. These discharge platforms with valve manifold installation feed a network distribution of fixed piped spigot points called mud points (MPs) for residue deposition within controlled cells in layers sloped away from the discharge point for layered residue deposition. The cells have perimeter berms constructed from rock to a height of 2m.

Currently, there are 17 No. mud points in the BRDA with 9 number located in the Phase 1 BRDA and 8 number located in the Phase 2 BRDA. The distribution network for the discharge platforms and the MPs were installed at the base of the BRDA when the basin was constructed, and the MPs are raised vertically corresponding to the increase in height of the BRDA.

The deposited bauxite residue is farmed to enhance drying of the residue, promote densification and to enhance exposure of the residue to the atmospheric carbon dioxide to reduce the liquid phase alkalinity. The farmed bauxite residue is tested to achieve a pH < 11.5 and is subsequently graded and compacted in preparation for the next deposition layer.

The BRDA surface is managed via a system of sprinklers which cover the entire exposed bauxite residue surface on an approximately a 75m x 75m grid. Sprinkling of the Bauxite Residue surface is considered a Best Available Technique (BAT), as identified by the European Commission. The sprinkler guns rotate and distributes water up to 50m radius such that adjacent points in the grid form overlapping radii (max. 25m) to provide complete coverage.

During extended dry periods, the LWP provides a buffer storage for the sprinkler system. The sprinkler operational patterns and duration are decided daily based on an assessment of the weather forecasts and programmed by the BRDA Operations Department. In full operation, the sprinkler system can discharge at a rate of 650 to 750 $m^3$ / hour.

The Perimeter Access Road and internal road and ramps in the BRDA are maintained using road sweepers and dust suppression is achieved using tractor towed water bowsers.

**Cell Layout**

The current layout of layered deposition cells for the Phase 1 BRDA (Cells 1 to 24) and Phase 2 BRDA (Cells 26 to 46) is shown in Figure 2.5. Residue farming within the cells allows for the reduction of the pH to < 11.5 and for the increase in the density and strength parameters of the deposited bauxite residue layer. Areas for deposition are partitioned by up to 3m high berms of farmed bauxite residue formed using a dozer. Two layers are deposited in each cell annually, after which the cell bunds are then re-formed from farmed bauxite residue using a dozer.

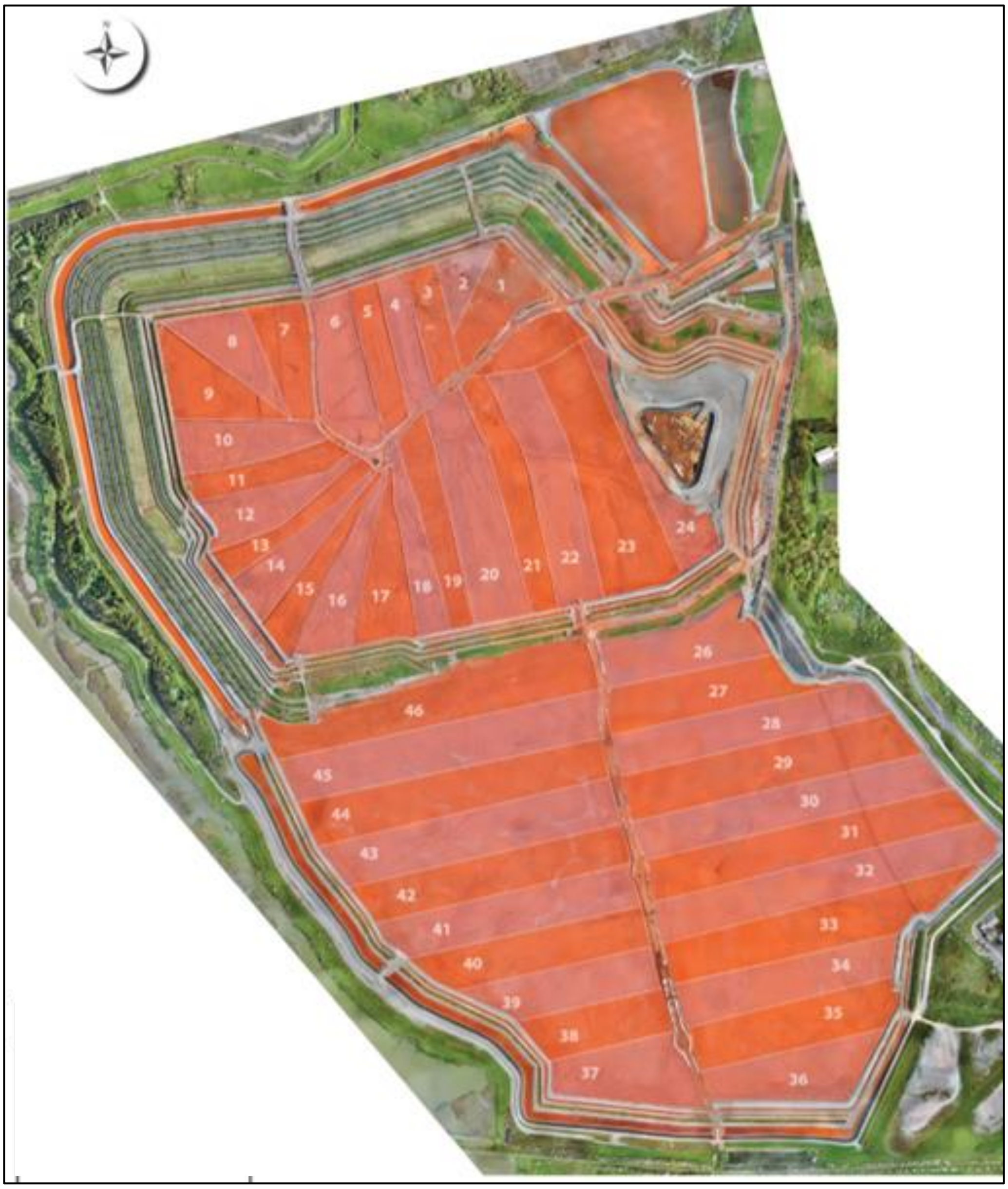


**Figure 2.5**: BRDA Layered Deposition Cell Layout (Source: Golder, 2021).

BRDA Raise

The approximate rate of rise of the BRDA was 12m in 14 years (0.86m / year from 2005 to 2019) for the Phase 1 BRDA and 14m in 14 years (1.00m / year from 2005 to 2019) for the Phase 1 BRDA Extension. This represents a reduction in the pre-2005 rate of the raising of the

Phase 1 BRDA that can be attributed to the additional footprint provided by the Phase 2 BRDA since 2011.

The majority of bauxite residue is being placed within the Phase 2 BRDA in recent years (80% in 2018 and 82.5% in 2019), the rate of rise in the Phase 2 BRDA has been slightly greater than the Phase 1 BRDA with an average depth of 14m placed alongside the centre of the North-South Road during the 10 years of operation (1.75 m / year). An average depth of 10m has been placed at the perimeters (east, west and south) during the 10 years of operation (1.0m / year).

**Raising of the Existing BRDA**

The BRDA is progressively raised by the upstream method, identified by the European Commission as the 'Best Available Technique'[1]. The upstream method involves constructing a permeable rock fill berm (stage raise) at the perimeter which is founded on the previously deposited and farmed bauxite residue. The stage raises are constructed in 2m vertical lifts (4m crest width, side-slopes of 1.5(H):1(V) and typically offset from inner crest to starting toe by a 4m wide bench), thus forming a supporting face to the overall structure, whilst also allowing drainage.

Unlike other tailings facilities or water retaining dams, the BRDA retains little to no surface water on the surface. The bauxite residue is discharged as a thickened slurry from several near central discharge points and migrates to the perimeter stage raises to form a dome which typically has the apex some 6m to 8m above the perimeter stage raise elevation. The slope produced averages grades between 2 % and 4 %. As noted above in Section 2.2.2.2, the permitted final elevation of the perimeter BRDA wall is 24m OD at the final stage, Stage 10, and the highest elevation of the BRDA for the dome is 32m OD.

A collection drain has been formed in the bench of the uppermost stage raise to collect seepage and runoff and divert the waters towards a piped drainage system (300mm and 450mm OD twin-walled HDPE pipes at max. 100m centres) leading directly to the PIC. This system allows for the progressive restoration of lower benches as the BRDA increases in height by eliminating the trickle down of the alkaline water over vegetation.

Downstream side slope restoration, comprising side-slope drainage and planting berms, was completed during 2013 along the northern and western sectors of the Phase 1 BRDA from Stage 1 to Stage 8. Interim side-slope restoration, comprising drainage between toe drains of stage raises and hydroseeding of the upstream faces of the stage raises, is ongoing, and has been completed along the northern and western sectors of Phase 1 BRDA to Stage 10 and along the western flanks of the Phase 2 BRDA to Stage 3.

[1] Best Available Techniques (BAT) Reference Document for the Management of Waste from Extractive Industries in accordance with Directive 2006/21/EC (European Commission, 2018)

#### 2.2.2.4 Current Status of BRDA

AAL have successfully raised the Phase 1 BRDA to Stage 10 along the east, north-east and north-west sectors and also are currently constructing the south-west and south sectors to Stage 10. The elevation of bauxite residue deposited varies from approx. 32m OD at the centre to approx. 22m OD to 24m OD at the perimeter stage raises.

For the Phase 2 BRDA, AAL have constructed to Stage 4 (12m OD) along the west and south boundaries. Bauxite residue has been placed to approx. 11m OD along the east perimeter wall, which will subsequently form the base of the internal perimeter interceptor channel (PIC) along this extent. The crest of east perimeter wall currently varies in elevation from Stage 6 (16m OD) to Stage 4 (12m OD) from its north-eastern extent to its eastern extent and transitions into the external PIC at the Observation Area located centrally on the east perimeter wall. The elevation of the bauxite residue deposited varies from approx. 20mOD centrally along the internal access road (north-south road), splitting the Phase 2 BRDA into east and west sectors. The elevation of bauxite residue at the east, south and west perimeter stages raises is at approx. 11m OD.

The Phase 1 and Phase 2 BRDAs are being progressively merged, with the Phase 2 BRDA overlapping on the upstream raises on the south face of the Phase 1 BRDA to a current elevation of approx. 15m OD.

The current average rate of production of bauxite residue is c.1.57 million tonnes / year (dependent on grade of ore) and is deposited at a characteristic dry density 1.63 tonnes / $m^3$, following mud-farming activities. The planned rate of void consumption is 0.9 to 1 million $m^3$ / year for bauxite residue and approx. 35,000 $m^3$ / year for rock fill.

#### 2.2.2.5 Salt Cake Disposal Cell

Salt cake is classified as a hazardous waste that is required to be segregated from the other BRDA deposits.

As such, a dedicated Salt Cake Disposal Cell (SCDC) is located to the east of the main Phase 1 BRDA area. This SCDC is an independent, composite lined cell with a triangular shape characterised by north, east and west dam walls. The permitted maximum height of the SCDC is 29m OD at crest level.

The SCDC is accessed from the central access ramp to the Phase 1 BRDA, via a turn-off to the south onto the access ramp leading to a turning point, which is at the crest elevation of the cell. The salt cake is produced in the adjoining refinery plant and hauled to the SCDC in dumpers, where it is tipped into the cell at designated 'Tipping Points'. The west dam wall is the 'Tipping Wall' and has a width of 23.5m. The north and east dam walls measure 8.0m in width and they provide through access around the crest of the cell and to a Decant Tower.

The total storage volume of the SCDC is estimated to be 72,800$m^3$ at the crest level (29m OD). The current cell capacity is expected to expire during 2023.

AAL has developed, in conjunction with a number of laboratories and technology suppliers, a process modification to avoid the production of saltcake from its facility. The research at AAL identified that the most suitable way of modifying the process was to install a Wet Air Oxidation (WAO) system within the refinery (located outside of the subject site). WAO was chosen because it was a mature technology with hundreds of installations worldwide which allows the oxidation products to be recovered to the refinery without any gaseous, liquid or solid emissions. The WAO will be fully integrated into the alumina production process, operate continuously and allow recovery of the process stream.

In summary this process involves oxidizing the saltcake with dissolved oxygen at an elevated temperature and will be used as a method of treatment for saltcake. There are no environmental emissions associated with this process and it is fully compliant with all relevant EPA 'Best Available Technique' (BAT) Guidance Notes. A detailed project schedule has been developed with commissioning to be completed by 2023.

Further detail regarding the SCDC can be found in Section 6.13 of the Engineering Design Report, prepared by Golder (Appendix A of EIAR).

## 2.3 Description of the Subject Site

The lands subject to this current application are located to the west and south west of the overall AAL facility. The subject site measures c. 222 ha and comprises three main elements - the BRDA area (including ancillary elements and SCDC) which itself comprises c.184ha, the Borrow Pit area and the Stockpile area (see Figure 2.6). Access to the subject site is provided from the existing access infrastructure associated with the wider facility.


**Figure 2.6:** Aerial View of the Subject Site (Source: Golder, 2021 – Cropped and Annotated by Tom Phillips + Associates).

### 2.3.1 BRDA (Including SCDC)

As noted above in Section 2.2, the BRDA comprises the majority of the subject site area. The Phase 1 BRDA area, located at the north of the application site measures c.104ha. The Phase 2 BRDA area, located at the south of the subject site measures c.80ha.

As outlined in earlier sections of this chapter, the BRDA areas are principally comprised of perimeter walls and channels enclosing a basin of bauxite residue which is stored in a terraced form structure comprising 10 no. permitted terraces known as stage raises. Deposits within the phase 1 area are at the stage 10 level, whilst deposits within the Phase 2 area, which has been in operation for a shorter time period is deposited at stage levels 4.

Ancillary infrastructure located within the BRDA area includes a Salt Cake Disposal Cell, located at the east of the phase 1 area and a Storm Water Pond (SWP) and Liquid Waste Pond located to the north east of the phase 1 BRDA area. Further detail in relation to the BRDA and its function is contained in Section 2.2 of this chapter.

### 2.3.2 Borrow Pit Area

The permitted borrow pit area is located at the north east of the application site and it's extraction area is c.4.5ha in size (LCCC Reg. Ref. 17/714; ABP Ref. 301011-18). It will serve the construction and operation of the permitted BRDA by providing processed rock which is required to build up the stage raises before residue is deposited and then contained by the rock-fill.

The permitted borrow pit area has a depth of c.8.5m OD. Rock extraction and the initial blasts at this borrow pit are expected to take place during April 2022. The permitted borrow pit area is expected to provide 375,000 $m^3$ of rock fill material which is considered to be sufficient to construct the existing BRDA to Stage 10 (220,000 $m^3$), to implement the closure design (105,000 $m^3$) and miscellaneous rock fill (50,000 $m^3$).

Adjacent to the permitted borrow pit area to the east is an area which is currently covered in vegetation. It is proposed that the borrow pit will extend eastwards into this area to facilitate the expansion and raising of the BRDA. Details in this regard are provided in Chapter 3 of this EIAR. The total extraction area of this planned extension to the borrow pit amounts to c.3.9ha.

### 2.3.3 Stockpile Area

A stockpile area is located at the south east of the application site. This area measures c.12.5ha. The area currently accommodates rock and topsoil which is used to construct and progressively restore the BRDA. In addition, portions of the area are covered in vegetation at present.

## 2.4 Planning Policy Context

### 2.4.1 Limerick County Development Plan 2010-2016

The *Limerick County Development Plan 2010-2016* (as extended) sets out Limerick City and County Council's overall strategy for the proper planning and sustainable development of the County to 2016 and beyond. It seeks to develop and improve, in a sustainable manner, the social, economic, cultural and environmental assets of the County.

The *Limerick County Development Plan 2010-2016* will continue to have effect until the publication of the Limerick City and County Development Plan 2022-2028 is adopted. The 2022-2028 Plan is currently at Draft stage and is addressed in Section 2.4.2 of this Chapter.

The importance of industry to Limerick and the State is acknowledged in Section 5.4.1, which states that:

> *“**Industry and enterprise together as sectors are crucial as drivers of economic growth**. In this context, enterprise means small and medium scale businesses in light industry as well as in internationally traded services such as in software, telecommunications and financial services. **These sectors play a leading role in improving Ireland’s versatility** and technological advancement, **giving it a greater competitive edge in international markets**, and **thereby creating revenue and employment**. Businesses in other sectors such as in retail and property will rely on the capacity of manufacturing and enterprise to raise incomes and stimulate confidence locally.”* [Our emphasis.]

The AAL facility is zoned as ‘Marine Related Industry’ in the Development Plan (refer to Figure 2.7). Objective ED 06 notes that the purpose of this zoning objective is as follows:

> *“Land zoned for Marine Related Industry, shall provide for marine related industry and large scale uses that create a synergy with the marine use. Marine related industry shall be taken to include the use of land for industry that, by its nature, requires a location adjacent to estuarine/deep water including a dependency on marine transport, transhipment, bulk cargo or where the industrial process benefit from a location adjacent to the marine area.”*

The AAL facility relies upon the Shannon Estuary for the import of raw materials and the export of alumina by ship, and is therefore consistent with this zoning objective. The proposed development will also assist in fulfilling the following Development Plan Objectives.

> *“**Objective ED 04: Safeguard Strategic Development locations along the estuary***
> ***It is the objective of the Council to safeguard the Strategic Development Locations at** Foynes Port, Foynes Island and **Aughinish Island for the sustainable growth and development of marine related industry** and industrial development at Askeaton.*
> *All proposed developments shall be in accordance with regional and national priorities and the SEA Directive, Birds and Habitats Directive, Water Framework Directive, Shellfish Waters Directive, Floods Directive and EIA Directive.*
> *Buffer zones shall be incorporated into proposals for developments where necessary to preserve potentially valuable habitats, for example, areas of estuary, shallow bays and inlets, mudflats, lagoon, salt marsh and woodland habitat which occur at or surrounding these Strategic Development Locations. The extent of such buffer distances shall be established in consultation with relevant statutory bodies. Detailed botanical, faunal and ornithological surveys should be undertaken in relation to proposed developments at these Strategic Development Locations to fully consider the potential effects of the development and inform how to best avoid significant ecological effects.”* [Our emphasis.]

> *“**Objective SE O2: Promoting Development***
> ***The Council will seek to promote the economic and industrial development of the Shannon estuary** in order to capitalise on its location in the Mid West*

*industrial and business region. Sufficient land will be zoned or identified for industrial and business use through the medium of Local Area Plans or zoning within this Plan including zonings in the Strategic Integrated Framework Plan for the Shannon Estuary."* [Our emphasis.]

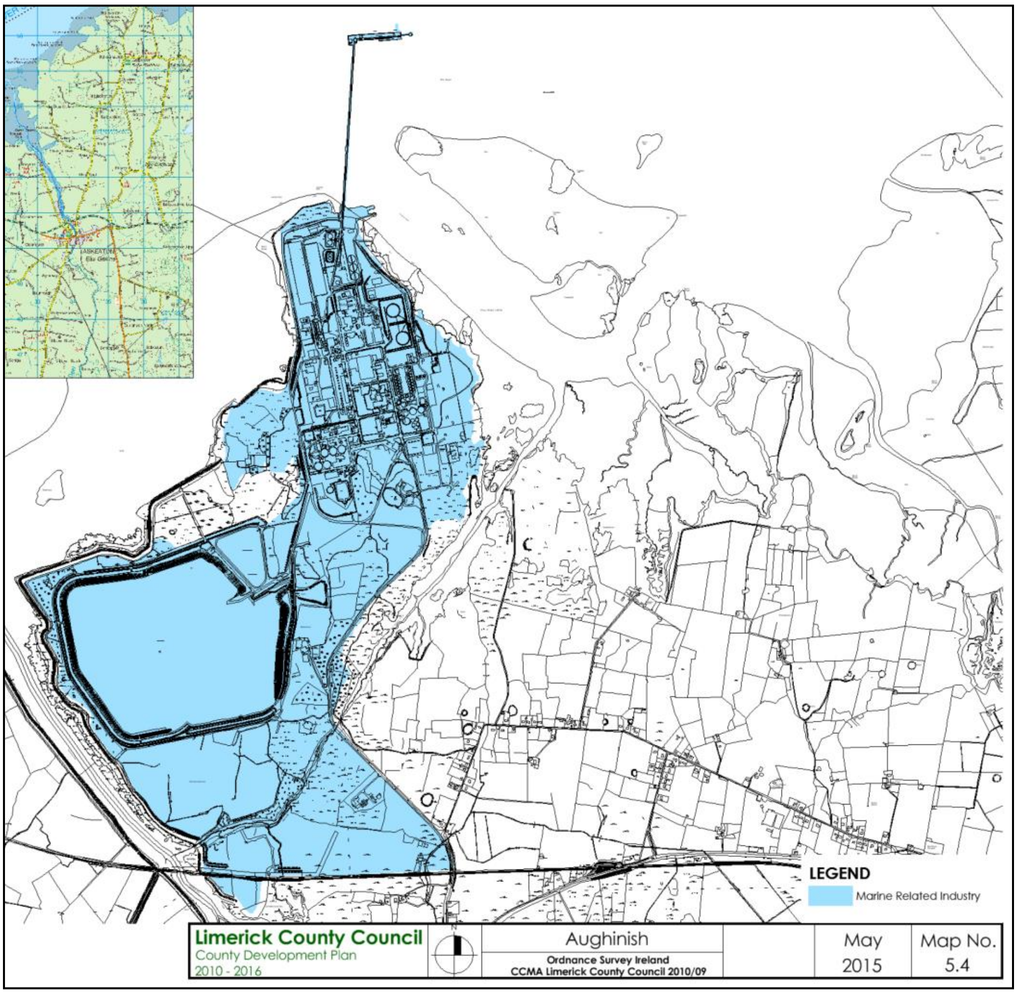



**Figure 2.7:** Marine Related Industry Zoning of Aughinish Island (Source: Extract from Map 5.4 of the *Limerick County Development Plan 2010-2016).*

### 2.4.2 Draft Limerick City and County Development Plan 2022-2028

Limerick City and County Council published the Draft Development Plan on the 26th June 2021. This Draft Plan sets out an overall strategy for the proper planning and sustainable development of the functional area of both Limerick city and county over a six year period between 2022 and 2028.

Chapter 4 of the Draft Plan is titled 'A Strong Economy' and highlights in Section 4 the importance of Shannon estuary to the economy of Limerick. Objective ECON 043 is of specific relevance to the subject site as it identifies Aughinish Island as a Strategic Development Location which should be safeguarded for the sustainable growth and development of marine related industry and industrial development.

> *"Safeguard Strategic Development locations along the Estuary It is an objective of the Council to safeguard the Strategic Development Locations at Foynes Port, Foynes Island and Aughinish Island for the sustainable growth and development of marine related industry and industrial development at Askeaton. All proposed developments shall be in accordance with regional and national priorities and the SEA Directive, Birds and Habitats Directive, Water Framework Directive, Shellfish Waters Directive, Floods Directive and EIA Directive. Buffer zones shall be incorporated into proposals for developments where necessary to preserve potentially valuable habitats, for example, areas of estuary, shallow bays and inlets, mudflats, lagoon, salt marsh and woodland habitat, which occur at or surrounding these Strategic Development Locations. The extent of such buffer distances shall be established in consultation with relevant statutory bodies. Detailed botanical, faunal and ornithological surveys should be undertaken in relation to proposed developments at these Strategic Development Locations, to fully consider the potential effects of the development and inform how to best avoid significant ecological effects."*

Further to the above, the boundaries of the Aughinish Island facility are outlined in Figure 4.4 of the Draft Plan.

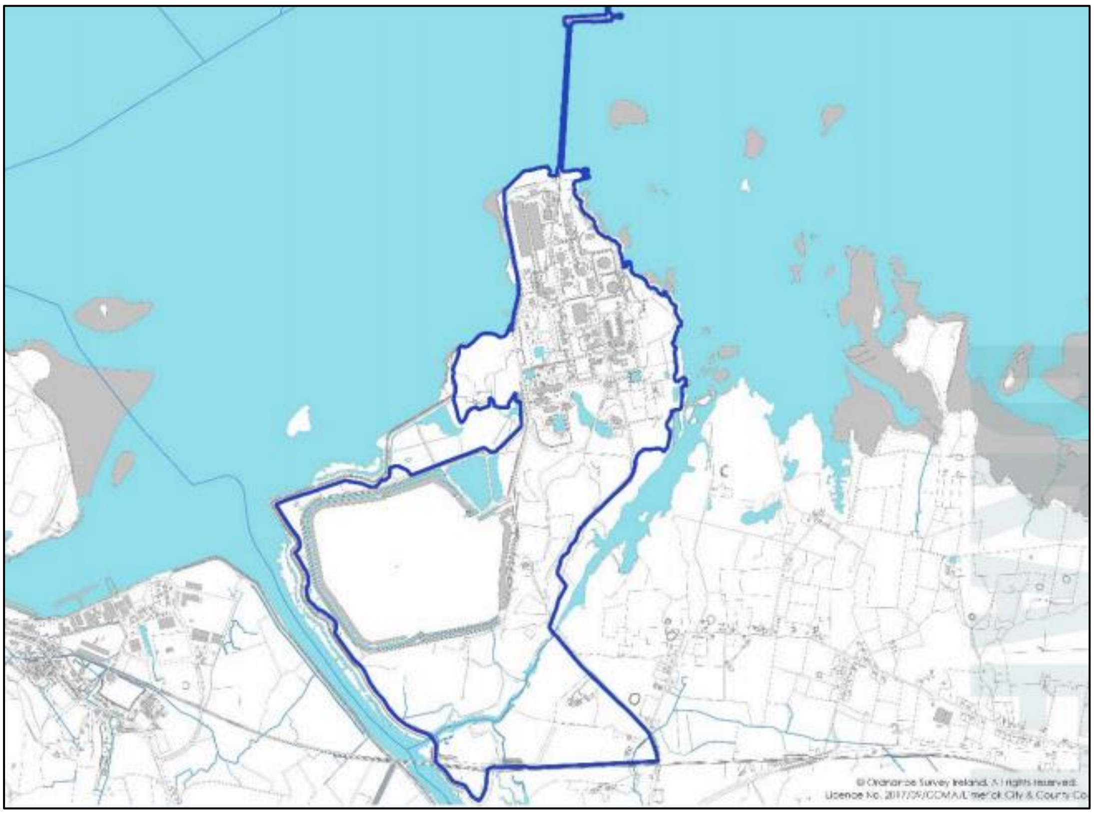
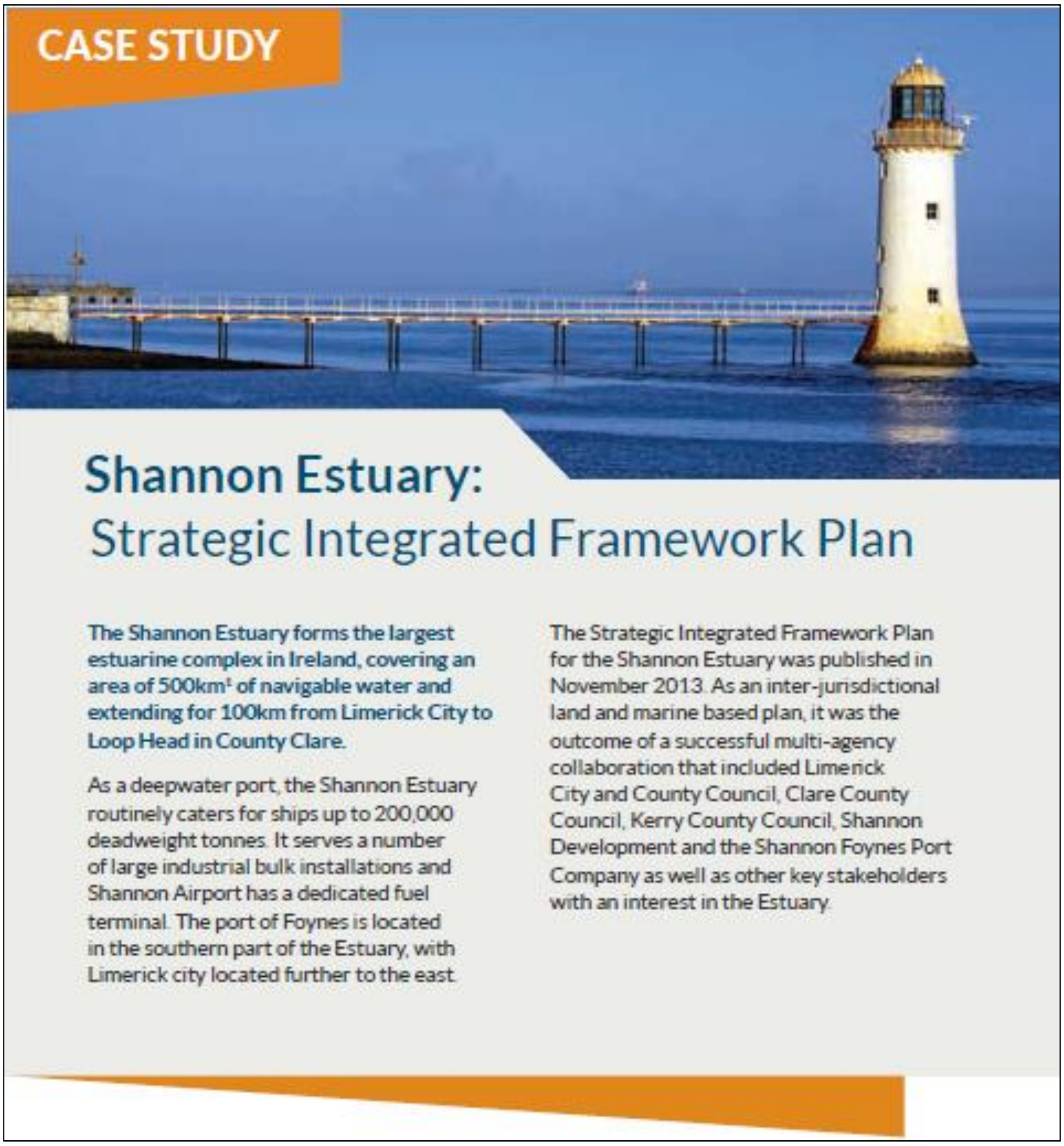


**Figure 2.8:** "Map of Aughinish" – Source: Map 4.4, Draft LCCC Development Plan 2022-2028.

### 2.4.3 National Planning Framework: Project Ireland 2040

The National Planning Framework (NPF) is a high-level strategic plan shaping the future growth and development of Ireland out to the year 2030. It is a framework to guide public and private investment, to create and promote opportunities for people, and to protect and enhance the environment.

The Shannon Estuary Strategic Integrated Framework Plan (SIFP) is identified as a case study within the NPF and is therefore considered to be fully supported at national planning level. The further development of the AAL facility is strongly supported in the SIFP (section 2.4.5 below refers).



CASE STUDY

Shannon Estuary:
Strategic Integrated Framework Plan

**The Shannon Estuary forms the largest estuarine complex in Ireland, covering an area of 500km$^1$ of navigable water and extending for 100km from Limerick City to Loop Head in County Clare.**

As a deepwater port, the Shannon Estuary routinely caters for ships up to 200,000 deadweight tonnes. It serves a number of large industrial bulk installations and Shannon Airport has a dedicated fuel terminal. The port of Foynes is located in the southern part of the Estuary, with Limerick city located further to the east.

The Strategic Integrated Framework Plan for the Shannon Estuary was published in November 2013. As an inter-jurisdictional land and marine based plan, it was the outcome of a successful multi-agency collaboration that included Limerick City and County Council, Clare County Council, Kerry County Council, Shannon Development and the Shannon Foynes Port Company as well as other key stakeholders with an interest in the Estuary.

**Figure 2.9:** Shannon Estuary SIFP identified as a Case Study in the National Planning Framework (Source: National Planning Framework, pg 105).

### 2.4.4 Regional Spatial & Economic Strategy for the Southern Region

The Regional Spatial & Economic Strategy (RSES) for the Southern Region provides the framework through which the NPF's vision and the related Government policies and objectives will be delivered for the region. In line with International best practice, the RSES for the Southern Region adopts a territorially differentiated and place-based approach to regional planning and development.

The RSES identifies that across the region there are examples of smaller scale settlements or networks that have a significant role in employment provision in their surrounding communities, often in highly skilled and world leading innovative sectors. An example of this type of network of settlements includes:

> *"North Kerry / **West Limerick / Shannon Estuary** / Clare*
> ***The RSES recognises and supports the economic role and potential of settlements including** Listowel, Abbeyfeale Newcastle West (Key Town), Kilrush as economic drivers in a potential North Kerry/**West Limerick**/Clare **network connected with the Shannon Estuary** (and Shannon Foynes Port. **Their attributes extend to include the Shannon Integrated Framework Plan (SIFP) area and strategic locations identified under the SIFP** as a Shannon Estuary Coastal Network. Reference to the SIFP network is also included as an example of our region's strategic marine and costal assets in Chapter 4."* [Our emphasis.]

Aughinish Alumina (Aughinish Island) is identified as Strategic Development Location F in the Shannon Estuary SIFP and therefore the development of the site is fully supported in the RSES.

Furthermore, we refer to Regional Policy Objective (RPO) 79 and RPO 142 which further supports the overall Shannon Estuary SIFP and the development of the strategic development locations identified in the document, such as AAL.

**RPO 79**

**Shannon Estuary and Other Harbour Plans**

a. The RSES recognises the national and international importance of the Shannon Estuary, its potential to attract multinational development and the significant work that has been undertaken to progress its promotion and development. It is an objective to support and promote the delivery of the Strategic Development Locations as set out in the SIFP for the Shannon Estuary subject to the implementation of mitigation measures outlined in the SEA and AA undertaken on SIFP and zoned in the Local Authority Development Plans.

b. It is an objective to promote the SIFP initiative as a good practice model for the Southern Region and to seek the preparation of similar initiatives for Cork Harbour and Waterford Harbour between the relevant stakeholders.

c. It is an objective to support the promotion, marketing and seeking of financial and expertise support for the Strategic Integrated Framework Plan (SIFP) for the Shannon Estuary and specific projects emerging there from.

d. Such initiatives shall be subject to the relevant environmental assessment requirements including SEA, EIA SFRA and AA as appropriate.

RPO 142, in relaton to Ports, states that:

> *"**It is an objective to strengthen investment to deliver actions under National Ports Policy** and investment in sustainable infrastructure projects that:*
> *……*

> *e. **Support the sustainable development of the 9 no. strategic development locations adjoining sheltered deep-water in line with the recommendations of the SIFP for the Shannon Estuary** and subject to the implementation of mitigation measures outlined in the SEA and AA undertaken on the SIFP."*

Having particular regard to the Shannon Estuary, the RSES also outlines the below.

## Shannon Estuary

- The Strategic Integrated Framework Plan (SIFP) (SIFP) provides a coherent spatial plan to recognise the economic potential of the Shannon Estuary.
- SIFP aims to support the multifunctional nature of the Shannon Estuary and seeks to transform the estuary into an international economic hub.
- SIFP has identified an additional 1,200 hectares for marine related development (9 no. strategic development locations) by building on existing industry connectivity and synergy as well as the existing infrastructure to create more sustainable and attractive network for further investment.
- Moneypoint and Shannon Foynes Port are strategic national assets along the estuary.
- Cahercon in County Clare is strategically located to provide a maritime centre of excellence with accommodation for maritime research which could work to create synergies with the considerable hinterland available, existing infrastructure and direct access to deep water.
- The SIFP is cited as a Good Practice example in Chapter 4.

**Figure 2.10:** Extract from Regional Spatial and Economic Strategy for the Southern Region

The AAL facility is identified as Strategic Development F in the Shannon Estuary SIFP and therefore the development of the site is fully supported through regional planning policy.

### 2.4.5 Strategic Integrated Framework Plan for the Shannon Estuary 2013-2020

The *Strategic Integrated Framework Plan for the Shannon Estuary 2013-2020* ('SIFP') is an inter-jurisdictional land and marine based framework plan to guide the future development and management of the Shannon Estuary. It was commissioned by Clare County Council, Kerry County Council, Limerick City and County Council, Shannon Development and the Shannon Foynes Port Company and was incorporated into the *Limerick County Development Plan* in 2015.

The SIFP notes in Section 2.1.1 that:

> *"**The lower Shannon Estuary** and its surrounding hinterland **facilitate large scale, national industrial activities, and as such is considered by many as a key economic driver for the national and regional economy.***
>
> ***The presence of** the deepwater port at Foynes, the Moneypoint ESB power station and **the Aughinish Alumina plant demonstrate the critical role played by the Shannon Estuary, in facilitating economic development within the national context**."* [Our emphasis.]

Aughinish Island is designated as a 'Strategic Development Location' (SDL) within the SIFP, and Section 5.4.4.6 of the SIFP describes the Aughinish Island SDL's assets:

> *"The SDL incorporates a **well established, strategic, industrial complex where further growth in the primary industry is anticipated**. This is likely to include the potential extension to the existing deepwater berthing facilities, to take advantage of the potential for larger vessels and upgrading of loading machinery. The hinterlands of the SDL are relatively flat with good access to the N69, and also straddle the existing Limerick-Foynes rail network corridor. The area is connected via a spur line to the Bord Gais Natural Gas Ring Main, and is connected to the 110kV electricity transmission network with a number of substations located on site. The existing industrial development has permission to expand to the south, and is currently pursuing opportunities to increase production and storage capacity. **The alumina facility anticipates remaining as a significant working industrial plant for the foreseeable future, generating considerable contributions and employment to the local and regional economy**."* [Our emphasis.]

The SIFP sets out the following development objectives for the Aughinish Island Strategic Development Location:

> *"**SIFP MRI 1.2.9: Aughinish Alumina***
> *To **safeguard the role and function of Aughinish Alumina as a key driver of economic growth in the region**, encouraging its sustainable growth, expansion and diversification to facilitate greater and more competitive trade potential.*
>
> ***SIFP MRI 1.2.10: Aughinish Marine Related Industry***
> *To support and facilitate the sustainable development of marine related industry on land within this Strategic Development Location, which harnesses the potential of the deep water, large hinterland and existing infrastructure. Other sustainable land uses may be acceptable where they are considered compatible or complementary with the level of flood risk, and where the ability to deliver the primary use (marine related industry) is not compromised. Development will be subject to compliance with the criteria set out in Objective SIFP MRI 1.2."* [Our emphasis.]

The proposed development will entail significant investment and enhancement of the AAL facility assisting the Planning Authority in achieving its Vision for the Shannon Estuary as set out in the SIFP.

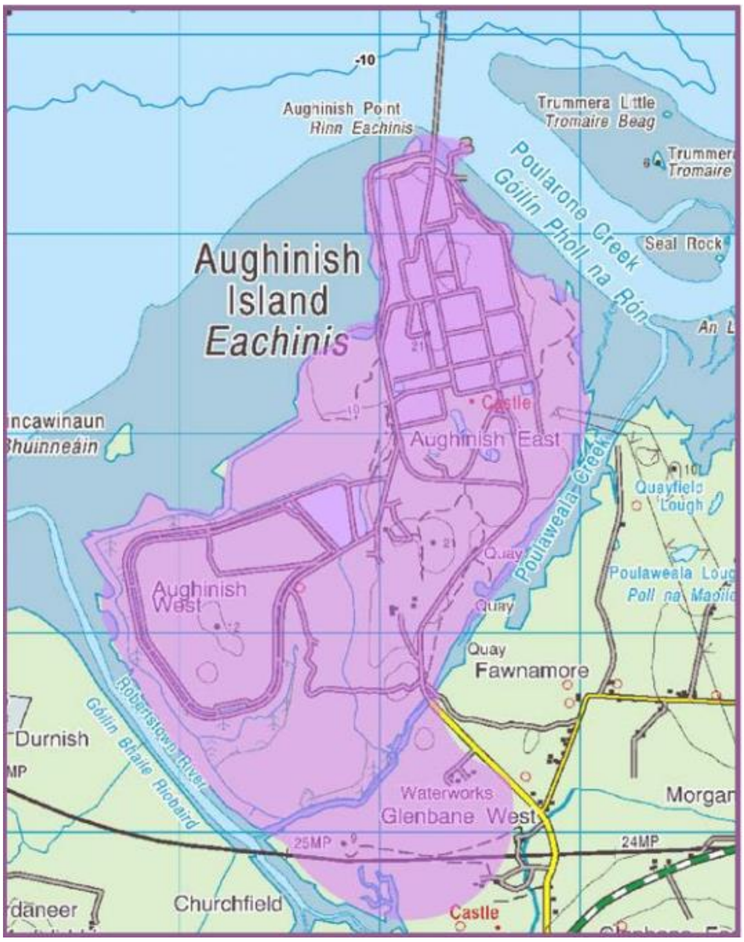



**Figure 2.11:** Extent of Aughinish Island Strategic Development Location F. Source: *Strategic Integrated Framework Plan for the Shannon Estuary*.

## 2.5 Reasonably Foreseeable Projects

In addition to the current operations which are ongoing at the subject site and wider AAL facility, there are also three projects which are currently envisioned to take place in the coming years. The required planning approvals for these projects will be sought once greater certainty regarding their progression/necessity is known. Details pertaining to these projects are outlined below.

### 1. Mill Building

It is proposed to install a mill building (Building No. 5) within the existing refinery plant area which is located to the north east of the subject site. This new building will facilitate the grinding of materials and will also contain a storage tank known as a bin which will facilitate bauxite storage of varying moisture. It should be noted that the mill building will not facilitate additional bauxite to be milled but rather facilitate more efficient handling of varying bauxite moisture contents.

The new mill building will be similar in size and shape to the existing mill building no. 4 whilst the proposed bin will be similar in shape to the existing bin no. 6. bin (bin No. 6). Sound insulated cladding will be used in the construction of the building, similar to that which has already been utilised in the construction of the existing mill building no. 4.

### 2. Electric Boiler

A High Pressure Electric Boiler is also envisioned to be installed at the refinery plant in the coming years. This boiler will be the first of its kind in Ireland and will facilitate efforts to further decarbonise the facility by enabling the combustion process currently used for steam generation to be replaced by electrification.

The high pressure electric boiler will have a 25 MegaWatt (MW) rating and capability to generate 40 tonnes per hour of high pressure steam. The electric boiler will be operated in times of excess renewable electrical power on the grid (i.e. high wind periods).

The operation of the 25MW electric boiler in the electricity market has been modelled by a third party Baringa Consultants. Based on these modelled operating hours the electric boiler would be in use 23% of the time on average. During this time 40 tonnes per hour of steam would be generated by the electric boiler instead of the gas boilers. This would result in an average emissions saving of 10,000 tonnes $CO^2$ per year. The utilisation in the market is forecast to increase in later years resulting in further emissions savings. The $CO^2$ saving comes from the reduction of natural gas use on site and through providing system services to the electricity grid Transmission System Operator that would otherwise be provided by fossil fuel generators.

The electric boiler would provide large scale grid services reducing curtailment on the grid and increasing the usage of renewable energy.

This boiler represents the Best Available Technology (BAT), for the carbon free production of high temperature heat for energy intensive industry. It is envisioned that the electric boiler will be housed within the existing gas boiler building.

### 3. Electrical Switch Room

An electrical switch room is currently located within the refinery plant area. This is a dedicated room to accommodate electrical equipment in the best possible conditions: cool, clean and dry with medium voltage and low voltage switchboards supplying electrical loads for steam generating equipment are located there. This switch room is currently at capacity and thus needs to be extended to allow for supply of further medium and load voltage electrical loads for steam generation and the associated control interconnection panels to allow control from the plant Distributed Control System (DCS). As such, it is envisioned that this switch room will be expanded to deliver additional capacity for the refinery plant.

The above works are intended to improve efficiencies at the facility. They are forecast to be undertaken within the next 5 years and are thus considered likely to occur. As such, these works have been considered in the cumulative impact analysis of the proposed development. Further detail in this regard is provided in Chapter 18 of this EIAR.

# 3.0 DESCRIPTION OF PROPOSED DEVELOPMENT

## 3.1 Introduction

This chapter of the EIAR has been prepared by Tom Phillips + Associates in conjunction with Golder Associates and the Applicant (AAL) and provides a detailed description of the proposed development together with details of the existing environment.

As set out in Chapter 2 of this EIAR, the subject site at Aughinish Island, Askeaton, Co. Limerick, is approximately 222ha and comprises a Bauxite Residue Disposal Area (BRDA) including Salt Cake Disposal Cell (SCDC), Borrow Pit, Stockpile Area and related ancillary infrastructure.

In summary, the Applicant is applying for planning permission for development comprising the expansion of the BRDA (including SCDC), Borrow Pit and Stockpile Area to facilitate the continued disposal of bauxite residue on site arising from the continued operation of the adjoining alumina refinery plant located on the wider AAL facility.

## 3.2 Overview of Proposed Development

The proposed development consists of works to the Bauxite Residue Disposal Area (BRDA) comprising of an expansion to increase its disposal capacity to accommodate additional bauxite residue arising from the continued operation of the permitted alumina refinery plant located on the wider AAL facility. The proposed increase in disposal capacity to the BRDA will result in a proposed increase in height of c.12m above the currently permitted stage 10 level (c. 32m OD) to a final stage 16 level (c. 44m OD). No increase to the existing footprint of the BRDA is proposed.

The proposed method of raising the BRDA will be the upstream method, consistent with the construction methodology for the permitted BRDA and involves the construction of rock fill embankments (Stages), offset internally and founded on the previously deposited and farmed bauxite residue, in 2 m high vertical lifts. The overall BRDA is raised systematically as the stages are filled with bauxite residue, farmed, carbonated and compacted, prior to deposition of the next layer.

Additional works proposed as part of this application include the following:

- A vertical extension to the existing Salt Cake Disposal Cell (SCDC) to accommodate further disposal of salt cake resulting in an increase in height of c.2.25m. The SCDC is located within the BRDA. A description of the SCDC and its function is provided in Chapter 2 of this EIAR.

- An extension of the existing borrow pit, located to the east of the BRDA, is also proposed. This extension proposes to increase the footprint of the borrow pit from c.4.5ha to c.8.4ha. This expansion will provide an additional 380,000m$^3$ of rock fill material which is needed to satisfy the requirements of the construction and operation of the BRDA.

- The continued use of an existing stockpile area at the south east of the subject site to store topsoil in order to satisfy the additional restoration requirements of the extended BRDA.

- Modifications to the existing water management infrastructure to accommodate the BRDA development to Stage 16 which will also allow for greater Inflow Design Flood (IDF) capacity for the entirety of the BRDA.

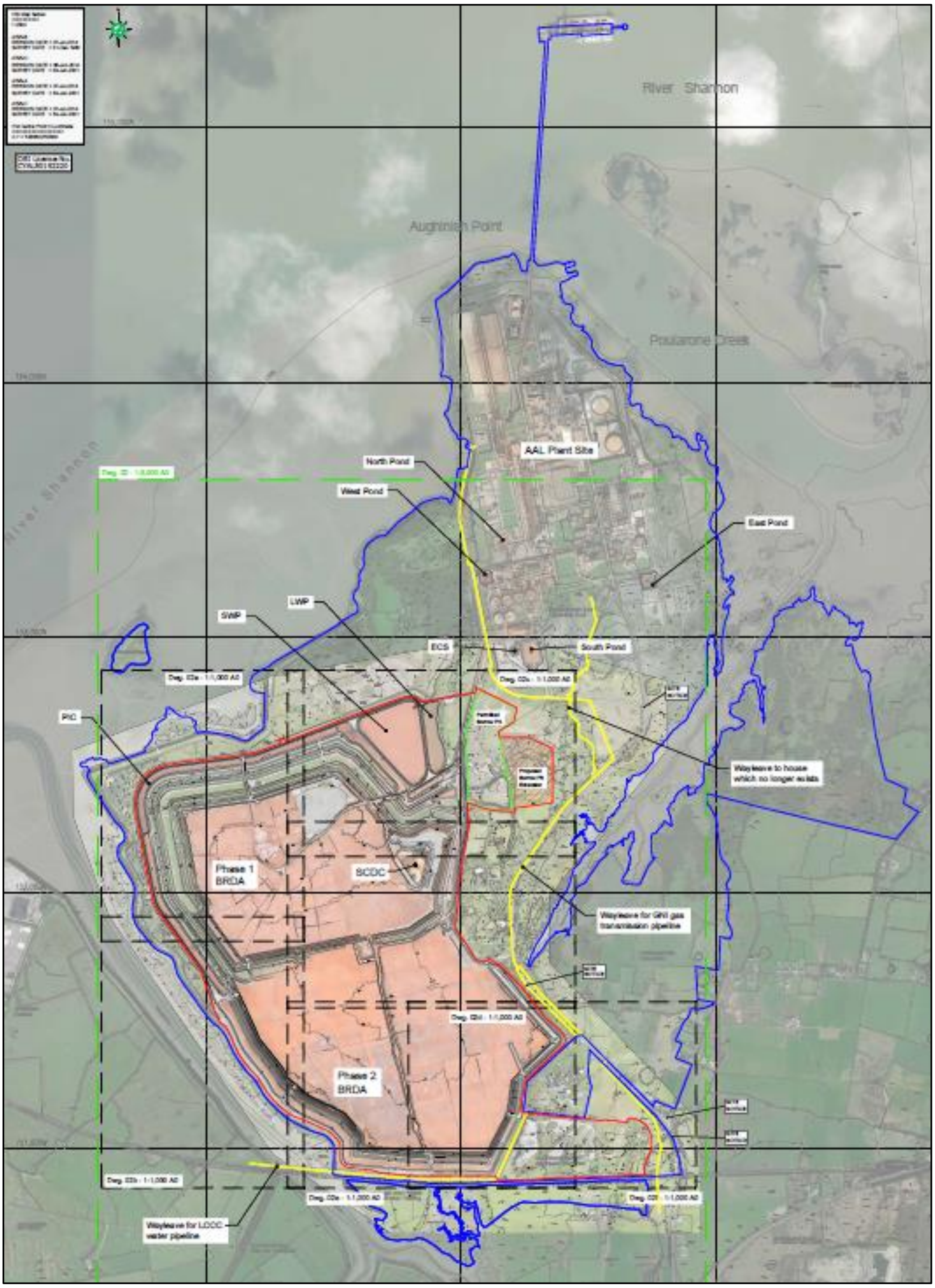



**Figure 3.1:** Subject Site Boundary Outlined in Red [Wider AAL Landholding Outlined in Blue] (Source: Extract from Golder Associates Dwg. No. 01a).

## 3.3 Proposed Works to the BRDA

As noted in Chapter 2, the permitted BRDA has capacity to provide a disposal area for bauxite residue until c.2030, for the current rate of alumina production (1.95 million tonnes per annum) at the adjoining refinery plant. As currently permitted, the BRDA will have a final perimeter elevation of 24m OD and a maximum dome crown elevation of 32m OD.

The subject application proposes that the permitted height of the overall BRDA (Phase 1 and 2 BRDA) be increased to accommodate additional bauxite residue disposal capacity. It is intended that this additional disposal capacity will extend the lifetime of the currently permitted BRDA up to c.2039 – an extension of approximately 9 no. years based on current residue disposal and production rates. The raising of the BRDA does not require any amendments to the existing BRDA footprint.

It is proposed that the existing BRDA can facilitate an increase in height to Stage 16 (currently permitted to Stage 10) which would provide a perimeter elevation of 36mOD and a maximum dome crown elevation of 44m OD. The proposed development will provide for the deposition of circa 0.9 to 1.0 million $m^3$ / year of bauxite residue and total of circa 8.0 million $m^3$ over the lifetime of the development (at current residue disposal and production rates).

The proposed method of raising the BRDA from Stage 10 to Stage 16 will be the upstream method, consistent with the construction methodology for the current BRDA and involves the construction of rock fill embankments (Stages), offset internally and founded on the previously deposited and farmed bauxite residue, in 2m high vertical lifts.

The proposed increased in height is 12m which will comprise 6 x 2m high stages raises (Stages 11 to 16), to provide a new perimeter crest elevation of 36m OD and a maximum dome crown elevation of 44m OD. The total area enclosed by the toe of the perimeter Stage 11 raise is 96.37ha. The Stage 10 bench is 12.5m wide bench, and subsequent benches from Stage 11 to Stage 16 are the standard 4m width, to form a new upper gradient of 4.83(H):1(V) and an overall BRDA wall gradient of 6.8(H):1(V).

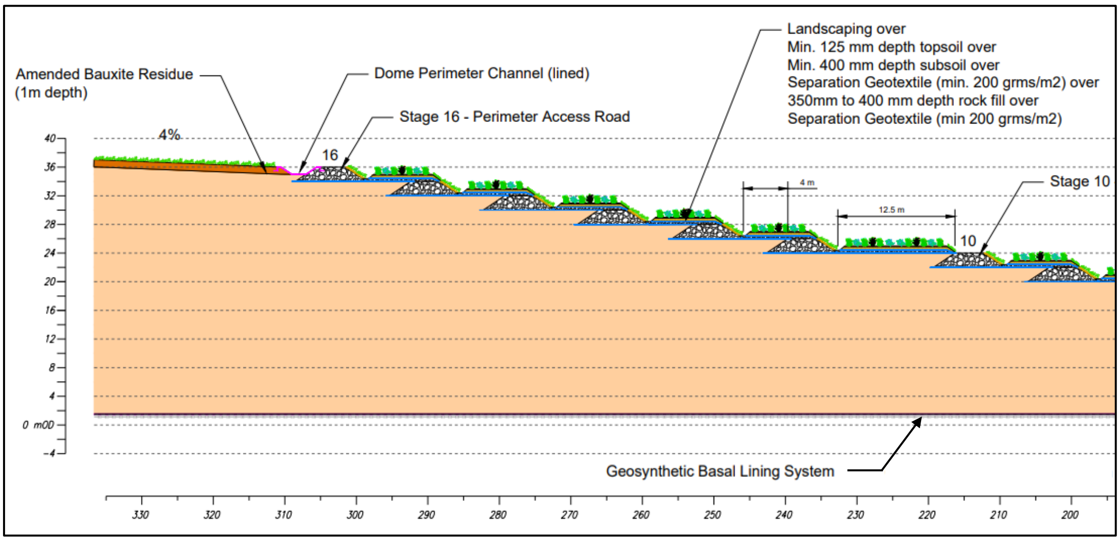



**Figure 3.2:** Section of Proposed BRDA Raise from Stage 11 to Stage 16 (Source: Golder, 2021).

The proposed BRDA Raise Development will provide an additional estimated 8.04 million $m^3$ of void for bauxite residue disposal (discounted for volume of rock fill stage raises) following from the April 2021 aerial survey, which represents an additional c. 13.1 million tonnes of bauxite residue disposal. The estimated total remaining void for bauxite residue disposal is proposed to increase to c. 17.16 million $m^3$ (discounted for volume of rock fill stage raises) following from the April 2021 aerial survey, which would represent an additional c. 28 million tonnes of bauxite residue capacity and a remaining life of c. 18 years up to 2039, based on the current rate of residue disposal and production.

The current BRDA water management infrastructure was designed to accommodate the BRDA development to Stage 10 and for an inflow design flood (IDF) with a return period of 1 in 200 years. As outlined in chapter 10 of this EIAR, it is proposed to modify the existing water management infrastructure to accommodate the BRDA development to Stage 16 and for an IDF of a greater return period, in accordance with Canadian Dam Association (CDA) guidelines, based on the classification of the BRDA.

### 3.3.1 Stage Raise Construction Methodology

The stage raises are constructed of hard, durable, well graded limestone rock fill, free of deleterious materials and with a maximum particle size of 300mm that is termed Type B material. The Type B material is sufficiently permeable to permit the initial draining of the bauxite residue paste and surface water runoff but becomes less effective as the deposition elevation increases due to fines content of the bauxite residue.

The required rock fill will be sourced from the permitted borrow pit and the proposed expanded borrow pit located at the north east of the subject site.

As noted in Chapter 2 of this EIAR, the rate of consumption of rock fill for stage raise construction in recent years has been in the 30,000 to 40,000 $m^3$ / year range. The permitted Borrow Pit footprint will provide 374,000 $m^3$ of rock fill material which is considered to be sufficient to construct the permitted BRDA to Stage 10 (198,000 $m^3$), to implement the closure design (106,000 $m^3$) with a contingency available (70,000 $m^3$).

The rock fill for the proposed BRDA Raise Development is expected to be sourced from the permitted Borrow Pit and the proposed Borrow Pit Extension and an estimated volume of 380,000$m^3$ is required to construct the BRDA to Stage 16. Additional volumes are required to implement the closure design (62,000 $m^3$) and raise the SCDC (27,000$m^3$), above the rock fill requirements for the construction of the BRDA to Stage 10. The total rock fill demand for the BRDA constructed to Stage 16 and for closure requirements is 778,000$m^3$ (from April 2021). The existing and proposed Borrow Pits will provide 754,000$m^3$ and there is 30,000$m^3$ currently stockpiled on site.

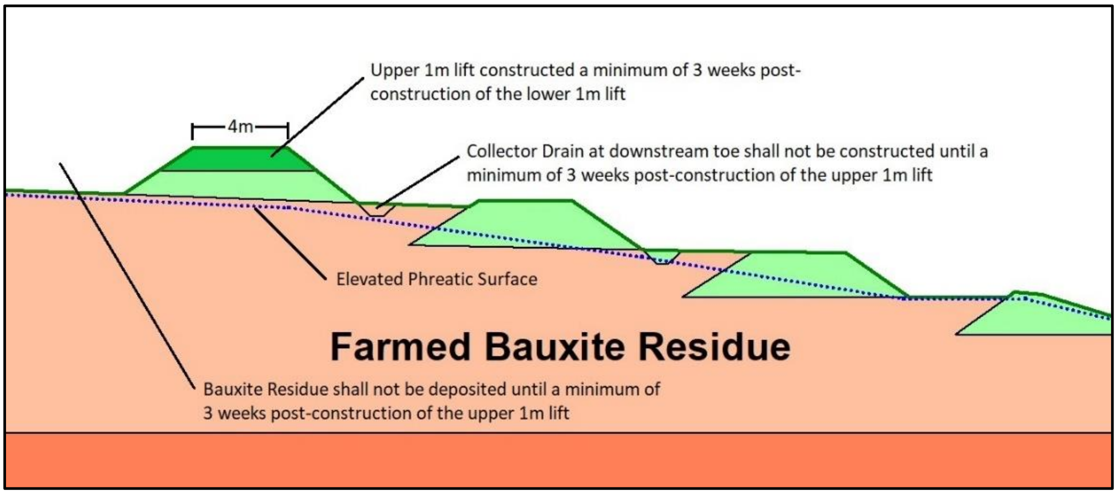


**Figure 3.3**: Stage Raise Construction Methodology (Source: Golder, 2021).

Stage raise construction follows the methodology described below and shown in Figure 3.3 above:

- As outlined in Chapter 2 of this EIAR, bauxite residue is pumped from the alumina refinery plant to the BRDA area. The bauxite residue can be directed into selected areas of the BRDA by valve operated piped discharge points.
- The farmed and compacted bauxite residue is filled to the elevation of the inner crest of a constructed stage raise.
- A minimum 14m width of subgrade, for the lateral extent of the stage raise to be constructed, is prepared for the construction of the subsequent stage raise, allowing 4m offset for the bench, 3m for the downstream slope at 1.5(H):1(V), 4m crest width and 1.5(H):1(V) upstream slope. Additional farmed mud is bulldozed into place and compacted to provide a level subgrade and/or to fill any low spots.
- A minimum 200 grms/m2 separation geotextile is placed on the subgrade in the footprint of the proposed stage raise, approx. 10m width.
- The lower 1m lift of the stage raise is constructed with Type B rock fill and trimmed to the design profile. The rock fill is nominally compacted by tracking over with heavy mechanical plant.
- The upper 1m lift of the stage raise is constructed in a similar fashion following a minimum of 3 weeks has passed to allow for pore pressure dissipation. The final crest width is 4m at the design elevation.
- The excavation of the collector drain at the toe of the downstream slope and the deposition of bauxite residue ensues after a minimum of 3 weeks has passed since the construction of the upper 1m lift.

In addition to the deposition of the bauxite residue in the BRDA area, process sand which is also a by-product of the alumina production process, will be used to construct additional ramps and access roads within the expanded BRDA. The process sand will be transported from the refinery plant by truck using the existing road network at the subject site and the wider AAL facility.

Please refer to the enclosed Engineering Design Report, prepared by Golder Associates and enclosed in Appendix A of this EIAR.

### 3.3.2 Phasing of Stage Raise Construction/Operation

It is expected that the Phase 1 BRDA will be fully constructed to Stage 10 and that all of Phase 2 BRDA will be raised to Stage 4 by the end of 2021.

For the permitted BRDA development to Stage 10, the bulk of bauxite residue will continue to be deposited in the Phase 2 BRDA (90%) and the rate of rise can be expected to be approximately 2m per year or one stage raise per year constructed in the Phase 2 BRDA until 2027.

The phasing for the BRDA Raise Development would allow a more balanced deposition strategy as the availability of capacity in the phase 1 BRDA area would reduce the reliance on the phase 2 BRDA area.

Under the proposed development strategy, the stage raise construction for the Phase 2 BRDA will continue to lag behind that of the Phase 1 BRDA by 4m to 6m (2 to 3 stage raises) until the Phase 1 BRDA reaches its design perimeter elevation of 36m OD (Stage 16). The bulk of the bauxite residue deposition will then be deposited in the Phase 2 BRDA until the Stage 16 elevation is reached.

Detail regarding the proposed construction phasing of the stage raises can be found in the Engineering Design Report enclosed in Appendix A. This phasing approach is based on the following assumptions:

- Approval for BRDA Raise Development.
- 14 $m^3$ of rock fill required per metre length of stage raise constructed.
- Internal stage raises will continue to be constructed in Phase 1 in the zone north of the Phase 2 BRDA.
- Bauxite residue is deposited in approximately equal thickness layers in both the Phase 1 BRDA and Phase 2 BRDA.

### 3.3.3 Proposed Water Management Works

The existing drainage arrangement related to the BRDA is outlined in Chapter 2 of this EIAR. In summary, the BRDA is surrounded by the Perimeter Interceptor Channel (PIC) which collects water emerging from the BRDA (seepage, bleed water, sprinkler water and surface water runoff) and conveys it via pumps either to the Effluent Clarification System (ECS) located in the plant and/or to the Storm Water Pond (SWP) / Liquid Waste Pond (LWP).

Golder Associates has undertaken a hydrological assessment to appraise the capacities of the existing water management structures, to inform the feasibility level design of the proposed BRDA Raise Development constructed to Stage 16.

Arising from this assessment, a number of improvements to the water management system for the proposed BRDA development will be implemented to allow for the existing water management system to accommodate an Inflow Design Flood (IDF) of a greater return period, in accordance with Canadian Dam Association (CDA) guidelines. At present the IDF allows for a 1 in 200 year flood event; the proposed modifications will allow for a revised IDF which will be 1/3 between the 1,000-year and the probable maximum flood (PMF)[1] event.

Proposed modifications to the water management system are outlined in full within Section 7.8.2 of the Engineering Design Report enclosed in Appendix A of this EIAR. In summary, these upgrades will consist of modifications to existing perimeter interceptor channels (PICs), construction of additional PICs, alterations to culverts, increased crest elevations on PICs, installation of a pump and overflow culverts, alterations to discharge points and upgrades to pump arrangements.

Further details in relation to hydrology and the proposed development including details of the hydrological assessment undertaken by Golder Associates can be found in Chapter 10 of this EIAR.

[1] The PMF is the most extreme meteorological event, among extreme events, corresponding to a theoretical maximum flood with an undefined return period (i.e., greater than 1 in 10,000 years). The methods for estimating the PMF include accounting for climate change (WMO 2009) and no additional factors are required to be applied to the PMF or the IDF (which is derived from the PMF).

In addition to the above, the existing sprinkler system network installed to manage the surface of the BRDA will be extended to serve the raised BRDA. As is currently the case, this revised system will use treated BRDA run-off water which will be distributed to separate sprinkler rows each with fixed point sprinkler heads. As outlined in further detail within Chapter 11 of this EIAR, this system minimises dust generation across the BRDA.

### 3.3.4 Landscaping and Restoration of the BRDA

As the bauxite residue is deposited and the stages are raised, it is intended that the side slopes and terraces of the BRDA will be progressively restored. This progressive restoration will consist of the installation of a permeable rock filter layer and the deposition of subsoil and topsoil to provide general cover. This subsoil and topsoil deposition will also consist of localised building up and profiling of BRDA stage raises to provide pockets of more organic terrain to mitigate the linear character of the underlying rock stages.

The final restoration will include the completion of the proposed side slope restoration planting scheme and the implementation of grassland and planting on the BRDA dome. Upon final restoration, the industrial character of the BRDA will be greatly reduced and the subject site will integrate sensitively into the surrounding green pastoral landscape.

Further details regarding the proposed landscaping and restoration of the BRDA can be found in Chapter 9 of this EIAR.

## 3.4 Proposed Works to Salt Cake Disposal Cell (SCDC)

As noted in Chapter 2 of this EIAR, salt cake consists of the organic degradation products from naturally occurring humates in the bauxite, including sodium hydroxide, aluminium oxide, sodium carbonate, sodium sulphate and sodium oxalate.

As salt cake is classified as hazardous according to the European Waste Catalogue, it is therefore deposited within a specially engineered composite lined cell (Salt Cake Disposal Cell, “SCDC”) within the BRDA.

As noted in Chapter 2, a Wet Air Oxidation (WAO) System has been developed to avoid the production of salt cake from the bauxite refinery process. A detailed project schedule has been developed with commissioning to be completed in the first half of 2023. In the interim and during periods of maintenance necessitating the down time of the WAO system, an extension to the SCDC is proposed as part of this application to provide headroom disposal.

The total current volume of the SCDC is estimated to be 72,800m$^3$ at the crest level. The remaining capacity of the SCDC is expected to expire during 2023. The existing crest height of the SCDC is 29.00m OD which ties into the overall height of the permitted BRDA at 32.00m OD. The proposed development comprises the vertical extension of the existing SCDC to a crest height of c. 31.25m OD which will have a maximum overall height of c. 35.50mOD when capped at cell closure. The extension of the SCDC will accommodate disposal for an additional c. 22,500 m$^3$ of salt cake in total.

The construction of the SCDC extension will be undertaken in one step as opposed to the staged BRDA construction. Approximately 27,000m$^3$ of processed rock fill material will be required to construct the perimeter wall of the SCDC raise. It is proposed that this rock material will be sourced from the adjoining borrow pit. The composite lining which will be placed inside the raised SCDC will comprise 4,500m$^2$ of a mixture of geosynthetic materials.

Additional ancillary materials which will be used in the construction of the SCDC include a non-calcareous drainage and gabion rock fill, a decant tower consisting of a high density polyethelene (HDPE) structured wall pipe, a crash barrier, concrete for posts, plinths and paths, and a conveyor belt.

### 3.4.1 Transportation of Salt Cake

As is currently the case, salt cake will be loaded at the refinery plant with a loading shovel into a dumper truck and transported to the composite lined SCDC by a designated Process Material and Handling Contractor (PMHC). This activity currently occurs approx. 3 days per week, however as the WAO system is commissioned, the frequency of this activity will decrease.

In order to ensure that the risk of potential spillages is ameliorated the transportation process of the salt cake will continue to be closely monitored with all movements logged and recorded. Taking into consideration the geometry and gradient of the route to the SCDC within the BRDA a free board of at least 300mm will continue to be maintained on all sides of the truck and the tailboard will be sealed closed with a hydraulic locking ram to prevent spillages. In the unlikely event of a spillage occurring during transportation the PMHC must immediately cordon off the area and recover the spillage by scraping the road surface with mechanical plant and removing the material in a sealed truck to the SCDC.

### 3.4.2 Deposition of Salt Cake within the SCDC

Once transported to the SCDC, the salt cake will be tipped by a dumper truck into the cell. This operation is carried out by the driver reversing the dumper truck onto a stop-end steel tipping plate (see Figure 3.4 below). Once the vehicle has reversed to the stop-end the driver raises the tipper body and empties the contents of the truck in to the designated cell. Once the dumper truck has tipped all of its content the tipper body is lowered and the tailboard sealed shut before returning to the refinery plant for loading or final washing. Three tipping plates are located on the west side of the SCDC to avoid salt cake build up, a long reach excavator operated by the designated BRDA Contractor pushes the salt cake in to the cell following tipping in order to keep the tipping plates clear.

As protection to the SCDC lining system along the tipping edge, tyres are positioned over a protection geotextile for the footprint of the three tipping areas. The tyres are tied together with a continuous length of nylon rope. In addition, re-used conveyor belts are deployed over the tyres giving extra protection at the designated tipping locations. Materials used are not impacted by the waste material itself.

A sprinkler ring main is currently placed around the perimeter of the SCDC. This sprinkler system will be maintained within the expanded SCDC which is proposed as part of this application and is purely a precautionary measure for dust suppression, despite the high moisture content of the salt cake. Further detail regarding dust suppression measures in the SCDC is contained in Chapter 11 of this EIAR.

When rain water or sprinkler system water comes in contact with salt cake, leachate is generated which is contained within the cell and is collected in a decant chamber (Volume capacity of 8.6m³) within the SCDC. The leachate is then transferred by an enclosed pipeline to a holding Tank (Volume capacity of 28m³) From here the leachate is pumped back to the plant via enclosed pipeline as a caustic recovery stream.

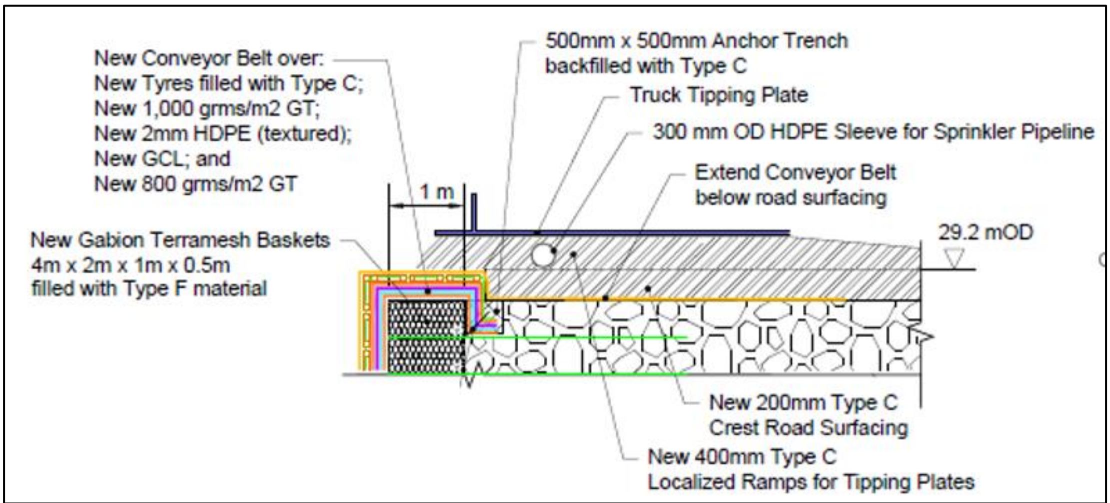



**Figure 3.4:** Typical Tipping Plate Section at SCDC (Source: AAL, 2021).

### 3.4.3 Cleaning of Equipment

As is currently the case, all equipment will be cleaned each day following task completion. The loading shovel and dumper truck will be washed at three designated hosing points which are located within a contained area beside the refinery plant. All washings will be collected in a collection sump and returned to the process preventing any contamination to ground.

Following contact with salt cake the long reach excavator located within the BRDA will be washed with a mobile water bowser, the excavator arm and bucket will be suspended over the designated salt cake and cleaned with the pressure washer from the tank, all washing will therefore be contained within the SCDC.

### 3.4.4 Closure Plan

A specific capping containment design, appropriate for the capping of a hazardous waste material, is proposed for the SCDC Raise which is in accordance with the EPA approved design for the current SCDC (Golder Associates, 2017B).

The proposed capping containment design takes into account Condition 8.5.21 of the licence (IEL P0035-07) requiring the final 1m of all exposed bauxite residue deposited in Phases 1 and 2 of the BRDA shall comprise 'amended mud' and the on-going 'amended' layer trials at Aughinish.

The final 1m depth of all exposed bauxite residue is required to comprise 'amended mud' or the 'amended layer'. As outlined in Section 8.2 of the Engineering Design Report, contained in Appendix A, large scale trials were carried out on the wide Stage 5 bench on the north and west sides of the Phase 1 BRDA. These trials determined that the current specification for the amended layer meet the following requirements:

- Farmed or carbonated bauxite residue that has a pH < 11.5.
- Addition of washed process sand at rate of 1,250 m3 / hectare / 0.5m depth layer and mixed thoroughly using a spader.
- Addition of gypsum at a rate of 90 tonnes / hectare / 0.5m depth layer and mixed thoroughly using a spader.
- Addition of approved organic soil improver / compost at a rate of 550 tonnes / hectare / 0.5m depth layer and mixed thoroughly using a spader.
- Rotovation of the top surface prior to grass seeding.

The proposed SCDC Raise dome blends into the overall BRDA dome at Stage 16. Further detail regarding the closure plan can be found in the Engineering Design Report prepared by Golder Associates and enclosed in Appendix A of this EIAR.

## 3.5 Proposed Borrow Pit Extension

As outlined in Chapter 2 of this EIAR, a borrow pit is located at the north east of the application site with an extraction area measuring c.4.5ha in size. This borrow pit is permitted under LCCC Reg. Ref. 17/714; ABP Ref. 301011-18 and serves the construction and operation of the BRDA by providing processed rock which is required to cover and build up the stage raises as residue is deposited.

The current borrow pit area has a permitted depth of c.8.5m OD and is expected to provide 374,000 $m^3$ of rock fill material which is considered to be sufficient to construct the permitted BRDA to Stage 10.

As part of the current application and in order to serve the expanded BRDA volume, it is proposed to extend the existing borrow pit eastwards into the adjoining areas which are currently covered in vegetation. The extended borrow pit extraction area will measure a total of 8.4ha in size, an increase in area of 3.9ha. This expansion will provide an additional 380,000$m^3$ of rock fill material which is needed to satisfy the requirements of the construction and operation of the BRDA.

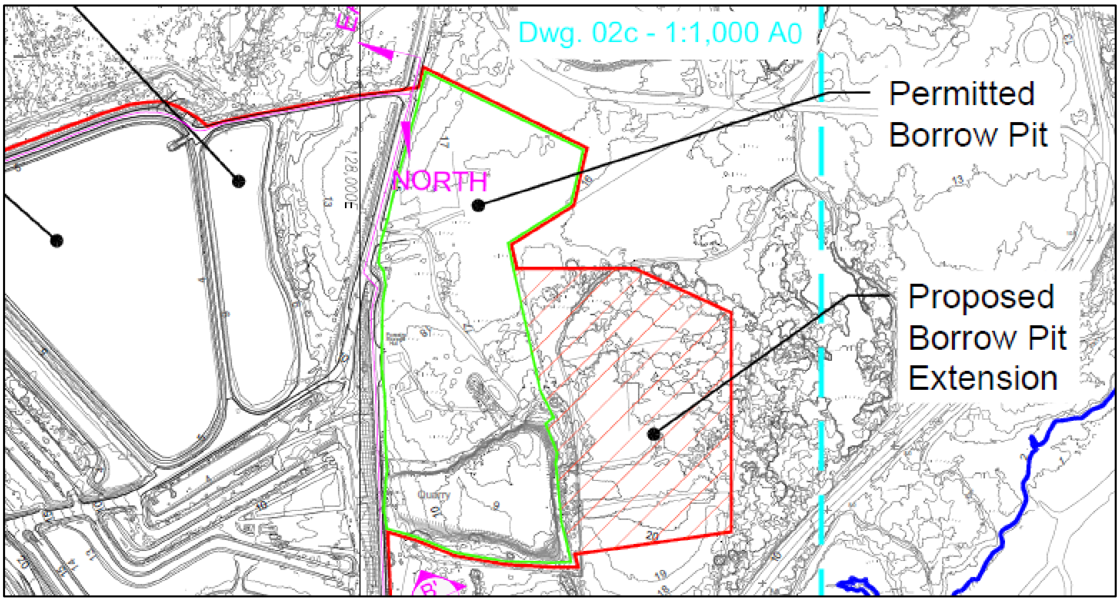



**Figure 3.5:** Permitted and Proposed Borrow Pit Extension (Source: Golder Associates – Drawing No. 02).

### 3.5.1 Phasing

It is proposed that the Borrow Pit will be extracted over a number of phases during the lifetime of the development. The Pit will be extracted first in a northern direction, from the existing former Borrow Pit area toward the plant after which the pit will be extracted alternately in an easterly direction. It is expected that the extraction of the Pit will be phased over the lifetime of the adjoining BRDA operations.

### 3.5.2 Volume Calculations

The volume of material to be extracted from the proposed extension to the Borrow Pit site has been calculated by Golder Associates. The calculations indicate that there is 380,000m$^3$ of material to be extracted within the proposed extension area. The extended and existing borrow pit will have a depth of 8.5m OD and provide a total of c. 754,000m$^3$ of rock.

An extraction rate of c.50,000m$^3$ is expected per annum for the ongoing raising of the BRDA. As such, it is requested that the lifetime of the borrow pit runs in parallel to the lifetime of the proposed BRDA (based on current residue disposal and production rates).

### 3.5.3 The Quarrying Process

The quarrying process in the extended borrow pit will mirror the permitted processes ongoing at the existing borrow pit. There are three broad stages in this quarrying process:

1) Blasting of rock faces;
2) Crushing and screening of Rock; and
3) Stockpiling of Rockfill.

Each of these steps is summarised below.

#### 3.5.3.1 Blasting of Rock Faces

In order to extract the limestone, the active rock face must be blasted using explosives. The blast charges will be placed at regular intervals with no more than one blast per week. The operational period of the Borrow Pit (blasting, crushing and stockpiling) will be restricted to between April and September each year.

The Applicant will employ specialist blasting contractors to design and carry out each blast in the Borrow Pit. All blasts at the site are subject to a specific design, which is carried out in accordance with the relevant design standards, which establish best practice and safety, and has regard to the built environment.

A site-specific protocol for blasting in cooperation with the blasting contractor and in accordance with current international best practice has been developed as part of the operation of the existing borrow pit and will be amended to apply to the extended borrow pit area. The protocol will consider all activities related to blasting, especially the selection of explosives (including forms such as slurries or emulsions), storage and handling controls, blast design considerations and loading controls.

Details in relation to the blasting on site are provided in the Engineering Design Report, enclosed in Appendix A of this EIAR.

#### 3.5.3.1 Crushing of Rock

Once blasting has occurred, the blasted rock is fed into the mobile primary crusher (by way of a wheel loading shovel), which is located on the Borrow Pit floor. There are two crushing stages, primary crushing and secondary crushing. Each crusher consists of a set of electrically operated rotating drums, which function to reduce the particle size of the rock to a scale that can be easily transported using belt conveyors. The crushing and screening rate is expected to be c. 450 to 550m$^3$ per day.

**Figure 3.7:** Example of Crushing Machinery Used **(Not at the applicant site)**

### 3.5.5 Stockpiling of Rock

The crushed rock will be stockpiled to the south of the proposed extraction area (within the existing former Borrow Pit area) using a wheeled loading shovel. The stockpiles rockfill will excavated out and loaded into dumper trucks as required to be deposited on site in the ongoing construction of the BRDA and other associated works within the Applicant's landholding. None of the rock will be transported for use off site.

### 3.5.6 Borrow Pit Operations

In this regard, the operation of the Borrow Pit will normally take place between 08:00 and 18:00 hours on Monday to Friday. No operations will take place on site on Saturdays, Sundays and Public Holidays.

### 3.5.7 Borrow Pit Safety and Security Infrastructure

In order to ensure that access to the borrow pit is restricted for safety and security reasons fences and landscaping berms will be located and regularly maintained along all boundaries of the extended borrow pit area, thereby discouraging inadvertent access to the Borrow Pit.

### 3.5.8 Borrow Pit Landscaping and Restoration Plan

A restoration landscaping proposal was prepared by Brady Shipman Martin Landscape Architects (BSM) for the original Borrow Pit development which comprised a combination of natural regeneration of vegetation with additional hedge and tree planting.

BSM have updated the restoration landscaping proposal to encompass the enlarged footprint provided by Borrow Pit Extension and the drawing and details are provided in Chapter 9.0 of the EIAR.

### 3.6 Works at Existing Stockpile Area

Existing rockfill stockpiles area are located at the southeast of the application site. This area is accessed via a security gate in the perimeter fencing. These rockfill stockpiles will be depleted for BRDA Stage raising. This area also has existing stockpiles of soil which are used in the progressive restoration of the adjoining BRDA. As part of the subject application, it is proposed to continue the use of the soil from this area to satisfy the additional restoration requirements of the extended BRDA.

### 3.7 Site Access and Access Road

The proposed development including the borrow pit and BRDA area will be accessed via the existing access arrangements. Access to the proposed development will thus be provided from the L1234 Aughinish Road to the south east of the application site which links to the N69. The Borrow Pit itself can only be accessed via the internal road system with the Applicant's landholding.

The extracted rock will not be transported outside of the Applicant's landholding and will be used solely for construction projects within the applicant's landholding. The haul route associated with the proposed development will relate to trucks exiting the application site and turning left (south) and joining the one-way internal haul route which runs around the perimeter of the BRDA.

Vehicles exiting the AAL facility (from the application site) shall make use of the existing wheel wash facilities within the plant area.

Similarly, access to the BRDA area will be possible through the existing internal road system on the wider AAL facility. Further detail regarding the proposed traffic arrangements on site can be found in Chapter 14 of this EIAR.

# 4.0 EXAMINATION OF ALTERNATIVES

## 4.1 Introduction

This chapter of the EIAR has been prepared by Tom Phillips + Associates and details the rationale underpinning the proposed development and an examination of alternatives.

The EIA Directive 2011/92/EU as amended by Directive 2014/52/EU requires an EIAR to contain:

> *'A description of the reasonable alternatives (for example in terms of project design, technology, location, size and scale) studies by the developer, which are relevant to the proposed project and its specific characteristics, and an indication of the main reasons for electing the chosen option, including a comparison of the environmental effects.'*

The EPA's 2017 draft Guidelines further state:

> *'The objective is for the developer to present a representative range of the practicable alternatives considered. The alternatives should be described with 'an indication of the main reasons for selecting the chosen option'. It is generally sufficient to provide a broad description of each main alternative and the key issues associated with each, showing how environmental considerations were taken into account deciding on the selected option. A detailed assessment (or mini – EIA) of each alternative is not required'.*

Arising from the above policy context, an examination of alternatives formed a central feature of the EIAR process.

## 4.2 Rationale for the Proposed Development

The rationale for the proposed development is based on the need to safeguard the future bauxite residue storage requirements of the alumina refinery facility adjoining the subject site. This facility is the largest of its kind in Europe and is thus of strategic national and European importance. Aluminium plays a key role in low carbon and energy efficient applications due to its particular properties:

- Aluminium is one third the density of steel: lighter aluminium component vehicles reduce fuel consumption
- Aluminium used in construction to improve energy performance of buildings: windows and insulation
- Aluminium can be recycled repeatedly without losing its properties

For these reasons, aluminium is a preferred material in the automotive, aerospace, packaging, building and electronic sectors. Into the future, Low Carbon technologies will require more and more aluminium to produce electric vehicles, solar panels, etc.

The production of alumina is thus critical to facilitating the production of renewable technologies and thereby ensuring that a low carbon and green economy centred on renewable energy production and electric transport modes can be delivered.

The maximum production level at the Aughinish facility is c.1.95 million tonnes of alumina per annum (as permitted under ABP Ref. PL13.217976). At this level of production, it is forecast that the existing permitted BRDA will reach its storage capacity in c. 2030, at current residue disposal and production rates. Given the importance of alumina in paving the way towards a Green economy, it is intended to maintain current production levels. In order to ensure this, increased storage for bauxite residue is required. This application seeks to ensure that such storage capacity is appropriately accommodated at the Aughinish facility by increasing the height of the permitted BRDA by c.12m to guarantee the continued operation of the wider alumina refinery facility.

In addition to the expansion of the existing BRDA's storage capacity, it is also proposed to increase the storage volume capacity of the existing Salt Cake Disposal Cell (SCDC) by increasing its height by 2.25m above its current permitted height. The expanded SCDC will provide additional storage capacity for Salt Cake which is also a by-product of the alumina refinery process.

An additional feature of the proposed development is to extend the permitted borrow pit area on the subject site (permitted under LCC Reg. Ref. 17/714; ABP Ref. 301011-18 and due to commence operation in April 2022). The proposed extension to the borrow pit area measures c.3.9ha, resulting in a total combined borrow pit area on the site of c.8.4ha. This expansion will provide an additional 380,000m$^3$ of rock fill which is needed to satisfy the requirements of the construction and operation of the BRDA.

## 4.3 Main Alternatives Studied

### 4.3.1 Alternative Locations and Designs

The Applicant has already provided significant capital investment in the operation of the alumina refinery facility at Aughinish Island. The location of the BRDA and SCDC at the south-west of the facility minimises transit requirements of residue and therefore maximises the efficiency of the overall operation. Given the existing infrastructure in place and the advantages of locating storage capacity adjacent to the refinery facility, an alternative location removed from the AAL landholding was considered to be inappropriate and unfeasible given the large capital investments it would require. As such, the primary design researched was whether additional BRDA and SCDC storage volume could be accommodated in the lands surrounding the AAL refinery facility.

A horizontal expansion of the existing BRDA and the development of a new BRDA area (including a new SCDC) on the overall AAL landholding were considered. Such a horizontal expansion would necessitate additional infrastructure to be constructed rather than the utilisation of existing infrastructure in the case of a vertical expansion. As it was determined in this instance that it would also be feasible to provide additional disposal capacity by means of a vertical expansion, this was considered to be a preferable design option. Further detail in relation to the feasibility of the vertical expansion design can be found in the Engineering Design Report appended to this EIAR.

The chosen design of the proposed development facilitates the expansion of the existing BRDA and SCDC storage capacity whilst also ensuring that the existing footprint of the BRDA and SCDC remains the same and that existing infrastructure is fully utilised. It also ensures that disposal capacity is delivered in a location directly adjoining the alumina refinery facility and thus negates the need for more distant transport movements away from the AAL landholding.

The proposed development will increase the height of the existing BRDA, however and as demonstrated within this EIAR, this will not result in any significant negative impacts. It should further be noted that the visual impact of the increased BRDA and SCDC height has been fully assessed in Chapter 9 of this EIAR which concludes that no significant negative effects will arise resulting from the proposed development.

With regard to the proposed extension to the existing borrow pit area, alternative sources of rock fill were considered. Such sources could potentially have been secured from quarries in the area such as the nearby Roadstone Quarry at Barrigone located approx. 2.5km from the subject site. However, the expansion of the permitted borrow pit (due to be in operation in April 2022) was considered more beneficial given that it would minimise impacts on the surrounding traffic network and also minimise dust / noise impacts arising from traffic movements to and from surrounding quarries and provide future security of supply from within the site.

### 4.3.2 Alternative Bauxite Residue and Salt Cake Management Methods

*Bauxite Residue*

Given that bauxite residue is the principal waste by-product of the Alumina refinery process, extensive research has been and is being undertaken in respect of its management with a view to minimising the volume required to be disposed of.

The alumina refinery industry as a whole continues to search with growing interest and success, for technically and economically viable options for residue critical element extraction and residue bulk utilisation, with the overall objective of producing less residue and contributing more to the circular economy. Innovative residue treatments can change residue properties, potentially allowing different long-term storage, rehabilitation and utilisation options.

However, it should be noted that bauxite residue management is not “one-size fits all” and technology selection and management practices have to be adapted to local circumstances. The solutions and practices used at each refinery are further influenced by local climatic, geographic and environmental conditions, as well as government policies, regulatory frameworks and community factors.

In this regard, AAL have, since 2015, been involved in research and developing technological options for bauxite residue reuse at the Aughinish facility, in collaboration with industry partners, European Universities and Research Institutes. Examples of these research projects include Al Geopolymer, Al Source, RECOVER, RemovAl, and ReActiv.

The Al Geopolymer project carried out by the University of Limerick for the EPA, involved a desk-based study focused on a state-of-the-art review related to geopolymers, including a technology overview. The objective of the research was to investigate the potential for wastes at the AAL facility (bauxite residues, etc.) to be used in geopolymer applications and the opportunities for these geopolymer applications within Ireland.

The Al Source project carried out by the University of Limerick for the EPA, examined bauxite residue as a potential source for Critical Raw Materials or CRMs, which are fundamental to Europe's economy, growth and jobs and are essential for maintaining and improving our quality of life.

The RECOVER, RemovAl and ReActiv projects are three EU funded projects, which AAL are involved in. These projects study the potential for the re-use of bauxite residue, at a pilot scale, in the construction sector, as an alternative raw material. These projects, as well as potentially finding a use for bauxite residue, aim to enable the construction sector to reduce their $CO_2$ emissions by utilising secondary raw materials in production. Research in this area is ongoing.

Notwithstanding the ongoing research efforts outlined above and AAL's continued commitment to exploring alternative uses and applications for bauxite residue, there are at present no alternative methods which would eliminate the existence of bauxite residue as a by-product from the alumina refinery process. As such, there is a need to facilitate the storage of bauxite residue. The current BRDA storage arrangement of the bauxite residue represents best practice in the industry and ensures that the bauxite residue is fully secured and risks of spillage or leakage of the residue beyond the BRDA is fully ameliorated.

*Salt Cake*

With regard to the expansion of the SCDC, ongoing investigations into the alternative treatment of Salt Cake have determined that a Wet Air Oxidation (WAO) System would eliminate the need for Salt Cake storage within the SCDC. Arising from this, a project schedule relating to the installation of this system has been developed with commissioning to be completed in 2023.

A description of this process is contained within Chapter 2 of this EIAR. There are no additional environmental emissions associated with this process and it is fully compliant with all relevant EU 'Best Available Technique'. The EPA have approved the operation of the process under Condition 1 of AAL's existing IE Licence. It is anticipated that this process will be integrated into the Plant in 2023. Until such time, the current SCDC is required to provide Salt Cake disposal capacity. The proposed SCDC extension will also facilitate salt cake disposal during periods of maintenance necessitating the downtime of the WAO system.

### 4.3.3 Borrow Pit Extension

The preliminary design of the borrow pit extension provided for a larger extraction area of c. 4.5ha which projected further to the south of that now proposed. In the preparation of the EIAR, a recorded monument (LI010-108; Enclosure; Chapter 5 refers) which may have been intersected by the application boundary was identified. Associated with this, it was also calculated that the rockfill requirements for construction of the proposed development were less than previously anticipated (due to the ongoing importation of rockfill from a local quarry up to and including Quarter 1 of 2022 and the existing stockpile of rock on site).

The revised design of the borrow pit extension area now ensures that there is a set-back from the boundary of the recorded monument to ensure there is no direct impact on this enclosure. Section 5.4 states that *'The recorded enclosure (LI010-108) possesses no surface expression; however, the proximity of the development will result in a slight negative indirect impact on the setting of the monument.'*

### 4.3.4 "Do Nothing" Alternative

In the event that AAL do not expand the capacity of the existing BRDA and SCDC, with the associated borrow pit extension, the wider alumina refinery facility would cease operations in c.2030 based on current production levels. Bauxite residue deposition would cease at the subject site and the restoration plan (permitted under ABP Ref. PL13.217976; LCC Reg. Ref. 05/1836) would be implemented. The closure of the facility at Aughinish would result in a significant loss in highly skilled employment opportunities in the wider area and result in the loss of one of the state's major industrial manufacturing facilities. This would have a significant negative impact on the local economy and also negatively impact on the diversification of the state's economic base.

Given the existing and forecast high levels of demand for alumina worldwide, particularly in the production of renewable energy technologies, additional alumina production capacity will likely be delivered at existing alternative alumina refinery facilities worldwide. The Aughinish facility operates in compliance with stringent environmental regulations and continued monitoring by the EPA.

The Aughinish facility thus represents the highest standards in excellence in alumina production. This is demonstrated by the findings of the Commodity Research Unit (CRU) which ranks the AAL facility within the top 10% of alumina refineries globally with respect to minimising carbon emissions. Furthermore, the AAL refinery is recognised as the most efficient high temperature refinery globally.

The expansion of existing facilities or the development of new facilities to replace the alumina refining capacity required in the event of the potential future closure of the Aughinish facility in locations (principally in Asia) where less stringent environmental protections and regulations exist, would likely result in an overall increase in emissions and wastes.

The replacement production of alumina to compensate for the loss of production capacity at Aughinish may be satisfied by the development of a new alumina refinery facility on a greenfield site. This would be a complex undertaking requiring significant capital investment. As stated above, there is also no guarantee that such a development would be subject to the stringent environmental protection measures which are in place at Aughinish. As such, pollutant emissions and wastes from the production of the displaced alumina produced at Aughinish are likely to rise in a 'do nothing' scenario where the development of a greenfield site is progressed. It is certain the amount of bauxite residue would not reduce as an alumina refinery on a greenfield site would still be dependent on bauxite as an ore.

Given the fact that best available techniques are currently employed at the Aughinish facility to minimise pollutant emissions and wastes at all times, replacement alumina production at alternative facilities will not therefore result in any environmental benefits overall. Indeed, it is likely that replacement production at alternative facilities which operate in less stringent environmental protection contexts will result in negative long-term environmental impacts.

In addition, and as stated above, a 'do nothing' scenario will also adversely impact on both the local economy of Limerick and also the economic diversification of the state.

With regard to the proposed extension to the Borrow Pit area, in a 'do nothing' scenario this development would no longer be required resulting in a positive environmental impact as the existing landform would remain in place. However, it should be noted that the extension of the proposed borrow pit is assessed fully in this EIAR and no significant negative impacts are identified.

## 4.4 Conclusion

The location and design of the proposed development represents the most appropriate option to ensure the ongoing operation of the alumina refinery facility adjoining the application site. The proposed development will ensure that high levels of demand for alumina for use in products such as renewable energy technologies is secured and satisfied within Europe into the future beyond 2030.

# 5.0 ARCHAEOLOGICAL, ARCHITECTURAL & CULTURAL HERITAGE

## 5.1 Introduction

IAC Archaeology has prepared this assessment on behalf of Aughinish Alumina Ltd. (AAL) to assess the impact, if any, on the archaeological, architectural and cultural heritage resource of a proposed development within the overall landholding of AAL, on Aughinish Island, County Limerick (OS Sheet 10). The planning application site comprises a large area within the AAL landholding on Aughinish Island (ITM 527543,651747).

AAL is a well-established alumina refinery on Aughinish Island on the southern bank of the Shannon Estuary, located within a substantial landholding. The area surrounding Aughinish Island is rural in nature with small towns and villages close by such as Foynes to the southwest and Askeaton to the southeast.

### 5.1.1 Proposed Development

The proposed development consists of works to the Bauxite Residue Disposal Area (BRDA) comprising of an expansion to increase its disposal capacity to accommodate additional bauxite residue arising from the continued operation of the permitted alumina refinery plant located on the wider AAL facility. The proposed increase in disposal capacity to the BRDA will result in a proposed increase in height of c.12m above the currently permitted stage 10 level (c. 32m OD) to a final stage 16 level (c. 44m OD). No increase to the existing footprint of the BRDA is proposed.

The proposed method of raising the BRDA will be the upstream method, consistent with the construction methodology for the current BRDA and involves the construction of rock fill embankments (Stages), offset internally and founded on the previously deposited and farmed bauxite residue, in 2 m high vertical lifts. The overall stack is raised systematically as the stages are filled with bauxite residue, farmed, carbonated and compacted, prior to deposition of the next layer.

Additional works proposed as part of this application include the following:

- A vertical extension to the existing Salt Cake Disposal Cell (SCDC) to accommodate further disposal of salt cake resulting in an increase in height of c.2.25m. The SCDC is located within the BRDA. A description of the SCDC and its function is provided in Chapter 2 of this EIAR.

- An extension of the existing borrow pit, located to the east of the BRDA, is also proposed. This extension proposes to increase the footprint of the borrow pit from c.4.5ha to c.8.4ha. This expansion will provide an additional 380,000$m^3$ of rock fill material which is needed to satisfy the requirements of the construction and operation of the BRDA.

- The continued use of an existing stockpile area at the south east of the subject site to store topsoil in order to satisfy the additional restoration requirements of the extended BRDA.

- Upgrades to the existing water management infrastructure to accommodate the BRDA development to Stage 16 which will also allow for greater Inflow Design Flood (IDF) capacity for the entirety of the BRDA.

Please refer to Chapter 3.0 of this EIAR and the Engineering Design Report (enclosed in Appendix A) for a more detailed description of the proposed development.

## 5.2 Methodology

This study determines, as far as reasonably possible from existing records, the nature of the cultural heritage resource within the 500m study area of the proposed development area using appropriate methods of study.

The study involved detailed interrogation of the archaeological, historical and architectural background of the Proposed Development. This included information from the Record of Monuments and Places of County Limerick, Limerick County Development Plan (2010–2016, as extended), the topographical files of the National Museum of Ireland, National Inventory of Architectural Heritage and cartographic and documentary records. A field inspection was carried out on 16th February 2021 in an attempt to identify any known cultural heritage sites and previously unrecorded features, structures and portable finds within the area covered by the proposed development. The field inspection was followed by a geophysical survey of the eastern, previously undisturbed portion of the planning application site (extended borrow pit).

An impact assessment and a mitigation strategy have been prepared. The impact assessment is undertaken to outline potential impacts that the proposed development may have on the cultural heritage resource, while the mitigation strategy is designed to avoid, reduce or offset any adverse impacts.

### 5.2.1 Guidance and Legislation

The following legislation, standards and guidelines were consulted as part of the assessment.

- National Monuments Acts, 1930–2014
- The Planning and Development Act 2000Heritage Act, 1995
- Environmental Protection Agency. 2015 Advice Notes for preparing Environmental Impact Statements (DRAFT Sept. 2015). Dublin, Government Publications Office.
- Environmental Protection Agency. 2017 Revised Guidelines on the Information to be Contained in Environmental Impact Statements (DRAFT Sept. 2017). Dublin: Dublin: Government Publications Office.
- Frameworks and Principles for the Protection of the Archaeological Heritage, 1999, (formerly) Department of Arts, Heritage, Gaeltacht and Islands
- Architectural Heritage (National Inventory) and Historic Monuments (Miscellaneous Provisions) Act, 2000 and the Local Government (Planning and Development) Act 1999
- Architectural Heritage Protection: Guidelines for Planning Authorities, 2011), (formerly) Department of Arts, Heritage and the Gaeltacht

### 5.2.2 Site Visits

Field inspection is necessary to determine the extent and nature of archaeological and architectural remains and can also lead to the identification of previously unrecorded or suspected sites and portable finds through topographical observation and local information.

The archaeological and architectural field inspection which was carried out on the 16th of February 2021, entailed:

- Walking the planning application site and its immediate environs.
- Noting and recording the terrain type and land usage.

- Noting and recording the presence of features of archaeological, architectural or cultural heritage significance.
- Verifying the extent and condition of recorded sites.
- Visually investigating any suspect landscape anomalies to determine the possibility of their being anthropogenic in origin.

### 5.2.3 Consultation

Following the initial research, a number of statutory and voluntary bodies were consulted to gain further insight into the cultural background of the baseline environment, receiving environment and a 500m radius study area, as follows:

- Department of Housing, Local Government and Heritage (DoHLGH)– the Heritage Service, National Monuments and Historic Properties Section: Record of Monuments and Places; Sites and Monuments Record; Monuments in State Care Database; Preservation Orders; Register of Historic Monuments and the Architectural Heritage Advise Unit;
- National Museum of Ireland, Irish Antiquities Division: topographical files of Ireland;
- National Inventory of Architectural Heritage: County Limerick
- Limerick County Council: Planning Section; and
- Trinity College Dublin, Map Library: Historical and Ordnance Survey Maps.

### 5.2.4 Desktop Study

This is a document search. The following sources were examined and a list of areas of archaeological, architectural and cultural heritage potential was compiled:

- Record of Monuments and Places for County Limerick;
- Sites and Monuments Record for County Limerick;
- Monuments in State Care Database;
- Preservation Orders County Limerick;
- Register of Historic Monuments County Limerick;
- Topographical files of the National Museum of Ireland;
- Limerick County Development Plan 2010–2016 (As extended);
- Aerial photographs;
- Excavations Bulletin (1970–2020);
- Cartographic and written sources relating to the study area;
- National Inventory of Architectural Heritage County Limerick (Architectural & Garden Survey)

**Record of Monuments and Places (RMP)** Section 12 (1) of the National Monuments Act (1994 amendment) provides that the Minister for Arts, Heritage, Gaeltacht and the Islands (now the Minister for Housing, Local Government and Heritage) shall establish and maintain a record of monuments and places where the Minister believes that such monuments exist. The record comprises of a list of monuments and relevant places and a map or maps showing each monument and relevant place in respect of each county in the State. Sites recorded on the Record of Monuments and Places all receive statutory protection under the National Monuments Act. Each recorded monument is surrounded by a ‘zone of notification’. These zones do not define the extent of a recorded monument but are the zone where notification under Section 12 of the National Monument Act (1930-2004) should be made to the DoHLGH if works are proposed in these areas.

**Sites and Monuments Record (SMR)** holds documentary evidence and field inspections of all known archaeological sites and monuments. Some information is also held about archaeological sites and monuments whose precise location is not known e.g. only a site type and townland are recorded. These are known to the National Monuments Section as 'un-located sites' and cannot be afforded legal protection due to lack of locational information. As a result, these are omitted from the Record of Monuments and Places. SMR sites are also listed on a website maintained by the Department of Housing, Local Government and Heritage (DoHLGH) – www.archaeology.ie.

**National Monuments in State Care Database** is a list of all the National Monuments in State guardianship or ownership. Each is assigned a National Monument number whether in guardianship or ownership and has a brief description of the remains of each Monument. A National Monument receives statutory protection and is described as 'a monument or the remains of a monument the preservation of which is a matter of national importance by reason of the historical, architectural, traditional, artistic or archaeological interest attaching thereto' (National Monuments Act, 1930, Section 2). The Minister for Housing, Local Government and Heritage may acquire National Monuments by agreement or by compulsory order. The state or local authority may assume guardianship of any National Monument (other than dwellings). The owners of National Monuments (other than dwellings) may also appoint the Minister or the local authority as guardian of that monument if the state or local authority agrees. Once the site is in ownership or guardianship of the State, it may not be interfered with without the written consent of the Minister.

**Preservation Orders and/or Temporary Preservation Orders** can be assigned to a site or sites that are deemed to be of national importance and may be in danger of injury or destruction. These are allocated under the 1930 Act. Preservation Orders make any interference with the site illegal. Temporary Preservation Orders can be attached under the 1954 Act. These perform the same function as a Preservation Order but have a time limit of six months, after which the situation must be reviewed. Work may only be undertaken on or in the vicinity of sites subject to Preservation Orders with the written consent, and at the discretion of the Minister.

**Register of Historic Monuments** was established (as a precursor to the RMP) under Section 5 of the National Monuments Act 1987, which requires the Minister to establish and maintain such a record. Historic monuments and archaeological areas present on the register are afforded statutory protection under the 1987 Act. The register also includes sites under Preservation Orders and Temporary Preservation Orders. All registered monuments are included in the Record of Monuments and Places. Inclusion within the RHM does not afford an archaeological site any more statutory protection than those registered as RMP sites.

**Topographical files of the National Museum of Ireland** comprise the national archive of all known finds recorded by the National Museum of Ireland. This archive relates primarily to artefacts but also includes references to monuments and unique records of previous excavations. The locations where artefacts are found are important sources of information on the discovery of sites of archaeological significance.

**Cartographic sources** are important in tracing land use development within the development area as well as providing important topographical information on areas of archaeological potential and the development of buildings. Cartographic analysis of all relevant maps has been made to identify any topographical anomalies or structures that no longer remain within the landscape. The following cartographic sources were analysed as part of the assessment;

- *William Petty's Down Survey Map,* Connello Barony, 1658
- *Ordnance Survey Mapping,* 1840–1900

**Documentary sources** were consulted to gain background information on the archaeological, architectural and cultural heritage landscape of the planning application site.

**Aerial photographic coverage** is an important source of information regarding the precise location of sites and their extent and provides a means of identifying new sites. It also provides initial information on the terrain and its likely potential for archaeology. Ordnance Survey aerial photographs (1995–2013) Google Earth (2008–2020) and Bing Maps (2021) coverage were examined for this assessment.

**Development Plans** contain a catalogue of all the Protected Structures, Architectural Conservation Areas (ACAs) and archaeological sites within the county. The Limerick County Development Plan (2010-2016, as extended) was consulted to obtain information on cultural heritage sites in and within the immediate vicinity of the proposed development.

**Excavations Bulletin** is a summary publication that has been produced every year since 1970. The hard copy publication summarises every archaeological excavation that has taken place in Ireland during that year up until 2010 and since 1987 this bulletin has been edited by Isabel Bennett. This information is vital when examining the archaeological content of any area, which may not have been recorded under the SMR and RMP files. The digital information is available online (www.excavations.ie) from 1970-2020.

**The National Inventory of Architectural Heritage (NIAH)** is a government-based organisation tasked with making a nationwide record of significant local, regional, national and international structures, which in turn provides County Councils with a guide as to what structures to list within the Record of Protected Structures. The NIAH have also carried out a nationwide desk-based survey of historic gardens, including demesnes that surround large houses.

### 5.2.5 Geophysical Survey

Geophysical survey is used to create 'maps' of subsurface archaeological features. Features are the non-portable part of the archaeological record, whether standing structures or traces of human activities left in the soil. Geophysical instruments can detect buried features when their electrical or magnetic properties contrast measurably with their surroundings. In some cases, individual artefacts, especially metal, may be detected as well. Readings, which are taken in a systematic pattern, become a dataset that can be rendered as image maps. Survey results can be used to guide excavation and to give archaeologists insight into the pattern of non-excavated parts of the site. Unlike other archaeological methods, the geophysical survey is not invasive or destructive.

A geophysical survey was undertaken to inform this assessment in April 2021 within the planning application site in Aughinish East townland (Leigh 2021, Licence 21R0086). A summary of the geophysical report is presented in Section 5.3.9 and the full technical report is included in Appendix 5.2.

### 5.2.6 Impact Assessment Methodology

The following impact types and definitions were used in order to assess the potential impacts of the proposed development site.

Impact Definitions (as defined by the EPA 2017 Guidelines, page 42)

| | |
|---|---|
| Imperceptible: | An effect capable of measurement but without noticeable consequences. |
| Not significant: | An effect which causes noticeable changes in the character of the environment but without noticeable consequences |
| Slight Effects: | An effect which causes noticeable changes in the character of the environment without affecting its sensitivities. |
| Moderate Effects: | An effect that alters the character of the environment in a manner that is consistent with existing and emerging trends. |
| Significant Effects: | An effect which, by its character, magnitude, duration or intensity alters a sensitive aspect of the environment. |
| Very Significant: | An effect which, by its character, magnitude, duration or intensity significantly alters the majority of a sensitive aspect of the environment. |
| Profound Effects: | An effect which obliterates sensitive characteristics |

## 5.3 Description of Receiving Environment

The planning application site is located within the townlands of Aughinish West, Aughinish East, Island Macteige, Glenbane West and Fawnamore, south of the River Shannon (Figure 5.1). The site is located within and to the east of an existing aluminium plant and as such there has been a large impact on the surrounding landscape. There are 19 archaeological sites located within the 500m study area of the planning application site, of which 10 are recorded monuments and nine are listed in the SMR only and do not receive statutory protection, as they represent a record of excavation. There are no recorded structures of built heritage merit located within 500m of the proposed site. The historic mapping depicts the planning application site in an entirely rural landscape prior to the relatively modern development of the alumina refinery facility.

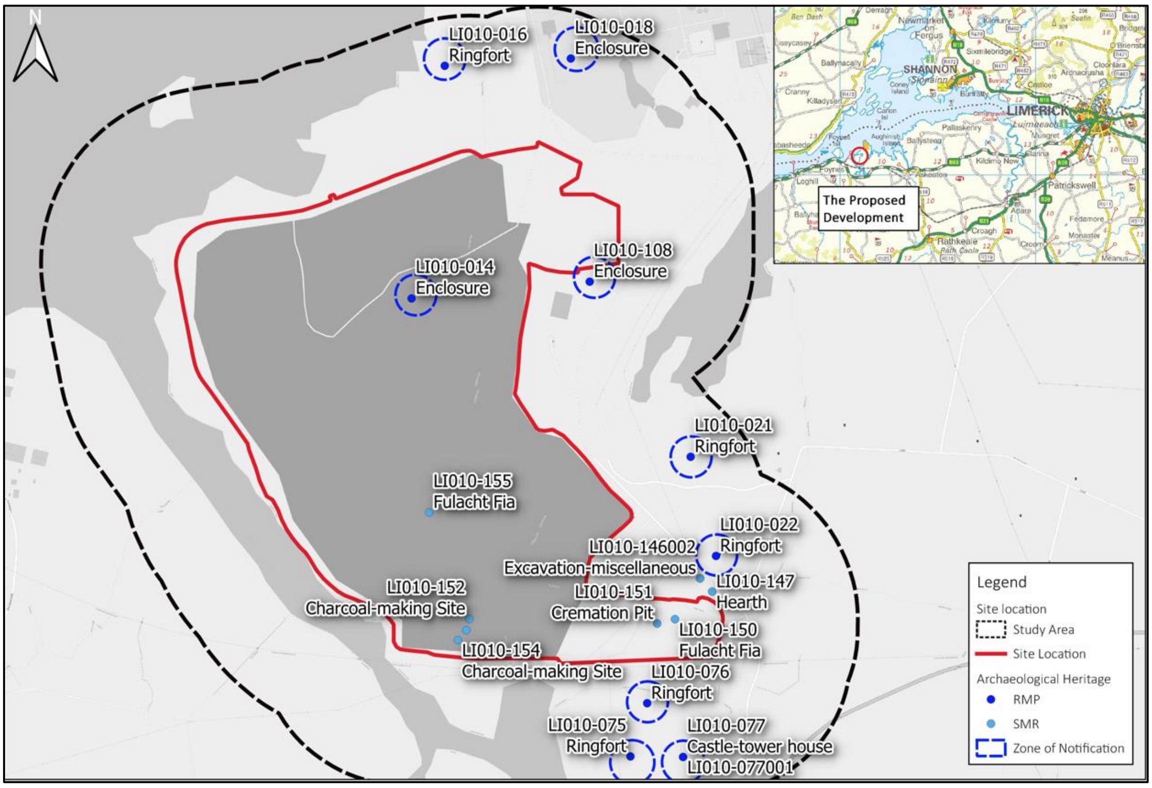



**Figure 5.1**: Site location showing surrounding recorded archaeological sites

### 5.3.1 Archaeological and Historical Background

***Mesolithic Period (c. 7000–4000 BC)***

Although recent discoveries may push back the date of human activity in Ireland by a number of millennia (Dowd and Carden 2016), the Mesolithic period is the earliest time for which there is clear evidence of prehistoric activity on the island. During this period people hunted, foraged and gathered food and appear to have led mobile, transient lives. The most common evidence indicative of Mesolithic activity at a site comprises of scatters of worked flint material; a by-product from the production of flint implements or rubbish middens consisting largely of shells (Stout and Stout 1997). The River Shannon would have been an excellent resource for people to utilise in terms of food, water and transport during the prehistoric period.

There are no recorded sites of this date located within the study area of the planning application site. Within the wider context of County Limerick, a late Mesolithic/early Neolithic axehead and lithics were found within alluvial deposits on the northern bank of the River Shannon as part of the Limerick Southern Ring Road (Bermingham et al. 2013, 45). The most significant discovery of this period, took place within the townland of Hermitage on the banks on the River Shannon, c. 40km to the northeast of the planning application site. Here, two cremations were excavated, the earliest of which dated to 7550–7290 cal. BC. These Mesolithic burials provide the earliest evidence in Ireland for formal burial practices (Collins and Coyne 2006).

***Neolithic Period (c. 4000–2500 BC)***

During the Neolithic period communities became less mobile and their economy became based on the rearing of stock and cereal cultivation. This transition was accompanied by major social change. Agriculture demanded an altering of the physical landscape; forests were rapidly cleared and field boundaries constructed. There was a greater concern for territory, which contributed to the tradition of the construction of large communal ritual monuments called megalithic tombs, which are characteristic of the period. In Ireland four main types of megalithic tomb have been identified: court tombs, portal tombs, passage tombs and wedge tombs. The first three types are earlier in date (pre- 2000 BC) and are largely confined to the northern half of the country, while wedge-tombs are slightly later in date and are most numerous in the west and southwest. While there are no recorded megalithic tombs located within the study area of the planning application site, a megalithic tomb (LI010-126) is located c. 4.2km to the east.

***Bronze Age (c. 2500–600 BC)***

The Bronze Age was characterised by the introduction of metalworking technology to Ireland and coincides with many changes in the archaeological record, both in terms of material culture as well as the nature of the sites and monuments themselves. Although this activity had markedly different characteristics to that of the preceding Neolithic period, including new structural forms and new artefacts (such as Beaker pottery), it also reflects a degree of continuity. Megalithic tombs were no longer constructed following the wedge tombs of the early Bronze Age, and the burial of the individual became more typical. Cremated or inhumed bodies were often placed in a stone cist, a stone-lined grave or even a simple pit. Burials were often made within cemeteries and marked within the landscape with the construction of an earthen barrow or cairn of stones. Two cremation pits were excavated within the planning application site in the townland of Glenbane West (LI010-151). These date to the middle Bronze Age (1323–1251 cal. BC) (Licence Ref. 08E0910, Bennett 2008:775). A pit-burial dating to the Bronze Age was also excavated c. 75m north of the south-eastern extent of the planning application site (Licence 04E1306, Bennett 2004:0975).

The most common Bronze Age site within the archaeological record is the burnt mound or *fulacht fia*. Although burnt mounds of shattered stone occur as a result of various activities that have been practiced from the Mesolithic to the present day, those noted in close proximity to a trough are generally interpreted as Bronze Age cooking/industrial sites. Alternative interpretations have been presented which include tanning, bathing, fulling and dyeing (Quinn and Moore 2009, 43). *Fulachtaí fia* generally consist of a low mound of burnt stone, commonly in a horseshoe shape, centred around an earth-cut trough. They are found in low-lying marshy areas or close to streams or rivers. Often these sites have been ploughed out and survive as a spread of heat-shattered stones in charcoal- rich soil with no surface expression. There were two *fulachtaí fia* (LI010-155 and LI010-150) within the planning application site, both of which have been fully excavated and recorded. Site LI010-155 was excavated in 2007 (Licence Ref.: 07E0805) and dated to 1612–1494 cal. BC (Bennett 2008:778). Site LI010-150 was excavated in Glenbane West and comprised a number of pits and troughs as well as a burnt spread in close proximity to a palaeochannel (Licence 08E0998, Bennett 2008:775). The site was dated to 1129-1007 cal. BC.

There were also traces of settlement evidence recorded to the northeast of the south-eastern section of the planning application site, in the form of a hearth site (LI010-147), c. 31m northeast and a group of pits or postholes (LI010-146002) c. 75m north. Both of these sites were identified and fully excavated under licence 04E1306 (Bennett 2004:0975).

***Iron Age (c. 600 BC–AD 400)***

There is increasing evidence for Iron Age (c. 600 BC–AD 500) settlement and activity in recent years as a result of development-led excavations. There are two phases of the Iron Age in Ireland, the Hallstatt and the La Tène, which are associated with distinct artwork and metalwork. Whilst the Shannon as a route way was known to Ptolemy in the second century AD (O'Sullivan 2001), there is very little in the way of recorded Iron Age activity within the landscape surrounding the planning application site. Evidence of Iron Age funerary practice has been identified within the wider region, including Ballysimon 1, Rathbane South and Coonagh West 4 that were excavated as part of the Limerick Southern Ring Road (Bermingham et al. 2013, 24).

***Early Medieval Period (AD 400–1169)***

During this period Ireland was not a united country but rather a patchwork of minor kingdoms all scrambling for dominance, with their borders ever changing as alliances were formed and battles fought. Kingdoms were a conglomerate of clannish principalities with the basic territorial unit known as a *túath*. Byrne (1973) estimates that there were probably at least 150 kings in Ireland at any given time during this period, each ruling over his own *túath*. In Munster the *Eóganachta* formed the ruling dynasties until the middle of the 10th century. These kings were distributed strategically throughout the region and ruled over many tribal units.

During this turbulent period, roughly circular defensive enclosures known as ringforts were constructed to protect farmsteads and these are considered to be the most common indicator of settlement during the early medieval period. These took the form of raths, mostly earthen-made and cashels which were constructed of stone. They are typically enclosed by an earthen bank and exterior ditch, and range from 25m to 50m in diameter. The smaller single-banked type of ringfort (univallate) was more likely to be home to the lower ranks of society while larger examples with more than one bank (bivallate/trivallate) housed the more powerful kings and lords.

Ringforts and potential ringforts- often also recorded as enclosures-are the most common archaeological sites recorded within the receiving environment of the planning application site. Indeed, West Limerick has one of the highest ringfort densities in the country, at c. 1.52 per square kilometre (Stout 1997). A number of ringforts are located within the study area of the planning application site, including LI010-075-6 in Dysert and LI010-021-2 in Fawnamore and LI010-016 in Aughinish West. An enclosure (LI010- 014) is recorded within the larger western section of the planning application site, although archaeological investigation prior to the existing industrial complex failed to identify any remains of archaeological significance (Licence 96E0168, Bennett 1996:232). A second enclosure (LI010-108) is recorded immediately to the south of the north-eastern section of the planning application site. Although this site has been suggested to represent a ringfort, the recent geophysical survey suggests it is more likely to be a moated site of medieval date (Licence 21R0086, Leigh 2021). In addition, a third enclosure (LI010-018) is located c. 350m north-northeast of the planning application site in the townland of Aughinish East.

Excavations within the planning application site discovered five charcoal-production pits of early medieval date (licence 08E0782, Bennett 2008:779). These features were later added to the SMR (LI010-152-4).

It was during the latter part of this period that attacks by the Norse on the lower Shannon area were recorded. The Annals of Clonmacnoise record that in AD 843 Foranan, Primate of Armagh, was taken hostage by the Vikings and held on their ships in Limerick (Lenihan 1866). The location of the Norse settlement in the following century is notable as the lowest fording point of the River Shannon, at the head of the tidal reach (O'Rahilly 1988). The Norse fortified a settlement on the southern part of an island bounded by the west by the Shannon and all other sides by the Abbey River. Later known as "Kings Island", this naturally defended location had the double advantage that it was navigable from the sea and was presumably a crossing point over the Shannon. This provided the Vikings with a secure base from which raids could be conducted along the river upstream of Limerick (ibid.). Coonagh, to the west of the King's Island, has also been described as an ancient fishing village of Viking origin, although to date no archaeological evidence for this has been found (Spellissy 1998, 316).

***Medieval Period (AD 1169–1600)***

The beginning of the medieval period was characterised by political unrest that originated from the death of Brian Borumha in 1014. Diarmait MacMurchadha, deposed King of Leinster, sought the support of mercenaries from England, Wales and Flanders to assist him in his challenge for kingship. Norman involvement in Ireland began in 1169, when Richard de Clare and his followers landed in Wexford to support MacMurchadha. Two years later de Clare (Strongbow) inherited the Kingdom of Leinster and by the end of the 12th century the Normans had succeeded in conquering much of the country (Stout and Stout 1997, 53).

The Anglo-Normans arrived at Limerick in 1175; however, they were forced to withdraw in 1176, and did not succeed in occupying the town until 1190 (Lee 1997). Prince John granted Limerick a charter seven years later, declaring that the citizens would have all the liberties and free customs through all Ireland that were enjoyed by the citizens of Dublin (ibid.). Several early sources state that during the early 13th century King John instructed that a castle should be erected (King John's Castle) along with a bridge (Thomond Bridge) within the English town of the settlement (Wiggins 2000). However, there are references to a castle within Limerick in 1202 and it is possible that this refers to the earlier ringwork, which was constructed by the Norman garrison in 1175 (Wiggins 2016). The 12th century ringwork ditch was identified during excavations at the castle in 1990–91, beneath the 13th century masonry (Wiggins 2000).

While there are no confirmed medieval sites recorded within the study area of the planning application site, the site recorded to the immediate south of the north-eastern extent of the planning application site (LI010-108), has been suggested to represent a possible moated site (SMR file). Moated sites are medieval farmsteads, typically constructed by the Anglo-Norman settlers, although many native Irish adopted the tradition. A recent geophysical survey carried out as part of this assessment, lends weight to this interpretation (Licence 21E0086, Appendix 5.2 A sub-rectangular ditched enclosure was identified to the south and east of the planning application site, with an entrance to the south. A small number of anomalies suggesting possible internal features were also identified as well as a possible associated land division boundary (Leigh 2021).

The upstanding remains of Dysert Castle (LI010-077) are located c. 367m south of the planning application site. It is believed this castle dates to the late 15th century AD and was originally located within a bawn (LI010-077001). This tower house is not shown on the Down Survey mapping of c. 1658 as it is located within lands annotated as 'unforfeited'. However, at the time of the Civil Survey (1654-6) it is recorded that a castle and 72 Irish acres were included in the lands owned by Sir Edward Wingfield (Simmington 1938).

***Post-Medieval Period (AD 1600–1900)***

The 17th century in County Limerick, as with other parts of the country, was characterised by two particular conflicts - the Irish Confederate Wars (1641–53) and the Williamite War (or War of the Two Kings; 1688–91). In 1651 a protracted siege by Cromwell's forces left Limerick City besieged with famine, pestilence and death. The city finally surrendered with a death toll of 5000 inhabitants. The Williamite Wars of the late 17th century saw the reactivation of the city mint to finance James II's campaign. Gun money was minted in Dublin and Limerick, allegedly from the brass of old cannons, hence its name. The city withstood attacks by Williamite forces throughout 1690 and 1691, becoming the last Jacobean stronghold to repel William's army. After the slaughter of 600 inhabitants who had become trapped outside the city walls and the failure of French reinforcements to arrive, Patrick Sarsfield signed the Treaty of Limerick in October 1691 (Spellissy 1998).

With the onset of the 18th century, the political climate settled and this saw a dramatic rise in the establishment of large residential houses around the country. This was largely due to the fact that after the turbulence of the preceding centuries, the success of the Protestant cause and effective removal of any political opposition, the country was at peace. The large country house was only a small part of the overall estate of a large landowner and provided a base to manage often large areas of land that could be dispersed nationally. During the latter part of the 18th century, the establishment of a parkland context (or demesnes) for large houses was the fashion. Although the creation of a parkland landscape involved working with nature, rather than against it, considerable construction effort went into their creation. Earth was moved, field boundaries disappeared, streams were diverted to form lakes and quite often roads were completely diverted to avoid travelling anywhere near the main house or across the estate. Major topographical features like rivers and mountains were desirable features for inclusion into, and as a setting, for the large house and parkland. Whilst there are multiple large houses and demesnes set along the Shannon estuary, none of located within the landscape surrounding the planning application site.

Another characteristic of the post-medieval landscape are the vernacular buildings that represent the post medieval homes of farmers and workers. 'Vernacular architecture' is a term used to describe traditional buildings constructed using locally available materials and according to local/regional styles i.e. the homes and workplaces of the ordinary people. This is in contrast to formal architecture, such as the grand estate houses of the gentry, churches and public buildings, which were often designed by architects or engineers. The majority of vernacular buildings are domestic dwellings. Examples of other structures that may fall into this category include shops, outbuildings, mills, limekilns, farmsteads, forges, gates and gate piers. Typically, the single-storied thatched cottage would be considered to represent the real vernacular style in Ireland. Prior to the development of the aluminium plant within the landscape containing the proposed development, a number of vernacular cottages once occupied the general area. Many of these disappeared during the later part of the 19th century following the negative impact of the potato famine on the rural landscape.

### 5.3.2 Summary of Previous Archaeological Excavations

A review of the Excavations Bulletin (1970-2020) has revealed that a number of archaeological investigations have taken place within the planning application site and its study area

Archaeological testing within the townlands of Island Mac Téige, Aughinish West and Glenbane West within the planning application site, identified a number of archaeological features which were later excavated (Licence 07E0805, Bennett 2007:1114). A *fulacht fia* (LI010-155) was excavated, comprising burnt spread material overlying a wood-lined rectangular pit. A number of stakeholes also suggest a possible structure above the trough. One of the stakes was dated to

1612–1494 cal BC. An adjacent group of stakeholes appeared to suggest a structure, which housed a hearth feature. The trough and burnt mound features overlaid a number of earlier wattle-lined pits, one of which was dated to 2491–2292 cal BC (Bennett 2008:778).

A number of archaeological features were identified within the southern part of the planning application site under licence 08E0782. Five charcoal-production pits, dating to the early medieval period were excavated (Bennett 2008:779). These features are included in the SMR under LI010-152- 4.

Two cremation pits were identified and excavated within the south-eastern section of the planning application site (Licence 08E0910, Bennett 2008:775). A sherd of prehistoric pottery was retrieved from one of the pits and one of the pits were dated to 1323-1251 cal. BC., which falls within the Middle Bronze Age (SMR file). These features were subsequently added to the SMR under LI010-151.

The remains of a *fulacht fia* or burnt mound were also uncovered within the southern extent of the planning application site (Licence 08E0998, Bennett 2008:775). Excavations revealed a number of features, including troughs and pits located alongside a palaeochannel which ran for c. 130m and wasc. 30m wide. A large spread of heat-shattered stone and charcoal-rich material was identified, indicating likely burnt mound activity. Charcoal from the base of a posthole within one of the troughs was dated to 1129-1007 cal. BC, within the Middle Bronze Age (SMR file). This site was added to the SMR following completion of the works (LI010-150).

Enclosure LI010-014, within the planning application site, was subject to archaeological testing under licence 96E0168, however; nothing of archaeological significance was identified (Bennett 1996:232).

Archaeological monitoring of groundworks associated with the preparation of areas for additional bauxite residue disposal, within the townlands of Aughinish West and Island Macteige and within the planning application site, was undertaken under licence 10E0183. No features or deposits of archaeological potential were identified during these works (Bennett 2011:403).

A hearth site was identified c. 31m northeast of the southern extent of the planning application site (Licence 04E1306, Bennett 2004:0975). The site has since been added to the SMR under LI010-147. As part of the same works, a pit-burial (LI010-146001) was excavated, c. 75m north of the southeastern extent of the planning application site, which comprised a subcircular with bone fragments in the basal fill. Burnt bone, seashell, flint debitage and a burnt hazelnut shell were recovered from the pit. A possible hammerstone was also retrieved (Bennett 2004:0975). A total of 43 pottery sherds representing a minimum of five vessels were noted within the pit. There is evidence that the pottery had been broken prior to deposition. In close proximity, a series of pits or postholes (LI010-146002) were identified which were located outside the wayleave of the pipeline, which may suggest settlement (Bennett 2004:0975).

An enclosure (LI010-018) was excavated prior to the development of the existing alumina refinery facility in 1974, c. 341m north of the planning application site. It consisted of an oval-shaped enclosure surrounded by an overgrown stone bank. Within the southwest quadrant of the enclosure, eight graves were identified, which were aligned east-west and closely spaced. Although the burials had been previously disturbed by agricultural activity, the remains of 12 individuals were recovered. These individuals ranged in age from infancy to old age and both males and females were present (SMR file). It was suggested that the enclosure was built as an animal enclosure, likely a sheep-fold between 1666 and 1750, and later used as a burial ground (Bennett 1974:0027).

### 5.3.3 Cartographic Analysis

**William Petty's Down Survey Map, Barony of Connello, 1658 (Figure 5.2)**

This map does not show the planning application site in great detail. The island is referred to as 'Aghainish Island'. There is nothing shown on the island itself, but a castle and church referred to as 'Morgins church' are located to the southeast in 'unforfeited lands'. This church is likely the RMP site LI010-036001, the former parish church of Dysert/ Morgans (Westropp 1904-5, 394), located c. 2.5km to the southeast; which was rebuilt by Franciscans from the Friary in Askeaton in 1496 (Lewis 1837, 151).

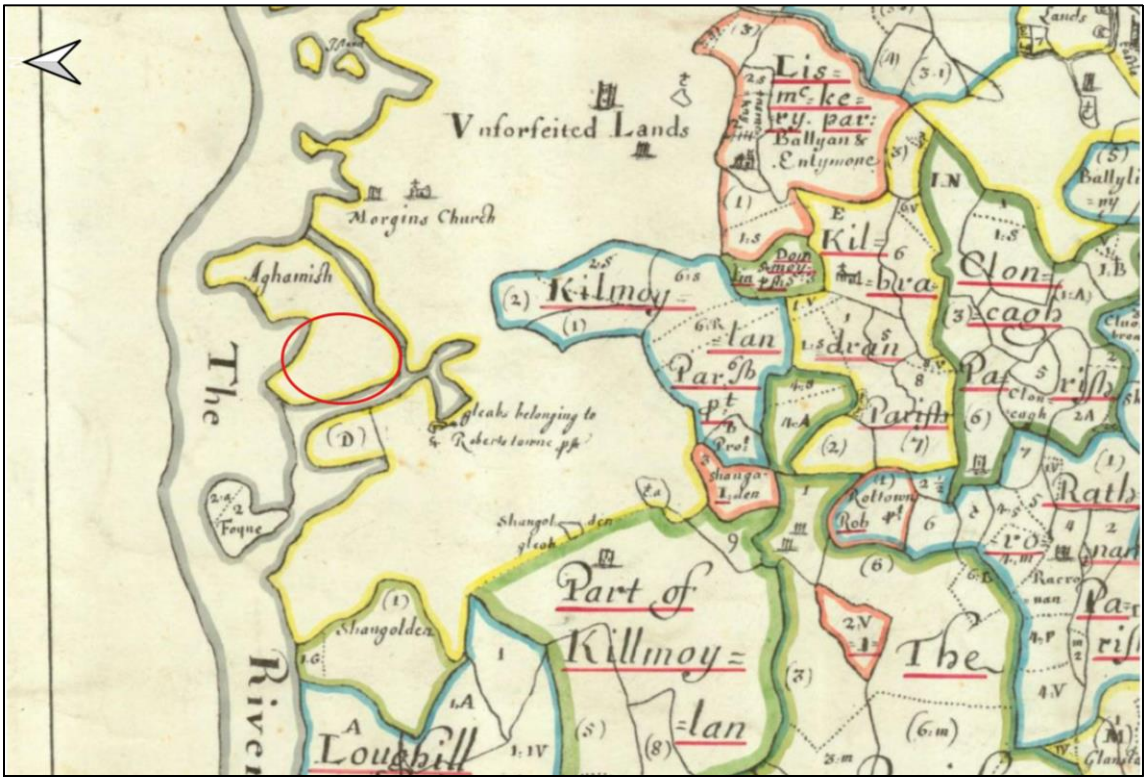



**Figure 5.2:** Extract from the Down Survey map of 1658 showing the approximate location of the planning application site

**First Edition Ordnance Survey Map, 1840, scale 1:10,560 (Figure 5.3)**

The first edition Ordnance Survey map is the first available cartographic source to show the planning application site in any detail. The site is located within a network of irregular fields indicating the presence of marginal and improved ground. Several small dwelling structures are evident in the mapping within the surrounding landscape. Many of the recorded enclosures and ringforts in the area are depicted. In particular, enclosure LI010-108 is shown as a sub-rectangular feature immediately south of the north-eastern section of the planning application site.

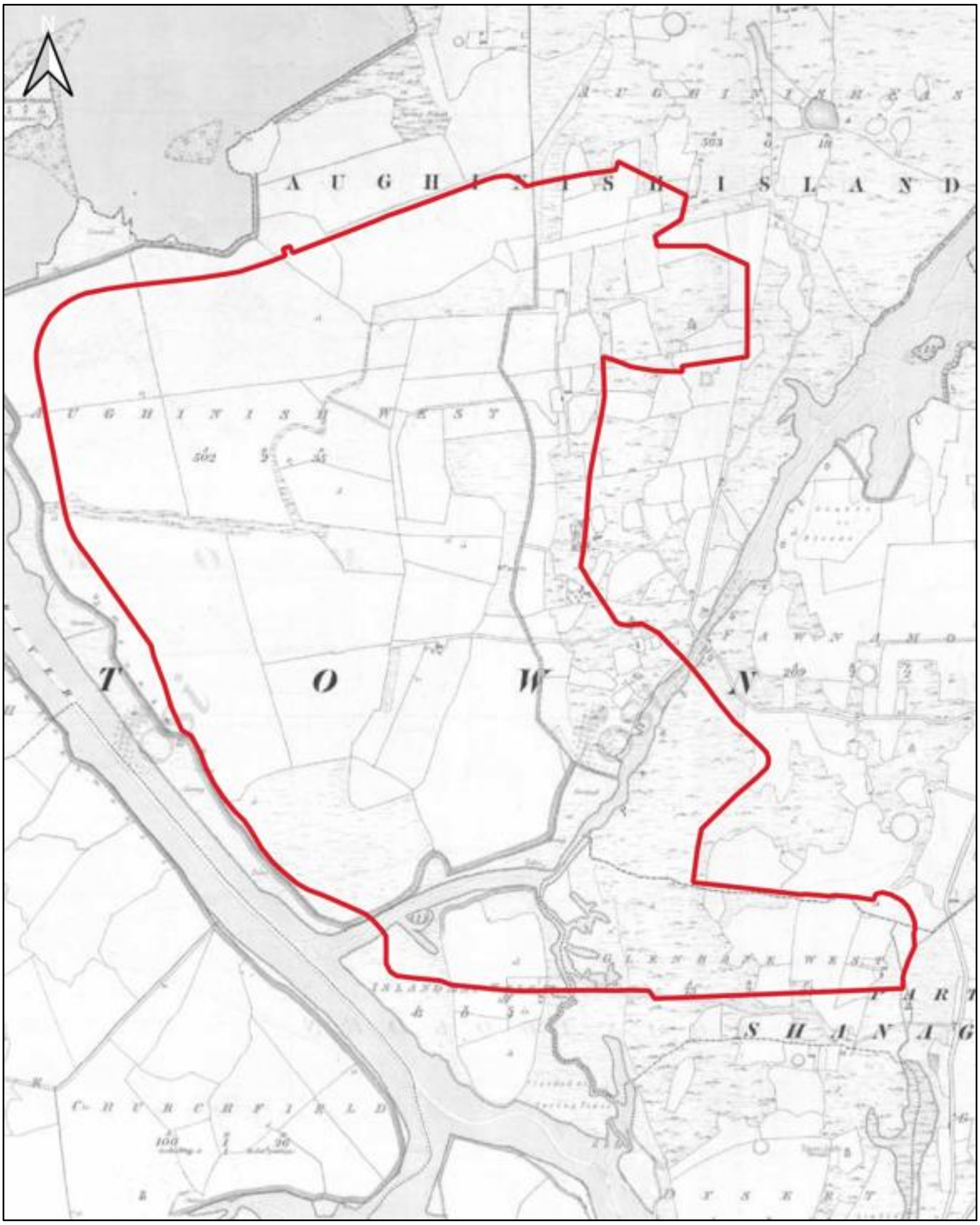



**Figure 5.3:** Extract from the first edition OS map of 1840 showing the planning application site

**Ordnance Survey Map, 1893, scale 1:10,560**
There are no significant changes to the planning application site by the time of this map. Enclosure LI010-108 is still shown as a sub-rectangular feature.

**Ordnance Survey Map, 1900, scale 1:2,500 (Figure 5.4)**
By the time of this map, published in 1900, enclosure LI010-014 is shown for the first time as a semi- circular feature immediately north of a field boundary. Enclosure LI010-108 is no longer depicted.

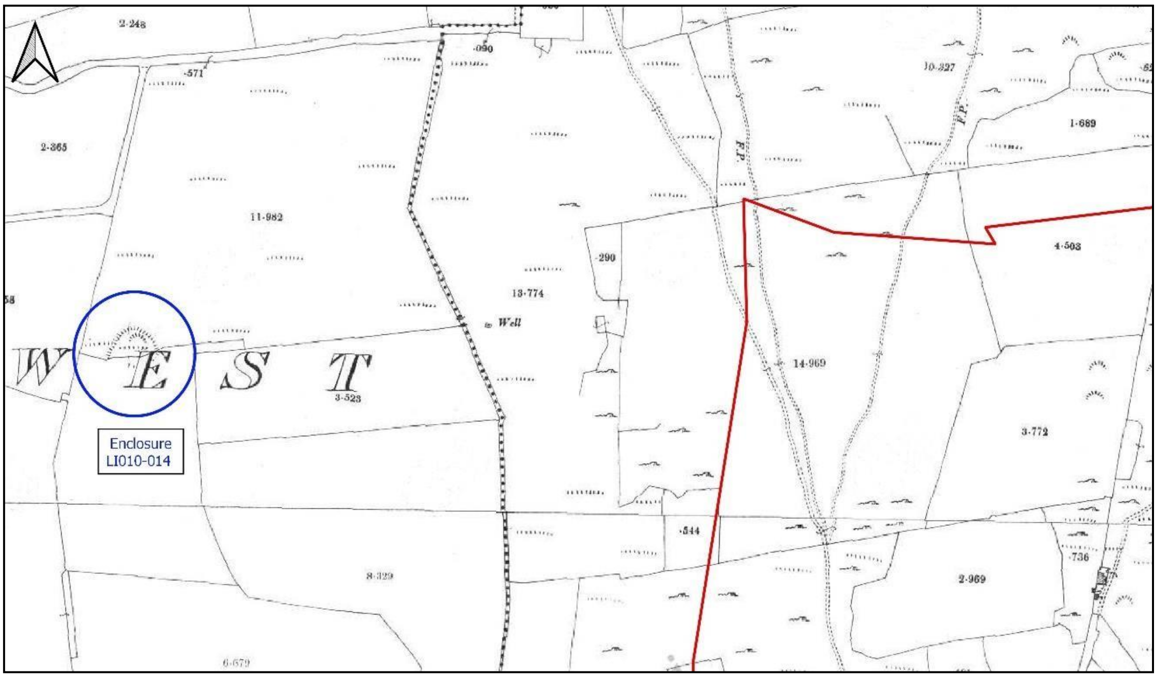



**Figure 5.4:** Extract from the OS map of 1900 showing enclosure LI010-014 within the planning subject site.

## 5.3.4 County Development Plan

**Archaeological Heritage**
The Limerick County Development Plan (2010–2016 as extended) recognises the statutory protection afforded to all RMP sites under the National Monuments Legislation (1930–2014). It is the objective of the council to protect and preserve (in situ, or at a minimum, preservation by record) all known sites and features of historical and archaeological interest and all sites and features of historical interest discovered subsequent to the publication of the Record of Monuments and Places. The development plan lists a number of aims and objectives in relation to archaeological heritage (Appendix 5.2).

There are 19 archaeological sites located within and in the immediate vicinity of the planning application site. Ten of these sites are recorded monuments and the remaining nine are listed in the SMR only and do not receive statutory protection, as they represent a record of excavation. None of the sites are National Monuments in State Care or subject to Preservation Orders. They are listed in Table 5.1 below and described in more detail in Appendix 5.1 (Figure 5.1).

| RMP No. | Classification | Location | Distance from Development | Statutory protection |
|---|---|---|---|---|
| LI010-014 | Enclosure | AughinishWest | within the planning application site (previously tested but nothing of significance identified) | Yes |
| LI010-152 | Charcoal- making site | IslandMacteige | within the planning application site (preserved by record) | No |
| LI010-153 | Charcoal- making site | IslandMacteige | within the planning application site (preserved by record) | No |
| LI010-154 | Charcoal- making site | IslandMacteige | within the planning application site (preserved by record) | No |
| LI010-155 | Fulacht fia | AughinishWest | within the planning application site (preserved by record) | No |
| LI010-151 | Cremation Pit | GlenbaneWest | within the planning application site (preserved by record) | No |
| LI010-150 | Fulacht Fia | GlenbaneWest | within the planning application site (preserved by record) | No |
| LI010-108 | Enclosure | AughinishEast | Immediately south of the north-eastern extent of planning application site | Yes |
| LI010-147 | Hearth | Fawnamore | c. 31m northeast of the south-eastern extent of the planning application site (preserved by record) | No |
| LI010-146001 | Pit-burial | Fawnamore | c. 75m north of the south-eastern extent of the planning application site (preserved by record) | No |
| LI010-146002 | Excavation- miscellaneous | Fawnamore | c. 75m north of the south-eastern extent of the planning application site (preserved by record) | No |
| LI010-076 | Ringfort-rath | Dysert | c. 160m south | Yes |
| LI010-022 | Ringfort-cashel | Fawnamore | c. 165m north of the south-eastern extent of the planning application site | Yes |

| RMP No. | Classification | Location | Distance from Development | Statutory protection |
|---|---|---|---|---|
| LI010-021 | Ringfort-rath | Fawnamore | c. 289m east | Yes |
| LI010-018 | Enclosure | Aughinish East | c. 341m north (preserved by record) | Yes |
| LI010-016 | Ringfort-rath | Aughinish West | c. 335m north | Yes |
| LI010-075 | Ringfort-rath | Dysert | c.354m south | Yes |
| LI010-077 | Castle-tower house | Dysert | c. 367m south | Yes |
| LI010-077001 | Bawn | Dysert | c. 367m south | Yes |

**Table 5.1:** Recorded Archaeological Sites within 250m of the site of proposed development

**Built Heritage**

The Limerick County Development Plan (2010–2016 as extended) recognises the statutory protection afforded to all protected structures under the Planning and Development Act. There are no protected structures located within 250m of the planning application site. The closest such site is Morgan's House (RPS Ref.: 602), located c. 1.7km to the east (Figure 5.5).

There are no Architectural Conservation Areas (ACAs) located within the study area of the planning application site.

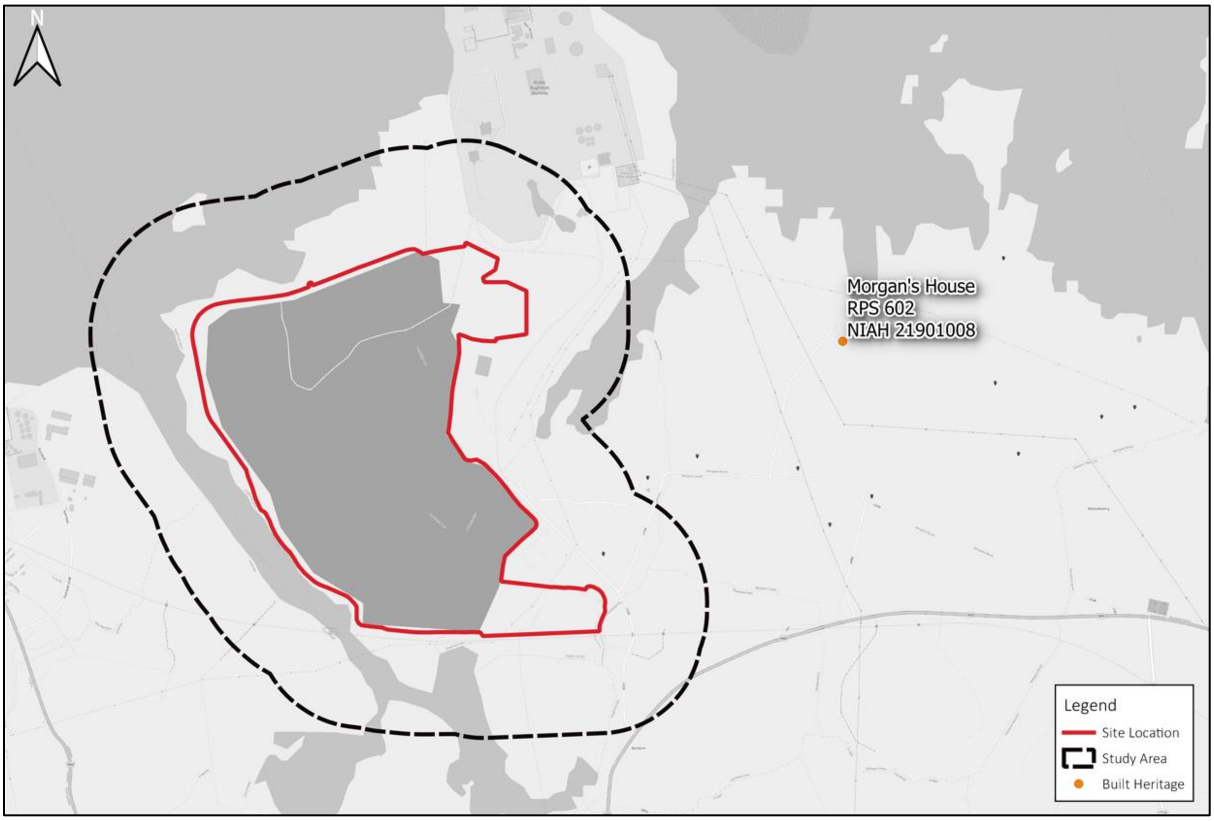



**Figure 5.5:** Location of the nearest built heritage site to the planning application site

## 5.3.5 National Inventory of Architectural Heritage

***Building Survey***

There are no NIAH structures located within 250m of the planning application site. The closest such site is Morgan's House (NIAH Ref.: 21901008), located c. 1.7km to the east. This is also a protected structure (Figure 5.5).

***Garden Survey***

There are no demesne landscapes located within 250m of the planning application site. The closest is a small demesne landscape associated with Morgan's House, c. 1.7km to the east.

## 5.3.6 Topographical Files

A review of the topographical files held by the National Museum of Ireland has produced no records from within the planning application site. Information on artefact finds from the study area in County Limerick has been recorded by the National Museum of Ireland since the late 18th century. Location information relating to these finds is important in establishing prehistoric and historic activity in the study area.

| NMI No. | Townland | Classification | Location (if recorded) |
|---|---|---|---|
| 2008:74 | Fawnamore | Polished stone axehead, incomplete, lower half only survives. Appears to have been broken in antiquity. D-shaped in cross-section. Chipping on both faces and on the butt. L 95mm; W 63mm; T 28mm. | Unclear- Recorded as 'Fawnamore Hill' |

| NMI No. | Townland | Classification | Location (if recorded) |
|---|---|---|---|
| IA/135/74 | Aughinish East | Pottery Sherds; Clay Pipe Frags; Nails (Iron); Glass; Misc. Iron; Bronze Disc-headed Pin; Tunic Button; Green Enamelled Strap-end and Buckle; Charles II Halfpenny; Polished Bone Handle Candle Snuffer; Statuette Base; Bronze Strap; Bronze Pin Shaft. | c. 716m to the northeast of proposed development |

**Table 5.2:** NMI Topographical Files

### 5.3.7 Aerial Photographic Analysis

Inspection of the aerial photographic coverage of the planning application site held by the Ordnance Survey (1995–2013), Google Earth (2008–2020) and Bing Maps (2021) did not result in the identification of any previously unrecorded areas of archaeological potential. The photography does illustrate that the western portion of the planning application site has already been impacted by the industrial development associated with the current use of the plant, while the small north-eastern parcel of land (extension to permitted borrow pit) remains as undisturbed greenfield (Figure 5.6). The south-eastern extent of the planning application site has seen disturbance as part of works associated with the adjacent industrial works.


**Figure 5.6:** Satellite imagery of the planning application site (Google Earth 2020)

### 5.3.8 Field Inspection

The field inspection, which was carried out on the 16th of February 2021, sought to assess the planning application site, its previous and current land use, the topography and any additional information relevant to the report. During the course of the field investigation the planning application site and its immediate surrounding environs were inspected. The field inspection focused on the previously undisturbed north-eastern parcel of the planning application site (extension to permitted borrow pit), given the western and south-eastern areas have been previously resolved of archaeology, and in the case of the western area, subsequently developed. The northern half of the north-eastern area is heavily overgrown, which made inspection difficult due to the vegetation cover (Plate 5.1). It was accessed via a narrow gravel pathway that extends along its western side. The area is bounded on the western side by a steel fence, which separates it from a disused Quarry and the Aughinish site lands (Plates 5.2-3).

To the south of the overgrown area, there is a narrow rectangular field orientated east-west. The field is bounded on the west side by the access pathway and the steel fence and hedging. The northern and southern boundaries consist of heavily overgrown mature hedgerows. The eastern boundary is not clearly defined and the fields gradually becomes heavily overgrown on the east side. The field is generally of level pasture with some gentle undulations. No surface anomalies or above ground expressions were evident and nothing of archaeological significance was noted (Plates 5.4- 5).

The southern portion of the eastern parcel extends into a larger field. While the upper northern portion of the field is relatively level, the field then slopes to the east and south (Plates 5.6-7). The field is bounded on the west side by the access pathway and the steel fence and hedging, and is bounded from the sub rectangular field to the north by a heavily overgrown mature hedgerow. The area to the east and south of the field becomes heavily overgrown and a dense woodland is located in the area south of the field (Plate 5.8). Within the planning application site, no surface anomalies or above ground expressions were evident and no visible sites of archaeological significance were noted.

In the southwest of this field is the location of a recorded monument LI010-108 (Enclosure), outside of the planning application site. No obvious expression of an enclosure (bank or ditch) was evident (Plate 5.9). In the vicinity of the recorded monument there was an area of large roughly cut boulders identified (Plates 5.10-11). These extended over an area that was approximately 14m long (roughly north-south, and was widest at its northern end (c. 6m) and narrowed at its southern end (3m). The area surrounding the stones was overgrown and it was not possible to fully define the area. Many of the stones were not well set and were loose to the touch, which suggests that they were not in a structural setting but it is unclear if they represent a deposit from historic quarrying or if they are from a collapsed structure such as a cairn. The deposit was generally 1m high but was uneven and a hollow was noticeable centrally at the northern end (Plate 5.12). Given the roughly linear alignment, it seems most likely that these represent a relatively modern deposit; however, there was no diagnostic material evident to confirm date or origin. The stones are located to the south of the planning application site.

Plate 5.1 Northern, overgrown portion of the planning application site, facing east

Plate 5.2 Boundary fence and hedge along western side of eastern parcel

Plate 5.3 View of disused borrow pit to the west, facing west

Plate 5.4 Sub rectangular field with view from NE corner, facing southwest

Plate 5.5 View along southern boundary of sub-rectangular field, facing east

Plate 5.6 Centrally in southern field, facing northwest

Plate 5.7 Centrally in southern field, facing northeast

Plate 5.8 Dense woodland south of the southern field, facing east

Plate 5.9 Site of recorded enclosure LI010-108, facing east

Plate 5.10 Boulders facing north

Plate 5.11 Boulders facing east

Plate 5.12 Northern end of Boulder deposit facing northwest (note hollow at ranging rod)

### 5.3.9 Geophysical Survey

A geophysical survey has been carried out in order to further assess the north-eastern portion of the planning application site (Licence 21R0086, Leigh 2021). The survey was carried out in April 2021 by J.M. Leigh Surveys Ltd. The area subject to the survey contained the recorded monument (LI010- 108), which was confirmed by the survey. The recorded enclosure was identified as a sub-rectangular enclosure with an entrance to the south, measuring c. 40m x 32m (Figure 5.7). It is probable that the enclosure represents a medieval moated site. A small number of responses were noted within the enclosure and a linear response was noted extending from the north-eastern corner of the enclosure- interpreted as a possible boundary feature associated with the site. To the south of the enclosure an area of increased magnetic response was identified, which may represent spreads of material associated with the enclosure or alternatively may represent modern activity. Within the current site boundary, a number of isolated responses are noted, (marked as 8 on Figure 5.7), which may represent small-scale archaeological features, although this interpretation is cautious as the responses may also indicate variations in natural subsoil. The full geophysical survey report can be found in Appendix 5.2.


**Figure 5.7:** Geophysical Survey Results (Licence 21R0086), Leigh 2021

### 5.3.10 Cultural Heritage Background

#### 5.3.10.1Toponomy of Townlands

Townland and topographic names are an invaluable source of information on topography, land ownership and land use within the landscape. They also provide information on history; archaeological monuments and folklore of an area. A place name may refer to a long-forgotten site, and may indicate the possibility that the remains of certain sites may still survive below the ground surface. The Ordnance Survey surveyors wrote down townland names in the 1830's and 1840's, when the entire country was mapped for the first time. Some of the townland names in the study area are of Irish origin and through time have been anglicised. The main reference used for the place name analysis is Irish Local Names Explained by P.W Joyce (1870). A description and possible explanation of each townland name in the environs of the planning application site are provided in the below table.

| Placename | Derivation | Possible Meaning |
|---|---|---|
| Aughinish East/West | *Eachinis* | Island of the Horses. Likely divided into east and west at a later date. |
| Fawnamore | *Fána Mhór* | Big slope |
| Glenbane West | *An Gleann Bán* | The white glen |
| Island Macteige | *Oileán Mhic Thaidhg* | The island of Mac Thaidhg |

**Table 5.3:** Placename analysis

### 5.3.10.2 Townland boundaries

The townland is an Irish land unit of considerable longevity as many of the units are likely to represent much earlier land divisions. However, the term townland was not used to denote a unit of land until the Civil Survey of 1654. It bears no relation to the modern word 'town' but like the Irish word baile refers to a place. It is possible that the word is derived from the Old English tun land and meant 'the land forming an estate or manor' (Culleton 1999, 174).

Gaelic land ownership required a clear definition of the territories held by each sept and a need for strong, permanent fences around their territories. It is possible that boundaries following ridge tops, streams or bog are more likely to be older in date than those composed of straight lines (ibid. 179). The vast majority of townlands are referred to in the 17th century, when land documentation records begin. Many of the townlands are mapped within the Down Survey of the 1650s, so called as all measurements were carefully 'laid downe' on paper at a scale of forty perches to one inch.

Therefore, most are in the context of pre-17th century landscape organisation (McErlean 1983, 315). In the 19th century, some demesnes, deer parks or large farms were given townland status during the Ordnance Survey and some imprecise townland boundaries in areas such as bogs or lakes, were given more precise definition (ibid.). Larger tracks of land were divided into a number of townlands, and named Upper, Middle or Lower, as well as Beg and More (small and large) and north, east, south and west (Culleton 1999, 179). By the time the first Ordnance Survey had been completed a total of 62,000 townlands were recorded in Ireland.

Although not usually recorded as archaeological monuments in their own right, townland boundaries are important as cultural heritage features as they have indicated the extents of the smallest land division unit in the country—the townland—which have been mapped since the 19th century. It remains unclear how old these land units actually are, though it has been convincingly argued that they date to at least the medieval period and may be significantly older than this (McErlean 1983; MacCotter 2008).

There are a number of townland boundaries within the planning application site, including Aughinish West/Aughinish East, Aughinish East/ Fawnamore, Aughinish West/ Fawnamore, Aughinish West/ Island Macteige, Aughinish West/ Glenbane West, Island Macteige/ Glenbane West, Glenbane West/Fawnamore (Figure 5.8). However, the sections of townland boundaries within the planning application site have been impacted and completely removed as a result of existing development within the overall planning application site.

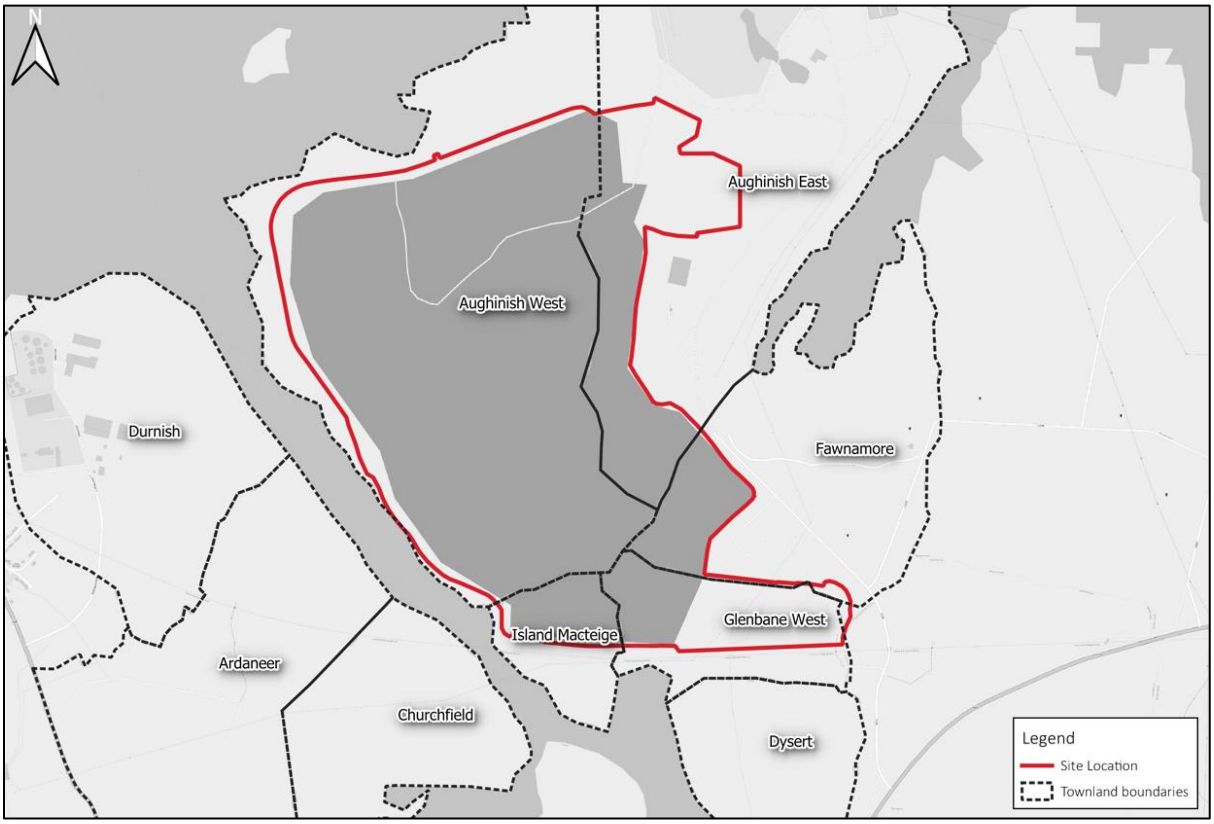



**Figure 5.8:** Townland boundaries within the planning application site

### 5.3.10.3 Cultural Heritage Sites

The term 'cultural heritage' can be used as an over-arching term that can be applied to both archaeology and architecture. However, it also refers to more ephemeral aspects of the environment, which are often recorded in folk law or tradition or possibly date to a more recent period. No specific cultural heritage sites have been identified within the planning application site or the within the study area.

While fishing traditionally contributed significantly to life along the Shannon and its estuary, it should be noted that industrial use of the River Shannon has a long history in the wider region. Nearby Foynes was originally identified as a potential port location in the mid-19th century and subsequently developed. This is recorded by Lewis in 1837 who claims that the location was at that time 'seldom resorted to by mariners' (prior to the development of the port). It seems that the Foynes area was rural with a small dispersed population prior to the port's development (Lewis 1837).

Between 1939 and 1947, Foynes acted as the last port of call for seaplanes crossing the Atlantic Ocean and was considered of key importance in the aviation world at that time. The terminal building of Foynes Airport now houses the Foynes Flying Boat & Maritime Museum (www.flyingboatmuseum.com). The establishment of the airport appears to have attracted significant settlement in the area.

The existing Aughinish Alumina Plant was established in 1983 with a number of subsequent upgrades having taken place since then. The plant operates its own shipping terminal which is located 2.6km north-northeast of the planning application site.

#### 5.3.11 Conclusions

The planning application site is located within the townlands of Aughinish West, Aughinish East, Island Macteige, Glenbane West and Fawnamore south of the River Shannon. The site is located within and to the east of an existing alumina plant and as such there has been an impact on the surrounding landscape. There are 19 archaeological sites within the planning application site and the study area, ten of which are recorded monuments. Of the archaeological sites, the most significant is enclosure LI010-108, immediately south of the north-eastern section of the planning application site. Enclosure LI010-014 within the planning application site has previously been proven to be non-archaeological in origin (licence 96E0168, Bennett 1996:232), but has not yet been delisted or reclassified within the current record as being non-archaeological. The nine SMR sites represent features which have been excavated and recorded within the planning application site and the study area as part of previous archaeological works.

There are no recorded structures of built heritage merit located within 500m of the proposed site. There are also no features or sites of specific cultural heritage identified within the planning application site and study area. The townland boundaries that once traversed the western section of the planning application site have been removed as part of previous approved industrial development works. In the wider region, the use of the River Shannon as a means of enabling industry is evident from the mid-19th century to the modern day.

The cartographic sources depict the planning application site within a rural and marginal area. While small structures, likely of vernacular style, are shown on the historic OS maps, there are none located within the planning application site today. There are also no demesne landscapes within the planning application site or the study area.

Examination of the available aerial photography and satellite imagery has shown that the west of the planning application site is entirely located within lands already impacted by previous approved industrial development. The north-eastern parcel of the planning application site remains as undisturbed greenfield and is of high archaeological potential.

A field inspection confirmed the undisturbed nature of the north-eastern parcel. No previously unknown features of archaeological significance were identified within the planning application site. While no evidence of enclosure LI010-108 in the southern part of the planning application site was identified, a group of boulders was identified to the south of its approximate location. Given the history of quarrying activity in the vicinity of the site, it is likely these are a result of a modern or early modern deposition.

A geophysical survey carried out as part of this assessment (Licence 21R0086, Leigh 2021) has confirmed the presence of a sub-rectangular enclosure to the immediate south of the north-eastern section of the planning application site (LI010-108). In addition to the enclosure, possible internal features, a possible associated land division boundary and isolated responses which may represent archaeological features, (the latter of which are located within the planning application site) have been identified.

### 5.4 Description of Potential Impacts

Recorded enclosure site (LI010-108), is located outside of the proposed development boundary. As a result, there is no predicted direct impact on the recorded monument. However, the geophysical survey (Licence 21R0086, Leigh 2021) identified isolated anomalies to the north of the enclosure and within the planning application site. It is possible that these anomalies represent small-scale archaeological features. There is also potential for previously unidentified archaeological features of deposits to survive within the planning application site, which were not indicated in the geophysical survey. Groundworks associated with the proposed development (prior to the application of mitigation) may have a direct significant negative impact on the archaeological features or deposits, if they survive. The recorded enclosure (LI010-108) possesses no surface expression; however, the proximity of the development will result in a slight negative indirect impact on the setting of the monument.

No impacts upon the architectural or cultural heritage resource have been identified in relation to proposed development.

The western and south-eastern sections of the planning application site have been fully resolved of archaeology and subsequently developed as part of an industrial complex. No potential impacts on the archaeological, architectural or cultural heritage resource have been identified within these areas.

### 5.4.1 Do Nothing' Impact

If the proposed development were not to proceed there would be no impact on the archaeological, architectural or cultural heritage resource.

## 5.5 Mitigation Measures

A programme of targeted archaeological test-trenching will be carried out within the north-eastern, previously undisturbed, section of the planning application site. These works will be carried out under licence to the National Monuments Service. If any features of archaeological potential are discovered during the course of the works further archaeological mitigation may be required, such as preservation in-situ or by record and/or monitoring. Any further mitigation will require approval from the National Monuments Service of the Department of Housing, Local Government and Heritage (DoHLGH).

As there are no potential impacts associated with development in the western and south-eastern sections of the planning application site, no mitigation is deemed necessary in these areas.

The record (both geophysical survey and photographic) presented within this assessment is considered to be an appropriate record of the current setting and extent of recorded enclosure LI010- 108.

## 5.6 Cumulative Impacts

The surrounding granted developments, along with potential future development have been reviewed as part of the cumulative impact assessment. As any archaeological remains identified within the planning application site will be subject to full preservation by record, no cumulative impacts upon the archaeological resource have been identified. Furthermore, no cumulative impacts upon the settings of the archaeological, architectural or cultural heritage resource have been identified.

## 5.7 Residual Impacts

Following the implementation of the above mitigation measures, no significant residual impacts are predicted upon the archaeological, architectural or cultural heritage resource.

## 5.8 Difficulties Encountered

A small area of the planning application site was unavailable during field inspection due to the dense vegetation occupying the north-eastern portion of the planning application site.

## 5.9 Interactions

The Landscape and Visual assessment has been reviewed as part of the archaeological, architectural and cultural heritage assessment.

## 5.10 Monitoring and Reinstatement

The mitigation measures recommended above will also act to monitor the potential impacts on the archaeological resource as a result of the construction of the proposed development.

No monitoring is required in relation to architectural and cultural heritage.

## 5.11 References

Bennett, I. (ed.) 1987?2010 *Excavations: Summary Accounts of Archaeological Excavations in Ireland*. Bray. Wordwell.

Bermingham, N., Coyne, F., Hull, G., Reilly, F. & Taylor, K., 2013. *River Road: The Archaeology of the Limerick Southern Ring Road.* Dublin: NRA (Scheme Monograph 14).

Byrne, F. J., 1973. *Irish Kings and High Kings*. London: Batsford.

Collins, T. and Coyne, F. 2006. 'As old as we felt' *Archaeology Ireland*, Vol. 20, No. 4, 21.

Culleton E. (ed.) 1999 Treasures of The Landscape; Townland Names by An Tathair Seamas S. De Vaal Dublin: Trinity College.

Department of Arts, Heritage, Gaeltacht and the Islands. 1999a. *Framework and Principles for the Protection of the Archaeological Heritage*. Dublin. Government Publications Office.

Department of Arts, Heritage, Gaeltacht and the Islands. 1999b. *Policy and Guidelines on Archaeological Excavation*. Dublin. Government Publications Office.
Dowd, M. and Carden, R. 2016. "First evidence of a Late Upper Palaeolithic human presence in Ireland." *Quaternary Science Reviews*: 158-163.

Environmental Protection Agency. 2015. *Draft Advice Notes on Current Practice (in the preparation of Environmental Impact Statements)*. Dublin. Government Publications Office.

Environmental Protection Agency. 2017. *Draft Guidelines on the Information to be Contained in Environmental Impact Statements*. Dublin. Government Publications Office.

Lee, D., (ed) 1997. *Remembering Limerick*: *historical essays celebrating the 800th anniversary of Limerick's first charter granted in 1197 Limerick.* Limerick Civic Trust in Association with FAS.

Leigh, J. 2021 Geophysical Survey Report- Aughinish East, County Limerick. Licence 21R0086. Unpublished report prepared by J.M. Leigh Surveys Ltd.

Lenihan, M., 1866. *Limerick and its History and Antiquities, Ecclesiastical, Civil and Military from the Earliest Ages, with Copious Historical, Archaeological, Topographical and Genealogical Notes*. Dublin: Hodges and Sons.

Lewis, S. 1837. Topographical Dictionary of Ireland (online edition).

Limerick County Council 2010 *Limerick County Development Plan 2010–2016* (as varied September 2014). Prepared by Forward Planning Department, Limerick County Council. Limerick, Limerick County Council.

MacCotter, P. 2008. Medieval Ireland: Territorial, Political and Economic Divisions. Four Courts Press, Dublin.

McErlean, T. 1983 "The Irish townland system of landscape organisation". In Reeves-Smyth, Terence; Hamond, Fred (eds) Landscape Archaeology in Ireland BAR British Series 116. pp. 315–39

National Monuments Service, Department of Housing, Local Government and Heritage (DoHLGH). Sites and Monuments Record, 1997, Maps and Manual, County Limerick.

O'Rahilly, C., 1988. Recent Research in Limerick City. *Archaeology Ireland*, Vol. 2, No. 4. 140-144.

O'Sullivan, A., 2001. *Foragers, Farmers & Fishers in a Coastal Landscape: An Intertidal Archaeological Survey of the Shannon Estuary*. Dublin: Royal Irish Academy.

Quinn, B. and Moore, D. 2009 *Fulachta fiadh* and the beer experiment. In M. Stanley, E. Danaher and J. Eogan (eds) *Dining and Dwelling: Proceedings of a public seminar on archaeological discoveries on national road schemes, August 2008*. National Roads Authority Monograph Series No.6. Dublin. National Roads Authority, 43–53.

Simington, R.C. (ed.) 1938 The civil survey, AD 1654-1656. Vol. IV: county of Limerick, with a section of Clanmaurice barony Co. Kerry. Dublin. Irish Manuscripts Commission.

Spellissy, S., 1998. *The History of Limerick City.* Limerick: The Celtic Bookshop.

Stout, G. and Stout, M., 1997. Early Landscapes: from Prehistory to Plantation. *In:* F.H.A. Aalen, F.H.A., Whelan, K. and Stout, M., (eds.) *Atlas of the Irish Rural Landscape*. Cork: Cork University Press.

Stout, M., 1997. *The Irish Ringfort*. Dublin: Four Courts Press.

Waddell, J., 2010. *The Prehistoric Archaeology of Ireland*. Dublin: Wordwell.

Westropp, T.J., 1906–7 "The Ancient Castles of the County of Limerick". *PRIA* **26**, 143-268. Wiggins, K., 2000. *Anatomy of a Siege: King John's Castle, Limerick, 1642* Bray: Wordwell.
Wiggins, K., 2016. *A Place of Great Consequence: Archaeological Excavations at King John's Castle, Limerick, 1990-8.* Dublin: Wordwell.

**Cartographic Sources**

William Petty's Down Survey Map, Connello Barony, 1658 Ordnance Survey Mapping, 1840–1900

**Electronic Sources**

www.archaeology.ie – DoHLGH website listing all SMR sites with aerial photographs www.bingmap.com – Aerial photographs of the planning application site

www.excavations.ie – Summary of archaeological excavation from 1970–2020 www.googleearth.com – Aerial photographs of the planning application site

www.heritagemaps.ie – The Heritage Council web-based spatial data viewer which focuses on the built, cultural, and natural heritage.

Irish Local Names Explained by P.W Joyce (http:// https://www.libraryireland.com/IrishPlaceNames/Contents.php; Accessed February 2021).

# 6.0 BIODIVERSITY

## 6.1 Introduction

This Biodiversity chapter of the EIAR has been prepared by Ecology Ireland Wildlife Consultants Ltd.

The assessment considers the potential impacts of the proposed development on the local flora, habitats and fauna.

Ecology Ireland has carried out extensive surveys and assessments associated with other developments at Aughinish since 2012. Most recently, this has included the ecological impact assessments in relation to the permitted borrow pit (LCCC Reg. Ref. 17/714; ABP-301011-18), the permitted Nature Trail development (LCCC Reg. Ref. 20/1325) and also the preparation of the Natura Impact Statement with regard to the operation of entire facility, required by the EPA as part of the recently issued Industrial Emissions Licence (P0035-07).

Ecological surveys were undertaken from 2019-2021 to provide detailed contemporary information of the habitats and species present within and adjacent to the application site. These surveys included habitat & botanical studies, baseline bird, mammal and other taxa surveys (including Lepidoptera, Odonata & Amphibian) studies. A comprehensive desktop review was also completed, including an assessment of cumulative impacts.

This Biodiversity assessment provides an assessment of the potential impacts on the existing ecology arising from the proposed development. Appropriate mitigation measures to minimise potential negative impact(s) to an acceptable level are also presented.

The main objectives of this Biodiversity assessment was to:

- evaluate the ecological significance of the study area (application site and surrounding lands) from a combination of desktop and field surveys
- assess potential impacts on the existing ecology, including cumulative and in combination impacts, that could arise from the proposed works
- develop mitigation measures to reduce or eliminate potential negative impact(s) on the existing local ecology arising from the proposed development.

A team of specialist ecologists have carried out extensive surveys at the Aughinish site and surrounding lands. These surveys recorded the fauna, flora and habitats that are present in the receiving environment. The team was led by Dr. Gavin Fennessy (BSc PhD MCIEEM; Birds & Mammals) and other key contributors were Marie Kearns (BSc MSc; Terrestrial Ecology), Claire Deasy (BSc MSc MCIEEM; Habitats & Botanical) and Michelle O'Neill (BSc H. Dip Field Ecology MCIEEM; Terrestrial Ecology & Botany). Analysis and reporting produced by Dr. Fennessy assisted by Athena Michaelides (BSc) and Eamonn Delaney (BSc MSc CEcol MCIEEM). Additional field notes, records and assistance was provided by AAL's on-site wildlife and environmental ranger Mr. Seán Dundon. Mr. Dundon is the principal author of the Biodiversity Management Plan for the AAL site which is a 5-year plan adopted in May 2021.

A Natura Impact Statement (NIS) has been prepared and accompanies this planning application in support of the Appropriate Assessment (AA) process.

### 6.1.1 Site Location & Project Description

The proposed development consists of works to the Bauxite Residue Disposal Area (BRDA) comprising of an expansion to increase its disposal capacity to accommodate additional bauxite residue arising from the continued operation of the permitted alumina refinery plant located on the wider AAL facility. The proposed increase in disposal capacity to the BRDA will result in a proposed increase in height of c.12m above the currently permitted stage 10 level (c. 32m OD) to a final stage 16 level (c. 44m OD). No increase to the existing footprint of the BRDA is proposed.

The proposed method of raising the BRDA will be the upstream method, consistent with the construction methodology for the current BRDA and involves the construction of rock fill embankments (Stages), offset internally and founded on the previously deposited and farmed bauxite residue, in 2 m high vertical lifts. The overall BRDA is raised systematically as the stages are filled with bauxite residue, farmed, carbonated and compacted, prior to deposition of the next layer.

Additional works proposed as part of this application include the following:

- A vertical extension to the existing Salt Cake Disposal Cell (SCDC) to accommodate further disposal of salt cake resulting in an increase in height of c.2.25m. The SCDC is located within the BRDA. A description of the SCDC and its function is provided in Chapter 2 of this EIAR.

- An extension of the existing borrow pit, located to the east of the BRDA, is also proposed. This extension proposes to increase the footprint of the borrow pit from c.4.5ha to c.8.4ha. This expansion will provide an additional 380,000$m^3$ of rock fill material which is needed to satisfy the requirements of the construction and operation of the BRDA.

- The continued use of an existing stockpile area at the south east of the subject site to store topsoil in order to satisfy the additional restoration requirements of the extended BRDA.

- Upgrades to the existing water management infrastructure to accommodate the BRDA development to Stage 16 which will also allow for greater Inflow Design Flood (IDF) capacity for the entirety of the BRDA.

Given that the proposed BRDA Raise and the proposed SCDC Raise sit entirely within the footprint of the existing BRDA, where reference is made to the BRDA within the following text, this will refer to both the BRDA and the SCDC areas unless otherwise stated.

Please refer to Chapter 3.0 of this EIAR and the Engineering Design Report (enclosed in Appendix A) for a more detailed description of the proposed development.

The current BRDA water management infrastructure was designed to accommodate the BRDA development to Stage 10 and for an inflow design flood (IDF) with a return period of 1 in 200 years. As outlined in Chapter 10 of this EIAR, it is proposed to modify the existing water management infrastructure to accommodate the BRDA development to Stage 16 and for an IDF of a greater return period, in accordance with CDA guidelines, based on the consequence classification of the BRDA.

The permitted alumina facility is located in the Lower Shannon Estuary transitional waterbody. The most recent WFD score (2010-2015) for Lower River Shannon transitional waterbody is of 'Moderate' Status and at risk of not achieving 'Good' Status (gis.EPA.ie/Envision). A small stream; the Durnish 24/Robertstown River (EPA nomenclature) is situated adjacent to Aughinish Alumina lands, where it flows southerly along the western boundary before discharging to Ahacronana/Dooncaha streams where they meet the Lower Shannon Estuary to the west of the site. After merging both Ahacronana and Dooncaha watercourses immediately discharge to the Lower Shannon Estuary. Upstream of this location Ahacronana is of 'Poor' status (WFD Status 2010 – 2015) and at risk of not achieving 'Good status'. The Dooncaha stream is of 'Moderate' status but at risk of not achieving 'Good' status (WFD; 2010-2015).

Potential impacts on Designated Conservation sites as a result of potential hydrological impacts are dealt with in the accompanying Natura Impact Statement in support of the AA process.

A site location map showing the application site and lands within the ownership of the applicant are shown in Figure 6.1. The details of the project description are provided in Chapter 3 of the EIAR.


**Figure 6.1 Site location map showing application and ownership/foreshore lease boundaries** (background image from Bing Mapping c. 2013)**.**

### 6.1.2 Proposed Works to the BRDA

The permitted BRDA has capacity to provide a disposal area for bauxite residue until c.2030, for the current rate of alumina production (1.95 million tonnes per annum) at the adjoining alumina refinery facility. As currently permitted, the BRDA will have a final perimeter elevation of 24mOD and a maximum dome crown elevation of 32mOD.

The subject application proposes that the permitted height of the overall BRDA (Phase 1 and 2 BRDA) be increased to accommodate additional bauxite residue disposal capacity. It is intended that this additional disposal capacity will extend the lifetime of the currently permitted BRDA (at current production and disposal rates) for approximately 9 years. The raising of the BRDA does not require any amendments to the existing BRDA footprint.

It is proposed that the existing BRDA can facilitate an increase in height to Stage 16 (currently permitted to Stage 10) which would provide a perimeter elevation of 36mOD and a maximum dome crown elevation of 44mOD. The proposed development will provide for the deposition of circa 0.9 million m3/year of bauxite residue and total of c. 8.0 million m3 over the lifetime of the development.

## 6.2 Study Methodology

This Biodiversity Chapter has been prepared following a thorough desktop review of available ecological information and a series of field surveys carried out between 2019 and 2021.

A team of specialist ecologists have carried out extensive surveys at the Aughinish site and surrounding lands. These surveys recorded the fauna, flora and habitats that are present in the receiving environment. Field surveys concentrated on the lands within and adjacent to the application site with consideration, as appropriate, of the wider receiving environment.

### 6.2.1 Scope of Desktop Review

The desk study undertaken included a thorough review of available ecological data including the following:

- Review of online web-mappers: National Parks and Wildlife Service (NPWS), EPA (Envision), Water Framework Directive (WFD), Geological Survey of Ireland (GSI) & Inland Fisheries Ireland (IFI).
- Review of the Bat Conservation Ireland (BCI) Private Database.
- Review of the publicly available National Biodiversity Data Centre (NBDC) webmapper.
- Records from the National Parks and Wildlife Services ('NPWS') web-mapper and review of specially requested records from the NPWS Rare and Protected Species Database for the hectad in which the Proposed Development is located.
- Review of NPWS Article 17 Metadata and GIS Database Files

Further details of the desktop review and baseline field assessments are described in the relevant sections below. The application boundary and principal existing and proposed infrastructure is shown in Figure 6.2.


**Figure 6.2 Application site showing the location of the principal components of the existing and proposed development.**

### 6.2.2 Consideration of Designated Conservation Sites

Designated nature conservation sites in the vicinity of the proposed development site were identified through desktop review. A nominal study area of 15km offset from the application boundary is used in the mapping of the designated sites. This is an arbitrary distance typically used for illustrative purposes (e.g. DoEHLG 2009). The potential for impacts upon more distant designated sites is considered in the event that any likely significant effects are identified in relation to these distant sites during the assessment process.

Nature Reserves and Refuges for Fauna are protected under the Irish Wildlife Acts (1976 - 2012). Designated conservation sites include national sites, Natural Heritage Areas (NHAs) and Proposed Natural Heritage Areas (pNHAs). European sites, Special Areas of Conservation (SACs) and Special Protection Areas (SPAs), have been designated under the EU Habitats Directive (92/43/EEC) and the EU Birds Directive (2009/147/EC) respectively. SACs and SPAs are collectively known as Natura 2000 sites and are legally protected by Irish law. Many designated sites overlap, e.g. a site can be designated as both an NHA and SAC.

There are 630 proposed NHAs (pNHAs), which were published on a non-statutory basis in 1995 but have not since been statutorily proposed or designated and are subject only to limited protection primarily under the Wildlife Amendment Act 2000, where subject to the appropriate notices being served there is an obligation to comply with the requirements that are contained therein and sanctions provided for if any such notices are not complied with. These sites are of significance for wildlife and habitats.

Prior to statutory designation, pNHAs are subject to limited protection, in the form of:

- Agri-environmental farm planning schemes continue to support the objective of maintaining and enhancing the conservation status of pNHAs.
- Forest Service requirement for NPWS approval before they will pay afforestation grants on pNHA lands
- Recognition of the ecological value of pNHAs by Planning and Licencing Authorities.
- Under the Wildlife Amendment Act (2000), NHAs are legally protected from damage from the date they are formally proposed for designation.

In accordance with Article 6 of the EU Habitats Directive a Natura Impact Statement has been prepared to assess the potential for significant effects upon Natura 2000 sites in the wider hinterland of the site. The purpose of the NIS is to identify whether adverse effects on a Natura 2000 site are likely to arise from the proposed development, either alone or in combination or cumulatively with other relevant projects and plans. The conservation objectives of Natura 2000 sites (i.e. to maintain the favourable conservation status of habitats and species for which the sites are selected) are referred to when carrying out assessments for plans and projects that might impact on these sites. The following guidelines were used in the completion of the associated NIS:

- Assessment of Plans and Projects Significantly Affecting Natura 2000 Sites – European Commission Methodical Guidance on the provisions of Article 6(3) and 6(4) of the 'Habitats' Directive 92/43/EEC (European Commission 2001);
- Appropriate Assessment of Plans and Projects in Ireland – Guidance for Planning Authorities (DoEHLG 2009).

- European Commission (2021) Assessment of plans and projects in relation to Natura 2000 sites – Methodological guidance on the provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC (2021/C 437/01).
- Commission notice Guidance document on the strict protection of animal species of Community interest under the Habitats Directive (C/2021/7301 European Commission; October 2021).

Recently, the overall operation of the AAL facility, including the operation of the permitted borrow pit, has been subject to AA as part of the Environmental Protection Agency (EPA) Industrial Emissions (IE) Licence review process (P0035-07). In the issue of the IE licence (P0035-07; September 2021) the EPA state that it completed an Appropriate Assessment of potential impacts on Natura 2000 sites and *"has made certain, based on best scientific knowledge in the field and in accordance with the European Communities (Birds and Natural Habitats) Regulations 2011 as amended, pursuant to Article 6(3) of the Habitats Directive, that the activities, individually or in combination with other plans or projects, will not adversely affect the integrity of any European site..."*

### 6.2.3 Field Studies

The following ecological surveys were completed over the period spanning February 2019-July 2021:

- Habitat and Botanical Surveys (2019-2021);
- Bird surveys in winter and summer (2019-2020). Transects and point counts as well as supplementary records from trail camera deployments;
- Mammal trail camera survey (August 2019 - January 2021);
- Mammal walkover surveys (2019-2021);
- Passive bat detector survey (Summer 2019 - Winter 2021);
- Additional monitoring at badger sett located c. 120m from the application site (October 2019 – June 2021);
- Casual recording of other taxa (amphibians, orthoptera, lepidoptera).

The field surveys concentrated on the lands within and adjacent to the application site boundary with due consideration of sensitive and protected species and habitats in the wider area. Details of the survey schedule are provided in Appendix 6.1.

### 6.2.4 Habitat and Botanical Surveys

The habitat and flora study involved undertaking a desktop review and a field assessment of the habitats and flora within the study area. The desktop study involved a review of botanical data available for the area to identify botanical species of conservation interest (e.g. rare, legally protected, invasive species) which have historically occurred in the area. The habitat and flora field assessment was carried out in accordance with best practice guidance (Smith *et al*. 2011). This involved a dedicated walkover of the entire lands under the Applicant's ownership at this site on a number of occasions between 2019 and 2021 (see Appendix 6.1), where the dominant habitats present were mapped and classified according to Fossitt (2000).

The BRDA is a waste disposal area, the surface of which has limited vegetative cover. The bauxite residue is classified as Refuse and other waste (ED5) according to Fossitt (2000). However, it also has characteristics of Spoil and Bare Ground (ED2) and there are some areas of buildings and artificial surfaces (BL3) within the BRDA footprint. These are manmade habitats of negligible ecological value. Apart from some landscaping on the edges of the stage raises the area is devoid of vegetation. The area is not included in the habitat mapping presented, as it has no botanical interest.

The habitat and botanical surveys were concentrated on the areas within the application site with vegetative cover i.e. the borrow pit and rockfill and soil storage area (Figure 6.2). During the habitat and botanical walkover surveys, any non-native invasive species present were recorded. The survey focused on the identification of invasive species listed under the Third Schedule of the European Communities (Birds and Natural Habitats) Regulations 2011 (As Amended) (S.I. 477 of 2015).

Evaluation of the conservation importance of habitats was conducted in accordance with NRA (2009) and Nairn & Fossitt (2004). The correspondence of any habitats within the study area to those listed on Annex I of the EU Habitats Directive 92/43/EC was evaluated with reference to the European Commission (2013) and the NPWS (2013). The conservation status of habitats and flora was also considered in respect of the following: Irish Red List for Vascular Plants (Wyse Jackson *et al*. 2016); Irish Red List for Bryophytes (Lockhart *et al*. 2012), Flora Protection Order (1999 as amended 2015); the EU Habitats Directive (92/43/EEC).

### 6.2.5 Bird Surveys

Existing data on bird use of the application site and surrounding area was gathered from existing ecological data. In addition, a series of dedicated breeding and wintering bird surveys were carried out. The conservation status of bird species recorded was considered by their inclusion in one or more of the following: Irish Wildlife Acts (1976 - 2012); Birds of Conservation Concern in Ireland (BoCCI) Red, Amber and Green lists (see Gilbert *et al*., 2021); EU Birds Directive (2009/147/EC) Annex I list.

A baseline bird assessment of the study area was completed by undertaking a series of line transect and point count surveys (see Bibby *et al*. 2000 and Sutherland *et al*. 2004). These surveys were carried out from summer 2019 to winter 2020 (each season with three survey visits; see Appendix 6.1). Transects 1-3 and all six of the point counts were surveyed across four seasons (two summer and two winter periods). An additional transect (T4) was added to provide additional coverage of the rockfill and soil storage area in 2020 (one summer and one winter). The survey transects, each of approximately 370-400m in length were surveyed to record the bird community present across the study area. These transects were selected to ensure that an adequate separation distance was maintained to minimise double-counting individual birds across the site (Figure 6.3).

On each transect, all bird species encountered (seen or heard) within two distance bands from the observer were recorded (<25m, 25-100m) and their abundance noted. All bird species encountered during the ecology field survey walkovers, but outside of the dedicated bird surveys, were also casually recorded as ‘additional’ species. Each point count was surveyed for a period of 5 minutes with all birds seen or heard recorded as within, or outside of 50m from the observer.

Contemporary transect survey data collected as part of the permitted Nature Trail planning application is also used to provide supplementary information on the breeding and wintering birds in the vicinity of the application site. The location of these Nature Trail transects are shown also shown in Figure 6.3.

### 6.2.6 Mammal surveys (non-volant)

A mammal survey of the site was also undertaken which involved a walkover of the site, identifying mammal species or signs of mammal activity seen (e.g. droppings, tracks, burrows etc.) and recording observations using field notes and/or handheld GPS units. Techniques used to identify mammal activity followed recognised guidelines (e.g. Clark 1988, Sutherland 1996, Bang & Dahlstrom 2004 and JNCC 2004). The mammal survey walkovers were carried out by Marie Kearns and Dr. Gavin Fennessy.

In parallel, a number of digital trail cameras (Camera-traps) which take photographs and/or video when triggered by heat or motion, were also deployed at the site for prolonged periods to record mammal activity within and adjacent to the proposed development site. Details of the deployment and collection dates of the trail cameras (Browning Dark Ops HD) are provided in Appendix 6.1 and the deployment locations are shown in Figure 6.4.

The cameras were set to take still images which were later analysed to identify the mammal (and bird) species present. The cameras are equipped with no-glow infrared 'flash' technology which enable clear night-time (as well as diurnal) images to be captured. Cameras were rotated between sampling locations with several cameras on-site from August 2019 through to January 2021.

An artificial badger sett constructed as mitigation associated with the development of BRDA Phase 2 is located c. 120m from the application boundary (south of the borrow pit extension area). This artificial sett has been sporadically occupied in recent years (G. Fennessy pers obs.). Contemporary information was collected on the badger activity in the vicinity of the artificial sett by deployment of multiple trail cameras in this area from November 2019 to June 2021.

The National Parks and Wildlife Service (NPWS) and National Biodiversity Data Centre (NBDC) online databases were consulted to identify any rare or protected mammal species located within the relevant grid squares surrounding the site.

The conservation status of mammal species was considered. The conservation status of mammals within Ireland and Europe is indicated by inclusion in one or more of the following: Irish Wildlife Acts (1976 - 2010); Red List of Terrestrial Mammals (Marnell et al. 2009); EU Habitats Directive.

### 6.2.7 Bat Surveys

As part of an initial desk-top review, the model of Bat Landscapes, available on the NBDC website was consulted. This model is based on the relative importance of landscape and habitat associations for bat species in Ireland and the index ranges from 0 to 100, where 100 is the most suitable for bats (Lundy *et al*. 2011).

There are no suitable structures within the Proposed Development site which have potential for roosting bats. A visual assessment was made of the roost potential of natural and man-made features within and adjoining the proposed development site.

In order to record the usage of the Proposed Development site and surrounding areas by bats, a multi-season deployment of passive bat detectors was carried out. Multiple bat detectors (Wildlife Acoustics SM4 & SM4 Mini) were deployed at multiple sampling locations from May

2019 and July 2021 (Figure 6.5). A total of 28 successful deployments were completed (Appendix 6.1) generating a large amount of data on the bat activity across the study area at all times of the year. The passive bat detectors were left out for a duration of days ranging from 7 to 45 and collected a large amount of data. These bat detectors are triggered by the high-frequency bat calls and record vocalisations onto a removable memory card. The detectors record all activity detected from sunset to sunrise and these calls are then analysed (using Kaleidoscope Pro v 5.1.9 and Bat Sound v 4.1) to identify the species present.

*Post hoc* analysis was used to evaluate the relative abundance of the bat species identified. The activity pattern of key species was investigated further to ascertain if the pattern of occurrence was suggestive of the presence of locally roosting bats.

The conservation of Bat species was considered. All Irish bat species and their breeding, roosting and resting locations are legally protected under both the Irish Wildlife Acts (1976 - 2010) and as Annex IV species in the EU Habitats Directive (92/43/EEC).


**Figure 6.3 Bird survey transect and point count locations** (background image from Bing Mapping c. 2013)**.**


**Figure 6.4 Trail camera deployment locations** (background image from Bing Mapping c. 2013)**.**


**Figure 6.5 Passive bat detector deployment locations** (background image from Bing Mapping c. 2013)**.**

### 6.2.8 Recording of Other taxa

A desktop study was conducted to review available records for other taxa such as invertebrates (butterflies, damselflies, dragonflies, moths, beetles etc.), amphibians and reptiles. NBDC records for the 2km grid squares which overlap the Application Site Boundary were reviewed and used to inform the scope of ecological surveys required.

Other taxa (e.g. Lepidoptera, Odonata, Amphibians and reptiles) encountered during the ecological field surveys were casually recorded for inclusion in this assessment. The conservation status of other taxa was assessed by examining their inclusion in one or more of the following: Irish Wildlife Acts (1976 – 2012); Irish Red List for Butterfly (Regan *et al*. 2010); Irish Red List for Damselflies & Dragonflies (Nelson *et al*. 2011); Irish Red List for Amphibians, Reptiles & Freshwater Fish (King *et al*. 2011); Regional Red List of Irish Bees (Fitzpatrick *et al*. 2006); and the EU Habitats Directive.

## 6.3 Results

A summary of the results of the desktop and field ecological assessments are outlined in the following sections.

### 6.3.1 Identification of European Designated Sites

All potential pathways for impact on designated sites have been considered in the impact assessment both within and outside the nominal 15km buffer area around the development site.

The proposed development area does not lie within any EU Natura 2000 or nationally designated conservation sites (Figure 6.6).

In all, 6 Natura 2000 sites are located within 15km of the proposed development site. The closest of these are;

- **Lower River Shannon SAC (002165)** – 0.01Km from the proposed development site;
- **River Shannon & River Fergus Estuaries SPA (004077)** – 0.01km from the proposed development;
- **Barrigone SAC (000432)** – 0.45km from the proposed development.

The Natura 2000 sites proximate to the application boundary are shown in Figure 6.8. All of the other Natura 2000 sites are located well over 5km from the proposed development site (Table 6.1a; Figure 6.6).

The potential impacts of the Proposed Development on Natura 2000 sites in the surrounding area is considered in detail in the Natura Impact Statement (under the EU Habitats Directive) which accompanies the planning application.

**Table 6.1a Summary of designated Natura 2000 sites within 15km of the application site.**

| Site Name & Designation | Site Code | Qualifying/Special Conservation Interests | Minimum Distance (km) |
|---|---|---|---|
| Lower River Shannon SAC | 002165 | The conservation objectives of this site are to maintain the favourable conservation condition of the Annex I habitats and fauna listed as Special Conservation Interests for this SAC:<br>• Sandbanks<br>• Estuaries<br>• Tidal Mudflats and Sandflats<br>• Coastal Lagoons*<br>• Large Shallow Inlets and Bays<br>• Reefs<br>• Perennial Vegetation of Stony Banks | 0.01 |

| Site Name & Designation | Site Code | Qualifying/Special Conservation Interests | Minimum Distance (km) |
|---|---|---|---|
| | | • Vegetated Sea Cliffs<br>• *Salicornia* Mud<br>• Atlantic Salt Meadows<br>• Mediterranean Salt Meadows<br>• Floating River Vegetation<br>• *Molinia* Meadows<br>• Alluvial Forests*<br>• Freshwater Pearl Mussel *Margaritifera margaritifera*<br>• Sea Lamprey *Petromyzon marinus*<br>• Brook Lamprey *Lampetra planeri*<br>• River Lamprey *Lampetra fluviatilis*<br>• Atlantic Salmon *Salmo salar*<br>• Bottle-nosed Dolphin *Tursiops truncatus*<br>Otter *Lutra lutra* | |
| | 004077 | The conservation objectives of this site are to maintain the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA: Breeding and Wintering<br>• Cormorant *Phalacrocorax carbo*<br>Wintering<br>• Whooper Swan *Cygnus cygnus*<br>• Light-bellied Brent Goose *Branta bernicla hrota*<br>• Shelduck *Tadorna tadorna*<br>• Wigeon *Anas penelope*<br>• Teal *Anas crecca*<br>• Pintail *Anas acuta*<br>• Shoveler *Anas clypeata*<br>• Scaup *Aythya marila* | 0.1 |

| Site Name & Designation | Site Code | Qualifying/Special Conservation Interests | Minimum Distance (km) |
|---|---|---|---|
| River Shannon & River Fergus Estuaries SPA | | • Ringed Plover *Charadrius hiaticula*<br>• Golden Plover *Pluvialis apricaria*<br>• Grey Plover *Pluvialis squatarola*<br>• Lapwing *Vanellus vanellus*<br>• Knot *Calidris canutus*<br>• Dunlin *Calidris alpina*<br>• Black-tailed Godwit *Limosa limosa*<br>• Bar-tailed Godwit *Limosa lapponica*<br>• Curlew *Numenius arquata*<br>• Redshank *Tringa totanus*<br>• Greenshank *Tringa nebularia*<br>• Black-headed Gull *Chroicocephalus ridibundus*<br>Wetlands | |
| Barrigone SAC | 000432 | • Juniperus communis formations on heaths or calcareous grasslands [5130]<br>• Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco-Brometalia) (* important orchid sites) [6210]<br>• Limestone pavements [8240]<br>• Euphydryas aurinia (Marsh Fritillary) [1065] | 0.45 |
| Stack's to Mullaghareirk Mts., West Limerick Hills & Mt. Eagle Bog SPA | 004161 | • Hen Harrier (Circus cyaneus) [A082] | 6.61 |
| Askeaton Fen Complex SAC | 002279 | The conservation objectives of this site are to maintain the favourable conservation condition of the Annex I habitats listed as Special Conservation Interests for this SAC<br>• Calcareous fens with *Cladium mariscus* and species of the Caricion davallianae* | 8.13 |

| Site Name & Designation | Site Code | Qualifying/Special Conservation Interests | Minimum Distance (km) |
|---|---|---|---|
| | | Alkaline fens | |
| Curraghchase Woods SAC | 000174 | The conservation objectives of this site are to maintain the favourable conservation condition of the habitats and fauna listed as Special Conservation Interests for this SAC:<br>• Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (Alno-Padion, Alnion incanae, Salicion albae)*<br>• *Taxus baccata* woods of the British Isles*<br>Lesser Horseshoe Bat *Rhinolophus hipposideros* | 11.05 |

### 6.3.2 Nationally Designated Sites

There are 20 NHA and pNHA sites located within this 15km hinterland area (Table 6.1b; Figure 6.7). The closest of these sites is Inner Shannon - South Shore pNHA which overlaps the existing Phase 2 BRDA. The existing Phase 2 BRDA overlaps the Inner Shannon Estuary – South Shore pNHA (000435; Figure 6.7).

**Table 6.1b NHA and pNHA designated conservation sites within 15km of the application site.**

| Site Name & Designation | Site Code | Site synopsis | Minimum Distance (km) |
|---|---|---|---|
| Inner Shannon Est. - South Shore pNHA | 000435 | This pNHA is part of the River Shannon Estuary and is comprised of extensive intertidal mudflats, fringing reedbeds, swamps, polders, salt marsh and wet marsh habitats; habitats which support many thousands of wading birds and duck. Greenland White-fronted and Greylag Geese frequent the southern shores of the estuary during the winter months. The estuary is also a stronghold for two rare plant species; triangular rush *Scirpus triqueter* and summer snowflake *Leucojuin pestirum*. The Inner Shannon Estuary – South overlaps with section of the Lower Shannon River SAC and The River Shannon and Fergus Estuaries SPA Natura 200 sites (see above for conservation objectives). | 0.00 |
| Barrigone pNHA | 000432 | Same as SAC | 0.45 |
| Sturamus Is. pNHA | 001436 | Sturamus Island is situated within the estuary of the River Shannon estuary and overlaps with The River | 1.30 |

| Site Name & Designation | Site Code | Site synopsis | Minimum Distance (km) |
|---|---|---|---|
| | | Shannon and River Fergus Estuary SPA and Lower River Shannon SAC. The site is a pNHA, of conservation interest as it is the only site in Co. Limerick that supports a Common Tern breeding colony. | |
| Fergus Est. & Inner Shannon - North Shore pNHA | 002048 | Fergus Estuary & Inner Shannon, N. Shore pNHA overlaps with The River Shannon and River Fergus Estuary and as such is of conservation significance for bird species and coastal/wetland habitats. | 2.68 |
| Cahiracon Wood pNHA | 001000 | Cahiracon Wood is an 8 ha Oak (Quercus species) woodland situated on the northern shore of the Shannon Estuary approx. 5km south of Killadysert in Co. Clare. The ground flora is a rich, comprised of species such as Ling Heather Calluna vulgaris, Wood Sage, Teucrium scarodania and Broad Buckler Fern, Dryopteris dilata. On the woodland margins the Great Horsetail, Equisetum telmeteia and Pendulous Sedge, Carex pendula are frequent. This site is of international scientific interest for Annex I Oak woodlands and breeding Peregrine Falcon, a species listed in Annex I of the EU Birds Directive. | 4.25 |
| Ballymorrisheen Marsh pNHA | 001425 | Ballymorrisheen Fen is located approx. 3km south east of Askeaton, Co. Limerick. This is a small to medium sized wetland site characterised by theree small waterbodies with fen vegetation/habitat along the shores, dominated by Saw Sedge Cladium mariscus and Common Reed Phragmites australis.<br>The conservation importance of this site is in its value as a wildlife refuge in an intensively managed landscape. Because of its Loughs and pools, which vary considerably in size and depth this area contains a wider range of habitat types. | 8.14 |
| Gortglass Lough pNHA | 001015 | This conservation site is primarily designated as a pNHA for Arctic Char, Salvelinus alpinas, however it also contains an excellent example of acid lake and associated habitats. | 8.21 |
| Cloonsnaghta Lough pNHA | 001004 | This pNHA site is of conservation importance primarily for supporting Arctic Char Salvelinus alpinas an Irish Red Data Book species. However, the lakes themselves are Annex I Habitat types. Blanket bog (small, individually, not more than 2ha) is present around each lake shore as is semi-natural wet grassland and scrub habitat. | 8.57 |
| Gorteennamrock pNHA | 001433 | This small wetland site is located c. 5km to the south east of Askeaton. Fen habitat present is dominated by Saw Sedge to the north and Common Reed further south.<br>This is considered of conservation significance as a wildlife refuge in an otherwise managed landscape. The | 9.30 |

| Site Name & Designation | Site Code | Site synopsis | Minimum Distance (km) |
|---|---|---|---|
| | | fen habitat is of botanical interest and the site may support Otter, Lutra lutra. | |
| Cappagh Fen pNHA | 001429 | This is a fen lake site with almost total dominance by reed beds. Three beds make up the site and only of them has open water. The extensive reed beds with common reed (*Phragmites australis*) Bulrush (*Typha latifolia*) and SHW Sedge (*Cladium mariseus*) provide useful habitats although they may not be especially species rich. | 9.46 |
| Paradise House pNHA | 000062 | A lesser horseshoe roost Rhinolophus hipposideros is present in the outbuildings associated with the ruins of Paradise House, outside Ballynacally, Co. Clare. A small number of bats (<50) use the outbuildings during the summer months, but it is not known if the site is a nursery site or a roost of male and non-breeding females. Surrounding mature woodland and the Shannon Estuary provide ideal foraging habitat for Lesser Horseshoe Bat. | 9.63 |
| Ballinvirick Marsh pNHA | 001427 | This is a small low-lying wetland site which has a good diversity of grassland species typically associated with calcareous grassland is found to the northwest of the site. Here early purple orchid (*Orchis mascula*) along with the caroline thistle (*Carlina vulgaris*) and Mountain everlasting (*Antennania dioica*) are found. | 10.15 |
| Moyreen Bog NHA | 002361 | Moyreen Bog NHA is an area of lowland blanket bog located 8km south east of Glin, 7km south of Loghill and 10km south west of Foynes in the townland of Moyreen in north Co. Limerick. Moyreen Bog NHA is of considerable conservation significance as it is a good example of a lowland blanket bog. It supports a wide range of lowland blanket bog species including a number of species of regional and international importance. | 10.84 |
| Ardagh Church pNHA | 000430 | The loft of the derelict Ardagh Church (or Las Church) supports a nursery colony of Natterer's bats Myotis nattereri, with up to 100 bats counted here in 1993, making it one of the biggest in the country at the time. | 10.85 |
| Curraghchase Woods pNHA | 000174 | Same as SAC | 11.05 |
| Derrygeeha Lough pNHA | 000050 | Derrygeeha Lough is a small freshwater lake approximately 2km inland from Clonderalaw Bay, with lake, wet woodland and cutover bog habitats. Its main interest is as one of only two known stations for the caddis fly Cyrnus insolutus in Ireland. | 11.82 |
| Fort Fergus pNHA | 000035 | A Lesser horseshoe bat (Rhinolophus hipposideros) roost is located in four small lofts in the farm buildings of Fort Fergus House, Ballynacally, Co. Clare. Small numbers of bats (<50) use the lofts during the summer, it is not | 11.91 |

| Site Name & Designation | Site Code | Site synopsis | Minimum Distance (km) |
|---|---|---|---|
| | | known if the site is a nursery site or a roost of male and non-breeding females. | |
| Clonderalaw Bay pNHA | 000027 | Clonderalaw bay is comprised of a narrow estuary associated with Crompaun and Cloon Rivers within the River Shannon estuary. This pHNA site overlaps with The River Shannon and River Fergus Estuaries SPA and as such is of conservation importance as part of the SPA complex. | 11.96 |
| Carrigkerry Bogs NHA | 002399 | Carrigkerry Bogs NHA consists of two upland blanket bogs that are both located within 2.5km of the village of Carrigkerry, Co. Limerick. These bogs are very interesting examples of an unusual peatland habitat, one that is intermediate in type between a raised bog and an upland blanket bog. Carrigkerry Bogs NHA is a site of high conservation value consisting of upland blanket bog with characteristic features and notable species of flora and fauna. | 12.16 |
| Glenastar Wood pNHA | 001431 | This is a small woodland site comprised primarily of Oak (Quercus petraea), and Birch (Betula pubescens). This site is of flora and fauna interest and provides an important wildlife refuge in the region. | 12.68 |
| Dromore & Bleach Loughs pNHA | 001030 | An area of low-lying lakes and fen with underlying calcareous substrate, some woodland and scrub also occur onsite. | 14.90 |

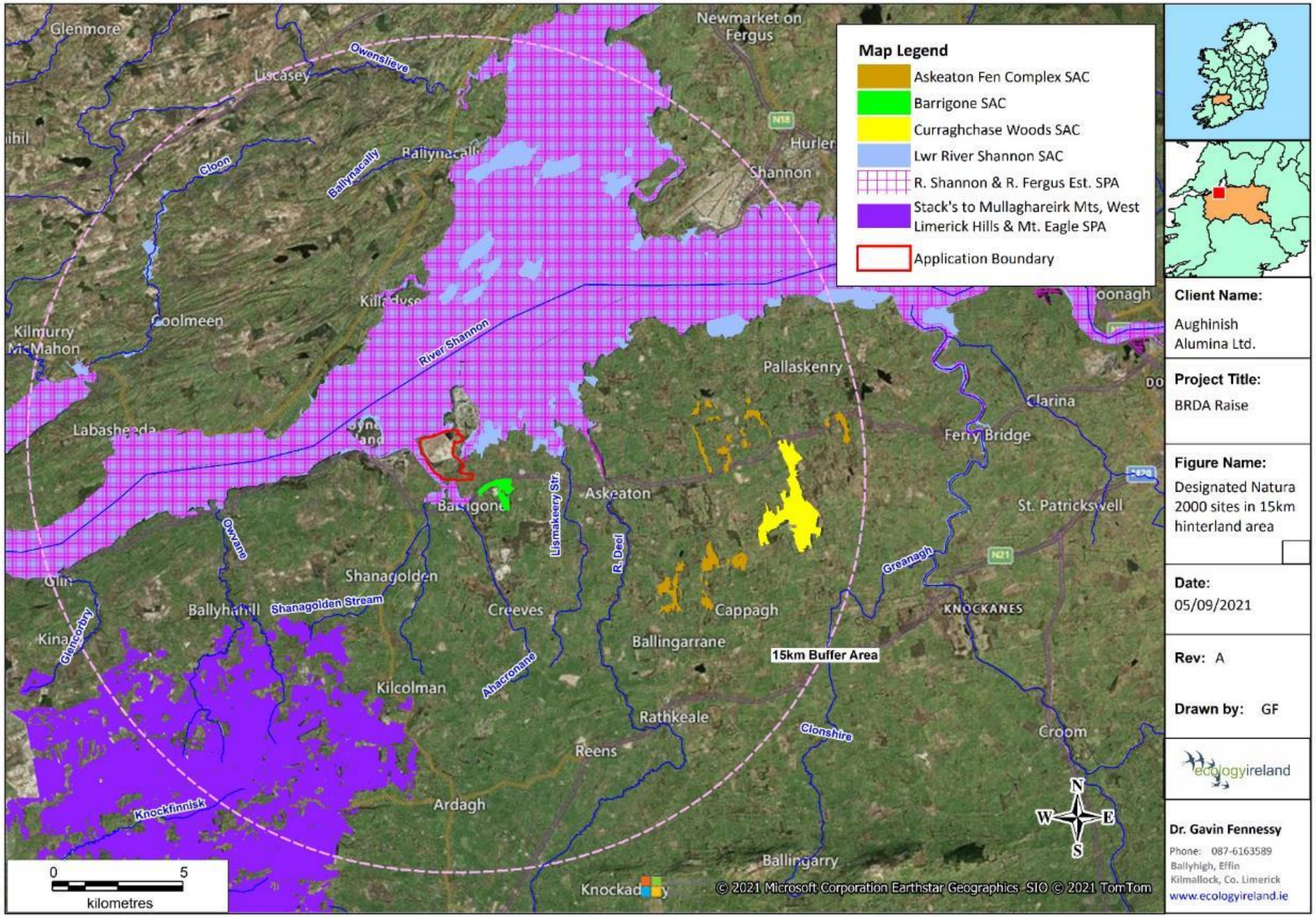



**Figure 6.6 Natura 2000 sites located within 15km of the proposed development site** (background image from Bing Mapping c. 2013).

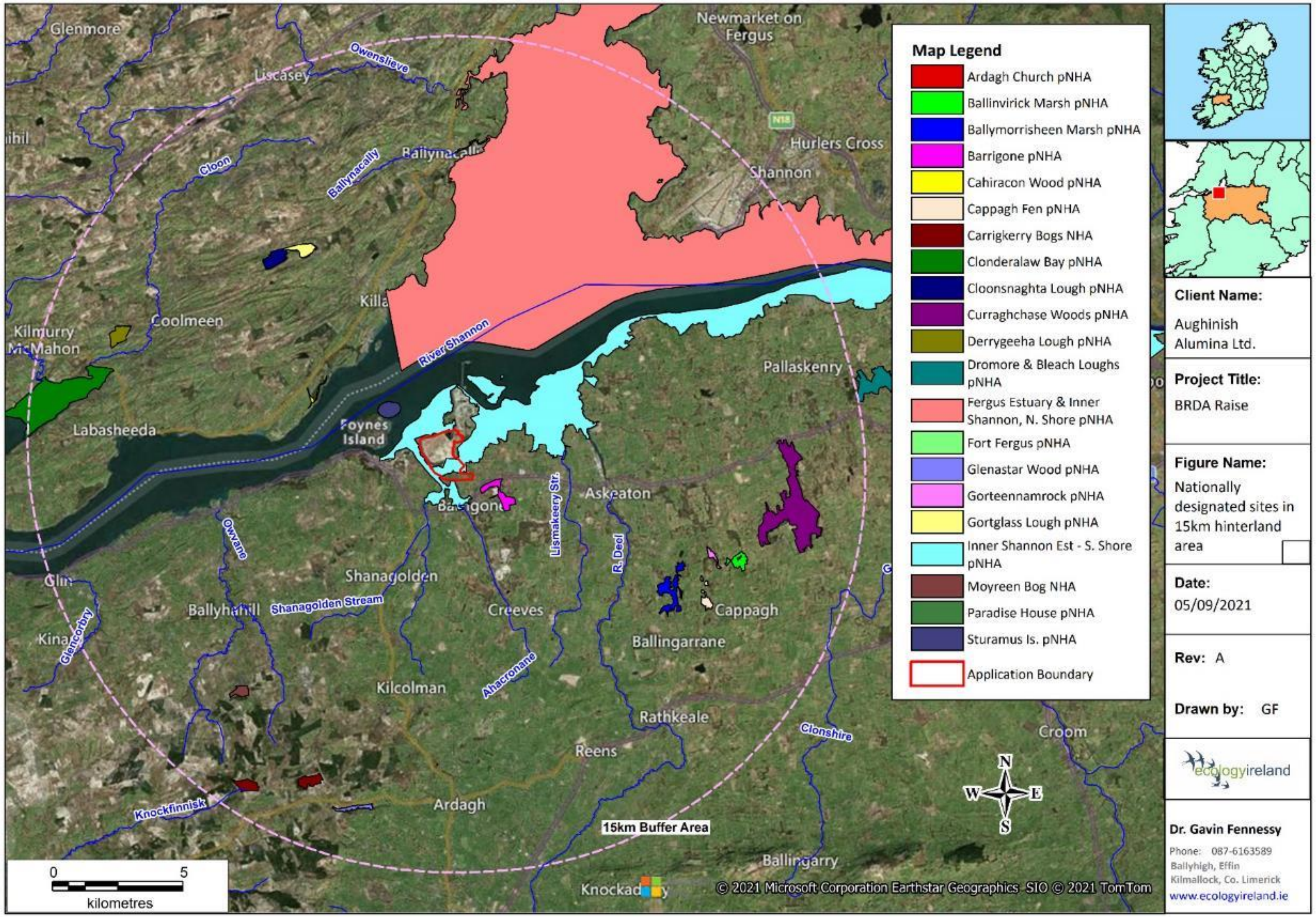



**Figure 6.7 NHAs and pNHAs within 15km of the proposed development site** (background image from Bing Mapping c. 2013).

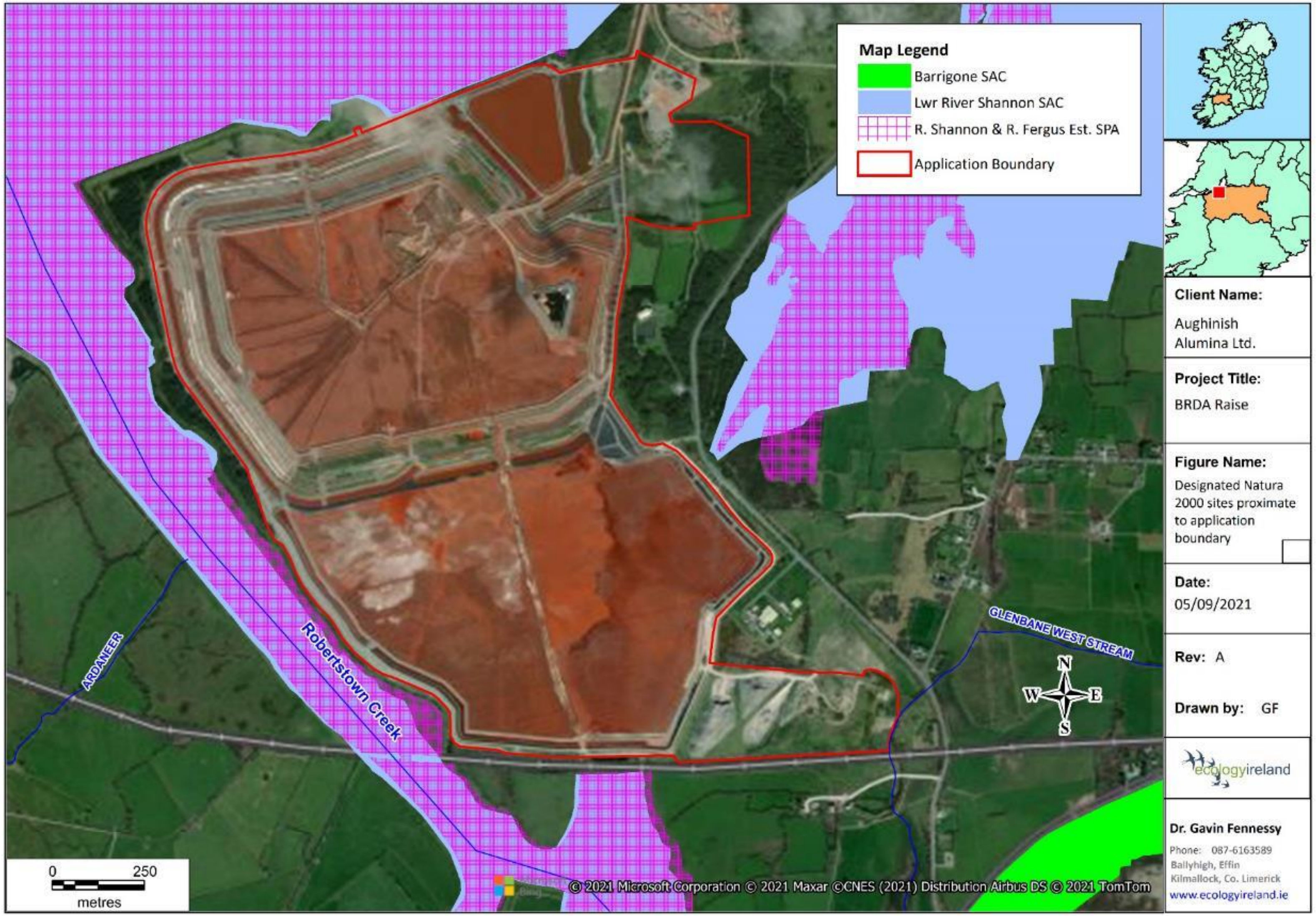



**Figure 6.8 Natura 2000 sites proximate to the application site boundary** (background image from Bing Mapping c. 2013)**.**

### 6.3.3 Habitat and Botanical Survey Results

#### 6.3.3.1 Desktop Study

The proposed development site is located within the Irish Grid 10km square R25 (10km), and 2km grid squares R25R, R25W, R25Q and R25V. The grid square R25W overlaps the proposed borrow pit site location and R25V overlaps the rockfill and soil storage area. Within these 2km grid squares; areas of Dry calcareous and neutral grassland habitat (GS1) are present.

There are a number of available records of rare or protected flora species within the grid squares which overlap the proposed development site. Cornflower *Centaurea cyanus* (2008 and 2018 – from Irish Vascular Plant Data; Paul Green) has been recorded for the 10km and 2km grid square (R25W) held by the NBDC. There is one available record for the rare species Hairy Violet *Viola hirta* for the 10km and 2km grid squares overlapping the study site (2020 – from Online Atlas of Vascular Plants 2012 -2020). Additionally, there is one record for Meadow Barley *Hordeum secalinum* (2006 – from Irish Crop Wild Relative Database) for the 10km grid square only.

There are no available rare plant records for this grid square held by NPWS. The Botanical Society of Britain and Ireland (BSBI) also hold records for near threatened and vulnerable species within the relevant grid squares. Irish Whitebeam *Sorbus hibernica*, classed as vulnerable, has been recorded in the R25V grid square in the past (BSBI dataset). BSBI hold records for the near threatened species from 2km grid squares R25W and/or R25V (i.e. covering areas outside of the existing BRDA) presented in Table 6.2 below.

**Table 6.2 Rare or protected plant species that have previously been recorded from the 2km grid squares R25W and/or R25V (after BSBI database).**

| Common Name | Scientific Name | Flora Protection Order 2015 | Red Data Book Category (Wyse-Jackson *et al.*, 2016) | Habitat |
|---|---|---|---|---|
| **Meadow barley** | *Hordeum secalinum* | Protected | Vulnerable | Mainly coastal distribution, lowland meadows, pastures and/or coastal grazing marshes |
| **Frog orchid** | *Coeloglossum viridea,* | Not listed | Near threatened | Limestone pavements, wet grassland and pastures, |
| **Autumn gentian** | *Gentianella amarella,* | Not listed | Near threatened | Found on dry, chalk grasslands and sand dunes |
| **Field gentian** | *Gentianella campestris,* | Not listed | Near threatened | Short turf, on dune systems and on machair. |
| **Autumn ladies tresses** | *Spiranthes spiralis* | Not listed | Near threatened | Short turf, on stable dune systems, calcareous grasslands |
| **Brackish water-crowfoot** | *Ranunculus baudotii* | Not listed | Near threatened | Brackish, coastal pools. |
| **Upright brome** | *Bromopsis erecta,* | Not listed | Near threatened | Typical of calcareous soil habitats |
| **Greater knapweed** | *Centaurea scabiosa,* | Not listed | Near threatened | Calcareous habitats |
| **Dwarf Spurge** | *Euphorbia exigua* | Not listed | Near threatened | Arable, mainly calcareous, soils |

**Cornflower** is an annual species found on roadside or traditionally within arable farmland (Parnell & Curtis 2012), and as such there is limited suitable habitat available within the study site that could support this species. This species was not recorded during the site assessments as part of the current or other surveys carried out by Ecology Ireland on lands in the ownership of the applicant on Aughinish Island. **Hairy Violet** is associated with calcareous substrates such as dry calcareous grassland, limestone rock and sand dunes (Parnell & Curtis 2012) but can also be found along dry woodland edges, roadside verges and railway embankments and as such some (*albeit* limited) suitable habitat is also available locally that could support Hairy Violet. Again, this species was not recorded during any of the site surveys undertaken on Aughinish Island in recent years. **Meadow Barley** has a very local and mainly coastal distribution where it is associated with brackish margins, primarily near the coast across the south and inland along the River Shannon (Parnell & Curtis 2012). It has also been recorded in lowland meadows, pastures and/or coastal grazing marshes in unimproved grasslands on heavy, (often calcareous) clay soils (Cope & Gray 2009). Given the overall location and nature of the habitats present within the application site, Meadow Barley is unlikely to occur within the development boundary, although likely to occur in brackish habitats nearby. None of the other near threatened or vulnerable species were recorded during this site assessment. No Bryophytes protected under the Flora (Protection) Order 2015 are documented for the study area (after NPWS database). While there are 25 records for Liverworts (Byrophytes of Ireland dates 1979-1994 after NBDC) in the relevant 10km square overlapping the study site all species are considered of least concern in Ireland at present.

**Great Burnet**, *Sanguisorba officinalis*, is a rare plant with a restricted distribution in Ireland. It has been recorded and subject to a conservation plan on Aughinish Island (https://bit.ly/31F2pK4). It was subject to successful translocation as part of the development of BRDA Phase 2 (loc cit.) and is monitored on an annual basis. The plant is not present within or directly adjacent to the application site.

During surveys for the permitted borrow pit (LCCC Reg. Ref. 17/714; ABP-301011-18) one invasive plant species; Japanese Knotweed *Fallopia japonica*, listed on Invasive Species Ireland's 'most-unwanted list' was found at one location, within the permitted borrow pit study area. This patch of Japanese Knotweed was subsequently treated by specialist contractors and this treatment appears to have been successful. AAL environmental staff are vigilant and aware of the possibility that such species can reoccur. To date no follow up treatments have been required and no additional stands of Japanese Knotweed have been recorded within the application site. No other species listed on the Third Schedule of the 2011 European Communities (Birds and Natural Habitats) Regulations (*i.e.* species of which it is an offense to disperse, spread or otherwise cause to grow in any place) have been recorded anywhere within the Aughinish facility.

Non-native species such as; Buddleia *Buddleia davidii* and Travelers Joy *Clematis vitalba* and Sycamore of medium risk of having damaging effects on native species (Kelly *et al.* 2013) have previously been recorded within Scrub (WS1) habitat, including within the borrow pit area.

#### 6.3.3.2 Habitat Surveys

The main habitats recorded within the proposed development site are listed in Table 6.3 and illustrated in Habitat mapping of the proposed borrow pit (extraction) boundary (see Figure 6.9) and rockfill and soil storage area (See Figure 6.10). There are no habitats within the planning application boundary that conform to those listed under Annex I of the EU Habitats Directive.

The Annex I protected habitat - 'semi-*natural dry grasslands and scrubland facies on calcareous substrates (Festuco-Brometea) (*important orchid sites) (6210)'* has been documented within the landownership boundary of AAL as part of the Irish Semi-Natural Grassland Survey 2007-2012 (O'Neill *et al.* 2013). An area of this Annex I grassland habitat is located to the northeast of the proposed development site outside of the planning application boundary and has been avoided by the proposed works. Another area mapped as containing areas of this grassland habitat (O'Neill *et al.* 2013) was located within the former borrow pit at the site. However, over time this area was encroached by scrub and the semi-natural grassland had gone rank from lack of management/grazing. More recently, this area has been subject to scrub clearance in early 2021 in anticipation of works at the permitted borrow pit and the area is currently classified as Spoil and Bare ground (ED2).

Dry meadows and grassy verges (GS2) and Scrub (WS1) are the dominant habitat types present overall within the areas with vegetative cover within the borrow pit area (Figure 6.11). The dry meadow and grassy verge (GS2) grassland, which is unmanaged, is located in the centre and west of the borrow pit area and has developed over previously disturbed ground rather than as a result of traditional farming/management practice. This habitat is considered of **Local importance (higher value)**. A large area of Scrub (WS1) habitat is located in the east of the borrow pit area with some smaller linear areas located in the western margins closer to the liquid waste pond (LWP). Due to its semi-natural state and importance to local wildlife Scrub (WS1) habitat is considered of **Local importance (Higher value)**.

Habitats of **Local importance (Lower Value)**, Buildings and artificial surfaces (BL3) and Spoil and Bare ground (ED2) were recorded in the centre and north of the proposed borrow pit extension area and in the centre of the proposed rockfill and soil storage area in the form of large spoil heaps respectively.

In the rockfill and soil storage area at Fawnamore, Dry calcareous and neutral grassland (GS1) was present in the southeast of the area where it formed a mosaic with improved agricultural grassland (GA1; Figure 6.12). Overall, the dry calcareous grassland (GSI) was evaluated as being of **Local Importance (Higher value)**, as this habitat can support a unique calcareous plant community including rare orchids. However, in the case of the rockfill and soil storage area the Dry calcareous grassland (GS1) often graded into other habitats such as Scrub (WS1) and Improved agricultural grassland (GA1) and has been the subject of ongoing disturbance, or has gone rank due to lack of grazing/cutting. The semi-natural grassland present is not currently of Annex I habitat quality. There is a small area of Immature woodland (WS2) which has been planted along the southern boundary of the rockfill and soil storage area and this is categorised as **Local importance (Higher value).**

In the BRDA large areas of spoil and bare ground persist in the form of bauxite residue storage areas, no vegetation grows here due to ongoing disturbance and compaction by bulldozers. The farmed bauxite residue and salt cake disposal cell do not fit neatly into current Fossitt habitat classifications. The category of Refuse and Other Waste (ED5) could apply, although the habitat description provided suggests that this habitat type is 'usually characterised by high nutrient levels and/or the presence of scavengers'. That is not the case at the BRDA and the habitat presents with characteristics of Spoil and Bare ground (ED2) as well as Refuse and Other Waste (ED5). There are other small areas of Spoil and bare ground (ED2) and Buildings and artificial surfaces (BL3) habitat types within the BRDA. The ecological value of all of these habitats is considered as **negligible.**

A number of artificial water bodies are present within the application site boundary including the;

- Storm water Pond (SWP);
- Liquid Waste Pond (LWP) and
- Perimeter Interceptor Channel (PIC).

These are classified as Other artificial lakes and ponds (FL8) with no associated vegetation. Due to the industrial nature of the waterbodies, their form and function, they are evaluated as being of **negligible value.**

Overall habitats present were evaluated as being of **Local importance lower to higher value**. No habitats of national or international importance were recorded within the application site boundary.

**Table 6.3 List of the main habitats recorded within or directly adjacent to the proposed development site area during the 2020 Habitat and botanical Survey (Evaluation of conservation importance after NRA 2009 and Nairn & Fossitt 2004).**

| Fossit Code | Habitat Type | Habitat Evaluation |
|---|---|---|
| **GS2** | Dry meadows and grassy verges | Local Importance (Higher value) |
| **WSI** | Scrub | Local Importance (Higher value) |
| **WL1** | Hedgerows | Local Importance (Higher value) |
| **GA1/GS1 Mosaic** | Improved agricultural grassland/Dry calcareous and neutral grassland Mosaic | Local Importance (Lower value) |
| **ED2** | Spoil and bare ground | Negligible value |
| **BL3** | Buildings and artificial surfaces | Negligible value |
| **WS2** | Immature woodland | Local Importance (Higher value) |
| **FL8** | Other artificial lakes and ponds | Negligible value |
| **ED5** | Refuse and other waste (i.e. in the BRDA) | Negligible value |

The following sections provide some additional detail on the principal habitats present and the botanical species recorded within these habitat types.

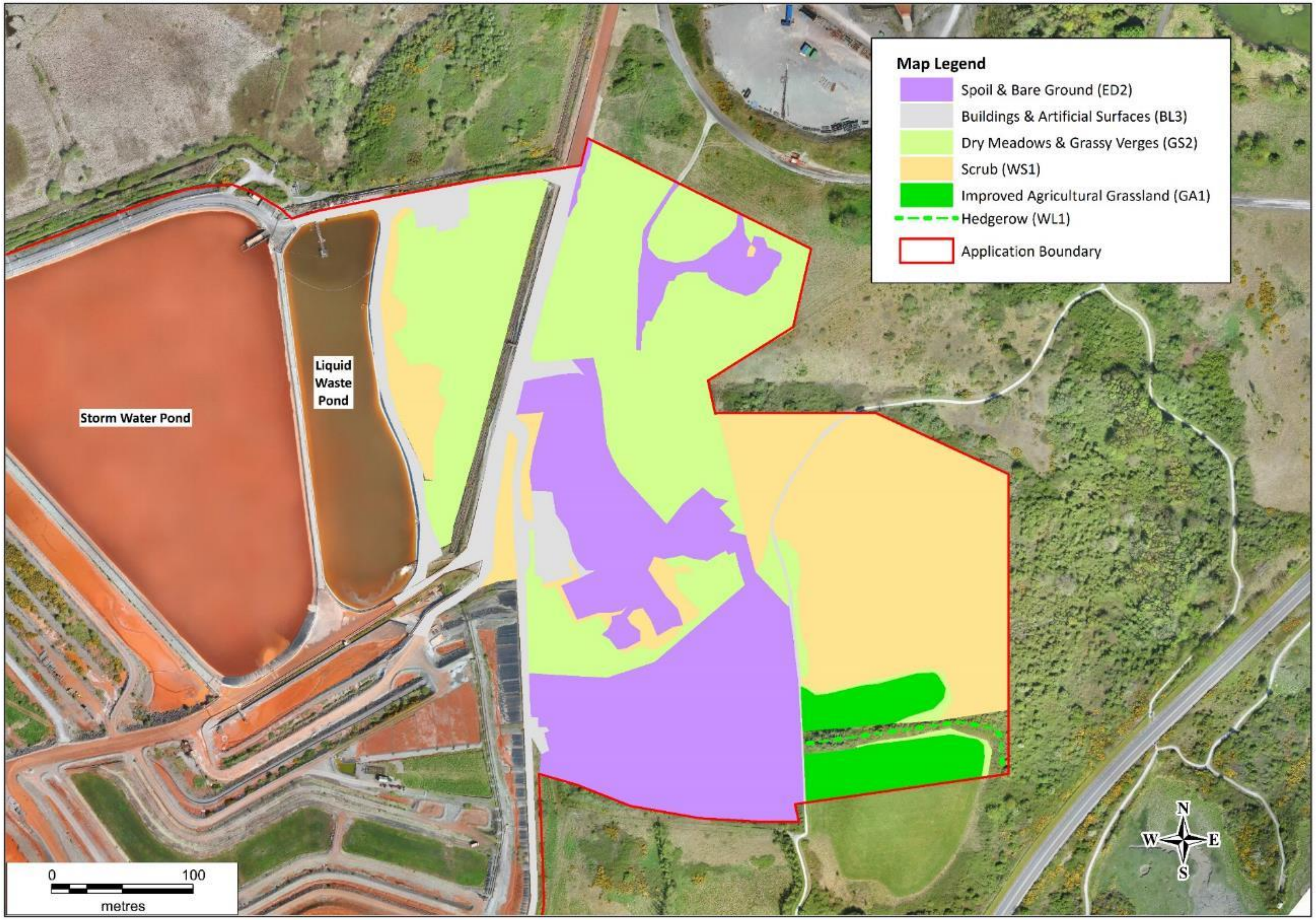



**Figure 6.9 Habitat map (Fossitt, 2000) of the proposed borrow pit area (including the permitted borrow pit).**


**Figure 6.10 Habitat map (Fossitt, 2000) of the proposed rockfill and soil storage area.**

### 6.3.3.3 Dry meadow and grassy verges (GS2)

Dry meadow and grassy verges (GS2) is a dominant habitat present within the proposed borrow pit area. This habitat has recolonised naturally on previously disturbed ground. The Dry meadow and grassy verge (GS2) vegetative community (Group 3; *Cynosurus cristatus* – *Plantago lanceolata* group, after O'Neill *et al.* 2013) is dominated by a typical species assemblage of grasses; Cock's-foot *Dactylis glomerata*, Red Fescue *Festuca rubra*, Creeping Bent *Agrostis stolonifera*, Yorkshire Fog *Holcus lanatus* and Sweet Vernal Grass *Anthoxanthum odoratum* and broadleaved herbs; Ribwort Plaintain *Plantago lanceolata*, Common Knapweed *Centaurea nigra*, Red Clover *Trifolium pratense*, Creeping Buttercup *Ranunculus acris*, Common Sorrel *Rumex acetosa*. Other occasional flora species include Bird's-foot Trefoil *Lotus corniculatus*, Self-heal *Prunella vulgaris*, Common Ragwort *Senecio jacobaea*, Trailing Tormentil *Potentilla reptans*, Creeping Thistle *Cirsium arvense*, Teasel *Dipsacus fullonum*, Common Nettle *Urtica diocia* and Common Vetch *Vicia sativa*. Colt's-foot *Tussilago farfara* is abundant along the northern section of this grassland area. Bramble *Rubus fruticosus* agg. and Bracken *Pteridium aguilinum* are common to the west. This grassland habitat (Dry meadow and grassy verge GS2) is at various stages of regeneration, with some bare substrate/spoil remaining in parts, however as the area is largely unmanaged/undisturbed grasses dominate the sward and are tussock/rank in parts that have established over a longer period of time.

In the rockfill and soil storage area to the south, the diversity of species in the grassland is reduced as it has become rank from lack of management/grazing in places. There are some small areas that may conform to GS2 within the rockfill and soil storage area, but these are present in the context of a dominant Spoil and Bare ground (ED2) habitat type.

Dry Meadow and Grassy Verge (GS2) has developed as a result of changes in management and/or recolonisation events rather than traditional grassland farm management, due to the nature of the habitat and in a local context, this habitat is considered of **Local importance (Higher value;** Nairn & Fossitt 2004).

#### 6.3.3.4 Scrub (WS1)

Areas of Scrub (WS1) are present across the proposed borrow pit extension area, in parts that have been left unmanaged/undisturbed for longer periods of time. This Scrub (WS1) habitat is dominated by low growing Bramble *Rubus fruticosus* agg., with frequent Gorse *Ulex europaeus*, Willow *Salix* spp. and Hawthorn *Crataegus monogyna* shrubs. Immature trees comprised of non-native Sycamore *Acer pseudoplatanus* and native Ash *Fraxinus excelsior* are present in Scrub (WS1) towards the north-eastern boundary of the proposed borrow pit extension.

An area of scrub in the centre of the rockfill and soil storage area becomes damp in winter and spring and supports Common Frog, *Rana temporaria*.

Due to the semi-natural state and local wildlife value, Scrub (WS1) habitat is considered to be of **Local Importance (Higher value).**

**Plate 6.1 Scrub area (WS1) located within the proposed borrow pit extension area.**

#### 6.3.3.5 Immature woodland (WS2)

Along a section towards the southern boundary of the proposed rockfill and soil storage area in Fawnamore a small embankment area has been planted with Immature woodland (WS2). This mixed Immature woodland (WS2) is comprised of young/immature Alder *Alnus glutinosa,* Downy Birch *Betula pubescens,* Silver Birch *B. pendula,* Pedunculate Oak *Quercus robur*, Cherry *Prunus* sp., Scots pine *Pinus sylvestris*, Rowan and Willows *Salix* spp. Dry meadow and grassy verge (GS2) dominated by tussock grasses (*e.g.* Cock's-foot, Creeping Bent, Yorkshire Fog, Red Fescue) persists in the understorey here. Another part of the planted immature trees are dominated by Sycamore and Ash.

**Plate 6.2 Immature woodland in the south of the proposed rockfill and soil storage area.**

Immature woodland (WS2) is a modified/planted habitat type, however; the mixed assemblage of native and non-native tree species provides additional habitat for local flora and fauna and as such is of **Local importance (Higher value).**

### 6.3.3.6 Improved agricultural grassland/Dry calcareous grassland mosaic (GA1/GS1)

**Plate 6.3 Improved agricultural grassland (GA1)/Dry calcareous and neutral grassland habitat mosaic.**

A mosaic of improved agricultural grassland (GA1 and Dry calcareous and neutral grassland (GS1) is present in the centre and east of the rockfill and soil storage area. Sections of this area outside of the existing stockpile area has been grazed by cattle and young calves and has shallow soils. Species recorded included frequent grasses such as Yorkshire fog, Cocksfoot grass and Crested dogs tail. The broadleaved component included frequent Creeping thistle, Common rush and occasional Common knapweed, Wild carrot, Common ragwort, Dandelion, Broad leaved dock, Ribwort plantain, Greater plantain, Yarrow, Red and white clover, Daisy, Lesser trefoil, Teasel, Common vetch, Creeping buttercup, Meadow buttercup and Common speedwell.

While the presence of species such as Common rush and meadow buttercup indicate a wet grassland type habitat in places, overall the proportion of dry grassland species present were in greater abundance than species associated with wet grassland.

This area is of **Local importance (Lower value).**

#### 6.3.3.7 Hedgerows (WL1)

Sections of hedgerow exist between the improved agricultural grassland fields within the proposed borrow pit extension area. There are also some scrubby/hedgerow field boundaries along parts of the perimeter of the proposed rockfill and soil storage area in Fawnamore. The species recorded in these hedgerows included frequent Gorse and Bramble with occasional Whitethorn, Blackthorn and Elder.

While limited in extent, the Hedgerows onsite support habitat for local flora and fauna and as such are of **Local importance (Higher value).**

#### 6.3.3.8 Buildings and Artificial Surfaces (BL3)

Buildings and artificial surfaces (BL3) present within the overall application site consist of maintained site tracks and other hard standing areas and storage sheds associated with existing on-site activities. Buildings and artificial surfaces (BL3) are considered highly modified habitats, lacking any significant vegetation cover and/or local wildlife potential and therefore are of **negligible value.**

#### 6.3.3.9 Spoil and Bare ground (ED2)

Areas that consist of bare ground and/or rubble and which have not been resurfaced or have not revegetated were recorded as Spoil and bare ground (ED2). Some of these areas are transient in nature but subjected to ongoing disturbance which prevents the establishment of any significant floral community. Two large heaps of spoil storage material are present in the proposed rockfill and soil storage area. The floor of the historical borrow pit has been cleared of scrub vegetation in early 2021 and this is also classified as Spoil and Bare ground (ED2).

The Spoil and bare ground (ED2) habits within the application site are considered highly modified habitats which are subject to intensive ongoing human disturbance and are lacking any significant vegetation cover and/or local wildlife potential and therefore are of **negligible value.**

**Plate 6.4 Spoil and bare ground (ED2) within the permitted borrow pit area.**

#### 6.3.3.10 Other artificial lakes and ponds (FL8)

A number of artificial water bodies are present within the application site including the;

- Storm water Pond (SWP);
- Liquid Waste Pond (LWP) and
- Perimeter Interceptor Channel (PIC).

The BRDA is surrounded by composite lined Perimeter Interceptor Channels (PIC) which are formed by constructing the Inner Perimeter Wall (IPW) and the Outer Perimeter Wall (OPW). The Perimeter Interceptor Channel (PIC) collects water emerging from the BRDA (seepage, bleed water, sprinkler water and surface water runoff) and conveys it via pumps either to the Effluent Clarification System (ECS) located in the plant and/or to the Storm Water Pond (SWP). The SWP is located in the north-east sector of the BRDA and its function is two-fold:

- To provide surge capacity for surface water that cannot be immediately processed by the ECS; and
- To provide a continuous flow of water that is used for dilution or wash water within some parts of the alumina plant.

Excess water from the SWP is pumped to the ECS via pumps. The Liquid Waste Pond (LWP) is located adjacent to the SWP and receives treated water from the ECS and conditions this water (cooling and settlement) prior to discharging to one of the following:

- Controlled discharge into the River Shannon;

- Onto the surfaces of the BRDA by sprinkling during dry and windy weather, typically periodically during April to September; and/or
- Directly into the SWP in order to maintain water inventory targets, typically in summer months.

The artificial lakes and ponds (FL8) are considered highly modified habitats, lacking any significant vegetation cover and/or local wildlife potential and therefore are of **negligible value.**

#### 6.3.3.11 Refuse and other waste (ED5)

The bauxite residue and salt cake deposition area are classified as Refuse and other Waste (ED5) with certain characteristics of Spoil and Bare ground (ED2).

The Refuse and other waste (ED5) habitat is considered a highly modified habitat lacking any significant vegetation cover and/or local wildlife potential and therefore is evaluated as having **negligible value.** Part of this area classified as "refuse and other waste" (ED5) lies within part of the mapping area of the Inner Shannon Estuary – South Shore pNHA. However, that had been considered by An Bord Pleanála when An Bord Pleanála considered and granted the application to extend the BRDA in 2006/2007 when the area was of a habitat type other than ED5 and which had, at that time, a higher ecological value and that permission has been subsequently implemented and now forms the site the subject matter of this application. In those circumstances it is appropriate to attribute the characteristics of habitat ED5 to that part of the proposed development located within the existing BRDA and the biodiversity assessment has been carried out on that basis.

### 6.3.4 Bird Survey results

#### 6.3.4.1 Desktop Study - Birds

A detailed desktop review of the relevant data available for the study area was undertaken. The National Parks and Wildlife Service (NPWS) and National Biodiversity Data Centre (NBDC) online databases were consulted to identify any rare or protected species located within the relevant national 2km Grid Squares (R25R, R25W, R25Q and R25V) encompassing the proposed application site and containing the Bauxite Residue Disposal Area (BDRA), Borrow Pit and Stockpile Area. In addition, field data collected from the wider area as part of other ecological assessments and monitoring were reviewed.

Table 6.4 summarises the bird species that have been recorded historically in the two hectads that overlap the proposed development site (NBDC; www.biodiversityireland.ie). As would be expected the diversity of species recorded in these hectads, which include both terrestrial and aquatic habitats, is relatively high. Many of these species are specialist waterbirds which would be unlikely to be recorded from the terrestrial habitats present within or directly adjacent to the application boundary. Table 6.4 also shows the current Birds of Conservation Concern in Ireland (BoCCI) status of each of the species historically recorded in these hectads, according to Gilbert *et al*. (2021). Of the 96 bird species shown in Table 6.4, 19 are currently Red-listed (of high conservation concern), of which nine species are wading bird species primarily associated with coastal and aquatic habitats: Bar-tailed Godwit, *Limosa lapponica*, Black-tailed Godwit, *Limosa limosa*, Curlew, *Numenius arquata*, Dunlin, *Calidris alpina*, Golden Plover, *Pluvialis apricaria*, Knot, *Calidris canutus*, Lapwing, *Vanellus vanellus*, Oystercatcher, *Haematopus ostralegus* and Redshank, *Tringa totanus*. Two further of these species are duck species, Scaup *Aythya marila* and Shoveler, *Anas clypeata*.

The proposed development is located within the industrial facility. The surrounding areas of the site are dominated by grassland and scrub. Much of this grassland is unmanaged and rank with relatively low attractiveness for roosting, breeding and ground foraging birds. The scrub and treelines present in the area are of greater importance for terrestrial species with a relatively high diversity of birds likely to be recorded in these areas, throughout the year.

The bare ground habitats present on site (including the BRDA) greatly reduce the foraging and nesting potential of the site for most bird species. There is a level of ongoing human and vehicular activity in the application site and adjoining areas associated with the operation of the industrial facility.

**Table 6.4 Bird species recorded in the tetrads overlapping the proposed development site.**

| Common Name | Scientific Name |
|---|---|
| American Golden Plover | *Pluvialis sdominica* |
| Barn Owl* | *Tyto alba* |
| Bar-tailed Godwit* | *Limosa lapponica* |
| Black Redstart | *Phoenicurus ochruros* |
| Blackbird | *Turdus merula* |
| Blackcap | *Sylvia atricapilla* |
| Black-headed Gull^ | *Chroicocephalus ridibundus* |
| Black-tailed Godwit * | *Limosa limosa* |
| Blue Tit | *Cyanistes caeruleus* |

| Common Name | Scientific Name |
|---|---|
| Bullfinch | *Pyrrhula pyrrhula* |
| Chaffinch | *Fringilla coelebs* |
| Chiffchaff | *Phylloscopus collybita* |
| Coal Tit | *Periparus ater* |
| Collared Dove | *Streptopelia decaocto* |
| Common Gull^ | *Larus canus* |
| Common Tern^ | *Sterna hirundo* |
| Common/Lesser Redpoll | *Carduelis flammea (cabaret)* |
| Coot^ | *Fulica atra* |
| Cormorant^ | *Phalacrocorax carbo* |
| Cuckoo | *Cuculus canorus* |
| Curlew* | *Numenius arquata* |
| Dipper | *Cinclus cinclus* |
| Dunlin* | *Calidris alpina* |
| Dunnock | *Prunella modularis* |
| Fieldfare | *Turdus pilaris* |
| Gadwall^ | *Ana strepera* |
| Goldcrest^ | *Regulus regulus* |
| Golden Plover* | *Pluvialis apricaria* |
| Goldfinch | *Carduelis carduelis* |
| Great Black-backed Gull | *Larus marinus* |
| Great Crested Grebe^ | *Podiceps cristatus* |
| Great Tit | *Parus major* |
| Greenfinch^ | *Carduelis chloris* |
| Greenshank | *Tringa nebularia* |
| Green Sandpiper | *Tringa ochropus* |
| Grey Heron | *Ardea cinerea* |
| Grey Plover^ | *Pluvialis squatarola* |
| Grey Wagtail* | *Motacilla cinerea* |
| Herring Gull^ | *Larus argentatus* |
| Hooded Crow | *Corvus cornix* |
| House Martin^ | *Delichon urbicum* |
| House Sparrow^ | *Passer domesticus* |
| Jackdaw | *Corvus monedula* |
| Kestrel* | *Falco tinnunculus* |
| Kingfisher^ | *Alcedo atthis* |
| Knot* | *Calidris canutus* |
| Lapwing* | *Vanellus vanellus* |
| Lesser Black-backed Gull^ | *Larus fuscus* |

| Common Name | Scientific Name |
|---|---|
| Linnet^ | *Carduelis cannabina* |
| Little Egret | *Egretta garzetta* |
| Little Grebe | *Tachybaptus ruficollis* |
| Long-tailed Tit | *Aegithalos caudatus* |
| Magpie | *Pica pica* |
| Mallard^ | *Anas platyrhynchos* |
| Meadow Pipit* | *Anthus pratensis* |
| Mistle Thrush | *Turdus viscivorus* |
| Moorhen | *Gallinula chloropus* |
| Mute Swan^ | *Cygnus olor* |
| Oystercatcher* | *Haematopus ostralegus* |
| Peregrine Falcon | *Falco peregrinus* |
| Pheasant | *Phasianus colchicus* |
| Pied Wagtail | *Motacilla alba* |
| Raven | *Corvus corax* |
| Redshank* | *Tringa totanus* |
| Redwing* | *Turdus iliacus* |
| Reed Bunting | *Emberiza schoeniclus* |
| Ringed Plover | *Charadrius hiaticula* |
| Robin | *Erithacus rubecula* |
| Rock Dove | *Columba livia* |
| Rock Pipit | *Anthus petrosus* |
| Rook | *Corvus frugilegus* |
| Ruff^ | *Philomachus pugnax* |
| Sand Martin^ | *Riparia riparia* |
| Scaup* | *Aythya marila* |
| Sedge Warbler | *Acrocephalus schoenobaenus* |
| Shelduck^ | *Tadorna tadorna* |
| Shoveler* | *Anas clypeata* |
| Skylark^ | *Alauda arvensis* |
| Snipe* | *Gallinago gallinago* |
| Song Thrush | *Turdus philomelos* |
| Sparrowhawk | *Accipiter nisus* |
| Starling^ | *Sturnus vulgaris* |
| Stock Dove* | *Columba oenas* |
| Stonechat | *Saxicola torquata* |
| Swallow^ | *Hirundo rustica* |
| Swallow^ | *Hirundo rustica* |
| Teal^ | *Anas crecca* |

| Common Name | Scientific Name |
|---|---|
| Turnstone^ | *Arenaria interpres* |
| Twite* | *Carduelis flavirostris* |
| Water Rail | *Rallus aquaticus* |
| Whitethroat | *Sylvia communis* |
| Whooper Swan^ | *Cygnus cygnus* |
| Wigeon^ | *Anas penelope* |
| Willow Warbler | *Phylloscopus trochilus* |
| Woodpigeon | *Columba palumbus* |
| Wren | *Troglodytes troglodytes* |

* Red-listed species; ^ Amber-listed species (Gilbert *et al*. 2021).

The estuary to the east of the proposed borrow pit extension is known as Poulaweala Creek and is known to be an important area for a range of wintering waterbirds. The estuary and associated terrestrial habitats on the eastern side of Poulaweala Creek are important for roosting Lapwing, Teal and Black-tailed Godwit. At Low Water the Poulaweala Creek area is important for foraging Shelduck, *Tadorna tadorna*, Wigeon, Black-tailed Godwit, Curlew and Redshank (www.npws.ie).

Ecology Ireland has previously carried out bird surveys elsewhere across AAL lands including waterbird surveys of Poulaweala Creek, Mangan's Lough and the adjoining areas of the Shannon Estuary (2012-present). This has involved carrying out repeated surveys of an area of wetland several hundred metres northwest of the proposed development and areas within Poulaweala Creek to the east of the proposed borrow pit site.

A variety of waterbirds have been recorded utilising these wetland areas. Teal, *Anas crecca* and Wigeon, *Anas penelope* are frequently present at Mangan's Lough during the winter months and several pairs of Mallard, *Anas platyrhynchos* are present throughout the year. A pair of Mute Swans, *Cygnus olor*, typically breed and winter at Mangan's Lough. Moorhen, *Gallinula chloropus* are also regularly observed in the area and several Cormorants, *Phalocrocorax carbo*, have been recorded on the lough on occasion (G. Fennessy pers obs). Other species of duck are occasional visitors to Mangan's Lough, including Scaup, *Aythya marila* and small numbers of Whooper Swan, *Cygnus cygnus*, have been recorded at the site in past winters (Seán Dundon pers comm.). Snipe were heard 'chipping' from the reedbed during a site visit on March 5th, 2015. Grey Heron, *Ardea cinerea* was observed roosting and foraging in this area on several of the site visits in 2020.

The diversity of waterbirds recorded in nearby estuarine and aquatic habitats is unsurprising given the proximity of Aughinish Island to the River Shannon and River Fergus Estuaries SPA. These together form the largest estuarine complex in Ireland and the SPA is considered to be the most important coastal wetland site in the country. The SPA spans three counties, Clare (north shore), Limerick and Kerry (southern shoreline). Historically, this SPA site has supported over 50,000 waterfowl during the winter months, including nationally important populations of Light-bellied Brent Goose, *Branta bernicla hrota*, Dunlin, Black-tailed godwit and Redshank.

The special conservation interests of The River Shannon and River Fergus Estuaries SPA are; Whooper Swan, Light-bellied Brent Goose, Shelduck, Wigeon, Teal, Pintail *Anas acuta*, Shoveler *Anas clypeata*, Scaup, Ringed Plover *Charadrius hiaticula*, Golden Plover, Grey Plover

*Pluvialis squatarola*, Lapwing, Knot, Dunlin, Black-tailed Godwit, Bar-tailed Godwit, Curlew, Redshank, Greenshank *Tringa nebularia*, Black-headed Gull *Chroicocephalus ridibundus*, Cormorant and Wetland and Waterbirds.

The River Shannon and River Fergus Estuaries SPA holds internationally important populations of four species, i.e. Light-bellied Brent Goose, Dunlin, Black-tailed Godwit and Redshank. In addition, there are 17 species that have wintering populations of national importance. The site also supports a nationally important breeding population of Cormorant. Of particular note is that three of the wintering bird species which occur regularly in the SPA are listed on Annex I of the E.U. Birds Directive, i.e. Whooper Swan, Golden Plover and Bar-tailed Godwit. Parts of the River Shannon and River Fergus Estuaries SPA are also designated as Wildfowl Sanctuaries.

The AAL facility is located in the townlands of Aughinish East, Aughinish West, Island Mac Teige, Glenbane West, and Fawnamore at or adjacent to Aughinish Island, Askeaton, Co. Limerick. The adjoining areas of SPA constitute a small percentage of the River Shannon and River Fergus Estuaries SPA. Regular counts of this SPA are limited due to the size of the area and the effort required to undertake coordinated counts. Some areas are also inaccessible and survey accuracy and frequency is a recognised issue (BirdWatch Ireland). Data from the NPWS and BirdWatch Ireland were consulted, on the available subsite counts from areas of the SPA proximate to Aughinish Island.

BirdWatch Ireland's "Review and Assessment of Waterbird Data from the Shannon-Fergus Estuary (2016)" states that the area located at Aughinish incorporates the surrounding lands including the lagoon of Mangan's Lough. This site overlaps to a small extent with Irish Wetland Bird Survey (I-WeBS) subsite 0I479 (Aughinish West) and the corresponding NPWS subsite 0I438 (Aughinish Island), as well as the neighbouring I-WeBS subsite 0I478 (Poulaweala - Courtbrown) and its constituent NPWS subsites 0I436 (Poulaweala Creek) and 0I437 (Aughinish East). In addition, a separate I-WeBS subsite exists for Mangan's Lough (0I011), which is within the boundaries of 0I479.

Table 6.5 summarises the waterbird survey data compiled for Poulaweala Creek, Aughinish East, Aughinish Island and Robertstown River from BirdWatch Ireland's review of waterbird data from the Shannon-Fergus Estuary (2016). Table 6.6. highlights the species for which the subsite is ranked highest for foraging and roosting relative to other subsites within the estuarine complex.

**Table 6.5 Results obtained from BWI 2016 study on waterbird data from the Shannon-Fergus Estuary in count areas proximate to Aughinish Island.**

| Area | Species | Number Present |
|---|---|---|
| Poulaweala Creek, Aughinish East, Aughinish Island and Roberstown River | **Bar Tailed Godwit (BA)** | 71 |
| | **Black Headed Gull (BH)** | 476 |
| | **Black Tailed Godwit (BW)** | 1069 (of international importance) |
| | **Cormorant (CA)** | 26 |
| | Common Gull (CM) | 52 |
| | Coot (CO) | 8 |
| | **Curlew (CU)** | 239 |
| | **Dunlin (DN)** | 368 |
| | Little Egret (ET) | 16 |
| | Gadwall (GA) | 22 |
| | Great Black Backed Gull (GB) | 33 |
| | Great Crested Grebe (GG) | 7 |
| | **Greenshank (GK)** | 37 of national importance |
| | **Golden Plover (GP)** | 320 |
| | **Grey Plover (GV)** | 96 |
| | Grey Heron (H.) | 18 |
| | Herring Gull (HG) | 7 |
| | **Knot (KN)** | 3 |
| | **Lapwing (L.)** | 2726 of national importance |
| | Lesser Black Backed Gull (LB) | 1 |
| | Little Grebe (LG) | 5 |
| | Mallard (MA) | 168 |
| | Moorhen (MH) | 11 |
| | Mute Swan (MS) | 7 |
| | Mediterranean Gull (MU) | 3 |
| | Oystercatcher (OC) | 64 |
| | **Redshank (RK)** | 246 |
| | Ringed Plover (RP) | 8 |
| | **Shelduck (SU)** | 74 |
| | **Shoveler (SV)** | 13 |
| | **Teal (T.)** | 348 |
| | Turnstone (TT) | 5 |
| | Water Rail (WA) | 1 |
| | **Wigeon (WN)** | 253 |
| | Whooper Swan (WS) | 1 |
| Mangans Lough | **Black Headed Gull (BH)** | 3 |
| | Coot (CO) | 16 |
| | **Curlew (CU)** | 3 |
| | Gadwall (GA) | 6 |
| | Grey Heron (H.) | 3 |
| | Little Grebe (LG) | 5 |
| | Mallard (MA) | 120 |
| | Moorhen (MH) | 3 |

| Area | Species | Number Present |
|---|---|---|
| | Mute Swan (MS) | 11 |
| | **Redshank (RK)** | 13 |
| | Snipe (SN) | 3 |
| | **Shelduck (SU)** | 8 |
| | **Shoveler (SV)** | 45 of national importance |
| | **Teal (T.)** | 89 |
| | **Wigeon (WN)** | 128 |

**Species in bold represent Species of Conservation Interest (SCIs) of the River Shannon and River Fergus Estuaries SPA.*

**Table 6.6 Results obtained from BWI 2016 study on waterbird data from the Shannon-Fergus Estuary in corresponding areas to the study site.**

| **Poulaweala Creek, Aughinish East, Aughinish Island and Roberstown River** | |
|---|---|
| Species for which the subsite ranked very high for intertidal foraging | Black Tailed Godwit, Greenshank, Grey Plover, Wigeon |
| Species for which the subsite ranked high – intertidal foraging | Bar Tailed Godwit, Black Headed Gull, Black Tailed Godwit, Curlew, Dunlin, Greenshank, Lapwing, Redshank, Shelduck, Teal, Whooper Swan |
| Species for which the subsite ranked very high – subtidal foraging | Cormorant |
| Species for which the subsite ranked high – subtidal foraging | Cormorant |
| Species for which subsite peak ranked very high – roosting | Black Tailed Godwit, Lapwing, Teal |
| Species for which subsite peak ranked high – roosting | Black Headed Gull, Black Tailed Godwit, Lapwing, Redshank |

Poulaweala Creek, Aughinish East, Aughinish Island and Roberstown River subsites supported 35 species, 18 of which were SCI species. Numbers of Black Tailed Godwits in this area exceeded the threshold for international importance and peak numbers of Lapwing and Greenshank exceeded the threshold of all-Ireland importance. High numbers of Cormorant, Curlew, Dunlin, Little Egret, Grey Heron, Mallard, Redshank, Shelduck, Teal and Wigeon were all noted, highlighting the importance of this part of the estuarine complex for a number of the wintering waterbird species.

The area of the Robertstown River was surveyed in 2015 and 2016 and a peak number of 1,776 waterbirds were counted using the intertidal area around the mouth of the Shannon River up to the N69 road. In all, 15 species were recorded, 11 of these being SCI species. Numbers of Curlew exceeding the threshold of the all-Ireland importance were recorded in this part of the intertidal area, along with good numbers of Black Tailed Godwit and Lapwing.

Aughinish Island (West) subsite (OI479 IweBS, corresponds to OI438 Aughinish Island) includes areas of subtidal and intertidal habitat. Thirty-four species have been historically recorded in this area during I-WeBS counts. Of the 18 SCI species present, peak numbers above the all-Ireland threshold have been recorded for Dunlin, Golden Plover, Grey Plover, Knot, Ringed Plover and Shoveler, as well as high numbers of Black-headed Gull, Curlew, Lapwing and Teal.

Surveys carried out in recent years around the River Shannon and River Fergus Estuaries SPA have shown that, for many species, there have been substantial declines in usage by waterbirds (NPWS, 2012). Count accuracy and consistency across a site as large and complex as the River Shannon and River Fergus Estuaries SPA is difficult to maintain. Recent I-WeBS coverage has suffered from a lack of surveying resources (Brian Burke pers comm.). Aerial surveys are used to record bird numbers across the site although it is accepted that aerial counts are not always comparable to data collected from ground vantage points.

The habitats present within the application site boundary are unsuitable for foraging waterbirds and as will be shown in Section 6.3.4.2.

#### 6.3.4.2 Existing Environment – Bird Survey Results

Due to the close proximity of the application site to the River Shannon it was important to ascertain if there was any usage of the proposed development site and adjoining lands by birds, particularly those listed as special conservation interests (SCIs) of the nearby River Shannon and River Fergus Estuaries SPA.

Figure 6.3 shows the location of survey transects and point counts used to assess the summer and winter bird communities on lands within and adjoining the application site. A total of 75 bird species were recorded during the winter and breeding season surveys (2019-2020). The species recorded in Table 6.7 reflect the range of habitats present in the area with species typical of woodland, farmland and coastal habitats well represented. The BoCCI status of all of the bird species recorded is also highlighted.

**Table 6.7 Summary of birds recorded on the summer and winter transects and point counts in 2019-2020.**

| Species | Scientific Name | Summer Surveys | Winter Surveys |
|---|---|---|---|
| Blackbird | *Turdus merula* | x | x |
| Blackcap | *Sylvia atriacapilla* | x | |
| Black-headed Gull^ | *Chroicocephalus ridibundus* | x | x |
| Blue Tit | *Cyanistes caeruleus* | x | x |
| Bullfinch | *Pyrrhula pyrrhula* | x | x |
| Buzzard | *Buteo buteo* | x | x |
| Chaffinch | *Fringilla coelebs* | x | x |
| Chiffchaff | *Phylloscopus collybita* | x | |
| Coal Tit | *Periparus ater* | x | x |
| Collared Dove | *Streptopelia decaocto* | x | x |
| Common Gull^ | *Larus canus* | x | |
| Cormorant^ | *Phalocrocorax carbo* | x | x |
| Crossbill | *Loxia curvirostra* | x | x |
| Cuckoo | *Cuculus canorus* | x | |
| Curlew* | *Numenius arquata* | | x |
| Dunnock | *Prunella modularis* | x | x |
| Fieldfare | *Turdus pilaris* | | x |
| Goldcrest^ | *Regulus regulus* | x | x |
| Golden Plover*~ | *Pluvialis apricaria* | | x |

| Species | Scientific Name | Summer Surveys | Winter Surveys |
|---|---|---|---|
| Goldfinch | *Carduelis carduelis* | x | x |
| Grasshopper Warbler | *Locustella naevia* | x | |
| Great Black-backed Gull | *Larus marinus* | | x |
| Great Tit | *Parus major* | x | x |
| Greenfinch^ | *Carduelis chloris* | x | |
| Grey Heron | *Ardea cinerea* | x | x |
| Grey Wagtail* | *Motacilla cinerea* | | x |
| Herring Gull^ | *Larus argentatus* | x | x |
| Hooded Crow | *Corvus cornix* | x | |
| House Martin^ | *Delichon urbica* | x | |
| House Sparrow^ | *Passer domesticus* | x | |
| Jackdaw | *Corvus monedula* | x | x |
| Jay | *Garrulus glandarius* | x | x |
| Kestrel* | *Falco tinnunculus* | x | x |
| Lesser Black-backed Gull^ | *Larus fuscus* | x | |
| Lesser Redpoll | *Acanthis cabaret* | x | x |
| Linnet^ | *Linaria cannabina* | x | x |
| Little Egret~ | *Egretta garzetta* | x | x |
| Long-tailed Tit | *Aegithalos caudatus* | x | x |
| Magpie | *Pica pica* | x | x |
| Mallard^ | *Anas platyrhynchos* | x | x |
| Meadow Pipit* | *Anthus pratensis* | x | x |
| Mistle Thrush | *Turdus viscivorus* | x | x |
| Moorhen | *Gallinula chloropus* | x | |
| Mute Swan^ | *Cygnus olor* | | x |
| Oystercatcher* | *Haematopus ostralegus* | x | x |
| Peregrine Falcon~ | *Falco peregrinus* | x | x |
| Pheasant | *Phasianus colchicus* | x | x |
| Pied Wagtail | *Motacilla alba* | x | x |
| Raven | *Corvus corax* | | x |
| Redshank* | *Tringa totanus* | | x |
| Redwing* | *Turdus iliacus* | | x |
| Reed Bunting | *Emberiza schoeniclus* | x | x |
| Robin | *Erithacus rubecula* | x | x |
| Rock Dove | *Columba l. livia* | | x |
| Rook | *Corvus frugilegus* | x | x |
| Sand Martin^ | *Riparia riparia* | x | |
| Sedge Warbler | *Acrocephalus schoenobaenus* | x | |
| Shelduck^ | *Tadorna tadorna* | | x |
| Siskin | *Carduelis spinus* | x | x |
| Skylark^ | *Alauda arvenis* | x | |
| Snipe* | *Gallinago gallinago* | x | x |
| Song Thrush | *Turdus philomelos* | x | x |

| Species | Scientific Name | Summer Surveys | Winter Surveys |
|---|---|---|---|
| Sparrowhawk | *Accipiter nisus* | x | x |
| Starling^ | *Sturnus vulgaris* | x | x |
| Stonechat | *Saxicola torquata* | x | x |
| Swallow^ | *Hirundo rustica* | x | |
| Swift* | *Apus apus* | x | |
| Teal^ | *Anas crecca* | | x |
| Treecreeper | *Certhia familiaris* | | x |
| Wheatear^ | *Oenanthe oenanthe* | x | |
| Whitethroat | *Sylvia communis* | x | |
| Willow Warbler^ | *Phylloscopus trochilus* | x | |
| Woodcock* | *Scolopax rusticola* | | x |
| Woodpigeon | *Columba palumbus* | x | x |
| Wren | *Troglodytes troglodytes* | x | x |

* Red-listed species; ^ Amber-listed species (Gilbert *et al*. 2021). ~ Annex I species (EU Bird's Directive).

Eleven of the 75 species recorded are currently Red-listed, or species of high conservation concern in Ireland (Gilbert *et al*. 2021). Most of these Red-listed species are waterbirds associated with the estuary and the majority of which are uncommon or entirely absent outside of the winter period e.g. Redshank. Appendix 6.2 presents the results of each season of the bird survey, with peak counts presented for each species recorded. A total of 62 bird species were recorded during the summer period with 56 species noted during the winter surveys.

The results of transect walkovers carried out as part of the permitted Nature Trail development (LCCC Reg. Ref. 20/1325) in winter 2019 and summer 2020 are presented in Table 6.8. The location of these transects is also shown in Figure 6.4. A total of 60 bird species were recorded during the winter and breeding season surveys on these transects. There is good agreement between the species recorded on these surveys with 59 of the 60 species recorded on the Nature Trail transects also recorded during the transect and point count surveys associated with the proposed development. One species, Lapwing (Red-listed) was recorded on the Nature Trail transects but not as part of the transects and point count surveys for the current development.

**Table 6.8 Transect survey results from the Nature Trail (NT) transects – see Figure 6.4. Recorded on transect 'x'. Only recorded in flight and/or beyond 100m from the survey transect 'P'.**

| Species | Scientific Name | Winter 2019/20 | | | | Breeding Season 2020 | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | T1 | T2 | T3 | T4 | T1 | T2 | T3 | T4 |
| Blackbird | *Turdus merula* | x | x | x | x | x | x | x | x |
| Blackcap | *Sylvia atriacapilla* | | | | | x | | x | |
| Black-headed Gull | *Chroicephalus ridibundus* | | | P | P | | P | | P |
| Blue Tit | *Cyanistes caeruleus* | x | | x | | x | | x | x |
| Bullfinch | *Pyrrhula pyrrhula* | | | x | x | | | x | |
| Buzzard | *Buteo buteo* | | P | | x | | | x | |
| Chaffinch | *Fringilla coelebs* | x | x | x | x | x | x | x | x |
| Chiffchaff | *Phylloscopus collybita* | | | | | x | x | x | |

| Species | Scientific Name | Winter 2019/20 | | | | Breeding Season 2020 | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | T1 | T2 | T3 | T4 | T1 | T2 | T3 | T4 |
| Coal Tit | *Periparus ater* | x | | x | x | x | | x | |
| Collared Dove | *Streptopelia decaocto* | | | x | | | | | |
| Common Gull | *Larus canus* | | P | | P | | | | |
| Cormorant | *Phalocrocorax carbo* | | | | P | | | | P |
| Curlew | *Numenius arquata* | | P | | P | | | | P |
| Dunnock | *Prunella modularis* | P | x | | x | | x | | x |
| Fieldfare | *Turdus pilaris* | P | x | x | | | | | |
| Goldcrest | *Regulus regulus* | | | x | | | | | |
| Goldfinch | *Carduelis carduelis* | x | | x | | x | x | x | |
| Great Tit | *Parus major* | | x | | x | x | x | | |
| Greenfinch | *Carduelis chloris* | | | | x | | | | |
| Grey Heron | *Ardea cinerea* | | | x | P | | | | P |
| Herring Gull | *Larus argentatus* | | P | | | | | | x |
| Hooded Crow | *Corvus cornix* | x | x | x | x | x | x | x | x |
| House Martin | *Delichon urbica* | | | | | | x | | |
| Jackdaw | *Corvus monedula* | x | x | | | x | x | | x |
| Jay | *Garrulus glandarius* | | | x | | | | | |
| Kestrel | *Falco tinnunculus* | | | x | | | | | |
| Lapwing | *Vanellus vanellus* | | | | P | | | | |
| Lesser Black-backed Gull | *Larus fuscus* | | | | | | | | P |
| Lesser Redpoll | *Acanthis cabaret* | x | x | x | | x | | | |
| Little Egret | *Egretta garzetta* | | | | x | | | | P |
| Long-tailed Tit | *Aegithalos caudatus* | x | | x | | | x | | |
| Magpie | *Pica pica* | x | x | x | x | x | x | x | x |
| Mallard | *Anas platyrhynchos* | | P | | P | | | | x |
| Meadow Pipit | *Anthus pratensis* | | | | x | | | | x |
| Moorhen | *Gallinula chloropus* | | | | | | | | P |
| Mute Swan | *Cygnus olor* | | | | P | | | | |
| Oystercatcher | *Haematopus ostralegus* | | | | P | | | | |
| Peregrine Falcon | *Falco peregrinus* | | | | | | | | x |
| Pheasant | *Phasianus colchicus* | x | x | | | x | | | |
| Pied Wagtail | *Motacilla alba* | | | | x | | | | |
| Raven | *Corvus corax* | | | P | | | | | |
| Redshank | *Tringa totanus* | | P | | P | | | | |
| Redwing | *Turdus iliacus* | x | x | x | | | | | |
| Reed Bunting | *Emberiza schoeniclus* | | | | x | | | x | x |
| Robin | *Erithacus rubecula* | x | x | x | x | x | x | x | x |
| Rook | *Corvus frugilegus* | x | x | x | | x | x | x | x |
| Sedge Warbler | *Acrocephalus schoenobaenus* | | | | | | | | P |
| Shelduck | *Tadorna tadorna* | | | | P | | | | |

| Species | Scientific Name | Winter 2019/20 | | | | Breeding Season 2020 | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | T1 | T2 | T3 | T4 | T1 | T2 | T3 | T4 |
| Siskin | *Carduelis spinus* | | | x | | | | | |
| Snipe | *Gallinago gallinago* | | x | | | | | | |
| Song Thrush | *Turdus philomelos* | P | x | x | | x | | x | |
| Starling | *Sturnus vulgaris* | x | | | x | | x | | x |
| Stonechat | *Saxicola torquata* | | | | | | | | x |
| Swallow | *Hirundo rustica* | | | | | x | x | x | x |
| Wheatear | *Oenanthe oenanthe* | | | | | | | x | |
| Whitethroat | *Sylvia communis* | | | | | | x | | |
| Wigeon | *Anas penelope* | | | | P | | | | |
| Willow Warbler | *Phylloscopus trochilus* | | | | | x | x | x | x |
| Woodpigeon | *Columba palumbus* | x | x | x | x | x | x | x | x |
| Wren | *Troglodytes troglodytes* | x | x | x | x | x | x | x | x |

* Red-listed species; ^ Amber-listed species (Gilbert *et al*. 2021).

Between the surveys carried out for the current proposed development and the Nature Trail application a total of 8 of the 22 SCI bird species of the River Shannon and River Fergus Estuaries SPA were recorded. These birds were all recorded in flight and were not associated with any of the terrestrial habitats within the application site boundary. Several further waterbird species which are SCI species of this SPA have been recorded in dedicated waterbird surveys in Poulaweala Creek. The focus of the transect survey was primarily to record the bird species associated with areas close to each transect. Some wintering waterbirds that regularly occur in relatively large numbers (e.g. in Poulaweala Creek) were not recorded in areas proximate to survey transects.

Table 6.9 presents the 11 Red-listed and 19 Amber-listed bird species recorded during the current bird surveys (Gilbert *et al*. 2021). Four of the Red-listed species are wading bird species that were recorded in a single survey season. Curlew (2 seen in flight at Point Count 1, near the seawall north of the BRDA during the winter 2019/2020 surveys), Oystercatcher (single record of individual beyond 50m from PC1 during summer 2019), Golden Plover (flock seen >50m from PC5 during the winter surveys in 2019/2020) and Redshank (heard beyond 50m from PC1 during the winter 2020/2021). Four largely resident, terrestrial bird species recorded are also Red-listed: Grey Wagtail, *Motacilla cinerea*, Kestrel, *Falco tinnunculus*, Meadow Pipit, *Anthus pratensis* and Snipe, *Gallinago gallinago*. Grey Wagtail, Meadow Pipit and Kestrel have suffered declines in their breeding numbers in recent years. Snipe is Red-listed both as a breeding and as a wintering species. The other three Red-listed species recorded as part of the 2019-2020 bird surveys (Table 6.9) are primarily migrants, Redwing, *Turdus iliacus*, Swift, *Apus apus*, and Woodcock, *Scolopax rusticola*. Woodcock breed in Ireland in fairly small numbers but are relatively common during the winter as migrants. Redwing, is a relatively abundant winter migrant thrush species which has been Red-listed as a European species of global conservation concern (SPEC 1). Swift, a summer migrant from Africa, have seen significant declines in their breeding numbers in the past decade.

**Table 6.9 Birds of elevated conservation concern recorded during the transect and point count surveys at the site in 2019-2020.**

| Common Name | Scientific Name |
|---|---|
| Curlew* | *Numenius arquata* |
| Golden Plover*~ | *Pluvialis apricaria* |
| Grey Wagtail* | *Motacilla cinerea* |
| Kestrel* | *Falco tinnunculus* |
| Meadow Pipit* | *Anthus pratensis* |
| Oystercatcher* | *Haematopus ostralegus* |
| Redshank* | *Tringa totanus* |
| Redwing* | *Turdus iliacus* |
| Snipe* | *Gallinago gallinago* |
| Swift* | *Apus apus* |
| Woodcock* | *Scolopax rusticola* |
| Black-headed Gull^ | *Chroicocephalus ridibundus* |
| Common Gull^ | *Larus canus* |
| Cormorant^ | *Phalocrocorax carbo* |
| Goldcrest^ | *Regulus regulus* |
| Greenfinch^ | *Carduelis chloris* |
| Herring Gull^ | *Larus argentatus* |
| House Martin^ | *Delichon urbica* |
| House Sparrow^ | *Passer domesticus* |
| Lesser Black-backed Gull^ | *Larus fuscus* |
| Linnet^ | *Linaria cannabina* |
| Mallard^ | *Anas platyrhynchos* |
| Mute Swan^ | *Cygnus olor* |
| Sand Martin^ | *Riparia riparia* |
| Shelduck^ | *Tadorna tadorna* |
| Skylark^ | *Alauda arvenis* |
| Starling^ | *Sturnus vulgaris* |
| Swallow^ | *Hirundo rustica* |
| Wheatear^ | *Oenanthe oenanthe* |
| Willow Warbler^ | *Phylloscopus trochilus* |

* Red-listed ^ Amber-listed species (after Gilbert *et al*. 2021). ~ Annex I Bird species (EC Bird's Directive)

The trail cameras deployed at the site were primarily used to record mammal activity but any birds observed were also recorded. Table 6.10 presents the species that were captured on the trail cameras deployed at the site in 2019-2020. The trail cameras confirmed the presence of Barn Owl, Tyto alba and also recorded a Whimbrel on passage in May. Sample images from the trail camera record are provided in Appendix 6.3.

**Table 6.10 Bird species recorded on the trail cameras deployed at the site in 2019-2020. The total number of 'registrations' for each species for each of the 9 collection (Coll.) cycles is summarised.**

| Bird Species | Coll. 1 | Coll. 2 | Coll. 3 | Coll. 4 | Coll. 5 | Coll. 6 | Coll. 7 | Coll. 8 | Coll. 9 |
|---|---|---|---|---|---|---|---|---|---|
| Barn Owl | 0 | 1 | 11 | 6 | 4 | 1 | 0 | 1 | 0 |
| Blackbird | 46 | 14 | 42 | 30 | 0 | 5 | 49 | 1 | 30 |
| Buzzard | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| Chaffinch | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Chiffchaff/Willow Warbler | 1 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 |
| Dunnock | 1 | 0 | 3 | 1 | 11 | 0 | 2 | 1 | 0 |
| Goldfinch | 1 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Great Black-backed Gull | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 |
| Great Tit | 0 | 1 | 11 | 0 | 2 | 0 | 0 | 0 | 0 |
| Greenfinch | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Grey Heron | 7 | 0 | 4 | 4 | 0 | 0 | 0 | 0 | 0 |
| Herring Gull | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 |
| Hooded Crow | 81 | 15 | 33 | 33 | 18 | 0 | 4 | 10 | 0 |
| Kestrel | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 |
| Little Egret | 36 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Magpie | 14 | 3 | 8 | 10 | 3 | 15 | 4 | 2 | 0 |
| Mallard | 1 | 0 | 7 | 7 | 0 | 0 | 0 | 0 | 0 |
| Pheasant | 44 | 42 | 25 | 22 | 1 | 47 | 7 | 8 | 0 |
| Redwing | 0 | 27 | 0 | 0 | 0 | 0 | 0 | 0 | 9 |
| Robin | 21 | 0 | 23 | 0 | 0 | 9 | 27 | 5 | 9 |
| Shelduck | 0 | 0 | 9 | 0 | 0 | 0 | 0 | 0 | 0 |
| Song thrush | 18 | 0 | 22 | 4 | 0 | 1 | 21 | 2 | 14 |
| Stonechat | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Water Rail | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Whimbrel | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Woodpigeon | 19 | 22 | 5 | 0 | 0 | 3 | 0 | 1 | 1 |
| Wren | 1 | 0 | 5 | 0 | 0 | 0 | 3 | 3 | 1 |

An additional trail camera was deployed on site in September 2020 in collaboration with NPWS. This camera was positioned on a deer carcass left in situ to provide supplementary feeding for a recently released White-tailed Eagle, Haliaeetus albicilla (Red-listed). White-tailed Eagle is a species that is subject to a reintroduction programme with young birds released to augment the birds already established in the country as part of an earlier release programme. The White-tailed Eagle was present on the north of the island for a number of weeks, joined on occasion by another recently released bird. These individuals then moved onwards to other locations in the wider area. Plate 6.5 shows a trail camera image of the White-tailed Eagle from September 2020.

Additional bird species that have been recorded as casual records within or in the vicinity of the application site included Pintail, *Anas acuta* and Shoveler, *Anas clypeata* (on Mangan's Lough), Little Grebe and Kingfisher, *Alcedo atthis* (seen on Conway's Lough).


**Plate 6.5 A young White-Tailed Eagle and a Hooded Crow observed at the carcass placed by NPWS to provide supplementary feeding for the recently released individual.**

### 6.3.5 Mammal Survey Results

#### 6.3.5.1 Desktop Study - Mammals

A detailed desktop review of the relevant data available for the study area was undertaken. The National Parks and Wildlife Service (NPWS) and National Biodiversity Data Centre (NBDC) online databases were consulted to identify any rare or protected species located within the relevant national 2km Grid Squares (R25V & R25W) encompassing the BRDA, Borrow Pit and Stockpile Area. In addition, field data collected from the wider area as part of other ecological assessments and monitoring were reviewed.

Based on Landscape Model of suitability for bats Aughinish Island provides suitable habitat for a number of bat species (suitability index 36.5 to 58.6 (all bats)), in particular Brown Long-eared Bat, *Plecotus auritus* (suitability index 50-79), Leisler's Bat, *Nyctalus leisleri* (suitability index 47-71), Common Pipistrelle *Pipistrellus pipistrellus* (suitability index 31-348-72) and

Soprano Pipistrelle *Pipistrellus pygmaeus* (suitability index 46-64) and Daubenton's Bat, *Myotis daubentonii* (suitability index 39-59). The island provides some, albeit to a lesser extent, suitable habitat for Nauthusius's Pipistrelle, *Pipistrellus nathusii* (suitability index 16-29), Whiskered Bat, *Myotis mystacinus* (suitability index 21-31) and Natterer's Bat, *Myotis nattereri* (suitability index 27-36, with small sections in west of the island considered slightly more suitable 37-48). Overall habitat suitability for Lesser Horse-shoe Bat, *Rhinolophus hipposideros* is considered relatively low (suitability index (29 – 49).

Table 6.11 summarises the mammal species that have been recorded historically in the two hectads that overlap the proposed development site.

**Table 6.11 Mammal species recorded in the tetrad overlapping the proposed development site (R25W & R25V).**

| Common Name | Scientific Name |
|---|---|
| Brown Long-eared Bat | *Plecotus auritus* |
| Daubenton's Bat | *Myotis daubentonii* |
| Badger | *Meles meles* |
| Otter | *Lutra lutra* |
| Irish Stoat | *Mustela erminea subsp. hibernica* |
| Leisler's Bat | *Nyctalus leisleri* |
| Pipistrelle sp. | *Pipistrellus pipistrellus sensu lato* |
| Fox | *Vulpes vulpes* |
| Soprano Pipistrelle | *Pipistrellus pygmaeus* |

Previous surveys carried out by Ecology Ireland within the AAL lands e.g. for the permitted borrow pit application (LCCC Reg. Ref. 17/714; ABP-301011-18) and the permitted Nature Trail development (LCCC Reg. Ref. 20/1325) confirmed the presence of Badger, Fox, Brown Rat, Otter and Rabbit, *Oryctolagus cuniculus* locally. In addition, the deployment of passive bat detectors confirmed a relatively diverse range of bat species from the permitted Nature Trails and adjoining areas. A Pine Marten, *Martes martes* was recorded as roadkill between the site and Askeaton in October 2019.

#### 6.3.5.2 Non-volant Mammals - Field Survey Results

The mammal (non-volant) assessment was undertaken by regular deployment of trail cameras and recording of field sightings and signs during these regular site visits. Wildlife trail cameras were deployed for prolonged periods in and adjacent to the application boundary from August 2019 to February 2021 (Figure 6.4; Appendix 6.1).

No breeding or resting places of rare or protected mammal species were recorded within the proposed development site. Otter signs are widespread around the coastal margins of the site and Otters have been observed on occasion in Poulaweala Creek in recent years (Seán Dundon pers. comm). Two artificial holts constructed as part of the mitigation requirements associated with the development of BRDA Phase 2 have not been occupied by Otters in recent years. No holts were recorded locally as part of the walkover surveys in 2019-2020.

Additional monitoring of cameras was carried out at an artificial badger (*Meles meles*) sett located c. 120m from the application boundary. This sett was intensively monitored from

October 2019 – June 2021 showing signs of sporadic activity. There is no other active sett located with or closely adjacent to the application boundary.

The only mammal species directly observed during site walkovers was Fox, *Vulpes vulpes*, Rabbit and Irish Hare, *Lepus timidus hibernicus*.

A total of 11 mammal species (excluding livestock and domestic pets) were recorded on the wildlife cameras deployed at the site. Of these several had not previously been recorded in the 2km Grid Squares in which the proposed development site is located (including Red Squirrel, *Sciurus vulgaris* and Stoat, *Mustela erminea*). The most frequent and widespread of the non-volant mammals recorded during each period of trail camera deployment at the site was Fox, closely followed by Badger. The total number of registrations of each mammal species for each period of deployment is presented in Table 6.12.

The conservation status of mammals was assessed with reference to the following: the Irish Wildlife Acts (1976 - 2012); the Red List of Terrestrial Mammals (Marnell *et al*. 2009); the EU Habitats Directive. Two of the species recorded are protected species in Ireland, the Otter, *Lutra lutra* and the Badger, *Meles meles*. The conservation status of the mammal species recorded as part of the trail camera study is shown in Table 6.13. Sample trail camera images of Fox, Badger and Otter are shown in Plates 6.6-6.8. Further trail camera images are provided in Appendix 6.3.

Additional mammal species including Hedgehog, *Erinaceus europaeus* and Pygmy Shrew, *Sorex minutus* are known to occur locally (Seán Dundon pers comm).

**Table 6.12 Trail camera record – deployments 2019-2020.**

| Species | Collection 1 | Collection 2 | Collection 3 | Collection 4 | Collection 5 | Collection 6 | Collection 7 | Collection 8 | Collection 9 |
|---|---|---|---|---|---|---|---|---|---|
| Fox | 191 | 129 | 117 | 52 | 26 | 36 | 20 | 27 | 23 |
| Badger | 68 | 58 | 20 | 10 | 5 | 8 | 10 | 4 | 58 |
| Otter | 63 | 0 | 0 | 0 | 8 | 46 | 4 | 5 | 0 |
| Mink | 9 | 0 | 1 | 4 | 3 | 14 | 0 | 2 | 1 |
| Brown Rat | 4 | 1 | 7 | 3 | 9 | 30 | 21 | 3 | 7 |
| Dog | 1 | 0 | 0 | 6 | 0 | 0 | 0 | 3 | 0 |
| Bat species | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Wood Mouse | 0 | 12 | 10 | 0 | 0 | 15 | 11 | 21 | 12 |
| Cat | 0 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| Irish Hare | 0 | 0 | 2 | 3 | 0 | 1 | 3 | 0 | 0 |
| Red Squirrel | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| Stoat | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 |
| Shrew sp. | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |

**Table 6.13 Mammal species identified on the wildlife camera record 2019-2021.**

| Common Name | Scientific Name | Conservation Status |
|---|---|---|
| Badger | *Meles meles* | Protected species |
| Fox | *Vulpes vulpes* | Least Concern |
| Mink | *Mustela vison* | n/a |
| Irish Hare | *Lepus timidus* | Least Concern |
| Wood Mouse | *Apodemus sylvaticus* | Least Concern |
| Rat | *Rattus norvegicus* | n/a |
| Greater White-toothed Shrew | *Crocidura russula* | Invasive; n/a |
| Stoat | *Mustela erminea* | Least Concern |
| Otter | *Lutra lutra* | Protected species |
| Red Squirrel | *Sciurus vulgaris* | Least Concern |
| Pine Marten | *Martes martes* | Least Concern |

**Plate 6.6 Fox was the most frequent and widely recorded mammal species on the wildlife cameras with over 600 observations throughout the monitoring period.**


**Plate 6.7 Badger was the second most widely recorded mammal species on the wildlife cameras with over 200 observations throughout the monitoring period.**


**Plate 6.8 An Otter observed on a trail camera. Otters were recorded over 100 times throughout the monitoring period.**

### 6.3.5.3 Results of Bat Surveys

Analysis of recorded bat calls using Kaleidoscope Pro v4.5 and BatSound v 4.1 confirmed the presence of eight species of bat. The bat species confirmed to be present along with their current conservation status is shown in Table 6.14. The summary of the analysis from the 28 deployments is presented in Table 6.15 (see also Figure 6.5).

In total, 82,295 separate 'triggers' or bat registrations were analysed from the 28 deployments. Of these "triggers", Soprano Pipistrelle, *Pipistellus pygmaeus* (>4000) and Common Pipistrelle, *Pipistellus pipistrellus* (>3000) made up the most registrations. Both these species equated to 49% and 38% of the bat species recorded. There were 300 registrations of Lesser Horseshoe Bat*, Rhinolophus hipposideros* recorded, however this only made up 0.36% of the total registrations. Lesser Horseshoe Bat was previously recorded at the site as part of the surveys for the permitted Nature Trail development.

The scrub, field boundaries and grassy verge habitat within the proposed borrow pit extension area has some local value for foraging and commuting bats. Similarly, the woodland habitats within and adjoining the application site are attractive for a range of foraging bat species. The immature woodland and scrub habitats in the Rockfill and soil storage area are attractive for foraging and commuting bats and are close to the well vegetated old rail-line to the south of the application site. However, the bare-ground habitats that dominate within the application site are of much lower value for the local bat community. Areas within the BRDA site are likely to be used infrequently by foraging and commuting bats and there is currently very low roosting potential across the proposed development site. None of the activity recorded was suggestive of the presence of any significant local roost sites with no clear bimodal pattern of activity associated with local roost emergence and return.

**Table 6.14 Bat species identified on the passive bat detectors deployed on site between 2019-2021.**

| Common Name | Scientific Name | Conservation Status |
|---|---|---|
| Daubenton's Bat | *Myotis daubentonii* | Protected species |
| Natterer's Bat | *Myotis nattereri* | Protected species |
| Whiskered Bat | *Myotis mystacinus* | Protected species |
| Common Pipistrelle | *Pipistrellus pipistrellus* | Protected species |
| Soprano Pipistrelle | *Pipistrellus pygmaeus* | Protected species |
| Brown Long-eared Bat | *Plecotus auritus* | Protected species |
| Leisler's Bat | *Nyctalus leisleri* | Protected species |
| Lesser Horseshoe Bat | *Rhinolophus hipposideros* | Protected species |

**Table 6.15 Summary of the analysis of passive bat detectors deployed in the area from 2019-2021.**

| Species | BD1 | BD2 | BD3 | BD4 | BD5 | BD6 | BD7 | BD8 | BD9 | BD10 | BD11 | BD12 | BD13 | BD14 | BD15 | BD16 | BD17 | BD18 | BD19 | BD20 | BD21 | BD22 | BD23 | BD24 | BD25 | BD26 | BD27 | BD28 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daubenton's Bat | 1 | 7 | | 34 | | | | 57 | | 51 | 2 | 16 | | 21 | 3 | 6 | 8 | | 6 | | 33 | 40 | 7 | 7 | | 2 | 5 | 18 |
| Natterer's Bat | 2 | | | 26 | | | 1 | 2 | | 130 | | 36 | | 8 | 4 | | 3 | 1 | | | 20 | 33 | 2 | | | | | 12 |
| Whiskered Bat | | 3 | | | | | | | | 32 | 2 | 15 | | 4 | | | 8 | | 18 | | 4 | | | | | | | 1 |
| Myotis sp. | | | 1 | 3 | | | 3 | 3 | 2 | 4 | 3 | 5 | | 6 | 2 | | 6 | 2 | 4 | 2 | 2 | | | | | | | 5 |
| 40kHz/50kHz Pipistrelle | | | | 5 | | | | 6 | | 11 | 2 | 6 | 6 | 23 | 14 | | 10 | 27 | 2 | 5 | 39 | | | 49 | | | 3 | 1 |
| Common Pipistrelle | 12 | 3084 | 239 | 472 | 1043 | | 509 | 7997 | 388 | 1263 | 491 | 616 | 1809 | 3663 | 307 | 1789 | 83 | 1404 | 265 | 396 | 81 | 39 | 4 | 3287 | | 731 | 1684 | 8 |
| Soprano Pipistrelle | 9 | 1364 | 234 | 3572 | 291 | 582 | 2736 | 3680 | 280 | 361 | 619 | | 3015 | | 1670 | 4670 | 577 | 3331 | 1062 | 4144 | 44 | 485 | 135 | 1610 | | 3806 | 2409 | 31 |
| Brown Long-eared Bat | | | 3 | 93 | | | | 11 | | | 17 | 15 | | 10 | 4 | 5 | | | 2 | 3 | 4 | | | 6 | | | | |
| Leisler's Bat | 5 | 395 | 15 | 105 | 106 | | 100 | 420 | 83 | 48 | 46 | 759 | 542 | 312 | 16 | 35 | 88 | 896 | 944 | 2090 | 31 | 8 | | 1061 | 10 | 272 | 83 | 18 |
| Lesser Horseshoe Bat | | 5 | 55 | 13 | 5 | 6 | 11 | 5 | | 4 | 44 | | | 1 | 56 | 2 | 2 | | 3 | 13 | 45 | 7 | | 22 | | | | 1 |

### 6.3.6 Results of Other Taxa Surveys

There were several sightings of Common Frog, *Rana temporaria* recorded during the site walkovers and they are relatively common in the grassland habitats at the site. In addition, six species of butterfly were recorded as casual observations during the survey (Table 6.16).

**Table 6.16 Lepidoptera recorded during the site walkovers 2019/2020.**

| Species (Scientific Name) |
|---|
| Holly Blue (*Celastrina argiolus*) |
| Meadow Brown (*Maniola jurtina*) |
| Peacock (*Inachis io*) |
| Ringlet (*Aphantopus hyperantus*) |
| Small Tortoiseshell (*Aglais urticae*) |
| Speckled Wood (*Pararge aegeria*) |

A relatively wide diversity of invertebrates has been recorded in the tetrad in which the proposed works are located (R25V & R25W). Four species of bumblebee of elevated conservation concern have been recorded in these two tetrads: Large Red-tailed Bumblebee, *Bombus lapidarius* (Near Threatened), Moss Carder Bee, *Bombus muscorum* (Near Threatened), Shrill Carder Bee, *Bombus sylvarum* (Endangered) and Red-tailed Carder Bee, *Bombus (Thoracombus) ruderarius* (Vulnerable).

For tetrad R25W there are also records of several Lepidopteran species of elevated conservation importance including Wall, *Lasiommata megera*, Small Blue, *Cupido minimus* (Endangered), Grayling, *Hipparchia semele* (Near Threatened), Dingy Skipper, *Erynnis tages* (Near Threatened), Wood White, *Leptidea sinapsis* (Near Threatened) and Small Heath, *Coenonympha pamphilus* (Near Threatened).

Invertebrate records historically recorded from the island, particularly from Poulaweala are shown in Table 6.17.

The scrub and grassland habitats elsewhere on Aughinish Island provide suitable habitat for invertebrate taxa (e.g. Odonata and Lepidoptera). There are a small number of Butterfly bushes in recolonising bare ground at the site e.g. on the edges of the stage raises within the BRDA and it is likely that these attract some pollinating insects, including butterflies during the summer months. A relatively wide variety of dragonflies and damselflies has also been recorded historically on the island, including Banded Demoiselle, *Calopteryx splendens*, Emperor Dragonfly, *Anax imperator* and Brown Hawker, *Aeshna grandis* from around the manmade ponds (Seán Dundon pers comm.).

**Table 6.17 Additional historic records of invertebrate species recorded from Aughinish Island (Seán Dundon, pers comm.)**

| Species | Scientific Name |
|---|---|
| Speckled Wood | *Pararge aegeria* |
| Wall | *Lasiommata megera* |
| Orange-tip | *Anthocharis cardamines* |
| Peacock | *Aglais io* |
| Brimstone | *Gonepteryx rhamni* |
| Painted Lady | *Vanessa cardui* |
| Comma | *Polygonia c-album* |
| Meadow Brown | *Maniola jurtina* |
| Red Admiral | *Vanessa atalanta* |
| Common Blue | *Polyommatus icarus* |
| Small Blue | *Cupido minimus* |
| Dingy Skipper | *Erynnis tages* |
| Ringlet | *Aphantopus hyperantus* |
| Silver-washed Fritillary | *Argynnis paphia* |
| Gatekeeper | *Pyronia tithonus* |
| Green-veined White | *Pieris napi* |
| Small Copper | *Lycaena phlaeas* |
| Grayling | *Hipparchia semele* |
| Small Tortoiseshell | *Aglais urticae* |
| Narrow-bordered Bee Hawkmoth | *Hemaris tityus* |
| Hummingbird Hawkmoth | *Macroglossum stellatarum* |
| Emerald Moth | *Hemithea aestivaria* |
| Elephant Hawkmoth | *Deilephila elpenor* |
| Poplar Hawkmoth | *Laothoe populi* |

## 6.4 Potential Ecological Impacts

The BRDA surface is farmed bauxite residue (ED5/ED2) with no vegetative cover. The BRDA surface is of negligible ecological value. There is some landscaping on the stage raises of the BRDA but this planting is primarily designed to mimimise visual impacts and it affords limited cover or foraging opportunities for birds or mammals. The surface of the BRDA is large and open in nature with relatively high-levels of disturbance associated with movement of plant and personnel. Sightings of birds or mammals on the BRDA are rare (Seán Dundon pers comm; G. Fennessy pers obs.). Similarly, over the course of dozens of field visits from 2012 to present there were no observations of birds using the Storm Water Pond (SWP), Liquid Waste Pond (LWP) or Perimeter Interceptor Channel (PIC).

The proposed borrow pit extension will not require the clearance of any Annex I habitat. This area is dominated by Scrub (WS1) and Improved Agricultural Grassland (GA1). The rockfill and soil storage area is dominated by relatively low ecological value habitats, in particular Spoil and Bare ground (ED2). The other dominant habitats in this area are Scrub (WS1), Improved Agricultural Grassland/Dry Calcareous and Neutral Grassland (GA1/GS1) mosaic and some recently established immature woodland (WS2).

The following section presents an assessment of the potential impacts of the proposed development on fauna, flora and habitats at the proposed site and in the wider area.

### 6.4.1 Potential Impacts on Designated Conservation Sites

The site is not located within any Natura 2000 site but is located proximate to several designated conservation areas which are considered within the zone of influence of the proposed development (i.e. indirect hydrological impact and ex-situ disturbance impacts). Indirect impacts on designated conservation sites are considered further below. The planning application is accompanied by a Natura Impact Statement in support of the Appropriate Assessment process.

The NIS that accompanies the planning application includes a Conceptual Site Model (CSM; RSK 2021) to consider the potential source-pathway-receptor linkages between the proposed development site and the designated Natura 2000 sites in the wider area. The NIS considers in detail the potential for adverse impacts upon Natura 2000 sites: The Lower River Shannon SAC and the River Shannon and River Fergus Estuaries SPA, including the potential for indirect habitat loss or degradation and the potential for disturbance or displacement of qualifying/special conservation interests of these designated sites.

The proposed development will occur within a highly regulated area with licensed environmental protection systems already in place. The entire operation of the AAL facility was recently subject to EPA licence review, a process which included a requirement by the agency to prepare a Natura Impact Statement in relation to the ongoing operations of the plant, including the permitted borrow pit, and considering in detail all emissions to the receiving environment. This included the surface and groundwater discharges from the BRDA (and the permitted borrow pit). It also included all emissions including noise, vibration, light, dust etc. arising from the overall plant area. This process established that the licensed activities are not adversely impacting the integrity of any Natura 2000 site. In the issue of the IE licence (P0035-07; September 2021) the EPA state that it completed an Appropriate Assessment of potential impacts on Natura 2000 sites and *"has made certain, based on best scientific knowledge in the field and in accordance with the European Communities (Birds and Natural Habitats) Regulations 2011 as amended, pursuant to Article 6(3) of the Habitats Directive, that the activities, individually or in combination with other plans or projects, will not adversely affect the integrity of any European site….."*

The current proposed development will facilitate the extension of life for the production facility but does not involve changes in relation to the primary activities or production rate at the facility. The proposed extension to the permitted borrow pit is directly adjacent to the permitted borrow pit and will operate in accordance with the environmental commitments in place for the permitted borrow pit. The rockfill and soil storage area will continue to be used for storage of rock and soil material used in the operation of facility.

**Indirect habitat loss**

Indirect habitat loss or deterioration of designated sites within the surrounding area could potentially occur from the effects of run-off or discharge into the aquatic environment through impacts such as increased siltation, nutrient release and/or contamination. This requires connectivity between the proposed development site and the designated sites (a 'pathway') in question e.g. through watercourses and/or drainage. There are no watercourses within the proposed development site connecting with/discharging to nearby designated sites thereby minimising the risk of any indirect habitat loss through impacts such as increased siltation, nutrient release and/or contamination on designated sites through watercourses. The NIS which accompanies the planning application considers the potential for indirect impacts on habitats through all potential pathways for emissions.

The proposed development will be incorporated into the existing environmental management systems regarding the capture, treatment and discharge of surface water. The AAL facility has one licenced discharge point to the Shannon Estuary (W1-1) for treated industrial (process) effluent and treated sanitary effluent, located close to the marine terminal. AAL is required under their IE Licence (P0035-07) to control and monitor water emissions from the site. Schedule B, Section B.2 – Emissions to Water sets out the emission limit values for treated effluent to the Shannon Estuary. A maximum daily volume of 30,000 $m^3$ at a maximum hourly rate of 1,250 $m^3$ is permitted. Section C.2.2 – Monitoring of Emissions to Water requires AAL to monitor flow, temperature, pH, biochemical oxygen demand, suspended solids, TOC, total phosphorus, soda, aluminium, oils, fats & greases, toxicity, and heavy metals (Mg, Al, As, Cd, Cr, Cu, Fe, Hg, Ni, Pb, Zn and Ti).

The drainage system on the southern part of the site which contains the processing areas and the BRDA is directed to the wastewater treatment plant and discharges at W1-1. Sanitary effluent is treated by a dedicated activated sludge plant. This discharge from the sanitary treatment system joins with the treated process effluent flow and ultimately discharges also at licensed emission point W1-1. Surface water in the area of the BRDA is also monitored on a monthly basis for pH, conductivity and soda. Chapter 10 (Hydrology) of this EIAR describes the BRDA water management, during operation and as part of the closure phase.

The proposed development will involve the use of rock which will be sourced from the proposed borrow pit within the AAL facilty. The use of materials such as soil and rock can cause environmental issues such as siltation of watercourses. However, in this case offloading and handling of the soil and rockfill material will take place in an area where surface water is captured and treated prior to discharge by existing, proven systems.

No indirect habitat loss or habitat degradation on any designated site is likely to occur as a result of the proposed development.

## Disturbance to key species of Designated Sites

The BRDA and salt cake disposal cell are of negligible ecological value and no protected species occur in the immediate vicinity of the salt cake disposal cell with any regularity or in any significant numbers.

The proposed working hours for the operation of the borrow pit is between 08:00 and 18:00 hours on Monday to Friday (see Chapter 3, EIAR, Description of Project). No operations will take place on site on Weekends and Public Holidays. Blasting and rock crushing has previously occurred with in this general location at Aughinish Island predating the designation of the nearby intertidal areas as part of the SPA.

The proposed development will see little change in the scale or type of activity within the application site. The borrow pit is proposed to be extended but will operate in line with the commitments provided for the permitted borrow pit. Therefore, there will be no blasting in the winter months (October through March) and the number of blasts during the summer period will be limited to seven annually.

Activities associated with the proposed borrow pit development have the potential to disturb and/or displace key faunal species of the designated site The River Shannon & River Fergus Estuaries SPA and Lower River Shannon SAC (Otter only) through increased disturbance such as, noise and/or visual cues. Otter sightings or signs have tended to be restricted to the coastal areas of Aughinish Island. The trail camera locations where Otters were recorded as part of the current study is shown in Figure 6.11. This confirms the coastal nature of the species which occurs widely around the island. It is unlikely that Otters occur within or closely adjacent to the application site with any regularity. The activity at the proposed borrow pit extension will be restricted to daylight hours (no works permitted at night, or on Sundays and Bank Holidays) when Otters are much less likely to be present in the area. This further minimises the risk that any Otters would be disturbed or displaced through the operation of machinery and personnel in the area. There are no signs that the areas within or adjacent to the proposed borrow pit extension area are of importance for Otters and it is not expected that the proposed development will have any significant impact upon Otters in the wider area.

As part of the recent IE Licensing review for Aughinish Alumina Ltd. (Reg. No.: P0035-07) a Marine Mammal Risk Assessment was requested by the Environmental Protection Agency (EPA) with a letter (dated 6th May 2020), stating:

*'In view of the proximity of the activity to the Lower River Shannon SAC (Site Code 002165) and the potential for impact on the Shannon Estuary's Bottlenose Dolphin population, particularly due to noise and vibration as a result of blasting at the borrow pit, please submit a marine mammal risk assessment (MMRA), completed by a suitably qualified marine ecologist, evaluating the risk to marine mammals from the proposed activities.*

*The risk assessment should be completed in accordance with the approach outlined in Guidance to Manage Risk to Marine Mammals from Man-made Sound Sources in Irish Waters published in January 2014 by the Department of Heritage, Culture and the Gaeltacht (available at https://www.npws.ie/marine/best-practice-guidelines). The MMRA shall clearly outline any additional mitigation measures required to protect marine mammals, as necessary.'*

Ecology Ireland assisted by marine mammal specialist Dr. Daphne Roycroft prepared a MMRA which is included as Appendix 6.4 to this Chapter. This report concluded that given the terrestrial location of the borrow pit site and the fact that all blasting activities will take place on land and not in the underwater environment, that this project was not considered to pose any risk of death, injury or disturbance to any marine mammal individuals. Dr. Roycroft confirmed that the same conclusion applies to the proposed borrow pit extension (Daphne Roycroft pers comm.).

The River Shannon & River Fergus Estuaries SPA is designated for the protection of highly mobile bird species (e.g. e.g. wintering Golden Plover, Lapwing, Curlew and Breeding Cormorant). Habitat characteristics and location within the active plant, the proposed development does not and is unlikely to attract any significant numbers of foraging wintering bird species into the application site during the active life of the facility. The limiting of the blasting events to outside of the wintering period will effectively minimise the potential disturbance of the SCI species.

Overall, the short-to-medium term loss of small grassland and scrub dominated habitat at the site is unlikely to have any significant adverse impact on the key bird species of The River Shannon & River Fergus Estuaries SPA (i.e. the natural range of species is neither being reduced, nor is likely to be reduced for the foreseeable future and there is, and will probably continue to be, a sufficiently large habitat to maintain the species population on a long-term basis).

There is no suitable habitat for breeding Cormorant within the proposed development boundary. Due to the overall low level of wintering bird activity recorded within or adjacent to the terrestrial areas within the application site (during this and previous studies at the same site), the availability of more expansive and suitable habitat locally (e.g. intertidal mudflats of Shannon Estuary, Fergus Estuaries etc.) the proposed development site is considered of negligible importance to SPA qualifying species overall, and as such there is no potential for adverse impacts on the faunal species of the nearby designated sites as a result of loss of habitats at the proposed application site.

The low level of blasting, occurring over the April to September summer period is unlikely to have significant adverse impact on bird species of nearby designated sites overall. Extraction works will take place during the hours of daylight, minimising disturbances to roosting birds and mammals and birds active in the nocturnal/crepuscular period. Furthermore, species are likely to be already somewhat tolerant of ongoing noise from the overall AAL industrial facility and an overall suburban anthropogenic-influenced environment heading towards Foynes and Shannon-Foynes Port. For these reasons, there is no predicted significant impacts on key faunal species as a result of noise from blasting or extraction operations associated with the proposed development.

There will be some additional human activity/vehicular noise associated with the operation of the borrow pit which will lead to a slight increase in human activity/vehicular noise levels in the vicinity of the application site (see Chapter 12 Noise and Vibration). However, the BRDA is already a highly industrialised area with regular human disturbance, and any wildlife species occurring in the vicinity of the BRDA, Borrow Pit and rockfill and soil storage area are likely to be tolerant to or accustomed to anthropogenic disturbance.

All air emissions (i.e. dust) during the construction and operational phase of the proposed development will continue to be controlled/limited by existing infrastructure and systems (e.g. dust suppression sprinklers/bowsers) in place and as such there is no potential for significant adverse impacts on adjacent habitats as a result of emissions to air from the proposed development.

The side slopes of the BRDA will be subject to progressive restoration and landscaping and upon closure the final restoration will include capping and seeding of the dome of the BRDA and establishing a hedgerow pattern consistent with the surrounding landscape. The PIC at the base of the BRDA will be lined with soil and revegetated to form a wetland margin that will collect surface water runoff from the spillways. Water quality will be monitored for a prolonged period post-closure (see Chapter 10 of the EIAR). The landscaped fields of the restored BRDA will be subject to considerably less movement of vehicles and personnel and will be considerably more attractive for local fauna. Given the topography and distance from the estuary it is unlikely that the area will be used to any significant extent by Otters. However, it is considerably more likely that the fields will be attractive to birds, including some field feeding and roosting wading bird species (e.g. Oystercatcher) and Gulls. The hedgerows which will be planted on the capped BRDA (post closure) will provide cover for songbirds and small mammals and potential prey for raptor species including Barn Owl.


**Figure 6.11 Distribution of Otter registrations from the trail camera record** (background image from Bing Mapping c. 2013)**.**

### 6.4.2 Potential Impacts on Habitats and Flora

The BRDA (including the SCDC) consists mainly of 'Refuse and other waste' (ED5; Fossitt 2000) with elements of Spoil and Bare ground (ED2) and Buildings and Artificial Surfaces (BL3). These are habitats of negligible ecological value.

The habitats within the proposed borrow pit extension area that will be lost are dominated by Scrub (WS1) and Improved Agricultural Grassland (GA1). The scrub is of local (higher) value and the improved agricultural grassland of local (lower) value.

The habitats within the rockfill and soil storage area are characterised by anthopogenic disturbance and there are extensive areas of Spoil and Bare ground (ED2) as well as a mosaic of Improved Agricultural Grassland and Dry Calcareous and Neutral Grassland (GA1/GS1). The grassland is of local (lower value). There are areas of immature woodland (WS2) and scrub (WS1) of higher value in this area also. It is not intended to clear any of the planted areas within the existing stockpile storage area and therefore there is very limited potential for loss or degradation of habitats in this area. The storage of rockfill and soil will continue in the areas currently used for this purpose.

No Annex I habitats listed under the EU Habitats Directive are present within the proposed application boundary. No botanical species protected under the Flora (Protection) Order (1999), listed in the EU Habitats Directive (92/43/EEC), or listed in the Irish Red Data Books are present within the application site boundary. No Third Schedule Invasive Plant Species are present within the application site. The potential for indirect habitat loss or degradation associated with the development is considered in Section 6.4.1 above and in detail in the NIS which accompanies the planning application for this development.

There will be a localised loss of a small area of scrub and grassland habitat associated with the proposed development. Chapter 9 of the EIAR includes information of the progressive restoration of the BRDA and the ultimate closure plan which will create an extensive area of landscaped and managed grassland, with hedgerows.

The localised loss of vegetative cover, primarily associated with the development of the borrow pit extension area, will have a localised non-significant negative effect on the habitats present. In the longer term the progressive restoration and landscaping measures outlined in Chapter 9 of the EIAR will lead to a likely slight to moderate positive effect on the habitats present within the application site.

### 6.4.3 Potential Impacts on Non-Volant Mammals

The potential for impacts, arising in relation to the proposed development, upon non-volant mammals which are qualifying interests of nearby designated Natura 2000 sites (Otter and Bottlenose Dolphin) are considered in Section 6.4.1 above and in detail in the NIS which accompanies the planning application for this proposed development.

The habitats present within the BRDA are not attractive to non-volant mammals. There is a lack of vegetative cover and associated lack of foraging and resting opportunities in this area. No breeding or resting places of protected mammal species were recorded from within the application site. No mammal species were recorded within the BRDA during the surveys of this area (May 2019 & January 2020). Non-volant mammals (or their signs) have been recorded very infrequently within the BRDA (Seán Dundon pers comm.). It is highly unlikely that there will be any direct impacts on any protected mammal species, or their habitat as a result of the raises to the BRDA (including the SCDC).

The noise and visual disturbance associated with the movement and operation of the plant and machinery during the active phase of the proposed development will be similar to current levels. Mammals that occur in the vicinity of the proposed application site are likely to be habituated to the daily workings of the AAL facility. The BRDA is in almost complete darkness at night (G. Fennessy pers obs.) and it is proposed that the lighting regimen will not change in any significant fashion as a result of the proposed development.

Post closure there will be a predictable and marked reduction in activity at the site and an associated drop in the levels of potential noise and visual disturbance.

The proposed borrow pit extension will require the clearance of an area of scrub that may lead to the localised displacement or loss of species including small mammals such as Pygmy Shrew and Hedgehog. Similarly, there will be a loss of some grassland dominated habitats that provide some foraging opportunities for non-volant mammals. Any such losses are localised and relatively limited in extent. Similar habitats are well represented in the wider area.

Blasting has the potential to cause localised disturbance of non-volant mammals. An artificial badger sett is located approximately 120m south of the application boundary. This sett has been occupied and inactive at various times in recent years (G. Fennessy pers obs.). Badgers also have some associated setts in the wider area (>150m) and the status and usage of these systems varies significantly from year to year. The artificial sett is constructed of a series of pipes and chambers buried in soil and located within woodland. The mammal surveys (including trail camera deployments) did confirm some badger foraging within the fields that are at the southeast of the proposed borrow pit extension area. The development of the borrow pit will potentially decrease the foraging lands available close to the artificial sett. The blasting and associated activities at the borrow pit could potentially disturb or displace badgers from the immediate area, including at the artificial sett. However, the blasts will be infrequent and seasonally restricted and only occur during the daytime.

Activities associated with the operation of the borrow pit (e.g. crushing of stone) could also potentially result in some localised disturbance of non-volant mammals, including Badger. Any such impacts are likely to be highly localised and intermittent in nature. Given that the vegetative cover and over-burden will be removed from the borrow pit to facilitate the rock extraction it is likely that there will be very limited mammal occurrence in this immediate area during the extractive phase.

Chapter 9 (Landscape and Visual Impact) includes details of the progressive restoration and landscaping plan which will be implemented as part of the closure plan. The maturing planted features will in time create new foraging and resting opportunities and commuting routes for locally occurring mammals.

The nature of the impacts on the local non-volant mammals arising from the proposed development are considered to be imperceptible-non-significant negative and localised. In the longer-term the closure plan will lead to a likely slight positive impact on the local abundance and diversity of non-volant mammals.

### 6.4.4 Potential Impacts on Bats

There is no known bat roost within the application site and there are very limited roosting opportunities present for bats anywhere within the site boundary. However, a fairly diverse bat community has been recorded in the wider Aughinish Island area. The scrub, woodland, hedgerows and farmland, as well as areas of wetland present in the wider area, are all attractive for foraging bats.

There are no features within the BRDA that are attractive for use by roosting, foraging or commuting bats. Bats may occasionally forage or commute over the BRDA but this area clearly represents sub-optimal habitat for bats.

The proposed borrow pit extension will require the clearance of an area of scrub which is likely to marginally decrease the local foraging resource for bats. The area is relatively small and similar scrub habitat is well represented throughout the island. The use of the rockfill and soil stockpile area will not require any significant clearance of vegetation. The woodland and other cover around the grassland habitats present in this area are likely to be increasingly attractive for foraging bats, particularly as the woodland matures.

There will be no significant changes in the nature or extent of artificial illumination within the proposed development area. The other noise and visual disturbance associated with the existing and proposed activities are primarily confined to the diurnal period when bats are generally not active. It is likely that bats will continue to occur in the vicinity of the application site in similar fashion to that recorded by field surveys described in this Biodiversity Chapter.

It is unlikely that there will be any significant medium-term changes in how bats commute through or opportunistically forage in the vicinity of the application site. In the longer-term with the implementation of the post-closure landscaping plan, the hedgerows and other woody vegetation will provide improved foraging and commuting opportunities for locally occurring bats.

### 6.4.5 Potential Impacts on Birds

The potential for impacts upon the special conservation interests of the River Shannon and River Fergus Estuaries SPA arising from the proposed development are considered in Section 6.4.1 above and in detail in the NIS which accompanies the planning application for this development. These considerations include the overall impacts on the habitats that support the wide range of waterbird species that occur in this part of the Shannon Estuary.

The majority of the application site is of low value for birds. Resident and locally occurring birds are most likely habituated to some extent to anthropogenic disturbance. The BRDA has very limited to negligible potential for foraging birds and the lack of vegetative cover over much of this area greatly restricts the nesting and roosting potential of this area by birds. The activity levels on the farmed bauxite residue makes it even more unlikely that it would be used by any significant numbers of daytime roosting birds. No birds were observed using the LWP or SWP during any of the survey visits.

The clearance of a scrub and some grassland habitat to facilitate the proposed borrow pit extension has the potential to lead to the loss and displacement of some locally breeding or roosting birds. These impacts would be localised and relatively limited in extent. Similarly, the noise associated with the blasting and other operations at the borrow pit have the potential to cause disturbance and displacement to birds occurring in areas close to the borrow pit site.

No significant loss of vegetative cover is proposed in relation to the usage of the rockfill and soil stockpile area. This portion of the application site is already used for a similar purpose and there is no proposal to remove the areas of immature woodland that have been established in this area. It is likely that a similar diversity and relative abundance of birds will persist in this area. With the maturation of the woodland in this part of the application site the local diversity of breeding species is likely to increase in the medium term.

In the absence of mitigation (e.g. in relation to the timing of vegetation removal and of blasting) there is potential for likely significant negative effects on birds occurring locally. This would include some potential for disturbance and displacement of waterbirds present in areas relatively close to the borrow pit area, particularly Poulweala Creek. However, as stated in Section 6.4.1 of this Chapter it is intended to limit all blasting activity to outside the overwintering period for birds. This was a commitment provided for the permitted borrow pit and this measure will be incorporated into the mitigation commitments for the entirety of the proposed borrow pit area (see Section 6.5 and Chapter 18 of the EIAR).

### 6.4.6 Potential Impacts on Other Taxa

The habitats present within the BRDA are not generally attractive to invertebrates or other taxa.

Common Frog was casually recorded on a number of occasions from the proposed borrow pit and the fields surrounding the stockpile area. A number of Lepidoptera and other invertebrate species were also present although there were no records of Marsh Fritillary from within of adjacent to the application site.

The loss of some areas of scrub and grassland associated with the development of the borrow pit extension area is likely to see a highly localised impact on the diversity and abundance of other taxa. The progressive restoration and landscaping of the BRDA will increase the potential use of these areas by other taxa. Similarly, post-closure the implementation of landscaping on the capped BRDA will include the management of grassland and hedgerow habitats. As these features become established it is likely that the diversity of pollinators and other taxa will increase in this area.

### 6.4.7 Cumulative and In-combination Impacts

The potential cumulative impact of the Proposed Development with other existing and/or approved projects has also been assessed. A survey of existing and/or approved projects in the area was undertaken to determine whether the nature and scale of each of these projects could be sufficient to generate cumulative impacts of significance on the environment. A summary of the projects identified as part of this survey are listed in Appendix 18.1 of the EIAR.

For the purposes of this survey, all planning applications which were recorded on the National Planning Applications Database (DoHPLG) with extant permissions or were otherwise under consideration as of August 2021 within a c. 15km radius of the Subject Development were included. A record of 'major' planning applications within c. 15km of the planning boundary was established in August 2021. These applications were determined to constitute new development of a commercial, industrial, agricultural or residential nature, which may be of significance to the cumulative assessment. The following types of applications were excluded from the final listing:

- Minor change of use applications;
- Residential applications of less than 10 no. units located greater than c. 1.5km of the subject site;
- Minor amendments to permitted applications;
- Retention applications;
- Minor signage applications;
- ESB infrastructure (i.e. substations, switch rooms and towers);
- Minor utilities works including lighting and junction upgrades;
- Developments of a scale that would not exacerbate significant environmental effects (e.g. internal reorganisation, car parking of less than 20 spaces, continuance of use, etc.);
- Developments that have become operational by the time of writing (as they have been considered in the baseline); and
- Applications that were granted prior to February 2016 as it is assumed that these permissions will have lapsed, unless otherwise stated in the Grant of Permission.

The 2017 EPA Draft Guidance (https://www.epa.ie/publications/monitoring--assessment/assessment/EPA_EIAR_Guidelines.pdf) describes cumulative effects as follows:

*"The addition of many minor or significant effects, including effects of other projects, to create larger, more significant effects. While a single activity may itself result in a minor impact, it may, when combined with other impacts (minor or significant), result in a cumulative impact that is collectively significant."*

It is necessary to consider the potential for cumulative effects due to cumulation of effects with those of other projects that are existing or are approved, but not yet built or operational. Operational projects may act in combination with impacts arising from a proposed scheme, but effects associated with operational projects may already be part of the background baseline recorded in the receiving environment.

The projects considered as part of this assessment are summarised in Table 6.18. These projects were by and large subject to their own assessments and where applicable, specific mitigation to minimise impacts upon the receiving environment. The potential for residual impacts and those that would act in concert or synergistally with the proposed development was considered.

Notable projects which are highlighted within some of the EIAR chapters as having the potential to result in cumulative effects include the capacity extension at Shannon Foynes Port and the Foynes to Limerick N69 road scheme.

The facility is located close to the Shannon Estuary and just upstream of Shannon-Foynes Port. Shannon Foynes deep water port is a significant national port, Ireland's second largest port operation and has statutory jurisdiction over all marine activities on a 500 $km^2$ area on the Shannon Estuary, stretching from Kerry/Loop Heads to Limerick City. It is responsible for most of the commercial ship traffic on the Shannon estuary. The planned developments at Shannon Foynes Port were considered and environmental assessments prepared as part of proposed expansions and improvements to the facility were studied.

In December 2019, Limerick City and County Council (LCCC) applied under section 51(2) of the Roads Act 1993 (as amended) to An Bord Pleanála for approval as Strategic Infrastructure Development (SID) in relation to a proposed road development consisting of:-

- Approximately 15.6km of Type 2 dual carriageway express road extending from Foynes to Rathkeale (with an intermediate roundabout junction at Ballyclogh) along with approximately 1.9km of single carriageway road between Ballyclogh and Askeaton;
- Approximately 17.5km of dual carriageway motorway, of which approximately 15.5km is new construction and/or widening of the existing road, from Rathkeale to Attyflin;
- A Service Area for Heavy Goods Vehicles approximately 5 ha in size near Foynes with access road and service roads, parking, facilities building and a new at-grade junction onto the Foynes port access road;
- LCCC submitted to the Board the Environmental Impact Assessment Report (formerly referred to as an Environmental Impact Statement) prepared in accordance with section 50 of the Roads Acts 1993 (as amended) in respect of the proposed road development. A Natura Impact Statement was also prepared and was submitted to the Board in respect of the proposed road development in accordance with Part XAB of the Planning and Development Acts 2000 – 2019. A decision from ABP is scheduled for late November 2021.

The permitted or existing projects given detailed consideration when assessing the potential for in-combination and cumulative impacts included the operation of the Wyeth Nutritionals Ireland Ltd. plant at Coolrahnee, Askeaton, licensed aquaculture activities and dredging and dumping activities in the Lower River Shannon.

No potential for significant cumulative or in combination effects on the local biodiversity were identified in relation to the plans and projects considered. Proposed projects of note such as the Foynes-Limerick N69 Roads scheme took into account potential impacts on biodiversity arising from their own project and in combination with other plans and projects and the detailed mitigation and monitoring commitments greatly lessened the scale and nature of potential residual impacts on biodiversity. Plans and projects might in themselves have identified potential ecological impacts, even some relatively minor residual effects. The potential for such residual effects, even when minor in scale or extent, to create larger more significant effects, was considered.

There was no project (or projects) identified where there was potential for significant additive or synergistic effects with the proposed AAL development.

Given the context of the existing site and considering the nature of the proposed works, it is concluded that it is unlikely that there will be any significant cumulative impacts upon flora, habitats and fauna arising from the proposed development.

**Table 6.18 Projects considered as part of the cumulative and in-combination assessment.**

| Reg. Ref. | Description of proposed development | Address of development | Name of Planning Authority | Hyperlink to application on Planning Authority website |
|---|---|---|---|---|
| 1724 | for the following proposed development which will comprise of the construction of a new steel framed aircraft hangar within the airport lands at Shannon Airport, Co. Clare. The hangar building includes for ancillary office space, workshops, plant rooms and storage space. The building will have signage on the eastern, southern and western facades. Ancillary buildings and structures within the curtilage of the site including an external pump house, gas skid and fire suppression tank are also proposed. Site works proposed include car parking, hardstands, landscaping, and all ancillary site developments at this address. An Integrated Pollution and Control License is required for the facility | Lismacleane & Ballyhennessy, Bunratty Lower, Shannon Airport | Clare County Council | http://www.eplanning.ie/ClareCC/AppFileRefDetails/1724/0 |
| 1918 | a ten year permission for the complete development of a Solar PV Energy development with a total site area of 30.15 hectares, to include, electrical transformer and invertor station modules, Solar PV panels ground mounted on support structures, access roads and internal access roads and internal access tracks, fencing, electrical cabling and ducting, CCTV and other ancillary infrastructure, a temporary site compound area, additional landscaping and habitat enhancement as required and associated site development works located in the townlands of Deelish and Mullagh. The proposed solar farm will be connected to the National Grid via the adjoining Ellaha and Ballinknockane solar farm previously granted planning permission under Limerick city & County Council planning ref 17/1220 | Deelish & Mullagh, Shanagolden, Co. Limerick. | Limerick County Council | http://eplan.limerick.ie/AppFileRefDetails/1918/0 |
| 15468 | smokeless and bio-mass based solid fuel manufacturing and packaging facility at and adjacent to existing coal storage and baggage facility. The development includes the demolition of existing buildings and storage structures, the upgrading, extension and change of use of an existing warehouse building for use as a solid fuel manufacturing process plant, construction of a new packaging plant building, construction of a new administration | Durnish, International Port Road, Shannon Foynes Port | Limerick County Council | http://eplan.limerick.ie/AppFileRefDetails/15468/0 |

| Reg. Ref. | Description of proposed development | Address of development | Name of Planning Authority | Hyperlink to application on Planning Authority website |
|---|---|---|---|---|
| | block and associated car park, installation of weighbridges and an associated kiosk, re-surfacing of the site and installation of a new drainage system, construction of storage areas for raw materials and finished product, construction of a new electricity substation, new site entrance works including the relocation of an existing entrance and construction of a new entrance and all associated site works including waste water treatment plant. This application is accompanied by an Environmental Impact Statement (EIS) and a Natura Impact Statement (NIS) | | | |
| 15948 | (1) portacabin used as staff canteen, (2) silo, mixing room and hoppers for materials, Planning Permission for (3) the construction of an extension to the main production building and (4) lay a concrete yard over existing hardcore area | Greaney Concrete, Robertstown, Shanagolden | Limerick County Council | http://eplan.limerick.ie/AppFileRefDetails/15948/0 |
| 16192 | a New Bulk fertiliser store and all associated works (this proposed development is within an existing Seveso site) | Morgan's South, Askeaton | Limerick County Council | http://eplan.limerick.ie/AppFileRefDetails/16192/0 |
| 16418 | a ten year permission for development on a site of c. 0.225 ha located within the existing Aughinish Alumina plant consisting of the installation of 2 no. deep thickeners (steel vessels with a diameter of c. 22m and maximum overall height of c.21.9m) and ancillary elements, including stairs, access platforms and walkways linking to adjacent vessels, pumps, cabling and pipework. The development will also consist of the provision of a hardstanding, an internal road (c. 6.1m wide and c. 40.6m long) to the east of the thickeners and all other site development works above and below ground (the application relates to development which comprises or is for the purposes of an activity requiring an Industrial Pollution & Control Licence, now replaced by an Industrial Emissions Licence) | Aughinish East Aughinish West Island Mac Teige Glenbane West, Morgan North & Fawnamore, at/or adjacent to Aughinish Island Askeaton | Limerick County Council | http://eplan.limerick.ie/AppFileRefDetails/16418/0 |
| 16669 | for development which consists of the construction of a single storey high-bay factory floor building with associated 2 storey commercial office building, with roof level plant over, a single | Block E, Shannon Free Zone, Shannon | Clare County Council | http://www.eplanning.ie/ClareCC/AppFileRefDetails/16669/0 |

| Reg. Ref. | Description of proposed development | Address of development | Name of Planning Authority | Hyperlink to application on Planning Authority website |
|---|---|---|---|---|
| | storey external re-finishing to an existing ESB substation, which is currently located within the existing buildings of Block E ( which are to be demolished under Permission No. P15/217), new entrance to roadway and associated carparking ( 91 approx. No ), modification of 2 No. existing vehicular entrances to the north of the site, set down areas, marshalling yard, with dock leveller, bicycle parking ( 40 approx. No.), a single storey refuse compound, building signage and all ancillary landscaping, site works and services. | | | |
| 16767 | construction of a dwelling house, shed, treatment plant, percolation area and all ancillary site works | Morgans North, Barrigone, Askeaton | Limerick County Council | http://eplan.limerick.ie/AppFileRefDetails/16767/0 |
| 16788 | for the development within a Strategic Development Zone of a Fire Training Ground at the Secondary Surveillance Radar Equipment site on the north side of Runway 06-24, Shannon Airport, Co Clare. The development will comprise of the installation of a Simulated Steel Aircraft Shell, a Fire Screen and Engine Rig for the purpose of training fire fighting personnel. Also included in the development will be an overground Water Storage Tank, 2 No. 2 Tonne LPG Gas Tanks, a 300 Gallon Jet A1 Fuel Tank, 3 No. sheds to house controls and fuel pressurisation unit, security fencing to surround site perimeter, concrete hardstanding areas, site lighting and all other associated site works. An Appropriate Assessment screening statement accompanies this planning Application. | Shannon Airport, Co Clare | Clare County Council | http://www.eplanning.ie/ClareCC/AppFileRefDetails/16788/0 |
| 16917 | to develop holiday retreat accommodation comprising of 8 No. units, create new entrance, car parking, install a new wastewater treatment system and water facilities along with all associated works | Cullenagh, Cloonkerry West, Labasheeda | Clare County Council | http://www.eplanning.ie/ClareCC/AppFileRefDetails/16917/0 |
| 16977 | the construction of a reception building which will include an assembly room with associated locker rooms, toilets and shower facilities, and a new waste water treatment and disposal system to | Shannongrove, Pallaskenry | Limerick County Council | http://eplan.limerick.ie/AppFileRefDetails/16977/0 |

| Reg. Ref. | Description of proposed development | Address of development | Name of Planning Authority | Hyperlink to application on Planning Authority website |
|---|---|---|---|---|
| | serve both the existing dwelling house and new reception building and all associated works | | | |
| 16986 | a juvenile playing field, to widen existing access roadway and incorporate a pedestrian footpath link from existing sports field to the public footpath and all associated works | Corgrig, Foynes | Limerick County Council | http://eplan.limerick.ie/AppFileRefDetails/16986/0 |
| 17111 | for the construction of a single storey meeting hub/coffee dock building with concealed bin store and plant area, adjustments to existing parking, provision of new car and cycle parking, building signage and all ancillary landscaping, site works and services | Shannon Industrial Estate, Shannon Free Zone, Shannon | Clare County Council | http://www.eplanning.ie/ClareCC/AppFileRefDetails/17111/0 |
| 17144 | the installation of an all weather playing surface, erection of enclosure fencing, stop nets, floodlights, new vehicular entrance, roadway, car park and all associated site developments works | Ministersland & The Cross, Ardagh, Co Limerick | Limerick County Council | http://eplan.limerick.ie/AppFileRefDetails/17144/0 |
| 17148 | the construction of a stand-alone single storey Gym/PE Hall with ancillary spaces over two storeys and all ancillary site works | Colaisten Na Trocaire, Rathkeale, Co Limerick | Limerick County Council | http://eplan.limerick.ie/AppFileRefDetails/17148/0 |
| 17250 | for the completion of the existing landfill and storage of timber overground (planning ref:s 06/233, 11/7059 & 12/164, the permission requires a waste licence. | Stokesfield, Shanagolden, Co Limerick | Limerick County Council | http://eplan.limerick.ie/AppFileRefDetails/17250/0 |
| 17293 | (a) Construction of an Agricultural Building to include Rotary Milking Parlour, Dairy, Ancillary Rooms, Underground Slatted Tank, Unroofed Waiting Yard and Livestock Handling Facilities, (b) Erection of a Meal Bin, (c) Construction of an extension to existing slatted shed to include cubicle housing, (d) Construction of a modification to existing agricultural building to include handling area, (e) Construction of a modification to existing agricultural building to include additional cubicles and straw bedding, (f) Construction of 2no. extensions to existing agricultural building to accommodate underground slatted tanks and cubicles, (g) | Shannongrove, Pallaskenry, Co Limerick | Limerick County Council | http://eplan.limerick.ie/AppFileRefDetails/17293/0 |

| Reg. Ref. | Description of proposed development | Address of development | Name of Planning Authority | Hyperlink to application on Planning Authority website |
|---|---|---|---|---|
| | Construction of a livestock underpass along with associated soiled water storage facilities & all other associated site works | | | |
| 17302 | extension of the existing Natural Gas Above Ground Installation in the townland consisting of the extension of the existing site footprint and boundary fence, installation of regulator/meter kiosk, instrumentation/boiler kiosk, underground and overground pipework, 2.4m high palisade fencing, light column and all associated civil, mechanical & electrical | Barrigone, Askeaton, Co Limerick | Limerick County Council | http://eplan.limerick.ie/AppFileRefDetails/17302/0 |
| 17346 | 1.Demolition of existing redundant storage sheds to south and east of existing museum premises. 2. Provision of new vehicular entrance gateway to N69. 3.Construction of a 2 storey extension south wing to provide additional archive and exhibition/display areas. 3. Construction of a 2 storey extension to the south of existing museum and modifications to the existing south wing to provide additional meeting/exhibition/display areas in existing west wing. 5. Construction of single storey Irish coffee area extension facing the N69 (this is a protected structure 1182) | Aras Ide, Foynes, Co Limerick | Limerick County Council | http://eplan.limerick.ie/AppFileRefDetails/17346/0 |
| 17566 | demolition of existing warehouse building, existing grain hopper & adjoining derelict building. The construction of an office extension to the rear of the existing Mill House Office building, works will include a glazed linkage between the new & existing Mill House, modifications to the existing Mill House, modifications to the existing entrance, new car parking area, construction o boundary wall, site landscaping, upgrade of exiting site services and all associated ancillary works associated with the site development and building works | Mill House, Leahies Foynes, Co Limerick V94 R232 | Limerick County Council | http://eplan.limerick.ie/AppFileRefDetails/17566/0 |

| Reg. Ref. | Description of proposed development | Address of development | Name of Planning Authority | Hyperlink to application on Planning Authority website |
|---|---|---|---|---|
| 17583 | for the further completion of construction of Westpark Business Campus with the construction of Block 6000, (immediately south of existing Block 7000), a mixed use, multi-storey block, similar to that granted under parent planning permission under Clare County Council PA Ref: P01-1066 and APB Ref: PL03.130244. Block 6000 will have a total gross internal area of 12,045 sqms with offices at upper floors 300-500 and data centre/light industrial / storage/ Research and Development uses at lower levels 100-200. The construction of an ancillary, multi-deck carpark (MDCP) located to the South of Block 4000 within the Campus. The MDCP will accommodate 580 spaces and will replace the existing, 101 at grade, split level, car park located to the South of Block 4000. The car park will also replace the 500 space MDCP located to the South of the Campus, granted by Clare County Council under Ref: P01-1066 and APB Ref PL.03-130244. The proposed development will use existing drainage services in place within the overall campus and the existing road network. The development includes, landscaping, ancillary parking adjacent to Block 6000, ESB Substation, service areas for goods vehicles. The application includes all other ancillary site development works as required to complete the block. | Westpark Business Campus, Shannon, Co. Clare | Clare County Council | http://www.eplanning.ie/ClareCC/AppFileRefDetails/17583/0 |
| 17584 | the demolition of 2 no. existing Oil Tanks and associated low-level bund wall, the construction of a two-storey Water Treatment Building at ground floor level consisting of plant/equipment rooms, the construction of a two-storey Waste Treatment Building at ground floor level consisting of plant/equipment rooms at its existing manufacturing facility | Deely North, Askeaton, Co Limerick | Limerick County Council | http://eplan.limerick.ie/AppFileRefDetails/17584/0 |
| 17645 | to construct 16 no. semi-detached residential dwellings (a mix of three and four bedroom house types) & all associated infrastructure including new vehicular access onto Main Street, connections to public utilities and all ancillary site development works | Main Street, Pallaskenry, Co. Limerick | Limerick County Council | http://eplan.limerick.ie/AppFileRefDetails/17645/0 |

| Reg. Ref. | Description of proposed development | Address of development | Name of Planning Authority | Hyperlink to application on Planning Authority website |
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| 17714 | a ten year permission for development on this site of c. 7 hectares located adjoining the existing Aughinish Alumina Ltd plant for the provision of a Borrow Pit with an extraction area of c. 4.5 hectares to extract c. 374.000 m³ of rock over a 10 year period. The extraction area is sought up to a maximum depth of c. 8.5 m O.D., with extraction to occur between April and September each year. The proposed development includes the demolition of a contractors shed and all ancillary site development, areas of stockpiling, landscaping and boundary treatment works above and below ground, including restoration of the extraction area. Aughinish Alumina Limited carries out an activity requiring an Industrial Pollution Prevention and Control Licence (now replaced by an Industrial Emissions Licence – Licence Register No. P0035-06). The development and operation of the proposed Borrow Pit is not a licensable activity.<br><br>An Environmental Impact Statement (EIS) will be submitted to the Planning Authority with the application. | Aughinish East Aughinish West Island Mac Teige Glenbane West Morgan North and Fawnamore at or adjacent to Aughinish Island, Askeaton, Co. Limerick | Limerick County Council | http://eplan.limerick.ie/AppFileRefDetails/17714/0 |
| 17742 | for extension to the External Car Park ancillary to the AAG Hanger Facility at Shannon Industrial Estate, Shannon, Co. Clare. The proposed works will involve relocation of the adjoining Shannon Airport boundary fence to the South West of the site, to provide 87 no. additional car parking spaces, external lighting and all associated site works and services | Shannon Industrial Estate, Shannon, Co. Clare | Clare County Council | http://www.eplanning.ie/ClareCC/AppFileRefDetails/17742/0 |
| 17768 | to erect an extension to existing milking parlour and provide a new dairy. Also for permission to demolish existing cow shed and construct an underground slurry tank adjacent to milking parlour and provide a cattle crush. Also to construct 2 no. underground slurry tanks adjacent to existing cattle sheds all on farmyard | Mount Trenchard, Foynes. | Limerick County Council | http://eplan.limerick.ie/AppFileRefDetails/17768/0 |

| Reg. Ref. | Description of proposed development | Address of development | Name of Planning Authority | Hyperlink to application on Planning Authority website |
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| 17872 | the installation of a 0.51m x 1.42m x1.8m (LxWxH) above ground enclosure to house a new natural gas District Regulating Installation (DRI) with all ancillary services and associated works, including vent stack | Main Street, Ballyhahill | Limerick County Council | http://eplan.limerick.ie/AppFileRefDetails/17872/0 |
| 17877 | hardcore existing green field and concrete pad, extension to existing production building and two silo's to the north of existing production building and one silo to the south of existing production building, and permission for a new carpark and entrance for a one way traffic system and all associated works | Ballygiltenan North, Glin. | Limerick County Council | http://eplan.limerick.ie/AppFileRefDetails/17877/0 |
| 17998 | Further to previously granted planning application Ref: P16-405 for amendments and additions to the car parking area and all associated site works and services. Previously granted were 202 nr. parking spaces. The new total will be 298 nr spaces (96 nr. additional) including 15 nr. accessible spaces and 29 nr. electrical car recharge spaces | Shannon Airport, Shannon, Co. Clare | Clare County Council | http://www.eplanning.ie/ClareCC/AppFileRefDetails/17998/0 |
| 18188 | for extension of the existing carpark area and construction of an entrance wall and canopy at Building 156, Shannon Free Zone. The proposed works will include extension of the existing car park to provide 24 No. additional car parking spaces, 4 No. accessible car parking spaces and construction of a wall and entrance canopy to the North elevation together with all site works and services | 156 Shannon Free Zone, Shannon, Co. Clare | Clare County Council | http://www.eplanning.ie/ClareCC/AppFileRefDetails/18188/0 |
| 18310 | construction of 3 no. buildings for production and storage purposes ancillary to existing manufacturing facility and all associated works | Ballygiltenan North, Glin, Co. Limerick. | Limerick County Council | http://eplan.limerick.ie/AppFileRefDetails/18310/0 |
| 18376 | 6 no. new flood lights, provision of a new walking track around the pitch and to widen the existing site entrance and all ancillary site works. Retention Permission is also sought for 6 no. flood lights | Ballingarrane, Cappagh, Askeaton Co. Limerick. | Limerick County Council | http://eplan.limerick.ie/AppFileRefDetails/18376/0 |
| 18448 | a 60m x 50m Floodlight Astroturf pitch, warm up area and associated site works including 2.5m high netting on top of 2.4m high perimeter fence and a new 4m wide gateway from existing playing pitch | Ballygiltenan North, Glin, Co. Limerick. | Limerick County Council | http://eplan.limerick.ie/AppFileRefDetails/18448/0 |

| Reg. Ref. | Description of proposed development | Address of development | Name of Planning Authority | Hyperlink to application on Planning Authority website |
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| 18490 | to construct an extension to existing car park including automated car park, control barriers, zebra crossing and all associated, above and below ground site works | Universal House, 1 Airport Avenue, Shannon Free Zone Shannon | Clare County Council | http://www.eplanning.ie/ClareCC/AppFileRefDetails/18490/0 |
| 18661 | the construction of a new vehicular entrance, single storey small animal veterinary clinic (floor area 280 sq. m) with carport and ancillary facilities, surface car parking, waste water treatment system with polishing filter and all associated site works together with the relocation of existing farm entrance | Kyletuan, Rathkeal , Co. Limerick. | Limerick County Council | http://eplan.limerick.ie/AppFileRefDetails/18661/0 |
| 18912 | for the construction of 3 no. Advanced Manufacturing Units at Blocks K & L. The buildings consist of a single storey high-bay industrial floor with ancillary office area and roof plant. Sites-works for all 3 buildings to include both a mix of new and upgraded vehicular entrances to service delivery/service yards and 296 no. car parking spaces. The construction of new hard surfaced ancillary delivery/service yards, 148 no. bicycle parking spaces, single storey refuse compounds, building signage, rainwater harvesting tanks, and all ancillary landscaping and associated site works and services. The buildings are to replace the existing structures on site, the demolition of which was granted under Pl. Ref no's 18/416 and 18/417. The planning application is accompanied by a Natura Impact Statement. | Shannon Free Zone West, Shannon, Co. Clare | Clare County Council | http://www.eplanning.ie/ClareCC/AppFileRefDetails/18912/0 |
| 18958 | phase 1 to consist of 30 no. dwellings as follows - 12 no. two storey 3 bed terrace units, 18 no. two storey semi detached 3 bed units, together with all associated access roadways, landscaping and all associated site works and connection to existing services | Pallas, Pallaskenry, Co. Limerick. | Limerick County Council | http://eplan.limerick.ie/AppFileRefDetails/18958/0 |
| 19205 | a ten year planning permission for a spectator stand, changing rooms, gymnasium and toilet facilities. Inclusive of all associated ancillary building and site works | Mick Neville Park, Wolfesburgess, Rathkeale, Co. Limerick. | Limerick County Council | http://eplan.limerick.ie/AppFileRefDetails/19205/0 |

| Reg. Ref. | Description of proposed development | Address of development | Name of Planning Authority | Hyperlink to application on Planning Authority website |
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| 19226 | for the further completion of construction of Westpark Business Campus with the construction of Block 6000 (immediately south of existing Block 7000), for a building of five storeys (with an additional area for mechanical plant on the roof area) on the western portion of the proposed building facing into the centre of the Campus with a further two basement storeys linking into a proposed, ancillary, multi-deck car park (MDCP) to the east of the site. Block 6000 will have a total gross floor area of 10,800 sqms for office use. The office building includes ancillary services including, secure internal, cycle parking with staff toilets and shower facilities. The ESB sub station and mechanical plant areas are contained within the office building. The proposed development will use existing drainage services in place within the overall Campus and the existing road network. The development includes all other ancillary site development works as required to complete the block | Westpark Business Campus, Shannon, Co. Clare | Clare County Council | http://www.eplanning.ie/ClareCC/AppFileRefDetails/19226/0 |
| 19421 | the construction of a seven unit glamping facility incorporating the conversion of an existing cottage to toilet and kitchen area, installation of a proprietary waste water system and all associated services | Kilcool, Rathkeale, Co. Limerick. | Limerick County Council | http://eplan.limerick.ie/AppFileRefDetails/19421/0 |
| 19465 | developing existing terrace of derelict buildings into 5 no. holiday homes and a management office, to install new waste treatment system, to form new entrance and site works and to consolidate and make sound the castle structure as a ruin. This is a Protected Structure 179 N3(1) and a Recorded Monument (RMP L1003-002) | Beagh Castle, Ballysteen, Co. Limerick. | Limerick County Council | http://eplan.limerick.ie/AppFileRefDetails/19465/0 |
| 19531 | for development which consists of the demolition of an existing service yard and ancillary carparking area to facilitate the construction of a two-storey extension to the existing light-industrial manufacturing facility. Works also include ancillary office and R & D areas with a new entrance foyer constructed over 3no. levels resulting in additional gross floor area of 9844m2. Other works include the reconfiguration and extension of an existing car | Shannon Industrial Estate, Shannon, Co. Clare | Clare County Council | http://www.eplanning.ie/ClareCC/AppFileRefDetails/19531/0 |

| Reg. Ref. | Description of proposed development | Address of development | Name of Planning Authority | Hyperlink to application on Planning Authority website |
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| | park to the south of the proposed building to provide 75 no. additional spaces ad the construction of a new car park to provide 44 no. spaces including accessible spaces and set down area. The provision of 2 no. loading bays to the rear of the proposed extension, upgraded vehicular and delivery/service yards, entrances, secure bicycle parking spaces, external open-sided storage enclosure, plant and services compound, signage to the proposed extension and wayfinding signage to the campus, rainwater harvesting tanks, plant and photovoltaic units to the roof level with all ancillary landscaping and associated site works and services. The development will also include the partial re-roofing of the existing facility to the northern corner of the campus | | | |
| 19535 | for the construction of a single storey Switchroom and amendments to existing substation with all associated site works at Block L, Shannon Free Zone West, Shannon, Co. Clare | Shannon Free Zone, Shannon, Co. Clare | Clare County Council | http://www.eplanning.ie/ClareCC/AppFileRefDetails/19535/0 |
| 19693 | for amendments to include the following; the inclusion of two number, approximately 17.6 meter tall fire suppression tanks in lieu of the original 5.3 meter tanks, minor alterations to the North Elevation to increase the quantity of brickwork, reduce ridge heights, alterations to the vehicle parking layout including a new storage area and an increase in size of the Pump House by 2.0 meters. An Integrated Pollution and Control Licence is required for the facility. The application falls within the remit of a Strategic Development Zone. | Shannon, Co. Clare | Clare County Council | http://www.eplanning.ie/ClareCC/AppFileRefDetails/19693/0 |
| 19853 | the construction of a single storey industrial packaging shed with conveyors supply mechanism, rectangular roller tray outfeed and all ancillary site works | Durnish Internal Port Road, Shannon Foynes Port, Foynes Co. Limerick. | Limerick County Council | http://eplan.limerick.ie/AppFileRefDetails/19853/0 |
| 20319 | construction of Phase 1 of a housing development consisting of 10no. semi-detached dwelling houses, 2no. detached dwelling | Ballyhahill, Co. Limerick | Limerick County Council | http://eplan.limerick.ie/AppFileRefDetails/20319/0 |

| Reg. Ref. | Description of proposed development | Address of development | Name of Planning Authority | Hyperlink to application on Planning Authority website |
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| | houses, new entrance, roads and services layout, connection to the public sewer together with all associated site works | | | |
| 20401 | amendments to Planning Reference 17/1152 which comprised of a) permission for site development works which will consist of vehicular/pedestrian access, internal roads and footpaths, connections to all adjacent utilities including foul sewer, provision of public lighting, boundary treatment, landscaping and all ancillary site works and b) Outline Permission for 9 no. serviced residential sites. The amendments sought include a revision to site boundaries and an increase in the overall density from 9 to 11 no. detached dwellings which will necessitate minor revisions to the overall site layout including the drainage design | Loughill, Co. Limerick | Limerick County Council | http://eplan.limerick.ie/AppFileRefDetails/20401/0 |
| 20416 | the development consists of the construction of a series of M&E Buildings to the yard of Building 2. There is a requirement for four buildings, to house a transformer, a substation, a RMU and a sprinkler tank room. We are also seeking PERMISSION for a sprinkler tank. We are proposing three ancillary plant compounds, housing the chiller plant, bin store and Air Conditioning Units. We propose minor changes to the elevations to include louvres and doors to access the proposed plant. There are minor amendments to the landscaping between buildings 2 and 3 to improve access to the site | Building 2 Block K, Airport Avenue Shannon Free Zone, Shannon | Clare County Council | http://www.eplanning.ie/ClareCC/AppFileRefDetails/20416/0 |
| 20575 | to: construct of 1 no Advanced Technology Manufacturing Unit. The building consists of a single storey high-bay industrial floor with ancillary office area and roof plant. Site works consists of the provision of an enclosed service yard with dedicated plant and refuse storage compound, rainwater harvesting tank and new sub-station, cycle parking and external landscaping, along with all associated site works, services and signage. Demolition of existing sub-station. The Building will replace the existing structures on site, the demolition which was granted under planning reference no P19-822. | Bay 77-79 Block R, Shannon Industrial Estate, Shannon Free Zone | Clare County Council | http://www.eplanning.ie/ClareCC/AppFileRefDetails/20575/0 |

| Reg. Ref. | Description of proposed development | Address of development | Name of Planning Authority | Hyperlink to application on Planning Authority website |
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| 20688 | the completion of the existing landfill and storage of timber overground (previous planning ref:s 06/233, 11/7059, 12/164& 17/250. The permission requires a waste licence | Stokesfield, Shanagolden, Co Limerick | Limerick County Council | http://eplan.limerick.ie/AppFileRefDetails/20688/0 |
| 20705 | for a renewable energy development on a 3.5 hectare site in the townland of Stonehall, Newmarket on Fergus, Co Clare. The proposed development will constitute the provision of the following: Construction of a Biomass processing and storage area utilising forestry products. Construction of a Gasification and Methanation Plant for the production of advanced biofuels. Construction of a Gasification and Combined Heat Power Plant for production of electricity and heating. Construction of a Battery Storage Facility (20MW). Construction of a Thermal Energy recovery and storage facility for district heating distribution. Construction of new on site 38kV substation. Creation of a new access road from the L-3169-0. All ancillary development including the provision of site office, car parking, internal access roads, perimeter landscaping, fencing, lighting, and on sire drainage. The Planning application is accompanied by a Natura Impact Statement. | Stonehall, Newmarket on Fergus, Co Clare | Clare County Council | http://www.eplanning.ie/ClareCC/AppFileRefDetails/20705/0 |
| 20786 | the development consists of the demolition of an existing carparking area and the relocation of an existing ESB substation to facilitate the construction of a four-storey office building with a gross floor area of 5636m2. Other works include the provision of 317no. carparking spaces including accessible spaces, EV charging areas and set-down areas, a relocated vehicular access to the site, an additional vehicular access point to ancillary parking on the opposite side of the road with a pedestrian crossing connecting both. Secure bicycle parking spaces, refuse store and plant and services building, incorporating the relocated substation. Signage and wayfinding, services plant and photovoltaic units to roof level with all landscaping and associated site works & services The planning application is accompanied by a Natura Impact Statement | Shannon Free Zone, Shannon, Co Clare | Clare County Council | http://www.eplanning.ie/ClareCC/AppFileRefDetails/20786/0 |

| Reg. Ref. | Description of proposed development | Address of development | Name of Planning Authority | Hyperlink to application on Planning Authority website |
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| 20824 | for development comprising an increased wind turbine blade length and associated reduction in turbine hub height, creation of a splayed junction, and all associated cabling, services and ancillary works at land at the site of the consented Crossmore Wind Farm. This site is located approximately 4km north of Kilmurry McMahon, 4.5km southeast of Kilmihil and 15km east of Kilrush in the townlands of Crossmore and Derrnageeha, Co Clare. The development will consist of: 1. An increase in the blade length of the previously-consented 7 no. wind turbine Crossmore Wind Farm, consented under planning application Ref: P09/123, from 45 metres to up to 57.5 metres; 2. Associated reduction in turbine hub height of up to 12.5m to maintain the previously approved overall turbine tip height of up to 125m (the previously approved hub height was 80m) 3. Creation of a splayed junction at the wind farm entrance on the Ballyduneen Road, off the N68, necessary to facilitate the proposed turbine / blade configuration; 4. All associated services and ancillary works. The application is seeking a ten year planning permission and 30 year operational life from the date of commissioning of the renewable energy development. | Crossmore and Derrynageeha, Co Clare | Clare County Council | http://www.eplanning.ie/ClareCC/AppFileRefDetails/20824/0 |
| 21106 | for ground investigation (GI) works, to inform the option selection and design of the proposed Shannon Town and Environs Flood Relief Scheme at Rineanna South, Shannon, Co Clare. The objective of the GI works is to establish ground conditions within the study area and contribute towards the option selection process for the proposed FRS. The GI sites are primarily located within or adjacent to existing flood embankments on the edge of the River Shannon estuary in proximity to residential and industrial areas. The proposed preliminary GI works will consist of the following: a) 54 No Borehole Cable Percussion (BHCP) (shell and auger); b) 65 No. Rotary Cores; c) 62 No. Cone Penetration Tests (CPTS); and, d) 25 No. Groundwater Standpipes. This application is accompanied by a Natura Impact Statement (NIS) | Rineanna South, Shannon, Co Clare | Clare County Council | http://www.eplanning.ie/ClareCC/AppFileRefDetails/21106/0 |

| Reg. Ref. | Description of proposed development | Address of development | Name of Planning Authority | Hyperlink to application on Planning Authority website |
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| 167005 | Extension of Permission 10/40 for the demolition of existing domestic garage, the construction of 4 no. detached dwellings, 16 no. semi-detached dwellings, together with access road, car parking and associated site works (this site is located in a proposed architectural conservation area) | Lower Main Street, Rathkeale | Limerick County Council | http://eplan.limerick.ie/AppFileRefDetails/167005/0 |
| 167044 | extension of permission 101008 for a new two storey Primary Care Centre consisting of 397sqm of general practitioners care centre on the ground floor and 546sqm of regional pimary care centre on the first floor, 33 carspaces to serve the new centre and all related site works including the demolition of the existing manufacturing building on the site | Church Street, Glin | Limerick County Council | http://eplan.limerick.ie/AppFileRefDetails/167044/0 |
| 171174 | ten year permission to develop a solar farm consisting of construction & operation of solar PV arrays mounted on metal frames on a 18HA site including: 1 no. electrical control building & onsite substation. Up to 4 no. inverter units, a temporary construction area & ancillary facilities, boundary fencing with CCTV units, an access track, all associated works, including (gross floor space of proposed works up to 144.80sqm) & habitat management & enhancement measures & drainage swale. The planning application is accompanied by an environmental report & stage 1 screening for appropriate assessment | Ballynash (Bishop, Foynes, Co. Limerick. | Limerick County Council | http://eplan.limerick.ie/AppFileRefDetails/171174/0 |
| 171220 | a ten year permission for the complete development of a Solar PV Energy development with a total site area of 61.29 hectares, to include one Transmission System Operator (TSO) electrical substation with associated switchgear, TSO compound and control building, one customer substation with transformer, communications pole, compound and control building, electrical transformer and inverter station modules, Solar PV panels ground mounted on support structures, access roads and internal access tracks, spare parts storage containers, fencing, electrical cabling and ducting, CCTV and other ancillary infrastructure, a temporary | Ellaha and Ballinknockane, Co. Limerick. | Limerick County Council | http://eplan.limerick.ie/AppFileRefDetails/171220/0 |

| Reg. Ref. | Description of proposed development | Address of development | Name of Planning Authority | Hyperlink to application on Planning Authority website |
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| | site compound area, additional landscaping and habitat enhancement as required and associated site development works | | | |
| 177019 | Extension of Permission from Ref No: 12/212 (2.49 hectares of reclamation at the East Jetty in Foynes Port. The reclamation works will be carried out between the rear of the existing East Jetty and the adjacent shoreline and will include dredging, importation of fill material, retaining wall construction, surfacing, drainage installation and site lighting. No buildings are proposed on the proposed reclaimed area which will be used for the storage and handling of cargo up to an anticipated height of approximately 7.7m. An Environmental Impact Statement (EIS) and Natura Impact Statement (NIS) accompany this application) | Foynes Port, Corgrig | Limerick County Council | http://eplan.limerick.ie/AppFileRefDetails/177019/0 |
| 181091 | construction of a viewing stand, access footpaths and all associated works | Kyletaun, Rathkeale, Co. Limerick. | Limerick County Council | http://eplan.limerick.ie/AppFileRefDetails/181091/0 |
| 181236 | the demolition of the existing three span bridge and construction of a new single span bridge consisting of piled abutments and a stell truss superstructure to facilitate the potential future re-introduction of freight traffic on the Limerick to Foynes railway line at Churchfield/Island MacTeige. The existing intermediate piers will remain in place in a non load bearing capacity. The works also includes the temporary relocation of a salt marsh during the construction of the bridge structure. A Natura Impact Statement has been prepared for the development | Churchfield/Island MacTeige, Foynes, Limerick. | Limerick County Council | http://eplan.limerick.ie/AppFileRefDetails/181236/0 |
| 191006 | for refurbishment works to existing coastal defence embankments at Shannon Airport, Shannon, Rineanna South, Co Clare. The proposed works include different combinations of armouring, top-soiling and grassing along the embankments. A Natura Impact Statement has been prepared and is included in the application. An Environmental Impact Assessment screening report has been | Shannon Airport, Shannon, Rineanna South | Clare County Council | http://www.eplanning.ie/ClareCC/AppFileRefDetails/191006/0 |

| Reg. Ref. | Description of proposed development | Address of development | Name of Planning Authority | Hyperlink to application on Planning Authority website |
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| | prepared and is included in the application. It concluded that an Environmental Impact Assessment is not required | | | |
| 191221 | an extension to the existing burial ground to incorporate laying of concrete footpaths providing access for 263 new grave plots and all associated works | Ballycannon, Croagh, Co. Limerick. | Limerick County Council | http://eplan.limerick.ie/AppFileRefDetails/191221/0 |
| 198000 | the proposed improvement works will be carried out within the existing 60kph speed limit zone over a length of 750m between L6135 Curraghchase Junction and the L6125 Junction. The improvement works proposed comprise a reduction of the N69 carriageway width to 6.5m over the 750m length of the scheme with a footway installed on the southern side (school side) and kerbing and a grass verge on the northern side of the carriageway. The proposed works also include for the installation of LED public lighting on the northern side of the carriageway, road lining and signage as well as surface water drainage along both sides of the N69 carriageway and pavement improvement works. Accommodation works will be undertaken as required including improvement works in and around the community hub of the national school and GAA club grounds. The implementation of the works proposed will result in a rearrangement of the existing road network in the vicinity of the scheme. Changes to the existing road network will include the reduction of road width to 6.5m over a 750m length and the installation of a kerbed footway abutting the westbound carriageway and kerbing and a verge abutting the eastbound carriageway over the scheme length | townlands of Killeen Ballyvogue, Cowpark Curraghchase North and Boherboy, Kilcornan Co. Limerick. | Limerick County Council | http://eplan.limerick.ie/AppFileRefDetails/198000/0 |
| 201041 | the construction of a new hurling wall and adjacent all-weather training area with perimeter fencing and floodlighting including all ancillary site works | Pallaskenry, Co. Limerick | Limerick County Council | http://eplan.limerick.ie/AppFileRefDetails/201041/0 |
| 201059 | construction of a two storey dwelling house, detached domestic garage, front boundary entrance walls, mechanical aeration unit with polishing filter system with all associated site works | Robertstown, Foynes, Co. Limerick | Limerick County Council | http://eplan.limerick.ie/AppFileRefDetails/201059/0 |

| Reg. Ref. | Description of proposed development | Address of development | Name of Planning Authority | Hyperlink to application on Planning Authority website |
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| 201325 | the provision of nature trail and upgrade of existing nature trail, construction of a car park comprising 29 no. car parking spaces, new vehicular access and associated landscaping and boundary treatment works. It is also sought to demolish existing derelict structures and a bird hide and construct a new bird hide in its place. A Natura Impact Statement(NIS) will be submitted to the planning authority with the application | Fawnamore & Aughinish East, Aughinish Island, Askeaton Co. Limerick | Limerick County Council | http://eplan.limerick.ie/AppFileRefDetails/201325/0 |
| 208004 | refurbishment of Ardagh Station House (which is a protected structure) and goods shed & change of use to commercial, community & tourism use, the refurbishment and renovation of the station house and goods shed and associated site works, the provision of car parking spaces and camper van parking bays, provision of a playground facility, enhancement and landscaping works to the site, circa 2.5 acres and entrance area, the provision of LED public lighting throughout the facility, new connections to existing public sewer and water services and all associated site works including installation of a holding tank and mechanical pumping system to nearby Irish Water pump station, connecting to Irish Water watermain on public road and lay firemain on site, construct stormwater network on site with interceptors and discharge to outfall, install timber post and rail fencing along boundary of greenway and parking area, installation of greenway furniture including seating, benches and cycle stands on the site, the removal of a section of stone wall to facilitate the widening of the existing entrance to accommodate 2-way traffic, installation of signage including information sign boards and related structures and additional directional signage on the greenway and related roads and the refurbishment of Barnagh Station House (which is a protected structure) and change of use to a community & tourism use on the Great Southern Greenway Limerick, the refurbishment and renovation of the station house and associated site works, upgrade of the railway platform, installation of signage including, | Ardagh Station House Kilreash Ardagh, & Barnagh Station House Ballymurragh East, Co. Limerick | Limerick County Council | http://eplan.limerick.ie/AppFileRefDetails/208004/0 |

| Reg. Ref. | Description of proposed development | Address of development | Name of Planning Authority | Hyperlink to application on Planning Authority website |
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| | information sign boards and related structures, the provision of LED lighting, enhancement and landscaping works to the site and install fencing along the boundary | | | |
| PL91. 301561 | Port capacity extension to consist of modifications to the existing jetties and quays, phased expansion of the port estate and all associated site development works | Port of Foynes, in the townlands of Corgrig and Durnish, Foynes, Co. Limerick | | https://www.pleanala.ie/en-ie/case/301561 |
| PL91. 306199 | Foynes to Rathkeale Protected Road Scheme 2019, Rathkeale to Attyflin Motorway Scheme 2019 and Foynes Service Area Scheme 2019 (forming the Foynes to Limerick Road (including Adare Bypass)). | Shangolden, Craggs, Askeaton West, Lismakeery, Nantian, Riddlestown, Rathkeale Rural, Rathkeale Urban, Dromard, Croagh, Adare North, Adare South, Clarina and Patrickswell, Co. Limerick. | | https://www.pleanala.ie/en-ie/case/306199 |

| Reg. Ref. | Description of proposed development | Address of development | Name of Planning Authority | Hyperlink to application on Planning Authority website |
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| PL03. 307798 | Proposed 400kV electricity transmission cables, extension to the existing Kilpaddoge Electrical Substation and associated works, between the existing Moneypoint 400kV Electrical Substation in the townland of Carrowdoita South County Clare and existing Kilpaddoge 220/110kV Electrical Substation in the townland of Kilpaddoge County Kerry. The development includes work in the foreshore. | Townland of Carrowdotia South County Clare and Kilpaddoge County Kerry | | https://www.pleanala.ie/en-ie/case/307798 |
| PA08. 311233 | Proposed Shannon Technology and Energy Park consisting of power plant, battery energy storage system, floating sorage and regasification unit, jerry, onshore receiving facilities, above ground installation and all ancillary structures/works. | Townlands or Kilcolgan Lower and Ralappane, Ballylongford, Co. Kerry | | https://www.pleanala.ie/en-ie/case/311233 |
| EC21/19 | Section 5 Declaration: Whether the proposed installation of additional plant and machinery within the existing industrial facility at Aughinish Alumina is Development or is or is not Exempted Development. The plant will provide for a caustic recovery process which eliminates the production of sodium oxalate at the overall facility. Declared exempted devleopment. | Aughinish Alumina Ltd., Askeaton, Co. Limerick | | |

### 6.4.8 Indirect effects

The proposed works will occur within an area which is heavily modified and industrialised, and disturbed by human activities. The overall AAL facility is subject to strict emission limits, as set out in the EPA IEL conditions. It is required to produce regular detailed environmental monitoring reports. The proposed development will facilitate an extension of life of the overall AAL facility and therefore increase the period during which there will be high-levels of anthropogenic activity in the area and also the duration for which there will be emissions associated with the operation of the plant. The nature of the activities in the processing area will be essentially unchanged but the increase in storage capacity in the BRDA will extend the lifetime of the overall facility. The accumulated scientific information of the receiving environment over the lifetime of the AAL facility to date provides a considerable amount of information on the local environment.

The overall AAL facility currently has in place an extensive infrastructure and management system to contain and/or treat potential pollutants and to ensure that emissions are within the strict license limits set down by the EPA in the IE Licence (P0035-07). Environmental management systems are regularly audited and proven to be effective. The Environmental Management System (EMS) covers all operations at the site and this has been designed to ensure that there is no significant adverse impacts upon the local ecology, in particular the designated Natura 2000 sites.

A Conceptual Site Model (RSK 2021) was prepared to consider whether there was potential for bioaccumulation in the sensitive marine environment as a result of the emissions from the plant. The model considered the available scientific evidence and the fundamental source-pathway-receptor model to evaluate the potential pathways that could connect activities at the plant and the immediate marine and terrestrial environments. A further confirmatory study to collect additional marine sediment data was undertaken in May 2021 (RSK 2021) to assess the significance of any potential releases from the plant on the possible elevation of heavy metals concentrations in marine sediments in the immediate vicinity of the plant. The sampling data from the study indicated that no pathways are being realised that may impact on sediment metal concentrations in the immediate marine environment. The data showed that metal sediment concentrations were around the typical background concentrations for the marine environment in Ireland, and therefore it was concluded that no pathway for heavy metals has realised an impact on the marine sediments, and hence marine benthic species in the immediate vicinity of the plant. There was no evidence that heavy metals concentrations are elevated in the marine sediments, and consequently no evidence that toxic impacts would occur to the marine benthic biota. These data indicated that there is no pathway from the AAL activity producing a negative impact on the invertebrate prey species of higher faunal organisms, including for instance intertidal feeding birds in the SPA designated habitat.

## 6.5 Mitigation Measures

The mitigation measures designed by the various specialists in relation to management of potential emissions to air and water and management of noise arising from the operation of the borrow pit are summarised in Chapter 18 of the EIAR. These measures together with the measures presented in the CEMP (and below) will be effective in addressing the potential impacts on the flora, habitats and fauna that occur in the receiving environment.

Biodiversity has been and is an ongoing part of the management of the AAL facility. In May 2021 AAL developed a 5-year Biodiversity Management Plan (BMP; Appendix 6.5) for lands under their control with the following stated objectives:

1. Identify habitats, areas of local biodiversity importance and ecological corridors.
2. Strengthen the knowledge base for conservation, management and sustainable application of biodiversity.
3. Increase awareness and appreciation of biodiversity and ecosystems services.
4. To conserve and/or enhance biodiversity and ecosystem services.

The BMP formalises and builds upon the existing and long-standing biodiversity management that has been undertaken by AAL at this site. The BMP sets out targets and objectives which will carry out monitoring and will implement practical conservation measures across the site. These measures will be very useful in supplementing the project specific mitigation measures presented below.

- There will be no clearance of woody vegetation in the bird breeding season from March 1st to August 31st inclusive. Prior to any vegetation removal the areas will be walked in the period directly before vegetation removal to minimise the risk of disturbance or mortality of resting mammals.
- Prior to any vegetation clearance these areas will be surveyed to check for the presence/absence of any Third Schedule Invasive Plant species. If any Third Schedule species are present these will be treated by specialist contractors under the supervision of a suitably qualified ecologist before any vegetation clearance will progress.
- Stockpiles of rockfill and soil will be inspected annually to confirm that no invasive plant species are present. If invasive plant species are present these will be treated and eradicated prior to the transport and use of material elsewhere on site.
- The fencing of the borrow pit area will include standard mammal gates to permit mammals to commute through this portion of the site. Gates/openings will be provided at approximately 250m intervals along the borrow pit fencing.
- The activity at the artificial sett will be monitored in advance and during the initial stages of the development of the borrow pit. Trail cameras will be permanently deployed at the artificial sett and the recent sett activity will be reviewed by the project ecologist and the site wildlife ranger on an annual basis prior to the commencement of the blasting schedule.
- Blasting will only be permitted between April-September, outside of the primary overwintering period for migrant waterbird species. Blasting will be relatively infrequent with c. 7 blasts per year.

- All emissions (i.e. dust, noise) during the operational phase of the proposed development will be controlled/limited (in line with licence conditions) and as such there is no potential for adverse impacts on key faunal species of the nearby designated sites as a result of emissions from the proposed development.
- There will be no significant change in the current night-time lighting regimen at the BRDA. All new or replacement lights will be shielded and downward directed with light fittings with a colour temperature in the 2700-3000K range. This is a colour temperature that is less disruptive to bats (BCT 2010). There will no permanent night-time lighting of the proposed borrow pit or the rockfill and soil stockpile areas.
- Any pooled surface water that is observed in the borrow pit site (e.g. during construction) shall be checked in the period of February-March to record the presence of any breeding Frogs. If spawn and/or tadpoles are present in an area that may be disturbed by activity at the site then Frogs, spawn and tadpoles should be translocated (under licence) by a suitably qualified ecologist to suitable sites elsewhere on Aughinish Island.
- A minimum of 15 bat boxes, including two night-roosts for Lesser Horseshoe Bats will be installed on lands within the applicant's control. The location of these boxes will be selected by a suitably qualified ecologist. These boxes will be monitored and maintained on an annual basis during the operational life of the plant.
- A total of 15 bird nest boxes (woodcrete or recycled plastic) will be installed on lands within the applicant's control. At least on Barn Owl box will be installed on the lands in the applicant's control. The design of the nest boxes and the location of their deployment will be selected by a suitably qualified ecologist. These boxes will be monitored and maintained on an annual basis during the operational life of the plant.
- During operations within the application site, deep excavations or areas of pooled water will be assessed on an ongoing basis, to either provide escape ramps for fauna or adequate mammal-proof fencing of a minimum of 1.2m in height. Any temporary excavations will be checked on a daily basis during working periods to minimise the risk of animals becoming trapped.
- All edible and putrescible wastes will be stored and disposed of in an appropriate manner. Similarly, all construction materials will be stored and stockpiled at planned locations.
- The site BMP will be reviewed after every 5-year period and a biodiversity monitoring programme agreed and implemented. Ahead of closure, a BMP for the closure phase will be produced with detailed commitments to monitor the biodiversity at an in the vicinity of the application site for the 30 years post-closure.

### 6.5.1 Residual Impacts

With the implementation of the environmental controls and mitigation described in the EIAR it is concluded that the residual impacts on habitats, birds, mammals (including bats) and other fauna will be at most slight neutral in the medium to longer term. In the longer term the landscaping and other mitigation (including the creation of grassland with hedgerows on the capped BRDA) are likely to see a moderate to significant positive effect on local biodiversity, particularly in the BRDA area.

## 6.6 References

Bang, P. & Dahlstrom, P. 2004. *Animal Tracks and Signs*. Oxford University Press, Oxford.

Bibby, C., Burgess, N., Hill, D. & Mustoe, S. 2000. *Bird Census Techniques* (2nd ed.), Academic Press.

Clark, M. 1998. *Badgers* (2nd ed.). British Natural History Series, Whittet Books.

Cope T. and Gray A. 2009. Grasses of the British Isles. B.S.B.I Handbook No.13. Botanical Society of the British Isles.

Department of Environment, Heritage & Local Government (DoEHLG). 2009. Appropriate Assessment of Plans and Projects in Ireland – Guidance for Planning Authorities. DoEHLG, Dublin.

European Commission. 2001. Assessment of Plans and Projects Significantly Affecting Natura 2000 Sites – European Commission Methodical Guidance on the provisions of Article 6(3) and 6(4) of the 'Habitats' Directive 92/43/EEC. European Commission DG Environment, Oxford UK.

Environmental Protection Agency (EPA). 2017. Draft Guidelines on the information to be contained in Environmental Impact Assessment Reports (EIAR). EPA, Wexford.

Fossitt, J.A. 2000. A Guide to Habitats in Ireland. Kilkenny: The Heritage Council.

Fitzpatrick, U., Murray, T.E., Byrne, A., Paxton, R.J. & Brown, M.J.F. 2006. The Regional Red List of Irish Bees. Queens University Belfast, Northern Ireland.

Gilbert G., Stanbury A. and Lewis L. 2021. Birds of Conservation Concern in Ireland 2020 –2026. *Irish Birds* 9: 523—544

JNCC. 2004. Common Standards Monitoring Guidance for Terrestrial Mammals, Version August 2004, ISSN 1743-8160.

King, J.L., Marnell, F., Kingston, N., Rosell, R., Boylan, P., Caffrey, J.M., FitzPatrick, Ú., Gargan, P.G., Kelly, F.L., O'Grady, M.F., Poole, R., Roche, W.K. & Cassidy, D. 2011. Ireland Red List No. 5: Amphibians, Reptiles & Freshwater Fish. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland.

Lockhart, N., Hodgetts, N. & Holyoak, D. 2012. *Rare and Threatened Bryophytes of Ireland*. Northern Ireland Publication No. 028, National Museums, Belfast.

Lundy, M.G., Aughney, T., Montgomery, W.I. & Roche, N. 2011. Landscape Conservation for Irish Bats & Species Specific Roosting Characteristics. Bat Conservation Ireland.

Marnell, F., Kingston, N. and Looney, D., 2009. Ireland Red List No. 3, Terrestrial Mammals. National parks and Wildlife Service, Department of the Environment, Heritage and Local Government, Dublin, Ireland.

Nairn, R. & Fossitt, J. 2004. The Ecological Impacts of Roads, and an Approach to their Assessment for National Roads Schemes. In: J. Davenport & J.L. Davenport (eds) The Effects of Human Transport on Ecosystems: Cars and Planes, Boats and Trains, 98-114. Royal Irish Academy, Dublin.

Nelson, B., Ronayne, C. & Thompson, R. 2011. Ireland Red List No.6: Damselflies & Dragonflies (Odonata). National Parks and Wildlife Service, Department of the Environment, Heritage and Local Government, Dublin, Ireland.

O'Neill, F.H., Martin, J.R., Devaney, F.M. & Perrin, P.M. 2013. The Irish semi-natural grasslands survey 2007-2012. *Irish Wildlife Manual*s, No. 78. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht, Ireland.

Parnell, J. & Cutis, T. 2012. *Webb's An Irish Flora* (8th edition), Cork University Press, Cork.
Smith G.F., O'Donoghue P., O'Hora K. & Delaney E. 2011. Best Practice Guidance for Habitat Survey and Mapping. The Heritage Council.

Sutherland, W.J. 1996. (ed). *Ecological census techniques: a handbook*. Cambridge University Press.

Sutherland, W.J., Newton, I. & Green, R.E. 2004. Bird Ecology and Conservation: A Handbook of Techniques. Oxford University Press, Oxford.

Regan, E.C., Nelson, B., Aldwell, B., Bertrand, C., Bond, K., Harding, J., Nash, D., Nixon, D., & Wilson, C.J. 2010. Ireland Red List No. 4 – Butterflies. National Parks and Wildlife Service, Department of the Environment, Heritage and Local Government, Ireland.

Wyse Jackson M., FitzPatrick Ú., Cole E., Jebb M., McFerran D., Sheehy Skeffington M. & Wright M. 2016. Ireland Red List No. 10: Vascular Plants. National Parks and Wildlife Service, Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs, Dublin, Ireland.

# 7.0 POPULATION HUMAN HEALTH AND AGRICULTURE

This chapter of the Environmental Impact Assessment Report has been prepared by Tom Phillips + Associates and AWN Consulting. The chapter examines the potential impacts of the proposed development on population and human health.

The chapter is separated into three sections. The first section (Section 7.2) has been undertaken by Tom Phillips + Associates and evaluates the potential direct and indirect effects of the proposed development on the surrounding population in terms of demographic, socio-economic and amenity impacts. The second section (Section 7.3) has been undertaken by AWN Consulting with input from WSP and addresses the potential direct and indirect effects of the proposed development on human health. The third section (Section 7.4) has been undertaken by ConsultUCD and addresses the potential direct and indirect effects of the proposed development on Agriculture and Animal Health.

## 7.1 The Proposed Development

The proposed development consists of works to the Bauxite Residue Disposal Area (BRDA) comprising of an expansion to increase its disposal capacity to accommodate additional bauxite residue arising from the continued operation of the permitted alumina refinery plant located on the wider AAL facility. The proposed increase in disposal capacity to the BRDA will result in a proposed increase in height of c.12m above the currently permitted stage 10 level (c. 32m OD) to a final stage 16 level (c. 44m OD). No increase to the existing footprint of the BRDA is proposed.

The proposed method of raising the BRDA will be the upstream method, consistent with the construction methodology for the current BRDA and involves the construction of rock fill embankments (Stages), offset internally and founded on the previously deposited and farmed bauxite residue, in 2 m high vertical lifts. The overall BRDA is raised systematically as the stages are filled with bauxite residue, farmed, carbonated and compacted, prior to deposition of the next layer.

Additional works proposed as part of this application include the following:

- A vertical extension to the existing Salt Cake Disposal Cell (SCDC) to accommodate further disposal of salt cake resulting in an increase in height of c.2.25m. The SCDC is located within the BRDA. A description of the SCDC and its function is provided in Chapter 2 of this EIAR.

- An extension of the existing borrow pit, located to the east of the BRDA, is also proposed. This extension proposes to increase the footprint of the borrow pit from c.4.5ha to c.8.4ha. This expansion will provide an additional 385,000m$^3$ of rock fill material which is needed to satisfy the requirements of the construction and operation of the BRDA.

- The continued use of an existing stockpile area at the south east of the subject site to store topsoil in order to satisfy the additional restoration requirements of the extended BRDA.

- Modifications to the existing water management infrastructure to accommodate the BRDA development to Stage 16 which will also allow for greater Inflow Design Flood (IDF) capacity for the entirety of the BRDA.

Please refer to Chapter 3.0 of this EIAR and the Engineering Design Report (enclosed in Appendix A) for a more detailed description of the proposed development.

## 7.2 Population

As noted above, this section of the chapter addresses the potential direct and indirect effects of the proposed development on the surrounding population in terms of socio-economic and amenity impacts.

### 7.2.1 Methodology

The following guidelines have informed the preparation of this section:

- Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessments (Department of Housing, Planning and Local Government – August, 2018)
- Guidelines on the Information to be Contained in Environmental Impact Assessment Reports (EPA, Draft August 2017)
- Guidelines on the Information to be Contained in Environmental Impact Assessment Reports (EPA, 2002)
- Environmental Impact Assessment of Projects – Guidance on the preparation of the
- Environmental Impact Assessment (European Union, 2017)

The preparation of this chapter was also informed by site visits and desktop studies of relevant policy documents and data sources including:

- Central Statistics Office (2016) - Census 2016
- Limerick County Council Development Plan 2010-2016 (As extended)
- Limerick City Development Plan 2010-2016 (As extended)
- Draft Limerick City and County Development Plan 2022-2028
- ESRI (2021) - Quarterly Economic Commentary, Summer 2021
- ESRI (2016) - Ireland’s Economic Outlook: Perspectives and Policy Challenges
- Health Safety Authority – www.hsa.ie

In order to assess the likely significant impacts of the proposed development on population, an analysis of recent Census data was undertaken. Data relating to the economic, demographic and social characteristics of the Local Authority District within which the subject site is located were examined.

The assessment of impacts on population entailed the identification of key populations potentially affected by the proposed development; a definition of the study area; and quantitative, qualitative, and documentary research.

Key populations potentially affected by the proposed development have been identified as persons residing and engaging in activities at or in close proximity to the subject site, persons with a stake in the general economy of the area, and persons enjoying the recreational and cultural amenities of the area.

***Study Area***

The primary Study Area has been defined as the District Electoral Division (DED) of Aughinish. Along with its three surrounding District Electoral Divisions of Askeaton West, Craggs and Shanagolden. The chosen study area includes all residences located within close proximity (c.5km) of the subject site.

Reference will also be made to the Limerick County area (which contains the District Electoral Divisions within the outlined study area mentioned above) and to the State as a whole. Research involved site visits, review of relevant policy documents and the analysis of population data supplied by the Central Statistics Office.

### 7.2.2 Receiving Environment

The area in which the subject site is located is predominantly rural in character. The AAL facility is prominent within the local area with agriculture being the dominant land use in the surrounding area.

The landscape generally consists of a low lying, agricultural landscape which extends to south and west of the Island from Foynes east through Barrigone to southeast of Askeaton. The low-lying terrain does include localised variations in topography, and field and road boundaries are typically defined by hedge and tree rows. Pasture predominates as a land use and there is little arable farming in the area.

Residential property is generally dispersed along local roads with increased density notable at settlements such as Barrigone, Fawnamore and along the N69 leading into Foynes and Askeaton.

### 7.2.4 Key Factors

#### 7.2.4.1 Population Trends

Population data for the study area has been obtained from the Central Statistics Office (CSO) for the purposes of this assessment and have been summarised in Tables 7.1 and 7.2. The local study area is comprised of 4 No. Electoral Divisions (EDs), including Aughinish. Askeaton West, Craggs and Shanagolden.

During the period of 2011 to 2016, the study area has grown by just 0.1% owing to the declining population within the Craggs and Shanagolden Electoral Divisions which both saw a decrease of 5.1% and 2.0%, respectively. This is much lower than the growth at Local Authority level at 1.6% and State level at 3.8%. However, we note that the Aughinish ED, including the proposed development site, has indicated a higher growth rate of 11.7% in the recent 5-year period.

**Table 7.1: Population Trends at LA and State Level (Source: CSO 2011, 2016).**

| Study Area | 2011 | 2016 | % Change |
|---|---|---|---|
| Limerick City and County[1] | 191,809 | 194,899 | 1.6% |
| Ireland | 4,588,252 | 4,761,865 | 3.8% |

**Table 7.2: Population Trends at Local Electoral Division Level (Source: CSO 2011, 2016).**

| Electoral Divisions | 2011 | 2016 | % Change |
|---|---|---|---|
| Aughinish | 213 | 238 | 11.7% |
| Askeaton West | 1,178 | 1,186 | 0.7% |
| Craggs | 272 | 258 | -5.1% |
| Shanagolden | 946 | 927 | -2.0% |
| **Cumulative ED Study Area** | 2,609 | 2,609 | 0% |

#### 7.2.4.2 Employment Industry

Employment industry data for the study area has been obtained from the Central Statistics Office (CSO) for the purposes of this assessment and are summarised in Tables 7.3 and 7.4 to include data at State level as well as the three surrounding EDs, Askeaton West, Craggs, and Shanagolden.

At State level, a majority of the population are employed within the Commerce and Trade and Professional Services Industries, both accounting for c.24% each of the total persons at work. Similar percentages are observed at the Limerick City and County level at c.21% and c.25% respectively. We note that at both County and State level, the Agriculture Forestry and Fishing and Transport and Communications industries saw a decline in number of persons at work.

[1] These figures account for combined results of segregated 2011 CSO data available for Limerick City and Limerick County prior to the merging of local authorities.

**Table 7.3: % Change in Persons aged above 15 years by Industry at LA and State Level (Source: CSO 2011, 2016).**

| Study Area | 2011 (A) | % of Total | 2016 (B) | % of Total | % Change[2] |
|---|---|---|---|---|---|
| **Limerick City and County[3]** | | | | | |
| Agriculture Forestry and Fishing | 4,331 | 6.1% | 4,263 | 5.5% | -1.6% |
| Building and Construction | 3,560 | 5.0% | 3,702 | 4.8% | 4.0% |
| Manufacturing Industries | 10,757 | 15.1% | 11,506 | 14.9% | 7.0% |
| Commerce and Trade | 15,982 | 22.5% | 16,529 | 21.4% | 3.4% |
| Transport and Communications | 4,968 | 7.0% | 5,652 | 7.3% | 13.8% |
| Public Administration | 3,473 | 4.9% | 3,376 | 4.4% | -2.8% |
| Professional Services | 17,537 | 24.7% | 19,278 | 25.0% | 9.9% |
| Other | 10,433 | 14.7% | 12,879 | 16.7% | 23.4% |
| **Total** | **71,041** | **100%** | **77,185** | **100%** | |
| **Ireland** | | | | | |
| Agriculture Forestry and Fishing | 91,526 | 5.1% | 89,116 | 4.4% | -2.6% |
| Building and Construction | 87,371 | 4.8% | 101,849 | 5.1% | 16.6% |
| Manufacturing Industries | 209,803 | 11.6% | 229,548 | 11.4% | 9.4% |
| Commerce and Trade | 456,289 | 25.2% | 480,117 | 23.9% | 5.2% |
| Transport and Communications | 146,530 | 8.1% | 171,194 | 8.5% | 16.8% |
| Public Administration | 113,860 | 6.3% | 106,797 | 5.3% | -6.2% |
| Professional Services | 425,349 | 23.5% | 471,656 | 23.5% | 10.9% |
| Other | 276,632 | 15.3% | 356,364 | 17.8% | 28.8% |
| **Total** | **1,807,360** | **100%** | **2,006,641** | **100%** | |

At the District Electoral Division level, the Cumulative ED Study Area results show an increase in number of persons at work across most industries except the Manufacturing Industries and Transport and Communications industry which demonstrates a 7.1% and 2.8% decrease respectively since 2011.

**Table 7.4: Persons aged above 15 years by Industry at Local Electoral Division Level (Source: CSO 2011, 2016).**

| Cumulative ED Study Area (Aughinish, Askeaton West, Craggs, Shanagolden) | 2011 | % of Total | 2016 | % of Total | % Change |
|---|---|---|---|---|---|
| Agriculture Forestry and Fishing | 46 | 4.8% | 50 | 5.0% | 8.7% |
| Building and Construction | 47 | 4.9% | 53 | 5.3% | 12.8% |
| Manufacturing Industries | 210 | 21.9% | 195 | 19.4% | -7.1% |
| Commerce and Trade | 186 | 19.4% | 194 | 19.3% | 4.3% |
| Transport and Communications | 107 | 11.2% | 104 | 10.3% | -2.8% |
| Public Administration | 30 | 3.1% | 45 | 4.5% | 50.0% |
| Professional Services | 211 | 22.0% | 214 | 21.3% | 1.4% |
| Other | 122 | 12.7% | 152 | 15.1% | 24.6% |
| **Total** | **959** | **100.0%** | **1007** | **100.0%** | |

[2] Calculated using the formula –(B-A)/A = % Change in number of persons employed in each industry.

[3] These figures account for combined results of segregated 2011 CSO data available for Limerick City and Limerick County prior to the merging of local authorities.

#### 7.2.4.3 Employment Status

The alumina extraction plant operated by the Applicant at Aughinish Island provides a total of 482 jobs directly plus another 385 maintenance and installation contractor employees, with considerable further employment for local service industries.

8 people in the ED of Aughinish are classed under 'Unemployed' and 'Looking for First Job'. This combined figure represents 4 per cent of the Labour Force. This is compared to County Limerick and the State at 8 per cent which show similar rates as per the 2016 census data.

The most recent ESRI Quarterly Economic Commentary however (Summer 2021) shows that the national unemployment rate as a percentage of the total labour force will reduce back to an expected 9.0 per cent by Q4 of 2021 from a 22.4 per cent in April 2021, with the average unemployment rate overall being 16.3 per cent for 2021 and 7.1 per cent for 2022.

Most recent CSO data in relation to Covid 19 adjusted unemployment rate figures demonstrates that this figure stood at 17.1% in August 2020 and has declined to 12.4% in August 2021 as public health restrictions have eased.

**Live Register**

More recent information regarding unemployment is provided by Live Register data. The Live Register is a monthly measurement of the numbers of people (with some exceptions) registering for Jobseekers Benefit (JB) or Jobseekers Allowance (JA) or for various other statutory entitlements at local offices of the Department of Employment Affairs and Social Protection (DEASP). As a result, this data source, whilst not providing an unemployment figure, can provide a good indication of up-to-date employment trends and economic activity in the subject site area.

Live Register figures are available at a national, county and local DEASP welfare office level. At local level, the relevant DEASP Social Welfare Office is located in Newcastle West. Figures at national, county and local levels, referenced in Table 7.5 below, all reflect a significant downward trend in the numbers recorded on the Live Register between January 2016 (the last census year) and January 2021. However, it is noted that between January 2021 and June 2021 Live Register figures at local levels have increased slightly due to the COVID 19 Pandemic.

**Table 7.5: A Comparison of Live Register Figures**

| Area | Jan. 2016 | Jan.2021 | June 2021 |
|---|---|---|---|
| **State** | 321,513 | 188,543 | 175,281 |
| **Limerick** | 13,421 | 7,243 | 6,881 |
| **Newcastle West** | 1,899 | 810 | 828 |
| | | | **Source: CSO Data 2021** |

In addition to the above figures, it is noted that additional persons have been in receipt of the Pandemic Unemployment Payment (PUP) since the outbreak of the Covid 19 pandemic in March 2020. The number receiving PUP in August 2020 stood at 226,959 across the State. In August 2021, this had decreased significantly to 143,606. As restrictions continue to ease and the economy fully reopens, the numbers receiving this temporary payment are anticipated to decrease significantly.

The proposed development seeks to ensure that the AAL facility continues to provide high levels of employment in the area beyond 2030 and thus maintain the relatively low levels of unemployment in the area when compared to 2016 levels.

#### 7.2.4.4 Economy

The Economic and Social Research Institute (ESRI) Quarterly Economic Commentary Summer 2021 notes that whilst 2021 saw a number of challenges emerge due to COVID-19 which had significant adverse impacts on the domestic Irish economy; the domestic growth outlook is expected to improve as the domestic demand is predicted to increase by 6.4 per cent in 2021 and 7.3 per cent in 2022.

The Commentary forecasts that Gross Domestic Product will grow by 11.1 per cent in 2021 and 6.9 per cent in 2022 which is still higher than the growth recorded in 2020 which stood at 3.4 per cent.

KPMG have carried out a Socio Economic Impact Statement of the current and potential future impact of AAL (Appendix 7.1 refers). Having regard to impact on the economy, the Statement notes that:

- Aughinish's operational activities and those of its supply chain generate €130 million in value for the Irish economy. Each €1 spent by Aughinish results in an additional €0.40 spend by suppliers.
- Aughinish's capital investment activities and the additional spend of suppliers generates ~€10 million in value for the Irish economy and, in particular, for the Mid-West.
- In 2021, capital investment will be more than 60% higher than in 2020 and will grow further as Aughinish's own contribution to decarbonisation, waste reduction, community amenities and other environmental projects increases over the coming years.
- Aughinish supports ~965 jobs through its spend on suppliers and across its value chain: ~840 jobs arising from operational activities and ~125 jobs arising from its capital activities.
- Through its operational activities, Aughinish supports the payment of ~€50 million in labour income across its supply chain. Additionally, labour income arising from capital activities is ~€6 million.
- The Aughinish CHP Plant (the largest in Ireland) produces 160 megawatts (MW) of electricity, using 45 MW to power the refinery and exporting 115MW of power to the national grid; enough to power 200,000 households.
- In 2020, the plant spent a total of €373 million on operational activities and €18 million on capital investment activities – significant sums in the context of the Mid-West economy.
- Aughinish's natural deep-water port is the third largest nationally in total tonnage after Dublin and Cork.

#### 7.2.4.5 Services and Amenities

The most proximate settlement centre is Foynes, which is located approximately 2.5 km to the west of the subject site, with Askeaton located c. 5 km to the west. These centres accommodate a range of services and facilities including, shops, restaurants, schools, banks, post offices and medical practices.

To the east of the subject site, Aughinish Nature Trails represents a recreational amenity area for both the local and wider area. A new Nature Trail / Walk has recently been permitted and is located to the east of the access road leading to the facility.

Limerick City is located c. 35 km to the east of the site. In this regard, there are a wide and diverse range of services and facilities located here within relatively close proximity of the subject site.

### 7.2.5 Likely Impacts

Consideration is given to the likely impacts of the development on the factors outlined above in Section 7.2.4. This consideration focuses on the overall impact if the development were not to proceed. It also focuses on the impact of the development at the construction/operational phase of the development. Due to the nature of the development, the construction and operational phases of the development are not separated as both will be ongoing as the Bauxite Residue and Salt Cake are deposited in the BRDA and as rock is extracted from the expanded borrow pit area.

#### 7.2.5.1 Impacts on Population

*Do Nothing Scenario*

In the absence of the proposed development, the alumina refinery facility would continue to operate at existing levels until c.2030 when the capacity of the permitted BRDA would be reached. In the longer term however, the facility would have to close as there would be no disposal area available to accommodate the bauxite residue deposits arising from the production process.

The closure of the facility would reduce the number of people employed in the area and employment prospects generally in the wider area, thereby decreasing the attractiveness of the area to potential new residents and also to existing residents who may be forced to relocate in order to find employment. The closure of the facility is thus likely to have a negative impact on population trends in the wider area.

*Do Something Scenario*

Were the proposed development to proceed, it would facilitate the ongoing operation of the wider refinery facility beyond 2030. Thus, the current significant levels of employment provided by the facility would be maintained into the longer term. This would likely ensure that current population trends would remain stable and continue to increase as a secure source of employment would remain in the locality attracting residents to the wider area.

The proposed development would thus result in a slight positive impact on population trends in the wider area.

#### 7.2.5.2 Impacts on Employment

*Do Nothing Scenario*

Were the development not to proceed, the BRDA would reach full capacity in c.2030 and the adjoining refinery facility would be forced to close as there would no longer be an area in which bauxite residue could be deposited. As such, whilst there would be minimal short-term impacts on employment as the facility continued to operate, there would be significant loss of employment in the wider area in the longer term.

Given the specialist nature of the facility and the large numbers employed, it is likely that replacement employment would be difficult to attain in the local area. As such, it is likely that there would be significant negative impacts on employment in a 'do nothing' scenario.

*Do Something Scenario*

The proposed development would facilitate the ongoing operation of the existing refinery facility and would thus ensure that the existing high levels of employment at the site were maintained. The continuation of the current high employment levels would represent a significant positive impact on employment figures in the area in the longer term.

#### 7.2.5.3 Impacts on Economy

*Do Nothing Scenario*

As noted above, the facility would be required to close in a 'do nothing' scenario. This would result in a large loss of employment and investment for the wider area and would thus have a significant direct negative impact on the economy of the wider area.

Indirectly, the loss of employment, wages and investment resulting from the closure of the facility would negatively impact upon businesses in the area which rely upon workers at the facility to purchase their goods and services.

*Do Something Scenario*

The progression of the proposed development would facilitate the ongoing operation of the facility into the longer term. It would thus secure investment and employment in the area and ensure that businesses in the area continued to indirectly benefit from the spending of well-paid workers at the facility. The proposed development would thus have a significant positive impact on the economy of the wider area.

#### 7.2.5.4 Impacts on Services and Amenities

*Do Nothing Scenario*

In a 'do nothing' scenario, there would be a significant loss of employment and investment in the wider area. This would have a significant negative impact on business owners in the area who are reliant on the custom of well-paid employees hired at the facility and who also rely on the custom of the facility itself for sub-contracting work. The loss of this customer base would have a significant negative impact on local businesses in Askeaton and Foynes and may result in some service and goods providers having to close as a result.

*Do Something Scenario*

In a 'do something' scenario, the facility would continue to operate, employment levels would remain strong and investment would continue to be directed into the wider area. This would ensure that there would continue to be a large pool of well-paid persons in the wider area with incomes to spend on services and goods in the locality. This would result in a significant positive impact on the provision of services in the wider area.

### 7.2.6 Additional Factors

#### 7.2.6.1 Landscape and Visual

Chapter 9 of this EIAR assesses the landscape and visual impacts of the proposed development. The effect of the proposed development on surrounding views including on residential receptors, amenity areas and scenic routes are assessed. With regard to residential receptors, whose sensitivity is classed as high, it is anticipated that following completion and restoration of the development, effects will be not significant, slight or moderate neutral in the long term. Please refer to Chapter 9 for a detailed overview of the effects of the proposed development in terms of landscape and visual impact.

#### 7.2.6.2 Traffic

Chapter 14 of this EIAR assesses the traffic and transportation impacts of the proposed development. This assessment finds that the proposed development will result in a minor increase in traffic levels in the surrounding area. It is noted that the forecasted traffic levels for the N69 (the main road in the surrounding area) will still be well below the theoretical capacity for this road. It is concluded that the proposed development will have no material impact upon the operation of the local road network and as such no mitigation measures are recommended.

As such, the proposed development will not result in significant impacts for the surrounding population in traffic terms.

#### 7.2.6.3 Health & Safety

AAL operates a safety management system at the wider refinery facility including the subject site. The safety management system operates to the International Safety Rating System (ISRS).

ISRS is a proactive programme of Loss Control Management which requires that standards are developed for its programme elements and outline what activities are to be carried out, by whom and at what frequency. The ISRS elements which form the basis of the RUSAL Aughinish loss control programme are:

| | |
|---|---|
| Element No 1 | Leadership and Administration |
| Element No 2 | Leadership Training |
| Element No 3 | Planned Inspections |
| Element No 4 | Critical Task Analysis & Procedures |
| Element No 5 | Accident / Incident Investigation |
| Element No 7 | Emergency Preparedness |
| Element No 8 | Rules and Work Permits |
| Element No 9 | Accident / Incident Analysis |
| Element No 10 | Knowledge and Skills Training |
| Element No 11 | Personal Protective Equipment |
| Element No 12 | Health and Hygiene Control |
| Element No 14 | Engineering and Change Management |
| Element No 15 | Personal Communications |
| Element No 16 | Group Communications |
| Element No 17 | General Promotion |
| Element No 18 | Hiring and Placement |
| Element No 19 | Material and Service Management |

<u>The Safety Management System of AAL ensures:</u>

- Proactive monitoring of the work place to identify all occupational safety and health hazards. When elimination of any such hazards is not feasible, every possible measure will be taken to control them
- Line Management are assigned the responsibility for the implementation of our safety management programme
- Qualified resources are provided to train educate and support both our employees and on-site contractors on safe work practices
- Safety, health and welfare issues form an integral part in the evaluation and decision-making process in capital expenditure and purchases of goods and services
- All employees and contractors understand that they must work safely, participate in risk assessments and implement control measures, report all incidents and hazards and to co-operate with the company in the achievement of a work place that is safe
- Continuous improvement by investigating incidents and accidents; implementing a robust system for identifying and closing any gaps in our systems and locking in lessons learned

AAL employ a full time Safety Coordinator, who has overall responsibility for the Safety Management System.

All contractors and subcontractors are required to comply with the company's control of contractor's procedures. In this regard, all contractors must possess appropriate insurances, be appropriately competent and provide method statements and risk assessments in advance of any works to be undertaken on the site.

Security fencing surrounds the perimeter of the BRDA and of the wider facility and CCTV monitors access locations. This ensures that access to the facility is strictly controlled and monitored at all times.

No residual health and safety concerns are anticipated.

External Emergency Plan for BRDA

As part of the EPA Licence for the site, an External Emergency Plan (EEP) for the BRDA is required. This was most recently updated and approved by Limerick City & County Council in August 2019, following discussions between stakeholders.

The EEP is activated without delay if a major accident occurs or an uncontrolled event occurs which could be reasonable expected to escalate into a major accident. The responsibility for activating the plan falls to identified personnel from Aughinish Alumina Ltd. and Limerick City & County Council.

The key actions in the plan for personnel at Aughinish Alumina Ltd. are set out below.

| KEY ACTIONS – Aughinish Alumina Ltd. | |
|---|---|
| 1. | Implement the pre-determined emergency response arrangements as set out in the Internal Emergency Plan (comprising Rusal Aughinish Emergency Response Plan and BRDA Containment Failure – Emergency Procedure). |
| 2. | Contact Limerick City & County Council to prompt the activation of this External Emergency Plan and provide all relevant information provided as per sections 1.3 and 1.4 of this plan. Contact EPA as per Condition 9.3 of AAL's IPPC Licence. |
| 3. | Ensure that a Meeting Point is identified and communicated to the Planning & Environmental Section of Limerick City and County Council. |
| 4. | Ensure the conference room in the on-site co-ordination centre is available along with 4 information boards/flip charts to detail (1) Current Situation (2) Key Issues (3) Strategic aims/priorities (4) Actions |
| 5. | Arrange for the Environmental Manager to meet with the Senior Officers of Limerick City and County Council at the agreed Meeting Point. |
| 6. | Provide all relevant information to the Limerick City and County Council in relation to the incident. |
| 7. | Provide site specific PPE and diphotherine spray to agencies where required. Identify location of drench showers and additional supplementary supplies of PPE / dipotherine on the BRDA road. |
| 8. | Provide a marshalling officer at Rendezvous Point (RVP). |
| 9. | Ensure that there is a co-ordinated public and media response, with Limerick City & County Council, to the emergency as outlined in Section 6.0 of the External Emergency Plan. |
| 10. | If required, establish a Media Briefing Centre in con-junction with Limerick City & County Council. |

**Figure 7.1: Extract from External Emergency Plan for Bauxite Reside Disposal Area (Limerick City & County Council, August 2019)**

Appendix B of the EEP highlights the meeting point at the facility as the reception / security building and includes details of site access and egress routes from the facility. The above measures are not impacted by the proposed development.

### 7.2.7 Mitigation Measures

No additional mitigation measures are deemed necessary over and above those outlined elsewhere in this EIAR in respect of environmental factors.

### 7.2.8 Residual Impacts

The proposed development is anticipated to result in a significant positive residual impact in terms of employment generation and economic contribution to the local area as it will facilitate the continued operation of the AAL facility beyond 2030.

## 7.3 HUMAN HEALTH

### 7.3.1 Introduction

This section addresses the likely significant direct and indirect effects of the proposed development on human health. It has been prepared by AWN Consulting Limited – Dr Fergal Callaghan (BSc(Chem) PhD(ChemEng) MRSC AMIChemE and reviewed by Teri Hayes, Director with AWN Consulting Ltd.

Dr Callaghan is a Director with AWN Consulting Ltd with responsibility for Risk Assessment with over 30 years experience, he is a member of the Royal Society of Chemistry (MRSC) and an associate Member of the Institute of Chemical Engineers (AMIChemE), he has a BSc in Industrial Chemistry and a PhD in Chemical Engineering.

A separate "Human Health Assessment for Bauxite Residue and Salt Cake" has been prepared by Theresa Rapaso-Subang, Senior Technical Lead, Toxicology and Risk Assessment, WSP Canada Inc. (WSP) and a copy of that Human Health Assessment is appended to this Chapter as Appendix 7.3.

The Human Health Assessment (HHA) prepared by WSP evaluated the toxicity of bauxite residue and salt cake by-products, assessed the source-pathway-receptor linkage to understand causal relationship between predicted exposures and bauxite residues / salt cake, as well as characterized health risks, if any, of nearby human populations with potential exposures released from the Project. The conclusions of the Human Health Assessment have been incorporated into this Chapter.

#### 7.3.1.1 Background

The proposed development consists of works to the Bauxite Residue Disposal Area (BRDA) comprising of an expansion to increase its disposal capacity to accommodate additional bauxite residue arising from the continued operation of the permitted alumina refinery plant located on the wider AAL facility. The proposed increase in disposal capacity to the BRDA will result in a proposed increase in height of c.12m above the currently permitted stage 10 level (c. 32m OD) to a final stage 16 level (c. 44m OD). No increase to the existing footprint of the BRDA is proposed.

The proposed method of raising the BRDA will be the upstream method, consistent with the construction methodology for the current BRDA and involves the construction of rock fill embankments (Stages), offset internally and founded on the previously deposited and farmed bauxite residue, in 2 m high vertical lifts. The overall stack is raised systematically as the stages are filled with bauxite residue, farmed, carbonated and compacted, prior to deposition of the next layer.

Additional works proposed as part of this application include the following:

- A vertical extension to the existing Salt Cake Disposal Cell (SCDC) to accommodate further disposal of salt cake resulting in an increase in height of c.2.25m. The SCDC is located within the BRDA. A description of the SCDC and its function is provided in Chapter 2 of this EIAR.

- An extension of the permitted borrow pit, located to the east of the BRDA, is also proposed. This extension proposes to increase the footprint of the borrow pit from c.4.5ha to c.8.4ha. This expansion will provide an additional 380,000m$^3$ of rock fill material which is needed to satisfy the requirements of the construction and operation of the BRDA.

- The continued use of an existing stockpile area at the south east of the subject site to store topsoil in order to satisfy the additional restoration requirements of the extended BRDA.

- Upgrades to the existing water management infrastructure to accommodate the BRDA development to Stage 16 which will also allow for greater Inflow Design Flood (IDF) capacity for the entirety of the BRDA.

Given that the proposed BRDA Raise and the proposed SCDC Raise sit entirely within the footprint of the existing BRDA, where reference is made to the BRDA within the following text, this will refer to both the BRDA and the SCDC areas unless otherwise stated. Please refer to Chapter 3.0 of the EIAR for a more detailed development description.

### 7.3.2 Methodology

In accordance with the Draft EPA Document (Revised Guidelines on the Information to be Contained in Environmental Impact Statements) (2017), this chapter has considered that:

> *"in an EIAR the assessment of impacts on population and human health should refer to the assessment of those factors under which human health effects might occur, as addressed elsewhere in this EIAR e.g. under environmental factors of air, water soil etc".*

This assessment has been prepared following review of:

- Draft Guidelines on the Information to be Contained in Environmental Impact Assessment Reports (EPA, 2017),
- Draft Advice Notes for Preparing Environmental Impact Statements (EPA, 2015), and European Commission (EC), Environmental Impact Assessment of Projects:
- Guidance on the preparation of the Environmental Impact Assessment Report (EU, 2017)

As per Article 3 of Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment, as amended by Directive 2014/52/EU:

1) *The environmental impact assessment shall identify, describe, and assess in an appropriate manner, in the light of each individual case, the direct and indirect significant effects of a project on the following factors:*
   a) *population and human health;*
   b) *biodiversity, with particular attention to species and habitats protected under Directive 92/43/EEC and Directive 2009/147/EC;*
   c) *land, soil, water, air and climate;*
   d) *material assets, cultural heritage and the landscape;*
   e) *the interaction between the factors referred to in points (a) to (d).*

*The effects referred to in paragraph 1 on the factors set out therein shall include the expected effects deriving from the vulnerability of the project to risks of major accidents and/or disasters that are relevant to the project concerned*

The 2017 publication by the European Commission (EC)*, Environmental Impact Assessment of Projects: Guidance on the preparation of the Environmental Impact Assessment Report*, considered that:

*"Human health is a very broad factor that would be highly Project dependent. The notion of human health should be considered in the context of the other factors in Article 3(1) of the EIA Directive and thus environmentally related health issues (such as health effects caused by the release of toxic substances to the environment, health risks arising from major hazards associated with the Project, effects caused by changes in disease vectors caused by the Project, changes in living conditions, effects on vulnerable groups, exposure to traffic noise or air pollutants) are obvious aspects to study.."*

The EPA Code of Practice: Environmental Risk Assessment for Unregulated Waste Disposal Sites, the defines risk assessment as a means of considering "the likelihood of occurrence and the consequences of the occurrence of an event. It represents a systematic means of determining and evaluating the nature, effect and extent of exposure a vulnerable receptor may experience in relation to a particular hazard." In such approaches, the focus is on identifying the source(s) of contaminants and their toxicity, the pathway by which the contaminants can reach a "receptor," i.e., people, animals, the environment. Pathways typically are air, surface or ground water, sediments in water, and contact with solid materials, including soils.

The above approach will be applied later in this Section to assess the potential health risks associated with the BRDA raise, salt cake cell raise and borrow pit

The magnitude of predicted impacts will be assessed as follows:

| Magnitude | Description of Magnitude |
|---|---|
| High | Change in an environmental and/or socio-economic factor(s) as a result of the proposed development which would result in a major change to existing baseline conditions (adverse or beneficial) |
| Medium | Change in an environmental and/or socio-economic factor(s) as a result of the proposed development which would result in a moderate change to existing baseline conditions (adverse or beneficial) |
| Low | Change in an environmental and/or socio-economic factor(s) as a result of the proposed development which would result in a minor change to existing baseline conditions (adverse or beneficial) |
| Negligible | Change in an environmental and/or socio-economic factor(s) as a result of the proposed development which would not result in change to existing baseline conditions at a population level, but may still result in an individual impact (adverse or beneficial) |
| No change | No change would occur as a result of the proposed development which would alter the exiting baseline conditions (adverse or beneficial) |

The significance of the predicted impacts will be assessed as follows:

| | | *Magnitude of Impact* | | | |
|---|---|---|---|---|---|
| | | Negligible | Low | Medium | High |
| Sensitivity of Receptor | Negligible | Negligible | Negligible or minor | Negligible or minor | Minor |
| | Low | Negligible or minor | Negligible or minor | Minor | Minor or moderate |
| | Medium | Negligible or minor | Minor | Moderate | Moderate or major |
| | High | Minor | Minor or moderate | Moderate or major | Major |

#### 7.3.2.1 Overview of Health Risk Assessment Approach

The HHA (included as Appendix 7.3) details the health risk assessment approach undertaken for the project. It is highlighted that risk assessment methods provide opportunities for the incorporation of public concerns and issues. This is particularly true for the problem formulation stage, as it is important that the right questions are asked, and the appropriate focus be given to subsequent stages in the assessment.

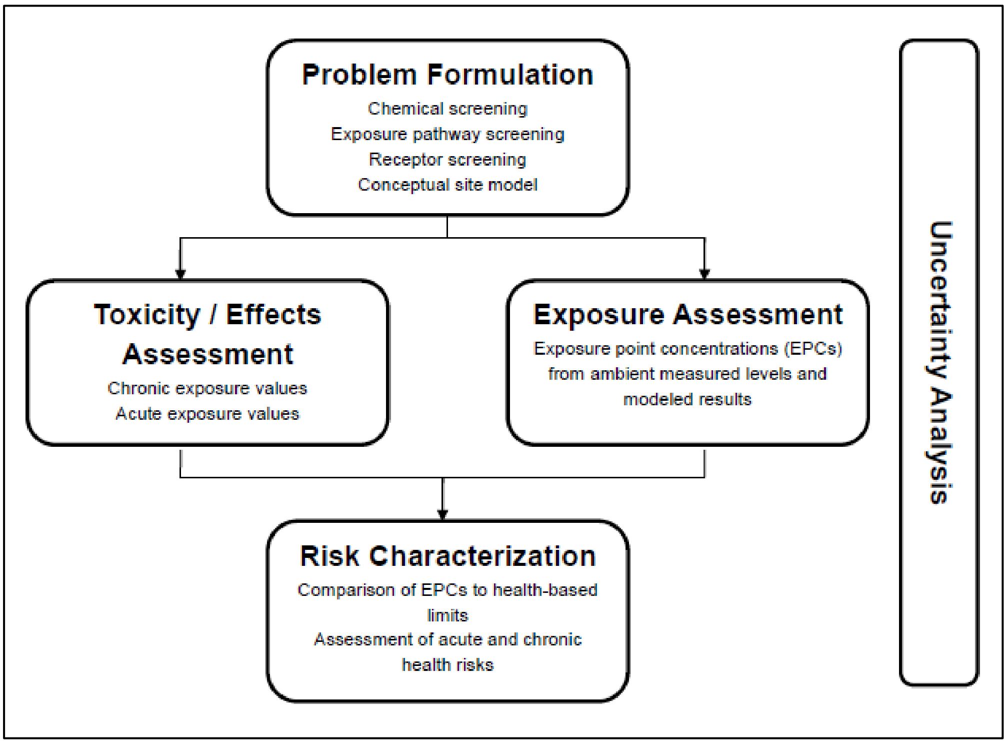
Risk assessment is widely used and recognized by regulators and the scientific community. Methods and guidance documents have been available for several years, and there is a growing body of experience in the development of risk reduction plans for proposed infrastructure projects. The risk assessment method used in the HHA is based on the following guidance documents:

- Guidance on the Management of Contaminated Land and Groundwater at EPA Licensed Sites, Ireland. Environmental Protection Agency, Office of Environmental Enforcement, 2013;
- Risk Assessment in the Federal Government: Managing the Process, United States National Research Council, National Academy Press, Washington, D.C., 1983; and
- Risk Assessment Guidance for Superfund Volume 1: Human Health Evaluation Manual (Part A), U.S. Environmental Protection Agency, EPA/540/1-89/002, dated December 1989.

Risk assessment informs the decision-making process by providing the information to *"match the effort with the risk"*. This means that the risk assessment findings inform the risk reduction plans so that they can be tailored to: (1) achieve an effective net reduction in risk; and (2) address the primary risk drivers whether these are the sources of contamination or specific pathways that link sources with receptors.

Risk assessment also allows risks to be ruled out; that is, it identifies chemicals of potential concern (COPCs) and pathways that do not represent a potential risk and can, therefore, be ruled out of consideration for risk reduction. The source-pathway-receptor model is the foundation, the core framework for the HHA that establishes the basis for understanding how risks can be reduced or eliminated.

The HHA follows a Risk Assessment Framework as per image below and further detailed in Section 3 of the HHA.




#### 7.3.2.2 Sources of Emissions During Construction and Operation

Given that the construction and operation of the BRDA, SCDC and Borrow Pit will take place in tandem, the traditional separation of construction and operational phases is not considered to be applicable in this instance. As such, it should be noted that whilst construction and operation impacts are identified, these will not take place at distinctly different time periods.

**BRDA Raise**

During the operation of the BRDA the existing operations will continue, however, the phasing of the BRDA raise over time will result in the elevation of these operations and associated emissions increasing above ground as each stage is completed.

The proposed development will generate a slight increase in heavy vehicle trips on the external road network specifically associated with the importation of soil and soil improver associated with the proposed raising of the BRDA. Table 14.8 of Chapter 14 presents the anticipated development traffic where it is anticipated that the additional number of heavy vehicle trips per day will be <13.

Furthermore, it should be noted that the use of the Borrow Pit site to source crushed stone for use by site operations has the beneficial effect of removing truck movements from the local road network where previously crushed stone was imported from off-site quarries.

Given that the operation of the BRDA extension will involve the construction of each stage elevation which in turn will require the extraction of material from the Borrow Pit, the construction and operational phases have been considered together in the air dispersion modelling and assessment provided in the Air Quality Chapter of the EIAR. Thus, dust / $PM_{10}$ / $PM_{2.5}$ emissions from the BRDA have been assumed to coincide with the emission of dust from the Borrow Pit in all modelling scenarios.

The BRDA raise is a potential source of dust emissions and has been assessed in the Air Quality Chapter by assessment of dust deposition rates, modelling of PM10 and PM2.5 and by modelling of heavy metal dust emissions.

It is also a potential source of noise and vibration impacts, which have been assessed as part of the Noise and Vibration Chapter.

Furthermore, it is a source of potential emissions to soil, water and groundwater, which has been assessed in the Soils, Hydrology and Hydrogeology sections of the EIAR.

**Salt Cake Disposal Cell Raise**

The salt cake is some 44 to 46% moisture and as such has no potential for dust generation. It is a potential source of noise emissions which is assessed in the Noise and Vibration Chapter, and it is a potential source of emissions to soil, water and groundwater, which has been assessed in the Soils, Hydrology and Hydrogeology sections of the EIAR.

**Borrow Pit**

Activities within the borrow pit will include occasional blasting of rock, on-site breaking and crushing of the rock, and excavator and dump truck movements to stockpile the materials.

The construction and operation of the Borrow Pit is a potential source of dust emissions and as noted in the Air Quality chapter of this EIAR, dust generation rates depend on the site activity, particle size, the moisture content of the material and weather conditions. Dust emissions are dramatically reduced during and after rainfall due to the cohesion created between dust particles and water and the removal of suspended dust from the air. It is typical to assume no dust is generated under “wet day” conditions where rainfall greater than 0.2mm has fallen.

Large dust particle sizes (greater than 75 microns) fall rapidly out of atmospheric suspension and are subsequently deposited in close proximity to the source. Particle sizes of less than 75 microns can remain airborne for greater distances and give rise to the potential dust nuisance at nearby sensitive receptors. This size range would broadly be described as silt.

Dust deposition typically occurs in close proximity to the dust-generating source. The proposed borrow pit extension is located within the main AAL site and therefore the nearest sensitive location beyond the AAL boundary is greater than 500m from the extraction of material. Generally, the potential for dust impacts is greatest within 100 m of dust generating activities, though residual impacts can occur for distances beyond 100 m.

The Borrow Pit is a source of noise and vibration impacts and has been assessed in the Noise and Vibration Chapter of the EIAR. It is also a potential source of soil, water and groundwater impacts and is assessed in the Soils, Hydrology and Hydrogeology sections of the EIAR

**NORM (Naturally Occurring Radioactive Materials).**

The bauxite residue is a low level source of NORM (Naturally Occurring Radioactive Material). It is an established fact that natural resources that are extracted from the ground such as coal, oil, natural gas and other mineral ores contain various amounts of natural radioactivity. When these resources are extracted and processed, their natural state can be modified which may result in the enhancement of the natural radioactivity content originally present. Such enhancements may be observed in the residues or the waste created and/or in the products or by-products and are sometimes high enough to pose a risk to both humans and the environment if they are not controlled properly. Materials of this kind are commonly referred to as Naturally Occurring Radioactive Materials or NORM.

The RPII (Radiological Protection Institute of Ireland) published a report in 2008 titled, this is included as an appendix to the HHA.

"*Radiological assessment of NORM Industries in Ireland – Radiation doses to workers and members of the public".*

The report states:

*Four large industries operating in Ireland and dealing with NORM were prioritised and investigated to determine the level of radiation to which workers and members of the public were exposed as a result of their work practices: the peat-fired power production, the coal-fired power production, the extraction of natural gas and the bauxite refining for the production of alumina (the last of these being the Aughinish site)*

*In each case, a thorough examination of the industrial process has been carried out to identify the potential radiation exposure situations arising from the occurrence of NORM at different stages of the respective process. At the core of our assessment methodology, the following aspects were targeted:*

- *the potential for enhancement of radionuclide concentrations above their natural levels in products, by-products, residues and waste;*
- *their availability to be released into the biosphere, due to physicochemical changes during processing or due to the method used to manage the residues and the waste produced.*

*Occupational radiation doses were estimated based on field measurements and analysis of samples collected onsite. For particular scenarios, exposure of members of the public were also considered: exposure to building materials containing peat and coal ash used by the construction industry, exposure to effluents discharged in the atmosphere (coal) and in rivers (peat, coal, bauxite) as well as exposure to radon for domestic gas users. Results were compared to national and international radiation protection standards to determine if any of these four industries needed to be controlled from a radiological point of view.*

*None of the four industries reviewed was found liable to give rise to an effective dose to workers or members of the public in excess of 1 mSv above background in any 12-month period.*

*As such they do not come under the scope of the Irish regulations, as far as ionising radiation is concerned. Compared to the situation in other countries, this is a very positive outcome which will need to be reviewed in the future and particular areas have already been identified for this purpose.*

As detailed in the HHA, Aughinish Alumina have commissioned more recent testing (since the testing completed by the RPII) for radionuclide content, to check if the concentrations of specific radionuclides referenced in the RPII 2008 report are still valid. It is evident that the bauxite residue samples from Q3 and Q4, 2020 were similar to those recorded by RPII in 2008 and therefore the conclusion drawn by the RPII that the radioactive dose associated with the bauxite residue is so low as to not require the BRDA to come under the remit of the relevant Irish Regulations, is still valid.

### 7.3.3 Receiving Environment

The AAL site is significant in scale and exhibits a general industrial character, characterised by silos, tanks, emissions stacks, storage buildings and miscellaneous items of plant and machinery. The lands subject to this proposed development measure c. 222ha and the alumina refinery processing plant is located to the north-east of this. The subject site is bounded by grassland and vegetation to the north, beyond which lies the Shannon Estuary. The subject site sits within a wider overall AAL landholding of c. 601ha which establishes a large landbank between the subject site and the residential and working receptors in the vicinity of the lands.

The site of the proposed BRDA raise is on the footprint of the currently permitted BRDA as is the proposed salt cake cell raise. The Borrow Pit is located within AAL lands. The identified study area for the HHA is a 10km square area which is centred on the proposed development site, illustrated in the figure below.

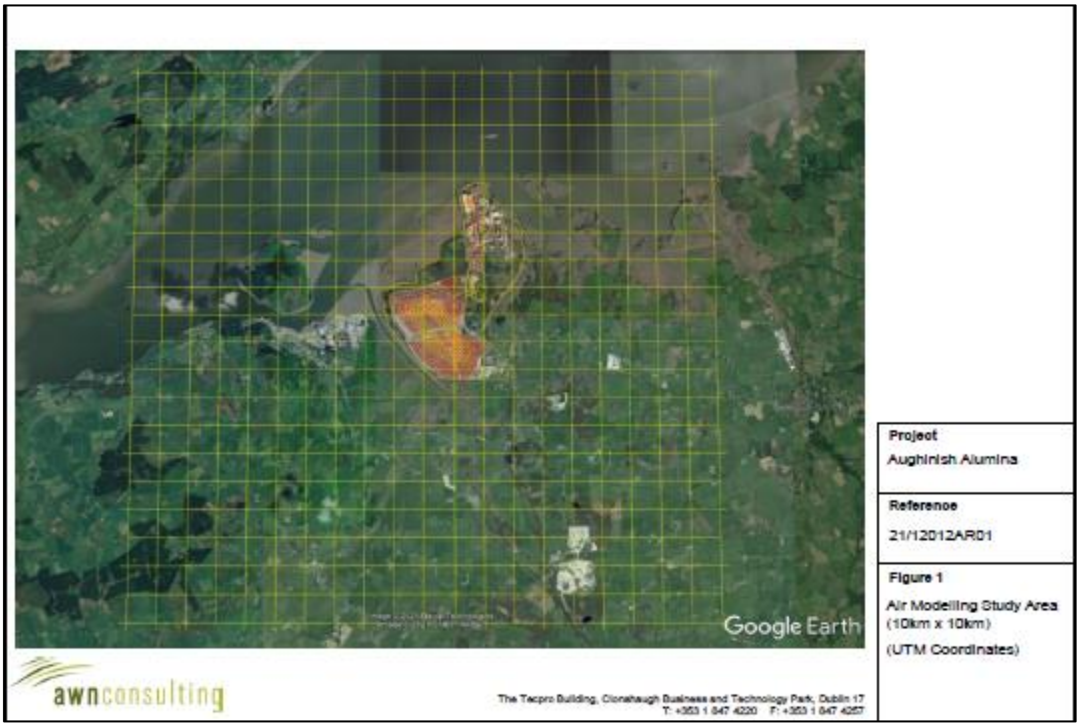



**Figure 7.3.1: Study Area for the HHA (Source: AWN Consulting)**

The human receptors evaluated in the HHA were identified on land uses within the project study area. The human receptors associated with the identified land uses are intended to be inclusive of human populations including sensitive subpopulations such as children and residents. As such, the following human receptors were identified within the Project Study Area in the HHA:

- **Schools** – Scoil Naisiunta Sheanain, a primary school with approximately 90 students, is the closest school located 1.9 km to the west of the BRDA. The HHA evaluated children, aged 5 to 13 years old, who are attending this school for a typical nine-hour day (including before and after school programs), five days per week, for 10 months (i.e., school year);
- **Workers** – Workers are considered to be adult teachers who work at the Scoil Naisiunta Sheanain primary school for a typical nine-hour work shift, five days per week, for 48 weeks of the year (i.e., assuming 4 weeks of vacation per year); and

- **Residential Community** –individuals who live in the residential communities near the Project. As was noted earlier, there are no residential receptors in the vicinity of the proposed development with the nearest receptor being over 900 metres away.

The appended HHA also characterises the health of the existing community in the vicinity of AAL by reference to County and National Level health studies and assessments (see Section 4.2.1 of the HHA – Appendix 7.3).

**Baseline Environment**

AAL currently conduct dust deposition monitoring at 24 locations and $PM_{10}$/$PM_{2.5}$ monitoring within the AAL boundary. The results of this monitoring for the period January 2016 to December 2020 are summarised in the Air Quality Chapter of this EIAR as follows:

The average dustfall levels measured at the locations were within the TA Luft limit value of 350 mg/($m^2$*day) over the years 2016 to 2020 with a maximum annual average of 111 mg/($m^2$*day) at location DG19 (see Figure 11.3 in Chapter 11 for location). The monthly average across all sites ranged from 9 - 111 mg/($m^2$*day). Overall, dustfall levels were found to be low, with the annual average across all twenty-four sites reaching at most 32% of the TA Luft limit value.

PM10 data is available from monitoring carried out at five stations owned and operated by Aughinish Alumina. These locations are in the vicinity of the facility and thus representative of baseline conditions, and the data from all five stations show low levels of PM10 with annual averages ranging from 7.9 to 10.3 µg/m3. Maximum 24-hr levels (as a 90$^{th}$ percentile) are also well below the ambient air quality standard peaking at 47% of the limit value.

Similarly, data from PM2.5 monitoring carried out by AAL at five stations show that PM2.5 levels at all five stations are low with annual averages ranging from 5.0 to 7.4 µg/m3 peaking at 30% of the limit value.

Ambient noise monitoring shows the site remains within its current EPA licence limits.

Surface and groundwater monitoring demonstrates that the site does not have significant impacts on the water environment.

### 7.3.4 Assessment of Impacts

Given that the construction and operation of the BRDA, SCDC and Borrow Pit will take place in tandem, the traditional separation of construction and operational phases is not considered to be applicable in this instance. As such, both construction and operation impacts are considered together.

#### 7.3.4.1 Construction and Operational Phase Impact

The likely potential pathways for human health impacts from the construction phase are:

- Dust generation and transmission through the air

- Noise and Vibration
- Impacts on the Water Environment

The likely receptors are:

- Residents of nearby properties - Dust and Heavy Metal
- Residents of nearby properties - Noise and Vibration
- Water Environment Impacts – no water abstraction point exists down-river of the AAL site, and groundwater beneath or in the immediate vicinity of the site is not used for drinking water purposes. As presented in Chapter 10 of this EIAR (the Hydrology and Hydrogeology Chapter the groundwater aquifer underneath the BRDA does not flow towards the farms or residences located inland of the Aughinish site.

**Air Quality**

The Air Quality Chapter has assessed the combined impacts of the BRDA raise, including salt cake raise and borrow pit construction, on human receptors. (Chapter 11 of the EIAR) notes:

> *Appendix 8 of the "Guidelines for the treatment of Air Quality During the Planning & Construction of National Road Scheme" discusses construction phase impacts. Table 11.11 (of the air quality chapter) shows the risk from dust soiling ranges from 25m – 100m and in relation to PM10, the risk ranges from 10m – 25m depending on the scale of the construction activity. Given that the façade of the nearest residences is approximately 1 km from the proposed site, the guidance above would indicate that there is negligible potential for impacts from soiling, PM10 and to vegetation and therefore, no significant impacts are expected when the mitigation measures outlined in Section 11.5.1 of the air quality chapter are taken into account. The impact due to construction dust at sensitive receptors is predicted to be temporary, reversible, and imperceptible.*

The Air Quality Chapter also concluded that the likelihood of effects from $PM_{10}$/$PM_{2.5}$ emissions, dust deposition and heavy metals emissions, from the operation of the BRDA raise, salt cake cell raise and borrow pit, after mitigation is applied, are low and are summarised as quality: negative, significance: slight and duration: long term.

**Noise and Vibration**

The Noise and Vibration chapter has assessed the combined effects of BRDA raise construction, Salt Cake cell raise construction and Borrow pit construction and notes, with regard to construction phase noise and vibration impacts that:

> *"In terms of the noise exposure of construction workers and potential hearing damage that may be caused due to exposure to high levels of noise, the Safety, Health and Welfare at Work (General Application) Regulations 2007 (Statutory Instrument No. 299 of 2007) provides guidance in terms of allowable workplace noise exposure levels for employees. The Regulations specify two noise Action Levels at which the employer is legally obliged to reduce the risk of exposure to noise. The appointed contractor will be required to comply with the Regulations and provide appropriate noise exposure mitigation measures*

*where necessary. The noise exposure level to off-site receptors during the construction phase will be below the lower Action Level and therefore the risk of noise exposure resulting in potential hearing damage to off-site receptors is minimal."*

The noise and vibration chapter also notes:

*"The assessment shows that the calculated noise level at all locations for all scenarios considered is below the daytime criterion of 55 dB LAr,T. Furthermore, the proposed BRDA raise to higher elevations will result in a reduction in noise level at some locations as a result of additional screening offered by the BRDA rock terraces stage raise embankments.*

*The noise emission from the general operation of the proposed development will not change the existing soundscape and no significant noise impact is expected."*

The noise and vibration chapter further notes:

*"With regard to blasting, the nearest sensitive location to the borrow pit is over 900m away and therefore any blast noise will have attenuated by almost 60dB. It is concluded that this would reduce blast noise to a level that is insignificant in terms of impacts at the nearest sensitive locations. Blasts would be expected to be audible in terms of an instantaneous loud noise, however, once attenuation due to distance is considered the sound pressure level of the blast would not be so high as to constitute a significant impact.*

The noise chapter also notes:

*Notwithstanding the assessment here demonstrating that air overpressure and vibration are not predicted to exceed the specified limits some good practice measures to minimise both parameters are specified in Section 12.5."*

The sensitivity of the human residential receptors to noise and air quality impacts is considered high and applying the matrix described in Section 7.3.2 above it can be concluded that as the magnitude of the impact is negligible. Having regard to the mitigation measures outlined in Chapter 12 Noise, the risk to human health is considered negligible and no additional mitigation measures are required over and above those listed in Chapter 12.

**Water Environment**

The interpretation of the hydrogeological conceptual model presented by Golder 2015 and described in Chapter 10 of this EIAR identified that the groundwater present beneath the Application Site generally comprises a freshwater lens that is both downgradient and isolated laterally from the mainland by being laterally hydraulically isolated by Poulaweala Creek and the Roberstown River and the underlying saline groundwater. It is noted that a portion of the Application Site in the southeast is within the mainland area of Glenbane West, however, groundwater flow in this area is west and north-westwards towards the Poulaweala Creek and the Robertstown River. 14 wells were identified within a 2km offset around the site (as noted in Chapter 10) but these wells are not identified to be part of the same hydrogeological system that underlies the Aughinish site.

With regard to impacts on the water environment it was concluded that the potential pathways for water-runoff from the BRDA to interact with groundwater or surface water are intercepted by appropriate barrier and drainage systems to intercept any run-off, subject it to treatment and prevent it from entering groundwater or surface water. There are no licensed discharges to surface water or groundwater from the BRDA.

Given the Proposed Borrow Pit's design maximum depth of extraction to 8.5 mOD (circa 2.5m above the groundwater table) and the size of the proposed Borrow Pit Extension site compared to the lateral extent of the mapped geological units and the distance between this site and any potential groundwater users in the vicinity of the site (c. 1.7 km east), the predicted impact on groundwater flows and levels is considered to be negligible (adverse).

The nearest mapped water borehole is located over 1.7 km from the Proposed Development and the area is known to have mains water supplies.

With the Proposed Development design measures in place, the predicted magnitude of impact is considered to be negligible (adverse). In this regard, the risk to human health is considered negligible and no additional mitigation measures are required over and above those listed in Chapter 10.

#### 7.3.4.2 Human Health Assessment

As noted in Section 7.3.1 above, a "Human Health Assessment for Bauxite Residue and Salt Cake" has been prepared by Theresa Rapaso-Subang, WSP. A copy of this report is provided as an appendix to this chapter. The HHA Executive Summary states:

*To complete the HHA, WSP evaluated the toxicity of bauxite residue and salt cake by-products, assessed the source-pathway-receptor linkage to understand causal Relationship between predicted exposures and bauxite residues, as well as Characterized health risks, if any, of nearby human populations with potential Exposures released from the Project.*

*Given that bauxite residues and salt cake waste by-products are mixtures and due to their limited (or absent) toxicology data, a literature search and review was completed for their constituents to determine the toxicology and associated health effects from exposures to solid waste mixtures as well as identify which chemicals of potential concern (or COPCs) will be carried forward for further evaluation in the HHA. All constituents were identified as COPCs for further assessment in the HHA, with exception of those constituents that were listed as "Generally Recognized as Safe" ("GRAS") by the US Food and Drug Administration (FDA). Those substances listed as GRAS have been concluded to have "no evidence in the available information …that demonstrates, or suggests reasonable grounds to suspect, a hazard to the public when they are used at levels that are now current or might reasonably be expected in the future" (US FDA, 2018). It was determined that constituents of bauxite residue and salt cake that would screened out from further assessment included: moisture, Bayer sodalite, Gibbsite, Quartz, Sodium carbonate (baking soda), Carbonate apatite, Sodium bicarbonate (baking soda), Sodium aluminate, Sodium hydroxide, Magnesium oxide, and potassium carbonate. The constituents of bauxite residue and salt cake that were screened out from further evaluation in the HHA totalled 33.5% and 61.5% of the total weight percentage, respectively.*

*Before assessing the potential health effects of Project-related emissions, the HHA characterized existing community health (i.e., Limerick county) by referring to several credible health-related sources including a 2015 Health Profile for the City of Limerick, a 2019 Health in Ireland report, and key health statistics from Ireland Central Statistics Office. Collectively, these sources suggested that the death rate for many diseases in Limerick is lower or equivalent to other counties and the national average. Death rates were only marginally higher for diseases such as myocardial infraction and other diseases of the circulatory system, and two times higher for diseases of the blood, blood forming organs, and immunological disorders. However, it is important to note that data between 2009to 2017 indicates that death rates for these diseases (and many others) are on a steady decline in Limerick.*

*The human receptors evaluated in the HHA were identified based on land use(s) within the Project Study Area and included sensitive subpopulations such as children and residents. The following human receptors were considered and evaluated in the HHA:*

- *Young children and teen students in a primary school (Scoil Naisiunta Sheanain);*
- *Adult workers (e.g., teachers) at the primary school; and,*
- *Individuals who live in residential communities near the Project.*

*A toxicological and jurisdictional review of available ambient air exposure limits was completed for all identified COPCs. Health-based TRVs were selected for each COPC and averaging period, if available, based on information obtained during this review. For non-cancer health endpoints, the findings of the risk analysis concluded the following:*

- *There are no health concerns associated with exposures to Project-related COPCs for students and teachers at the nearby primary school.*
- *Predicted health risks for students and teachers at the nearby primary school are associated with exposures to background ambient concentrations of PM10 and PM2.5; constituting over 45% to as high as 99% of the predicted health risks.*
- *There are no health concerns associated with exposures to Project-related COPCs for nearby residents, for all life stages (i.e., infancy, toddler, child, teen and adult).*

*For cancer health endpoints, the findings of the risk analysis concluded the following:*

- *Potential inhalation exposures of chromium trioxide, arsenic trioxide and PM10 from Project-related emissions are associated with de minimis incremental risk of cancer for students and teachers at the primary school as well as nearby residents.*

*The HHA was carried out to err on the side of caution to ensure that the results are protective of human health. As such, it is important to highlight that and that the conclusions were based on the following conservative approach that have been applied in the HHA:*

*The risk analysis applied worst-case Project emissions of PM10 and PM2.5 at the Project boundary. That is, all human receptors evaluated in the HHA were assumed to be exposed to maximum 24-hr concentrations, calculated as 90 percentile concentrations, at the Project boundary.*

*In addition, the exposure assessment only considered predicted air concentrations from scenario 1, which represents the earliest stage of BRDA elevation construction and the worst-case predicted air concentrations.*

*Predicted air concentrations show a slight decrease as the BRDA is raised (i.e., with each successive scenario), with the final scenario (5) having the lowest predicted air concentrations as the surface area of the BRDA is significantly reduced compared to the other scenarios. Therefore, using predicted air concentrations from scenario 1 in addition to assuming that human receptors are present at the Project boundary exposed to maximum concentrations for the purpose of the exposure assessment is considered an overly conservative approach, and is likely to overestimate risk.*

*These worst-case concentrations were selected to develop the COPC-specific exposure concentrations used for the purpose of the exposure assessment. Given that these concentrations are based along the AAL facility boundary, and that the nearest off-site receptor is located approximately 1.9 kilometres to the west of the AAL facility, use of these worst-case concentrations is considered a conservative approach, and is likely to overestimate risk.*

*The HHA assumed that emissions of the bauxite residue and salt cake predominantly occurs as particulates or fugitive dusts. To assess potential exposures to bauxite residue and salt cake, this HHA assumed their constituents will be present in the dusts emitted from the Project at the same percentage composition. That is, the predicted concentration for each COPC is based on the percentage of each COPC modelled PM10 (annual and 24-hr) and PM2.5 (annual and 24-hr) concentrations to reflect the percentage of each COPC in the dust. Therefore, this HHA assumes that both bauxite residue and salt cake are both present as dust, with levels of their constituents present at the same percentage composition as in the solid waste by-product. This assumption maintains an overly conservative approach given that the moisture content of both bauxite residue (21%) and salt cake (41% to 46%, with a mean of 44%) are high. The presence of salt cake constituents as particulates or dust is highly unlikely given that moisture content is approximately 50%.*

*Conservative assumptions were applied when calculating the exposure estimates (i.e., conservative assumptions for exposure durations and frequencies). For example, residents were assumed to be exposed to predicted exposure concentrations at the Project boundary continuously, for 24-hours, daily.*

*Based on the findings of this HHA based on the use of maximum predicted exposure concentrations of PM10 and PM2.5, and in combination with the use of overly conservative exposure assumptions applied in the risk analysis, bauxite residue and salt cake do not pose a health concern to human receptors in the nearby primary school and nearby residences.*

#### 7.3.4.3 Do ‘Nothing’ Impact

AAL produces alumina from bauxite using the Bayer process. The “do-nothing” scenario assumes that the existing operations will continue in line with the conditions of the facilities’ Industrial Emissions licence (IE Licence P0035-07) and the facility will close in 2030.

The do-nothing scenario is unlikely to alter the current ambient environment and the current concentrations of particulates, dust deposition and heavy metals.

### 7.3.5 Mitigation Measures

Mitigation measures to control dust are presented in the Air Quality Chapter 11. Mitigation measures to control noise, vibration and blasting are presented in Chapter 12. Mitigation measures to manage impacts to groundwater and surface water are presented in Chapter 10. No additional mitigation measures are required over and above these to protect human health.

### 7.3.6 Indirect Effects

AAL operates a long-established alumina extraction plant. The landholding extends to c. 601 ha. The facility is licensed, under IE Licence P0035-07, to emit dust from a range of main emission points and to emit noise. Annual noise monitoring has confirmed that levels are in compliance with the EPA license requirements. In addition, the overlap between the noise emissions from these licenced emissions points and from the BRDA raise / borrow pit is insignificant with annual noise levels not expected to change significantly as a result of the proposed development.

Air dispersion modelling of dust emissions from these main emission points has confirmed that levels are in compliance with the ambient air quality standards. In addition, the overlap between the emissions the licenced main emissions points and from the BRDA / borrow pit is insignificant.

### 7.3.7 Cumulative Impacts

There are no nearby sources with significant emissions to air or with significant emissions of noise or vibration to overlap with site emissions from the BRDA and borrow pit and thus therefore no offsite cumulative impact are relevant. With appropriate mitigation measures it is not predicted that any cumulative impacts will occur during the construction or operational phases due to air quality, dust, noise or vibration impacts. No cumulative impacts of significance were identified in the Hydrogeology and Hydrology Chapter.

It can therefore be concluded that the cumulative human health impact is considered to be negligible.

### 7.3.8 Residual Impact

There are no significant predicted residual impacts on the water environment, noise environment or on air quality and therefore no significant residual impact on human health associated with the proposed development.

### 7.3.9 Interactions

The potential interaction with Hydrogeology and Hydrology, Air Quality and Noise and Vibration has been considered in the preparation of this assessment.

### 7.3.10 Monitoring

It is recommended that surface water, groundwater, air quality, noise and vibration monitoring as presented in this EIAR and as required by the site IE Licence is undertaken.

### 7.3.10 Difficulties Encountered In Compiling Information

No significant difficulties were encountered in the process of compiling this chapter of the EIAR.

## 7.4 AGRICULTURE AND ANIMAL HEALTH

### 7.4.1 Introduction

This section of the EIAR assess the potential likely significant impacts and effects that the Proposed Development may have on agricultural activities and animal health.

This section has been prepared by:

**Dr Vivian Gath**, B.Sc, MVB, PhD, Herd Health & Animal Husbandry, School of Veterinary Medicine, UCD, is a member of the Animal Husbandry and Herd Health section of the School of Veterinary medicine. My PhD thesis was on the influence of nutrition on the reproduction of bovines. I am a lecturer in veterinary nutrition and have 30 peer reviewed publications, I am also a designated veterinarian for UCD Lyons research farm, where we have approximately 140 dairy cows, 50 beef animals, 300 ewes and 11 horses. The farm also has a small flock of goats and occasional batches of approximately 60 weaned pigs. I have been involved in a extensive DAFM investigation involving an alleged environmental impact on the health and welfare of horses on a stud farm.

**Prof Kevin McDonnell**, B.Agr.Sc, M.Eng.Sc, PhD, Ag Systems technology, School of Agriculture & Food Science and School of Biosystems and Food Engineering, UCD. Kevin McDonnell has 20+ years of experience in agricultural research and management at national and international level on research projects worth in excess of €56 million. He has published over 150 peer reviewed papers and supervised over 70 research students to completion as well as providing guidance and advice to the agricultural sector.

### 7.4.2 Methodology

This assessment has been undertaken following:

(i) A site visit to the lands and to the surrounding area;
(ii) A desktop review of published literature;
(iii) A desktop review of reports prepared in the context of previous planning applications / IE Licence applications in respect of the Aughinish Facility; and
(iv) An analysis of the available documentation and information specific to the Proposed Development.

As part of the overall site inspection a visual assessment of the land and activities on the planning application site; the overall lands within the control of AAL as well as the surrounding lands was carried out. Existing agricultural practices in the environs of the Proposed Development were also considered and appraised.

The assessment of agricultural impacts has also been informed by the assessments considered and discussed in other parts of this EIAR, in particular in the chapters on Soils Land and Geology, Air Quality, Hydrology & Hydrogeology and Biodiversity.

The overall Alumina Manufacturing Facility including the BRDA operates under an Industrial Emissions Licence (P0035-07) as issued (28$^{th}$ Sept 2021) (regulated by the Environmental Protection Agency) and under a series of planning permissions. Documentation reviewed included An Bord Pleanala Inspector’s report PL13.217976; An Bord Pleanala Inspector's report ABP301011-18; EPA Inspector's Report of Industrial Emissions Licence review (P0035-

07) of 2020; documentation relating to and in connection with the licensing of the facility conducted by the Environmental Protection Agency from 1998 to 2021.

The supporting data sources for the assessment included the 2010 Census of Agriculture (the 2020 database was not available due to Covid Delays in the Census programme). It also included the EPA Corrine land use mapping CLC 2018 Catalogue Web Service.

The data collected formed the basis of the assessment of the potential impacts of the Proposed Development on agricultural activities and animal health. The review of the associated technical literature allowed the team to assess the impact of the Proposed Development on the surrounding area and on the wider environment from an animal health and agricultural perspective.

### 7.4.3 Description of the Existing Environment

From the 2010 Agricultural Census data the agricultural land based in Co Limerick is 209,133 ha, consisting of 5,991 farms in Limerick with an average size of 34.5ha. The majority of these farms are specialist dairy (1,443) or specialist beef (3,502), with a total of 388,129 animals and the average agricultural output per farm in Limerick is €39,703 which is 29% higher than the national average.
There are no agricultural activities immediately adjoining the Proposed Development site.
The predominate land use to the south of the site is pastoral farming/agricultural, to the west there is an area of mixed pastureland and industrial, commercial units, to the east there is a mixed use of land with industrial/commercial units, natural vegetation, and pastureland further east, and to the north is a small stretch of salt marsh (EPA Corine 2018). An equine facility located at some significant distance to the east of the AAL Facility will not be affected because of its separation distance alone from the Proposed Development.

The soil type and drainage varies throughout the area. The surrounding lands primarily consist of relatively flat, low-lying and poorly drained farmland comprising of estuarine soils and clays overlying glacial till and limestone, with the two prominent soil types being the Shannon Series and the Rineanna Complex. Some of the soils are thin overlain outcropping limestone rock. These soils are free draining. In low lying areas the soils are gleys with restricted drainage owing to the nature of the soil and due to tidal influence.

### 7.4.4 Assessment of Impacts

#### i) Loss of Agricultural Land

The extension to the BRDA and the SCDC is located within the footprint of the existing BRDA and as such there will be no loss of agricultural land from this aspect of the Proposed Development.

The Proposed Development also includes an extension of the permitted borrow pit which is located within the overall AAL Facility. This area of the proposed borrow pit extension has been used as an occasional hay meadow for a local farmer when the weather allows for a crop of hay to be made. As the borrow pit extends, the use of this land as an occasional hay meadow will not be possible.

### ii) Noise

Noise arising from the Proposed Development is considered at Chapter 12 of the EIAR. Having regard to the anticipated noise levels that will be generated by the Proposed Development it is considered that there will be no effect on agriculture or on animal health arising from noise emissions.

From an agricultural and animal health perspective there will be no material change to the existing noise environment. The anticipated noise levels and the nature and frequency of that noise would not be such as to create any significant effect on agricultural activity. Chapter 12 assesses the noise levels at specified noise sensitive locations as defined in AAL's operating licence P0035-07. The levels of noise that would be experienced by animals in existing agricultural farmyards would be significantly greater than the level of noise level resulting from the proposed activity and which noise levels would be such as to be tolerated and accepted without any impact and would as a consequence have no effect on agricultural practices or on animal health.

The level of noise generated by the Proposed Development and in particular from the BRDA activity would not be significantly different than existing noise levels currently generated and it is not anticipated that there will be any impact from noise effects in respect of any of the existing agricultural activity.

The noise generated at the borrow pit as assessed in Chapter 12 will not be significant in relation to agriculture and animal health and in particular its level at the nearest agricultural property will have no impact on animal health or farming practices. Furthermore, the fact that blasting at the borrow pit will be limited to April to September and will be of a limited duration further ameliorates any impacts in that regard.

The change in the noise environment arising from the Proposed Development relative to the existing position will be imperceptible. As such, noise generated by the Proposed Development will have no impact on animal health or on farming practices.

### iii) Air Emissions

For any air emission from the Proposed Development to have an impact on agricultural activity and/or animal health there has to be a migration from the pollutant off the site and a transport pathway. In addition, there has to be a sensitive receptor.

While the types of emission have generally remained constant, there have been significant reductions in the level of certain emissions associated with the Alumina Plant operations (e.g. in the case of SOx – reductions of the order of 99%.). There is no evidence that emissions from the AAL Facility generally or from the BRDA cause any adverse effects in relation to agricultural animals nor has there been any specific attribution made as between respiratory or other adverse animal health impacts and emissions from industrial installations in the region e.g. as concluded by the EPA in its reports (2001) into animal health in the region.

Chapter 11 of the EIAR sets out the appropriate standards to be complied with in respect of air quality. While these standards are primarily designed to protect human health and the environment they also protect animal health. These standards also include a margin of appreciation which ensures that compliance with the standards will ensure that no adverse effect will arise in respect of emissions from the Proposed Development in respect of animal health or agricultural practice.

Furthermore, the separation distances from the Proposed Development to the nearest farming activity is such that the level of any emission concentrations will be significantly below the requisite standards.

In the light of the predicted emissions which are likely to be generated from the Proposed Development, it is considered that any such emission will not give rise to any significant effect on animal health or on agricultural activities generally.

Having regard to the limited potential for odour from the Proposed Development (per the Air Quality Chapter of this EIAR, the bauxite residue deposited in the BRDA is not odorous nor the saltcake in the SCDC and the activities associated with the borrow pit are not odorous) the odour profile will remain essentially unchanged if the Proposed Development is granted permission and in those circumstances it is not anticipated that there will be any significant effects on animal health or on agricultural activities related to odour.

### iv) Dust Emissions

The Proposed Development will not result in any change in dust levels from those generated by the existing BRDA and wider AAL Facility. Therefore, dust emissions arising from the Proposed Development are unlikely to have any significant effect on animal health or agricultural practices.

The international guidance is the TA Luft Dust Deposition Guideline value of 350 milligrams per square meter per day (mg/($m^2$/day)). Compliance with that standard would raise no concerns in respect of either animal health and welfare or agriculture activity. Dust monitoring carried out relating to the current activity indicate dust levels within the AAL facility boundary averaging 69mg/($m^2$/day). These are significantly lower than those required under TA Luft threshold.

AAL also carries out periodic sampling for dust (monthly) and has also installed a continuous ambient air dust monitoring system adjunct to its boundary to assess if fugitive emissions from the facility could be contributing to dust depositions off site. Based on an assessment of the dust deposition from the BRDA which was carried out by AWN Consulting, the monthly dust deposition from dust gauges at the boundary of the facility was between 1-10 mg/$m^2$/day indicating that the dust levels detected are significantly below the TA Luft standard and are comparable with expected norms for dust values in a non-industrial area. Additionally, the current dispersion modelling presented in Chapter 11 of this EIAR predict an operational contribution dust deposition rate from the BRDA plus borrow pit of between 3.3-13.1 mg/$m^2$/day. Consequently, it is not likely in those circumstances dust would give rise to any adverse effect on agriculture or animal health in the surrounding area.

### v) Water Discharges

The AAL site discharges to water consist of cleanstorm water, which is discharged into the estuary pursuant to the EPA Industrial Emissions Licence at emission points SS1, SS2 , SS3 ,SS4 and SS5 (EPA Licence P0035-07), and as a consequence will have no impact on adjoining agriculture activity or animal health. Additional there is a treated effluent discharge at emission point W1-1 controlled by the EPA licence. There are no discharges to ground water and as a consequence there would be no impact on wells or other ground water sources used in agricultural activity.

As is set out in Chapters 3, 8 and 10 of the EIAR, the borrow pit area has no hydrological links with any watercourses in the vicinity and therefore will have no impact on water quality. Surface water from the BRDA is pumped to the storm water pond and then to the wastewater treatment plant prior to licensed and monitored discharge (Chapter 10) which prevents any contamination of agricultural or livestock waters.

**Overall Summary**

It is considered that there will be no impact arising from the Proposed Development on agricultural and/or animal health in the immediate environments of the site, on the surrounding lands or in the surrounding area.

### 7.4.5 Cumulative Effects

Having considered the impact on agriculture and animal health of the proposed development cumulatively with the projects described in the Chapter 18 of this EIAR no significant cumulative effects are likely to arise.

### 7.4.6 Mitigation Measures

The potential impacts arising out of the proposed development on agriculture and animal health are insignificant and no additional mitigation measures are required other than those proposed elsewhere in the EIAR (Hydrology and Hydrogeology, Soils Lands and Geology, Air Quality and Noise and Vibration).

### 7.4.7 Residual Impacts

No residual impacts are anticipated. Following implementation of the mitigation measures specified elsewhere in the EIAR the residual impact significance is considered to be not significant.

### 7.4.8 Difficulties Encountered

The CSO 2020 database is not available owing to COVID-19 delays in the census programme.

**REFERENCES:**

EPA, Environmental Protection Agency (EPA) interactive web maps (accessed 2021)
An Bord Pleanala Inspector’s report PL13.217976 (2006)
An Bord Pleanala Inspectors report ABP301011-18 (2018)
EPA Inspectors Report of Industrial Emissions License review (P0035-07) of 2020
EPA License P0035-07 (2021)
EPA Report: Investigations of Animal Health Problems at Askeaton, County Limerick (inc DAFM VLS) 2001
EPA Report: Investigations of Animal Health Problems at Askeaton, County Limerick: Soil, Herbage, Feed & Water (inc DAFM, Teagasc, Bord Slainte) 2001.
Central Statistics Office (2010) PR 25346 Census of Agriculture 2010 - Final Results (cso.ie) (accessed 2021).

# 8.0 SOILS, LAND AND GEOLOGY

## 8.1 Introduction

This Chapter of the Environmental Impact Assessment Report (EIAR) has been prepared by Golder Associates Ireland Ltd (Golder) and addresses the potential direct and indirect significant effects, and the significance of these effects, of the Proposed Development on soils, land and geology receptors located in the vicinity of the Application Site.

The following assessment was prepared by Barry Balding (BA MSc PGeo EurGeol) and Hannah McGillycuddy (BSc MSc) in conjunction with inputs from the wider EIAR team and EIAR Chapter technical leads.

Barry is a Principal Geologist, Geophysicist, Project Director and Project Manager based in the Golder-WSP Naas Office. Barry has 30+ years of technical and management experience in consultancy and industry and has extensive experience in producing EIARs and planning applications for the extractive industry.

Hannah is a Geo-Environmental Scientist based in the Golder-WSP Naas Office. Hannah has 6 years of experience and has worked on a diverse range of projects during this time including planning applications, environmental monitoring and environmental impact assessment reports for the extractive industry.

The proposed development consists of works to the Bauxite Residue Disposal Area (BRDA) comprising of an expansion to increase its disposal capacity to accommodate additional bauxite residue arising from the continued operation of the permitted alumina refinery plant located on the wider AAL facility. The proposed increase in disposal capacity to the BRDA will result in a proposed increase in height of c.12m above the currently permitted stage 10 level (c. 32m OD) to a final stage 16 level (c. 44m OD). No increase to the existing footprint of the BRDA is proposed.

The proposed method of raising the BRDA will be the upstream method, consistent with the construction methodology for the current BRDA and involves the construction of rock fill embankments (Stages), offset internally and founded on the previously deposited and farmed bauxite residue, in 2 m high vertical lifts. The overall BRDA is raised systematically as the stages are filled with bauxite residue, farmed, carbonated and compacted, prior to deposition of the next layer.

Additional works proposed as part of this application include the following:

- A vertical extension to the existing Salt Cake Disposal Cell (SCDC) to accommodate further disposal of salt cake resulting in an increase in height of c.2.25m. The SCDC is located within the BRDA. A description of the SCDC and its function is provided in Chapter 2 of this EIAR.

- An extension of the existing borrow pit, located to the east of the BRDA, is also proposed. This extension proposes to increase the footprint of the borrow pit from c.4.5ha to c.8.4ha. This expansion will provide an additional 380,000m$^3$ of rock fill material which is needed to satisfy the requirements of the construction and operation of the BRDA.

- The continued use of an existing stockpile area at the south east of the subject site to store topsoil in order to satisfy the additional restoration requirements of the extended BRDA.

- Modifications to the existing water management infrastructure to accommodate the BRDA development to Stage 16 which will also allow for greater Inflow Design Flood (IDF) capacity for the entirety of the BRDA.

A general site layout of these individual features has been provided in Figure 8.1, and also includes the planning application boundary (red line) and the ownership boundary (blue line) of Aughinish Alumina Limited (AAL).

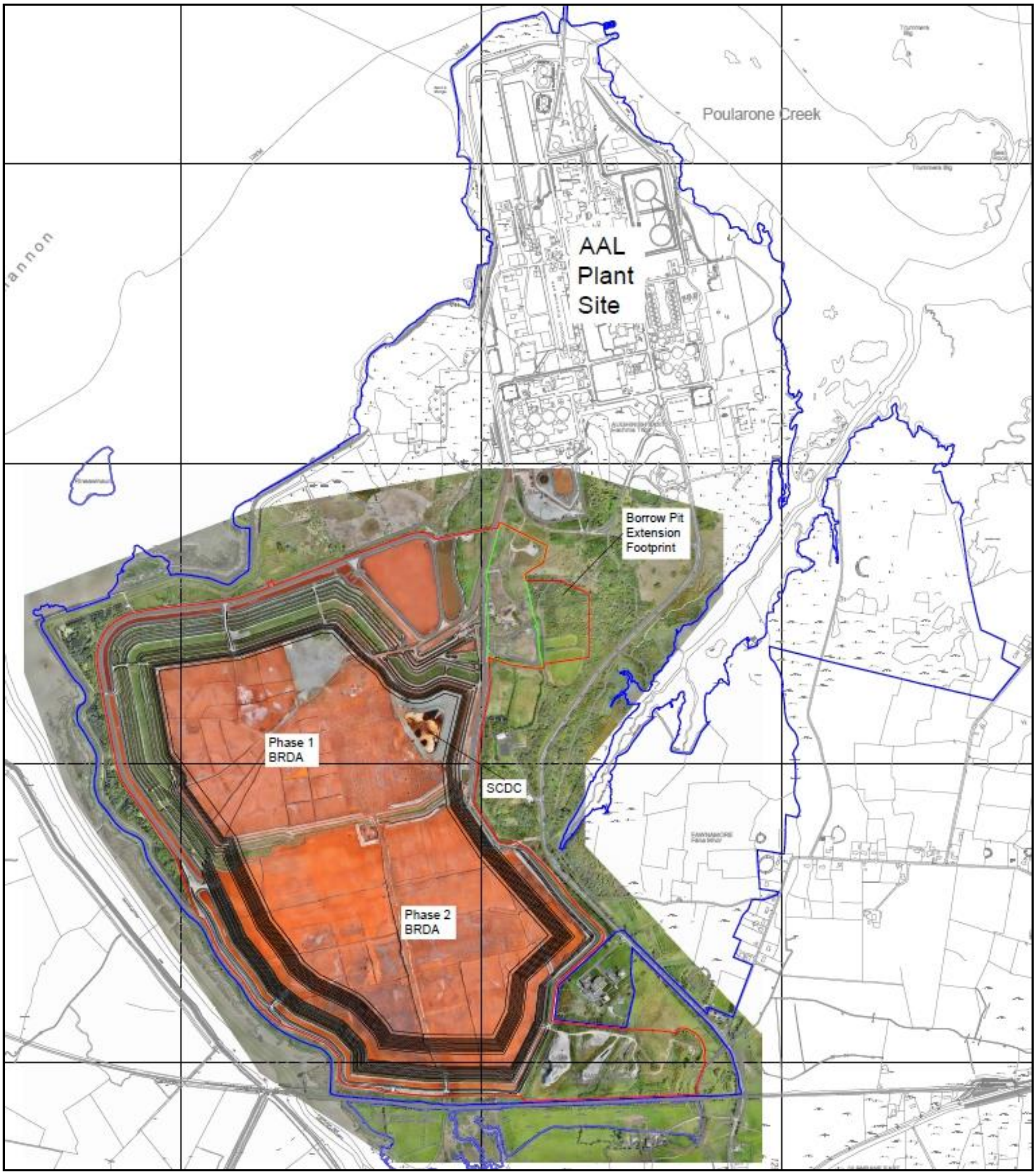



**Figure 8.1: Site Location Map - Blue Line is the AAL Ownership Boundary, Red Line is the Application Boundary and Green Line is the permitted Borrow Pit Footprint**

## 8.2 Technical Scope

The technical scope of this assessment is to identify the likely direct and indirect significant effects that the Proposed Development may have on soils, land and geology, during the construction, operation and closure of the Proposed Development.

The assessment considers the potential sources of change resulting from Proposed Development activities detailed in the project description (Chapter 3: Project Description). The potential to impact geologically important sites and land quality is considered. It should be noted that this assessment does not, however, constitute a contaminated land risk assessment, a geotechnical / geohazard risk assessment, or detailed quantitative human health risk assessment.

The potential effects associated with hydrological and hydrogeological receptors is considered in Chapter 10: Hydrology and Hydrogeology. The effects of the development on land use aspects such as human health is addressed in Chapter 6: Human Health Any secondary effects on ecology or biodiversity as a result of changes in land quality are considered in Chapter 7: Biodiversity.

## 8.3 Geographical and Temporal Scope

The geographical Study Area for the assessment covers the Site boundary and a buffer zone that extends to 2 km (IGI 2013 guidelines, listed in Section 8.4.1), from the Application Site boundary (the Study Area), see Figure 8.2 below.

The permitted Borrow Pit and the proposed Borrow Pit Extension sit outside of the footprint of the BRDA and to the east of the Phase 1 BRDA; the 2km buffer for the study area has been extended from these area boundaries also.

The general site layout, showing the Plant, the BRDA, the SCDC and the Borrow Pit Extension, has been provided in Figure 8.1.

The Proposed Development involves construction activities as an intrinsic part of the preparatory, construction, operational and closure phases, as the facility is progressively raised in elevation as it is filled with bauxite residue and is progressively restored on the side-slopes. Therefore, this assessment will consider an overall construction phase encompassing the preparatory construction activities, construction activities during general operations and the closure construction activities.

The Proposed Development will enter into an aftercare phase following the completion of the combined construction/operational phase. In accordance with Condition 10 of the EPA issued licence (IEL P0035-07), AAL are required to have an approved plan in place for the orderly closure, decommissioning and aftercare of the facility. This plan is called the Closure, Restoration and Aftercare Management Plan (CRAMP) and covers both the refinery plant area and the BRDA. The most recent update was conducted by AAL during 2019 and submitted with the IEL P0035-07 application and subsequently approved by the EPA in 2021 with the granting of the licence.

Financial provisions for the CRAMP are deposited by AAL annually into a Secured Fund and a Parent Company Guarantee (PCG) is in place to match the balance for the Secured Fund target value in place. The CRAMP is funded for a minimum 35-year period following closure (5 years of active aftercare and 30 years of passive aftercare).

Given that the proposed BRDA Raise and the proposed SCDC Raise sit entirely within the footprint of the existing BRDA, where reference is made to the BRDA site within the text, this will refer to both the BRDA and the SCDC areas, unless otherwise stated.

The existing BRDA site is comprised of two distinct footprints; Phase 1 BRDA and Phase 2 BRDA, which are merging as the bauxite residue raises in elevation:

- The Phase 1 BRDA is the older section of the BRDA, first established in 1983 and is situated in the northern section of the overall site. It includes the original Phase 1 BRDA footprint and the Phase 1 BRDA Extension footprint.
- The Phase 2 BRDA was commissioned in 2011 and constitutes the southern section of the overall BRDA site.

This assessment will establish both the baseline and proposed conditions within the Site initially, and then the wider conditions within the wider Study Area.


**Figure 8.2: Study Area (Red Line is the Application Boundary and Yellow Line is a 2 km offset)**

## 8.4 Legislation, Guidance and Policy Context

This section addresses the legislation and guidance that has been considered when preparing this Chapter, and key policy context relevant to soils, land and geology that has guided the focus of the assessment.

### 8.4.1 Legislation and Guidance

This assessment has been made with cognisance to relevant guidance, advice and legislation, including, but not limited to:

- Gov.uk online guidance, Guidance on Land Contamination Risk Management (LCRM). Available at https://www.gov.uk/government/publications/land-contamination-risk-management-lcrm (2020). Uses a tiered approach to risk assessment, including preliminary risk assessment, generic quantitative risk assessment and detailed quantitative risk assessment.
- Irish Government. Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment (2018).
- Directive 2011/92/EU as amended by Directive 2014/52/EU.
- European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2018 (SI No. 296 of 2018) which amended the Planning and Development Act, 2000, and the Planning and Development Regulations, 2001.
- European Commission. Environmental Impact Assessment of Projects: Guidance on the preparation of the Environmental Impact Assessment Report (2017).
- The EPA Guidelines on the Information to be Contained in Environmental Impact Assessment Reports (Draft, August 2017).
- The EPA Advice Notes for Preparing Environmental Impact Statements (Draft, September 2017).
- CIRIA C741: Environmental Good Practice on Site (2015, Fourth Edition) in relation to source of impact and mitigation.
- Institute of Geologists of Ireland. Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements (April 2013).
- The National Roads Authority Guidelines for the Creation, Implementation and Maintenance if an Environmental Monitoring Plan (2009) in relation to impact mitigation.
- The National Roads Authority Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes (2008) in relation to aspects to be considered and assessment approach (including relative receptor importance and cross discipline interactions).
- Guidance for Pollution Prevention (GPPs) – these guidance documents provide environmental good practice guidance for the UK including for activities such as oil and chemical storage, works in or near water, works on construction sites, and dealing with spills and pollution incidents.

Relevant statutory instruments in the context of the protection of groundwater, surface water and geology:

- S.I. No. 272/2009 – European Communities Environmental Objectives (Surface Waters) Regulations 2009, as amended; and
- S.I. No. 9/2010 – European Communities Environmental Objectives (Groundwater) Regulations) 2010, as amended.

### 8.4.2 Local Policy

The National Planning Framework (Project Ireland 2040) includes National Policy Objective 60 to: *"Conserve and enhance the rich qualities of natural and cultural heritage of Ireland in a manner appropriate to their significance".*

Limerick City and County Council (LCCC) is currently preparing the new Limerick Development Plan 2022 – 2028. Consideration has been given here to both the existing Limerick County Development Plan 2010 – 2016 (as extended) prepared by Limerick County Council (LCC) and the proposed 2022 – 2028 plan.

The AAL facility is zoned as 'Marine Related Industry' in the existing Development Plan. Objective ED 06 notes that the purpose of this zoning objective is as follows:

*"Land zoned for Marine Related Industry, shall provide for marine related industry and large scale uses that create a synergy with the marine use. Marine related industry shall be taken to include the use of land for industry that, by its nature, requires a location adjacent to estuarine/deep water including a dependency on marine transport, transhipment, bulk cargo or where the industrial process benefit from a location adjacent to the marine area."*

Specific policies relating to the protection of the soils, land and geology include the following:

**Objective EH P1: Sustainable Management and Conservation.**
It is the policy of LCC to ensure the sustainable management and conservation of areas of natural environmental and geological value within the County; and

**Objective EH 04: Conservation of Geological Sites in County Limerick.**
It is the objective of LCC to seek the conservation and protection of features of geological interest within the County, particularly those that would have been recognised in the past as Areas of Scientific Interest or by the Geological Society of Ireland as being of particular value.

## 8.5 Assessment Methodology and Significance Criteria

This section presents the method used to assess the likely direct and indirect significant effects that the Proposed Development may have on soils, land and geology. It establishes the stages of the assessment, and the qualitative criteria used to assess impact magnitude and determines the level of effect significance.

### 8.5.1 Qualitative Assessment Method

The assessment of potential effects has been undertaken using the qualitative assessment method outlined below and is supported by the baseline condition information, the preliminary Construction Environmental Management Plan (CEMP) and the Proposed Development design.

The Proposed Development design is understood to comprise the project design principles and standards adopted to avoid or prevent adverse safety and environmental effects, construction and operation to appropriate codes of practice and guidelines, and including fixed procedural commitments such as instrumentation and monitoring. This measure provides the baseline for the assessment of impacts.

The assessment follows a staged approach. A summary of the stages involved is included below:

1) Confirm baseline conditions – determine baseline and develop conceptual site model by consideration of available records and data sets, site reports and published information.
2) Confirm the key receptors and their value/importance.
3) Qualitatively characterise the magnitude of impacts on the receptors – describe what potential changes could occur to each receptor as a result of the Proposed Development, identify source-pathway receptor linkages, and assign the magnitudes of impact.
   This stage takes into account design standards and target criteria, ground investigation and laboratory testing data, stability assessments conducted, good practice in construction environment management and pollution prevention.
4) Determine the initial effect significance of each potential impact on each sensitive receptor.
5) Consider the need for additional mitigation if it is considered necessary to reduce the initial magnitude of the impact and associated effect significance further.
6) Assess the residual impact magnitude and residual effect significance after all mitigation is applied.

Stages 1 and 2 have been completed using published literature and guidance along with the available information specific to the Proposed Development, which is presented in Chapter 2: Site Location and Context and Chapter 3: Description of the Proposed Development.

For the identification of receptor value/importance that completes Stage 2, and for the description of impact magnitude (Stage 3), a common framework of assessment criteria and terminology has been developed by Golder and is based on the EPAs Draft 2017 EIAR Guidelines. This framework follows a 'matrix approach' to environmental assessment which is based on the characteristics of the impact (magnitude and nature) and the value (sensitivity) of the receptor.

- The descriptions for value (sensitivity) of receptors are provided in Table 8.1 and the descriptions for magnitude of impact are provided in Table 8.2.
- The significant effect shown in Table 8.3 is then derived from receptor value and the magnitude of impact. A description of the significance categories used is provide in Table 8.4.

The potential for an impact to occur at a receptor has been determined using the understanding of the baseline environment and its properties, and consideration of whether there is a feasible linkage between a source of impact and each receptor, i.e., a conceptual site model.

This follows the method of preliminary risk assessment that is widely presented in some of the guidance documents listed in Section 8.4.1

**Table 8.1: Environmental Value (Sensitivity) and Descriptions**

| Value (Sensitivity) of Receptor / Resource | Typical Description |
|---|---|
| **High** | High importance and rarity, national scale, and limited potential for substitution. For example:<br>• Attribute has a high quality, significance or value on a Global/European/National designation;<br>• Large volumes of nationally or locally important peat;<br>• Well drained and highly fertile soils;<br>• Proven economically extractable mineral resource; and<br>• Human health. |
| **Medium** | Medium or high importance and rarity, regional scale, limited potential for substitution.<br>For example:<br>• Regionally important sites;<br>• Sub-economic extractable mineral resource; and<br>• Moderately drained and/or moderate fertility soils. |
| **Low** | Low or medium importance and rarity, local scale.<br>For example:<br>• Locally designated sites;<br>• Uneconomically extractable mineral resource; and<br>• Poorly drained and/or low fertility soils. |
| **Negligible** | Very low importance and rarity, local scale.<br>For example:<br>• Environmental equilibrium is stable and is resilient to impacts that are greater than natural fluctuations, without detriment to its present character. |

**Table 8.2: Magnitude of Impact and Typical Descriptions**

| Magnitude of Impact (change) | | Typical Description |
|---|---|---|
| **High** | Adverse | Loss of resource and/or quality and integrity of resource; severe damage to key characteristics, features or elements.<br>Significant harm to human health - death, disease, serious injury, genetic mutation, birth defects or the impairment of reproductive functions.<br>Significant harm to buildings/infrastructure/plant - Structural failure, substantial damage or substantial interference with any right of occupation. |
| | Beneficial | Large scale or major improvement of resource quality; extensive restoration; major improvement of attribute quality. |
| **Medium** | Adverse | Loss of resource, but not adversely affecting the integrity; partial loss of / damage to key characteristics, features or elements. |
| | Beneficial | Benefit to, or addition of, key characteristics, features or elements; improvement of attribute quality. |
| **Low** | Adverse | Some measurable change in attributes, quality or vulnerability; minor loss of, or alteration to, one (maybe more) key characteristics, features or elements. |
| | Beneficial | Minor benefit to, or addition of, one (maybe more) key characteristics, features or elements; some beneficial impact on attribute or a reduced risk of negative impact occurring. |
| **Negligible** | Adverse | Very minor loss or alteration to one or more characteristics, features or elements. |
| | Beneficial | Very minor benefit to or positive addition of one or more characteristics, features or elements. |

The assessment of magnitude of impact considers whether the change that causes the impact is positive or negative, and whether the impact is direct or indirect, short- medium- or long-term, temporary or permanent, and if it is reversible.

For the purposes of this assessment, a direct impact is one that occurs as a direct result of the Proposed Development and is likely to occur at or near the Proposed Development itself. Indirect impacts (or secondary/tertiary impacts) are those where a direct impact on one receptor has another knock-on impact on one or more other related receptor(s), e.g., assess whether the Proposed Development results in a change in land quality, which then has an indirect impact on human health. Indirect impacts can occur within the study area or away from the Proposed Development.

For the purposes of this assessment, the following definitions of duration have been used:

- **Temporary** – effect likely to last less than 1 year without intervention;
- **Short term** – effect likely to last 1 to 7 years without intervention;
- **Medium term** – effect likely to last 7 to 15 years without intervention;
- **Long term** – effect likely to last 15 to 60 years without intervention; and
- **Permanent** – effect likely to last over 60 years without intervention.

An irreversible impact is defined as a change to the baseline that would not reverse itself naturally. Such impacts will usually be long-term and irreversible, such as the removal of the best and most versatile agricultural soils. A reversible impact is defined as a change to the baseline conditions that would reverse naturally once the source of the impact is exhausted or has stopped.

### 8.5.2 Significance Criteria

The approach followed to derive the significant effect from the receptor value and the magnitude of impact (Stage 4) is shown in Table 8.3.

Where Table 8.3 includes two significance categories, reasoning is provided in the text for the lower of the two significance categories selected.

A description of the significance categories used is provide in Table 8.4.

**Table 8.3: Significance Matrix**

| | Magnitude of Impact (Degree of Change) | | | | |
|---|---|---|---|---|---|
| | | Negligible | Low | Medium | High |
| Environmental Value (Sensitivity) | High | Slight | Slight or Moderate | Moderate or Large | Profound |
| | Medium | Imperceptible or Slight | Slight or Moderate | Moderate | Large or Profound |
| | Low | Imperceptible | Slight | Slight | Slight or Moderate |
| | Negligible | Imperceptible | Imperceptible or Slight | Imperceptible or Slight | Slight |

**Table 8.4: Significance Categories and Typical Descriptions**

| Significance Category | Typical Description |
|---|---|
| **Profound** | An effect which obliterates sensitive characteristics. |
| **Large** | An effect which, by its character, magnitude, duration or intensity alters a significant proportion of a sensitive aspect of the environment. |
| **Moderate** | An effect that alters the character of the environment in a manner that is consistent with existing and emerging baseline trends. |
| **Slight** | An effect which causes noticeable changes in the character of the environment without affecting its sensitivities. |
| **Imperceptible** | An effect capable of measurement but without significant consequences. |

If required, following the assessment of the level of effect significance, additional mitigation measures are presented that will be used to avoid, prevent or reduce the magnitude of the potential impact (Stage 5).

The significance of the effect taking into account the additional mitigation is then assessed (Stage 6) to give the residual effect significance.
Any monitoring that will be required to measure the success of the mitigation is also presented in residual impacts and effects Table 8.11 in Section 8.11.

Residual adverse effects of 'large' or 'profound' significance are considered to be '**significant**' for the purposes of this assessment.

Residual adverse effects that are 'moderate', 'slight' or 'imperceptible' are those which at their highest effect are consistent with existing and emerging baseline trends and are considered to be '**not significant'**.

The criteria and terminology in Table 8.4. has been based on and is consistent with the EPA's Draft 2017 EIAR Guidelines. The EPA's 'Significant Effects' and 'Very Significant' categories have been combined into one 'Large' category.

Furthermore, the EPA's 'Not Significant' category has been combined with the 'Slight Effects' category. These substitutions provide conservatism by attributing a higher effects category to adverse effects. The removal of the 'significant' and 'not significant' terminology from the matrix stage of the method avoids confusion when an overall significance is attributed to the particular impact.

The effects of the Proposed Development will also be considered cumulatively with those that could foreseeably result from other known developments in the assessment study area that are going through the planning process.

## 8.6 Receiving Environment

This Section presents baseline information on soils, land use, land quality and geology. Information about the water environment (including hydrology and hydrogeology) is included in Chapter 10: Hydrology and Hydrogeology.

### 8.6.1 Soils

#### 8.6.1.1 Site Area

The mapped Quaternary sediments (GSI, 2021) are stated to comprise a spoil heap, estuarine silts and clays, till derived from limestones and bedrock outcrop or subcrop at the BRDA site (Figure 8.3). However, the mapping does not reflect the development of the Phase 2 BRDA, and it is more accurate to indicate that the entire BRDA site comprises a spoil heap under the GSI's classification.

Prior to the construction of the BRDA site, the area was a green field site, and the natural topography of the area was low lying. Planning permission for the original BRDA was granted by Limerick County Council (LCC) in February 1979 and the BRDA commenced operations following commissioning of the plant in 1983.

Historical mapping by Ordnance Survey Ireland (OSI) indicates that the bulk of the Phase 1 BRDA and the western sector of the Phase 2 BRDA is constructed over relatively flat, low-lying and poorly drained farmland (elevations between 0 mOD and 2 mOD), with the underlying soils comprising estuarine silts and clays with intermittent overlying thin till layers (sandy gravelly CLAY to silty sandy gravelly CLAY of low plasticity, typically 8% to 10%). The estuarine silts and clays vary in depth from ca. 10m to 30m along the northern perimeter of the Phase 1 BRDA (greatest depth at the north-east and north-west sectors), from ca. 4m to 10m along the western perimeter of the Phase 1 BRDA, from ca. < 1m to 8m along the north-western perimeter of the Phase 2 BRDA and are largely absent under the centre of the Phase 1 BRDA, under the Phase 1 BRDA Extension and under the bulk of the Phase 2 BRDA.

Generally, two layers of estuarine soils were present, comparable to the findings from the investigation at the adjacent Foynes Harbour (Long 2018).

- **Sandy Silt Layer** – Generally occurs as the surface layer and some underlying layers. Characterised by a higher tip resistance (qt), in the form of spikes and higher undrained shear strength.
- **Silty Clay Layer** – Generally occurs underlying the Sandy Silt layers. Characterised by lower, more uniform tip resistance (qt), and lower undrained shear strength.

Site investigation work associated with the feasibility study for developing the AAL facility (including the BRDA) in the 1970s and development of the facility has been reviewed for this assessment. A report by Clark et al. (1981) noted that a broad divide existed on Aughinish Island with the western area (including the BRDA/SCDC) overlying an area of low-lying estuarine deposits (ca. up to 25m in thickness), which in turn overlie glacial till and limestone bedrock.

Baseline soil reporting in 1979 and 1983 identified two major soils units on Aughinish Island; the Rineanna Complex in Aughinish East and the Shannon Series in Aughinish West (An Foras Taluntais, 1979 and Fleming and Parle, 1983).

The Shannon Series dominates the baseline soil beneath the majority of the BRDA site and under the SCDC site; a small occurrence of the Patrickswell soils (of the Rineanna Complex) are noted within the Phase 2 BRDA and Phase 1 BRDA.

The Shannon Series were identified to have formed from estuarine alluvium while the Rineanna Complex soils were identified to have formed from glacial drift and shallow limestone.

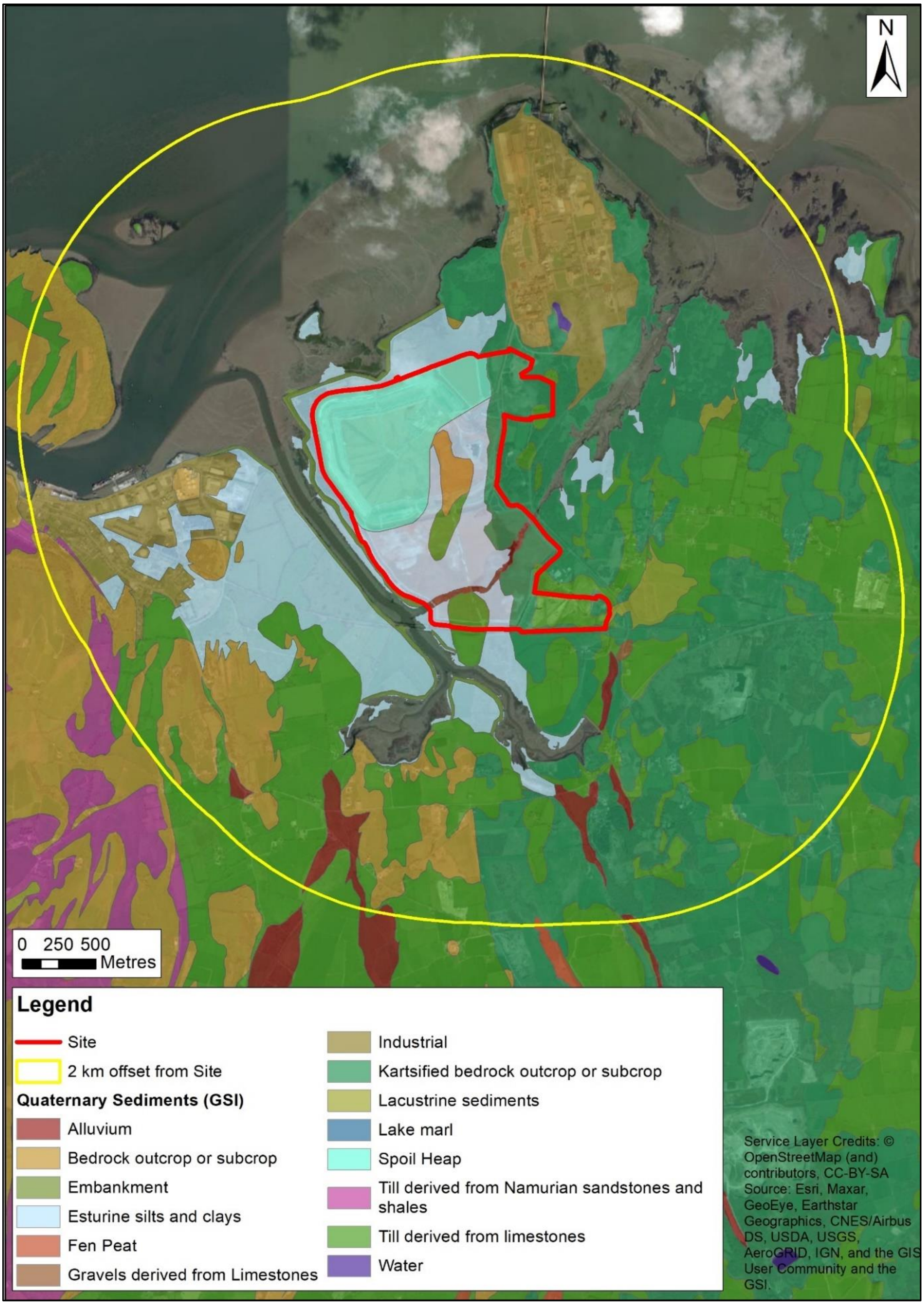



**Figure 8.3: Quaternary Soils mapping (GSI, 2021)**

The Rineanna Complex and Shannon Series were further subdivided by An Foras Taluntais (1979) based on the following descriptions:

- The Rineanna Complex (Soil Groups 1 to 4, 4b and 4L in Figure 8.4 below):
  - The Burren-deep phase – excessively drained shallow Rendzina with organic clay loam texture at <0.25 m depth.
  - Ballincurra – well to excessively drained shallow brown earth with loam texture at 0.3m to 0.4m depth.
  - Elton – well drained grey-brown podzolic soil with loam texture at > 0.75m depth.
  - Patrickswell – well drained grey-brown podzolic soil with loam texture at < 0.75m depth. A Patrickswell-boulder phase, signified by the presence of boulders, and a Patrickswell-lithic phase, signified by surface bedrock exposure, have also been identified.
  - Burren-Ballincurra complex – a mixture of the Burren and Ballincurra soils with proportions of 60% and 40% respectively.

- The Shannon Series (Soil Groups 5 to 9 in Figure 8.4 below):
  - Shannon silty clay – poorly and imperfectly drained gley with a silty clay texture.
  - Shannon silt to silt loam – poorly and imperfectly drained gley with a silt-to-silt loam texture

An Foras Taluntais (1979) classified soils of Aughinish Island are presented in Figure 8.4 below.

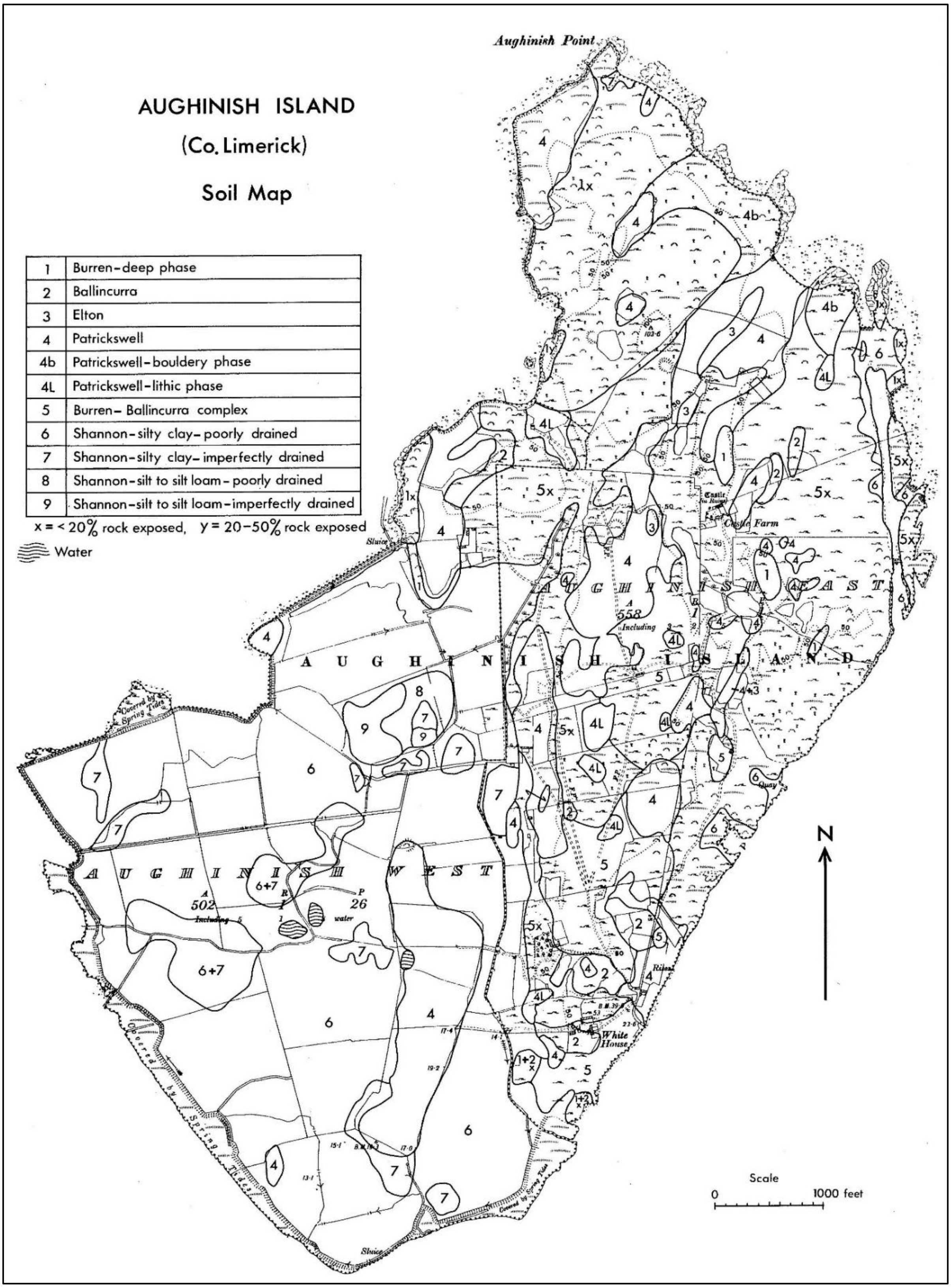



**Figure 8.4: Soil map of Aughinish Island prior to development of the AAL Facility (Reproduced from An Foras Taluntais, 1979)**

Soil sampling was originally carried out in May 1978 by An Foras Taluntais with 25 soil samples taken from the Rineanna Complex and the Shannon Series. Samples taken were analysed for pH, phosphorous, potassium, magnesium and arsenic.

Up to 514 soil samples were analysed in June/July 1979 (Fleming GA & Parle PJ, 1983) from an area covering approx. 8 $km^2$, including both the BRDA and the Plant footprint. Sampling took place systematically at 20 $m^2$ gridline intersections. The summary results from the sampling programmes are presented below in Table 8.5.

**Table 8.5: Soil Substance Summary Statistics (Samples taken in 1979)**

| Variable | Unit | Count | Minimum | Maximum | Average |
|---|---|---|---|---|---|
| pH | pH | 539 | 4 | 8.5 | 6.2 |
| Phosphorous | ppm | 539 | 1 | 120 | 8.9 |
| Potassium | ppm | 539 | 6 | 645 | 192.5 |
| Magnesium | ppm | 25 | 100 | 940 | 314.4 |
| Arsenic | ppm | 50 | 3.8 | 25 | 14.2 |

The baseline range in pH of the soils is identified to be between 4 to 8.5 with an average of 6.2. Fleming GA & Parle PJ, (1983) noted that a number of key features should be noted regarding the regional soil geochemical signature. Clare Shales contain elevated selenium, molybdenum, uranium and arsenic. Natural arsenic had been reported in concentrations ranging from 5 to 55 ppm.

In addition, soils partially derived from Shales, such as the Rineanna Complex, are likely to have high natural potassium content due to the presence of micaceous minerals. The Elton soil is reported as one of the highest potassium releasing soils in Ireland.
Due to the development of the existing BRDA (including SCDC) site, the baseline soils were largely removed and/or covered by engineered containment and bauxite residue, which is discussed further in Section8.6.2, below.

Soil mapping from An Foras Taluntais (1979) in Figure 8.4 indicates that the soils at the permitted Borrow Pit and proposed Borrow Pit Extension site are composed of Patrickswell – lithic phase, Patrickswell and Burren-Ballincurra soils of the Rineanna Complex. Given the undisturbed nature of the proposed Borrow Pit Extension site, these soils remain in situ. As stated in the 2017 EIAR (TPA, 2017), much of the soil cover at the permitted Borrow Pit site has been removed due to previous activities, including the handling and temporary storage of overburden and for aggregate materials which were imported for use in the construction of the BRDA. The GSI's current Quaternary sediments mapping (Figure 8.3) indicates that the soils at the permitted proposed Borrow Pit sites are a mix of till derived from limestones and karstified bedrock outcrop or subcrop (GSI, 2021).

A site investigation has previously been carried out at, and in the vicinity of permitted Borrow Pit footprint, with the drilling of six (6) boreholes (BH1, BH2, BH3, BH4 BH5 and BH6) during 2017 (Golder 2017A). These boreholes all encountered fine grained Waulsortian Limestone and were drilled to a depth of 15 m below ground level (bgl), refer to Appendix 8.1 for detailed logs and Figure 8.5, below, for the locations of the boreholes. Soil cover was absent in both BH4 and BH6, soil was encountered to depths between 0.2 mbgl and 1.1 mbgl in the remaining four boreholes. Soil, when encountered, was described as a pale or pale to medium grey, silty gravelly overburden

Additional site investigation was carried out at, and in the vicinity of the proposed Borrow Pit Extension footprint, with the drilling of four (4) boreholes (MW01, MW02, MW03 and MW04) in October 2020 and three (3) boreholes (MW05, MW06, MW07) in June 2021, see Figure 8.5.

Similarly, these boreholes all encountered fine grained Waulsortian Limestone and were drilled to a depth of 15m for MW01 to MW04 and to a depth of 20m for MW05 to MW07. Soil cover was present at shallow depths of 0.15 mbgl to 0.4 mbgl and was identified as light to medium grey silty gravel (MW01 to MW04) or brown silty clay overburden (MW05 to MW07). The soil cover data from the investigations is in line with the original baseline mapping of the site in 1979 which originally indicated a thin soil cover for the Rineanna Complex.

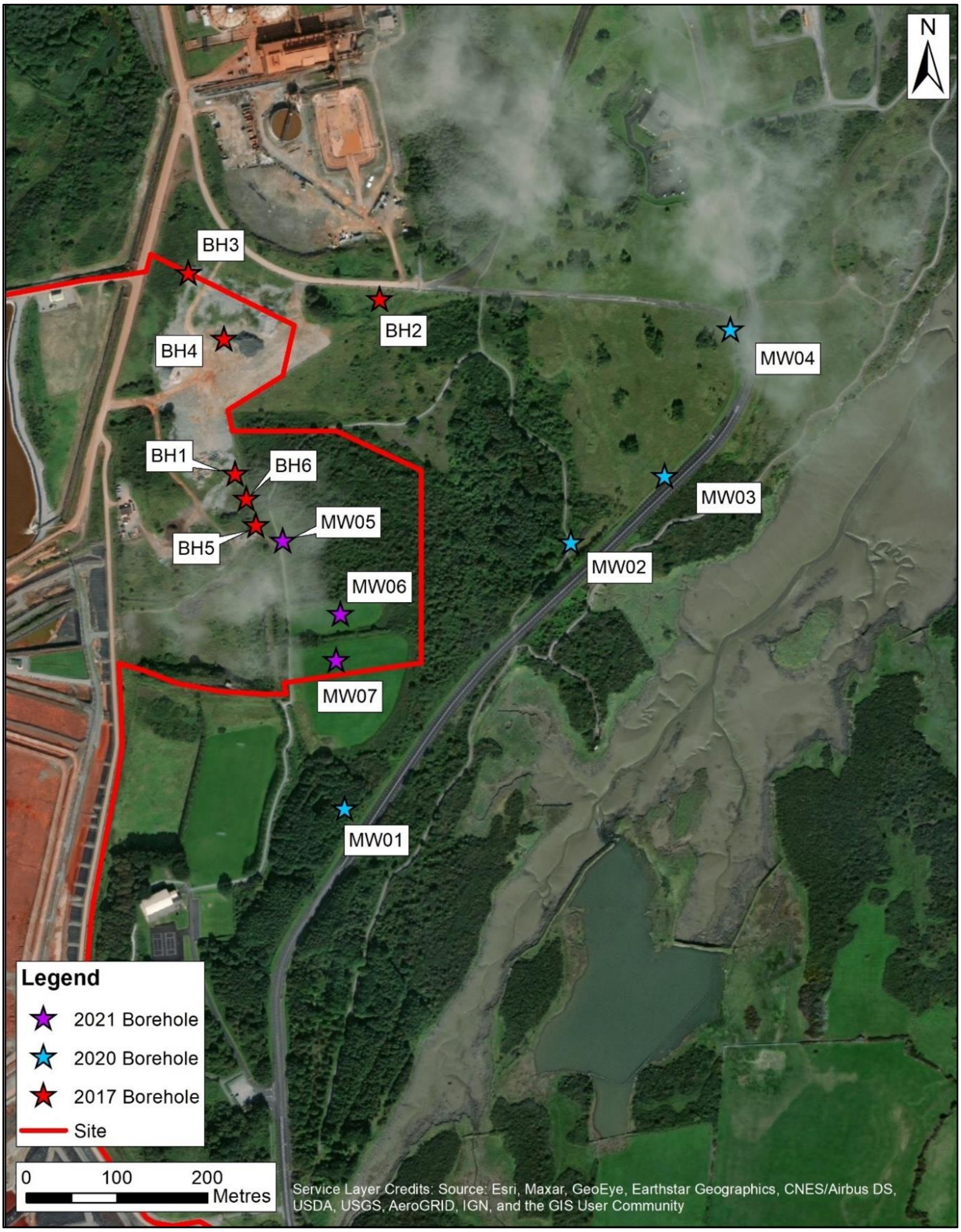



**Figure 8.5: Borehole locations (Red for 2017, Blue for 2020 and Purple for 2021) within and near the permitted Borrow Pit and the proposed Borrow Pit Extension footprints.**

#### 8.6.1.2 Study Area

The mapped Quaternary sediments (GSI, 2021) comprise several units within the Study Area (Figure 8.3).

To the east of the Application Site, sediments are composed of till derived from limestone or sediment cover is lacking and karstified bedrock is subcropping or outcropping in the area. Lesser areas of lacustrine sediments or estuarine silts and clays are noted in the east, although these are proximally located to coastal areas.

To the west the predominant sediment is estuarine silts and clays along the Lower Shannon Estuary. Further west the area is noted as 'industrial' beneath the Foynes industrial area and a mixture of bedrock outcrop or subcrop and till or gravel derived from limestones is noted further inland.

Immediately to the south of the Application Site, estuarine silts and clays are present which are associated with the Robertstown River. Sediments composed of till derived from limestone then extend to the south-west and west and sediments composed of till derived from limestone or sediment cover is lacking and karstified bedrock is subcropping or outcropping in the area extend to the south-east and east.

Directly north of the Application Site, estuarine silts and clays are present to the coastal boundary with the Lower Shannon Estuary. The AAL Plant lies to north-east and the remaining sediments, primarily located along the eastern and western flanks of the industrial area, are noted as till derived from limestones in thin pockets, or sediment cover is lacking and karstified bedrock outcrop or subgroup is prevalent. Beneath the industrial area (AAL Plant) the GSI have mapped the area as 'industrial', however, historically this area was mapped karstified bedrock outcrop or subcrop.

The topography of the AAL facility prior to 1978 and commencement of the development, was dominated by two limestone outcrops with elevations of 28.7 mOD and 19 mOD (Golder, 2014). These outcrops were located in the middle of the current refinery plant area, separated by a northeast-southwest trending valley, dipping towards the southwest. Extensive regrading works were carried out during construction of the Plant, with blasting of the two outcrops occurring, and ca. 1.6 million $m^3$ of crushed rock being used to infill the valley (Golder, 2014). Drift deposits were generally observed to be absent across the refinery plant area. However, the low-lying valley areas contained a thin layer of glacial channel fill comprising clayey sand and sandy clay with gravel, overlain by a substantial thickness of glacial clay with a proven depth of up to 42 m below ground level (mbgl) (Golder, 2014). The construction of the refinery plant area resulted in the majority of soils which were present in being either completed removed to bedrock or being covered over by sealed concrete slabs (Golder, 2014). It is considered that very little soil remains at the refinery plant area. Clark *et al.* (1981) noted the presence of glacial drift infill within varying diameter palaeokarst features inclusive of widened joints and bedding planes, minor cave passages, cylindrical cavities and a sediment infilled sinkhole in the refinery plant area.

Baseline soil investigations were reported in 1979 and 1983 as part of the original ground investigations for the AAL development and are discussed earlier in Section 8.6.1.1. In the refinery plant area, these soils have since been removed or covered over by structures during the construction of the facility. However, the data serves to identify the regional composition of soil. The Rineanna Complex soils dominated the refinery plant area with some lesser areas of the Shannon Series to the east, Figure 8.4.

Soil quality monitoring of the conditions on the refinery plant area was carried out in late 2016 and early 2017 by Golder as part of IE Licence P0035-06 (now P0035-07) monitoring requirements (Golder 2018, 2019B). The sample locations are dispersed around the perimeter of the BRDA and refinery plant areas. The soil quality monitoring report, along with a location map and a description of the soil samples is included in Appendix 8.2.

Seven (7) samples were analysed for relevant compounds, including metals, semi-volatile organic compounds (SVOCs), gasoline range organics (GRO), extractable petroleum hydrocarbons (EPH), and nonyl phenol ethoxylates (Golder, 2018, 2019B).

The key findings from the soil quality monitoring report are summarized below and indicated that there was no noticeable significant impact from industrial activities:

- The soil pH ranged from 7.69 to 8.44, which does not show any significant acidification or alkalinisation. The operation of the Site uses caustic soda in the majority of processes but also uses acid in some processes. The results do not show any significant acidification or alkalinisation of the soils from industrial activities.
- Samples were analysed for aluminium, arsenic, cadmium, lead, mercury, nickel, sodium, and total sulphate.
  - Concentrations of aluminium ranged from 1,893 to 16,060 mg/kg (0.1% - 1.6%). Aluminium is the third most abundant element in the Earth's crust and concentrations in soils can range from 4% to 5% regionally. The facility is an alumina refinery and the results do not show any noticeable significant impact from industrial activities.
  - Concentrations of arsenic ranged from 2.9 to 23.1 mg/kg, which is below the geochemical signature for the area and therefore not significant. Soil sampling in 1979 by Fleming GA & Parle PJ (1983) in Area A (1 mile radius from the plant site) identified arsenic levels between 8.5 mg/kg and 55 mg/kg and in Area B (a 2-mile radius beyond Area A) As values ranging from 3.8 to 25 mg/kg.
  - No mercury was detected in any samples.
  - The range and concentrations of the other heavy metals detected in the soils sampled from the seven (7) locations are generally typical of soil background levels in Ireland.
- No samples exhibited potential evidence of impact from industrial activities with regards to hydrocarbons, e.g., no extractable petroleum hydrocarbons or gasoline range organics were detected.
- No SVOCs were detected in these samples.
- Nonyl phenol ethoxylates are non-ionic surfactants that are used in lubricating oil additives, detergents, and emulsifiers that are of environmental concern due to their ability to mimic the hormone oestrogen, which is of special concern to the reproduction of aquatic organisms. They have a low mobility in soils and sediments and can bioaccumulate. No nonyl phenol ethoxylates were detected in any samples.

### 8.6.2 Made Ground

Figure 8.6 below shows the location plan for the BRDA which includes the SCDC.

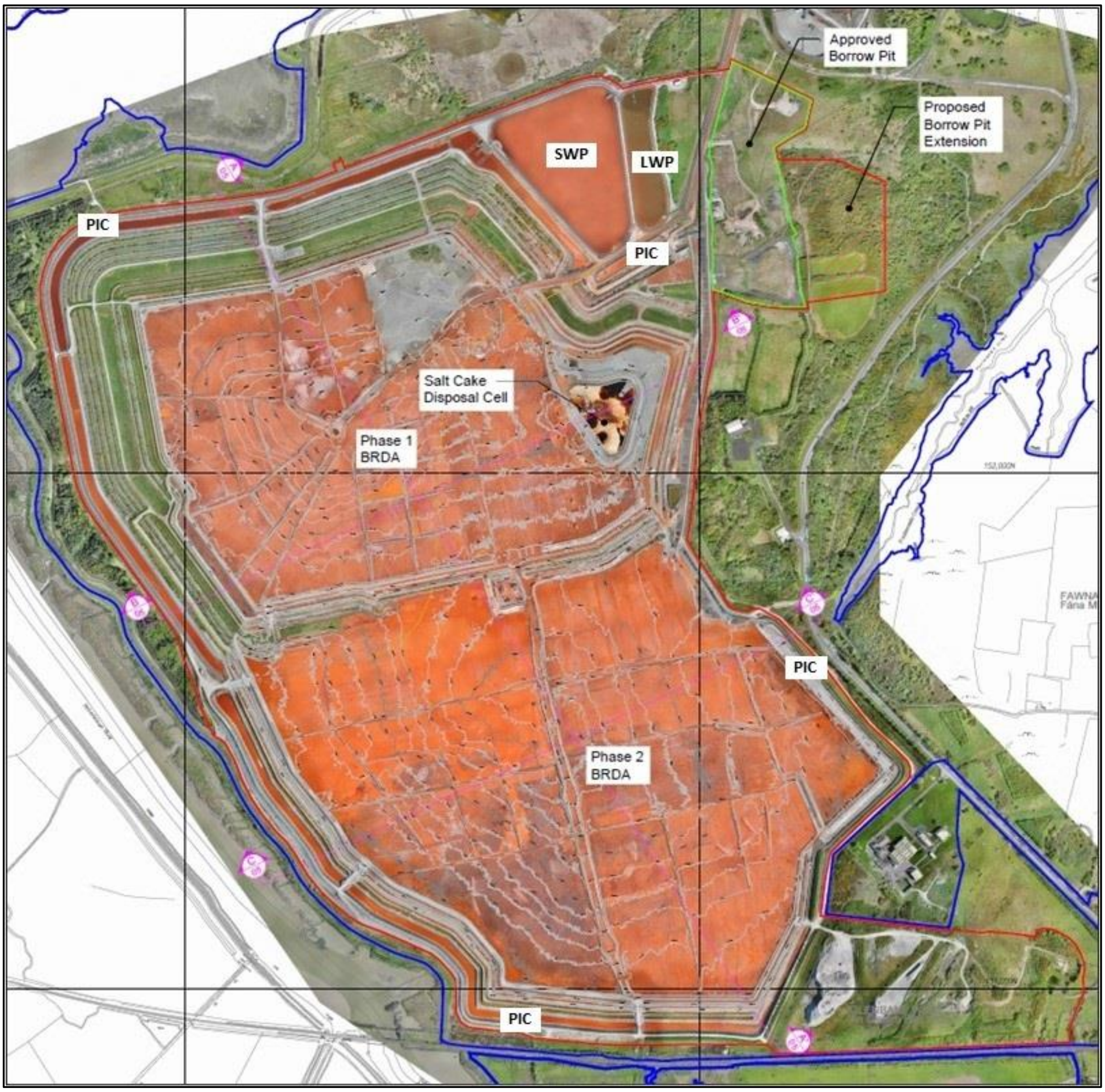



**Figure 8.6: AAL BRDA Location Plan**

The north-eastern BRDA site is composed of the Liquid Waste Pond (LWP) and Storm Water Pond (SWP), both are artificial lined ponds. Leachate and storm water from the BRDA is pumped to the Storm Water Pond prior to treatment and disposal, this is discussed further in Chapter 10: Hydrology and Hydrogeology.

The Phase 1 and Phase 2 of the BRDA are surrounded by a Perimeter Interceptor Channel (PIC) which is formed by constructing outer and inner perimeter embankment walls. The Phase 1 and Phase 2 PICs connect at the west sector of the facility where the Phase 1 and Phase 2 BRDAs' adjoin.

The Phase 1 BRDA was formed from two facilities, (Original BRDA and the Phase 1 BRDA Extension) which merged over time.

The Phase 2 BRDA area is a southern extension of the Phase 1 BRDA and is merged into the Phase 1 BRDA. The Phase 2 BRDA was granted planning permission in 2007 and was commissioned in 2011. The maximum permitted elevation of the perimeter of the BRDA is 24 mOD (Stage 10) and the maximum permitted dome crown elevation is 32 mOD. The current elevation of the BRDA dome surface is variable across the site, from ca. 23 mOD to ca. 32 mOD in Phase 1 BRDA and from ca. 11 mOD to ca. 20 mOD in Phase 2 BRDA.

Unlike conventional tailings facilities or water retaining dams, the BRDA retains little to no surface water on the bauxite residue surface. The bauxite residue is discharged as a paste from several near central discharge points to form a dome which typically has the apex some 6m to 8m above the perimeter BRDA wall elevation.

The BRDA itself is built upwards in a series of upstream raised 2m high berms known as 'stage raises'. The stage raises are constructed of processed limestone rock fill which is separated from the underlying bauxite residue by a layer of separation geotextile. Monitoring instrumentation comprising piezometers, extensometers and inclinometers are installed around the perimeter of the raise at designated stage raises and along designated sections in accordance with the Physical Stability Monitoring Plan for the BRDA (Golder 2021A).

The overall BRDA site is composed of the Phase 1 BRDA and Phase 2 BRDA, both of which are still discernible within the current footprint, as is the SCDC located in the eastern sector of the Phase 1 BRDA.

There have been two (2) previous SCDCs located within the Phase 1 BRDA during its life. The previous SCDCs were not lined facilities and comprised shallow hollowed-out areas on the basal and surrounding low permeability deposited bauxite residue, circa 1 ha. in footprint, with the removed bauxite residue used to construct the cell berms.

The original SCDC (active prior to 2000) was located in the south-west sector of the Phase 1 BRDA and as it reached capacity, the cell was subsequently infilled with process sand for solids containment and capped over with low permeability deposited bauxite residue as the BRDA was subsequently raised.

The latter SCDC (active prior to 2013) was located centrally in the Phase 1 BRDA and has been infilled with process sand for the purposes of a stable working platform for a site investigation. The permanent capping containment of this cell will be undertaken in 2022 in accordance and compliance with IE Licence P0035-07.

Prior to 2009, bauxite residue deposited in the Phase 1 BRDA did not undergo a process known as 'mud-farming' and is referred to as 'unfarmed'. Since 2009, the deposited bauxite residue has been 'farmed' and includes the bauxite residue in the Phase 1 BRDA from above Stage 6 (16 mOD) and all of the Phase 2 BRDA. The farming process consists of ploughing and aerating bauxite residue for a prolonged period (the process typically takes 5 to 6 months) to reduce the pH < 11.5, prior to placing the next layer.

The eastern sector of the BRDA (Phase 1 BRDA Extension and the eastern sector of the Phase 2 BRDA) is constructed over a ridge of outcropping crop, sloping upwards from west to east, which had intermittent cover of till material in minor depths. Preliminary works were undertaken on this ridge prior to the installation of the basal lining system; mechanical grading was undertaken for the Phase 1 BRDA Extension, and blasting and mechanical grading was carried out for the eastern sector of the Phase 2 BRDA.

Further grading, shaping and surface dressing with a compacted layer of till (minimum 1m depth) was then carried out in both footprints to provide a subgrade for the installation of the composite lining system during construction (1996 - 1998 for the Phase 1 BRDA Extension, and 2010 - 2011 for the Phase 2 BRDA).

AAL produces alumina ($Al_2O_3$) by treating bauxite ore using the Bayer process which involves the dissolution of aluminium hydrate ($Al_2O_3.3H_2O$) from the bauxite under high pressure in sodium hydroxide (caustic soda). Four (4) waste streams derived from the extraction process are deposited in the BRDA and comprise the made ground when deposited. Bauxite residue and process sand are the primary waste streams that comprise the bulk of the material deposited:

- Hydraulic deposition (pumped) discharge of bauxite residue paste (≈ 90.6% bauxite residue, AAL AER 2020) is from 'Mud Points' located centrally within the BRDA into purpose-built cells. Cell bunds are constructed from farmed bauxite residue using a bulldozer and low ground pressure excavators and their locations correspond to the annual design deposition plan. The bauxite residue can be further directed into selected areas or sub-cells of the BRDA by rotating and/or extending spigots at the end of the discharge points. Bauxite residue paste then migrates by gravity to perimeter stage raises and/or cell bunds at between 2% and 4% grade, and dewatering occurs through the rock fill of the stage raises, which then migrates to the perimeter interceptor channel (PIC) encompassing the BRDA. Layered deposition to aid dewatering of the paste has been implemented since start-up and AAL have engaged intensive mud-farming techniques since 2009.
- Process sand (≈ 6.9% process sand, AAL AER 2020) is poorly graded, medium sand by-product, primarily resulting from the addition of limestone in the early stages of the Bayer process. It is removed at the clarification stage by sand traps and is hauled from the AAL Plant by dumper and tipped at designated locations in the BRDA. It is typically used in the construction of internal haul roads, ramps and berms in the BRDA.

The secondary waste streams are:

- Scales and sludges (≈ 1.5%, AAL AER 2020) arise from maintenance of plant infrastructure and are removed periodically, and subsequently hauled and tipped at internal designated areas within the BRDA.
- Salt cake (≈ 1.0%, AAL AER 2020) is a by-product of the process of purification of the caustic soda liquor used in the alumina extraction process from the bauxite ore.

Salt cake is classified as a hazardous waste and is required to be segregated from the bauxite residue within the BRDA i.e., within the composite lined, independent SCDC.

The bauxite residue, process sand, scales and sludges deposited in the BRDA are classified as non-hazardous according to the European Waste Catalogue. Salt cake is classified as hazardous and is deposited in the SCDC, an independently lined engineered cell located within the BRDA.

The BRDA falls within the scope of Directive 2006/21/EC on the management of waste from the extractive industries. The BRDA is a Category A waste facility.

AAL conduct full chemical analyses of the farmed bauxite residue composition on a quarterly basis and Table 8.6 below provides a summary of the data from 2018 to 2020.

**Table 8.6: AAL BRDA - Farmed Bauxite Residue Composition (2018 - 2020)**

| Compound | Formula | Wet Basis (w/w%) Range and Average (2018-2020) | |
|---|---|---|---|
| Moisture | Free $H_2O$ | 21.64 - 27.52 | 23.98 |
| Hematite | $Fe_2O_3$ | 16.65 - 20.7 | 17.96 |
| Aluminium Goethite | $(Fe,Al)2O_3.H_2O$ | 20.79 - 25.33 | 23.17 |
| Calcium Cancrinite | $3(Na_2O.Al_2O_3.2SiO_2)2CaCO_3$ | 6.83 - 13.41 | 10.38 |
| Gibbsite | $Al_2O_3.3H_2O$ | 3.99 - 4.91 | 4.55 |
| Bayer Sodalite | $3(Na_2O.Al_2O_3.2SiO_2.2H_2O)0.8Na_2CO_3.0.2Na_2SO_4$ | 3.10 - 7.37 | 5.56 |
| Perovskite | $CaTiO_3$ | 3.10 - 4.29 | 3.89 |
| Anatase and Rutile | $TiO_2$ | 2.67 - 3.7 | 3.17 |
| Hydrogarnet | $3CaO.Al_2O_3.SiO_2.4H_2O$ | 1.20 - 4.40 | 2.34 |
| Boehmite | $Al_2O_3.H_2O$ | 0.72 - 2.02 | 1.57 |
| Quartz | $SiO_2$ | 0.57 - 1.17 | 0.90 |
| Sodium Carbonate | $Na_2CO_3$ | 0.06 - 0.86 | 0.46 |
| Zircon | $ZrSiO_4$ | 0.22 - 0.28 | 0.25 |
| Gypsum | $CaSO_4.2H_2O$ | 0.04 - 0.19 | 0.11 |
| Carbonate Apatite | $5.2CaO.0.8Na_2O.2.5CO_2.P_2O_5$ | 0.28 - 0.38 | 0.32 |
| Sodium Sulphate | $Na_2SO_4$ | 0.00 - 0.28 | 0.06 |
| Sodium BiCarbonate | $NaHCO_3$ | 0.00 - 0.45 | 0.08 |
| Sodium Fluoride | NaF | 0.00 - 0.02 | 0.01 |
| Sodium Aluminate | $NaAl(OH)_4$ | 0.02 - 0.11 | 0.06 |
| Sodium Hydroxide | NaOH | 0.00 - 0.05 | 0.00 |
| | | | |
| **Trace Metals: Semi-Quantitative XRF** | | | |
| Chromium TriOxide | $Cr_2O_3$ | 0.12 - 0.16 | 0.14 |
| Vanadium Pentoxide | $V_2O_5$ | 0.00 – 0.00 | 0.00 |
| Magnesium Oxide | MgO | 0.07 - 0.12 | 0.10 |
| Cerium Oxide | CeO | 0 .00- 0.00 | 0.00 |
| Potassium Carbonate | $K_2CO_3$ | 0.02 - 0.06 | 0.04 |
| Manganese Oxide | MnO | 0.02 - 0.04 | 0.03 |
| Gallium TriOxide | $Ga_2O_3$ | 0.00 - 0.01 | 0.01 |
| Arsenic TriOxide | $As_2O_3$ | 0.00 - 0.01 | 0.00 |
| Niobium PentOxide | $Nb_2O_5$ | 0.01 - 0.01 | 0.01 |
| Zinc Oxide | ZnO | 0.00 - 0.01 | 0.00 |
| Lead oxide | PbO | 0.00 - 0.01 | 0.01 |
| Yttrium TriOxide | $Y_2O_3$ | 0.01 - 0.01 | 0.01 |
| Strontium Oxide | SrO | 0.00 - 0.01 | 0.01 |
| Copper Oxide | CuO | 0.00 - 0.05 | 0.01 |
| Cobalt Oxide | $CO_3O_4$ | 0.00 – 0.00 | 0.00 |
| Thorium Oxide | ThO | 0.00 – 0.00 | 0.00 |

The five (5) principal compounds of the farmed bauxite residue, which account for ≈ 75% of the composition, are Moisture, Aluminium Goethite, Hematite or Ferric Oxide (which accounts for the characteristic colour), Calcium Cancrinite and Bayer Sodalite. These five (5) compounds have no associated hazardous classification.

Gibbsite, Perovskite and Antase & Rutile (Titanium Dioxide) make up the next (3) largest compounds, which account for ≈ 13% of the composition. Antase & Rutile have hazardous classifications in their pure form but at the 4% to 5% range present here, their concentrations are not considered to confer hazardous properties. The overall classification for the AAL farmed bauxite residue is non-hazardous.
Bauxite residue is generally regarded as a thixotropic clayey silt and there is an indication that bauxite residues may be cemented or aggregated. The bauxite residue particles are sub-rounded, friable with a low crushing strength. The amorphous particles have a capacity to retain moisture, generally at 1% to 3% of the moisture content (Golder 2014).

Based on the mineralogy, it can be expected that the bauxite residue would not behave as a clay but would exhibit properties similar to those of a granular silt. The majority of the material is clay and silt size. About 90% by weight of the bauxite residue is finer than 40 microns and the $D_{50}$ is between 2 and 5 microns (0.002 to 0.005 mm). Moisture content values typically range between 32% and 45% for unfarmed bauxite residue and typical range between 29% and 36% for farmed bauxite residue (Golder testing from 2004 to 2019).

The aqueous solution entrained within the bauxite residue during the pumping from the Plant contains a small amount of residual dissolved caustic and alumina. It is this residual caustic which initially gives the bauxite residue paste its elevated pH (12 to 13). Exposure to air during the mud farming and carbonation phase permits most of the caustic soda to convert to sodium carbonate and sodium bicarbonate with a consequent reduction in pH to < 11.5. The density and geotechnical strength parameters are also enhanced by the process.

Process sand is extracted from bauxite and is classified as a poorly graded, medium sand. The mineral grains are amorphous or very poorly crystalline and comprise red brown friable particles of oxides, hydrated oxides and oxi-hydroxides such as boehmite, goethite and gibbsite which are sub rounded and readily crushed between the fingers. 100% of the particles are less than 2 mm in diameter, ≈ 50% of particles between 2 mm and 0.425 mm in diameter and ≈ 96% of particles greater than 0.063mm in diameter. Moisture content values range from 13% to 23%.

Similar to the bauxite residue, the amorphous process sand particles have a capacity to retain moisture and the process sand possesses a residual level of caustic soda when initially deposited leading to an elevated pH, which subsequently reduces < 11.5 following exposure to air and weathering.
The scale and sludges removed from the plant infrastructure during maintenance programs are similar in nature and characteristics to either the bauxite residue paste or the process sand and are approved for co-deposition in BRDA.

The typical composition of salt cake is provided in Table 8.7, below. The key hazard is corrosivity which is related to the elevated presence of caustic soda (NaOH) above the threshold value corresponding to a hazardous classification.
A dedicated, independent, composite lined SCDC is located within the Phase 1 BRDA Extension (eastern sector of the Phase 1 BRDA) and overlies a 17m to 18m depth of deposited unfarmed bauxite residue which has a characteristic hydraulic conductivity value of $5.0 \times 10^{-9}$ m/s. The

Phase 1 BRDA Extension basin is also composite lined, comprising a 2 mm thick HDPE geomembrane overlying a compacted clay liner.

**Table 8.7: Typical Composition of Salt Cake (AAL, July 2021)**

| Component | Wet Basis (% w/w) | Hazard Code | Threshold (% w/w) | Classification |
|---|---|---|---|---|
| Caustic Soda (NaOH) | 17.74 | H314 | 0.5 | Hazardous |
| Alumina | 9.82 | Not classified | NA | NA |
| Sodium Carbonate | 3.11 | H319 | 20 | NA |
| Sodium Oxalate | 15.35 | H302, H312 | 25, 55 | NA |
| Sodium Sulphate | 0.16 | Not classified | NA | NA |
| Sodium Chloride | 1.00 | Not classified | NA | NA |
| Sodium Fluoride | 0.40 | H301, H315, H319 | 5, 20, 20 | NA |
| Sodium Acetate | 1.45 | Not classified | NA | NA |
| Sodium Formate | 0.75 | Not classified | NA | NA |
| Moisture | 44.09 | - | - | - |
| Total | **93.87** | | | |

### 8.6.3 BRDA Stability

The stability assessment for the permitted BRDA and the Proposed Development is discussed in detail in the Engineering Design Report for the BRDA Raise Development. In accordance with Section 4.2.1.3.4.3 of the 2018 Best Available Techniques (BAT) Reference Document for the Management of Waste from the Extractive Industries, with Directive 2006/21/EC, EUR 28963 EN, (MWEI BREF 2018), and in the absence of a National or EN Standard, AAL have selected to undertake the classification of the BRDA in accordance with the CDA Guidelines (CDA 2014) and to adopt the target level standard-based criteria for design parameters which are dependent on the consequence of failure. The analysis for undrained (total stress) condition within the bauxite residue is considered the critical stability case. While in general geotechnical terms and for other more free-draining tailings this is considered the 'short term', for the bauxite residue this represents a 'long term' condition that requires a minimum factor of safety (FoS) of 1.5.

The BRDA has been divided into sectors which have similar foundation conditions, bauxite residue deposition characteristics and side-slope profile. These sectors are named based on their location e.g., North-East sector in the Phase 1 BRDA and vary in width around the perimeter of the BRDA but are generally spaced at 200m to 350m. Stability sections lines have been assigned to each sector and monitoring instrumentation is installed along the alignment of the stability section lines on the side-slopes at designated elevation intervals as the BRDA is raised.
The stability sections assessed comprise the following (see Drawing 12 of the Design Report):

- **Phase 1 BRDA:** Section A-A, Section B-B, Section C-C, Section D-D, Section E-E, Section F-F, Section K-K and Section L-L.
- **Phase 2 BRDA:** Section M-M, Section N-N, Section O-O, Section P-P, Section Q-Q, Section R-R, Section S-S, Section T-T, Section U-U, Section V-V, Section W-W and Section X-X.

The stability analyses for the Phase 1 BRDA and the Phase 2 BRDA have returned FoS in compliance with the target FoS criteria for the permitted BRDA constructed to Stage 10 and for the proposed BRDA Raise to Stage 16. These target FoS criteria are consistent with the current international guidelines for tailings dam safety management and best practice.

### 8.6.4 Land Use

#### 8.6.4.1 Land Use within the Site

The current land use for the area of the Proposed Development comprising the extension of the BRDA and the construction of a new SCDC, is the existing BRDA; Corine 2018 land mapping identifies this area as ‘industrial or commercial units’ (Figure 8.7).

Corine 2018 identifies the land use for the proposed Borrow Pit Extension as ‘land principally occupied by agriculture with areas of natural vegetation’. The land use for the permitted Borrow Pit site is referred to as ‘industrial or commercial units’. No agricultural activities take place currently on the proposed Borrow Pit Extension footprint. It is a vegetated area within the wider AAL facility.

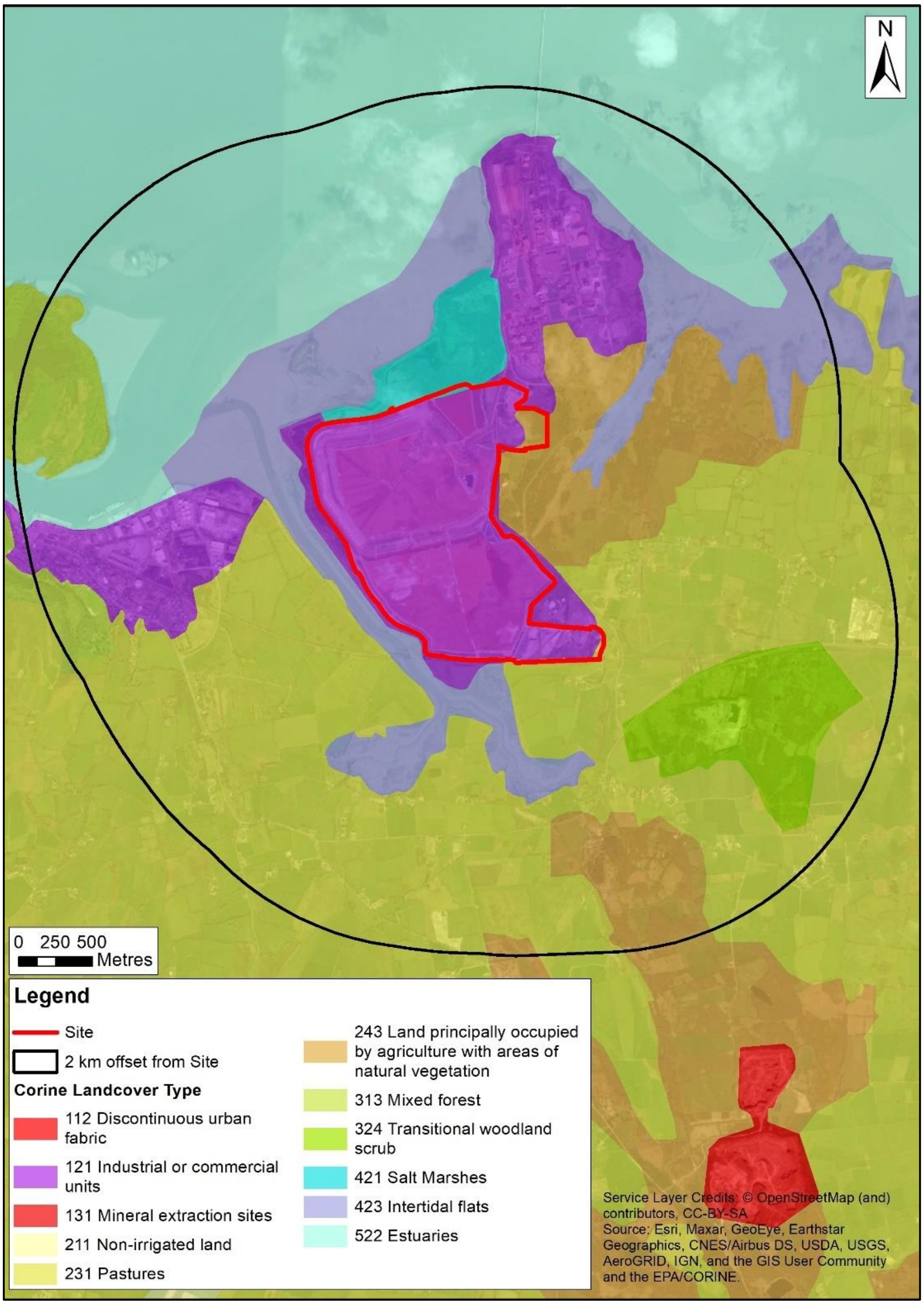



**Figure 8.7: Corine 2018 Land Use Mapping**

#### 8.6.4.2 Land Use within the Study Area

The BRDA, the SCDC and the Borrow Pit Extension footprints all sit within AAL facility's industrial site footprint. The wider Study Area identifies several different land types within Aughinish Island and surrounding townlands (Island MacTeige, Glenbane West and Fawnamore).

The predominant land use to the south of the Study Area is pastoral farming/agricultural, within which some areas may contain naturally vegetated areas (Corine, 2018) (Figure 8.7).

- To the north of the Site is a small stretch of salt marsh.
- To the east of the Site is a noted mixed use of land with 'industrial or commercial units' denoting the main AAL facility to the north-east which transitions into agricultural land with areas of natural vegetation and pastureland further east.
- To the south of the Site is noted intertidal flats which transitions into mixed pastureland. An area of transitional woodland scrub is noted to the southeast of the Site. However, the central area in this zone is occupied by the Roadstone owned Barrigone Quarry which is an operational limestone quarry and may be considered a 'mineral extraction site' under the Corine land cover system.
- To the west of the Site, Corine 2018 mapping notes an area of mixed pastureland and industrial or commercial units around Foynes.

In addition to land areas in the Study Area, there are notable regions, which are occupied by waterbodies, and these surround the Site to the west and north and also occur further to the east. The Shannon estuary is noted as 'estuaries', with 'intertidal flats' noted as occurring in the intertidal zones north, west and east of the Site (Corine 2018).

A review of available aerial imagery in the area (Google Maps, Geohive) was undertaken to see if other designations are applicable. One-off housing or ribbon development is common in the area along the road network approaching the Study Area from the south-east and east (along the L1234 and L6064), in areas previously noted as pasture or agricultural with natural vegetation.

#### 8.6.4.3 Historical Land Use Mapping

Historical mapping has been considered in this assessment to establish the historical land usage in the area, and if this has changed over time from the current baseline conditions. There are a number of historical maps available for the area (Ordnance Survey of Ireland, 2021) which were reviewed including:

- 6" historical map (1837-1842).
- 25'' OSI maps (1888-1913).
- 6" Cassini Map (1830s to 1930s).
- Aerial photography (1995, 2000, 2005 and 2005 – 2012).
- AAL historical records and reports (site investigation reports).

##### 8.6.4.3.1 Site Area

Aerial photography over the BRDA site dated between 1995 – 2012 shows that the northern BRDA site (Phase 1 BRDA) was in situ during these years (OSI, 2021).

Aerial photography dated between 1995 – 2012 for the southern BRDA site (Phase 2) shows that the lands were mixed scrubland, woodland and agricultural fields with minor access tracks gradually developing over time (OSI, 2021).

The OSI’s historical 25” and 6" mapping indicate that the BRDA site was once agricultural fields. Figure 8.8, below, shows the historical field boundaries at the BRDA site, while the field boundaries at the Borrow Pit sites remain largely unchanged since 1840.

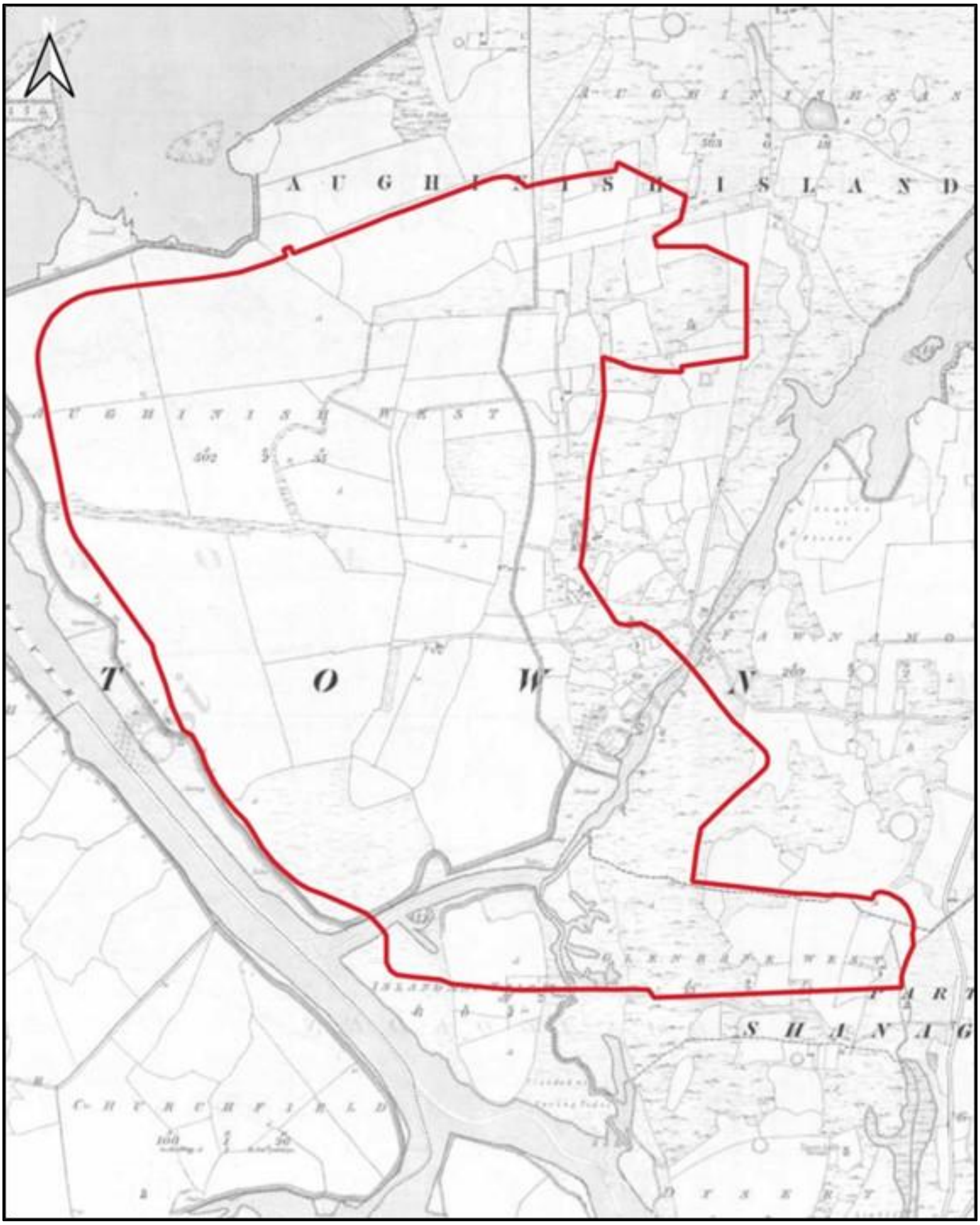



**Figure 8.8: Extract from the first edition OS map of 1840 showing the Proposed Development area (Source: OSI, 2021)**

OSI historical mapping (25" and 6") over the Borrow Pit sites indicate that they had changed little over this time period and both sites were composed of scrubland and small isolated fields.

OSI aerial photography for the proposed Borrow Pit Extension area during the period 1995 - 2012 indicates it has remained unchanged during this period also. However, OSI aerial photography during this same period for the permitted Borrow Pit site show the site had been partially excavated in the southern area by 1995. By 2000, and onwards, the site appears to have been disused and partial revegetation has occurred.

#### 8.6.4.3.2 Study Area

OSI aerial photography in the wider Study Area dated between 1995 – 2012 remains largely unchanged with agricultural fields and housing predominant within the area to the south and east. Figure 8.2 shows a later aerial image from 2016 and the Study Area has remained largely unchanged.

The predominant area to the north is the Lower Shannon Estuary. To the west is a mixture of agricultural fields, housing and the Foynes industrial area.

Additional housing and industrial units have developed over time, notably in the Foynes area and to the east of the Site along the L1234 and L6064.

Historical OSI mapping (6" and 25") indicates that the current Foynes development was undeveloped, and the wider study area was predominantly fields with some isolated housing, and farmsteads. A lime kiln is noted on the 25" map, ca. 150m east of the Roadstone limestone quarry.

### 8.6.5 Bedrock Geology

#### 8.6.5.1 Site Area

The mapped bedrock geology (GSI, 2021) comprises Waulsortian Formation limestones beneath the eastern sector of the BRDA and the in the area of the Borrow Pits and the Plant. The overlying Rathkeale Formation limestones and mudstones underlie the central and western sectors of the BRDA (see Figure 8.9 below).

The Waulsortian Formation is characterised as a medium bedded to massive, fine to coarsely crystalline, blue grey limestone. The Rathkeale Formation is characterised as impure muddy limestones and shaley mudstones.

Aggregate potential mapping (GSI, 2021) classifies the BRDA site area as having 'low' or 'very low' potential as a source for extracting rock to crush, while the Borrow Pit sites are classified as having 'very high' potential, Figure 8.10.

Structurally no major faults have been identified by the GSI at the Site.

Bedding underlying the BRDA area dips gently to the west, while bedding near the Borrow Pit sites dips shallowly to the east indicating that the bedrock sequence is gently folded within this area with a fold axis striking NNE - SSW.

A broadly folded sequence was imprinted on the area during the Variscan (formerly Hercynian) orogeny. It is noted by Clark et al (1981) that Aughinish Island sits on the western limb of the Shannon Anticline, which plunges gently WSW along the estuary.

Borehole drilling has taken place on the BRDA site since the 1980s to install monitoring wells around the periphery of the BRDA to act as observation wells, refer to Chapter 10: Hydrology and Hydrogeology for a detailed discussion of these wells.

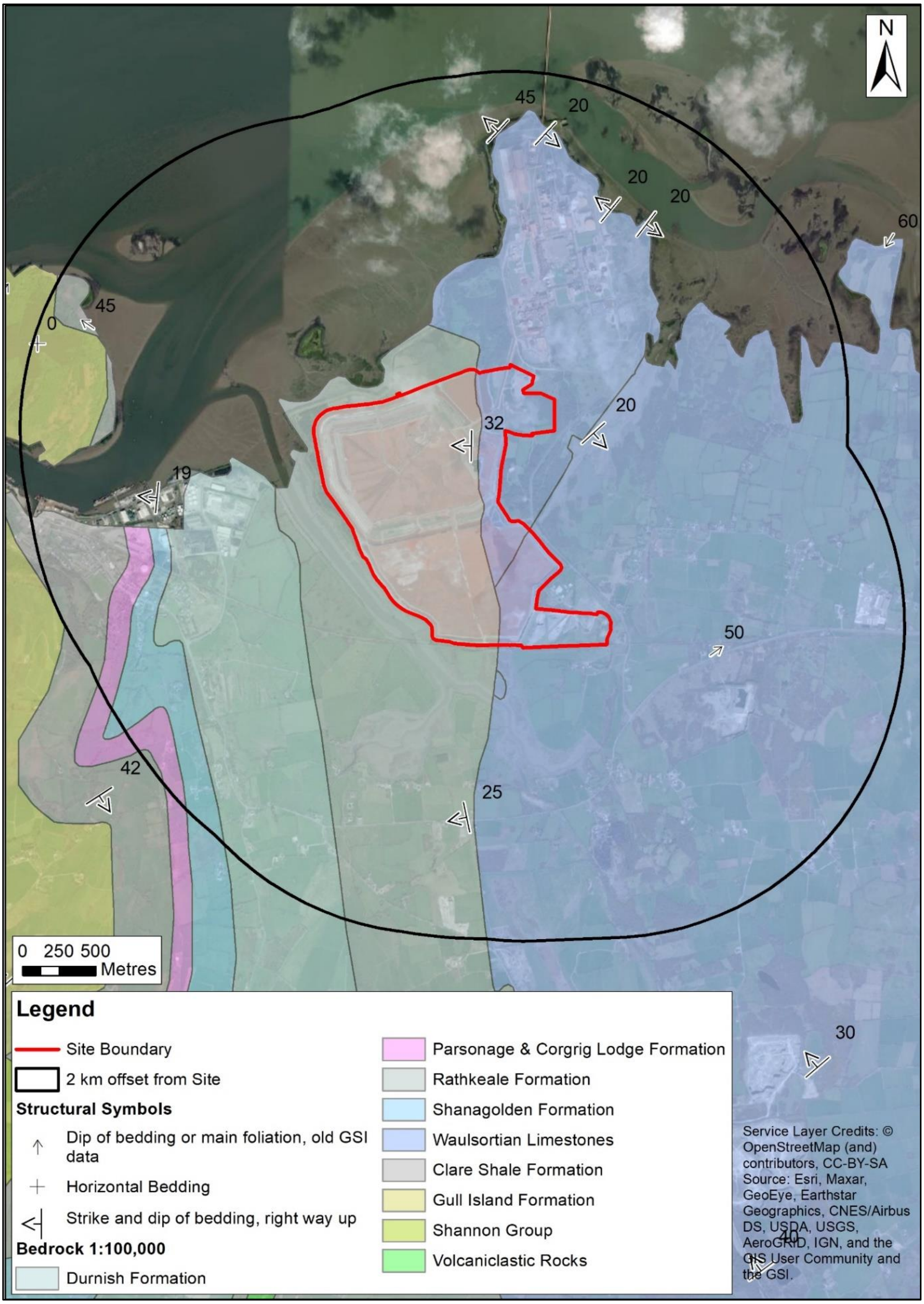



**Figure 8.9: Bedrock Geology 1:100,000 map (GSI, 2021)**

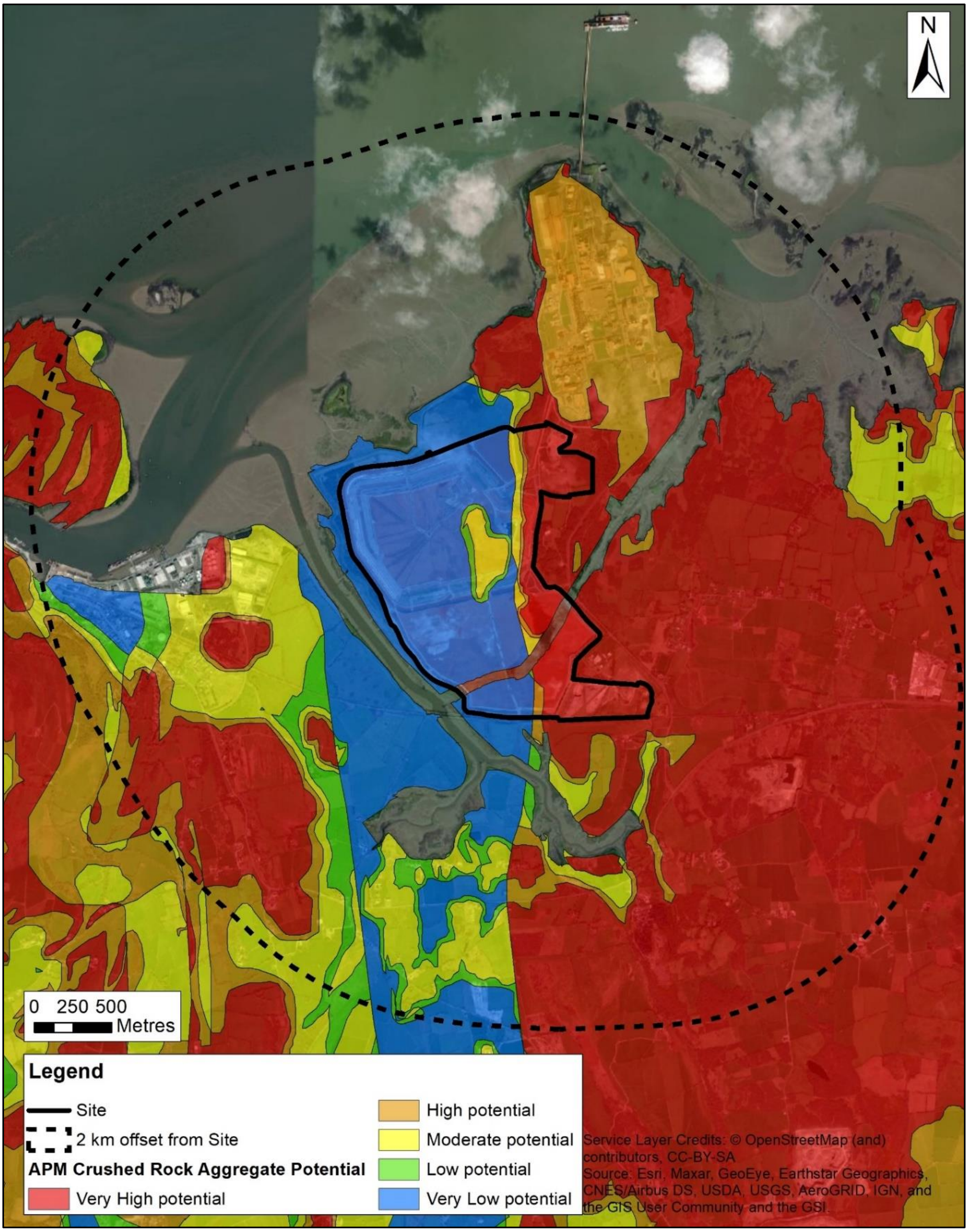



**Figure 8.10: APM Crushed Rock Aggregate Potential (GSI, 2021)**

Borehole logs and a location map for boreholes surrounding the Site are included in Appendix 8.3. Bedrock was encountered at varying depths beneath the BRDA site with rock either at surface (W5) or up to 26.8 mbgl (OW-11).

- Beneath the LWP and SWP in the north-eastern corner of the BRDA site, depths were between 6.7 – 6.9 mbgl in boreholes OW1 and OW2. Notably in OW-12 weathered limestone was encountered at 25.9 mbgl, before sand and gravel was encountered at 29.5 mbgl, and limestone was again encountered at 32.3 mbgl, indicting the presence of palaeokarst features. Small cavities and fissures were recorded during the drilling of several of other boreholes, including OW-2 and OW-8.
- The Phase 1 BRDA had bedrock depths between 13.2 mbgl (OW-10) and 26.8 mbgl (OW-11).
- Depths to bedrock are broadly shallowest on the eastern side of the Phase 2 BRDA, where rock is either at surface or up to 3.15 mbgl (W2).
- The western side of the Phase 2 BRDA encountered bedrock at deeper depths, between ca. 8.5 mbgl (OW-31) and 11.2 mbgl (OW-7)

The mapped bedrock geology (GSI, 2021) comprises Waulsortian Formation limestones beneath the Borrow Pit sites, Figure 8.9. Site investigations has been carried out in the vicinity and within the northern perimeter of the permitted Borrow Pit footprint, including borehole/monitoring well drilling and geophysical surveying (see Figure 8.5 and Figure 8.11).

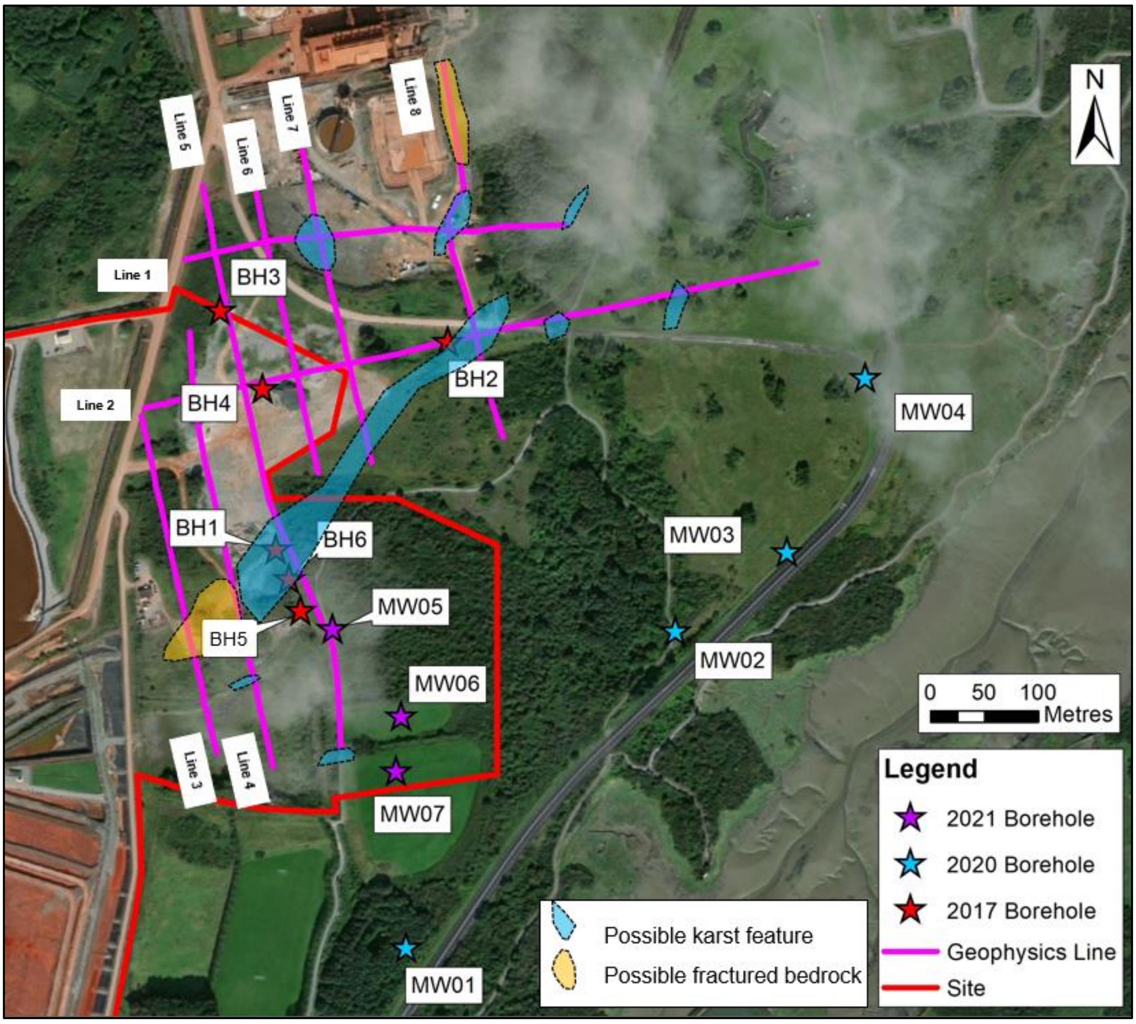



**Figure 8.11: Site investigations (2017, 2020 and 2021) in the vicinity of the Borrow Pit sites**

A copy of the Golder 2017A geophysical report which was completed as part of site investigation works for the permitted Borrow Pit is included in Appendix 8.4. Pseudo-sections indicate that the overburden thicknesses are shallow within the area (typically < 1m) and that discrete fracture zones / palaeokarst features are present.

A review of the borehole logs, which were drilled as part of site investigations for the permitted Borrow Pit, indicate that bedrock is a pale to medium grey, fine-grained limestone (Appendix A and Golder, 2017). Soil cover was absent in both BH4 and BH6, with soil encountered at depths between 0.2 mbgl and 1.1 mbgl in the remaining four boreholes. Bedrock was encountered at ground level in BH4 and BH6, and is composed of a pale to medium grey, fine-grained limestone. A thin soil cover (ca. 0.2 mbgl) was present in BH5 and in BH3 (ca. 0.3 mbgl) before a pale to medium grey fine-grained limestone was encountered. Bedrock was encountered at 1.1 mbgl in BH1 and was noted as compositionally the same as that in the other boreholes. Cavities were observed in all BH2, BH3, BH5 and BH6, including a 2m cavity at a shallow depth (3 mbgl) in BH6.

Additional site investigation was carried out at, and in the vicinity of the proposed Borrow Pit Extension footprint, with the drilling of four (4) boreholes (MW01, MW02, MW03 and MW04) in October 2020 and three (3) boreholes (MW)5, MW06, MW07) in June 2021, see Figure 8.5 and Figure 8.11. Similarly, these boreholes all encountered fine grained Waulsortian Limestone with discrete fracture zones / palaeokarst features present. The boreholes were drilled to a depth of 15m for MW01 to MW04 and to a depth of 20m for MW05 to MW07.

### 8.6.5.2 Study Area

The mapped bedrock geology (GSI, 2021) comprises several Carboniferous formations including the Clare Shale, Parsonage & Corgrig Lodge, Shanagolden, Durnish, Rathkeale and Waulsortian Limestone Formations (Figure 8.9 and Figure 8.12).

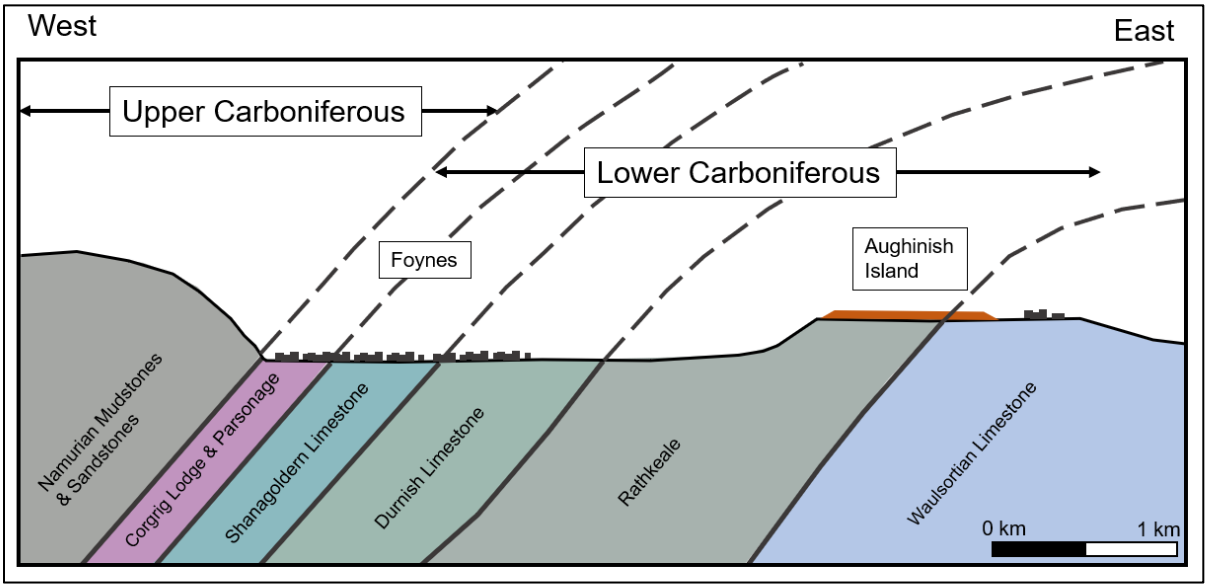



**Figure 8.12: Schematic geological section showing stratigraphy between Foynes and Aughinish Island (after Clark et al, 1981).**

Whilst no major structural faults have been identified by the GSI in the BRDA footprint, geological investigations in the area have previously identified several faults which trend northeast-southwest across the plant area. These fault zones are highlighted by the presence of northeast-southwest trending valleys, which have been subsequently infilled with glacial drift and then limestone fill during construction work in the 1970s of the facility.

Both primary and secondary altered limestones have been identified at the refinery plant area. Primary dolomitic limestones comprise light grey to crystalline rock, often with thin laminations of argillaceous material and chert (Golder, 2014). The alteration of limestone to primary dolomitic limestone is described by Clark *et al.* (1981) as having been formed by the inundation of brines soon after deposition; primary dolomitic limestone is identified in either lenses or entire basin areas.

On the other hand, the alteration of limestone to secondary dolomitic limestone is described by Clark et al. (1981) to have been altered by the circulation of magnesium-rich fluid through fault and fracture zones. On the Plant Site secondary dolomitic limestones have been observed in linear zones up to 30m wide and have been entirely altered to a yellow-brown or pink secondary dolomite.

Weathering of the primary and secondary dolomitic limestones in places has resulted in the formation of weathered profiles ranging from weak friable rocks to yellow-brown dolomitic sand depending on the increasing degree of weathering. Weathering of the dolomitic limestone in places has also caused the generation of karst-like features.

The grading process on the refinery plant area, which commenced in 1978 whereby ca. 1.6 million $m^3$ of rock was blasted and removed, or redistributed, allowed for detailed site investigation work to be carried out on the bedrock geology (Clark *et al.,* 1981). A geological model was developed from this work, which identified that bedrock on the Plant site exhibits a mound and basin structure. Mound areas are typically tens to hundreds of metres across and are represented by medium-bedded to massive, fine to coarsely crystalline, blue-grey limestone, which forms a major part of the island (Clark *et al*., 1981). The basin areas are the intervening areas or lagoonal areas, which favoured the formation of thinly bedded, finely crystalline, blue-grey limestone and in places a light grey, dolomitic limestone (Clark *et al.*, 1981).

### 8.6.6 Palaeokarst

Drilling during historical ground investigation work identified a number of minor palaeokarst features, i.e., infilled ('choked') cavities and fissures, in the Waulsortian Limestone in the vicinity of the Plant Site. Similar features were encountered in boreholes drilled as part of investigations related to the Borrow Pit Areas (refer to Appendix D for geological logs) and the BRDA footprint (the eastern sector of the BRDA footprint is underlain by Waulsortian Limestone). As is the case with the Plant Site, the palaeokarst features intersected under the Borrow Pit Areas and BRDA were found to be 'choked' with sediment, usually consisting of sand sized grains of dolomite, indicating in-situ alteration of the host rock rather than transported material associated with collapse, or extensive cave systems.

Limited development of palaeokarst features in the Waulsortian Limestone occurred during the Cenozoic Era, i.e., since about 66 million years ago, primarily controlled by the presence of dominant subvertical structural features in the bedrock. However, by the start of the Holocene epoch (ca. 12,000 years ago) which followed the last ice age, the karstic environment had become clogged and 'choked' with sediment, thus minimising active groundwater circulation. The karst features became "buried, inert and fossilised karst", termed 'palaeokarst' (Drew & Jones, 2000).

Under certain circumstances a palaeokarst feature can be reactivated by the following conditions;

- Increase in normal stress leading to consolidation of infilling material or collapse of a soil arch;
- Dewatering of groundwater resulting an increase of effective stress of the infilling or by migration of the infilling into an adjacent void;
- Recharge due to hydrostatic loading by water ingress from such structures as unlined reservoirs.

The Aughinish area has been significantly stressed during the ice age, as a large ice sheet covered the area as far as the edge of the continental shelf to the west of the Site. This would have consolidated the sediments in the underlying palaeokarst, and therefore, there would be little probability of the palaeokarst consolidating as a result of the loading resulting from the BRDA, when the loading of the materials from the BRDA is compared to the loading provided by the ice sheet.

In addition, there is little, if any overburden associated with the Waulsortian Limestone at the Site, so the probability of a collapse of a soil arch over an open cavity, should one occur in the bedrock, is considered to be very unlikely.

Recharge of palaeokarst due to water leakage from the BRDA is unlikely as the facility basin is composite lined along the eastern sector (Phase 1 BRDA Extension and the Phase 2 BRDA) and retains very little water in the perimeter interceptor channels (PICS) located in the eastern sector, where the Waulsortian is underlying.

Electrical Resistivity Imaging (ERI) surveys have previously been carried out on the downstream side of the BRDA footprint on Glenbane West and Fawnamore side of the facility to assist in the locating of monitoring wells W1 to W9. The results of the ERI surveys together with follow-up drilling indicated massive Waulsortian Limestone with little structure and no indication of palaeokarstic features.

### 8.6.7 Geological Assets

There are no active quarries within the immediate Site area, however, there is one semi-active limestone quarry ca. 1.2 km southeast of the Site and within the Study Area. The limestone quarry (Barrigone Quarry) was previously operated on a full-time basis by Roadstone Ltd and had been left unworked for a prolonged period. In recent years, Roadstone have operated the quarry for short durations annually to explicitly provide rock fill to fulfil the AAL BRDA operational construction needs. The quarry is also mapped by the GSI (2021) as a mineral locality for 'limestone (in general)'.

There are no audited geological heritage sites or unaudited heritage sites within the Site. Two unaudited geological heritage sites occur within the Study Area, no audited sites occur within the Study Area. The most proximal of the unaudited sites is 'Foynes Island' which is ca. 1.3 km west of the Site. It is noted for its sequence of the Gull Island, Clare Shale and Tullig Sandstone Formations, and it is the type locality for two goniatite fossil species from the Clare Shale Formation (GSI, 2021). The Irish Geological Heritage (IGH) theme associated with this site is IGH 9 which signifies that the site fits within the Upper Carboniferous and Permian periods.

The second site is the 'Foynes road section and inland outcrop' which is described by the GSI (2021) as 'east of road quarries – new road section and in people's gardens' with the features noted as 'Gull Island Formation?'.

According to the GSI mapping (2021) it sits within IGH 8 which signifies it is Lower Carboniferous in age, however, the sequence is younging westwards and the Gull Island Formation is Upper Carboniferous and would more appropriately fit within IGH 9.

### 8.6.8 Geotechnical Considerations

Geotechnical monitoring is carried out on a continuous basis at the existing BRDA site as part of the Industrial Emissions Licence (IEL) P0035-07 requirements for the facility.

The Annual Review, the most recent version being the 2020 Annual Review (Golder 2021B), summarises the monitoring results from the piezometers, the inclinometers and extensometers, the visual inspection of the facilities and assesses the stability of the BRDA, the inner and outer perimeter walls (IPW and OPW respectively) forming the perimeter interceptor channel (PIC), the SWP and the LWP.

The assessment of the current data indicates that the BRDA is performing in compliance with the target FoS criteria for the permitted BRDA constructed to Stage 10 (see Engineering Design Report for the BRDA Raise and Section 8.6.3). These target FoS criteria are consistent with the current international guidelines for tailings dam safety management and best practice. Visual inspection of the BRDA also indicates no signs of distress in the walls. At the end of 2020, the Phase 1 BRDA is at Stage 10 along its eastern, north-eastern, northern, north-western and western sectors, while the Phase 2 BRDA is at Stage 4 along its eastern, south-eastern and south sectors and at Stage 3 along its south-western, western and north-western sectors. Stage 10 is being prepared for construction / being constructed along the Phase 1 BRDA south-western, southern and south-eastern sectors, while Stage 4 is being prepared for construction along the western sector of the Phase 2 BRDA.

The Physical Stability Monitoring Plan for the BRDA (Golder 2021A) is provided in Appendix M of the Engineering Design Report for the BRDA Raise and it provides the plans, sections and schedule for the installation of and monitoring of geotechnical instruments for the BRDA, along with a series of scheduled audits, inspections and conformance checks to assess the performance of the BRDA.

A summary of the instruments and their respective readings currently installed in the BRDA is provided below. The data received from inclinometers, extensometers, and standpipes are generally satisfactory with the instruments functioning well and the indicated movements and water levels are within what is considered to be satisfactory.

- Casagrande and standpipes piezometers installed within the BRDA measure the piezometric level below the perimeter walls in both the bauxite residue and the underlying estuarine deposits. In addition, eight (8) piezometers (coded EP for Environmental Piezometers) measure the piezometric level in the estuarine deposits at the north and west downstream toes of the outer perimeter channel embankment wall for the Phase 1 BRDA.

- Piezometers installed beneath the estuarine deposits beneath the Phase 1 BRDA compose two series; the APL-series and the APU-series. The APL-series are located on Stage 2 at ca. 8 mOD and the APU-series are located on Stage 5 at ca. 14 mOD. The piezometric elevations of the APL-series are tightly congregated between 2.0 mOD and 4.2 mOD and correspond to a depth of 7m to 8m of bauxite residue deposited over the estuarine deposits. The piezometric elevations of the APU-Series are more widely dispersed with readings between 5.3 mOD and 11.5 mOD and correspond to a depth of 13m to 14m bauxite residue deposited over the estuarine deposits. The highest piezometric elevations of note are at 1APU and 2PAU on the north-east and north sections of the Phase 1 BRDA, respectively, where the readings are generally within 2.0m to 3.5m of surface. The estuarine deposits vary in depth and layering (clayey silt to silty clay) throughout the Phase 1 BRDA, but site investigations have shown greater depths of the silty clay layers in the north and north-west. The readings from 2020 are generally stable for the piezometers and are consistent with previous years and follow the trend of slightly elevated readings being recorded during Q4 2019 and Q1 2020 which drop back during Q2 and Q3 2020 (Golder 2021B).
- Outside of the BRDA footprint, the piezometric elevation in the estuarine deposits is monitored by the Environmental Piezometers (EP1 to EP8) installed at the downstream toe of the OPW of the PIC. The piezometers in the estuarine deposits beyond the downstream toe of the BRDA generally read piezometric levels between 0.3 m to 1.3 m below ground elevation or 0.4 mOD to 1.5 mOD (Golder 2021B). These elevations are less than those recorded in the APL-series and the APU-series, as they are not subject to the direct loading of the deposited bauxite residue. However, the elevations are close to surface and reflect the low permeability of the estuarine soils, which is similar to that of the bauxite residue. The readings over the four quarters of 2020 are generally stable, are consistent with previous years and follow the trend of slightly elevated readings being recorded during Q4 2019 to Q1 2020 which drop back during Q2 and Q3 2020 (Golder 2021B).
- Standpipe piezometers in the bauxite residue are located between Stage 5 at 14 mOD and Stage 10 at 24 mOD in the Phase 1 BRDA. The piezometric level readings in the bauxite residue for the lower-level standpipes, between Stage 5 and Stage 8, in the active areas of the Phase 1 BRDA are typically between 1.5 m to 4.0 m below the surface level of the BRDA. The upper-level standpipes, between Stage 9 and Stage 10, in the active areas of the Phase 1 BRDA typically have piezometric readings in the 5m to 10m depth range. The piezometric elevation varies considerably from 10.2 mOD to 21.5 mOD, which corresponds to the slope of the facility and the location of piezometer installations at vertical intervals along defined sections of the slope. In general, the bulk of the standpipe piezometers showed a noticeable drop in piezometric elevation for Q2 2020 following a prolonged period of dry weather. Similarly, a noticeable increase in piezometric elevation was recorded for Q4 2020 following a particularly wet October and November (Golder 2021B).
- In the Phase 2 BRDA the standpipe piezometers in the bauxite residue are located at Stage 3 at 10 mOD along the western flank. Piezometers were installed in the West Embankment during November 2020. The first readings from these piezometers were taken in Q4 2020. Bauxite residue deposition was active in the area at the time and hence an elevated piezometric level was recorded at the 5 No. installations, varying between 1.3 m and 2.5 m depth or 9.2 mOD to 8.2 mOD (Golder 2021B).
- Four series of inclinometers have been installed along the designated stability sections of the Phase 1 BRDA, namely at positions A, B, C and D. Upper and Lower inclinometer pairs were installed in the lower slope for the A and B series, and subsequently only single inclinometer were installed in the upper slope for the C and D series. Inclinometers are

installed on Stages 3, 4, 5, 6, 7, 8, 9 and 10 within Phase 1 BRDA. The A and B-Series inclinometers have been monitored since installation in the Spring of 2007, the C-series have been monitored since installation in March 2015, and D-Series have been monitored since installation in April 2018. All inclinometers show some degree of movement, and these movements are measured along the A-axis, which is perpendicular to the side-slope of the BRDA, with the negative readings indicating displacement downslope and the positive readings indicating upslope movement. The upper ca. 0.5m of the inclinometers protrudes above ground level. On occasion, this has led to the instruments being disturbed during the landscaping works or construction projects, hence displacements in the upper 2m are generally disregarded. Cumulative displacements during the installed life of the most active inclinometers are considered to be low (typically < 50 mm). The inclinometers are behaving as expected due to loading from additional stage raises, bauxite residue placement, activities on the BRDA and the merging of the Phase 1 and Phase 2 BRDAs.

- Extensometers are also installed along the casing of a number of the Phase 1 BRDA inclinometers. These instruments (spiders) measure the relative vertical movement of the bauxite residue from a datum point at the base of the inclinometer. The spiders can slide on the casing along the vertical axis of the inclinometer. In the Phase 1 BRDA, the datum point is generally in the stiff glacial till layer or the bedrock underlying the estuarine deposits. In the Phase 1 Extension BRDA (extensometers on 8AIL), the datum point is in the bauxite residue to avoid puncturing of the geosynthetic basal lining system. The number of spiders installed varies depending on the length of the inclinometer and varies from 6 in the AIU series and 2 to 3 in the AIL series. The movement of the uppermost spider reflects the maximum vertical movement, if lower spiders show greater movement, then this may be a result of slippage on the casing.

The permitted Borrow Pit area, which is located to the immediate east of the Phase 1 BRDA, has not yet commenced operating and geotechnical monitoring is therefore not currently taking place at that site. IEL P0035-07 was issued on 28 September 2021 and provides conditions for the operation of the Borrow Pit.

### 8.6.9 Naturally Occurring Radioactive Material

Naturally occurring radioactive material (NORM) is material found in the environment that contains radioactive elements of natural origin. Two sources of NORM are present at the Site.

- The Radon Map for Ireland (EPA, 2021) indicates that the Proposed Development is located in an area where between 1% and 5% of homes are estimated to be above the radon reference level (reflecting the nature of the underlying bedrock geology).

The majority of the Study Area has the same radon reference level as the Site area. A small area in the east of the Study Area has a higher radon reference level where between 10% and 20% of homes in the 10 km grid are estimated to be above the reference level. The area south of the estuary also has a reference level which is higher than the Site area level with between 5% and 10% of homes likely to show exceedances in radon levels.

- In addition to naturally occurring radon in the bedrock, mineral raw materials such as bauxite exhibit natural radioactivity which is slightly above the average level in the earth's crust. In bauxite, both thorium 232 (Th-232) and uranium 238 (U-238) are present in measurable amounts. Material such as this is termed naturally occurring radioactive material (NORM).

The EPA is currently the competent Authority in Ireland for dealing with regulatory, monitoring and advisory responsibilities in matters pertaining to ionising radiation and radioactive contamination in the environment. Formerly, the Radiological Protection Institute of Ireland (RPII) was the competent Authority.

The RPII has previously surveyed the Aughinish site and assessed the facility, raw materials (bauxite) and bauxite residue for NORM properties as part of the industry-specific radiological assessment undertaken for four (4) large industries operating in Ireland, dealing with NORM, which were prioritized to determine the level of radiation to which workers and members of the public were potentially exposed as a result of their work practices (RPII 2008).

The results of the gamma spectrometry analysis of the samples collected by the RPII at the AAL facility are replicated in Figure 8.13 below, along with published data from similar facilities in other countries for comparison.

Activity concentrations for both Th-232 and U-238 decay series were detected and found to be in radioactive equilibrium in the bauxite residue. All measured activity concentrations were found to be below the European Commission (EC) and the International Atomic Energy Agency (IAEA) indicative recommended exclusion / exemption values for NORM materials. Below these concentrations, the radiation dose received by a worker or a member of the public dealing with this type of material is unlikely to exceed 300 microsieverts (mSv) per year. The threshold for an effective dose to workers or members of the public being > 1,000 microsieverts (mSv) per year (S.I. 125 of 2000).

| Reference and material | U-238 (maximum) | Th-232 (maximum) | U-235 |
|---|---|---|---|
| This study | | | |
| Bauxite slurry | 140 | 120 | < 10 |
| Scale top digester | 250 | 260 | 20 |
| Scale decanter | 40 | 40 | < 10 |
| Red sand | 150 | 170 | 7 |
| Red mud | 240 | 460 | 7 |
| Liquid effluent (Bq/l) | 3 | 0.3 | < 10 |
| [Von Philipsborn and Kühnast, 1992] | | | |
| Bauxite ore (Sierra Leone)Bauxite | 30 | 30 | |
| ore (Boké – Rep. Guinea) | 130 | 160 | |
| Bauxite ore (Queensland – Australia) | 90 | 100 | |
| Red mud (unspecified origin) | 120 | 210 | |
| [Beretka and Mathews, 1985] | | | |
| Red mud (Australia) | 330 | 1130 | |
| Red sand (Australia) | 50 | 390 | |
| [FNCA, 2005] | | | |
| Bauxite (Australia) | 120 | 500 | |
| Red mud (Australia) | 400 | 1300 | |
| [Cooper, 2005] | | | |
| Bauxite (Western Australia) | 120-350 | 450-1050 | |
| Red sand (Western Australia) | 5-200 | 300-800 | |
| Red mud (Western Australia) | 150-600 | 1000-1900 | |
| [European Commission, 2007] | | | |
| Red mud (Hungary) | 250-570 | 260-400 | 7-11 |
| Red mud (Bosnia and Herzegovina) | 72 | 190 | 3 |
| [European Commission, 2001a] | | | |
| Bauxite | 50-500 | 50-500 | |
| Red mud | 260-540 | 340-500 | |
| [Timmermans and van der Steen, 1996] | | | |
| Bauxite | 500 | 400 | |
| [IAEA, 2003] | | | |
| Bauxite | 10-9000 | 35-1400 | |
| Red mud | 100-3000 | 100-3000 | |
| [Marsh, 1991] | | | |
| Average in Irish soils | 46 | 25 | |

**Figure 8.13: Radionuclide activity concentrations (Bq / kg dry weight) in samples collected at the AAL BRDA and compared with other published data (RPII 2008)**

RPII 2008 concluded that the low levels of NORM at the Aughinish facility are in compliance with safe levels and below the threshold at which the facility would come within the scope of the Irish Regulations from a radiological point of view.

AAL undertook additional radioactive assessment of the farmed bauxite residue and process sand during 2021. Two samples (2) of farmed bauxite residue (composite samples from Q3 2020 and Q4 2020) and one sample (1) of process sand (composite sample produced during 2020) were tested via alpha- and gamma-spectrometry for the presence of thorium and uranium isotopes at the Socotec Laboratories in Oxfordshire, UK. One (1) thorium (Th-232) and three (3) uranium (U-234, U-235 and U238) decay series were detected.

| Customer Reference | Laboratory Reference | Ac-228 (Bq kg$^{-1}$) | Ra-224 (Bq kg$^{-1}$) | Pb-212 (Bq kg$^{-1}$) | Bi-212 (Bq kg$^{-1}$) | Tl-208 (Bq kg$^{-1}$) |
|---|---|---|---|---|---|---|
| Farmed Bauxite Residue Q3 2020 | NA3281 * | 313 ± 26 | 251 ± 57 | 314 ± 26 | 350 ± 51 | 101.0 ± 8.9 |
| Farmed Bauxite Residue Q4 2020 | NA3282 * | 304 ± 25 | 267 ± 59 | 312 ± 25 | 329 ± 48 | 105.0 ± 8.9 |
| Process Sand 2020 | NA3283 * | 164 ± 15 | 120 ± 45 | 151 ± 14 | 160 ± 39 | 47.3 ± 5.2 |

The direct daughter of $^{232}$Th is $^{228}$Ra which does not produce any significant gamma ray emissions. We can estimate the activity of $^{228}$Ra from the daughter radionuclide $^{228}$Ac but the $^{228}$Ra may not be in equilibrium with the $^{232}$Th. Radium-224 is a good estimator of the activity of $^{228}$Th. The immediate daughter of $^{224}$Ra is $^{220}$Rn which is a gas and thus it is possible for $^{212}$Bi & $^{212}$Pb to underestimate the $^{228}$Ra activity however that is not the case for these samples. Bismuth-212 decays to two possible radionuclides with only a 35.9% probability to $^{208}$Tl and allowing for this it appears that there is reasonable equilibrium from $^{228}$Ac through to $^{208}$Tl.

**Table notes**
1. Results are presented as Bq.kg$^{-1}$ of sample as received and are decay corrected to the sampling date provided.
2. Analyses and/or samples marked with an asterisk are not UKAS accredited under schedule 1252.
3. Uncertainties are rounded to 2 significant figures; results are rounded to the same precision.
4. For results below the Limit of Detection, the LoD is rounded up to 2 significant figures.
5. Detector calibrations are based upon homogeneous standard solutions. For quantification purposes the sample is assumed to be homogeneous.

**Figure 8.14: Thorium Isotope Testing (AAL 2021) – Ac is the proxy for Th-232**

| Customer Reference | Laboratory Reference | U-234 | U-235 | U-238 |
|---|---|---|---|---|
| | Reference Date: | 31 August 2021 | | |
| Farmed Bauxite Residue Q3 2020 | NA3281* | 68 ± 11 | 5.5 ± 2.8 | 58 ± 10 |
| Farmed Bauxite Residue Q4 2020 | NA3282* | 91.2 ± 8.5 | 5.0 ± 1.5 | 92.7 ± 8.6 |
| Process Sand 2020 | NA3283* | 82.0 ± 9.7 | 4.0 ± 1.7 | 79.7 ± 9.6 |

**Notes:**
1. Results and/or samples marked with an asterisk are not UKAS accredited.
2. Results are presented as Bq.kg$^{-1}$ of sample as received, relative to the reference date.
3. Uncertainties are quoted at 2 s.d. based on a total uncertainty budget.

**Figure 8.15: Uranium Isotope Testing (AAL 2021)**

A comparison of the 2008 and the 2021 results shows:

- Th-232 was present in the unfarmed bauxite residue at an average value of 460 Bq / kg in 2008 and was present in the farmed bauxite residue at an average value of 309 +/- 25 Bq / kg in 2020 (average of Q3 value of 313 and Q4 value of 304 for Ac-228)
- Th -232 was present in the process sand at an average value of 170 Bq / kg in 2008 and was present in the process sand at 164 +/- 15 Bq / kg in 2020.
- U-238 was present in the unfarmed bauxite residue at an average value of 240 Bq / kg in 2008 and was present in the farmed bauxite residue at an average value of 75 +/- 10 Bq / kg in 2020 (average of Q3 value of 58 and Q4 value of 93 for U-238)
- U-238 was present in the process sand at an average value of 150 Bq / kg in 2008 and at 80 +/- 10 Bq /kg in 2020.
- U-235 was present in the unfarmed bauxite residue and the process sand at average values of 7 Bq / kg in 2008 and was present in the farmed bauxite residue and process sand at average values of 5.3 +/- 2.8 Bq / kg (average of Q3 value of 5.5 and Q4 value of 5.0 for U-235) and 4 +/- 1.7 Bq / kg, respectively, in 2020.

The 2020 test results returned values comparably with and slightly lower across the board with the previous RPII assessment. As such, the BRDA does not present a radiation hazard to either site operatives, visitors or the surrounding environment and is not considered further in the assessment.

## 8.7 Selection of Sensitive Receptors

Land within the Site is already in industrial usage or forms part of a vegetated area within the larger industrial site area. As there would be no loss of productive land or further land take required to enable the Proposed Development, it is not considered further in this assessment.

Separate consideration is given to the ecological value of the proposed Borrow Pit Extension site in Chapter 7: Biodiversity.

No geological heritage sites or mineral sites have been identified as part of the baseline within the Site, however, two unaudited geological heritages have been identified within the Study Area and one limestone quarry which has been intermittently active in the recent past. Given the distance between the unaudited geological heritage sites and the Site, the nature of the Proposed Development and the lack of interaction with the unaudited geological heritage sites, these are not considered further in the assessment.

Similarly, the Roadstone Barrigone Quarry has been intermittently active over the recent past on a limited level and does not currently represent a site of high mineral resource potential in the area and has not been considered further in the assessment.

There is very limited natural soil cover present on the Site and in the wider Study Area, and it is unlikely that the superficial deposits which are present would represent a future resource. However, bedrock geology within the proposed Borrow Pit Extension site is of site importance for use within the Proposed Development area. To enable the extraction of the bedrock, the overlying superficial deposits will be removed from the proposed Borrow Pit Extension site. Therefore, the impacts to, and effects on, natural resources (soils and bedrock) will be considered further in this assessment.

As the Proposed Development will include a vertical raise of the existing BRDA and SCDC, consideration has been given to the existing structures and their geotechnical considerations. Tailings storage facilities are typically classified according to the consequence in the event of failure and the BRDA is considered to have a 'High' hazard potential classification (HPC), in accordance with CDA 2014 and based on environmental and economic considerations (Golder 2019A). Therefore, the impacts to, and effects on, the BRDA and SCDC will be considered further in this assessment.

Taking account of the above and the qualitative assessment method described in Section 8.5.1**.**, the receptors carried forward in this assessment and their assigned importance are presented in Table 8.8.

**Table 8.8: Soil, Land and Geology Receptors**

| Receptor | Value and Reasoning |
|---|---|
| Natural resources (soil and bedrock) at and immediately adjacent to the Proposed Development | Medium value.<br>While the bedrock is ubiquitous in Ireland and aggregate could be sourced from offsite, the crushed rock potential beneath the proposed Borrow Pit Extension site is classified as 'very high' and represents a locally important, high quality economic geology resource for the Site. |
| Built structures (BRDA, SCDC) | High value.<br>The BRDA is a large tailings facility.<br>The SCDC is a hazardous waste storage facility within the BRDA. |

## 8.8 Characteristics of the Proposed Development

The Proposed Development involves the following three main elements:

- Proposed increase in height of the BRDA to accommodate the additional storage of bauxite residue, equivalent to an additional circa 9-year capacity at the current rate of production;
- Proposed increase in height of the SCDC to accommodate additional storage of salt cake at the Facility (circa 22,500 m$^3$), equivalent to 3 years of storage at current rate of production; and
- Proposed eastern extension of the permitted Borrow Pit to provide additional rock (crica 380,000 m$^3$) to be used in the construction of the proposed BRDA and SCDC raises and closure works.

### 8.8.1 Proposed BRDA Raise

It is proposed that the existing BRDA can facilitate an increase in height to Stage 16 (currently permitted to Stage 10) which would provide a perimeter elevation of 36 mOD and a maximum dome crown central elevation of 44 mOD. The Proposed Development will provide for the deposition of circa 0.9 million m$^3$ / year of bauxite residue and total of circa 8.0 million m$^3$ over the lifetime of the development.

The proposed method of raising the BRDA from Stage 10 to Stage 16 will be the upstream method, which is consistent with the construction methodology for the current BRDA and involves the construction of rock fill embankments (Stages), offset internally and founded on the previously deposited and farmed bauxite residue, in 2m high vertical lifts. This construction method is also consistent with Best Available Techniques (BAT) for the management of waste from extractive industries. The overall BRDA is raised systematically as the space created by the perimeter Stages are filled with bauxite residue, farmed, carbonated (reduction in pH through reaction with atmospheric carbon dioxide) and compacted, prior to deposition of the next layer. The upstream construction methodology is illustrated in Figure 8.16 and Figure 8.17 below. The stability of the permitted BRDA to Stage 10 and the proposed BRDA to Stage 16 is discussed in detail in the Engineering Design Report for the BRDA Raise and a summary is provided in Section 8.6.3.

**Figure 8.16: North and West Sectors of the Phase 1 BRDA (April 2021)**

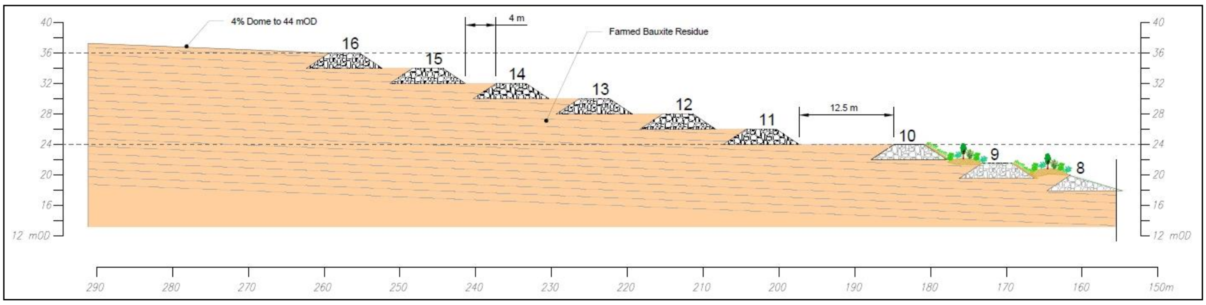



**Figure 8.17: Representative Section of the BRDA Raise from Stage 11 to Stage 16 (landscaping omitted for clarity)**

### 8.8.2 Proposed SCDC Raise

The current SCDC is located in the north-east sector of the BRDA. The existing crest height of the SCDC is at 29 mOD, which ties into the overall height of the permitted BRDA at 32 mOD. The Proposed Development comprises the 2.25m high vertical extension, via downstream and centre-line methods, of the existing SCDC to a crest height of ca. 31.25 mOD, which will have a maximum overall height of ca. 35.5 mOD when capped at its northern extent.

The embankment walls will be constructed of processed rock fill that is placed and compacted in layers overlapping the existing cell walls and above farmed bauxite residue deposited locally. The upstream side-slopes will be composite lined comprising a 2 mm HDPE geomembrane overlying a geosynthetic clay lining (GCL) with engineered fill and non-woven protection geotextile layers placed, as appropriate.

Rock fill for construction of the cell will be sourced from the development of the on-site Borrow Pit.

### 8.8.3 Proposed Borrow Pit Extension

The permitted Borrow Pit is located to the east of the Phase 1 BRDA. It is proposed to extend the extraction area of the permitted Borrow Pit to c. 8.4 hectares (from c. 4.5 hectares) which would provide a total of c. 754,000 m$^3$ of rock.
The quantum of rock to be extracted from the permitted Borrow Pit and the proposed Borrow Pit Extension area will be processed and used in the construction of the proposed BRDA and SCDC raises and the closure works.

The Borrow Pit Extension is proposed to be developed from surface to a maximum extraction elevation of 8.5 mOD and operated in accordance with the conditions for the current Borrow Pit (listed below) and any subsequent Conditions imposed for the Borrow Pit Extension.

- The development conditions imposed by ABP Board Order ABP-301011-18 in November 2018 and subsequent Board Direction issued in February 2019; and
- The relevant conditions of Industrial Emissions Licence (IEL), P0035-07, issued by the EPA on 28 September 2021.

***Note:*** *AAL are aware that there is no guarantee that the same development and operational conditions would be applicable in the granting of permission or an IE licence for the proposed Borrow Pit Extension. The adoption of the current development and operational conditions permits the assessment of the impact and its significance.*

### 8.8.4 Construction Soil Materials

The construction of the BRDA raise and the SCDC raise requires rock fill material which is proposed to be sourced solely from the Borrow Pit areas (permitted and proposed). Similarly, the civil elements of the BRDA closure and restoration works require rock fill material which is proposed to be sourced solely from the Borrow Pit areas (permitted and proposed).

Superficial deposits are required to be removed from the footprint of the Borrow Pit Extension. The superficial deposits are very thin (circa < 0.5m to 1m depth) and of value locally. The removed soils will remain in the immediate area and will be utilized in the construction of screening berms. Any surplus soil materials shall be hauled to the stockpile yard to the south of the BRDA and shall be available for future landscaping and/or restoration works. There are current stockpiles of topsoil and subsoil available on Site that allow AAL to conduct interim landscaping and progressive closure and restoration works.

An assessment of the remaining stockpile volumes has been conducted and additional soil materials will be required to complete the proposed closure and restoration works for the BRDA, the SCDC and the Borrow Pit Extension area. The soil materials required include commercial soil materials that will be sourced from approved and licenced providers and brought to Site as needed during the closure and restoration works, and soil by-products that are proposed to be sourced from local developments as they become available. These soil by-products are proposed to be imported to Site in accordance with the EPA objective for excess uncontaminated soils to be beneficially used (EPA 2019) and stockpiled for future use.

Soil materials and quantities proposed to be imported to Site are listed below:

- Subsoil and Topsoil ≈ 365,000 tonnes, for use in BRDA Side-Slope Restoration.
- Organic Soil Improver ≈ 61,000 tonnes for use in BRDA Side-Slope and Dome Restoration.
- Gypsum ≈ 15,300 tonnes for use in the BRDA Perimeter Stage 5 & Stage 10 Benches, the SCDC Dome and BRDA Dome Restoration at Stage 16.

## 8.9 Potential Effects

The main potential impacts and associated effects considered in the assessment during the construction, operation and closure of the Proposed Development relate to the following:

- Removal of superficial and bedrock deposits at the proposed Borrow Pit Extension site during the stripping and extraction process;
- Activities or events that might impact bedrock or soil during operations e.g., leaks and spills from machinery or stored substances (including from stored imported soil, which is proposed to be imported during the operational and closure phases of the development as soil materials become available locally and to progressively restore the side-slopes of the BRDA), or discharges; and
- A trigger event e.g., blasting in the proposed or permitted Borrow Pit areas causing instability or failure within the BRDA and/or the SCDC (both existing and proposed facilities).

These potential impacts and associated effects are considered and assessed in the following sections.

### 8.9.1 Operational Phase Impacts

No removal of superficial deposits or bedrock will be required within the BRDA or SCDC sites as they are both vertical extensions of the existing structures.

A level of preparatory works will be required for the footprint of the BRDA stage raises and the SCDC cell walls. Bauxite residue removed during the preparation of the formation for the stage raise or the cell walls will be deposited locally in the BRDA.

Removal of superficial deposits and bedrock will take place at the proposed Borrow Pit Extension site. Activities at this site will involve the extraction of rock by drilling and blasting, thus creating a void, and as such, there is the potential to affect human health of workers if the earthworks created were to become unstable. The stability of the excavation and stockpiles generated within the proposed Borrow Pit Extension site will be monitored and managed by the Contractors and in line with the Mines and Quarries Act (1965) and the Safety, Health and Welfare at Work (Quarries) Regulations 2008 (as amended). The potential impact magnitude is predicated to be **negligible (adverse).**

Bedrock will be extracted from the proposed Borrow Pit Extension site by blasting. Blasting is already permitted onsite, in the permitted Borrow Pit area and as such, assessments on the stability of both the BRDA and SCDC have been previously undertaken for blasting onsite and will take place during operations at the permitted Borrow Pit site. Risk assessments are also routinely completed and updated for the facility and operations. The proposed Borrow Pit Extension site will be incorporated into the existing monitoring plan and risks assessments.

Stability issues may also arise during the excavation of the quarry faces and the forming of stockpiles of blast and processed rock fill or from the stockpiling of imported soil for restoration activities. The management of the existing quarry faces, stockpiles and silt ponds will be in accordance with the Health and Safety Authority's *'Guidelines to the Safety, Health and Welfare at Work (Quarries) Regulations 2008*, (as amended), and the recommendations of geotechnical appraisals carried out on site.

The recent Risk Assessment and Break-Out Study for the BRDA (Golder 2019A) is an update of previous risk assessment and break out studies completed in 2006 and 2013. The 2019 update includes an assessment of the operation of the permitted Borrow Pit and reviewed the potential impacts of blasting at the permitted Borrow Pit site on the BRDA. The report identified that the annual probability of slope failure for the sectors of the BRDA closest to the Borrow Pit i.e., Sector F and Sector G, located at the east and northeast flanks of the Phase 1 BRDA, respectively, as being **Almost Impossible to Highly Improbable.**

The site for the Borrow Pit Extension is at a greater distance from the BRDA than the permitted Borrow Pit and instability resulting from blasting within this area is considered to be even less likely than from the permitted Borrow Pit site. If failure of the BRDA were to occur, it would be confined to Sectors F (the eastern flank of the Phase 1 BRDA) and G (the north-eastern flank of the Phase 1 BRDA) of the BRDA. Given the Almost Impossible to Highly Improbable likelihood and localised containment the potential impact magnitude is predicted to be **negligible (adverse).**

Fuel and other substance leaks or spills from stored substances or from machinery/equipment used during development could affect the chemistry of the soil and lead to ground contamination. There will be no underground tanks, no septic tanks, refuelling will take place using a mobile bowser fuelling plant and only in designated areas suitable for refuelling, there are no planned discharges to ground, and hazardous materials will be managed and stored appropriately. Imported commercial soils will be uncontaminated and sourced from approved and licenced providers in accordance with EPA guidance. These imported soils are proposed to be stockpiled in the existing stockpile yard to the south of the BRDA and be utilized for progressive restoration during the operational and closure phases of the Proposed Development. The predicted potential impact magnitude on soil or bedrock is therefore predicted to be **negligible (adverse).**

The vulnerability of the existing BRDA and SCDC, and the vulnerability of the proposed raises to structural failure has been considered in detail in the Engineering Design Report & specifically in Appendix G Breach Analysis for the BRDA Raise Development and in Chapter 16: Major Accidents and Disasters.

The Risk Assessment and Break-Out Study (Golder 2019A) has been undertaken in accordance with CDA 2014 for the classification of the BRDA and ancillary infrastructure which proposes target level design criteria specific for tailings dams. Potential "pathways" of the BRDA dam wall breaches that could conceivably result in the release of significant volumes of material to the downstream environment were considered. A review of statistical tailings facility failures identified the primary failure modes for tailings facilities.

These potential failure modes have been considered for the BRDA and are listed below:

- Earthquake event - leading to Slope Failure or Dynamic Liquefaction.
- Tidal Surge or Wave Event - leading to Erosion Induced Slope Failure. As sectors of the BRDA are located close to the River Shannon, erosion resulting from a Tidal Surge or Wave Event is also considered as a possible failure mechanism.
- Rainfall Event - leading to Erosion Induced Slope Failure.
- Blast Event - leading to Static Liquefaction induced Slope Failure or Dynamic Liquefaction. Controlled Blast Events would take place to the north-east of the BRDA once planning permission and EPA licence for the development and operation of a Borrow Pit is approved.
- Slope Instability – strength failure through bauxite residue or erosion of the side-slopes.
- Static Liquefaction - of the unfarmed bauxite residue (leading to lower or overall slope failure) or farmed bauxite residue (leading to upper slope failure). Trigger Events such as Rate of Rise, Excessive Strain/Creep, Foundation Creep or a Rainfall Event are potential mechanisms that could result in static liquefaction.
- Foundation Failure – strength failure through the foundation soils leading to Overall Slope Failure via Static Liquefaction.
- Overtopping Event (discharged bauxite residue) – leading to erosion induced slope failure.

Once the potential failure modes were established, the next step identified events or a sequence of events which had the potential to initiate containment failure and subsequently the release of bauxite residue and/or water from the BRDA or ancillary structures.

The Risk Assessment and Break-Out Study (Golder 2019A) was undertaken for the BRDA constructed to Stage 10. The assessment is considered appropriate for the BRDA constructed to Stage 16 as the BRDA footprint, the failure mechanisms and discharge pathways in a breach scenario remain unchanged. However, there is potential for increased volume of discharge and increased extent of discharge during a breach scenario due to the proposed increase in elevation of the BRDA to Stage 16 and these values have been reassessed in the Engineering Design Report & specifically in Appendix G Breach Analysis for the BRDA Raise Development.

A summary is provided below and Drawing 10 of the EIAR provides a plan for the locations and structures listed.

- The Phase 1 BRDA has a Very Unlikely (≈1 in 10,000) to Highly Improbable (≈1 in 100,000) annual risk of containment failure and Phase 2 BRDA has a Highly Improbable (≈1 in 100,000) to Almost Impossible (≈1 in 1,000,000) annual risk of containment failure These values are significantly less than the annual average probability of worldwide tailings dam failures based on statistical data (≈ 1 in 2,000), (Golder 2019A).

The impact of a breach scenario is largely dependent on the volume of material discharged and distance travelled by the material discharged. Both of these factors are dependent on the ability of the bauxite residue to liquefy.  Where the bauxite residue is farmed, the material would slump rather than liquefy.

The estimated volume of bauxite residue that could potentially be released in a breach scenario has been assessed by two methods and the range is 40,000 $m^3$ to 90,000 $m^3$.

- Where the bauxite residue is farmed, the material would slump rather than liquefy. The distance travelled would be small, a distance of the order of 12.1m from the downstream toe of Phase 2 BRDA and into the Perimeter Interceptor Channel (PIC). Both the upper levels (above Stage 7) of the Phase 1 BRDA and all of Phase 2 BRDA would be expected to slump into the PIC or within ≈ 12m of the downstream toe.

- Where the material is potentially able to liquefy, which are confined to the lower slopes of the Phase 1 BRDA to Stage 6 (16 mOD at perimeter to 20 mOD centrally), the distance travelled would be a maximum of 224m, although the presence of the PIC at the downstream toe may contain the flow even further, if intact. This run-out distance assumes that the farmed bauxite residue above the unfarmed bauxite residue also liquefies. If only the elevation of the unfarmed bauxite residue is considered, then the run-out distance is reduced to 52m.

The area between the Flood Tidal Defence Berm (FTDB) and the BRDA, Storm Water Pond (SWP) and Liquid Waste Pond (LWP) is at an elevation of approx. 1 mOD and has a footprint of ≈ 187,000 $m^2$, excluding the Special Protection Area (SPA) or Special Areas of Conservation (SAC) footprints and is therefore capable of retaining circa 0.75 million $m^3$ of tailings and/or water provided that the FTDB at a crest elevation of 5 mOD remains intact.

In the event of a breach scenario resulting in bauxite residue flowing into the SWP and/or the PIC, the contaminant wastewater will be displaced and would flow via the open drainage network leading to the sluice gate valve in the West Drain (see Drawing 10), which leads to the Robertstown River. AAL have installed a penstock valve on this sluice gate which can be closed to prevent discharge to the Robertstown River .

If the FTDB is breached due to a tidal surge, and a BRDA breach scenario occurred, the bauxite residue and containment wastewater would potentially be washed into the Robertstown and Shannon Rivers. However, the expected break-out volumes are relatively small.

Through the implementation of good operational practices, regular monitoring and the mitigation procedures outlined in Section 8.10.2, the potential impact of the BRDA raise is predicated to be **low (adverse).**

Structural failure could occur in either the existing or proposed SCDC, independently of the existing and proposed BRDA. Consequences of this failure could include dam wall failure, crest settlement or slope instability. Given that the SCDC is located within the Phase 1 BRDA Extension footprint, if the SCDC were to be breached and salt cake were to mobilise, it would be contained within a composite lined area. With the implementation of design and best practice, regular operational monitoring and management by Contractors, the potential impact magnitude is predicated to be **negligible (adverse).**

The evaluation of effects takes into account the predicted impact magnitude combined with receptor sensitivity. The evaluation of effect significance during the operational phase (taking account of the Proposed Development design) discussed above is presented in Table 8.9.

As can be seen from Table 8.3, any negligible initial impact magnitude will result in a slight, not significant or imperceptible level of effect significance, which are all ‘not significant’.

Therefore, Table 8.9 only includes those sources of impact that may result in a low to high initial impact magnitude.

**Table 8.9: Evaluation of Initial Impacts and their Effect Significance**

| Project Phase | Receptor | Sensitivity | Source of Impact/Description of Change* | Impact Magnitude* | Level of Effect * |
|---|---|---|---|---|---|
| Operational | Built Structure (BRDA) | **High** | Structural failure of either structure leading to slumping, settlement or slope instability | Low (adverse) | Moderate |

** Taking account of the Proposed Development Design, see Section 8.5.1.*

### 8.9.2 Closure Phase Impacts

The Proposed Development will enable the BRDA to be constructed to Stage 16. Interim landscaping of the side-slopes takes place on a phased basis as the BRDA is raised. Plans and details for the closure of the BRDA at Stage 16 are provided on Drawing 10 and on Drawings 12a to 12i for the EIAR.

The Side-Slope Closure Plan proposes that the BRDA side slopes will be capped with a rock fill capping containment layer which will provide a continuous rock fill blanket across the entire footprint of the BRDA side slopes. The rock fill blanket will comprise the rock fill from which the stage raises have been constructed and additional rock fill placed over the exposed bauxite residue benches, interconnecting from stage raise to stage raise.

The horizontal benches for each stage raise will have their rock fill capping containment layer (blanket) overlain by subsoil / topsoil layers and subsequently vegetated. However, a strip of the rock fill blanket ('infiltration strip') will remain exposed (i.e., not overlain with subsoil / topsoil or vegetated) which will allow surface water runoff to infiltrate into the rock fill blanket at each stage raise.

The primary drainage system is an internal one i.e., within the rock fill blanket (300mm to 400mm depth, depending on the stage raise), with runoff entering via the infiltration strip and propagation of the IDF flows through the continuous rock fill blanket to the PICs.

The secondary drainage system is a surface one i.e., via rip-rap lined overflow chutes from stage raise to stage raise (width varying from 0.5m to 2.0m, depending on the stage raise). This system has been designed to allow controlled discharge of the IDF in the event that the rock fill blanket, or a meaningful section thereof, does not have sufficient drainage capacity to accommodate the IDF e.g., due to long term clogging of the rock fill blanket and/or infiltration strip(s).

The Dome Closure Plan proposes that the BRDA dome be capped with a minimum 1m depth of 'amended mud' or the 'amended layer' in accordance with the IE Licence. The current specification for the 'amended layer' is for it to be constructed in two 0.5m depth layers, to provide a neutralized soil material (< 9.0 pH) to support vegetation. Runoff from the dome is intercepted by sixteen (16) dome perimeter drainage channel segments which convey the intercepted runoff directly to the eight (8) spillways, i.e., no storage or attenuation of waters.

The spillways are distributed along the perimeter of the BRDA dome and traverse down the side-slopes, perpendicular to the respective PICs, at slopes varying between 6.3(H):1(V) and 6.8(H):1(V). The spillways are lined, have rip-rap rock fill armouring to slow the flows and alleviate turbulence and hydraulic jumps, vary in base width from 4m to 8m, have a 1m design depth, and convey the runoff from the dome perimeter channel segments directly to the PICs. Gabion mattresses are provided for flow energy dissipation at entry to the PICs from the spillways.

A wetland shall be constructed in the PIC with PIC segments separated by weirs to control water depth. Discharge to the environment will be via two (2) designated breach locations in the PIC for which spillways will be constructed.

A specific capping containment design, appropriate for the capping of a hazardous waste material, is proposed for the SCDC Raise which is accordance with the EPA approved design for the current SCDC (Golder 2017B). The capping design comprises a combination of geosynthetic layers overlain by the amended layer to blend with the overall dome capping for the BRDA.

During the construction of the BRDA and SCDC closure works, fuel and other substances could be spilled or leak from plant and machinery during operations which could result in ground contamination. There will be no underground tanks, no septic tanks, refuelling will take place using a mobile bowser fuelling plant and only in designated areas suitable for refuelling, there are no planned discharges to ground, and hazardous materials will be managed and stored appropriately. The predicted potential impact magnitude on underlying soil or bedrock is **negligible (adverse).**

Similarly, leaks or spills which could result in ground contamination within the Borrow Pit Extension area would have a predicted potential impact magnitude on soil or bedrock of **negligible (adverse).**
Upon closure of the Borrow Pit area, exposed faces will be battered down where necessary and other faces will be left exposed. Any exposed faces may offer suitable habitat for nesting birds and increase biodiversity. The predicted impact is **low (beneficial).**

Built structures such as the BRDA and SCDC would be capped and vegetated during final closure. Active monitoring of these structures will be continued for a minimum of 5 years after closure and will include stability checks and assessments. The monitoring is the passive after-care phase is expected to continue for a minimum of an additional 30 years. With routine monitoring and inspections post closure, the predicted potential impact magnitude from the built structure for the Proposed Development is **low (adverse).**

The evaluation of effects takes into account the predicted impact magnitude combined with receptor sensitivity. The evaluation of effect significance from each of the initial construction and after-use impacts (taking account of the Proposed Development design) discussed above is presented in Table 8.10.

As can be seen from Table 8.3, any negligible initial impact magnitude will result in a slight, not significant or imperceptible level of effect significance, which are all 'not significant'. Therefore, Table 8.9 only includes those sources of impact that may result in a low to high initial impact magnitude.

**Table 8.10: Evaluation of Initial Impacts and their Effect Significance**

| Project Phase | Receptor | Sensitivity | Source of Impact/Description of Change* | Impact Magnitude* | Level of Effect * |
|---|---|---|---|---|---|
| Closure | Natural Resources | **Medium** | Exposed or partially exposed faces in the borrow pit extension area. Potential favourable habitat for nesting birds. | Low (beneficial) | Slight |
| | Built Structures (BRDA and SCDC) | **High** | Capping and revegetation. Continued aftercare monitoring (including stability checks and assessments) for a minimum of 30 years. | Low (adverse) | Moderate |

** Taking account of the Proposed Development Design, see Section 8.5.1.*

## 8.10 Mitigation and Management

The Proposed Development design is understood to comprise the project design principles and standards adopted to avoid or prevent adverse safety and environmental effects, construction and operation to appropriate codes of practice and guidelines, and including fixed procedural commitments such as instrumentation and monitoring.

This measure provides the baseline for the impact assessment and determination of additional mitigation / management measures required to reduce and if possible offset likely significant adverse environmental effects, in support of the determined significance of effects.

### 8.10.1 Proposed Development Design

The elements of the Proposed Development design and good working practices that reduce the potential for impacts to soils, land and geology include the following:

- The design of the Borrow Pit Extension follows the Health and Safety Authority's *'Guidelines to the Safety, Health and Welfare at Work (Quarries) Regulations 2008*, (as amended), and rock will be extracted in accordance with the proposed design;
- Security fencing will be installed at the Borrow Pit Extension boundary and the gate will be locked and controlled by the Site's management. The exposed edges in the quarry will be protected with safety berms;
- Installation of the additional pump upgrades and coordinate the operational procedures required for the BRDA water management system to perform effectively during the operational inflow design event;
- Site operations at the Borrow Pit Extension will be managed in accordance with relevant health and Safety legislation (Safety, Health & Welfare at Work Act (2005, as amended); and the Mines and Quarries Act (1965, as amended)) and subsequent

Quarries Regulations relating to health and safety, training, and appropriate site management;

- Regular inspections, audits, stability assessments and daily walk-over condition and stability checks are and will be carried out on the proposed BRDA Raise, SCDC Raise and Borrow Pit Extension sites in accordance with the Physical Stability Monitoring Plan (Golder 2021) and the operating procedures for the BRDA are directed by the series of stand-alone Standard Work Method (SWM) documents which are prepared, maintained and updated by the AAL BRDA Engineering Team;

- The current AAL Physical Stability Monitoring Plan, AAL Emergency Plan, AAL BRDA Operational, Safety and Maintenance (OSM) Manual and the AAL Operating Procedures for the BRDA (SWMs) will be updated to include the Proposed Development; and

- Installation works to insert as per existing practice, the piezometers, inclinometers and settlement systems in the BRDA, as the facility increases in elevation.

### 8.10.2 Additional Mitigation / Management

Additional mitigation and/or management is intended to avoid, prevent, reduce or, if possible, offset any identified significant adverse effects on the environment. The initial assessment of potential effects (taking into account the Proposed Development design) has not identified any significant adverse effects. However, to further mitigate the initial effects associated with natural resources and built structures, the following additional mitigation procedures will take place:

- Adoption of the existing AAL Environmental Management System (EMS) and other procedures (including Health and Safety) for the Aughinish Site;

- A draft Construction Environment Management Plan (CEMP) has been developed which incorporates relevant mitigation measures for environmental protection during construction to ensure the Proposed Development is compliant with the licence requirements. Enforcement of the final CEMP and licence requirements will minimise potential for environmental impact;

- The management of construction works, to be conducted by external Contractors and internal AAL alliance Contractors, will be carried out in line and in accordance with all monitoring provisions identified in the final CEMP, with the IEL requirements, with the AAL Environmental Manual for Contractors (AAL, October 2016), and with any Conditions imposed by the planning authorities;

- Installation of gabion mattress protection on the downstream slope of the SWP and LWP and increase in the elevation of existing gabion mattresses installed on the downstream slope of the OPW for the PIC along the north and west flanks of the BRDA, as detailed in the Closure Restoration and Aftercare Management Plan (CRAMP). The most recent CRAMP update was conducted by AAL during 2018 and subsequently approved by the EPA in October 2018;

- Continued layered deposition and mud farming in accordance with the Conditions of the IEL. Regular validation of the strength parameters of the deposited bauxite residue in order to achieve the target FoS, as the BRDA is raised in elevation. This is proposed to take place at a minimum of every 4 years;

- Operational procedures to avoid water collecting in the perimeter interceptor channel along Sectors E and F, when constructed in future at downstream of Inner Stage 4 and Inner Stage 6, respectively, by providing sufficient gradient to allow surface water to runoff;

- Refuelling and the addition of hydraulic oils or lubricants to vehicles or generators will take place on-site using a mobile bowser fuelling plant (i.e., no bulk fuel storage tanks will be used). This will only take place in designated areas. The designated areas will have impermeable surfaces, any fuel/oils that enter the drains will be intercepted, and the refuelling areas will be equipped with easily accessible spills kits that staff have been trained to use;

- Any waste removal will be managed and undertaken by a competent Contractor according to best practice and disposed of accordingly by a licenced waste disposal Contractor (see Chapter 13: Material Assets - Waste Management of this EIAR);

- Groundwater monitoring of existing wells on the site will be undertaken on a regular basis (refer to Chapter 10: Hydrology and Hydrogeology); and

- The AAL Health and Safety Department will ensure compliance with relevant safety and statutory legislation and best practices.

Post passive aftercare phase licensee and subsequent occupiers of the Proposed Development will be responsible for managing their activities and applying for (and working within the constraints of) any environment authorisations or consents required for their operations. If the requirements of relevant regulations, licenses and permits, e.g., Industrial Emissions Licences, under The Environmental Protection Agency Act 1992 and the Protection of the Environment Act 2003) are adhered to, then it is considered that the magnitude of impact and likelihood will be reduced to acceptable levels.

## 8.11 Monitoring

The future monitoring programme at the Site will include regular monitoring of water levels within the proposed BRDA, SCDC and Borrow Pit areas.

Regular visual inspections of the dam wall integrity by a suitably qualified engineer will be undertaken for both the Proposed Development and regular visual inspections of the faces in the proposed Borrow Pit Extension site.

## 8.12 Cumulative Effects

As a result of the design and mitigation measures implemented for the Proposed Development, it is considered that any impacts associated with the proposed activities will not contribute to cumulative impacts in association with the activities located in the vicinity. The proposed activities onsite (raising of the BRDA and SCDC, and extension of the Borrow Pit) will supersede the existing BRDA, SCDC and permitted Borrow Pit.

The Proposed Development has been designed to integrate and complement the existing structures with the proposed structures, and no cumulative impacts are anticipated with the addition of the proposed extensions.

## 8.13 Residual Impacts

The proposed activities onsite (raising of the BRDA and SCDC, and extension of the Borrow Pit) will supersede the existing BRDA, SCDC and permitted Borrow Pit.

The Proposed Development has been designed to integrate and complement the existing structures with the proposed structures, and no cumulative impacts are anticipated with the addition of the proposed extensions.

A summary of the sources of impact, predicted magnitudes of residual impact (accounting for combined mitigation) and subsequent residual effect significance is presented in Table 8.11 below.

In all cases the residual effect is **Not Significant and not greater than slight.**

**Table 8.11: Evaluation of Predicted Residual Impacts and their Effect Significance**

| Project Phase | Receptor (importance) | Potential Source of Impact | Direct or Indirect | Duration* | Reversible or Irreversible | Summary of Mitigation (Proposed Development Design and Additional Mitigation) | Residual Magnitude of Impact (direction) | Residual Effect Significance |
|---|---|---|---|---|---|---|---|---|
| Operational and Closure | Natural Resources - bedrock and superficial deposits) in the Borrow Pit Extension area (Medium) | Ground contamination through fuel spills or leaks from the BRDA and SCDC to underlying natural resources | Direct | Long term | Reversible | Good practice pollution prevention measures and regular plant and equipment maintenance procedures.<br>Waste management procedures. | Imperceptible or Slight (decrease) | Not significant / Imperceptible or slight |
| | Built structures - BRDA and SCDC (High) | Geotechnical failure | Direct | Permanent | Reversible | Current practices and FoS.<br>Operational phase procedures that will be implemented (listed in Section 8.10.2).<br>Regular aftercare monitoring and inspection.<br>Good practices during closure works. | Slight (decrease) | Not significant / slight |

** Maximum duration without intervention*

### 8.14 'Do-Nothing' Scenario

In the event that the Proposed Development does not progress there are unlikely to be impacts on the geological, land or soil environment in the area of the Site.

The existing BRDA and SCDC would be closed in accordance with the Closure, Restoration and Aftercare Management Plan (CRAMP) and covers both the refinery plant area and the BRDA and the facility would likely close subsequently.

The proposed Borrow Pit Extension area would not be developed, beyond the permitted footprint, and there would be no increased potential for contamination at this site as no removal of superficial or bedrock would occur, and it would remain a green field area within an industrial landholding

### 8.15 Major Accidents and Disasters

Environmental impact assessments are required to address the vulnerability of the proposed projects to major accidents and / or disasters.

These unforeseen and unplanned events are to be assessed on the risk of their occurrence, (likelihood and consequence) and are assessed in greater detail in Chapter 16: Major Accidents and Disasters.

In the context of soils, land and geology the following natural hazards, at an extreme level and above the target design criteria, have the potential to lead to a structural failure of the BRDA, the SCDC or both, and would constitute a major accident or disaster;

- Seismic Event;
- Storm Event;
- Tidal Surge or Wave Event; or
- Significant Karst Features.

The likelihood of these events occurring at an extreme level and to lead to a structural failure of the BRDA, the SCDC or both has been assessed to be in the range of **Extremely Unlikely** to **Highly Improbable or Negligible** (see Chapter 16: Major Accidents and Disasters).

As noted previously in the Chapter, the AAL facility has been in operation since 1983. There have been no major events of the nature listed above at the facility

These risks will be further reduced should the mitigation measures outlined above are adhered to.

### 8.16 Difficulties Encountered

No particular difficulties were encountered in obtaining data and undertaking the assessment of soils, land and geology.

## 8.17 Summary and Conclusions

This assessment considers the potential direct and indirect significant effects that the Proposed Development may have on soils, land and geology, during the construction, operation and closure of the Proposed Development.

The main receptors identified that required assessment for the Proposed Development were natural resources, i.e., superficial deposits and bedrock, for the Borrow Pit Extension area and the built structures (BRDA Raise and SCDC Raise). Both the Borrow Pit Extension and the built structures have the potential to be affected by geotechnical issues during operational and/or aftercare phases.

The assessment has concluded that the Proposed Development would not lead to significant effects during its operational and closure phases.

Land within the Site is already in industrial usage or forms part of a vegetated area within the larger industrial site area, and as such, there would be no loss of productive land or further land take required to enable the Proposed Development, and it was not considered further in this assessment.

No NORM hazard (radon or bauxite residue) was identified for site operatives, visitors or the surrounding environment. Therefore, its potential impacts and effects were not considered further in the assessment.

No audited geological heritage sites have been identified as part of the baseline. Therefore, the impacts to, and effects on geological sites was not considered further in this assessment.

Known design, construction management and operation measures were accounted for in the assessment of initial impacts and effects. Where additional mitigation measures could be incorporated to reduce the initial impacts and effects, these were identified and included in an assessment of residual impacts and effects.

In summary, the significance of residual effects on soils, land and geology resulting from the different potential sources of change are predicted to be **no greater than imperceptible** and, therefore, **not significant** in terms of this assessment.

## 8.18 References

AAL AER 2020, Annual Environmental Report, EPA, 2020

An Foras Taluntais, 1979. Soil Survey Report on Aughinish Island, Co. Limerick.

Canadian Dam Association, Technical Bulletin 2014, Application of Dam Safety Guidelines to Mining Dams

Clark et al., 1981, R. G. Clark, J. C. Gutmanis, A. E. Furley & P. G. Jordan, Engineering geology for a major industrial complex at Aughinish Island, Co. Limerick, Ireland.

EC 2018, Environmental Impact Assessments of Projects Guidance on the Preparation of the Environmental Impact Assessment Report (Directive 2011/92/EU as amended by 2014/52/EU). European Commission 2018.

Environmental Protection Agency (EPA) 2015, Draft Advice Notes for preparing Environmental Impact Statements. Environmental Protection Agency, Johnstown Castle Estate, Co. Wexford, Ireland.

Environmental Protection Agency (EPA) 2017, Draft Guidelines on the information to be contained in Environmental Impact Assessment Reports (EIAR). Environmental Protection Agency, Johnstown Castle Estate, Co. Wexford, Ireland.

Environmental Protection Agency (EPA) 2019, Guidance on Soil and Stone By-products, Environmental Protection Agency, Johnstown Castle Estate, Co. Wexford, Ireland, Version 3, June 2019

Environmental Protection Agency (EPA), 2021: Online Mapping - https://gis.epa.ie/EPAMaps/ accessed 11 February 2021.

EU Environmental Impact Assessment Directive (Council Directive 2014/52/EU).

Fleming. G.A, Parle. P.J (1983); Baseline Survey in the vicinity of Aughinish Island.

Geological Surveys of Ireland (GSI), 2021: Spatial Resources Online Mapping - https://dcenr.maps.arcgis.com/apps/MapSeries/index.html?appid=a30af518e87a4c0ab2fbde2aaac3c228 accessed 11 February 2021.

Golder 2014, Golder Associates Ireland Ltd, Aughinish Alumina: Baseline Soil and Groundwater Report.

Golder 2017A, Golder Associates Ireland Ltd, Geophysical Survey at Aughinish Alumina (included in Tom Phillips + Associates, 2017).

Golder 2017B, Golder Associates Ireland Limited, Response to EPA RFI Ref No. R1008329, Salt Cake Disposal Cell Raise, October 2017

Golder 2018, Golder Associates Ireland Ltd, Technical Memorandum: Update to Soil and Groundwater Baseline Report, Aughinish Alumina.

Golder 2019A, Golder Associates Ireland Ltd, Risk Assessment and Break-Out Study for the Bauxite Disposal Area (BRDA).

Golder 2019B, Golder Associates Ireland Ltd, Technical Memorandum: Update to Soil and Groundwater Baseline Report, Aughinish Alumina Limited

Golder 2021A, Golder Associates Ireland Ltd, Physical Stability Monitoring Plan for the AAL BRDA, 2021 Update

Golder 2021B, Golder Associates Ireland Ltd, AAL Phase 1 and 2 BRDA, Annual Review Report 2020

Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment, Department of Environment, Community and Local Government, 2018.

HSA, 2008. The Safety, Health and Welfare at Work (Quarries) Regulations, 2008 (S.I. 28 of 2008).

Institute of Geologist of Ireland, 2013. Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements.

Key Issues Consultation Paper - Transposition of 2014 EIA Directive (2014/52/EU) in the Land Use Planning and EPA Licencing Systems, 2$^{nd}$ May 2017.

Mines and Quarries Act, 1965, as amended. Number 7 of 1965.

National Roads Authority, 2009. Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes.

Ordnance Survey of Ireland, 2021: Online mapping portal: http://map.geohive.ie/mapviewer.html, accessed 11 February 2021.

RPII 2008, Radiological Protection Institute of Ireland, Radiological assessment of NORM Industries in Ireland – Radiation doses to worker and members of the public, December 2008

RPS, 2005. Expansion of BRDA and Increase in Alumina Production Capacity at Aughinish Alumina Ltd. The National Guidelines on Quarries and Ancillary Activities for Planning Authorities. Department of Environment Heritage and Local Government, 2004.

Tom Phillips + Associates, 2017. Environmental Impact Assessment Report in Respect of Proposed Borrow Pit at Aughinish Alumina LTD., Aughinish Island, Askeaton, Co. Limerick.

# 9.0 LANDSCAPE & VISUAL IMPACT

## 9.1 Introduction

This Chapter of the Environmental Impact Assessment Report (EIAR) has considered the potential landscape and visual impacts of the Proposed Development by Aughinish Alumina Ltd to raise their existing Bauxite Residue Disposal Area (BDRA) at Aughinish Island near Askeaton, Co. Limerick. The Proposed Development is to increase the height of the permitted BRDA by a total of 12.0m or six additional 2.0m high stages thereby providing additional capacity to facilitate continued operation of the facility for a further nine years to 2039. The Proposed Development also includes extension of the permitted Borrow Pit on site to provide the additional rock fill material that will be used to form the additional stage raises.

Brady Shipman Martin was commissioned to prepare this chapter on behalf of Aughinish Alumina Ltd. It was carried out by John Kelly, B.Arch, MRIAI and Alex Craven, BSC MLA. John is Managing Partner of Brady Shipman Martin and has over 25 years' experience in LVIA of development proposals of all topologies and scales. Alex is a Senior Landscape Architect at Brady Shipman Martin and has over 10 years' experience specialising in LVIA.

The assessment involved reviewing plans, sections and elevations of the existing and Proposed Development, various publications and reports, including other chapters of the EIAR, together with visits to the site and environs of the Proposed Development.

## 9.2 Methodology

### 9.2.1 Study Area

The study area is primarily defined by the extents of the predicted zone of visual influence, which takes in landscape and visual receptors which have potential intervisibility with the Proposed Development. In some circumstances there may be occasions where valued landscape features or designations may be affected by changes within their context that may not have direct visual intervisibility, for example protected structures which may be affected indirectly by changes to their landscape context. In these cases, the study area would be extended to include these features and their context.

For the purposes of this assessment the study area includes the Proposal Development site and adjacent landscapes of County Limerick, the adjacent seascape of the Shannon Estuary and Fergus Estuary, the neighbouring landscapes of County Clare, plus any other relevant visual receptors within these areas.

### 9.2.2 Relevant Legislation, Policy and Guidelines

The assessment has been carried out with reference to the following legalisation, policy and guidelines:

**Legislation**

- *Directive 2014/52/EU of the European Parliament and of the Council of 16 April 2014 amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment (the EIA Directive);*
- *Planning and Development Act 2000, as amended;*
- *Planning and Development Regulations 2001, as amended; and*
- *European Landscape Convention 2000.*

**Policy**

- *Limerick County Development Plan 2010-2016 (Limerick County Council, 2010) (As Extended).*
- *Draft Limerick Development Plan 2022 – 2028*
- *Clare County Development Plan (as Varied) 2017-2023. (Clare County Council, 2019)*
- *Strategic Integrated Framework Plan for the Shannon Estuary 2013-2020. (Clare County Council, Kerry County Council, Limerick City and County Councils, Shannon Development and the Shannon Foynes Port Company 2013.)*

### 9.2.3 Guidelines

The assessment has been carried out with reference to the following legalisation, policy and guidelines:

- *Draft Guidelines on the Information to be contained in Environmental Impact Assessment Reports (hereafter referred to as the EPA Guidelines) (EPA 2017);*
- *EPA Draft Advice Notes for preparing Environmental Impact Statements (EPA 2015);*
- *Guidelines for Landscape and Visual Impact Assessment (hereafter referred to as the GLVIA) 3rd edition (Landscape Institute and the Institute of Environmental Management and Assessment [IEMA] 2013);*
- *Technical Information Note 05/2017 (Revised 2018) on Landscape Character Assessment (hereafter referred to as the TCA) (Landscape Institute 2018);*
- *Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment (hereafter referred to as the GEIA) (Department of Housing, Planning and Local Government DHPLG 2018);*
- *Landscape Institute Technical Guidance Note 06/2019 on Visual Representation of Development Proposals (hereafter referred to as the VRDP) (Landscape Institute 2019).*
- *Draft Advice Notes on current practice in the preparation of Environmental Impact Statements (Environmental Protection Agency, 2015)*
- *Guidelines on the information to be contained in Environmental Impact Statements. (Environmental Protection Agency, 2002); and,*
- *Advice Notes on current practice in the preparation of Environmental Impact Statements. (Environmental Protection Agency, 2003)*

While the Draft EPA Guidelines (EPA 2017) provide a general methodology, impact ratings and assessment structure applicable across all environmental assessments, the GLVIA (Landscape Institute and IEMA 2013) provides specific guidance for landscape and visual impact assessments. The TCA (Landscape Institute 2018) is a resource for the application of landscape character assessment to landscapes. Therefore, in this chapter, a combination of the approaches outlined in the Draft EPA Guidelines (EPA 2017) and in the GLVIA (Landscape Institute and IEMA 2013), supported by the TCA (Landscape Institute 2018) and the professional experience and expertise of the assessor, is utilised in the landscape and visual assessment.

### 9.2.4 Key Definitions

The following key definitions are relevant to the methodology for the landscape and visual impact assessment:

**Landscape** '*means an area, as perceived by people, whose character is the result of the action and interaction of natural and / or human factors*' (European Landscape Convention 2000).

**Landscape Character Assessment** '*is the process of identifying and describing variation in the character of the landscape. It seeks to identify and explain the unique combination of elements and features (characteristics) that make landscapes distinctive*' (Natural England 2014).

**Landscape Character Types** '*are distinct types of landscape that are relatively homogeneous in character. They are generic in nature in that they may occur in different areas in different parts of the country, but wherever they occur they share broadly similar combinations of geology, topography, drainage patterns, vegetation, historical land use, and settlement pattern*' (Natural England 2014).

**Landscape Character Areas** '*are single unique areas which are the discrete geographical areas of a particular landscape type. Each will have its own individual character and identity, even though it shares the same generic characteristics with other areas of the same type*' (Natural England 2014).

**Landscape and Visual Impact Assessment** '*is a tool used to identify and assess the significance of and the effects of change resulting from development on both the landscape as an environmental resource in its own right, and on people's views and visual amenity*' (Landscape Institute and IEMA 2013)

**Visual Impact Assessment** '*is concerned with changes that arise in the composition of available views and the overall effect on the visual amenity of an area*' (Landscape Institute and IEMA 2013).

**Landscape impact vs. landscape effect** - 'Impact' is defined as the action been taken, whilst 'effect' is defined as result (change or changes) of that action, e.g. the 'impact' of the Proposed Development on the woodland has a significant 'effect' on the character of the landscape.

### 9.2.5 Data Collection and Collation

Data collection and collation is based on initial desk studies, supported by site and study area visits and augmented by further specific site reviews, within the locality and wider landscape setting of the Proposed Development, together with the selection and preparation of verified Photomontages of the Proposed Development.

Desk studies, which allow for identification of designated and potential significant / sensitive areas, involved a review of:

- *Limerick County Development Plan 2010-2016 (Limerick County Council, 2010) (As Extended).*
- *Draft Limerick Development Plan 2022 – 2028. (Limerick City and County Councils, June 2021)*
- *Clare County Development Plan 2011-2017. (Clare County Council, 2011)*
- *Strategic Integrated Framework Plan for the Shannon Estuary 2013-2020. (Clare County Council, Kerry County Council, Limerick City and County Councils, Shannon Development and the Shannon Foynes Port Company 2013.)*
- *Historical and current mapping and aerial photography (e.g. ordnance survey Ireland, google earth, google maps);*

- *Mapping of the Proposed Development; and*
- *Other reports and documents relating to the receiving environment, including other chapters of this EIAR and in particular, Chapter 4 (Proposed Description; Chapter 5 (Construction); Chapter 12 (Biodiversity); Chapter 15 (Archaeology & Cultural Heritage) and Chapter 16 (Architectural Heritage).*

Site-based studies, which allow for verification of desk study findings and for analysis of current conditions in the baseline environment, involved:

Surveys of the site and the wider landscape context of the Proposed Development;

- *Further field surveys to verify conditions at specific areas within the landscape receiving environment of the Proposed Development;*
- *Selection of locations for verified Photomontages of the Proposed Development.*
- *The information collected in the desk study and field surveys has been collated and presented in Section* ***Error! Reference source not found.*** *of this Chapter.*

The publicly available datasets listed in Table 9.1 have been consulted in the analysis of the baseline environment.

| SOURCE | NAME | DESCRIPTION | VERSION |
|---|---|---|---|
| Ordnance Survey Ireland (OSI) | Geohive | Current and historical mapping | map.geohive.ie/mapviewer.html |
| OSI | Geohive | Historical aerial imagery | map.geohive.ie/mapviewer.html |
| Google | Google Maps | Mapping and aerial imagery | www.google.com/maps |
| Microsoft | Bing | Mapping and aerial imagery | www.bing.com/maps |
| EPA | EPA Maps | Environmental datasets | gis.epa.ie/EPAMaps |
| National Parks and Wildlife Service (NPWS) | NPWS Maps and Data | Datasets provides information on national parks, protected sites and nature reserves | www.npws.ie/maps-and-data |
| Department of Culture, Heritage and the Gaeltacht (DCHG) | Historic Environment Viewer | National Monuments Service Sites and Monuments Record (SMR) and the National Inventory of Architectural Heritage (NIAH) | webgis.archaeology.ie/historic environment/ |

**Table 9.1:** Publicly Available Datasets

### 9.2.6 Appraisal Method for the Assessment of Impacts

As noted under Section 9.2.3 in preparing the landscape and visual impact assessment this Chapter utilises a combination of approaches as outlined in the EPA Guidelines (EPA 2017) and in the GLVIA (Landscape Institute and IEMA 2013), supported by the TCA (Landscape Institute 2018) and the professional experience and expertise of the author.

The EPA Guidelines provide a generalised methodology suitable for guiding the range of environmental assessments that are carried out under the EIA process, whereas GLVIA provides guidance that is specifically relevant to landscape and visual impact assessment. GLVIA has been used in this assessment to inform the methodology in direct relation to assessing landscape and visual sensitivity, magnitude of change and effects. In order to provide an assessment of effects which is comparable to other types of environmental assessment it is necessary to use the significance criteria specified in the EPA guidelines. A matrix showing the relationship between sensitivity, magnitude and effect significance has been adapted from Figure 3.5 in the EPA Guidelines (EPA 2017) and is shown below in Figure 9.1 Classification of Significance of Landscape and Visual Impacts.

This matrix only differs from the EPA Guidelines in that a 'very high' level of both magnitude and sensitivity has been provided, the intention of which is to create an extra degree of definition to help distinguish between impacts that would lead to either Significant, Very Significant and Profound levels of effect. In addition to predicting the significance of the impacts, EIA methodology (EPA 2017) requires that the quality of the impacts be classified as positive / beneficial, neutral, or negative / adverse.

### 9.2.7 Methodology for Assessment of Landscape Effects

Assessment of potential landscape effects involves:

- *Classifying the sensitivity of the receiving environment of the landscape resource; and*
- *Describing and classifying the magnitude of change in the landscape resulting from the Proposed Development.*
- *These factors are combined to provide a classification of significance of impacts of the Proposed Development.*

**Methodology for Assessment of Landscape Sensitivity**

The sensitivity of the landscape is a function of its existing land use, patterns and scale, enclosure, visual characteristics and value. The nature and scale of the Proposed Development is taken into account, as are trends of change and the relevant policy framework. Five categories are used to classify sensitivity, as set out below in **Error! Reference source not found.**9.2 Landscape Sensitivity.

| SENSITIVITY | DESCRIPTION |
|---|---|
| Very High | Areas where the landscape exhibits very strong, positive character with valued elements, features and characteristics that combine to give an experience of unity, richness and harmony. The landscape character is such that its capacity to accommodate change is very low. These attributes are recognised in policy or designations as being of national or international value and the principal management objective for the area is protection of the existing character from change. |
| High | Areas where the landscape exhibits strong, positive character with valued elements, features and characteristics. The landscape character is such that it has limited / low capacity to accommodate change. These attributes are recognised in policy or designations as being of national, regional or county value and the principal management objective for the area is the conservation of existing character. |

| SENSITIVITY | DESCRIPTION |
|---|---|
| Medium | Areas where the landscape has certain valued elements, features or characteristics but where the character is mixed or not particularly strong, or has evidence of alteration, degradation or erosion of elements and characteristics. The landscape character is such that there is some capacity for change. These areas may be recognised in policy at local or county level and the principal management objective may be to consolidate landscape character or facilitate appropriate, necessary change. |
| Low | Areas where the landscape has few valued elements, features or characteristics and the character is weak. The character is such that it has capacity for change; where development would make no significant change or would make a positive change. Such landscapes are generally unrecognised in policy and the principal management objective may be to facilitate change through development, repair, restoration or enhancement. |
| Negligible | Areas where the landscape exhibits negative character, with no valued elements, features or characteristics. The character is such that its capacity to accommodate change is high; where development would make no significant change or would make a positive change. Such landscapes include derelict industrial lands, as well as sites or areas that are designated for a particular type of development. The principal management objective for the area is to facilitate change in the landscape through development, repair or restoration. |

**Table 9.2:** Landscape Sensitivity

**Methodology for Assessment of Magnitude of change in the Landscape**

Magnitude of change is a factor of the scale, extent and degree of change imposed on the landscape by the Proposed Development, with reference to its key elements, features and characteristics and the affected surrounding character areas (collectively termed 'landscape receptors'). Five categories are used to classify magnitude of change, as set out below in Table 9.3 Magnitude of Landscape Change.

| MAGNITUDE OF CHANGE | DESCRIPTION |
|---|---|
| Very High | Change that is large in extent, resulting in the loss of or major alteration to key elements, features or characteristics of the landscape, and / or introduction of large elements considered totally uncharacteristic in the context. Such development results in fundamental change in the character of the landscape. |
| High | Change that is moderate to large in extent, resulting in major alteration to key elements, features or characteristics of the landscape, and / or introduction of large elements considered uncharacteristic in the context. Such development results in change to the character of the landscape. |
| Medium | Change that is moderate in extent, resulting in partial loss or alteration to key elements, features or characteristics of the landscape, and / or introduction of elements that may be prominent but not necessarily substantially uncharacteristic in the context. Such development results in change to the character of the landscape. |

| MAGNITUDE OF CHANGE | DESCRIPTION |
|---|---|
| Low | Change that is moderate or limited in scale, resulting in minor alteration to key elements, features or characteristics of the landscape, and / or introduction of elements that are not uncharacteristic in the context. Such development results in minor change to the character of the landscape. |
| Negligible | Change that is limited in scale, resulting in no alteration to key elements features or characteristics of the landscape, and / or introduction of elements that are characteristic of the context. Such development results in no change to the landscape character. |

**Table 9.3:** Magnitude of Landscape Change

**Methodology for Assessment of Significance of Effects**

To classify the significance of impacts, the magnitude of change is measured against the sensitivity of the landscape based on Figure 3.5 in the EPA Guidelines (EPA 2017), as adapted and presented below in Figure 9.1. Determining the significance of impacts that are rational and justifiable is also based on the professional judgement, expertise and experience of the author.

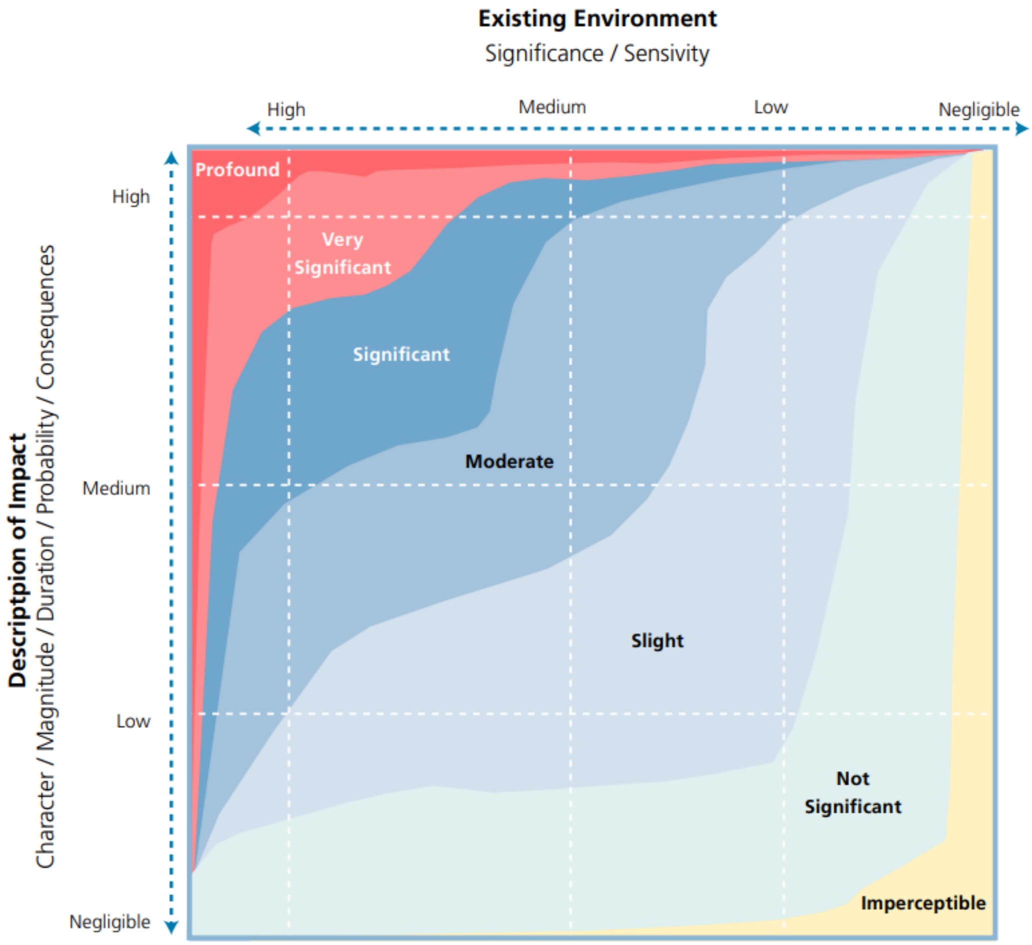



**Figure 9.1:** Classification of Significance of Landscape and Visual Impacts

**Quality, Duration and Frequency of Landscape and Visual Effects**

Consideration of quality (i.e. positive, neutral, negative), duration (i.e. temporary (lasting up to 1 year); short-term (lasting 1 to 7 years); medium-term (lasting 7 to 15 years); long-term (lasting 15 to 60 years); or permanent (lasting over 60 years)) and frequency of effects, is as described in Table 3.3 of the EPA Guidelines (EPA 2017).

**Views and Visual Amenity**

Visual impact assessment is concerned with changes that arise in the composition of available views and the overall effect on the visual amenity of an area. This includes effects on protected and designated views as well as on the typical range of views from publicly accessible places. Visual receptors may include but are not limited to people in public open spaces, outdoor sport facilities, public trails and walking routes, residential properties, gardens, designated views, scenic routes, places of congregation, visitor attractions, publicly accessible heritage features, and other land use areas where people experience views of the landscape.

Visual assessment is informed by available information and site observations as described in Section 9.2.5 Data Collection and Collation and considered sufficient for the visual assessment of the impacts of the Proposed Development. While individual private dwellings have not been surveyed on site, potential effects on residential receptors are considered in detail in Section 9.5.3.2.1 below.

**Methodology for Assessment of Visual Effects**

Assessment of visual effects involves identifying a number of key / representative viewpoints in the baseline environment of the Proposed Development, and for each one of these:

- *Classifying the viewpoint sensitivity; and*
- *Classifying the magnitude of change in the view.*

These factors are combined to provide a classification of significance of the impacts of the Proposed Development on each viewpoint.

**Methodology for Assessment of Sensitivity of the Viewpoint / Visual Receptor**.

Viewpoint sensitivity is a function of two main factors:

- *Susceptibility of the visual receptor to change. The duration and frequency of exposure informs the susceptibility; a greater length of time or more frequent experience of views results in a receptor being more susceptible to changes in views. The level of awareness of people to views also affects susceptibility; people engaged in activities reliant on appreciation of views are of higher susceptibility than those focused on other activities. Visual receptors most susceptible to change include residents at home, people engaged in outdoor recreation focused on the landscape (e.g. park / walk users), or where the quality of the activity is dependent on the appreciation of views over the landscape. Visual receptors less susceptible to change include travellers on road, rail and other transport routes (unless on recognised scenic routes), people engaged in outdoor recreation where the surrounding landscape does not influence the experience, and people in their place of work or shopping; and,*
- *Value attached to the view. This depends to a large extent on the subjective opinion of the visual receptor but also on factors such as policy and designations which indicate a shared social value (e.g. scenic routes, protected views), or the view or setting being associated, place of congregation, with a heritage asset, visitor attraction or having some other cultural status.*

Five categories are used to classify a viewpoint's sensitivity, as set out in the following Table 9.4 Categories of Viewpoint Sensitivity.

| SENSITIVITY | DESCRIPTION |
|---|---|
| Very High | Views or viewpoints (views towards or from a landscape feature or area) that are recognised in policy or otherwise designated as being of national value. Designed views which may be from or be directed towards a recognised heritage asset or other important designated feature, where a key management objective for the view is its protection from change. Visual receptors using national trails or nationally recognised public rights of way. Views recognised in art or literature may also be of very high value. The principal management objective for the view is its protection from change. |
| High | Viewpoints or views that are recognised in policy or otherwise designated as being of value, or viewpoints that are highly valued by people that experience them regularly (e.g. views from houses or outdoor recreation amenities focused on the landscape). The composition, character and quality of the view may be such that it is likely to have high value for people experiencing it and is consequently vulnerable to changes which may lower this value. The principal management objective for the view is its protection from change that reduces visual amenity. |
| Medium | Views that may not have features or characteristics that are of particular value, but have no major detracting elements, and which thus provide some visual amenity. These views may have capacity for appropriate change and the principal management objective is to facilitate change to the composition that does not detract from visual amenity, or which enhances it. Visual receptors may include people with a moderate susceptibility to change engaged in outdoor sports which do not rely on an appreciation of the surrounding landscape / landscape, or road users on minor routes passing through areas of valued landscape character. |
| Low | Views that have no features of appreciable value, and/or where the composition and character are such that there is little appreciable value in the view. Visual receptors include people involved in activities with no particular focus on the landscape. For such views the principal management objective is to facilitate change that does not detract from visual amenity or enhances it. |
| Negligible | Views that have no features of appreciable value or characteristics, or in which the composition may be unsightly (e.g. in derelict landscapes). For such views the principal management objective is to facilitate change that repairs, restores or enhances visual amenity. Visual receptors may include people at their place of work, indoor recreational or leisure facilities or other locations where views of the wider landscape have little or no importance. |

**Table 9.4:** Categories of Viewpoint Sensitivity

**Methodology for Assessment of Magnitude of change in the View / Viewpoint.**

Classification of the magnitude of change takes into account the size or scale of the intrusion of the Proposed Development into the view (relative to the other elements and features in the composition (i.e. its relative visual dominance); the degree to which it contrasts or integrates with the other elements and the general character of the view; and the way in which the change will be experienced (e.g. in full view, partial or peripheral view, or in glimpses). It also takes into account the geographical extent of the change, as well as the duration and reversibility of the visual effects. Five categories are used to classify magnitude of visual change to a view, as set out in the following Table 9.5 Categories of Magnitude of Visual Change.

| MAGNITUDE | DESCRIPTION |
|---|---|
| Very High | Full or extensive intrusion of the development in the view, or partial intrusion that obstructs valued features or characteristics, or introduction of elements that are completely out of character in the context, to the extent that the development becomes dominant in the composition and defines the character of the view and the visual amenity. |
| High | Extensive intrusion of the development in the view, or partial intrusion that obstructs valued features, or introduction of elements that may be considered uncharacteristic in the context, to the extent that the development becomes co-dominant with other elements in the composition and affects the character of the view and the visual amenity. |
| Medium | Partial intrusion of the development in the view, or introduction of elements that may be prominent but not necessarily uncharacteristic in the context, resulting in change to the composition but not necessarily the character of the view or the visual amenity. |
| Low | Minor intrusion of the development into the view, or introduction of elements that are not uncharacteristic in the context, resulting in minor alteration to the composition and character of the view but no change to visual amenity. |
| Negligible | Barely discernible intrusion of the development into the view, or introduction of elements that are characteristic in the context, resulting in slight change to the composition of the view and no change in visual amenity. |

**Table 9.5:** Categories of Magnitude of Visual Change

**Methodology for Assessment of Significance of Visual Effects**

As with landscape effects, classification of the significance of visual effects, involves measurement between the magnitude of change to the view and the sensitivity of the view / viewpoint, as set out above in Figure 9.1.

**Quality of Effects**

In addition to predicting the significance of the impacts, EIA methodology (EPA 2017) requires that the quality of the impacts be classified as positive / beneficial, neutral, or negative / adverse. For landscape to a degree, but particularly for visual effects, this will involve a degree of subjectivity. This is because landscape and visual amenity are perceived by people and are therefore subject to variations in the attitude and values, including aesthetic preferences of the receptor. One person's attitude to the Proposed Development may differ from another, and thus their response to the effects on the landscape or a view may vary.

Additionally, in certain situations there might be policy encouraging a particular development in an area, in which case the policy is effectively prescribing a degree of landscape and visual change. If the Proposed Development achieves the objective of the policy the resulting effect might be considered positive, even if existing landscape character or views are significantly altered. The classification of quality of landscape and visual effects seeks to take these variables into account and provide for a rational and robust assessment.

### 9.2.8 Photomontage Methodology

Accurate Visual Representations (AVRs), or photomontages, of the Proposed Development have been produced by BSM. The methodology for the preparation of photomontages has regard to the Landscape Institute Technical Guidance Note 06/19 Visual Representation of Development Proposals (Landscape Institute 2019) and is further informed by experience in photomontage production. The AVRs are prepared as accurate verified photo-realistic views (equivalent to Type 4 as set out in VRDP (Landscape Institute 2019). The method follows five main steps:

- *Photography;*
- *Survey;*
- *3D Modelling and Camera Matching;*
- *Rendering and Finishing of Photomontages; and*
- *Presentation.*

#### 9.2.8.1 Photography

**Conditions, Date and Time**

Baseline photographs are clear and representative of the relevant context at each location. Wherever possible, photographs are taken with all key elements of the view clearly visible and unobscured by foreground obstructions, such as vehicular or pedestrian traffic, street furniture, trees, signage, etc. Photographs are up to date insofar as possible, and are taken in good clear weather conditions, without precipitation, excessive darkness or shade, or sun glare etc. The date and time of each photograph is recorded, together with camera and lens metadata.

**Camera and Camera Set-Up**

Baseline photographs have been taken using a digital single-reflex lens (SLR) camera with a high-resolution full frame sensor. At each viewpoint the camera is positioned on a tripod with the lens 1.65m above ground level (the level of the average adult's eyes), directed at the site and levelled in the horizontal and vertical axes.

**Lenses**

Prime lenses (fixed focal length with no zoom function) have been used as this ensures that the image parameters for every photograph are the same and that all photographs taken with the same lens are comparable. A 24mm prime lens has been used for all viewpoints. This lens captures a horizontal field of view of 73°. This relatively wide field of view is preferred as it shows more of the landscape context. For some viewpoints considering middle to distant intervention, a 50mm prime lens has also been used, capturing a 39° horizontal field of view.

**Survey**

The coordinates of each viewpoint / camera position, including the elevation have been measured accurately relative to the topographic survey of the Proposed Development site. For each viewpoint, the coordinates of several static objects or 'reference points' in the view (e.g. electricity pylons, posts, corners of buildings, etc.) have also been measured in a similar manner. The coordinates of the camera and 'reference points' are used later in the process to ensure that the direction of view of the camera in the 3D digital model matches that of the view of the photograph.

#### 9.2.8.2 3D Model and Camera Matching

**Creation of 3D Model**

Engineering and landscape drawings have been used to generate a 3D digital model of the Proposed Development at various phases of development and with sufficient detail for the viewpoint(s). The 3D digital model has then been exported to specialist software to allow for application of materials and textures to the model.

**3D Camera Positions**

The coordinates of the camera and 'reference points' for each view have been inserted into the 3D digital model, with information on the focal length of the lens and horizontal angle of coverage attributed to each camera / view, and the direction of each view is calculated and aligned so as to match the geometry of the original baseline photograph. Additionally, the date and time have been set to match that of the baseline photograph so as to ensure the sunlight characteristics in the renderings generated match that of the baseline photographs.

**Rendering of 3D Model and Finishing Photomontages**

For each photomontage viewpoint, a series of a high-resolution renders of the Proposed Development at various phases of development and progressive restoration have been generated as seen from each camera / view position at various phases of development and restoration, with sunlight and shadow matching that of the baseline photograph. Renders of the Proposed Development have then been inserted (or montaged) into the baseline photograph and the composite images edited to take away any elements to be removed from the existing baseline, or parts of the Proposed Development that would be screened by intermediate built or landscape features, to create accurate visual representations of the Proposed Development. The intent is to provide best-fit presentations which assist in illustrating the principal effects of the Proposed Development at a number of stages of development and progressive restoration and at c. 10 years following completion of the final restoration.

**Presentation and Viewing**

Individual photomontages are presented, in 'As Existing' and 'As Proposed' versions, including representations at a number of Progressive Development Intervals throughout the overall project programme that include progressive and final restoration, on A3 pages in landscape format in the accompanying *BRDA RAISE: Accurate Visual Representations* booklet. For each photomontage, the viewpoint number, location description, and the date and time of photography are provided on the page. While all views are based on a 24mm prime lens with a 73° angle of coverage, a further image is provided where appropriate for more distant viewpoints showing an A3 enlargement (centred on the Proposed Development) to equate to the coverage of a 50mm/ 39° prime lens view.

## 9.3 Receiving Environment

### 9.3.1 Landscape Context

#### 9.3.1.1 Shannon Estuary

The Shannon Estuary is the defining landscape characteristic of the region and is set in the context of the rural landscapes of County Limerick and County Clare that include substantial industrial facilities and port related industries along the riverbanks.

The broader landscape itself is generally that of an enclosed farm type, essentially that of a hedgerow dominant landscape. Closer to the estuary, there are agricultural lowlands with less regular field patterns to other agricultural landscapes of the County.

These agricultural lowlands comprise a large area of northern part of County Limerick and is bounded on one side by the Shannon Estuary while its southern boundary is defined by the gradually rising ground, which leads onto the agricultural zone and the western hills zoned to the south.

The Shannon Estuary is characterised by the natural estuary leading through a range of coastal, estuarine and rural landscape typologies. Another inherent feature of the landscape context is, however, the presence of large-scale industrial and infrastructural developments. Some of these, such as AAL, Foynes Port, Tarbert and Moneypoint power stations are located along the estuary with direct access to shipping and are more prominent that those set inland. Others include Shannon Airport, Wyeth Medical, Irish Cement at Mungret and Limerick City itself and are parts of the wider infrastructure required that support living and economics in the region. It is noted that Tarbert and Moneypoint power stations are scheduled to close 2023 and 2025, however, the wind farm adjacent to Moneypoint power station will remain.

AAL is one of the more significant built features on the southern estuary of the River Shannon. The built structures of the AAL plant remain the primary built visual feature in the wider landscape setting whereas the red-brown colouring of the bauxite residue is locally prominent.

The AAL plant and structures incorporate illumination required for safe operation and maintenance. The plant and buildings, together with similar installations at Foynes Port, are readily visible at night from the County Clare side of the Estuary

#### 9.3.1.2 Local Landscape Setting

AAL is located on Aughinish Island along the southern side of the estuary in a rural, low-lying area dominated by the estuary, its associated wetlands, mudflats and large areas of open water.

The landscape context comprises similarly rural and low-lying landscape extending south from the estuary; east around Askeaton; and north of the estuary in County Clare. By contrast, to the west and southwest the landscape rises prominently to Knockpatrick Hill (172m) c. 2.5km south of Foynes) from where expansive views are offered over the low-lying landscape and the estuary Figure 9.2.

The existing buildings and structures of the AAL plant are located on low-lying flat ground adjacent to the Estuary shoreline and the jetty extends almost 1.0km into the Estuary. The AAL plant and associated structures are visually prominent from both the estuary and the surrounding landscape.

The Bauxite Residue Disposal Area (BRDA) extends further inland, and its characteristic red-brown colouring renders it prominent aspects of the facility particularly from surrounding landscape on the southern side of the estuary.

The AAL plant and structures incorporate illumination required for safe operation and maintenance. Such lighting renders the facility intermittently prominent at night as views towards the facility are alternately open or screened by vegetation. It is noted that a small number of lights are used to delineate the haul roads on the BRDA however these are visually insignificant.

The locality of the development is not an important tourist area however the N69 Limerick to Tralee Road provides a link between the major tourism areas of the mid-west and the south-west and is a designated tourist area.  It is noted that the N69 is a subsidiary route to the N21 Limerick to Tralee Road, which at over 12km to the south is well outside the primary zone of visual influence of the facility.  In County Clare on the northern side of the estuary, part of the R473 Ennis to Kilrush Road through Killadysert is listed as a scenic route.

### 9.3.2 Visual Characteristics

The AAL plant and the BRDA can be seen across much of the Shannon Estuary, often in the context of other industrial development along the edge of the estuary. Views from inland are generally experienced either from viewpoints close to the development or from distant upland areas.

The landscape surrounding much of the site to the south of the estuary is low-lying and well-enclosed by well-treed hedgerows or undulations in the landform which provide good levels of screening. The main exception to this is Knockpatrick Hill which provides expansive views over the Shannon Estuary from Moneypoint in the west to Limerick in the east and including Foynes Port and Aughinish Alumina Ltd. at 2.5 to 5.0km distance to the northeast.

To the north of the estuary the southern fringe of County Clare including the designated scenic route of the R473 offer some elevated views over the estuary and the existing BRDA, although these are often limited by frequent blocks of plantation woodland and by the screening effect of Foynes Island. Beyond the elevated edge overlooking the Shannon Estuary visibility diminishes rapidly towards the interior of County Clare. For low lying areas around the Fergus Estuary views are generally limited to the shoreline due to the enclosed low-lying nature of the landscape.

### 9.3.3 Description of the Proposed Development Site

The AAL plant is located on Aughinish Island, a limestone ridge previously separated from the mainland by the tidal channel of Poulaweala Creek.  The island is now connected by means of reclamation and protected by a series of embankments which have been raised and strengthened many times over the centuries. The main buildings and structures associated with AAL lie along the northern projection of the island, while the BRDA lies along the west of the island.

The site is composed of the established and continually emerging Phase 1 and Phase 2 BRDA, a Salt Cake Disposal Cell incorporated within Phase 1 BRDA, areas of rock, mixed scrub and grassland to the east of the BRDA and a stockpile area to the southeast of the BRDA for storage of rock and soil materials.

A surface water management and treatment network comprises a series of connected Perimeter Interceptor Channels (PICs) around the base of the BRDA leading to a Storm Water

Pond (SWP) to the northeast. Storm water is piped from the SWP to an Effluent Clarification System (ECS) located within the AAL refinery plant area and outside the proposed development area. Treated water is then pumped back into the Liquid Waste Pond (LWP) where the clean water is cooled and stored for use or discharge.

The alumina extraction process at the facility results in the production of a non-hazardous bauxite residue which is deposited within the BRDA, located to the south-west of the facility. The current and emerging BRDA has a terraced construction facilitating incremental storage of bauxite residue in ten terraced stages of 2.0m height each.

The BRDA is currently in Operational Phase and the top layer of bauxite residue is exposed to the elements and visible as a red-brown colour. Phase 1 BRDA presently includes the stack wall to Stage 10 or 24.0m OD along the northeastern and northwestern sides and that of the southwestern side is under construction. The level of bauxite residue ranges from 22.0m and 24.0m along the perimeters and up to 32.0m OD at the centre. Phase 2 BRDA stack walls are presently at Stage 4 or 12.0m OD and bauxite residue levels ranging from 10.5m OD at the perimeters and c. 15.0m centrally. In addition, an internal access road is constructed in a north-south alignment as a spine along the centre of the Phase 2 BRDA and ranges in level from c. 15.0m OD to 20.0m OD. The extant planning approval is for continued operation of both phases of the BRDA up to Stage 10 (or a level of 24m OD) and restoration with a top dome rising further up to a maximum of 32.0m OD. See Chapter 2 for further details.

There is an extant planning permission to establish a 4.5 hectare borrow pit to the northeast of the BRDA, which will provide crushed rock-fill for the ongoing construction of the side slopes of the BRDA. Further details are provided in Chapter 2. The lands of and surrounding the permitted borrow pit comprise rock, grassland, contractor compound areas and areas of dense scrub woodland comprising naturally regenerated bushes, young trees, and native undergrowth.

The side slopes of the existing BRDA comprise three different finishes:

1. The northern and western sides of Phase 1 BRDA, up to Stage 8, have exposed rock stack wall slopes while the terraces have had a rock blanket and ameliorated soil applied and seeding and mixed woodland and bush species are established. The wide Stage 5 terrace has had a 1.0m depth amended bauxite residue, applied in two 500mm layers. The lower layer comprises neutralised bauxite residue, washed processed sand and gypsum, while the upper layer also includes organic compost. The Stage 5 terrace is seeded.
2. The rock stack wall slopes of the lower stages of Phase 2 BRDA have been hydroseeded to promote greening of the rock stages and the flat terraces are presently untreated.
3. The upper stages of Phase 1 and Phase 2 BRDA present as exposed sloped rock stack walls and untreated bauxite residue terraces.

### 9.3.4 Planning History

Aughinish Alumina Ltd has been in operation since the early 1980’s, commencing with the plant and the original Phase 1 BRDA and subsequent planning permissions facilitating extension of the Phase 1 BRDA and commissioning the Phase 2 BRDA.

The planning history of the Proposed Development area is covered in Chapter 2 of this EIAR.

### 9.3.5 Landscape and Visual Planning Policy Context and Designations

#### 9.3.5.1 Limerick County Development Plan (As Extended)

Limerick County Development Plan 2010 – 2016 (LCDP) came into effect on 29th November 2010 with the purpose of setting out the County Council's overall strategy for planning and development within the County until 2016 and beyond. The LCDP was subsequently extended until such time as the new Limerick Development Plan 2022-2028 (LCCC) comes into effect. The LCDP, and Draft LCCC, have been reviewed to ascertain relevant land use designations to assist in the appraisal of important landscape and visual features and landscape quality. It should be noted that landscape planning policies relevant to AAL or the Shannon Estuary are listed here however the wider and more comprehensive planning policy review is included in Chapter 2 of the EIAR, Section 2.4.

The Planning and Development Acts 2000 to 2010 requires that County Development Plans must set out objectives for:

- *The preservation of the character of the landscape, including the preservation of views and prospects and the amenities of places and features of natural beauty or interest.*
- *The preservation, improvement and extension of amenities and recreational amenities, including: Areas of special amenity, Landscape conservation areas, Tree preservation orders, Public rights of ways.*

##### 9.3.5.1.1 Landscape Policies and Designations

The following policies are considered important with regards to landscape and visual issues in relation to the proposed development:

- *Policy EH P2: It is the policy of the Council to promote the distinctiveness and where necessary safeguard the sensitivity of Limerick's landscape types through the landscape characterisation process and also where possible to develop the means to successfully integrate differing kinds of development within them.*
- *Objective EH O5: Enhancing Tree Cover: It is the objective of the Council to preserve and enhance the general level of tree cover within the County, both in the countryside at large and also in the County's towns. The Council strongly encourages the establishment of native species, in particular broadleaf species.*
- *Objective EH O6: Landscaping and Development:*
  - *(a) Ensure the adequate integration of development into the landscape by the retention of existing trees and landscape features and/or suitable planting.*
  - *(b) Encourage, where appropriate, the use of native species. The layout of landscaping planting and features to act as wildlife corridors within developments, particularly residential developments, and linking with other habitats in the area will be encouraged.*
  - *(c) Resist the removal of substantial lengths of roadside boundaries. Where an alternative, suitable site is available for the development, applicants should consider such an alternative on the basis that avoids the necessity for widespread boundary removal. Only in exceptional circumstances should roadside boundaries be removed.*
- *Objective EH O12: Shannon Coastal Zone Landscape Character Area*
  - *To protect the views and prospects along the N69 (see Map 7.6), as a priority for the Planning Authority.*
  - *To encourage the use of site-specific designs with careful attention to landscaping.*

- *Objective EH O17: Scenic Views and Prospects*
  - *(a) It is the objective of the Council to safeguard the scenic views and prospects by integrating them into landscape character areas, which will ensure a more balanced approach towards landscape issues within the County.*
  - *(b) In areas where scenic views and prospects are listed in Map 7.6 there will be a presumption against development except that which is required in relation to farming and appropriate tourism and related activities, or a dwelling required by a long term landowner or his/her family that can be appropriately designed so that it can be integrated into the landscape.*
  - *(c) The Planning Authority will exercise a high level of control (layout design, siting, materials used, landscaping) on developments in these areas. In such areas site specific designs are required. It should be noted that in areas outside these delineated areas, high standards will also be required.*
- *Objective EH O36: Historic Gardens, Designed Landscapes and their associated Non-Structural Elements*
  - *To protect important non-structural elements of the built heritage associated with a Protected Structure such as historic gardens and parkland, and curtilage and demesnes features such as hedgerows and terracing, individual trees and shelterbelts, copses and woodland, as well as walls and ha-has, the areas they occupy and in their vicinity will be defined as Architectural Conservation Areas. Additional Architectural Conservation Areas of this type may be identified and included during the lifetime of the Plan. The Planning Authority will not permit insensitive developments that compromise the character of such Architectural Conservation Areas. Development proposals on sites in the vicinity of an Architectural Conservation Area will only be permitted where it can clearly be demonstrated that the development will not materially affect the character, integrity, amenity and setting of the Area.*

There are Architectural Conservation areas at the town centre of Foynes, at the town centre of Askeaton and at the designed landscape of Ballysteen House.

#### 9.3.5.1.2 Landscape Character Areas

The LCDP divides the county, excluding the extents of Limerick City, into ten Landscape Character Areas (LCAs). The Plan provides description along with specific policy objectives. No indication of sensitivity or capacity is presented in the Plan, and instead this needs to be determined by professional judgement. These LCAs are also carried through into the Draft Limerick Development Plan 2022-2028. The LCAs are as follows:

1. Agricultural Lowlands
2. Ballyhoura /Slieve Reagh
3. Galtee Uplands
4. Knockfierna Hill
5. Lough Gur
6. Shannon Integrated Coastal Management Zone
7. Southern Uplands
8. Tory Hill
9. Slieve Felim Uplands
10. Western Hills/Barnagh Gap/Sugar Hill (Western Uplands)

Those LCAs of relevance to this assessment include:

1. Agricultural Lowlands;
6. Shannon Estuary Integrated Coastal Management Zone; and
10. Western Uplands

Other LCAs are not assessed due to their distance and/or lack of intervisibility.

**Shannon Estuary Integrated Coastal Management Zone**

The proposed development site is located entirely within the Shannon Estuary Integrated Coastal Management Zone (ICMZ). This zone comprises a large area of the northern part of County Limerick and is bounded to the north by the Shannon Estuary and extends to the Agricultural Lowlands and Western Uplands zones to the south. One of the main features of the area is the presence of the estuary, which is perhaps the defining characteristic of the region. The landscape itself is generally that of an enclosed farm type, essentially that of a hedgerow dominant landscape. This differs from the other agricultural landscapes of the County in that the field patterns, particularly close to the estuary, tend to be less regular than those elsewhere in the County.

It is a stated planning objective (Objective EH 012) of the ICMZ to protect the views and prospects along the N69 Coast Road as a priority for the Planning Authority from Foynes to the west of the Proposed Development site and continuing a further c.20km westwards along the coast to Glin and Tarbert at the Limerick/Kerry County boundary. Additionally, development identified under the Shannon Integrated Framework Plan (SIFP) will adhere to the mitigation measures for landscape management as appropriate.

**Western Uplands**

The Western Uplands LCA begins approximately 5km west of Newcastle West and the views and prospects from the Barnagh Gap are incorporated into the LCA. This hill range dominates the surrounding landscape to the east and is clearly visible from Newcastle West. Because of this and the extensive traffic through the region on the N21 any visual disturbance would be very obvious. The Barnagh Gap/Sugar Hill area in particular deserves separate treatment within this region. The area generally has an upland character with isolated farmsteads, improved grassland punctuated by blocks of forestry, which is one of the characteristics of the area. This part of the County has been among the most heavily modified by forestry. There are no planning objectives associated with this area which are of specific relevance to the proposals.

**Agricultural Lowlands**

This is the largest of the Landscape Character Areas in the County and comprises almost the entire central plain. This landscape is a farming landscape and is defined by a series of regular field boundaries, often allowed to grow to maturity. This well-developed hedgerow system is one of its main characteristics. In terms of topography the landscape is generally rather flat with some locally prominent hills and ridges. The pastoral nature of the landscape is reinforced by the presence of farmyards. There are no planning objectives associated with this area which are of specific relevance to the proposals.

#### 9.3.5.1.3 Views and Prospects

The preservation of the character of the landscape, including the preservation of views and prospects and the amenities of places and features of natural beauty or interest is listed as a mandatory objective of the LCDP. The views and prospects designated in the LCDP are incorporated into the landscape character areas and identify parts of the County that are valuable amenities for locals and visitors alike and which properly conserved could help to provide the basis for further development of the tourist industry in County Limerick.

Map 7.6 of the LCDP sets out protected views and prospects within the LCDP Area. The only view/prospect of relevance to the study area is located along the N69 adjacent to the Shannon Estuary from Foynes to Glin. This is incorporated into the Shannon Estuary Integrated Coastal Management Zone.

Section 7.3.7 of the LCDP states that the route along the N69 from Foynes is less suitable for walking purposes than other routes listed in the Plan due to the busy road network yet at certain points along them they provide opportunities for visitors and locals alike to stop and enjoy the view.

Regarding the section of coastal roadway between Foynes and Glin, Section 9.4 of the LCDP states that the extreme sensitivity from a visual and environmental perspective should be borne in mind when considering any new development proposals. However, the route is located over 1.5km from the proposed development site, and the existing BRDA is only visible for a small portion of the eastern extents of the route and it is seen in the background beyond the large-scale building developments at Foynes Port.

### 9.3.5.2 Strategic Integrated Framework Plan (SIFP) for the Shannon Estuary

The Strategic Integrated Framework Plan (SIFP) for the Shannon Estuary has been developed by an interjurisdictional steering group to produce a land and marine based framework to guide the future development and management of the Shannon Estuary.

It is a key objective of the SIFP: To ensure that all proposals or development pay due regard to the special quality of the landscape and seascape

Development Objective SIFP LDS 1.1 (Conserving the Valued Landscape) states the aim: To conserve, and where possible, enhance the special and distinctive character and quality of the Estuary’s landscape and seascape.

Development Objective SIFP LDS 1.2 (Due regard to Quality of Landscape and Seascape) states the aim: To ensure that all proposals for the development site take into account the special quality of the landscape of the Shannon Estuary, and take appropriate measures to minimise visual effects.

### 9.3.5.3 Draft Limerick Development Plan 2022-2028

The draft plan is due to supplant the extended LCDP. The following policies have relevance to the assessment of Landscape and Visual impacts:

Objective EH P8 – Landscape Character Areas: “*It is a policy of the Council to promote the distinctiveness and where necessary safeguard the sensitivity of Limerick’s landscape types, through the landscape characterisation process in accordance with the ‘Draft Guidelines for Landscape and Landscape Assessment’ (2000) as issued by the Department of Environment and Local Government, in accordance with the European Landscape Convention (Florence*

*Convention) and with 'A National Landscape Strategy for Ireland – 2015- 2025'. The Council shall implement any relevant recommendations contained in the Department of Arts, Heritage and the Gaeltacht's National Landscape Strategy for Ireland, 2015 – 2025.*" This is analogous to current Policy EH P2 of the LCDP, and the listed LCAs correspond the LCAs described in Section 9.3.5.1.2.

Objective EH O10 – Trees and Hedgerows: "*It is an objective of the Council to: a) Require the planting of native trees, hedgerows and vegetation and the creation of new habitats in all new developments and public realm projects. The Council will avail of tree planting schemes administered by the Forest Service, in ecologically suitable locations, where this is considered desirable. b) Require, in the event that mature trees or extensive mature hedgerow is proposed to be removed, that a comprehensive tree and hedgerow survey be carried out by a suitably qualified individual, demonstrating that the subject trees/hedgerow are of no ecological or amenity value.*"

Objective EH O12 - Blue Green Infrastructure: "*It is an objective of the Council to: a) Promote a network of Green and Blue infrastructure throughout Limerick. b) Promote connecting corridors for the movement of species and encourage the retention and creation of features of biodiversity value, ecological corridors and networks that connect areas of high conservation value such as woodlands, hedgerows, earth banks, watercourses, wetlands and designated sites. In this regard, new infrastructural projects and linear developments in particular, will have to demonstrate at design stage, sufficient measures to assist in the conservation of and dispersal of species. c) Ensure the integration and strengthening of green infrastructure into the preparation of Local Area Plans. d) Where possible remove barriers to species movement, such as the removal of in-stream barriers to fish passage for example.*"

Objective EH O23 - Light Pollution: "*It is an objective of the Council to ensure that the design of external lighting schemes minimise the incidence of light spillage or pollution in the immediate surrounding environment. In this regard, developers shall submit lighting elements as part of any design, with an emphasis on ensuring that any lighting is carefully directed, not excessive for its purpose and avoids lights spill outside the development and where necessary will be wildlife friendly in design.*"

Objective EH O51 - Architectural Conservation Areas: "*It is an objective of the Council to: a) Protect the character and special interest of an area, which has been designated as an Architectural Conservation Area (ACA) as set out in Volume 3. b) Ensure that all development proposals within an ACA be appropriate to the character of the area having regard to the Character briefs for each area. c) Ensure that any new development or alteration of a building within an ACA or immediately adjoining an ACA, is appropriate in terms of the proposed design, including scale, height, mass, density, building lines and materials. d) Seek a high quality, sensitive design for any new development(s) that are complementary and/or sympathetic to their context and scale, whilst simultaneously encouraging contemporary design which is in harmony with the area. Direction can also be taken from using traditional forms that are then expressed in a contemporary manner, rather than a replica of a historic building style. e) Seek the retention of all features that contribute to the character of an ACA, including boundary walls, railings, soft landscaping, traditional paving and street furniture. f) Seek to safeguard the Georgian heritage of Limerick.*"

#### 9.3.5.4 Clare County Development Plan

Given the relative proximity to County Clare a review of Clare County Development Plan 2017-2023 (CCDP) has been undertaken to establish if there is any relevant landscape and visual related designations that may influence the assessment within the study area.

##### 9.3.5.4.1 Landscape Policies and Designations

The following policies are considered important with regards to landscape and visual issues in relation to the proposed development:

- *Strategic Aims*
  - *To ensure the implementation of the National Landscape Strategy for Ireland 2015-2025 in County Clare;*
  - *To implement the 'Clare's Living Landscapes' approach to landscape management and enhancement throughout the County;*
  - *To encourage the utilisation of the Clare County Landscape Character Assessment in both the preparation and assessment of planning applications;*
  - *To utilise the 'Clare Living Landscapes' approach to ensure that development in the County takes place in the location / landscape deemed most appropriate;*
  - *To sustain the natural and cultural heritage of the County.*
- *CDP13.1 Development Plan Objective: Landscape Character Assessment*
  - *To encourage the utilisation of the Landscape Character Assessment of County Clare and other relevant landscape policy and guidelines and to have regard to them in the management, enhancement and promotion of the landscapes of County Clare.*
- *CP13.2 Development Plan Objective: Settled Landscapes. To permit development in areas designated as 'settled landscapes' that sustain and enhance quality of life and residential amenity and promote economic activity subject to:*
  - *Conformity with all other relevant provisions of the Plan and the availability and protection of resources;*
  - *Selection of appropriate sites in the first instance within this landscape, together with consideration of the details of siting and design which are directed towards minimising visual impacts;*

Regard being given to avoiding intrusions on scenic routes and on ridges or shorelines.

- *CP13.3 Development Plan Objective: Settled Landscapes. To permit development in areas designated as 'settled landscapes' that sustain and enhance quality of life and residential amenity and promote economic activity subject to:*
  - *Conformity with all other relevant provisions of the Plan and the availability and protection of resources;*
  - *Selection of appropriate sites in the first instance within this landscape, together with consideration of the details of siting and design which are directed towards minimising visual impacts;*
  - *Regard being given to avoiding intrusions on scenic routes and on ridges or shorelines.*
- *CP13.4 Development Plan Objective: Shannon Estuary Working Landscape*
  - *A) To permit development in these areas that will sustain economic activity of regional and national significance – especially through the protection of resources to sustain largescale energy projects, logistics, large-scale manufacturing and associated infrastructure. All such developments shall be required to conform to*

*relevant management and conservation objectives for designated and protected habitats and species within the estuary;*

*B) That selection of appropriate sites in the first instance within this landscape, together with consideration of the details of siting and design, are directed towards reducing visual impact and that residual visual impacts are minimised;*

*C) That particular regard should be given to avoiding intrusions on scenic routes and on ridges or shorelines. Developments in these areas will be required to demonstrate:*
  - *i) That sites have been selected to avoid visually prominent locations wherever feasible;*
  - *ii) That site layouts avail of existing topography and vegetation to reduce visibility from scenic routes, walking trails, public amenities and roads;*
  - *iii) That design for buildings and structures reduce visual impact through careful choice of form, finish and colours and that any site works seek to reduce visual impact of the development.*

- *CDP 13.5 Development Plan Objective: Heritage Landscapes. To require that all proposed developments in Heritage Landscapes demonstrate that every effort has been made to reduce visual impact. This must be demonstrated for all aspects of the proposal – from site selection through to details of siting and design. All other relevant provisions of the Development Plan must be complied with. All proposed developments in these areas will be required to demonstrate:*
  - *That sites have been selected to avoid visually prominent locations wherever feasible;*
  - *That site layouts avail of existing topography and vegetation to reduce visibility from scenic routes, walking trails, public amenities and roads;*
  - *That design for buildings and structures reduce visual impact through careful choice of form, finish and colours and that any site works seek to reduce visual impact of the development.*

- *CDP 13.6 Development Plan Objective: Seascape Character Areas.*

  *A) To require all proposed developments within Seascape Character Areas to demonstrate that every effort has been made to reduce the visual impact of the development. This must be demonstrated by assessing the proposal in relation to:*
    - *Views from land to sea;*
    - *Views from sea to land;*
    - *Views along the coastline.*

  *B) To ensure that appropriate standards of location, siting, design, finishing and landscaping are achieved.*

- *CDP 13.7 Development Plan Objective: Scenic Routes*

  *A) To protect sensitive areas from inappropriate development while providing for development and change that will benefit the rural community;*

  *B) To ensure that proposed developments take into consideration their effects on views from the public road towards scenic features or areas and are designed and located to minimise their impact;*

  *C) To ensure that appropriate standards of location, siting, design, finishing and landscaping are achieved.*

#### 9.3.5.4.2 Landscape Character Assessment

Section 13.2 of the CCDP references the Landscape Character Assessment of County Clare commissioned by the Heritage Council and published in 2004. This is a key resource for the County Development Plan which gives guidance and advice on the key characteristics of the area, the land cover, ecology and also the current condition of the landscape and how sensitive it is to change. The Landscape Character Assessment of County Clare identifies Landscape Character Types (LCTs) and Landscape Character Areas (LCAs) and these are illustrated in Figures 13.1 and 13.2 of the CCDP respectively.

#### 9.3.5.4.3 Landscape Character Types

The CCDP /Landscape Character Assessment of County Clare divides the county into 26 Landscape Character Types (LCTs). Landscape character types are distinct types of landscape that are relatively homogenous in character. They are generic in nature in that they may occur in different localities throughout the county. They commonly share similar combinations of geology, topography, land cover and historical land use.

The nearest LCTs to the site are LCT 8 – Farmed Lowland Ridges and LCT 10 - Flat Estuarine Farmland and Islands.

**LCT 8 - Farmed Lowland Ridges**

The key characteristics of most relevance to this assessment are as follows:

- *Linear ridge topography*
- *Land cover is pasture, deciduous woodland and scrub*
- *A variety of enclosures are evident and include dense hedgerows, earth banks and some stone walls.*
- *Quite a settled area, with traditional farm buildings and cottages. Small villages with increasing modern buildings are also present. Communication routes and views are generally aligned along valleys.*

**LCT 10 – Flat Estuarine Farmland and Islands**

- *Land cover is pasture/mudflats/foreshore/salt marsh, with little tree cover*
- *Distinctively flat farmland adjacent to estuaries, which are inundated daily by the tide*
- *Proximity to estuary*
- *Elevation is close to 0m AOD*
- *Limited roads are often located on elevated causeways through the wetter areas. Settlement is quite limited, confined to areas of higher ground and the low hills which are found occasionally through these areas*
- *Estuary side development: power stations, masts etc, are noted as a Force for Change*

#### 9.3.5.4.4 Landscape Character Areas

The CCDP / Landscape Character Assessment of County Clare divides the county into 21 Landscape Character Areas (LCAs). The nearest LCAs to the site are LCA 14 -Fergus Estuary and LCA 18 – Shannon Estuary Farmlands.

**LCA 14 – Fergus Estuary**

The Landscape Character Assessment states that the key characteristics of this LCA are:

- *Flat estuarine farmland divided by drainage ditches, post and wire fences and degraded thorny hedgerows.*
- *Open expansive views are afforded across the estuary to the River Shannon, though these are limited in places due to flood defence embankments.*
- *Settlement is sparse reflecting the areas past tendency to flood, some settlement on higher ground. On eastern boundary, increased settlement due to proximity to Shannon Airport and town.*
- *Scattered holy wells with a number of graveyards and standing stones.*
- *Newmarket-on-Fergus and Kildysart are both designated ACA (Architectural Conservation Area).*

In relation to condition and sensitivity, the Landscape Character Assessment notes that the landscape is generally of variable condition, with degrading influences on the eastern side, however, the western side of the estuary is generally undeveloped with a strong sense of remoteness. This is punctuated by the villages of Kildysart and Ballynacally.

It is also noted that due to the low lying and flat nature of the landscape, tall or large development is highly visible; this also applies to development on the Limerick and Kerry sides.

**LCA 18 – Shannon Estuary Farmlands**

The Landscape Character Assessment states that the key characteristics of this LCA are:

- *Prominent ridged landscape with linear hills;*
- *Secluded areas interspersed with open views across the estuary. Views are afforded across the Shannon estuary and across to Limerick from elevated areas and on the estuary shores;*
- *Flatter coastal fringe;*
- *Scattery Island important focal point; and*
- *Complex patterns of pasture, woodland and scrub habitats.*

In relation to condition and sensitivity, the Landscape Character Assessment notes that the area is in variable condition, with a more intact character to the east and north, where it is less accessible. Moneypoint Power Station is a singularly large-scale detractor on the Shannon, accompanied by a number of prominent pylons. The woodland scrub around Clonderlaw Bay and the broadleaved areas in the grounds of Kilrush house are classified as visually vulnerable and sensitive under the county development plan. The coastline to Clonderlaw Bay is also classified as an area of high amenity under this plan.

### 9.3.5.5 Seascape Character Areas

The Plan / Landscape Character Assessment of County Clare identifies 12 Seascape Character Areas (SCAs). The relevant areas for the proposal are SCA 11 - River Shannon, which lies adjacent to the proposal site, and SCA 12 - Fergus Estuary which is located on the far side of the River Shannon.

**SCA 11 – River Shannon**

The Landscape Character Assessment states that the key characteristics of SCA 11 – River Shannon are:

- *Coastal fringe is flatter and slopes down towards the sea.*
- *Views to scattered farmhouse settlements.*
- *Deep water berthing facilities.*
- *Views of shipping, commercial, industrial activity, pastureland and forestry.*
- *Focal point for travelling the waterways of Ireland.*
- *Shannon Airport is a landmark transport node of transcontinental significance*
- *Car ferry service to Tarbert along the north coast of County Kerry.*

In relation to condition and sensitivity, the Landscape Character Assessment notes that the estuary is in moderate to good condition. However, industrial and commercial activity dominates the view from land to sea. Low lying, flat and open views to sea increase the area's sensitivity to change particularly from shipping and industrial activities.

**SCA 12 – Fergus Estuary**

The Landscape Character Assessment states that the key characteristics of SCA 12 – Fergus Estuary are:

- *The Fergus Estuary is a designated SPA.*
- *Influence of the sea is apparent although sea defence banks prevent views to estuary in some areas.*
- *Impacts upon the estuary due to climatic change, sea level rise, increasing storms etc.*
- *Open expansive views across the estuary to the River Shannon.*
- *Estuary side factories are a detractor, e.g. Clarecastle Test Centre.*
- *Views to Deer Island, Coney Island, Feenish and Deenish Island.*

In relation to condition and sensitivity, the Landscape Character Assessment notes that the quality of the Fergus estuary is good. However, there is evidence of poorly sited small-scale developments. The estuary would be very sensitive to change. The rural and tranquil estuarine landscape of high ecological and landscape value could easily be affected by inappropriate development, pollution or climate change.

### 9.3.5.6 Living Landscape Types

The Plan has developed objectives for future planning of rural areas of County Clare by considering the County to consist of three types of areas:

- *Settled Landscapes – where people work and live comprising the network of farmland, villages and towns in the County;*
- *Working Landscapes – intensively settled and developed areas within Settled Landscapes or areas with a unique natural resource comprising two areas, The Western Corridor between Ennis and Limerick, and the Shannon Estuary between Moneypoint and Ballynacragga Point excluding Clonderalaw Bay;*
- *Heritage Landscapes – where natural and cultural heritage are given priority. It is stated in the Plan that these are 'envisioned as the most valued parts of the County'.*

*Areas include Clonderlaw Bay and Fergus Estuary part of Heritage Landscape 3 – The Fergus / Shannon Estuary.*

- *Each area is outlined in Map 13a of the Plan. The Plan sets out a series of objectives for new development within these areas, see Section 9.3.5.1.1 'Landscape Policies and Designations' above.*

### 9.3.5.7 Scenic Routes

Section 13.5 of the Development Plan sets out protected views and prospects from Scenic Routes within the study area. There are number of such designations in the study area as follows:

- *Scenic Route SR 18 – Along coast road from Carrigaholt to Doonaha;*
- *Scenic Route SR 19 – Coast road south east of Cappagh to Carrowdotia South;*
- *and SR 20 – R473 from outside Labasheeda to T junction before Killadysert.*

## 9.4 Description of the Proposed Development

The Proposed Development includes a number of distinct but related parts that will facilitate continued operation of AAL at Aughinish Island until 2039, or 9 years beyond the lifetime of the currently permitted development.

The key components of the Proposed Development include:

- *Increase in height of the permitted ten stage BRDA by six additional stages of 2.0m height each, or 12.0m in total and to the level of 36.0m OD at the perimeter of the BRDA;*
- *Corresponding raise of the final dome from the permitted 24.0m OD and 32.0m OD at the perimeter and high point respectively to 32.0m and 44.0m OD.*
- *Increasing the capacity of the existing Salt Cake Disposal Cell (SCDC) within BRDA Phase 1 by raising the level of the existing rock bund and lining system;*
- *Expansion of the permitted borrow pit eastwards for a further 3.9 hectares to provide the additional rock fill material needed to establish the additional rock stack walls for the proposed BRDA raise;*
- *Progressive installation of 8 No. surface water spillways on the side slopes of the BRDA. These will be lined with concrete canvas and rip-rap rock armouring and will ultimately transfer surface water from the completed dome and side slopes of the BRDA to the existing Perimeter Interceptor Channel;*
- *Hydroseeding of rock side slopes as each stage of the BRDA is filled and the stack wall for the next stage is constructed so as to present a greener appearance of the BRDA side slopes that untreated rock.*

Refer to the Engineering and Landscape design drawings submitted with the application for full details of the Proposed Development.

**Progressive Restoration**

A key aspect of the Proposed Development is the progressive restoration of the BRDA throughout the operation of the development. Restoration will be implemented across Stages 1 to 5 while Stages 6 to 10 are being established. Similarly, restoration of Stages 6 to 10 will be implemented while Stages 11 to 16 are being established.

- *Transfer of soil material from the existing stockpile to the southeast of the BRDA to the Borrow Pit, and import of additional topsoil to the Borrow Pit, for grading, amelioration and blending as required in preparation for use on the BRDA side slopes;*
- *Progressive restoration of side slopes and terraces to include:*
  - *Capping of terraces with up to 500mm deep rock fill blanket over a geotextile membrane;*
  - *Application of 1.0m depth amended bauxite across Stage 5 to the toe of Stage 6 in two 500mm deep layers, with the lower layer comprising a blend of neutralised bauxite residue, washed processed sand and gypsum, and the upper layer also including organic compost for grass growth;*
  - *Overlaying the rock fill blanket with a geotextile membrane and minimum 500mm depth of subsoil and topsoil to provide landscape cover to the terraces that ties into the hydroseeded rock slopes;*
  - *Building up of subsoil and topsoil to form localised landscape mounds from Stages 1 to 5 and Stages 6 to 10 to mitigate the stepped and linear character of the underlying BRDA side slopes. See Landscape Masterplan, Drawing 6368_350; and,*
  - *Seeding of terraces and landscape mounds and additional planting of ground cover, shrubs and trees on landscape mounds. See Landscape Masterplan, Drawing 6368_350.*
- *Final restoration and closure to include:*
  - *Application of 1.0m depth amended bauxite across Stage 10 to the toe of Stage 11 in two 500mm deep layers, with the lower layer comprising a blend of neutralised bauxite residue, washed processed sand and gypsum, and the upper layer also including organic compost for grass growth;*
  - *Restoration of side slopes and terraces from Stage 11 to 16 including landscape mounds as described above for Stages 1 to 5 and Stages 6 to 10;*
  - *Application of 1.0m depth amended bauxite across the dome in two 500mm deep layers, with the lower layer comprising a blend of neutralised bauxite residue, washed processed sand and gypsum, and the upper layer also including organic compost for seeding and landscaping;*
  - *Seeding of terraces and landscape mounds from Stages 11 to 16 and additional planting of ground cover, shrubs and trees on landscape mounds. See Landscape Masterplan, Drawing 6368_350.*
  - *Seeding of the dome, planting hedgerows and trees in accordance with Landscape Masterplan, Drawing 6368_350.*
  - *Restoration of the Borrow Pit in accordance with Landscape Masterplan, Drawing 6368_350; and,*
  - *Planting of the existing Perimeter Inceptor Channels as wetlands that will also serve to lead surface water runoff to the existing ponds and clarifiers to the northeast of the BRDA*

For full details of the Proposed Development, please refer to the Engineering and Landscape design drawings submitted with the application together with the Chapter 3 of the EIAR

## 9.5 Potential Landscape and Visual Effects

New development has the potential to impact on the immediate site environs or the surrounding site context, or both. The quality of effects can be positive, neutral or negative and the significance of effects is determined by the particular characteristics of the development and the existing context.

This section assesses the potential landscape and visual effects resulting from proposed changes to the baseline environment without implementation of the proposed progressive restoration measures. For the purposes of this assessment the baseline is understood to be the existing landscape and visual conditions of the Study Area as they stand at the time of writing. However, it must be acknowledged that the continued operation of AAL under the various extant permissions will result in a further increase in volume of the BRDA and area of the borrow pit to the extents described in Section 9.5.1.

Landscape and Visual Effects of the Proposed Development are described below including during Construction and Operational Phases and with reference to the Accurate Visual Representations (AVRs) included in the booklet of Accurate Visual Representations submitted as part of the application.

### 9.5.1 Do-Nothing Scenario

In the event that the Proposed Development does not proceed, the operational stages of the extant permissions pertaining to the development of the BRDA will continue to operate as permitted. The existing BRDA will continue to increase in height up to their permitted development height. The permitted Borrow Pit will be implemented, and rock extracted to facilitate the ongoing operation of the BRDA. Progressive restoration will be implemented on the side slopes after which the dome and final restoration landscaping will be completed. This will result in effects on the landscape character and visual amenity of the receiving environment, some of which will be negative.

### 9.5.2 Landscape Effects

#### 9.5.2.1 Construction Phase Effects

The Construction Phase will have relatively minor landscape effects, given that the raising of the BDRA will occur during and as a continuation of the current Operational Phase. Aspects which pertain to the Construction Phase include:

- *general site works, including continued operation of the BRDA including adaptation of site access roads, site lighting and bauxite residue deposition pipework.*
- *enabling works for borrow pit extension to the east including removal of dense scrub woodland to the west of the main entrance road. This includes removal of an area of naturally regenerated bushes, young trees, undergrowth; and,*
- *continued stockpiling of topsoil and subsoil which will continue to be utilised for progressive restoration of the side slopes on the existing BRDA and for the longer-term restoration of the overall BRDA facility.*

##### 9.5.2.1.1 Effect on Landscape Fabric

The sensitivity of the receiving landscape fabric of the site is **low** given the presence the existing BRDA, former borrow pit, associated features and ongoing operational activity. A few elements of landscape value exist in the area allocated for borrow pit expansion, namely an area of scrubland and nature trail. The magnitude of change during the Construction Phase will be l**ocally medium** for the area of scrub woodland, but **low** for the site overall. The effect on overall landscape fabric of the site during the Construction Phase will be **not significant, negative, and temporary**, but **locally moderate, negative and temporary** for the area of scrubland.

#### 9.5.2.1.2 Effect on Landscape Context

The construction impacts will be limited to the site and will be minimal relative to the existing BRDA and other ongoing activities. There will be no perceivable effect on the overall landscape character of the surrounding landscape, the magnitude of change will be **negligible**, and the effect will be **imperceptible, neutral, temporary**.

### 9.5.2.2 Operational Phase Effects

The landscape baseline includes the existing BRDA, former borrow pit, stockpiling area and other associated features, as well as the adjacent AAL facility with its numerous prominent buildings and structures, and other industrial development within the local area of the Shannon Estuary.

The existing BRDA is set in low lying relatively open landscape, where the overall AAL facility dominates the view. There will be a small increase in the overall footprint of the development with the extension of the borrow pit to the east, however, any landscape features in this area will be lost during the Construction Phase. The Proposed Development will involve increasing the height and capacity of the exiting BRDA in a manner that adds six additional 2.0m high stages over the permitted ten 2.0m high stages. Construction will be similar to the existing BRDA such that the first additional stage will be smaller in area than, and set entirely within the footprint of, the uppermost permitted Stage 10, and each subsequent stage will have a correspondingly smaller footprint.

The increase in height will make the BRDA more prominent in the landscape in comparison with the baseline condition. However, the nature of the mound geometry results in a smaller surface area of bauxite residue being exposed with the filling of each consecutive stage, and therefore, over time the most conspicuous characteristic of the operation (the red-brown colour of the residue) is reduced. The primary effects of the Operational Phase will result from the increase in duration of the phase, in that the proposals will comprise a continuation of the operation of the BRDA into the long-term. The Proposed Development will not have a significant impact on landscape character.

#### 9.5.2.2.1 Effect on Landscape Fabric

Following the construction works and removal of vegetation from the borrow pit area, the site fabric will have no remaining appreciable landscape features of value. The sensitivity of the receiving landscape fabric of the site would be **negligible**. The main impacts on the fabric of the site will result from the upwards extension of the BRDA, excavation of the borrow pit area and dynamic movement and storage of excavated rock within the Site, and these activities are already established on the site. There would be some alteration to elements and features of the landscape over a large geographical area, namely the topography of the borrow pit and BRDA areas, but changes of this nature are established characteristics of the heavily modified and dynamic landscape of the site. The magnitude of change during the Operational Phase will be **medium**. The effect on landscape fabric of the site during the Operational Phase will be **not significant, negative, long-term**.

#### 9.5.2.2.2 Effect on Landscape Context

Changes to the landscape context would result from an awareness or perception of the changes to the fabric of the site by inhabitants, users or visitors to the surrounding landscape. This can result from a number of sensory factors, but in the case of the Proposed Development, these are mostly limited to visual cues, and to a lesser degree noise, combined with a knowledge or understanding of the current and historic character of the Site. Therefore, the effects on the landscape context are closely linked to the intervisibility of the proposals with the various landscape / seascape character areas and other landscape receptors. Visual effects are assessed separately in Section 1.5.3, but these two assessments are interlinked.

In-theory, the proposals would be increasingly prominent in the Landscape Context as the Operational Phase progresses, due to the progressively increasing height of the BRDA. However, conversely the visibility of the most visual prominent aspect of the BRDA, the red-brown residue, decreases as the BRDA progresses and the top surface reduces in area and is increasingly screened by the side slopes. Therefore, the effects on the landscape context are expected to be relatively constant across the Operational Phase, notwithstanding local variations such topography and vegetation screening which can result in varying effects on local landscape character.

The proposals will result in the continued operation of the BRDA through the short-term and into the long-term. The increase in the duration of the operation of the BRDA will result in an impact on the landscape character of the surroundings.

#### 9.5.2.2.3 Effect on Landscape Context – Limerick Landscape Character Areas

<u>Shannon Estuary ICMZ</u>

The landscape character of the area surrounding the site is defined in the Limerick CDP; the site is entirely within the Shannon Estuary ICMZ landscape character area. The sensitivity of this area to change is not defined within the Limerick CDP and this must instead be determined by professional judgement. Due to the presence of substantial detracting features such as Foynes Port, AAL Production Plant, and other industrial development within the area, the sensitivity to further industrial development is determined to be **low / medium**. The proposals will represent a continuation of an existing industrial use on an established site within a landscape of other prominent industrial uses, but they will extend the lifespan of the BRDA and associated operations. The proposals would be large in scale and prominent, and although the raised topography of the BRDA would not be an uncharacteristic element in the landscape, the presence of six additional stages of the BRDA without mitigation measures would be uncharacteristic. The magnitude of change for the Shannon Estuary ICMZ as such would be **medium / high**. The effect would be **moderate, negative, long-term**.

The effects on other surrounding landscape character areas in County Limerick are limited by the distance of the proposals from these areas. The site is located 4.4km from Western Uplands LCA and 5.8km from Agricultural Lowlands LCA, the two closest landscape character areas within County Limerick.

<u>The Western Uplands LCA</u>

The Western Uplands LCA has upland areas which provide views over the Shannon Estuary ICMZ. The Barnagh Hill area is designated as a scenic route, the effect on this is described separately in Section 0. The sensitivity of this character area to change is not defined within the Limerick CDP and this must instead be determined by professional judgement. Due to the rural nature, lack of major development and the presence of views from upland areas towards the Shannon ICMZ, the sensitivity is determined to be **medium / high**. The proposals would be visible from limited elevated locations within the character area, but views are generally well screened by landform and the presence of forestry. Where visible the proposals would be seen at a substantial distance and in the context of other existing industrial development along the Shannon Estuary and would represent a continuation of an existing industrial land use. There would be no change to the existing character of the views and the proposals would conform to the established industrial characteristic of the landscape context and would not affect any of the characteristics of this area as described in the Limerick CDP. The magnitude of change would be **negligible**. The effect would be **imperceptible, neutral, long-term**.

The Agricultural Lowlands LCA

The Agricultural Lowlands LCA has a flat low-lying character with some locally prominent hills and ridges. The well-enclosed nature of the pastoral landscape with frequent well-treed hedgerows results in little intervisibility with the Shannon Estuary ICMZ and the proposals would not be visible from within this LCA. The proposals would not affect any of the characteristics of this area as described in the Limerick CDP. Due to the rural nature and limited major development the sensitivity is determined to be **medium**. The proposals would not affect any of the characteristics of this area as described in the Limerick CDP. The magnitude of change would be **negligible**. The effect would be **imperceptible, neutral, long-term**.

#### 9.5.2.2.4 Draft Limerick Development Plan

The Proposed Development supports the draft policies and objectives of the Plan:

- *The effects on draft Landscape Character Areas are as discussed above in Section 9.5.2.2.3.*
- *The mitigation measure described in Section 0 proposed the planting of substantial quantities of native trees and hedgerows in line with draft Objective EHO10 – Trees and Hedgerows.*
- *The provision of an interconnected network of habitat types including new hedgerow field boundaries supports draft Objective EH O12 – Blue Green Infrastructure.*
- *The proposals have very limited provision of lighting which is not expected to have an adverse impact, in line with draft Objective EH O23 - Light Pollution*
- *The impacts on draft conservation areas are as laid out in Section 9.5.3.8.1.*

#### 9.5.2.2.5 Effect on Landscape Context – Clare Landscape Character Types

The LCTs identified within the Landscape Character Assessment are broad high-level assessments. Although estuary-side developments are noted as a Force for Change no indication of sensitivity of these LCTs is stated. As predominantly rural areas including some development and intervisibility to development along the Shannon Estuary, it is determined that the sensitivity would be **medium / high**. The proposals will be seen at distance and will not result in alteration to key elements features or characteristics of these landscape types, and where visible the proposals will be elements that are characteristic of the existing industrialised context. The magnitude of change would be **negligible**. The effect would be **imperceptible, neutral, long-term**.

#### 9.5.2.2.6 Effect on Landscape Context – Clare Landscape Character Areas

The landscape character areas identified within the Landscape Character Assessment of County Clare (LCACC) which have potential to experience indirect effects resulting from the proposals are LCA 18 - Shannon Estuary Farmlands (3.8km) and LCA 14 – Fergus Estuary (4.6km). These are situated along the southern edge of the county, overlooking the Shannon Estuary. Views over to the southern shore of the Shannon Estuary and the existing AAL plant and BRDA are experienced from a limited number of locations within these areas, as are views of other existing industrial development at Foynes and elsewhere. The presence of these views informs the character of these areas; open views over the estuary are noted as a key characteristic of both areas in the LCACC. Although no sensitivity is described the condition of both these areas is described in the Plan as 'variable' with localised areas that are more remote or intact. In regard to this, it is determined that the sensitivity would be **medium / high**. The proposals will be seen at distance and will not result in alteration to key elements features or characteristics of the landscape, and where visible the proposals will be elements that are characteristic of the context. Such development results in no perceivable change to the landscape character of either area. The magnitude of change would be **negligible**. The effect would be **imperceptible, neutral, long-term**.

No perceivable effects are expected on other LCACC landscape character areas in County Clare due to distance or physical separation by the landscape character areas stated above.

#### 9.5.2.2.7 Effect on Landscape Context – Clare Living Landscapes

The nearest Living Landscape Type to the Proposed Development is the Shannon Estuary Working Landscape located between Moneypoint and Ballynacragga Point excluding Clonderlaw Bay. The objectives set out in the Plan for this landscape type are focused on development within these areas, however, the proposal is located at distance from the area.

Heritage Landscape 3 covers several non-contiguous areas along the northern shore of the Shannon Estuary. The nearest parts extend around the Fergus Estuary between Kildysart and Shannon Airport and around Clonderlaw Bay east of Killimer. Again, the objectives set out in the plan are focused on guiding development within the area, although the plan states Heritage Landscapes are 'envisioned as the most valued parts of the County', which implies a **high** sensitivity to development.

As with the landscape character areas described above, the proposals will not result in alteration to key elements, features or characteristics of the Living Landscapes, and where visible the proposals will be seen at distance as elements that are characteristic of the context. Such development results in no perceivable change to the landscape character of either area. The magnitude of change would be **negligible**. The effect would be **not-significant, neutral, long-term**.

#### 9.5.2.2.8 Effect on Landscape Context - Seascape Character Areas

The objectives set out in the Plan for seascape character areas (SCA) relate to development within the area. The nearest areas identified in the Plan to the proposal are SCA 11 - River Shannon - that runs between the shoreline and the Clare County boundary, and SCA 12 – Fergus Estuary which is contained within the Fergus Estuary up to its junction with the SCA 11. No sensitivity is defined within the Plan for these areas but given the proximity and existing views to the existing industrial developments along the Shannon Estuary, the sensitivity is determined to be **low**.

There will be some intervisibility between these areas and the proposals which will be relatively prominent in locations closest to the development. From these locations (towards the Clare boundary in the centre of the estuary) the proposals would be large in scale and prominent, and although the raised topography of the BRDA would not be a uncharacteristic element in the landscape, the presence of 5 new stages of the BRDA without mitigation measures would be uncharacteristic. Nevertheless, the proposals would be seen in the context of other existing industrial development including the more prominent adjacent AAL plant. Views from the Fergus Estuary are more screened by the presence of the islands within the area.

The magnitude of change for the SCA 11 and SCA 12 would be **low** but locally **medium / high** in areas closest to the development. The effect would be **slight, negative, long-term**.

#### 9.5.2.3 Completed Phase Effects

At the end of the Operational Phase activity at the BRDA, borrow pit and stockpiling areas would cease. Mitigation measures concerning the treatment of these areas at the end of the Operational Phase are discussed in Section 0, and post-mitigation predicted effects are described in Section 9.9.

Without implementation of the progressive restoration proposals, , vegetation of the side slopes and domed top would probably commence through natural establishment from a seed bank brought in by wind or other means. Without amendment of the bauxite residue or topsoiling of the rock side slopes, the vegetation establishment is likely to be much reduced in comparison with the progressive restoration proposals. The significance of effects on landscape receptors during the Completed Phase would be the same as those experienced in the Operational Phase listed above. There would be a very gradual transition to a **neutral** effect for landscape receptors which would experience a negative effect during the Operational Phase. This would happen at a much slower rate than intended under the mitigation proposals **Positive** effects may be felt in the long-term but, without topsoiling and substrate amelioration, it is not certain that vegetation could establish to an adequate level to achieve a naturalistic appearance for the BRDA.

### 9.5.3 Visual Effects

The primary visual effects result largely from two factors: firstly, the increase of the vertical height of the BRDA and the visible extent of the side slopes; and secondly, the characteristic red-brown colour of the bauxite residue material which contrasts with the predominantly green landscape setting.

From nearby low-lying viewpoints the key visual effect would generally occur due to the vertical nature of the BRDA or stockpiles and visibility of the terraced side-slopes and less from visibility of top surface of residue material. The alternating bands of rock to the side slopes, particularly where this is freshly placed, is likely to be the most visually prominent feature. This effect becomes more accentuated as the operation of the BRDA continues and the height increases, due to the greater visibility of the side slopes and reduced visibility of the residue on the upper surface. For nearby areas to the southeast the rock stockpiling area will also create a prominent visual disturbance, with a variable impact over time due to stock levels.

From elevated or distant viewpoints, the primary visual effect occurs from the residue itself, which typically represents the most visually prominent aspect of the BRDA due to its characteristic colour. Due to the sloping profile of the BRDA geometry the visible surface area of residue decreases with each increase in height, and the visual effect would be reduced over the lifespan of the Operational Phase. However, this reduction in visual effect of the residue is counterbalanced to an extent by the raising of the overall height and an increased vertical extent of visible side-slopes.

Overall, where views are experienced, the proposals will not represent uncharacteristic new aspects as the proposals will be seen largely within the extents of the existing BRDA and in the context of adjacent industrial development. The proposed construction and Operational Phases will take place within the context of the existing operational BRDA facility with its various on-going activities. However, the proposals will extend the duration of the operation and the visual effect. This section assesses the effects without mitigation measures in place, and as such, the impact from unvegetated side slopes of the BRDA. Comprehensive landscape and visual mitigation is proposed to alleviate these effects, and the predicted effects with mitigation are described in Section 9.9.

#### 9.5.3.1 Construction Phase Effects

The construction impacts will be limited to the site and will be minimal relative to the existing BRDA and other ongoing activities. Potential construction effects are most likely to arise from the clearance of the scrubland area for establishment of the borrow pit, but this is well screened by surrounding scrub in the vicinity and by trees and landform in the wider area. There will be no perceivable effect on visual receptors of the surrounding landscape. The magnitude of change for all visual receptors will be **negligible**, and the effect will be **imperceptible, neutral, temporary**.

#### 9.5.3.2 Operational Phase Effects

##### 9.5.3.2.1 Residential Receptors

Residential receptors have been categorised into localised groups of receptors which experience similar effects. These are shown on Figure 9.3 and discussed below. While the Accurate Visual Representations (AVRs) submitted with the application are taken from publicly accessible locations, there is a strong correlation between AVR viewpoint locations and residential receptor groups such that the AVRs are also representative of the views from the locality of residential receptors.

**R1 – Foynes**

This is composed of receptors at a variety of residential properties within Foynes centre and outskirts, and including properties on the elevated land at Marine Cove and in the townland of Leahys to the west.

Sensitivity
Receptors would be people at home and sensitivity is **high**.

Magnitude
Views from properties are generally focused onto adjacent streets or roads. The proposals are well screened by adjacent built form or intervening landform or vegetation. Where views of the proposals are experienced, these are likely to be minimal and partially screened / filtered by tree canopies in nearby woodland or hedgerows or seen in the context of the extensive industrial development of Foynes Port and other built form of the settlement. There would be no overall change in the character or visual amenity of views from this group. The magnitude of change would be **negligible**.

Effect
The effect in the Operational Phase would be **not-significant, neutral, long-term**.

**R2 – Ballynacragga**

This is composed of receptors at a series of isolated properties in the townland of Ballynacragga, south-west of Foynes. The properties are situated on elevated land overlooking the low-lying areas to the east

Sensitivity
Receptors would be people at home and sensitivity is **high**.

Magnitude
Curtilages to properties often contain screening elements in the form of outbuildings, or boundary trees and hedges. Views are likely to be experienced between or over adjacent screening features, particularly from upper floors where they are present. The proposals would be experienced as a continuation of the existing BRDA and stockpiling operation and would often be seen in the context of the extensive industrial development of Foynes Port, AAL and built form in Foynes. There would be no substantial change in the character of the views but where the proposals are seen there would be an extension of the duration of adverse effects on visual amenity currently experienced due to the existing operation. The magnitude of change would be **medium**.

Effect
The effect in the Operational Phase would be **moderate, negative, long-term**.

**R3 – South Foynes and Croaghane**

This is composed of receptors at a range of properties on the southern edge of Foynes along the sections of the N69, the R521, the L6114 and along unnamed roads through to Croaghane. Properties are generally detached single-storey dwellings either individually located or in small groups close to the road.

Sensitivity
Receptors would be people at home and sensitivity is **high**.

Magnitude
The properties are located on sloping topography which slopes gradually up from the low-lying area around the N69 to the eastern side of Knockpatrick Hill. The easterly aspect allows some views towards the proposal site, however, for the lower-lying properties the landform around Ardaneer would provide substantial screening. The properties are within a pastoral landscape of small fields with well-treed margins and the curtilages of the houses are largely contained by thick hedgerows and boundary tree planting. Where open views out are available these are restricted by landform around or are from gable end frontages with insignificant windows. The proposals would likely be only visible glimpsed through screening vegetation, mainly hidden behind screening landform or seen at oblique angles to the main focus of views. There would be no substantial change in the character of the views but where the proposals are seen there would be an extension of the duration of adverse effects on visual amenity currently experienced due to the existing operation. The magnitude of change would be **low**.

Effect
The effect in the Operational Phase would be **slight, negative, long-term**.

**R4 – Small group, along N69 south-east of Foynes at Sroolane North**

This is composed of receptors at a group of three properties on the northern side of the N69, southeast of Foynes.

Sensitivity
Receptors would be people at home and sensitivity is **high**.

Magnitude
These properties have views out to the north towards the proposal site. The two western properties have some screening in the form of trees within their curtilage, whereas the eastern property has no substantial screening. Trees along intervening hedgerows provide a degree of screening but the existing BRDA can been seen. The proposals would increase the prominence of the BRDA and this would likely extend above the level of tree screening. There would be a moderate change in the character of the views and there would be an extension of the duration of adverse effects on visual amenity currently experienced due to the existing operation. The magnitude of change would be **medium** for the two western properties and **high** for the eastern property.

Effect
The effect in the Operational Phase would be **moderate, negative, long -term** for the two western properties and **significant, negative, long-term** for the eastern property.

**R5 – Small group, Sroolane North / Churchfield**

This is composed of receptors at a group of two single-storey properties on the boundary of Sroolane North / Churchfield.

Sensitivity
Receptors would be people at home and sensitivity is **high**.

Magnitude
These properties have minimal windows facing towards the proposal site or have good levels of screening from trees and vegetation in their curtilages and nearby area. The existing BRDA may be partially visible. The proposed changes may be glimpsed through or around tree screening and from minor windows but there will be no impact on key views from the properties. There would be no substantial change in the character of the views but there would be an extension of the duration of any adverse effects on visual amenity currently experienced due to the existing operation. The magnitude of change would be **medium**.

Effect
The effect in the Operational Phase would be **moderate, negative, long-term**.

**R6 – Single property, Churchfield**

This is composed of receptors at a single two-storey property within Churchfield townland.

Sensitivity
Receptors would be people at home and sensitivity is **high**.

Magnitude
This property has open views out to the south over farmland and the Robertstown River. Views to the north towards the BRDA are screened by trees on the curtilage boundaries. There may be some glimpsed views of the proposals particularly at the later stages of operation and during the winter months when trees are not in leaf, but these would be oblique from the

direction of views from the northern elevation. There would be no change in the character of the views. The magnitude of change would be **low**.

Effect
The effect in the Operational Phase would be **slight, negative, long-term**.

**R7 – Small group, west Robertstown**

This is composed of receptors at a group of five properties along a local road in Robertstown townland.

Sensitivity
Receptors would be people at home and sensitivity is **high**.

Magnitude
These properties are of relatively recent construction and are designed with their principal views towards the adjacent road to the west, or out to the N69 to the south. Windows facing towards the BRDA are minimal. Views of the proposals may be experienced from minor elevations, but these would be partially screened by either adjacent buildings are intervening trees within their curtilages, or most notably mature specimens along the local road to the north. The magnitude of change would be **low**.

Effect
The effect in the Operational Phase would be **slight, negative, long-term**.

**R8 – Small group, north Robertstown**

This is composed of receptors at a small group of properties in Robertstown townland adjacent to mudflats surrounding a tributary of the Robertstown River.

Sensitivity
Receptors would be people at home and sensitivity is **high**.

Magnitude
The properties have open views out across the undeveloped landscape of mudflats and saltmarshes towards Aughinish Island. The existing BRDA is visually prominent in the views primarily due to the red-brown colour of the bauxite residue. Other developments, such as Foynes Port, are well screened by intervening tree canopies in field boundaries in the surrounding landscape and are not easily discerned in the views. The presence of overhead lines can be seen at distance across the views. The overall character of the views are rural / estuarine with some clear industrial disturbance.

The proposals would form a noticeable increase in the vertical extent and the visual prominence of the BRDA in the views. Due to the low-lying nature of the properties, the side slopes of the BRDA would become the most visually intrusive element in contrast to the flat saltmarsh landscape. Over time the red colour of the bauxite residue would become less visually obvious as the angle of view to the top surface increases. The proposals would lead to a perceptible change in the character of the views as the industrial character of the BRDA becomes more dominant over the landscape. There would be an increase of the duration of adverse effects on visual amenity from the proposed extension of the BRDA Operational Phase. The magnitude of change would be **high**.

Effect
The effect in the Operational Phase would be **significant, negative, long-term**.

**R9 – Robertstown, Oorla and Rincullia**

This is composed of receptors at properties along the boundary of Robertstown townland, where it meets Oorla and Rincullia townlands, along or adjacent to the L6069 road.

Sensitivity
Receptors would be people at home and sensitivity is **high**.

Magnitude
These properties are partially screened by built form or vegetation within their curtilages or undulations in landform and trees within the local area. Trees are present along the edges of the L6069 and within clumps and hedgerows in Oorla townland that provide the most significant screening elements. This screening is intermittent and due to the relative proximity of the proposal site views of the proposals are likely to be seen in between and over screening particularly in the later stages of the Operational Phase. Generally, where the proposals would be seen the existing BRDA is likely to be currently visible, and the proposals would be experienced as a continuation of that. There would be a minor but notable change in the character of views from the increased visibility of the BRDA and the would be an increase of the duration of adverse effects on visual amenity from the proposed extension of the BRDA Operational Phase. The magnitude of change would be **medium**.

Effect
The effect in the Operational Phase would be **moderate, negative, long-term**.

**R10 – Individual Property, Rincullia**

This is composed of receptors at an individual property in Rincullia townland, south of the N69.

Sensitivity
Receptors would be people at home and sensitivity is **high**.

Magnitude
This property has substantial tree screening around its curtilage, and additional screening is provided by a block of woodland north of the N69. The proposals may be partially seen through the tree canopies particularly in the winter months. There would be no substantial change in the character of the views or effect on visual amenity. The magnitude of change would be **low**.

Effect
The effect in construction and Operational Phases would be **slight, negative, long-term**.

**R11 – Sroolane**

Single property within open fields in between the N69 and the R521 to the south of Foynes.

Sensitivity
Receptors would be people at home and sensitivity is **high**.

Magnitude
The property is in a slightly elevated position and has open views out into adjacent fields, however primary elevations are to the east and west facing away from the site. There may be some views out to the proposals from minor side elevations, but these would be partially

screened by intervening hedgerow trees to the north. Where seen the proposals would form a continuation of the existing BRDA, albeit with larger extents which would be more visible above screening tree canopies. There may be a minor change in the character of the views and there would be an extension of the duration of adverse effects on visual amenity currently experienced due to the existing operation. The magnitude of change would be **medium**.

Effect
The effect in the Operational Phase would be **moderate, negative, long-term**.

### R12 – Shanagolden

This is composed of receptors at properties in and around Shanagolden and including Knockpatrick.

Sensitivity
Receptors would be people at home and sensitivity is **high**.

Magnitude
The proposals would be completely screened by landform in most cases with the exception of a limited number of properties on the northern edge of the group but in these cases intervening tree canopies within in curtilage or to field boundaries would provide the necessary additional screening to substantially restrict views. There would be no perceivable change in the character or visual amenity of views from this group. The magnitude of change would be **negligible**.

Effect
The effect in the Operational Phase would be **not-significant, negative, long-term**.

### R13 – North-east of Shanagolden

This is composed of receptors at properties on north-east side of Shanagolden along unnamed road to Oldabbey townland, as scattered individual properties or small groups of detached properties close to the road.

Sensitivity
Receptors would be people at home and sensitivity is **high**.

Magnitude
The properties are mainly located in a relatively low-lying area with a gently sloping northerly aspect with minor undulations. The properties are generally well screened by trees and hedges within their curtilages. Where open views are present from the properties into adjacent fields, they are broken by frequent intervening trees along well-treed field boundaries. Minor views of the proposals are likely to be experienced from these properties, but these would be heavily screened or filtered by tree canopies or screened by undulations in the landform. There would be no substantial change in the character of the views but where the proposals are visible there would be an extension of the duration of adverse effects on visual amenity currently experienced due to the existing operation. The magnitude of change would be **low**.

Effect
The effect in the Operational Phase would be **slight, negative, long-term**.

### R14 – L1222 south of N69

This is composed of receptors at a small group of properties along the L1222 south of the N69, in Robertstown townland.

Sensitivity
Receptors would be people at home and sensitivity is **high**.

Magnitude
Although located relatively close to the proposal site, most of these properties are positioned with their main elevations facing away from the proposal site. One of the properties does have a longer elevation facing northwards towards the proposal site, however, it likely to be well screened by the mature trees and outbuildings within its curtilage. A low rise in topography and several tall hedgerows with hedgerow trees are present within the intervening landscape which would provide good levels of screening, albeit reduced in winter. Partially screened or filtered views are likely to be experienced obliquely from the main elevations of the properties, or more directly from gable side elevations. There would be no substantial change in the character of the views but there would be an extension of the duration of adverse effects on visual amenity currently experienced due to the existing operation. The magnitude of change would be **low**.

Effect
The effect in the Operational Phase would be **slight, negative, long-term**.

### R15 – Robertstown/Stokesfield/Oldabbey

This is composed of receptors at various isolated properties located within Robertstown, Stokesfield and Oldabbey townlands, north-east of Shanagolden.

Sensitivity
Receptors would be people at home and sensitivity is **high**.

Magnitude
Properties are generally well screened or positioned with primary elevations facing away from the proposal site. The proposals may be visible from minor side elevations and/or from main elevations filtered by tree canopies in curtilage or intervening filed boundaries. Where visible the proposals will be seen as a continuation of the existing BRDA operation. There would be no substantial change in the character of the views but there would be an extension of the duration of adverse effects on visual amenity currently experienced due to the existing operation. The magnitude of change would be **low**.

Effect
The effect in the Operational Phase would be **slight, negative, long-term**.

### R16 – Group in Oldabbey

This is composed of receptors at isolated properties in low lying area to the east of Shanagolden in Oldabbey townland.

Sensitivity
Receptors would be people at home and sensitivity is **high**.

Magnitude
These properties have moderately open views onto adjacent fields in the direction of the proposal site, although these are generally interrupted by screening trees in intervening field

boundaries. The proposals are likely to be visible glimpsed between tree canopies. Where visible the proposals would generally be seen as a continuation of the existing BRDA operation and in proximity to the existing AAL plant, however, in some locations the increase in height of the BRDA and stockpiling may introduce a new feature in the view where this activity is not currently visible. This would be to a minor extent within views due to the distance from the proposal site. There would be no substantial change in the character of the views but there would be an extension of the duration of adverse effects on visual amenity currently experienced due to the existing operation. The magnitude of change would be **low**.

Effect
The effect in the Operational Phase would be **slight, negative, long -term**.

**R17 – Group in Craggs / Mulderricksfield / Barrigone**

This is composed of receptors at a group of properties along a local road through Barrigone / Craggs / Mulderricksfield townland.

Sensitivity
Receptors would be people at home and sensitivity is **high**.

Magnitude
Views from these properties are generally limited by surrounding vegetation in the property curtilages and surrounding built form. A minority of the properties have more open views towards the proposal site, but primary elevations are largely facing towards the local road and view to the site would be oblique or from minor windows. Where visible the proposals would generally be seen as a continuation of the existing BRDA operation and in proximity to the existing AAL plant. In this case, there would be no substantial change in the character of the views but there would be an extension of the duration of adverse effects on visual amenity currently experienced due to the existing operation. The magnitude of change would be **low / medium**.

Effect
The effect in the Operational Phase would be **slight / moderate, negative, long-term**.

**R18 – Group in Glenbane East**

This is composed of receptors at a group of three single-storey properties in Glenbane East.

Sensitivity
Receptors would be people at home and sensitivity is **high.**

Magnitude
The properties have views out onto the adjacent local road (L1234) and partially screened views into the adjacent fields and beyond. Views of the existing BRDA are substantially screened by intervening trees to nearby field boundaries. There may be a minor intrusion of the proposed development as the height extends above tree screening, and in this case, the composition of the view would be affected but there would be no perceivable change the character of the views. The magnitude of change would be **low**.

Effect
The effect in the Operational Phase would be **slight, negative, long-term**.

### R19 – Two Properties in Dysert

This is composed of receptors at two two-storey properties in Craggs.

Sensitivity
Receptors would be people at home and sensitivity is **high**.

Magnitude
These properties are in close proximity to the existing BRDA and stockpiling areas. There are some elements of screening in the form of surrounding built form and trees in the curtilage. The proposals would increase the scale and duration of the industrial activity in the views, although these would not represent a new form of development in the views and character of the views would not be changed. The magnitude of change would be **medium**.

Effect
The effect in the Operational Phase would be **moderate, negative, long-term**.

### R20 – Group in Fawnamore / Morgans North / Morgans South

This is composed of receptors at a group of approximately fifty properties along the L1234 and L6064 in Fawnamore / Morgans North / Morgans South.

Sensitivity
Receptors would be people at home and sensitivity is **high**.

Magnitude
These properties are generally positioned with primary elevations facing away onto the adjacent road or into open fields and away from the proposal site. In cases where there are primary elevations facing towards the site these are well screened by vegetation within curtilages or nearby built form. The existing BRDA is also screened by bands of woodland planting in the intervening area. The proposals may be glimpsed through or above this screening particularly in the later stages of the development when the BRDA reaches its maximum height. There would be no substantial change in the character of the views but there may be a minor introduction of a new feature in the form of the glimpsed views of the proposed BRDA. The magnitude of change would be **low**.

Effect
The effect in the Operational Phase would be **slight, negative, long-term**.

### Group R21 – Two properties, Morgans

This is composed of receptors at a group of two properties on the L6064 in Morgans South townland.

Sensitivity
Receptors would be people at home and sensitivity is **high**.

Magnitude
The properties have open rural views from their frontages across fields to the west towards the site. Development is not very evident in the view and overhead lines form the main visual detractor. The hills west of Foynes form the backdrop to the views. There is substantial tree screening in the intervening area, mainly to field boundaries in the middle distance, however part of the taller northern section (Phase 1) of the existing BRDA can be seen in the distance between tree canopies. The proposals would extend the height of the BRDA above the height of much of the tree screening, and the visible extents of the BRDA in the view would be

substantially increased and they would be clearly perceived in the views, albeit at a sufficient distance for the proposals not to be visually dominant within the views. The proposals will rise above the skyline and at the maximum height of the BRDA the hill at Ballynacragga to west of Foynes will be obscured by the proposals. There would be a perceivable change in the character of the views and there would be an extension of the duration of adverse effects on visual amenity. The magnitude of change would be **medium**.

Effect
The effect in the Operational Phase would be **moderate, negative, long-term**.

**R22 – Groups of properties along L1234**

This is composed of receptors at groups of properties along L1234, along boundary of Morgans North / Morgans South townlands.

Sensitivity
Receptors would be people at home and sensitivity is **high**.

Magnitude
Properties have primary elevations facing towards the road and views towards the proposal site are screened by adjacent buildings, vegetation in the curtilages and the field boundaries in the surrounding area, and the proposals would be entirely screened by these screening features. There would be no substantial change in the character of the views or adverse visual effects. The magnitude of change would be **negligible**.

Effect
The effect in the Operational Phase would be **not-significant, negative, long-term**.

### 9.5.3.3 Open Space Receptors

**Aughinish Nature Trails**

AAL has developed nature trails on the eastern side of the main access roadway to Aughinish and west of the Poulaweela Creek. These lead through areas which are currently a mixture of young woodland, meadow and areas of scrub.

Sensitivity
This is an area of local recreational value and receptors would be users of the trails with an appreciation of the views out onto the Poulaweala Creek, the Shannon Estuary and surrounding countryside. Views would be experienced within the context of the nearby AAL plant and BRDA. The sensitivity would be **medium / high**.

Magnitude
The proposals would be partially screened by avenue tree planting along the Aughinish access road and other tree planting within adjacent AAL areas and also by virtue of much of the nature trail being located along the creek side of the terrain between the creek and the access road. The raised BRDA would be partially visible as a distinct landscape element from some sections of the nature trails. However, where the proposals would be seen this would be in the context of the existing industrial operations at AAL and there would be no change to the character of the views. The attention of users is also likely to be directed out over Poulaweala Creek, the Shannon Estuary and adjoining countryside. The magnitude of change would be **low / medium**.

Effect
The effect in the Operational Phase would be **slight / moderate, negative, long-term**.

**Horgan Park / Shannonside FC**

Horgan Park playing pitch is located along the eastern side of the L1234 north of the limerick to Foynes railway line and c. 500m southeast of the existing BRDA. The L1234 is tree lined on both sides and the playing pitch set at a low elevation relative to the road. Immediately west of the pitch, the terrain rises sharply and is covered in mixed ground cover and scrub that provides a strong sense of visual enclosure to the pitch.

Sensitivity
The playing field provides amenity value to both local and visiting teams. Receptors would include local and visiting team members as well as supporters. The sensitivity would be **medium / high**.

Magnitude
The proposals would be substantially screened by virtue of the low-lying nature of the facility and the visual enclosure afforded by the landscaped terrain along the western side of the pitch as well as the mature trees along both sides of the nearby L1234. There may be glimpse views of the raised BRDA beyond the landscape screening from the eastern edge of the playing field however the enclosed nature of the facility is such that the magnitude of change would be **low**.

Effect
The effect in the Operational Phase would be **slight, neutral, long-term**.

#### 9.5.3.4 Scenic Routes

#### 9.5.3.5 Limerick CDP – N69

This route follows the N69 from Foynes town centre to the boundary of County Limerick with County Kerry east of Tarbert.

Sensitivity
Receptors would be mainly people in vehicles with some recreational users with an appreciation of the scenic views and sensitivity is **high**.

Magnitude
The section of the route west of Foynes is screened by landform and views of the proposals would be limited to the area around Foynes Harbour. The proposed increase in height of the BRDA will be noticeable in the middle distance but would be partially screened and in the context of the large scale infrastructural / industrial development at Foynes Harbour and the existing AAL plant. There would be no perceivable change top the character or visual amenity of the view. The magnitude of change would be **low**.

Effect
The effect in the Operational Phase would be **slight, neutral, long-term**.

#### 9.5.3.6 Limerick CDP – Bernagh Hill

This route crosses elevated land between Carrigkerry and Ballymurragh East. The exact alignment of the route is not evident from the mapping in the Limerick CDP, however it assumed to follow a series of local roads through the forested and undulating upland landscape. Sensitivity is **high**.

Magnitude
The route largely follows the eastern edge of the upland area and views are therefore most extensive towards the low-lying areas to the east. Views of the Site are not expected to be experienced due to screening from landform and forestry. The magnitude of change would be **negligible**.

Effect
The effect in the Operational Phase would be **not-significant, neutral, long-term**.

### 9.5.3.7 Clare CDP – R473

This route follows the R473 from Kildysart to Ballygeery East.

Sensitivity
Receptors would be mainly people in vehicles with some recreational users with an appreciation of the scenic views and sensitivity is **high**.

Magnitude
Much of the route is screened by the landform, neighbouring hedgerows or areas of woodland and views out from the route are generally limited and focused by these screening elements. The existing BRDA and AAL plant are visible on the far side of the Shannon Estuary from a small number of locations along the eastern half of the route, but visibility decreases towards the west due in part to screening by topography at elevated areas at Foynes and on Foynes Island. Where visible, the proposals would be seen in the context of the visually prominent existing AAL plant and as a continuation of the existing BRDA. The proposals would be infrequently glimpsed through or between screening elements and would be generally seen whilst travelling at a moderate speed. There would be no perceivable change in the character of the views but there may be minor adverse visual effects. The magnitude of change would be **low**.

Effect
The effect in the Operational Phase would be **slight, neutral, long-term**.

### 9.5.3.8 Other Receptors

**Knockpatrick Graveyard**

An historic graveyard containing a ruined church, to the top of Knockpatrick Hill.

Sensitivity
Receptors would be visitors to the graveyard and recreational users whose experience is informed by the wide expansive views which in some directions are very scenic. The AAL plant, BRDA and Foynes Port are dominant features in views to the east and these detract from the views and reduce sensitivity. Sensitivity is **medium / high**.

Magnitude
The views from this location are very expansive covering a large area of the Shannon Estuary and beyond to the hills of County Clare. Foynes Port and the AAL plant are clearly visible, as is the BRDA which is very prominent due to the angle of view which reveals the top surface of the red coloured bauxite residue. The view is wide-ranging and predominantly rural in character with a strong influence from industrial and infrastructural development to the east. The proposals would be clearly distinguishable; however, they will be experienced as a continuation of the existing BRDA and will not form an uncharacteristic new element in the views. As the stages progress the visibility of bauxite residue would decrease due to the

reduced surface area, and in turn, the visual prominence decreases to an extent. This is partially counteracted by the growth of the side slopes and associated rock terracing and drainage channels which also draw the eye. Upon completion the BRDA will continue to be clearly distinguishable present in an otherwise low-lying and flat landscape and notable for its regular geometry which contrasts with the natural and irregular form of the elevated land in the foreground and the hills of County Clare in the distance. However, as a proportion of the expansive views available from this location, the proposals would only form a relatively small extent of the overall view. Nevertheless, a primary contributor to the effect is the extension of the operational lifespan of the BRDA beyond that currently permitted.

The magnitude of change will be **medium / high** and the effect will be **moderate / significant, negative, long-term**.

#### 9.5.3.8.1 Limerick CDP – ACAs

Architectural Conservation Areas are present in the centre of Foynes, Askeaton and at Ballysteen House. It should be noted that Ballysteen House is not listed as an ACA in the Draft Limerick Development Plan.

<u>Sensitivity</u>
Receptors would be mainly visitors and occupants of the designated area. The sensitivity is **high**.

<u>Magnitude</u>
The impact on Foynes and Askeaton ACAs is limited by the enclosed nature of the designations, which by their nature enclosed by built form within the settlement. Views from Ballysteen House are well screened with the exception of planned landscape vistas through the grounds and surrounding landscape out away from the direction of the Site. The magnitude of change for these ACAs would be **negligible.**

<u>Effect</u>
The effect in the Operational Phase would be **not-significant, neutral, long-term**.

## 9.6 Mitigation

The proposed BRDA raise is a continuation of the permitted and emerging BRDA development that will result in an additional six stage raises on top of the permitted ten stage raises. The overall development will be capped with a gently sloped dome at stage sixteen in the same manner and form as the permitted dome at stage ten.

The terraced and sloped appearance of the BRDA derives from the nature and process of bauxite residue disposal and is a function of geotechnical and hydrological requirements described in Chapter 2 of the EIAR and in the Engineering Design Report submitted with the application. The role of landscape mitigation is to consider and identify landscape solutions that can be applied progressively to the completed stages of the BRDA that will result in a more natural appearance of the BRDA that integrates with the landscape context.

### 9.6.1 Mitigation Principles

The principles adopted in developing landscape mitigation proposals include:

1 Breaking down the overall scale and geometric appearance of the BRDA terraces and slopes;
2 Adopting a progressive restoration approach so that revegetation and restoration is not dependant on completion of the BRDA and will be implemented as the BRDA evolves, including:
3 Short and medium term solutions to reduce the prominence of newly established rock stage lifts through preliminary revegetation using hydro seeding that has been successful on the existing BRDA in greening the rock slopes;
4 Medium and longer term landscape mitigation that will introduce additional landscape features on the overall side slopes that will disrupt the continuous geometric nature the side slopes;
5 Ensuring the optimum final land use provides a strong natural and biodiversity rich closure solution.

In addition, AAL has gained significant experience over the last twenty years in establishing different plant species on the terraces and slopes of the built stages of the BRDA informs the landscape mitigation proposals.

AAL have an ongoing working relationship with University of Limerick in researching, trialling, monitoring and evidence-based development of alternative revegetation strategies – see Section 8.2 of the accompanying Engineering Design Report. Trial areas of revegetation were planted in neutralised bauxite residue that had been weathered for three or four years and in which alternative amelioration composition were mixed to reduce the pH value of the bauxite residue and enhance its nutritional composition, including:

- *process sand and compost;*
- *process sand and gypsum; and*
- *process sand and compost.*

The outcome of collaboration with UL has identified a schedule of plant species that are known to establish successfully in the amended bauxite residue.

### 9.6.2 Objectives for Landscape Mitigation

1. The final restoration landscape masterplan should render a more natural and rural appearance than the expansive geometric terraced form that results from the bauxite residue disposal process and the necessary geotechnical and hydrological features.
2. Restoration should be progressive so that it is not dependent on completion of the BRDA and can mitigate stage raises as they are formed over the lifetime of the proposed development.
3. Integration with the permitted and emerging BRDA including application of the new proposed landscape mitigation to the side slopes of the unbuilt but permitted BRDA.
4. Optimise the natural and biodiversity characteristics of the final BRDA.

### 9.6.3 Mitigation Proposals

Landscape mitigation will be progressive and will include preliminary treatment of rock stage lifts as they are completed by hydro seeding the sloped surfaces. Hydro seeding has been used effectively on completed slopes of the existing BRDA and provides a greener and more neutral appearance to the rock slopes than the bright freshly formed limestone rock material.

**Preliminary**

Hydroseeding will typically take place once a rock stage has been filled with bauxite residue and the next rock stack wall has been formed. As such, there will typically be no more than one or two stages of rock stack walls presenting in bare rock. Additionally, the hydroseeded slopes below the upper rock slopes will appear progressively more mature as each subsequent stage downwards will have established for a longer period.

**Intermediate**

The BRDA, including the permitted and proposed, is subdivided into three groups of five or six stages. The lower two groups, Stages 1 to 5 and Stages 6 to 10, are the permitted BRDA. The upper group is the proposed extension and will comprise Stages 11 to 16 and the final dome.

As each group of stages is completed and operations move to the next group, final restoration proposals can be implemented on the completed group so that landscape mitigation is also progressive.

Works associated with final restoration will include both engineering and landscaping works:

- *Rock fill to a depth of 500mm will be applied over each of the terraces to establish a continuous permeable rock layer connecting the rock stage lifts. This provides a surface water drainage route from the side slopes to the existing perimeter interceptor channel.*
- *Spillways will be constructed at eight locations around the BRDA comprising either a 6.0m or 8.0m wide channel running perpendicular to the stage lifts and incorporating sloped side that tie in with adjoining stage lifts. Spillways will be lined with concrete canvas and will have rip-rap fill armouring to slow the flows of surface water to the perimeter interceptor channel at the base of the BRDA. The rip-rap finish will weather over time and become more integral with the overall BRDA however, they will subdivide and disrupt the continuous geometric appearance of the BRDA side slopes.*
- *Ameliorated soil will be applied to a minimum depth of 400mm over the terraces and feathering into the hydro seeded rock stage slopes.*

- *Provision of localised areas of landscape mounds on the completed terraces and slopes of the BRDA so as to disrupt the rhythmic and continuous appearance that is an inherent characteristic of the stage raises;*
- *Localised landscape mounds will be formed using ameliorated subsoil and topsoil. These will be organic forms of varying sizes and shapes spanning two or more stages. The landscape mounds will break up and disrupt the regularity of the terraces and provide adequate depth of soil for planting that will comprise grasses and low-level herbaceous vegetation around the edges of the mounds and leading to mixed ground cover and shrubs towards the centre of the mounds. Trees will also be planted within the central areas where the soil depth is greatest.*
- *Landscape mounds will be provided to the undeveloped stages of the permitted BRDA so as to integrate both developments.*
- *The interface between the side slopes and spillways will be treated using a similar approach to the landscape mounds incorporating grass and shrubs so as to provide effective integration of the spillways within the overall restored BRDA feature.*
- *A number of access tracks will be maintained for maintenance purposes but similarly integrated with the landscaping.*

### 9.6.4 Restoration

Operation will cease when the proposed Stage 16 and associated dome have been formed. At that point, landscape mitigation and spillways on Stages 1 to 10 inclusive will have been completed and established to different degrees.

Final restoration will include restoration of Stages 11 to 16 inclusive, and also seeding of the dome. Additionally, hedgerows will be planted across the dome to establish a field pattern that breaks down the overall scale of the dome and presents a field pattern that is more consistent with the surrounding landscape context.

The perimeter interceptor channel around the base of the BRDA will be lined with soil and revegetated to form a wetland that will collect surface water runoff from the spillways and lead to the storage pond and clarifier to the northeast of the BRDA and discharge to the River Shannon.

## 9.7 Predicted Effects

### 9.7.1 Predicted Landscape and Visual Effects

Predicted Landscape and Visual effects are the effects which are expected to occur following the application of mitigation measures. As described in Section 0, mitigation measures are proposed to be implemented to the side slopes progressively throughout the Operational Phase, and to the domed top at the end of the Operational Phase. This will comprise topsoiling, hydroseeding, and planting of shrubs trees and eventually hedgerows. They will progressively mature during the Operational and Completed Phases. It should be noted that the nature of the proposed development is dynamic, due to the progression of the BRDA stages, changing volumes of stockpiling and successive planting / seeding works resulting in varying impacts throughout the lifespan of the development. The intention of the mitigation proposals is to ensure that the extents of unmitigated rock side-slopes are kept to a minimum throughout the Operational Phase, as far as is operational feasible. This will aid in negating adverse effects on the landscape fabric, integrating the proposals into the landscape context and reducing visual effects.

A comparison of the pre-mitigation potential effects and the post-mitigation predicted effects in the Construction and Operational Phases are outlined in Table 9.6 and Table 9.7 respectively. Predicted effects for the Completed Phase are described in Section 9.9.1.1.

A review of Accurate Visual Representations is included in Section 9.9.2 in order to illustrate the changes resulting from the proposals throughout the lifespan of the project. These are shown with the mitigation measures implemented at various stages of maturation and provide an accurate indication of the predicted post-mitigation effects.

| CONSTRUCTION PHASE | | | |
|---|---|---|---|
| Landscape Receptors | | | |
| **Landscape Receptor** | **Sensitivity** | **Magnitude** | **Effect** |
| Landscape Fabric of the Site | Low | **Pre-Mitigation** | |
| | | Low (locally Moderate, scrub woodland) | Not significant, Negative, and Temporary (locally Moderate, Negative Temporary for scrubland) |
| | | **Post-Mitigation** | |
| | | No Construction Phase mitigation proposed.<br><br>Low (locally moderate) | Not significant, Negative, and Temporary (locally Moderate, Negative Temporary for scrubland) |
| Landscape Context of the Site | Low | **Pre-Mitigation** | |
| | | Negligible | Imperceptible, Neutral, Temporary |
| | | **Post-Mitigation** | |
| | | No Construction Phase mitigation proposed.<br><br>Negligible | Imperceptible, Neutral, Temporary |
| **Visual Receptor** | **Sensitivity** | **Magnitude** | **Effect** |
| All Visual Receptors | High | **Pre-Mitigation** | |
| | | Negligible | Not significant, Negative, and Temporary (locally Moderate, Negative Temporary for scrubland) |
| | | **Post-Mitigation** | |
| | | No Construction Phase mitigation proposed.<br><br>Negligible | Not significant, Negative, and Temporary (locally Moderate, Negative Temporary for scrubland) |

**Table 9.6:** Comparison of pre-mitigation potential effects and post-mitigation predicted effects

| OPERATIONAL PHASE | | | |
|---|---|---|---|
| **Landscape Receptor** | **Sensitivity** | **Magnitude** | **Effect** |
| Landscape Fabric of the Site | Negligible | **Pre-Mitigation** | |
| | | Medium | Not significant, Negative, and Long-Term |
| | | **Post-Mitigation** | |
| | | Low / Medium<br><br>Progressive mitigation measures will ensure neutralisation of impacts on landscape fabric by introducing elements and features of landscape value as successive stages are completed and hydroseeding / planting occurs on the side slopes. | Not significant, Neutral, and Long-Term |
| Landscape Context – Shannon Estuary ICMZ | Low / Medium | **Pre-Mitigation** | |
| | | Medium / High | Moderate, Negative, Long-Term |
| | | **Post-Mitigation** | |
| | | Medium<br><br>Progressive mitigation measures will aid integration of the BRDA into the landscape of this LCA as the successive stages are completed and hydroseeding / planting occurs on the side slopes. | Slight / Moderate, Neutral, Long-Term |
| Landscape Context - Western Uplands LCA | Medium / High | **Pre-Mitigation** | |
| | | Negligible | Imperceptible, Neutral, Long-Term |
| | | **Post-Mitigation** | |
| | | Negligible.<br><br>Progressive mitigation measures will aid integration of the proposals into the landscape context but will not perceivably alter the effects on this LCA. | Imperceptible, Neutral, Long-Term |
| | Medium | **Pre-Mitigation** | |

| OPERATIONAL PHASE | | | |
|---|---|---|---|
| Landscape Context - The Agricultural Lowlands LCA | | Negligible | Imperceptible, Neutral, Long-Term |
| | | **Post-Mitigation** | |
| | | Negligible.<br><br>Progressive mitigation measures will aid integration of the proposals into the landscape context but will not perceivably alter the effects on this LCA. | Imperceptible, Neutral, Long-Term |
| Landscape Context – Clare Landscape Character Types | Medium / High | **Pre-Mitigation** | |
| | | Negligible | Imperceptible, Neutral, Long-Term |
| | | **Post-Mitigation** | |
| | | Negligible.<br><br>Progressive mitigation measures will aid integration of the proposals into the landscape context but will not perceivably alter the effects on this LCA. | Imperceptible, Neutral, Long-Term |
| Landscape Context – Clare Landscape Character Areas | Medium / High | **Pre-Mitigation** | |
| | | Negligible | Imperceptible, Neutral, Long-Term |
| | | **Post-Mitigation** | |
| | | Negligible.<br><br>Progressive mitigation measures will aid integration of the proposals into the landscape context but will not perceivably alter the effects on this LCA. | Imperceptible, Neutral, Long-Term |
| Landscape Context – Clare Living Landscapes | High | **Pre-Mitigation** | |
| | | Negligible | Not-Significant, Neutral, Long-Term |
| | | **Post-Mitigation** | |
| | | Negligible.<br><br>Progressive mitigation measures will aid | Not-Significant, Neutral, Long-Term |

| OPERATIONAL PHASE | | | |
|---|---|---|---|
| | | integration of the proposals into the landscape context but will not perceivably alter the effects on this LCA. | |
| Landscape Context - Clare Seascape Character Areas:<br>SCA 11 - River Shannon and SCA 12 – Fergus Estuary | Low | **Pre-Mitigation** | |
| | | Low (locally medium / high) | Slight, Negative, Long-Term |
| | | **Post-Mitigation** | |
| | | Low (locally medium / high)<br><br>Progressive mitigation measures will aid integration of the proposals into the landscape context and will result in a neutral effect. | Slight, Neutral, Long-Term |
| Residential Receptor Group R1 – Foynes | High | **Pre-Mitigation** | |
| | | Negligible | Not-significant, Neutral, Long-Term |
| | | **Post-Mitigation** | |
| | | Negligible<br><br>Progressive mitigation measures will aid integration of the proposals into the views. | Not-significant, Neutral, Long-Term |
| Residential Receptor Group<br>R2 – Ballynacragga | High | **Pre-Mitigation** | |
| | | Medium | Moderate, Negative, Long-Term |
| | | **Post-Mitigation** | |
| | | Low<br><br>Progressive mitigation measures will aid integration of the proposals into the views resulting in a reduced effect. | Slight, Negative, Long-Term |
| Residential Receptor Group<br>R3 – South Foynes and Croaghane | High | **Pre-Mitigation** | |
| | | Low | Slight, Negative, Long-Term |
| | | **Post-Mitigation** | |

| OPERATIONAL PHASE | | | |
|---|---|---|---|
| | | Negligible<br><br>Progressive mitigation measures will aid integration of the proposals into the views resulting in a reduced effect. | Not-Significant, Neutral, Long-Term |
| Residential Receptor Group<br>R4 – Small group, N69 south-east of Foynes | High | **Pre-Mitigation** | |
| | | Medium (2no. properties, western side), High (1no.property eastern side) | Moderate, Negative, Long-Term (2no. properties, western side), Significant, Negative, Long-Term (1no. property, eastern side) |
| | | **Post-Mitigation** | |
| | | Low / Medium (2no. properties, western side), Medium / High (1no.property eastern side)<br><br>Progressive mitigation measures will aid integration of the proposals into the views resulting in a reduced effect. | Slight / Moderate, Negative, Long-Term (2no. properties, western side), Moderate / Significant, Negative, Long-Term (1no. property, eastern side) |
| Residential Receptor Group<br>R5 – Small group, Sroolane North / Churchfield | High | **Pre-Mitigation** | |
| | | Medium | Moderate, Negative, Long-Term |
| | | **Post-Mitigation** | |
| | | Low<br><br>Progressive mitigation measures will aid integration of the proposals into the views resulting in a reduced effect. | Slight, Negative, Long-Term |
| Residential Receptor Group<br>R6 – Single property, Churchfield | High | **Pre-Mitigation** | |
| | | Low | Slight, Negative, Long-term |
| | | **Post-Mitigation** | |
| | | Negligible / Low<br><br>Progressive mitigation measures will aid integration of the proposals into the views | Not-Significant / Slight, Negative, Long-Term |

| OPERATIONAL PHASE | | | |
|---|---|---|---|
| | | resulting in a reduced effect. | |
| Residential Receptor Group<br>R7 – Small group, west Robertstown | High | **Pre-Mitigation** | |
| | | Low | Slight, Negative, Long-term |
| | | **Post-Mitigation** | |
| | | Negligible / Low<br><br>Progressive mitigation measures will aid integration of the proposals into the views resulting in a reduced effect. | Not-Significant / Slight, Negative, Long-Term |
| Residential Receptor Group<br>R8 – Small group, north Robertstown | High | **Pre-Mitigation** | |
| | | High | Significant, Negative, Long-term |
| | | **Post-Mitigation** | |
| | | Medium / High<br><br>Progressive mitigation measures will aid integration of the proposals into the views resulting in a reduced effect. | Moderate / Significant, Negative, Long-term |
| Residential Receptor Group<br>R9 – Robertstown, Oorla and Rincullia | High | **Pre-Mitigation** | |
| | | Medium | Moderate, Negative, Long-Term |
| | | **Post-Mitigation** | |
| | | Low / Medium<br><br>Progressive mitigation measures will aid integration of the proposals into the views resulting in a reduced effect. | Slight / Moderate, Negative, Long-Term |
| Residential Receptor Group<br>R10 – Individual Property, Rincullia | High | **Pre-Mitigation** | |
| | | Low | Slight, Negative, Long-Term |
| | | **Post-Mitigation** | |
| | | Negligible / Low<br><br>Progressive mitigation measures will aid integration of the proposals into the views resulting in a reduced effect. | Not-Significant / Slight, Negative, Long-Term |

| OPERATIONAL PHASE | | | |
|---|---|---|---|
| Residential Receptor Group<br>R11 – Sroolane | High | **Pre-Mitigation** | |
| | | Medium | Moderate, Negative, Long-Term |
| | | **Post-Mitigation** | |
| | | Low / Medium<br><br>Progressive mitigation measures will aid integration of the proposals into the views resulting in a reduced effect. | Slight / Moderate, Negative, Long-Term |
| Residential Receptor Group<br>R12 – Shanagolden | High | **Pre-Mitigation** | |
| | | Negligible | Not-Significant, Negative, Long -Term. |
| | | **Post-Mitigation** | |
| | | Negligible<br><br>Views are negligible and mitigation is unlikely to change the effect. | Not-Significant, Negative, Long -Term. |
| Residential Receptor Group<br>R13 – North-east of Shanagolden | High | **Pre-Mitigation** | |
| | | Low | Slight, Negative, Long-Term |
| | | **Post-Mitigation** | |
| | | Negligible / Low<br><br>Progressive mitigation measures will aid integration of the proposals into the views resulting in a reduced effect. | Not-Significant / Slight, Negative, Long-Term |
| Residential Receptor Group<br>R14 – L1222 south of N69 | High | **Pre-Mitigation** | |
| | | Low | Slight, Negative, Long-Term |
| | | **Post-Mitigation** | |
| | | Negligible / Low<br><br>Progressive mitigation measures will aid integration of the proposals into the views resulting in a reduced effect. | Not-Significant / Slight, Negative, Long-Term |
| Residential Receptor Group | High | **Pre-Mitigation** | |
| | | Low | Slight, Negative, Long-Term |
| | | **Post-Mitigation** | |

| OPERATIONAL PHASE | | | |
|---|---|---|---|
| R15 – Robertstown / Stokesfield / Oldabbey | | Negligible / Low<br><br>Progressive mitigation measures will aid integration of the proposals into the views resulting in a reduced effect. | Not-Significant / Slight, Negative, Long-Term |
| Residential Receptor Group<br>R16 – Group in Shanid | High | **Pre-Mitigation** | |
| | | Low | Slight, Negative, Long-Term |
| | | **Post-Mitigation** | |
| | | Negligible / Low<br><br>Progressive mitigation measures will aid integration of the proposals into the views resulting in a reduced effect. | Not-Significant / Slight, Negative, Long-Term |
| Residential Receptor Group<br>R17 – Group in Craggs / Mulderricksfield / Barrigone | High | **Pre-Mitigation** | |
| | | Low / Medium | Slight / Moderate, Negative, Long -Term |
| | | **Post-Mitigation** | |
| | | Low<br><br>Progressive mitigation measures will aid integration of the proposals into the views resulting in a reduced effect. | Slight, Negative, Long -Term |
| Residential Receptor Group<br>R18 – Group in Glenbane East | High | **Pre-Mitigation** | |
| | | Low | Slight, Negative, Long-Term |
| | | **Post-Mitigation** | |
| | | Negligible / Low<br><br>Progressive mitigation measures will aid integration of the visible elements of the proposals into the background context. | Imperceptible / Slight, Negative, Long-Term |
| Residential Receptor Group | High | **Pre-Mitigation** | |
| | | Medium | Moderate, Negative, Long-Term |

| OPERATIONAL PHASE | | | |
|---|---|---|---|
| R19 – Two Properties in Craggs | | **Post-Mitigation** | |
| | | Low / Medium<br><br>Progressive mitigation measures will aid integration of the proposals into the views resulting in a reduced effect. | Slight / Moderate, Negative, Long-Term |
| Residential Receptor Group<br>Group R20 – Group in Fawnamore / Morgans North / Morgans South | High | **Pre-Mitigation** | |
| | | Low | Slight, Negative, Long-Term |
| | | **Post-Mitigation** | |
| | | Negligible / Low<br><br>Progressive mitigation measures will aid integration of the proposals into the views resulting in a reduced effect. | Not-Significant / Slight, Negative, Long-Term |
| Residential Receptor Group<br>Group R21 – Two properties, Morgans | High | **Pre-Mitigation** | |
| | | Medium | Moderate, Negative, Long-Term |
| | | **Post-Mitigation** | |
| | | Low / Medium<br><br>Progressive mitigation measures will aid integration of the proposals into the views resulting in a reduced effect. | Slight / Moderate, Negative, Long-Term |
| Residential Receptor Group<br>Group R22 – Groups of properties along L1234 | High | **Pre-Mitigation** | |
| | | Negligible | Not-Significant, Negative, Long-Term |
| | | **Post-Mitigation** | |
| | | Negligible<br><br>Views are negligible and mitigation is unlikely to change the effect. | Not-Significant, Negative, Long -Term. |
| Open Space Receptors - Aughinish Nature Trails | Medium / High | **Pre-Mitigation** | |
| | | Low / Medium | Slight / Moderate, Negative, Long-Term |
| | | **Post-Mitigation** | |

| OPERATIONAL PHASE | | | |
|---|---|---|---|
| | | Low<br><br>Progressive mitigation measures will aid integration of the proposals into the views resulting in a reduced effect. | Slight, Negative, Long-Term |
| Open Space Receptors Horgan Park | Medium / High | **Pre-Mitigation** | |
| | | Low | Slight, Neutral, Long-Term |
| | | **Post-Mitigation** | |
| | | Negligible<br><br>Views are negligible and mitigation is unlikely to change the effect. | Not-Significant, Neutral, Long-Term |
| Scenic Routes - Limerick CDP - N69 | High | **Pre-Mitigation** | |
| | | Low | Slight, Neutral, Long-Term |
| | | **Post-Mitigation** | |
| | | Negligible<br><br>Progressive mitigation measures will aid integration of the proposals into the views resulting in a reduced effect. | Not-Significant, Neutral, Long-Term |
| Scenic Routes - Limerick CDP - Bernagh | High | **Pre-Mitigation** | |
| | | Negligible | Not-Significant, Neutral, Long-Term |
| | | **Post-Mitigation** | |
| | | Negligible<br><br>Views are negligible and mitigation is unlikely to change the effect. | Not-Significant, Negative, Long -Term. |
| Scenic Routes - | High | **Pre-Mitigation** | |

| OPERATIONAL PHASE | | | |
|---|---|---|---|
| Clare CDP – R473 | | Low | Slight, Neutral, Long-Term |
| | | **Post-Mitigation** | |
| | | Negligible<br><br>Progressive mitigation measures will aid integration of the proposals into the views resulting in a reduced effect. | Not-Significant, Neutral, Long-Term |
| Other Receptors – Knockpatrick Graveyard | Medium / High | **Pre-Mitigation** | |
| | | Medium / High | Moderate / Significant, Negative, Long-Term |
| | | **Post-Mitigation** | |
| | | Medium<br><br>Progressive mitigation measures will aid integration of the proposals into the views resulting in a reduced effect. | Moderate, Negative, Long-Term |
| Limerick CDP - ACAs | High | **Pre-Mitigation** | |
| | | Negligible | Not-Significant, Neutral, Long-Term |
| | | **Post-Mitigation** | |
| | | Negligible<br><br>Views are negligible and mitigation is unlikely to change the effect. | Not-Significant, Neutral, Long-Term |

**Table 9.7:** Comparison of pre-mitigation potential effects and post-mitigation predicted

#### 9.7.1.1 Completed Phase Effects

At the end of the Operational Phase activity at the BRDA, borrow pit and stockpiling areas would cease. As some mitigation is proposed to occur during the Operational Phase, the Landscape and Visual Effects at the start of the Completed Phase would the same as those outlined for the post-mitigation Operational Phase effects in Table 9.7.

Mitigation measures concerning the treatment of the proposals at the end of the Operational Phase are discussed in Section 9.6. The amelioration of the BRDA residue, topsoiling, seeding and planting measures will allow the establishment of a varied range of vegetation types across the BRDA. The vegetation with be distributed in a mosaic like set of swathes which, over time, will be successful in disguising the hard engineered character of the BRDA. The domed top will be seeded and managed as grassland, intersected by native hedgerows. This corresponds in terms of landscape character and fabric to the established agricultural character of the surrounding landscape, although the grassland will be managed exclusively for nature and biodiversity rather than as pasture. Initially, over the medium-term, this is likely to result in a neutralisation of the landscape and visual effects. Once established towards the end of the medium-term the mitigation proposals will be successful in integrating the development into the landscape context as well as providing a benefit to visual amenity. Over the long-term it is expected that there will be positive improvement of the landscape and visual resource when compared to both the baseline environment and the restoration proposals specified under the existing permitted development.

### 9.7.2 Review of Accurate Visual Representations (AVRs) / Photomontages

Landscape and Visual Effects are described below with reference to a series of 22 Accurate Visual Representations (AVRs) taken from publicly accessible locations and representative of the range of views available from the surrounding landscape towards the AAL facility. The AVRs, together with a View Location Map, are provided in the accompanying *BRDA RAISE: Accurate Visual Representations* booklet. These show representations of the proposals at various development intervals throughout the Operational Phase and including post establishment in the Completed Phase. As such, they illustrate the predicted visual effects and, where relevant, Cumulative effects are also shown.

AVRs are presented including the following stages of development:

**As Existing (2021)**

**Progressive Development Interval 1:**
BRDA Phase 1 at Stage 10 and BRDA Phase 2 at Stage 4 (Est. end 2021)

**Progressive Development Interval 2:**
BRDA Phase 1 at Stage 12 and BRDA Phase 2 at Stage 8 (Est. 2027)

**Progressive Development Interval 3:**
BRDA Phase 1 at Stage 14 and BRDA Phase 2 at Stage 12 (Est. 2034)

**Progressive Development Interval 4:**
Completed BRDA at Stage 16 and including dome. (Est. 2039)

**Progressive Development Interval 5:**
Completed BRDA with all landscape mitigation implemented (Est. 2039)

**Progressive Development Interval 6:**
Completed BRDA after landscape maturation (Est. 2045)

**Cumulative**

#### 9.7.2.1 View 1 from local road in Morgans North at Poulaweala Creek

This shows the existing view looking west across the Poulaweala Creek from a local road in Morgans North. In the foreground is an area rough grassland and intertidal marsh, strewn with boulders bisected by an unpaved track lined with low rubble stone walls in a partially dilapidated state, running towards the edge of the creek. The creek and bordering intertidal areas are visible in the middle ground. Beyond the creek the land rises up culminating in a low rocky hill located within the middle of the view. The land on the far side of the creek is covered with a mosaic of grassland and scrubland vegetation with swathes of gorse being particularly visually prominent. Various structures of the AAL plant are visible in the distance to the right side of the view and a row of overhead service poles stretch off from the plant towards the left side of the frame as well as crossing the creek in the middle distance. In the far distance, at the end of a vista formed by the creek, the skyline is punctuated by Knockpatrick Hill and the hill at Shanagolden Demesne. The existing BRDA is not visible from this location and the view is predominantly rural with some features of value, but the existing AAL plant forms a substantial detractor. Receptors would be mainly local vehicle traffic and pedestrians. The sensitivity of this view is **low / medium**.

The proposed views show a gradual increase in the height of the BRDA during the Operational Phase in the left of the view to the southwest, at the end of the vista formed by the creek. As the height increases the BRDA rises above the existing skyline is some places and, at completion, fully screens the hill at Shanagolden Demesne reducing the visual link with the wider landscape context. Knockpatrick Hill is still visible and is not screened by the proposals from this location. The proposals would be noticeable as a novel feature in the view, with the red of the bauxite residue being relatively visually prominent during operation. However, the proposals would be seen at distance and are partially screened by intervening landform. The extents of the changes in the view are minor in proportion to the full extents of the view. The industrial structures of the AAL plant are much more visually prominent from this location.

The magnitude of change during the Operational Phase would be **medium**, and the effect will be **slight / moderate, negative, long-term**.

Upon completion of the BRDA and establishment of mitigation measures the proposals will visually blend better with the surrounding landscape. The magnitude of change with mitigation will be **low**, and the effect will be **slight, negative, long-term**.

#### 9.7.2.2 View 2 from local road in Morgans North

This shows the existing view from a local road in Morgans North looking west across agricultural land. Grassland with areas of rush covers much of the view stretching from the foreground to a low ridge and mixed hedgerow containing deciduous trees and non-native conifers in the middle distance. The scrubland on the western banks of the Poulaweala Creek defines the skyline of the right hand side of the view. In the far distance in the middle of the view can be seen the distinctive pointed form of Knockpatrick Hill and the rounded hill the north at Ballynacragga which form the skyline. The view is rural in nature and development is limited and the existing BRDA is not visible. A small house to the left of the view at Morgans North is the only clearly visible development in the view. Receptors would be mainly local vehicle traffic and pedestrians. The sensitivity of this view is medium.

The proposed views show a gradual increase in the height of the BRDA in the middle distance across much of the centre of the view. As the height of the BRDA increases it rises above the existing skyline obscuring views of Knockpatrick Hill and the hill at Ballynacragga, with the exception of the topmost section of the peak of Knockpatrick Hill. At completion the BRDA forms a new uniform and level skyline across much of the view in contrast to the existing varied and undulating skyline of the existing view. During the Operational Phase the proposal will form an industrial feature in the landscape. However, due to the low-lying position of the viewpoint, subsequent vertical angle of the view and intervening screening by landform, visibility of the red bauxite residue is minimal. The majority of the valued aspects of the view will remain intact and the view will remain largely rural in character.

The magnitude of change during the Operational Phase will be **medium** and the effect will be **moderate, negative, long-term**.

Upon completion of the BRDA and establishment of mitigation measures the proposals will be better integrated with surrounding landscape. The proposed use of swathes of vegetation and localised undulations in topography will over time help disguise the uniform profile of the BRDA. The magnitude of change with mitigation will be **low / medium**, and the effect will be **slight / moderate, negative, long-term**.

#### 9.7.2.3 View 3 from L1234 road bridge over Limerick-Foynes branch railway

This shows the existing view looking northwest from the road bridge on a local road crossing the disused Limerick to Foynes railway line. The railway is seen to the left of the view running west in a straight line into the distance surrounded by scrubland vegetation. Young trees frame the view in the foreground. Several small fields with areas of scrubland, pasture, young tree planting and lines of hedgerows are visible below in the middle of the view, forming layers of vegetation of varying texture with no clearly discernible pattern. Beyond this the BRDA can be seen in the middle distance forming a level skyline punctuated by the elevated topography of Foynes Island behind. In the far distance on the left, the hill at Ballynacragga forms a focal point at the end of the vista created by the railway line. The view is largely rural in character with industrial features present in the form of the railway, the existing BRDA and associated AAL buildings. Receptors would be mainly local vehicle traffic and pedestrians. The sensitivity of this view is **low/ medium**.

The proposed views show a gradual increase in the height of the BRDA in the middle distance across much of the centre of the view. As the height of the BRDA increases it raises the skyline above Foynes Island, fully obscuring it during Stage 14 of Phase 1. The raised BRDA creates an increased elevated topography in the centre of the view, but the industrial nature of the existing BRDA is already apparent in the existing view. The visibility of the red bauxite residue diminishes in the early stages of Operational Phase becoming hidden by the side slopes until the dome is graded towards the completion of the Operational Phase, and this is a beneficial aspect of the proposals. The character of the view will remain largely rural with some detracting industrial elements. The visibility of the hill at Ballynacragga is not directly affected.

The magnitude of change during the Operational Phase will be **low/ medium**, and the effect will be **slight / moderate, negative, long-term**.

The proposed use of swathes of vegetation and localised undulations in topography will over time help disguise the uniform profile of the BRDA, which will integrate well with the variable layers of the vegetation currently present in the view. The magnitude of change with mitigation will be **low / medium**, and the effect will be **slight / moderate, neutral, long-term**.

The illustration of cumulative changes shows the final Completed Stage proposals in combination with the provision of areas of woodland / tree planting measures associated with the existing permitted AAL development.

#### 9.7.2.4 View 4 from N69 opposite Reilig Mhuire Cemetery at Tomdeely North

This shows the view from the N69 looking west along the road. The road stretches from the foreground into the middle distance with a gradual turn to the left. The road is a wide major rural road corridor with wide grassland verges with drystone walls and some occasional tree planting to the boundary with adjacent fields. The view of the existing BRDA is limited by tree planting along the road, within field boundaries and to adjacent building curtilages in Morgans North. The character is rural but strongly informed by the road corridor. Receptors would be mainly vehicle traffic travelling at speed. The sensitivity of this view is **low / medium**.

The proposed views show that proposals would be entirely screened by a combination of landform trees and buildings in Morgans North. The magnitude of change during the Operational Phase will be **negligible** and the effect will be **imperceptible**. Mitigation measures will not change the effect.

#### 9.7.2.5 View 5 from N69 in Morgans South

This shows the view looking west from the N69 in Morgans South. The road is a major rural route with a wide carriageway which stretches from the foreground into the middle distance with a straight section then a gradual turn to the left. The road is lined with wide grassland verges with bordering hedgerows clipped to a moderate height. A number of mature trees line the road to the north becoming denser into the distance, a dense block of conifers is present to the left side of the road. A single storey house and farmstead with a number of agricultural buildings can be seen in adjacent fields to the right of the view. Elevated land at Ballynacragga, Foynes Island and to the north of the Shannon Estuary can be seen in the distance. The existing BRDA is visible in the middle of the view, as are the cranes and taller structures at Foynes Port, and there are a number of pylons and overhead services which cross the view in the middle distance. The character of the view is rural, but is strongly influenced by the presence of the road with some industrial and infrastructural elements detracting from the quality of the view. Receptors would be mainly vehicle traffic travelling at speed. Sensitivity is **low / medium**.

The proposed views show a gradual increase in the height of the BRDA in the middle distance across a small proportion of the centre of the view. The BRDA would be partially screened behind intervening vegetation along the north side of the road. The raised BRDA would form an elevated element in the landscape and, when close to completion, would change the skyline and obscure the elevated landform at Ballynacragga and Foynes Island. The structures at Foynes Port will also become screened as the BRDA progresses. The changes would be noticeable and would disrupt some more long distance views. However, the changes would occupy a relatively small proportion of the overall field of view, and the focus of attention for receptors in this location is more likely to be directed towards the vista along the N69 road or towards adjacent buildings.

The magnitude of change during the Operational Phase is **medium** and the effect will be **slight / moderate.**

The proposed use of swathes of vegetation and localised undulations in topography will over time help integrate the BRDA into the landscape. The magnitude of change with mitigation will be **low / medium**, and the effect will be **slight, negative, long-term**.

### 9.7.2.6 View 6 from N69 in Glenbane East

This shows the view looking northwest from the N69 in Glenbane. In the foreground is the carriageway and a large double gate within the drystone boundary to the northern edge of the road. The landscape beyond is a mixture of pastoral fields, mixed woodland, young woodland planting, scrubland, with small scale residential development and large scale industry in the form of the AAL plant, the existing BRDA, and associated structures, as well as Foynes Port. Elevated land at Ballynacragga, Foynes Island and the north side of the Shannon Estuary is visible in the distance. The character is largely rural, however, the industrial development is clearly visible and strongly influences the character of the view. Receptors would be mainly vehicle traffic travelling at speed. The sensitivity of this view is **low / medium**.

The proposed views show the gradual increase in height of the BRDA which rises prominently above the skyline in the centre-left of the view. Elevated land at Foynes Island and the far side of the Shannon Estuary becomes fully screened as the BRDA nears completion, as does development at Foynes Port. The proposals would introduce a prominent landform that alters the skyline, occupies a substantial extent of the field of view and has minimal screening from existing landscape features. However, as the existing BRDA is clearly evident in the view, the proposed changes will not introduce a new form of landscape element which is uncharacteristic in the context. The visibility of red bauxite residue will reduce as the height increases with the exception of the grading of the final dome top.

The magnitude of change during the Operational Phase will be **high** and the effect will be **slight / moderate, negative, long term.**

The proposed use of swathes of vegetation and localised undulations in topography will over time help disguise the uniform profile of the BRDA, and will ensure integration with the variable mixed vegetation present nearby in the view. The magnitude of change with mitigation will be medium, and the effect will be slight / moderate, neutral, long-term.

### 9.7.2.7 View 7 from L6052 in Glenbane East

This shows the existing view looking northwest from a local road in Glenbane East. The road carriageway and closely clipped hedgerow to the road edge is in the foreground. Beyond this is an extensive view over a pastoral landscape of large fields bordered with areas of scrubland, sloping down to the left of the view to low lying land surrounding the Robertstown River. Industrial and infrastructure development is prominent in the view in the form of Foynes Port to the distance in the left and AAL plant to the distance in the right. The existing BRDA is central to the view, and due to the elevated nature of the viewpoint, the top surface of the BRDA if visible and the red bauxite residue fills a substantial proportion of the middle distance of the view. The far distance is defined by elevated land at Foynes Island and land on the north side of the Shannon Estuary. Dysert Castle is visible in front of the BRDA. The character of the view is predominantly rural with a strong influence from industrial and infrastructural development. Receptors would be mainly local vehicle traffic and occasional pedestrians. Sensitivity of the view is **low / medium.**

The proposed views show the gradual increase in height of the BRDA, which creates an increased topographical feature in the landscape, however, the visual prominence of the residue reduces as the height increases. In the later stages of the Operational Phase the proposals result in partial screening of the elevated landform on the boundary of the Shannon Estuary and there is a change in the skyline as the BRDA reaches completion. There will be a reduction in the sense of an expansive landscape from the disruption of long-distance views. However, the proposals will not introduce an element that is uncharacteristic of the landscape context, and the reduction in the visibility of the bauxite residue over time will be a beneficial aspect.

The magnitude of change during the Operational Phase will be **high** and the effect will be **slight / moderate, negative, long-term.**

The proposed use of swathes of vegetation, and introduction of a field pattern to the top of the BRDA as mitigation will over time aid in integration with the surrounding landscape. The magnitude of change with mitigation will be **medium**, and the effect will be **slight / moderate, neutral, long-term.**

#### 9.7.2.8 View 8 from N69 in Glenbane East

This shows the view looking northwest from the N69 in Glenbane East. The landscape is composed mainly of pastoral fields with scrubby hedgerows and patches of rushes in places. The land slopes down to the northwest towards the Robertstown River which can be seen at the foot of the nearest field as a shallow inlet bordered by marshy ground. Dysert Castle can be seen prominent above the skyline and in the middle of low lying pasture to the northwest. Beyond this is a farmstead at Glenbane West with associated farm buildings, tree planting and small fields bounded by scrubby hedgerows. In the distance in the middle of the view is the existing BRDA, and to the right is the AAL plant, which although it is partially screened by intervening trees, the chimneys and other taller structures are clearly visible. The tops of some structures at Foynes Port can be glimpsed above a ridge on the far side of the Robertstown River. Elevated land at Ballynacragga, Foynes Island and on the far side of the Shannon Estuary define the furthest extents of the view. The view is predominantly rural with some valued features but some notable intrusion by the AAL plant and to a lesser degree the BRDA and Foynes Port. Receptors would be mainly vehicle traffic travelling at speed. The sensitivity of the view is **medium**.

The proposed views show the gradual increase of the height of the BRDA creating an increased topographical feature which rises prominently above the skyline. As the Operational Phase progresses the visibility of the red bauxite residue become lessened as the side slopes screen the top surface of the residue, and in the middle stages (approximately Phase 1 Stage 12-14) the noticeability of the BRDA is reduced compared to the baseline, however, visibility increases again with grading of the final domed top. As there is existing industrial development and the existing BRDA on the view, the proposals would introduce an increased topographical feature but not a new form of landscape element. Long-distance views of elevated landform on the north side of the Shannon Estuary will be only minorly directly affected by the proposals. The prominence of Dysert Castle above the skyline is reduced.

The magnitude of change will be **medium-high** and the effect will be **moderate, negative, long-term.**

The proposed use of swathes of vegetation, and minor topographical variation as mitigation will over time aid in integration with the surrounding landscape. The magnitude of change with mitigation will be **medium**, and the effect will be **moderate, neutral, long-term**.

#### 9.7.2.9 View 9 from L6069 in Oorla

This shows the view looking north from a local road in Oorla. The landscape is mainly pastoral field divided by intermittent hedgerows which generally sloping away to the west or north towards low lying land surrounding the Robertstown River, which can be seen below to the left in the middle distance. Development can be seen in the form of a single storey residential property to the right foreground of the view, and the BRDA and AAL planting in the centre of the view in the distance. The red residue of the BRDA is particularly prominent from this location and is visible across much of the centre of the view. A coniferous woodland is present to the left of the frame screening some of the view of the BRDA beyond. The stockpiling areas are also clearly visible from this location although the attention of the viewer is strongly attracted away by the strong colour of the BRDA. Overall, the view is of low-lying topography with the BRDA, AAL and stockpiling areas forming the skyline. The view is largely rural with a strong influence on landscape character by the industrial uses. Receptors would be mainly local traffic and occasional pedestrians. The sensitivity of the view is **low**.

The proposed views show the incremental increase in height of the BRDA. During the early stages of the Operational Phase the visibility of the bauxite residue drastically diminishes as the side slopes begin to screen the top surface of the residue and upon completion of Phase 1 Stage 12 the residue is no longer visible from this viewpoint. However, visibility of residue increases again with grading of the final domed top. As further stages progress the BRDA raises the skyline forming an increased elevated feature in the landscape. The AAL plant becomes almost totally screened by the BRDA with the exception of a topmost section of chimney, which is a positive aspect. A drainage channel on the southern elevation of the BRDA is visually prominent from this location. Due to the proximity to the proposals the BRDA, when complete, occupies a large proportion of the view.

The magnitude of change during the Operational Phase will be **high** and the effect will be **slight, negative, long-term**.

The proposed use of swathes of vegetation, and minor topographical variation as mitigation will over time aid in integration of the side slopes and drainage channel with the surrounding landscape. The magnitude of change with mitigation will be **medium**, and the effect will be **slight, neutral, long-term**.

### 9.7.2.10View 10 from N69 in Robertstown

This shows the view looking north from the N69 in Robertstown. The view is taken up mainly with a large pastoral field bounded with hedgerows, and surrounded by some scattered single storey houses and other agricultural structures. The BRDA and AAL plant is visible in the distance partially screened by a clump of coniferous woodland planting and intervening trees within field boundaries. The skyline is formed by a combination of these elements and areas of higher elevation on the north side of the Shannon Estuary. The view is largely rural with a moderate influence on landscape character by the industrial uses. Receptors would be mainly vehicle traffic travelling at speed. The sensitivity of the view is **low / medium**.

The proposed views show the gradual increase in height of the BRDA which reduces the visual prominence of the red bauxite residue and almost completely screens the AAL plant upon completion, which eliminates this visual detractor from the view and reduces visual clutter. There is the introduction of an increased topography but this integrates moderately well with the existing landform in the landscape context creating a new skyline of a similar apparent height to that of the other visible elevated areas, which themselves are only very minorly screened by the proposals.

The magnitude of change during the Operational Phase will be **medium / high** and the effect will be **slight / moderate, neutral, long-term**.

Upon mitigation the proposed use of swathes of vegetation, and minor topographical variation will over time further aid in integration of the side slopes into the surrounding landscape and will improve the view beyond the baseline. The magnitude of change is **medium** and the effect is **slight / moderate, positive, long-term**.

### 9.7.2.11 View 11 from N69 in Robertstown

This shows the view looking north from the N69 in Robertstown. The view is taken up mainly with a large pastoral field bounded with a tall hedgerow and some mature trees to its northern extent. These partially screen the BRDA and AAL plant which are visible in the distance beyond the Robertstown River. The skyline is formed by a combination of these elements and areas of higher elevation on the north side of the Shannon Estuary, to the left of the view. A small number of single and two storey residential properties are visible along the south side of the Robertstown River. The view is largely rural with a moderate to strong influence on landscape character by the industrial uses. Receptors would be mainly vehicle traffic travelling at speed. The sensitivity of the view is **low / medium**.

The proposed views show the gradual increase in height of the BRDA, which reduces the visual prominence of the red bauxite residue, and eventually screens the visual detracting AAL plant from the view and thus reduces visual clutter. There is the introduction of an increased topography but this integrates moderately well with the existing landform in the landscape context creating a new skyline of a similar apparent height to that of the other visible elevated areas, which themselves are not screened by the proposals. However, the drainage channel on the southern elevation of the BRDA is visible and is an incongruous element on the side slope.

The magnitude of change during the Operational Phase will be **medium / high** and the effect will be **slight / moderate, neutral, long-term**.

Upon mitigation the proposed use of swathes of vegetation, and minor topographical variation will over time further aid in integration of the side slopes into the surrounding landscape and will improve the view beyond the baseline. The magnitude of change will be **medium** and the effect will be **slight / moderate, positive, long-term.**

### 9.7.2.12 View 12 from L6069 in Robertstown at Robertstown Graveyard

This shows the view looking north over Robertstown Creek from a local road at Robertstown Graveyard. The character is of an estuarine landscape with a substantial area of tidal marsh or mudflats bordered by areas of grassland, woodland and scrubland. The BRDA is a substantial part of the view which is visible beyond the river, and is clearly visible due to the eye catching colour of the residue. The AAL plant can be seen beyond. The view is largely rural / estuarine with a moderate to strong influence on landscape character by the industrial uses. Receptors would be mainly local traffic, occasional pedestrians and visitors to the adjacent ruined church and graveyard. The sensitivity of the view is **low / medium.**

The proposed views show the incremental increase in height of the BRDA. During the early stages of the Operational Phase the visibility of the bauxite residue drastically diminishes as the side slopes begin to screen the top surface of the residue and upon completion of Phase 1 Stage 12 the residue is no longer visible from this viewpoint. However, visibility of residue increases again with grading of the final domed top. As further stages progress the BRDA raises the skyline forming an increased elevated feature in the landscape. The AAL plant becomes almost totally screened by the BRDA with the exception of a topmost section of chimney, which is a positive aspect. Due to the proximity to the proposals the BRDA, when complete, occupies a large proportion of the view. The terraced nature of the BRDA is particularly evident against the sky here where there is limited screening and no landscape backdrop.

The magnitude of change during the Operational Phase will be **high** and the effect will be **slight / moderate, neutral, long-term.**

Following mitigation, the proposed use of swathes of vegetation, and minor topographical variation will over time aid in integration of the side slopes with the surrounding landscape. The proposed topography does not look completely uncharacteristic in the context of an estuarine landscape with localised areas of higher ground, and the terraced nature of the side slopes will be in time disguised by scrubby vegetation. The AAL plant will be screened and combined with the integration provided by the mitigation proposals, there will be an improvement to the view beyond the baseline. The magnitude of change with mitigation will be **medium**, and the effect will be **slight / moderate, neutral, long-term.**

#### 9.7.2.13View 13 from N69 in Sroolane North

This shows the view looking northeast from the N69 in Sroolane. The view is mainly composed of pastoral fields of varying sizes separated by post and wire fencing and intermittent hedgerows with occasional mature trees. The AAL plant and BRDA are visible in the distance, forming the only visible development with the exception of a small cluster of residential properties to the right of the view in the middle distance. The character of the view is predominantly rural with a moderate influence from industrial development. The view is largely rural with a moderate to strong influence on landscape character by the industrial uses. Receptors would be mainly vehicle traffic travelling at speed. The sensitivity of the view is low / medium.

The proposed views show the incremental increase in height of the BRDA in the distance in the centre of the view. The full width of the BRDA is visible from this viewpoint, and the terraced nature of the side slopes is particularly evident against the sky. There is some limited screening from intervening trees to field boundaries. As the height increases the visibility of the residue decreases, with the exception of the final grading of the domed top. The BRDA at completion substantially screens the AAL plant, although a portion of the tallest chimney remains visible. The proposals will create an increased topographical feature in the landscape but this will not form an uncharacteristic feature given the existing industrial context.

The magnitude of change during the Operational Phase will be **high** and the effect will be **slight / moderate, neutral, long-term.**

Following mitigation, the proposed use of swathes of vegetation, and minor topographical variation will over time aid in integration of the side slopes with the surrounding landscape. The AAL plant will be screened and combined with the integration provided by the mitigation proposals, there will be an improvement to the view beyond the baseline. The magnitude of change with mitigation will be **medium**, and the effect will be **slight / moderate, neutral, long-term.**

#### 9.7.2.14View 14 from N69 on eastern edge of Foynes.

This shows the view looking east from the N69. The view is partially screened by trees and scrubby vegetation along the edge of the road and to adjacent field boundaries, but a gap in this screening in the centre of the view allows the existing BRDA to be seen in the distance beyond areas of pastoral fields. The BRDA extends across most of horizontal portion of the centre of the view but the extent of visible residue is minimal due to the low angle of the view and screening by intervening trees to field boundaries. Nevertheless, the red colour of the bauxite residue draws the eye. The AAL plant is not visible from this location. The character of the view is prominently rural, although an unexceptional view, with a moderate influence from the road corridor and a minor influence from industrial uses. The view is largely rural with a moderate to strong influence on landscape character by the industrial uses. Receptors would be mainly vehicle traffic travelling at speed. The sensitivity of the view is **medium**.

The proposed views show the gradual increase in height, during the Operational Phase, of the BRDA in the distance in the centre of the view. This introduces an increased topography and the skyline is raised but no distant views are screened. The raised BRDA will be seen as a continuation of the existing BRDA and will not form an uncharacteristic landscape element in the view. The full extents of the proposals will be screened by intervening vegetation. Over the course of the Operational Phase the visibility of red bauxite residue will be reduced and eventually eliminated.

The magnitude of change during the Operational Phase will be **low / medium** and the effect will be **slight / moderate, neutral, long-term.**

Following mitigation, the proposed use of swathes of vegetation, and minor topographical variation will over time ensure integration of the side slopes with the surrounding landscape, particularly given the existence of similar scrubby vegetation in the view. The magnitude of change with mitigation will be **low**, and the effect will be **slight, neutral, long-term.**

#### 9.7.2.15View 15 from Dernish Avenue, Foynes.

This is the view looking east from Dernish Avenue in Foynes. The location is a residential street looking over a painted garden wall, front garden and driveway in the foreground, with an area of rough grassland beyond. Areas of scrubland and open woodland adjoin the grassland and in combination with intervening tall hedgerows fully screen the views of the existing AAL and BRDA. Minor overhead services cross the view and two timber service poles are present as prominent vertical elements in the foreground. The character is rural with some conspicuous development in the form of the overhead services. Receptors would be mainly local residents. The sensitivity of the view will be **medium**.

The proposed views show the gradual increase in height of the BRDA during the Operational Phase. The proposals are screened by vegetation until the BRDA passes Phase 1 Stage 12. As further stages progress the visibility becomes greater, however the screening by intervening trees is still substantial and the change affects only a small proportion of the overall view.

The magnitude of change during the Operational Phase will be **low** and the effect will be **slight, negative, long-term.**

Mitigation measure will ensure effective integration with the landscape given the surrounding tree cover. The magnitude of change with mitigation will be **negligible** and the effect will be **not significant, neutral, long-term.**

#### 9.7.2.16View 16 from Corgrig Wood, Foynes.

This shows the view looking east from Corgrig Wood. A small open space is present in to the left of the view. The view is well enclosed by adjacent residential single or two-storey properties and trees within the local area. The existing BRDA is screened by intervening trees and buildings. There are a number of utilitarian lighting columns and overhead service poles which can be seen across the view including in the foreground. The character of the view is a rural suburban residential streetscape with moderate levels of tree cover and no major detracting features. Receptors would be mainly local residents. The sensitivity of the view is **medium**.

The proposed views show the gradual increase in height of the BRDA during the Operational Phase. The BRDA remains almost completely screened by intervening trees and buildings but can be glimpsed through the tree canopies. The extent of visibility in the view is minimal, and the proposals would be barely discernible and completely screened during the summer months while trees are in leaf.

The magnitude of change during the Operational Phase will be **negligible** and the effect will be **not significant, neutral, long-term.** Mitigation measures will not change the effect.

#### 9.7.2.17View 17 from Marine Cove, Foynes.

This shows the view looking northeast from Marine Cove. The view is elevated and expansive extending from the Shannon Estuary, over much of Foynes, over Foynes Port to the AAL plant and jetty, and across to the BRDA which stretches horizontally across the centre of the view. An open space of grassland forms the foreground of the view. There are long distance views to hills in south County Clare and to minor hills around Dromore / Curraghchase in north-central County Limerick. The character of the view of a settlement on the edge of an estuarine landscape with prominent port and industrial development. Receptors would be mainly local residents. The sensitivity of the view is **low**.

The proposed views show the gradual increase in height of the BRDA during the Operational Phase. All stages of the BRDA development can be seen with only minor screening from the silo buildings of the port. The proposals result in a reduction in visibility of the red bauxite residue as the side slopes begin to screen the top surface of the BRDA. The raised topography of the proposed BRDA is clearly evident in the view forming a prominent feature above the skyline and screening some long-distance views of minor hills beyond. Views of hills in County Clare are not directly impacted, and extensive views will remain over the estuary. The terracing of the side slopes and drainage channels on the southern elevations of the BRDA are evident from this viewpoint. The BRDA will be a prominent topographic feature in the landscape but the industrial nature of the development is not uncharacteristic given the context of intense industrial and infrastructural development in the view.

The magnitude of change during the Operational Phase will be **medium-high** and the effect will be **slight, negative, long-term.**

Following mitigation, the proposed use of swathes of vegetation, and minor topographical variation will over time disguise the terraced nature of the side-slopes, the form of the drainage channels and will generally aid in integration of the BRDA with the surrounding landscape. The magnitude of change with mitigation will be **medium**, and the effect will be **slight, neutral, long-term.**

#### 9.7.2.18View 18 from N69 on western edge of Foynes

This shows the view looking east from Foynes across the harbour. The Shannon Estuary and port development in Foynes form the main focus of the view. Foynes Island frames the view to the left and the AAL plant is a focal point at the end of the vista created by the river. The

BRDA is only partially visible in the centre of the view in the distance due to being largely screened by various built form in the port. The character is of a port development on a large tidal river, with a strong influence of industrial / infrastructural development at the port and at AAL. Receptors would be mainly local traffic and pedestrians. The sensitivity of the view is **low**.

The proposed views show the gradual increase in the BRDA seen to the left of the port, and rising slightly above the level of port buildings with the final stages and grading of the domed top. The proposals would be a noticeable change but would not change the character of the view; the character would remain visually dominated by industrial and infrastructural development.

The magnitude of change during the Operational Phase will be **low** and the effect will be **slight, neutral, long-term.**

Following mitigation, the proposed use of swathes of vegetation, and localised topographical variation will over time aid in visually breaking up the engineered form of the BRDA, and this will be an improvement on the baseline. However, when seen in the context of surrounding development the level of integration with the rest of the view will be minimal. The magnitude of change with mitigation will remain **low** and the effect will be **slight, positive, long-term.**

#### 9.7.2.19View 19 from Knockpatrick graveyard, Knockpatrick.

This shows the view looking north from Knockpatrick graveyard on Knockpatrick Hill. The view is expansive covering a large area of the Shannon Estuary from Foynes to Shannon and beyond to Woodcock Hill and other hills of County Clare. Aughinish Island and surrounding low-lying areas of pastoral farmland fill the centre of the view extending off into the distance to the east. Foynes Port and the AAL plant are clearly visible, as is the BRDA which is very prominent due to the angle of view which reveals the top surface of the red coloured bauxite residue. The view is wide-ranging and predominantly rural in character with a strong influence from industrial and infrastructural development. Receptors would be visitors to the graveyard. Sensitivity of the view is **medium**.

The proposed views show the gradual increase in height of the BRDA. The proposals will be clearly distinguishable, but they will be experienced as a continuation of the existing BRDA and will not be seen as an uncharacteristic element in the view. As the stages progress the visibility of bauxite residue decreases due to the reduced surface area, and in turn the visual prominence decreases to an extent. This is partially counteracted by the growth of the side slopes and associated terracing and drainage channels which also draw the eye. Upon completion the BRDA will form a prominent topographical feature in an otherwise low-lying and flat landscape, and it will be distinctive due to the regular geometry which contrasts with the natural and irregular form of the elevated land in the foreground and the hills of County Clare in the distance.

The magnitude of change during the Operational Phase will be **medium / high** and the effect will be **moderate, neutral, long-term.**

Following mitigation, which will be implemented in a progressive manner as the BRDA develops, the proposed use of swathes of vegetation, additional localised areas of topographical variation and landscaping, and the introduction of a field pattern to the top surface will over time soften the engineered character of the side slopes, aid in visually breaking up the form of the BRDA and establish a more naturalistic landscape character, and this will be an improvement on the baseline. The magnitude of change with mitigation will be medium and the effect will be slight / moderate, positive, long-term.

### 9.7.2.20View 20 from R473 in Cahiracon, County Clare

This shows the view looking south-east from the R473 in Cahiracon. The view looks out across an area of rough rushy grassland to a belt of trees and the Shannon Estuary beyond. The AAL plant and BRDA can be seen on the far side of the estuary in the centre of the view, and ports of Foynes Port can be seen to the right, partially screened behind Foynes Island. The buildings, structures of the AAL plant and the jetty extending out into the estuary are visually prominent in the view, whereas the BRDA is relatively inconspicuous due to the distance and the low angle of the view which reduces visibility of the residue on the top surface. The character of the view is rural and estuarine with a moderate influence from development at the AAL plant, and to a lesser extent at the BRDA and Foynes Port. Receptors would be mainly vehicle traffic travelling at speed. The sensitivity of the view is **medium**.

The proposed views show the gradual increase in height of the BRDA on the far side of the estuary in the centre of the view. The proposals result in a general reduction in the visibility of the bauxite residue as each subsequent stage is filled with the exception of the grading of the final domed top at which point the visibility is approximately equal to the baseline situation. Upon completion the BRDA will form an increased topographical feature which will appear against a backdrop of other elevated land behind and will be moderately well integrated into the landscape.

The magnitude of change during the Operational Phase will be **low / medium** and the effect will be **slight / moderate, neutral, long-term.**

Following mitigation, the proposed use of swathes of vegetation, minor topographical variation will over time aid in visually breaking up the form of the BRDA, and this will be an improvement on the baseline. The magnitude of change with mitigation will be **low** and the effect will be **slight, positive, long-term.**

Night-time views for Viewpoint 20 are also provided. The proposals will be seen in the context of prominent lighting at the AAL plant, and there will be minimal additional lighting introduced. The proposals will not result in any perceivable change in visible lighting within the view. The magnitude of change will be **negligible**, and the effect will be **imperceptible**.

### 9.7.2.21View 21 from River Shannon

This shows the view from the River Shannon from east of Foynes Island and looking in a south easterly direction towards the northern face of the existing Phase 1 BRDA at Aughinish Alumina at c. 1.75km. Set in the open water of the estuary, the view from this location is panoramic and expansive and includes the water, the southern and northern shorelines of the River Shannon at County Limerick and County Clare.

The view as presented includes the northern side slopes of the existing Phase 1 BRDA at Stage 10, parts of the Aughinish Alumina plant to the left and parts of Foynes Port to the right. The wider panorama also includes the AAL jetty and full plant, Foynes Island, the full extent of Foynes Port and more distant rural upland areas of County Limerick and County Clare. It is noted due to the prevailing weather conditions and low winter sun angle at the time of photography that visibility of some of the more distant upland areas is substantially reduced.

Receptors would be mainly shipping and port-related traffic but would also include pleasure craft on the river. The sensitivity of the view is **medium / high**.

The proposed views show the gradual increase in height of the BRDA on the southern shoreline of the River Shannon as the proposed six additional stages are implemented.

Upon completion the BRDA will present in a similar but higher manner to the existing BRDA and set in the same mixed landscape, riverine and industrial context.

The magnitude of change during the Operational Phase will be **medium** and the effect will be **moderate, negative, long-term.**

Following mitigation, the proposed use of landscape mounding on the side slopes and vegetation of the dome will soften the appearance of the BRDA and render in a manner that is more consistent with the surrounding rural landscape context.

The magnitude of change with mitigation will be **medium** and the effect will be **slight / moderate, neutral, long-term.**

### 9.7.2.22View 22 from R521 at Rathbrouder

This shows the view from the elevated ground along the R521 as it leads northwards towards Foynes from Newcastle West and Ardagh to the south. The view illustrates the nature of the Western Uplands landscape character area and overlooking the Shannon Estuary Integrate Coastal Management Zone in the distance. The view comprises rolling upland agricultural land with layers of hedgerows defining the boundaries of small fields. The elevated terrain of Knockpatrick Hill is clearly visible to the left of the view at c. 3.0km and the existing AAL facility is partially visible towards the centre of the view at c. 6.0km. The extent of visibility of the AAL facility varies along this stretch of road depending on the immediate terrain and the presence of foreground landscape elements and includes much of the AAL plant and some of the existing BRDA. There are occasional residential and farming properties along the route.

Receptors would include vehicular traffic travelling northwards and residents of local properties where property boundaries permit longer distance views. The sensitivity of the view is **medium / high**.

The proposed views show the gradual increase in the profile of the BRDA seen in the distance and in front of the AAL plant. Upon completion, visibility of the BRDA will be greater than at present however that of the AAL plant will be substantially reduced.

The magnitude of change during the Operational Phase will be **low / medium** and the effect will be **slight /moderate, neutral, long-term.**

Following the proposed restoration, the BRDA will be consistent with the landscape context and the AAL plant will be substantially screened. The magnitude of change with mitigation will be **low** and the effect will be **slight, positive, long-term.**

### 9.7.3 Cumulative Effects

There are two permitted / proposed developments of a scale and type likely to cause cumulative effects in combination with the Proposed Development. These are:

1. Capacity Extension at Shannon Foynes
2. Foynes to Limerick Road Scheme

The proposed site of Foynes Capacity Extension lies immediately to the east of the current port within an area of greenfield land. This area which measures 62.10 hectares extends to include specific areas in which the proposed development will occur within the existing Port estate and, on lands directly adjacent to it. The proposed development works are concentrated in two specific locations – (i) adjacent to the existing quay walls within the existing Port estate (measuring 0.51ha or 5,142$m^2$), and (ii) undeveloped lands adjacent to the east of the exiting port estate (measuring 33.95ha or 339,559$m^2$).

There is potential for cumulative landscape effects to occur due to the increase in the intensity of large-scale development within the Shannon Estuary landscape. This will from part to of the trend towards an increasing intensification of port / industrial / infrastructural development within this landscape. These types of development are already present in the landscape context and the landscape is not highly sensitive towards these types of development. Cumulative effects on the local landscape character are likely to be notable for areas in proximity to the three schemes, e.g. Around the eastern edge of Foynes, but are not expected to be significant for the wider landscape, as defined by the various landscape character assessments described in Section 9.3.5.

There is potential for cumulative visual effects to occur where both the port extension and the BRDA can be seen within the same view. This is most likely to occur in locations around the north-eastern edge of Foynes and from elevated views, most notably Knockpatrick Hill. When seen together there will be a perception of the increase in the intensity of large-scale development in the views. For elevated views the changes will form a relatively small section of the view, and they will be seen in the context of other established large-scale port and industrial development. Significant cumulative visual effects are not expected for the Proposed Scheme and the Capacity Extension at Shannon Foynes.

Potential for cumulative visual effects from the combination of the Proposed Development and the N69 upgrade are possible. However, the road scheme passes through low-lying land with frequent screening features and it is likely that views of the road upgrade will be limited to localised areas. In these cases, the road itself will be the primary cause of any significant visual effects. From the elevated location on Knockpatrick Hill the road is substantially screened by landform and other screening elements.

This assessment is supported by cumulative photomontages which show the Proposed Development at the completed stage with the two projects mentioned above. In addition, these also show the landscape enhancement proposals proposed under the extant permission for the BRDA. The photomontages do not show any significant cumulative effects and they verify the conclusions made in this section.

# 10.0 HYDROLOGY AND HYDROGEOLOGY

## 10.1 Introduction

This Chapter of the Environmental Impact Assessment Report (EIAR) has been prepared by Golder Associates Ireland Ltd (Golder) and addresses the likely direct and indirect significant impacts and effects, and the significance of these effects, of the Proposed Development on surface water and the groundwater receptors located in the vicinity of the Application Site.

It considers groundwater levels, flow regime, and quality; and surface water flows, quality and flood risk. The potential for changes in the water environment to impact identified water dependent habitat receptors is considered in Chapter 6: Biodiversity.

The following assessment was prepared by Barry Balding (BA MSc PGeo EurGeol) and Hannah McGillycuddy (BSc MSc), Gareth Digges La Touche (BSc, MSc, FRGS, FGS, CGeol, EurGeol) and Richard Lansley (BSc, MSc, FGS, CGeol) in conjunction with inputs from the wider EIAR team and EIAR Chapter technical leads.

Barry is a Technical Director and Geologist, Geophysicist, Project Director and Project Manager based in the Golder-WSP Naas Office. Barry has 30+ years of technical and management experience in consultancy and industry and has extensive experience in producing EIARs and planning applications for the extractive industry.
Hannah is a Geo-Environmental Scientist based in the Golder-WSP Naas Office. Hannah has 6 years of experience and has worked on a diverse range of projects during this time including planning applications, environmental monitoring and environmental impact assessment reports for the extractive industry.
Gareth is a Technical Director based in Golder-WSP's United Kingdom operations. Gareth has 29 years of technical experience in geoscience consulting and has extensive experience in hydrogeological studies related to waste management, mining and other extractive industries and contaminated sites.
Richard is an Associate Director based in Golder-WSP's United Kingdom operations. Richard has 20 years of experience in hydrogeological consulting related to waste management, quarrying and contaminated sites. Richard prepared the hydrogeological conceptual model for the Aughinish facility and completes the routine assessment and review of groundwater conditions of the Plant Area in line with its licence requirements.

The proposed development consists of works to the Bauxite Residue Disposal Area (BRDA) comprising of an expansion to increase its disposal capacity to accommodate additional bauxite residue arising from the continued operation of the permitted alumina refinery plant located on the wider AAL facility. The proposed increase in disposal capacity to the BRDA will result in a proposed increase in height of c.12m above the currently permitted stage 10 level (c. 32m OD) to a final stage 16 level (c. 44m OD). No increase to the existing footprint of the BRDA is proposed.

The proposed method of raising the BRDA will be the upstream method, consistent with the construction methodology for the current BRDA and involves the construction of rock fill embankments (Stages), offset internally and founded on the previously deposited and farmed bauxite residue, in 2 m high vertical lifts. The overall stack is raised systematically as the stages are filled with bauxite residue, farmed, carbonated and compacted, prior to deposition of the next layer.

Additional works proposed as part of this application include the following:

- A vertical extension to the existing Salt Cake Disposal Cell (SCDC) to accommodate further disposal of salt cake resulting in an increase in height of c.2.25m. The SCDC is located within the BRDA. A description of the SCDC and its function is provided in Chapter 2 of this EIAR.

- An extension of the existing borrow pit, located to the east of the BRDA, is also proposed. This extension proposes to increase the footprint of the borrow pit from c.4.5ha to c.8.4ha. This expansion will provide an additional 380,000m$^3$ of rock fill material which is needed to satisfy the requirements of the construction and operation of the BRDA.

- The continued use of an existing stockpile area at the south east of the subject site to store topsoil in order to satisfy the additional restoration requirements of the extended BRDA.

- Modifications to the existing water management infrastructure to accommodate the BRDA development to Stage 16 which will also allow for greater Inflow Design Flood (IDF) capacity for the entirety of the BRDA.

A general site layout of these individual features has been provided in Figure 10.1 above and also includes the planning application boundary (red line) and the ownership boundary (blue line) of Aughinish Alumina Limited (AAL).

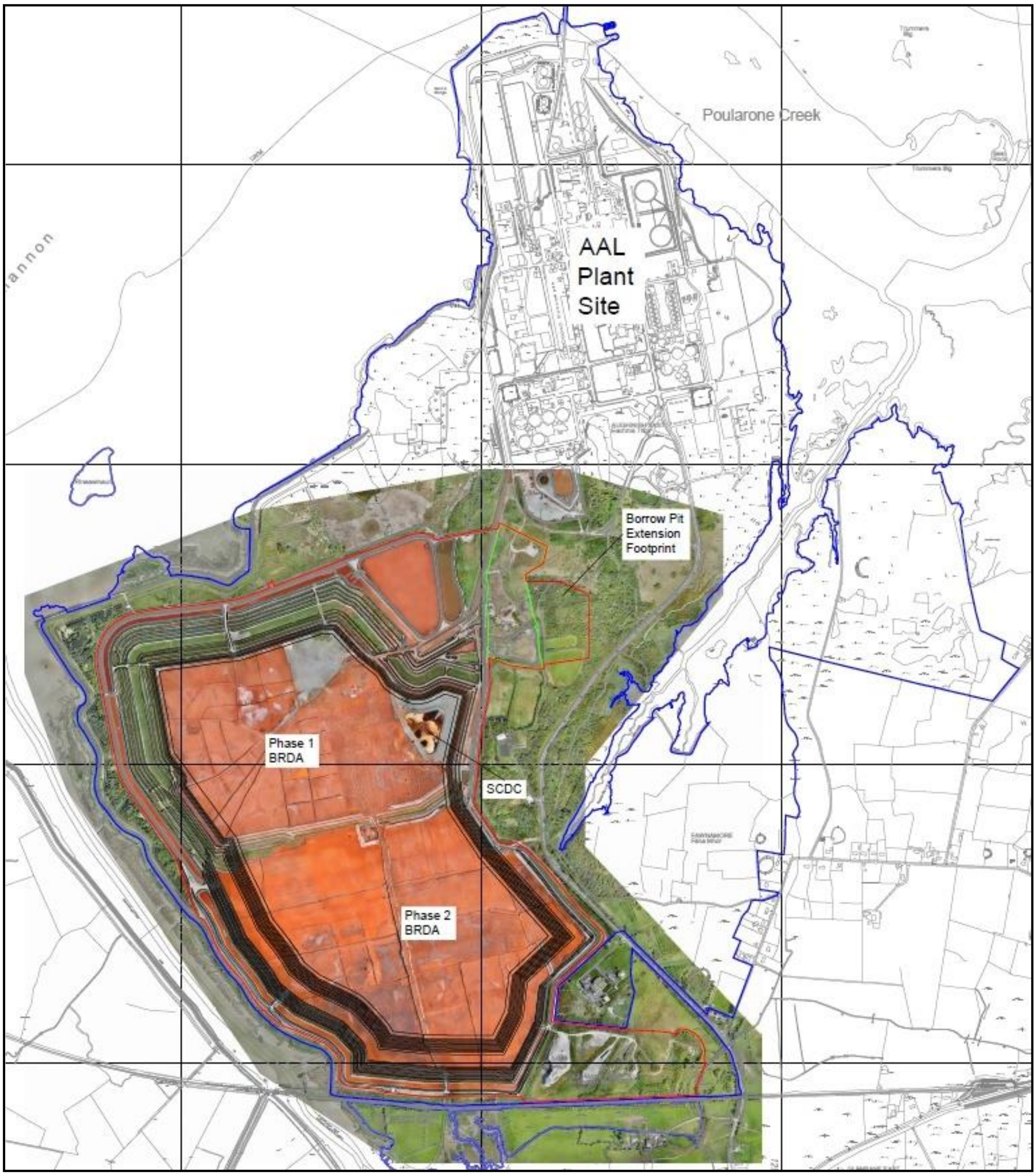



**Figure 10.1: Site Location Map - Blue Line is the AAL Ownership Boundary, Red Line is the Application Boundary and Green Line is the permitted Borrow Pit Footprint**

## 10.2 Technical Scope

The technical scope of this assessment is to identify the likely direct and indirect significant effects that the Proposed Development may have on the water environment, during the construction, operation and closure of the Proposed Development.
The assessment considers the potential sources of change resulting from the Proposed Development activities as detailed in the project description (Chapter 3: Project Description) on hydrological (surface water) receptors and hydrogeological (groundwater) receptors.
The assessment also identifies potential secondary effects on land, people, ecology (including water dependent habitats or ecological receptors) and infrastructure, as appropriate.

The potential effect of secondary changes in the water environment to impact land, people, ecology and infrastructure are considered further in the following chapters of the EIAR:

i) Chapter 7: Populations and Human Health;
ii) Chapter 6: Biodiversity;
iii) Chapters 13, 14 and 15: Material Assets – Waste Management, Material Assets – Traffic and Transportation and Material Assets – Site Services; and
iv) Chapter 18: Interactions and Cumulative Impacts.

This Chapter also addresses the potential secondary effects of changes in land quality on water quality. As such, it draws on the assessment presented in Chapter 8: Soils, Land and Geology.

## 10.3 Geographical and Temporal Scope

The geographical Study Area for the assessment covers the Site boundary (Figure 10.2) and a buffer zone that extends to 2 km from the boundary (IGI 2013 guidelines, listed in Section 10.4.2). This Study Area allows for the identification of nearby off-site water features that may be affected by changes associated with the Proposed Development.

The permitted Borrow Pit and the proposed Borrow Pit Extension sit outside of the footprint of the BRDA and to the east of the Phase 1 BRDA; the 2km buffer for the study area has been extended from these area boundaries also.

The general site layout, showing the Plant, the BRDA, the SCDC and the Borrow Pit Extension, has been provided in **Error! Reference source not found.**.
The Proposed Development involves construction activities as an intrinsic part of the preparatory, construction, operational and closure phases, as the facility is progressively raised in elevation as it is filled with bauxite residue and is progressively restored on the side-slopes. Therefore, this assessment will consider an overall construction phase encompassing the preparatory construction activities, construction activities during general operations and the closure construction activities.

The Proposed Development will enter into an aftercare phase following the completion of the combined construction/operational phase. In accordance with Condition 10 of the EPA issued licence (IEL P0035-07), AAL are required to have an approved plan in place for the orderly closure, decommissioning and aftercare of the facility. This plan is called the Closure, Restoration and Aftercare Management Plan (CRAMP) and covers both the Plant area and the BRDA. The most recent update was conducted by AAL during 2019 and subsequently approved by the EPA in 2021 as part of the most recent IEL review.

Financial provisions for the CRAMP are deposited by AAL annually into a Secured Fund and a Parent Company Guarantee (PCG) is in place to match the balance for the Secured Fund target value in place. The CRAMP is funded for a minimum 35-year period following closure (5 years of active aftercare and 30 years of passive aftercare).

Given that the proposed BRDA Raise and the proposed SCDC Raise sit entirely within the footprint of the existing BRDA, where reference is made to the BRDA within the text, this will refer the both the BRDA and the SCDC areas unless otherwise stated.

The existing BRDA site is comprised of two distinct footprints; Phase 1 BRDA and Phase 2 BRDA, which are merging as the bauxite residue raises in elevation:

- The Phase 1 BRDA is the older section of the BRDA, first established in 1983 and is situated in the northern section of the overall site. It includes the original Phase 1 BRDA footprint and the Phase 1 BRDA Extension footprint.
- The Phase 2 BRDA was commissioned in 2011 and constitutes the southern section of the overall BRDA site.

This assessment will establish both the baseline and proposed conditions within the Site initially, and then the wider conditions within the wider Study Area.


**Figure 10.2: Study Area (Red Line is the Application Boundary and Yellow Line is a 2 km offset)** Aerial Photo Source – Bing Maps (2013)

## 10.4 Legislation, Guidance and Policy Context

This section addresses the legislation and guidance that has been considered when preparing this Chapter, and key policy context relevant to the water environment that has guided the focus of the assessment.

### 10.4.1 Relevant Legislation

This assessment has been made with cognisance to relevant guidance, advice and legislation relating to the water environment, which have been used to steer the focus of the baseline information collection, the categorisation of receptor sensitivities, and the Proposed Development design measures that have been included.

- European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2018, S.I. 296 of 2018.
- Irish Government. Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment (2018).
- The EPA Guidelines on the Information to be Contained in Environmental Impact Assessment Reports (Draft, August 2017).
- European Commission. Environmental Impact Assessment of Projects: Guidance on the preparation of the Environmental Impact Assessment Report (2017).
- Institute of Geologists of Ireland. Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements (April 2013).
- Directive 2011/92/EU as amended by 2014/52/EU of the European Parliament and of the Council.
- S.I. No. 9/2010 – European Communities Environmental Objectives (Groundwater) Regulations) 2010, as amended by S.I. No. 149 of 2012 and S.I. No.366 of 2016.
- S.I. No. 272/2009 – European Communities Environmental Objectives (Surface Waters) Regulations 2009, as amended by S.I. No. 327 of 2012, S.I. No. 386 of 2015 and S.I. No. 77 of 2019.
- The EU Directive on the Assessment and Management of Flood Risks (2007/60/EC) is transposed into Irish law by the European Communities (Assessment and Management of Flood Risks) Regulations 2010 and its subsequent amendment. The legislation outlines the requirements for flood risk assessments to be completed as part of the planning process.
- Planning and Development Regulations, S.I. No. 600/2001, as amended.
- The European Union (EU) Water Framework Directive (WFD) (2000/60/EC) is the European legislation that establishes a framework for the protection of groundwater and surface water, including the establishment of river basin districts, the requirement to prevent further deterioration by preventing or limiting inputs of pollutants into groundwater, reducing pollution and promoting sustainable water use.
- The Groundwater Daughter Directive (GWDD) (2006/118/EC) sits beneath the WFD and relates to water protection and management. It establishes measures to prevent and control groundwater pollution, including criteria for assessing good chemical status and identifying trends.

The WFD and GWDD has been transposed into Irish law by means of many Regulations. These Regulations cover governance, the shape of the WFD characterisation, monitoring and status assessment programmes in terms of assigning responsibilities for the monitoring of different water categories, determining the quality elements and undertaking the characterisation and classification assessments. They include, but are not limited to, the following:

- European Communities (Water Policy) Regulations 2003 and its subsequent amendments;
- European Communities Environmental Objectives (Surface Waters) Regulations, 2009 and its subsequent amendments;
- European Communities Environmental Objectives (Groundwater) Regulations, 2010 and its subsequent amendments; and
- European Communities (Technical Specifications for the Chemical Analysis and Monitoring of Water Status) Regulations 2011.
- The Local Government (Water Pollution) Act 1977 (as amended) and associated Statutory Instrument Regulations made under that Act outline the general prohibition of entry of polluting matter to water, the requirement to licence both trade and sewage effluent discharges, licencing of water abstractions, controlling discharges to aquifers, and notification of accidental damages.

### 10.4.2 Relevant Guidance

Other guidance relating to the EIA process that has been used to guide the assessment of potential impacts to the water environment and the identification of relevant mitigation include:

- Best Available Techniques (BAT) Reference (REF) Document for the Management of Waste from the Extractive Industries in accordance with Directive 2006/21/EC; EUR 28963 EN (MWEI BREF, 2018).
- Gov.uk online guidance, Guidance on Land Contamination Risk Management (LCRM). Available at https://www.gov.uk/government/publications/land-contamination-risk-management-lcrm (2020). Uses a tiered approach to risk assessment, including preliminary risk assessment, generic quantitative risk assessment and detailed quantitative risk assessment.
- Department of Housing, Planning and Local Government Guidelines for Planning Authorities and An Bord Pleanála (ABP) on carrying out Environmental Impact Assessment (August 2018).
- EPA Guidelines on the Information to be Contained in Environmental Impact Assessment Reports, Environmental Protection Agency (Draft, August 2017).
- CIRIA C750: Groundwater control – design and practice (2016, Second Edition).
- CIRIA C741: Environmental Good Practice on Site (2015, Fourth Edition) in relation to source of impact and mitigation.
- Institute of Geologists of Ireland (IGI) Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements (2013).

- National Roads Authority Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes (2008c.) in relation to aspects to be considered and assessment approach (including relative receptor importance and cross discipline interactions).
- National Roads Authority Guidelines for the Creation, Implementation and Maintenance of an Environmental Operating Plan (2007) in relation to impact mitigation.
- The EPA's Environmental Management Guidelines: Environmental Management in the Extractive Industry (Non-Scheduled Minerals; April 2006).
- CIRIA C532: Control of water pollution from construction sites. Guidance for consultants and contractors (2001);
- Scottish and Northern Irish Pollution Prevention Guidelines (PPGs) and Guidance for Pollution Prevention (GPPs). These guidelines, although not Irish guidance, provide environmental good practice guidance for activities such as oil and chemical storage, works in or near water, works on construction sites, and dealing with spills and pollution incidents.

### 10.4.3 Local Policy

The National Planning Framework (Project Ireland 2040) includes National Policy Objective 60 to: *"Conserve and enhance the rich qualities of natural and cultural heritage of Ireland in a manner appropriate to their significance".*

Limerick City and County Council (LCCC) is currently preparing the new Limerick Development Plan 2022 – 2028. Consideration has been given here to both the existing Limerick County Development Plan 2010 – 2016 (as extended) prepared by Limerick County Council (LCC) and the proposed 2022 – 2028 plan.

The AAL facility is zoned as 'Marine Related Industry' in the existing Development Plan. Objective ED 06 notes that the purpose of this zoning objective is as follows:

> *"Land zoned for Marine Related Industry, shall provide for marine related industry and large scale uses that create a synergy with the marine use. Marine related industry shall be taken to include the use of land for industry that, by its nature, requires a location adjacent to estuarine/deep water including a dependency on marine transport, transhipment, bulk cargo or where the industrial process benefit from a location adjacent to the marine area."*

Specific policies relating to the protection of the water environment and management of surface water and groundwater include the following:

**Policy ED P7: Integrated planning of the Shannon estuary**

Facilitate integrated planning to develop the capacity of the Shannon Estuary as a prime transport, industrial development and tourist asset. LCCC will promote overall sustainable development within the Shannon Estuary and support all legislative environmental commitments provided in the Strategic Integrated Framework Plan for the Shannon Estuary, inter alia The EU Habitats Directive, The EU Birds Directive, The Floods Directive and the Water Framework Directive.

**Objective ED 04: Safeguard Strategic Development locations along the estuary**

It is the objective of LCCC to safeguard the Strategic Development Locations at Foynes Port, Foynes Island and Aughinish Island for the sustainable growth and development of marine related industry and industrial development at Askeaton.
All Proposed Developments shall be in accordance with regional and national priorities and the SEA Directive, Birds and Habitats Directive, Water Framework Directive, Shellfish Waters Directive, Floods Directive and EIA Directive.
Buffer zones shall be incorporated into proposals for developments where necessary to preserve potentially valuable habitats, for example, areas of estuary, shallow bays and inlets, mudflats, lagoon, salt marsh and woodland habitat which occur at or surrounding these Strategic Development Locations. The extent of such buffer distances shall be established in consultation with relevant statutory bodies. Detailed botanical, faunal and ornithological surveys should be undertaken in relation to Proposed Developments at these Strategic Development Locations to fully consider the potential effects of the development and inform how to best avoid significant ecological effects.

**Objective ED O29: Mineral Extraction and Environmental Impacts**

It is the objective of LCCC to:

a) minimise environmental and other impacts of mineral extraction through rigorous application of development management and enforcement requirements for quarry and other developments; and
b) in particular, to have regard to visual impacts, methods of extraction, noise levels, dust prevention, protection of rivers, lakes and other water sources, impacts on residential and other amenities, impacts on the road network (particularly with regard to making good any damage to roads), road safety, phasing, re-instatement and landscaping of worked sites.

**Objective EH O19: River Basin Management Plans**

It is the objective of LCCC to implement the programmes of measures developed by the River Basin District Projects under the Water Framework Directive in relation to:

a) Surface and groundwater interaction;
b) Dangerous substances;
c) Hydro-morphology;
d) Forestry;
e) On site wastewater treatment systems;
f) Municipal and industrial discharges;
g) Urban pressures; and
h) Abstractions.

**Policy IN P11: Management of Water Resource**

It is the policy of LCCC to seek to ensure water resources and services are managed and planned, in association with other policies and objectives in this plan, to meet the following goals:

i) To protect human health and the environment;
j) To facilitate the provision of proper water services for domestic and non-domestic requirements;
k) To support proper planning and sustainable development, including sustainable use of water resources; and
l) To ensure the danger of flooding risk is averted as far as possible and where flooding is inevitable its consequences minimised.

**Objective IN O25: Protection of Surface water bodies**

It is the objective of LCCC to ensure the integrity of surface water bodies is maintained; and where damaged, to seek, as resources allow, to restore their integrity. Priority will be given to those waters deemed to be sensitive in respect of their uses, and vulnerable due to low assimilation capacity. The Council shall give particular priority to the need to protect human health, designated habitats, and to minimise costs of water/wastewater treatment.

**Objective SE O16: Water Quality**

Development proposals in the Shannon Estuary Area will be required to have regard to the quality of the water resources in the area. They will be required to demonstrate that they will have no significant adverse consequences for water quality.

•

## 10.5 Assessment Methodology and Significance Criteria

This section presents the method used to assess the likely direct and indirect significant effects that the Proposed Development may have on the water environment. It establishes the stages of the assessment, and the qualitative criteria used to assess impact magnitude and determines the level of effect significance.

### 10.5.1 Qualitative Assessment Method

The assessment of potential effects has been undertaken using the qualitative assessment method outlined below and is supported by the baseline condition information, the preliminary Construction Environmental Management Plan (CEMP), the existing BRDA Water Management System and the Proposed Development design.

The Proposed Development design is understood to comprise the project design principles and standards adopted to avoid or prevent adverse safety and environmental effects, construction and operation to appropriate codes of practice and guidelines, and including fixed procedural commitments such as instrumentation and monitoring. This measure provides the baseline for the assessment of impacts.

The assessment follows a staged approach. A summary of the stages involved is included below:

1) Confirm baseline conditions – determine baseline and develop conceptual site model by consideration of available records and data sets, site reports and published information.
2) Confirm the key receptors and their value/importance.
3) Qualitatively characterise the magnitude of impacts on the receptors – describe what potential changes could occur to each receptor as a result of the Proposed Development, identify source-pathway receptor linkages, and assign the magnitudes of impact.
   This stage takes into account design standards and target criteria, monitoring data collected, assessments conducted for the existing BRDA water management systems, seepage assessments, good practice in construction environment management and pollution prevention.
4) Determine the initial effect significance of each potential impact on each sensitive receptor.
5) Consider the need for additional mitigation if it is considered necessary to reduce the initial magnitude of the impact and associated effect significance further.
6) Assess the residual impact magnitude and residual effect significance after all mitigation is applied.

Stages 1 and 2 have been completed using published literature and guidance along with the available information specific to the Proposed Development, which is presented in Chapter 2: Site Location and Context and Chapter 3: Project Description.

For the identification of receptor value/importance that completes Stage 2, and for the description of impact magnitude (Stage 3), a common framework of assessment criteria and terminology has been developed by Golder and is based on the EPAs Draft 2017 EIAR Guidelines. This framework follows a 'matrix approach' to environmental assessment which is based on the characteristics of the impact (magnitude and nature) and the value (sensitivity) of the receptor.

- The descriptions for value (sensitivity) of receptors are provided in Table 10.1 and the descriptions for magnitude of impact are provided in Table 10.2.
- The significant effect shown in **Error! Reference source not found.** is then derived from receptor value and the magnitude of impact. A description of the significance categories used is provide in **Error! Reference source not found.**.

The potential for an impact to occur at a receptor has been determined using the understanding of the baseline environment and its properties and consideration of whether there is a feasible linkage between a source of impact and each receptor, i.e., a conceptual site model.

This follows the method of preliminary risk assessment that is widely presented in some of the guidance documents listed in Section 10.4.1.

**Table 10.1: Environmental Value (Sensitivity) and Descriptions**

| Value (Sensitivity) of Receptor / Resource | Typical Description |
|---|---|
| **High** | High importance and rarity, national scale, and limited potential for substitution. For example:<br>• Global/European/National designation - or supports an internationally important feature.<br>• WFD river designation of 'High' and in hydraulic connectivity with the Site.<br>• Human health receptors.<br>• Regionally important aquifer with multiple wellfields.<br>• Inner source protection area for a regional resource.<br>• Regionally important potable water source supplying > 2,500 homes (surface water or aquifer).<br>• Floodplain protecting > 50 residential or commercial properties or nationally important infrastructure, e.g., motorways / national roads, from flooding. |
| **Medium** | Medium or high importance and rarity, regional scale, limited potential for substitution.<br>For example:<br>• Regionally important sites.<br>• Regionally important aquifer.<br>• Outer source protection area for a regional resource.<br>• Locally important potable water source supplying > 1,000 homes (surface water or aquifer). |
| **Low** | Low or medium importance and rarity, local scale.<br>For example:<br>• Locally important aquifer.<br>• Outer source protection area for a local resource.<br>• Local potable water source supplying > 50 homes (surface water or aquifer). |
| **Negligible** | Very low importance and rarity, local scale.<br>For example:<br>• Environmental equilibrium is stable and is resilient to impacts that are greater than natural fluctuations, without detriment to its present character.<br>• Poorly productive aquifer.<br>• Local potable water source supplying < 50 homes (surface water or aquifer). |

**Table 10.2: Magnitude of Impact and Typical Descriptions**

| **Magnitude of Impact (change)** | | **Typical Description** |
|---|---|---|
| **High** | Adverse | Loss of resource and/or quality and integrity of resource; severe damage to key characteristics, features or elements.<br>Significant harm to human health - death, disease, serious injury, genetic mutation, birth defects or the impairment of reproductive functions.<br>Significant harm to buildings/infrastructure/plant - Structural failure, substantial damage or substantial interference with any right of occupation.<br>Significant pollution of the water environment, which is defined by:<br>• A breach of, or failure to meet, any statutory quality standard for the water environment at an appropriate pollution assessment point.<br>• A breach of, or a failure to meet, any operational standard adopted by EPA for the protection of the water environment.<br>• Pollution results in an increase in treatment required for an existing drinking water supply.<br>• Pollution results in an increase level of treatment required of water abstracted for industrial purposes.<br>• Pollution results in deterioration in the status of a water body, failure to meet good status objectives defined by the Water Framework Directive, or failure of a protected drinking water area to meet its objectives as defined by the Water Framework Directive.<br>• There is a significant and sustained upwards trend in concentration of pollutants in groundwater being affected by the land in question.<br>• There is a material and adverse impact on the economic, social and/or amenity use associated with a particular water environment. |
| | Beneficial | Large scale or major improvement of resource quality; extensive restoration; major improvement of attribute quality. |
| **Medium** | Adverse | Loss of resource, but not adversely affecting the integrity; partial loss of/damage to key characteristics, features or elements. |
| | Beneficial | Benefit to, or addition of, key characteristics, features or elements; improvement of attribute quality. |
| **Low** | Adverse | Some measurable change in attributes, quality or vulnerability; minor loss of, or alteration to, one (maybe more) key characteristics, features or elements. |
| | Beneficial | Minor benefit to, or addition of, one (maybe more) key characteristics, features or elements; some beneficial impact on attribute or a reduced risk of negative impact occurring. |
| **Negligible** | Adverse | Very minor loss or alteration to one or more characteristics, features or elements. |
| | Beneficial | Very minor benefit to or positive addition of one or more characteristics, features or elements. |

The assessment of magnitude of the impact will consider whether the change that causes the impact is positive or negative, and whether the impact is direct or indirect, short-, medium- or long-term, temporary or permanent, and if it is reversible.

For the purposes of this assessment, a direct impact is one that occurs as a direct result of the Proposed Development and is likely to occur at or near the Proposed Development itself. Indirect impacts (or secondary / tertiary impacts) are those where a direct impact on one receptor has another knock-on impact on one or more other related receptor(s), e.g., the Proposed Development results in a change in groundwater quality, which then has an indirect impact on surface water quality and/or users of the water, such as human health or ecology. Indirect impacts can occur within the study areas or away from the Proposed Development.

For the purposes of this assessment, the following definitions of duration have been used:
- **Temporary** – effect likely to last less than 1 year without intervention;
- **Short-term** – effect likely to last 1 to 7 years without intervention;
- **Medium-term** – effect likely to last 7 to 15 years without intervention;
- **Long-term** – effect likely to last 15 to 60 years without intervention; and
- **Permanent** – effect likely to last over 60 years without intervention.
-

An irreversible impact is defined as a change to the baseline that would not reverse itself naturally. Such impacts will usually be permanent and irreversible, such as changes to the groundwater flow regimes caused by changes to the properties of the subsurface. A reversible impact is defined as a change to the baseline conditions that would reverse naturally once the source of the impact is exhausted, removed or has stopped.

### 10.5.2 Significance Criteria

The approach followed to derive effects significance from receptor value and magnitude of impacts (Stage 4) is shown in Table 10.3. Where Table 10.3 includes two significance categories, the reporting of a single significance category is supported by rationale provided in supporting text. A description of the significance categories used is provided in Table 10.4.

**Table 10.3: Significance Matrix**

| | | Magnitude of Impact (Degree of Change) | | | |
|---|---|---|---|---|---|
| | | Negligible | Low | Medium | High |
| **Environmental Value (Sensitivity)** | High | Slight | Slight or Moderate | Moderate or Large | Profound |
| | Medium | Imperceptible or Slight | Slight or Moderate | Moderate | Large or Profound |
| | Low | Imperceptible | Slight | Slight | Slight or Moderate |
| | Negligible | Imperceptible | Imperceptible or Slight | Imperceptible or Slight | Slight |

**Table 10.4: Significance Categories and Typical Descriptions**

| Significance Category | Typical Description |
|---|---|
| **Profound** | An effect which obliterates sensitive characteristics. |
| **Large** | An effect which, by its character, magnitude, duration or intensity alters a significant proportion of a sensitive aspect of the environment. |
| **Moderate** | An effect that alters the character of the environment in a manner that is consistent with existing and emerging baseline trends. |
| **Slight** | An effect which causes noticeable changes in the character of the environment without affecting its sensitivities. |
| **Imperceptible** | An effect capable of measurement but without noticeable consequences. |

Following the assessment of the level of effect significance, mitigation measures are presented that will be used to avoid, prevent or reduce the magnitude of the potential impact (Stage 5).

The significance of the effect, taking into account the mitigation, is then assessed (Stage 6) to give the residual effect significance.

Any monitoring that will be required to measure the success of the mitigation is also presented in residual impacts and effects tables in Section 10.10.

Residual effects of 'large' or 'profound' significance will be considered to be '**significant**' for the purposes of this assessment.

Residual adverse effects that are 'moderate', 'slight' or 'imperceptible' are those which at their highest effect are consistent with existing and emerging baseline trends and are considered to be '**not significant'**.
The criteria and terminology in Table 10.4 has been based on and is consistent with the EPA's Draft 2017 EIAR Guidelines. The EPA's 'Significant Effects' and 'Very Significant' categories have been combined into one 'Large' category.

Furthermore, the EPA's 'Not Significant' category has been combined with the 'Slight Effects' category. These substitutions provide conservatism by attributing a higher effects category to adverse effects. The removal of the 'significant' and 'not significant' terminology from the matrix stage of the method avoids confusion when an overall significance is attributed to the particular impact.

The effects of the Proposed Development will also be considered cumulatively with those that could foreseeably result from other known developments in the assessment study area that are going through the planning process.

## 10.6 Receiving Environment

This section presents baseline information on the water environment (hydrology, hydrogeology and flooding). An outline description is presented below. Refer to Chapter 8: Soils, Land and Geology for a more detailed discussion of these topics.

### 10.6.1 Location and Topography

The Application Site is located on Aughinish Island, Island MacTeige, Glenbane West and Fawnamore, within the property of the long-established alumina extraction plant operated by AAL. Aughinish Island and the surrounding areas are predominantly rural in character with the remaining land usage comprising agriculture, single low density residential housing and protected habitats (wetlands and grasslands).

AAL own a circa 601 ha. landholding (the Site) which is shown by the blue line on Figure 10.1 and is located on the southern side of the Shannon Estuary, near the village of Foynes, Co. Limerick. This is approximately 6 km north-west of Askeaton and approximately 30 km west of Limerick City. The BRDA portion of the Application Site is located in the south-western sector of the landholding and is circa 184 ha. in size, see

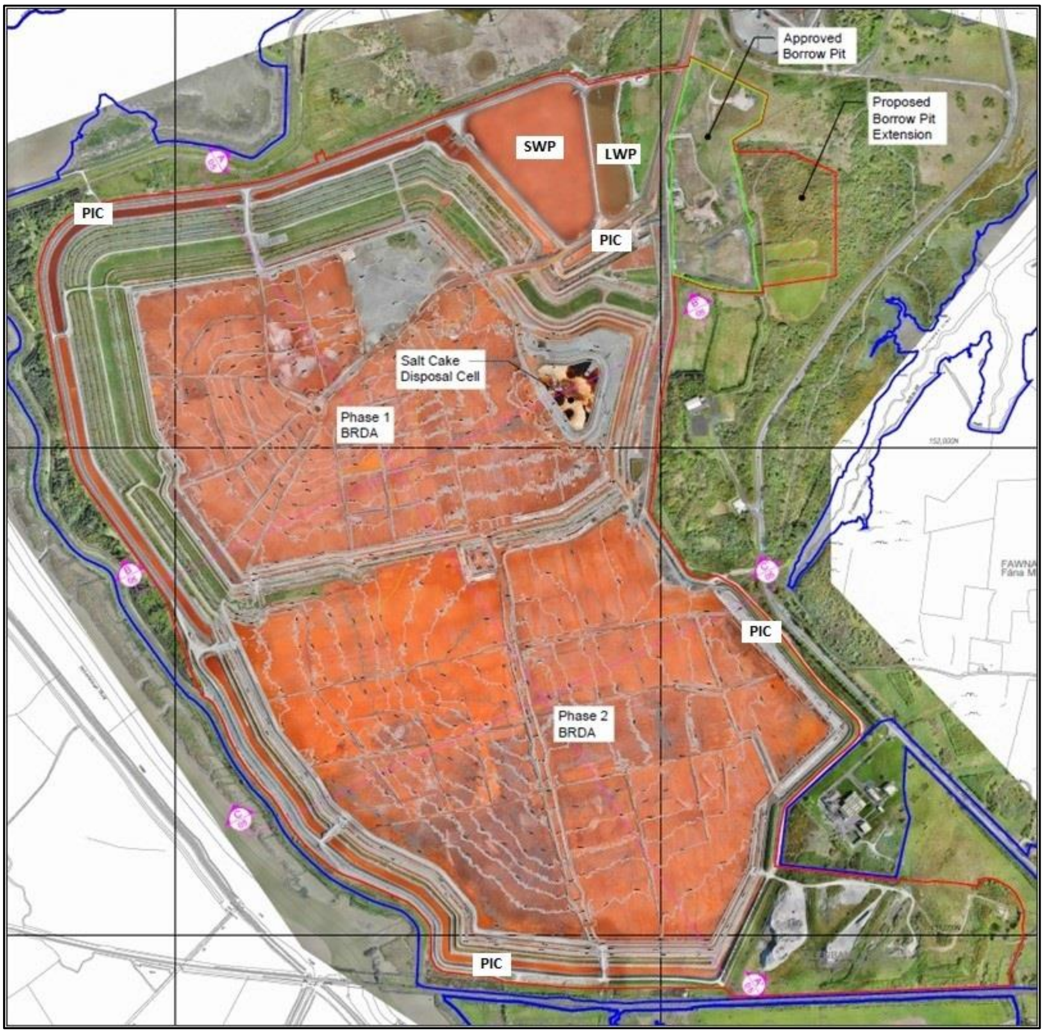



**Figure 10.3**.

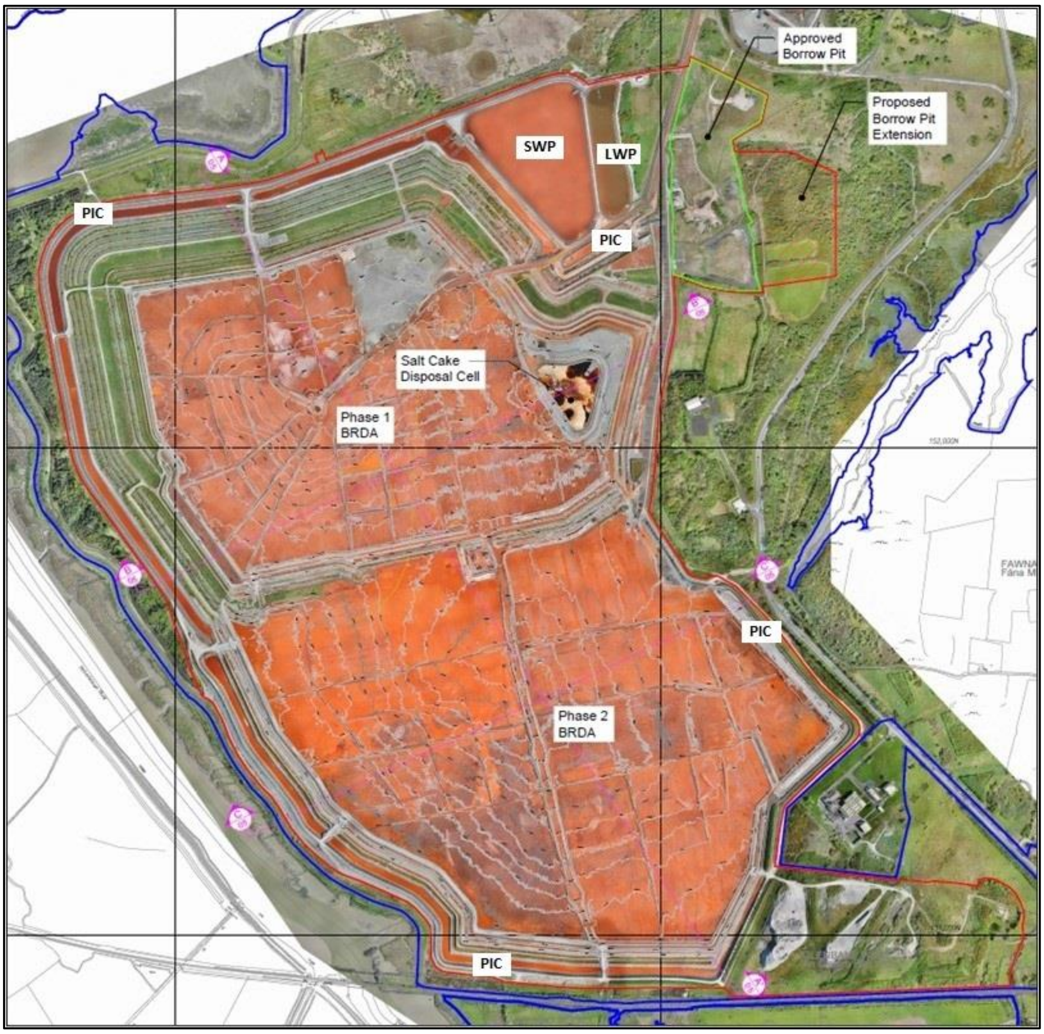



**Figure 10.3: BRDA Location Map**

The SCDC is located within the BRDA. The Borrow Pit Extension area is located towards the centre of the land holding. The Proposed Development seeks to extend the extraction footprint of the Borrow Pit from circa 4.5 ha. to circa 8.4 ha.

The topography of the Application Site currently varies from c. 22 mOD to 32 mOD in the Phase 1 BRDA, from c. 11 mOD to 20.0 mOD in the Phase 2 BRDA. The ground elevations at the downstream toe of the facility (pre-development ground elevations) vary from c. 1 mOD in the north to c. 6 mOD in the south. The BRDA portion of this Application seeks to raise the height of the existing BRDA, therefore the current baseline of the Proposed Development is located over the existing BRDA, which for the majority of the footprint has a downstream toe of c. 1.0 mOD.

The topography of the Borrow Pit Extension varies between 16 mOD and 20 mOD, with the higher ground located to the north-east of the footprint. The permitted Borrow Pit area comprises land which was previously disturbed ground which has been partly used as a compound area for an on-site Landscaping Contractor for AAL. The proposed Borrow Pit Extension area comprise land that is undisturbed and adjoins to east side of the permitted Borrow Pit. As identified in the 2017 Application for the original Borrow Pit (LCC Reg. Ref.: 17/714, ABP Ref. ABP-301011-18), the Landscaping Contractor has relocated to another area within the AAL landholding. The southern portion of the permitted Borrow Pit area comprises a former Borrow Pit which was previously associated with the construction of the original plant. The extraction works within this former Borrow Pit area were completed in 1982 and it has since been left to regenerate naturally. There is a difference in height of c. 9 m between the base of the former Borrow Pit (last used in the early 1980s) and the rest of the Site surface due to the previous extraction.

### 10.6.2 Soils

Historical mapping by Ordnance Survey Ireland (OSI) indicates that the bulk of the Phase 1 BRDA and the western sector of the Phase 2 BRDA is constructed over relatively flat, low-lying and poorly drained farmland (elevations between 0 mOD and 2 mOD), with the underlying soils comprising estuarine silts and clays with intermittent overlying thin till layers (sandy gravelly clay to silty sandy gravelly clay of low plasticity, typically 8% to 10%).

The estuarine silts and clays vary in depth from c. 10 m to 30 m along the northern perimeter of the Phase 1 BRDA (greatest depth at the north-east and north-west sectors), from c. 4 m to 10 m along the western perimeter of the Phase 1 BRDA, from c. < 1 m to 8 m along the north-western perimeter of the Phase 2 BRDA and are largely absent under the centre of the Phase 1 BRDA, under the Phase 1 BRDA Extension and under the bulk of the Phase 2 BRDA. Generally, two layers of estuarine soils were present, comparable to the findings from the investigation at the adjacent Foynes Harbour (Long 2018).

- **Sandy Silt Layer** – Generally occurs as the surface layer and some underlying layers. Characterised by a higher tip resistance (qt), in the form of spikes and higher undrained shear strength.
- **Silty Clay Layer** – Generally occurs underlying the Sandy Silt layers. Characterised by lower, more uniform tip resistance (qt), and lower undrained shear strength.

Baseline soil reporting in 1979 and 1983 identified two major soils units on Aughinish Island; the Rineanna Complex in Aughinish East and the Shannon Series in Aughinish West (An Foras Taluntais, 1979 and Fleming and Parle, 1983).

The Shannon Series dominates the baseline soil beneath the majority of the BRDA and all over the SCDC site; a small occurrence of the Patrickswell soils (of the Rineanna Complex) are noted within the Phase 2 BRDA and Phase 1 BRDA. The Shannon Series were identified to have formed from estuarine alluvium while the Rineanna Complex soils were identified to have formed from glacial drift and shallow limestone.

Soil sampling was originally carried out in May 1978 by An Foras Taluntais with 25 soil samples taken from the Rineanna Complex and the Shannon Series. Samples taken were analysed for pH, phosphorous, potassium, magnesium and arsenic. Up to 514 soil samples were analysed in June/July 1979 (Fleming GA & Parle PJ, 1983) from an area covering approx. 8 $km^2$, including both the BRDA and the Plant footprint. Sampling took place systematically at 20 $m^2$ gridline intersections. The summary results from the sampling programmes are presented below in Table 10.5.

**Table 10.5: Soil Substance Summary Statistics (Samples taken in 1979)**

| Variable | Unit | Count | Minimum | Maximum | Average |
|---|---|---|---|---|---|
| pH | pH | 539 | 4 | 8.5 | 6.2 |
| Phosphorous | ppm | 539 | 1 | 120 | 8.9 |
| Potassium | ppm | 539 | 6 | 645 | 192.5 |
| Magnesium | ppm | 25 | 100 | 940 | 314.4 |
| Arsenic | ppm | 50 | 3.8 | 25 | 14.2 |

The baseline range in pH of the soils is identified to be between 4 to 8.5 with an average of 6.2. Fleming GA & Parle PJ, (1983) noted that a number of key features should be noted regarding the regional soil geochemical signature. Clare Shales contain elevated selenium, molybdenum, uranium and arsenic. Natural arsenic had been reported in concentrations ranging from 5 to 55 ppm. In addition, soils partially derived from Shales, such as the Rineanna Complex, are likely to have high natural potassium content due to the presence of micaceous minerals. The Elton soil is reported as one of the highest potassium releasing soils in Ireland. Due to the development of the existing BRDA (including SCDC) site, the baseline soils were largely removed and/or covered by engineered containment and bauxite residue.

Soil mapping from An Foras Taluntais (1979) indicates that the soils at the permitted Borrow Pit and proposed Borrow Pit Extension site are composed of Patrickswell – lithic phase, Patrickswell and Burren-Ballincurra soils of the Rineanna Complex. Given the undisturbed nature of the proposed Borrow Pit Extension site, these soils remain in situ. As stated in the 2017 EIAR (TPA, 2017), much of the soil cover at the permitted Borrow Pit site has been removed due to previous activities, including the handling and temporary storage of overburden and for aggregate materials which were imported for use in the construction of the BRDA. The GSI's current Quaternary sediments mapping indicates that the soils at the permitted proposed Borrow Pit sites are a mix of till derived from limestones and karstified bedrock outcrop or subcrop (GSI, 2021).

A site investigation has previously been carried out at, and in the vicinity of permitted Borrow Pit footprint, with the drilling of six (6) boreholes (BH1, BH2, BH3, BH4 BH5 and BH6) during 2017 (Golder 2017A).

These boreholes were drilled to a depth of 15 m below ground level (bgl), and all encountered fine grained Waulsortian Limestone, refer to Appendix 8.1 of Chapter 8.0: Soils, Land and Geology for detailed logs. The locations of the boreholes are shown in Figure 10.4 below.

Soil cover was absent in both BH4 and BH6, however, soil was encountered to depths between 0.2 mbgl and 1.1 mbgl in the remaining four boreholes. Soil, when encountered, was described as a pale or pale to medium grey, silty gravelly overburden

Additional site investigation was carried out at and in the vicinity of the proposed Borrow Pit Extension footprint, with the drilling of four (4) boreholes (MW01, MW02, MW03 and MW04) in October 2020 and three (3) boreholes (MW05, MW06, MW07) in June 2021, see Figure 10.4 below.

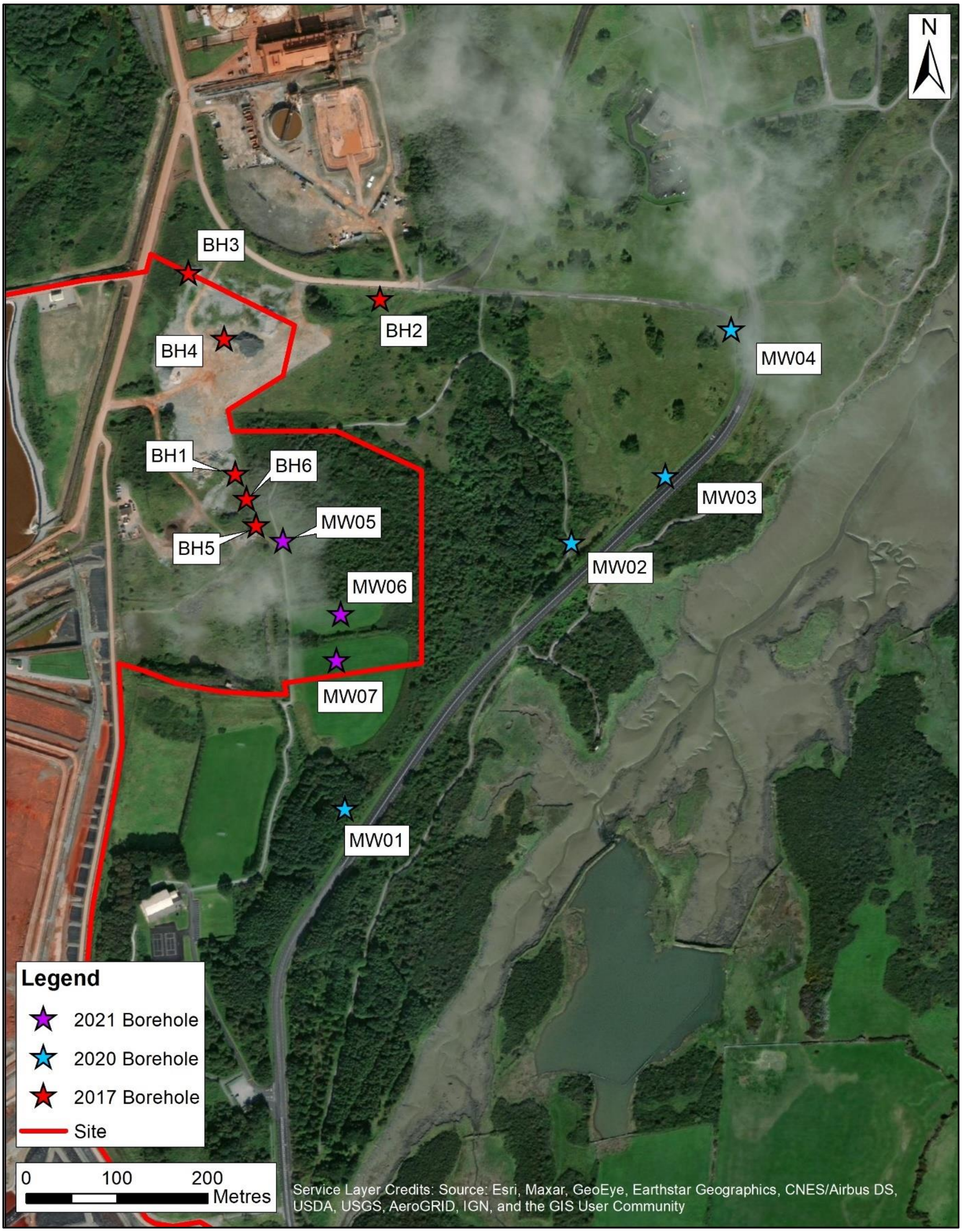



**Figure 10.4: Borehole locations (Red for 2017, Blue for 2020 and Purple for 2021) within and near the permitted Borrow Pit and the proposed Borrow Pit Extension footprints**

Similarly, these boreholes all encountered fine grained Waulsortian Limestone and were drilled to a depth of 15 m for MW01 to MW04 and to a depth of 20 m for MW05 to MW07. Soil cover was present at shallow depths of 0.15 mbgl to 0.4 mbgl and was identified as light to medium grey silty gravel (MW01 to MW04) or brown silty clay overburden (MW05 to MW07). The soil cover data from the investigations is in line with the original baseline mapping of AAL facility in 1979 which originally indicated a thin soil cover for the Rineanna Complex.

Within the wider Study Area, Quaternary sediments comprise several units, including till derived from limestone to the east, estuarine silts and clays to the west and an absence of mapped sediments to the north given the coastal nature of the area.

The topography of the AAL facility prior to 1978 and commencement of the development, was dominated by two limestone outcrops with elevations of 28.7 mOD and 19 mOD (Golder, 2014). These outcrops were located in the middle of the current Plant area, separated by a northeast-southwest trending valley, dipping towards the southwest. Extensive regrading works were carried out during construction of the Plant, with blasting of the two outcrops occurring, and ca. 1.6 million $m^3$ of crushed rock being used to infill the valley (Golder, 2014). Drift deposits were generally observed to be absent across the Plant area. However, the low-lying valley areas contained a thin layer of glacial channel fill comprising clayey sand and sandy clay with gravel, overlain by a substantial thickness of glacial clay with a proven depth of up to 42 m below ground level (mbgl) (Golder, 2014). The construction of the Plant area resulted in the majority of soils which were present in being either completed removed to bedrock or being covered over by sealed concrete slabs (Golder, 2014). It is considered that very little soil remains at the Plant area. Clark *et al.* (1981) noted the presence of glacial drift infill within varying diameter palaeokarst features inclusive of widened joints and bedding planes, minor cave passages, cylindrical cavities and a sediment infilled sinkhole in the Plant area.

Baseline soil investigations were reported in 1979 and 1983 as part of the original ground investigations for the AAL development. In the Plant area, these soils have since been removed or covered over by structures during the construction of the facility. However, the data serves to identify the regional composition of soil. The Rineanna Complex soils dominated the Plant area with some lesser areas of the Shannon Series to the east,

Soil quality monitoring was carried out in late 2016 and early 2017 by Golder as part of IE Licence P0035-06 (now P0035-07) monitoring requirements (Golder 2018, 2019B). The sample locations are dispersed around the perimeter of the BRDA and Plant areas. The soil quality monitoring report, along with a location map and a description of the soil samples is included in Appendix 8.2 of Chapter 8: Soils, Land and Geology.

Seven (7) samples were analysed for relevant compounds, including metals, semi-volatile organic compounds (SVOCs), gasoline range organics (GRO), extractable petroleum hydrocarbons (EPH), and nonyl phenol ethoxylates (Golder, 2018, 2019B).

The key findings from the soil quality monitoring report are summarized below and indicated that there was no noticeable significant impact from industrial activities:

- The soil pH ranged from 7.69 to 8.44, which does not show any significant acidification or alkalinisation. The operation of the Site uses caustic soda in the majority of processes but also uses acid in some processes. The results do not show any significant acidification or alkalinisation of the soils from industrial activities.

- Samples were analysed for aluminium, arsenic, cadmium, lead, mercury, nickel, sodium, and total sulphate.
- Concentrations of aluminium ranged from 1,893 to 16,060 mg/kg (0.1% - 1.6%). Aluminium is the third most abundant element in the Earth's crust and concentrations in soils can range from 4% to 5% regionally. The facility is an alumina refinery and the results do not show any noticeable significant impact from industrial activities.
- Concentrations of arsenic ranged from 2.9 to 23.1 mg/kg, which is below the geochemical signature for the area and therefore not significant. Soil sampling in 1979 by Fleming GA & Parle PJ (1983) in Area A (1 mile radius from the plant site) identified arsenic levels between 8.5 mg/kg and 55 mg/kg and in Area B (a 2-mile radius beyond Area A) As values ranging from 3.8 to 25 mg/kg.
- No mercury was detected in any samples.
- The range and concentrations of the other heavy metals detected in the soils sampled from the seven (7) locations are generally typical of soil background levels in Ireland.
- No samples exhibited potential evidence of impact from industrial activities with regards to hydrocarbons, e.g., no extractable petroleum hydrocarbons or gasoline range organics were detected.
- No SVOCs were detected in these samples.
- Nonyl phenol ethoxylates are non-ionic surfactants that are used in lubricating oil additives, detergents, and emulsifiers that are of environmental concern due to their ability to mimic the hormone oestrogen, which is of special concern to the reproduction of aquatic organisms. They have a low mobility in soils and sediments and can bioaccumulate. No nonyl phenol ethoxylates were detected in any samples.

### 10.6.3 BRDA and SCDC Areas – Made Ground

AAL produces alumina ($Al_2O_3$) by treating bauxite ore using the Bayer process which involves the dissolution of aluminium hydrate ($Al_2O_3.3H_2O$) from the bauxite under high pressure in sodium hydroxide (caustic soda). Four (4) waste streams derived from the extraction process are deposited in the BRDA and comprise the made ground when deposited. Bauxite residue and process sand are the primary waste streams that comprise the bulk of the material deposited:

- Hydraulic deposition (pumped) discharge of bauxite residue paste (≈ 90.6% bauxite residue, AAL AER 2020) is from 'Mud Points' located centrally within the BRDA into purpose-built cells. Cell bunds are constructed from farmed bauxite residue using a bulldozer and low ground pressure excavators and their locations correspond to the annual design deposition plan. The bauxite residue can be further directed into selected areas or sub-cells of the BRDA by rotating and/or extending spigots at the end of the discharge points. Bauxite residue paste then migrates by gravity to perimeter stage raises and/or cell bunds at between 2% and 4% grade, and dewatering occurs through the rock fill of the stage raises, which then migrates to the perimeter interceptor channel (PIC) encompassing the BRDA. Layered deposition to aid dewatering of the paste has been implemented since start-up and AAL have engaged intensive mud-farming techniques since 2009.

- Process sand (≈ 6.9% process sand, AAL AER 2020) is poorly graded, medium sand by-product, primarily resulting from the addition of limestone in the early stages of the Bayer process. It is removed at the clarification stage by sand traps and is hauled from the AAL Plant by dumper and tipped at designated locations in the BRDA. It is typically used in the construction of internal haul roads, ramps and berms in the BRDA.

The secondary waste streams are:

- Scales and sludges (≈ 1.5%, AAL AER 2020) arise from maintenance of plant infrastructure and are removed periodically, and subsequently hauled and tipped at internal designated areas within the BRDA.
- Salt cake (≈ 1.0%, AAL AER 2020) is a by-product of the process of purification of the caustic soda liquor used in the alumina extraction process from the bauxite ore.

Salt cake is classified as a hazardous waste and is required to be segregated from the bauxite residue within the BRDA i.e., within the composite lined, independent SCDC.

The bauxite residue, process sand, scales and sludges deposited in the BRDA are classified as non-hazardous according to the European Waste Catalogue. Salt cake is classified as hazardous and is deposited in the SCDC, an independently lined engineered cell located within the BRDA.

The BRDA falls within the scope of Directive 2006/21/EC on the management of waste from the extractive industries.  The BRDA is a Category A waste facility.

AAL conduct chemical analyses of the farmed bauxite residue and the salt cake composition on a regular basis and the analyses are provided in Chapter 8: Soils, Land and Geology. A summary of the data for each waste stream is provided below:

- The five (5) principal compounds of the farmed bauxite residue, which account for ≈ 75% of the composition, are Moisture, Aluminium Goethite, Hematite or Ferric Oxide (which accounts for the characteristic colour), Calcium Cancrinite and Bayer Sodalite. These five (5) compounds have no associated hazardous classification.

Bauxite residue is generally regarded as a thixotropic clayey silt and there is an indication that bauxite residues may be cemented or aggregated.  The bauxite residue particles are sub-rounded, friable with a low crushing strength. The amorphous particles have a capacity to retain moisture, generally at 1% to 3% of the moisture content (Golder 2014).

Based on the mineralogy, it can be expected that the bauxite residue would not behave as a clay but would exhibit properties similar to those of a granular silt. The majority of the material is clay and silt size.  About 90% by weight of the bauxite residue is finer than 40 microns and the $D_{50}$ is between 2 and 5 microns (0.002 to 0.005 mm). Moisture content values typically range between 32% and 45% for unfarmed bauxite residue and typical range between 29% and 36% for farmed bauxite residue (Golder testing from 2004 to 2019). The aqueous solution entrained within the bauxite residue during the pumping from the Plant contains a small amount of residual dissolved caustic and alumina. It is this residual caustic which initially gives the bauxite residue paste its elevated pH (12 to 13). Exposure to air during the mud farming and carbonation phase permits most of the caustic soda to convert to sodium carbonate and sodium bicarbonate with a consequent reduction in pH to < 11.5. The density and geotechnical strength parameters are also enhanced by the process.

- Process sand is extracted from bauxite and is classified as a poorly graded, medium sand. The mineral grains are amorphous or very poorly crystalline and comprise red brown friable particles of oxides, hydrated oxides and oxi-hydroxides such as boehmite, goethite and gibbsite which are sub rounded and readily crushed between the fingers. 100% of the particles are less than 2 mm in diameter, ≈ 50% of particles between 2 mm and 0.425 mm in diameter and ≈ 96% of particles greater than 0.063mm in diameter. Moisture content values range from 13% to 23%.
- The scale and sludges removed from the plant infrastructure during maintenance programs are similar in nature and characteristics to either the bauxite residue paste or the process sand and are deposited in the BRDA in accordance with the IE Licence.
- Salt cake - by-product of the process of purification of the caustic soda liquor used in the alumina extraction process from the bauxite ore. Salt cake is classified as a hazardous waste and is required to be segregated from the bauxite residue within the BRDA. A dedicated, independent, composite lined SCDC is located within the Phase 1 BRDA Extension (eastern sector of the Phase 1 BRDA) and overlies a 17m to 18m depth of deposited unfarmed bauxite residue which has a characteristic hydraulic conductivity value of $5.0 \times 10^{-9}$ m/s. The Phase 1 BRDA Extension basin is also composite lined, comprising a 2 mm thick HDPE geomembrane overlying a compacted clay liner. The salt cake has a high concentration of caustic soda (≈ 40%), Oxalate (≈ 26%), Alumina (≈ 16%) and Organic Carbon (≈ 11%). The caustic liquor is decanted from the cell via a caustic recovery system (decant tower, recovery pipeline and recovery tank) and is recycled in the Plant.

The north-eastern BRDA site is composed of the Liquid Waste Pond (LWP) and Storm Water Pond (SWP), both of which are engineered lined ponds. Leachate and storm water from the BRDA is pumped to the Storm Water Pond prior to treatment and disposal.

The Phase 1 and Phase 2 of the BRDA are surrounded by a Perimeter Interceptor Channel (PIC) which is formed by constructing outer and inner perimeter embankment walls. The Phase 1 and Phase 2 PICs connect at the west sector of the facility where the Phase 1 and Phase 2 BRDAs' adjoin.

The Phase 1 BRDA was formed from two facilities, (Original BRDA and the Phase 1 BRDA Extension) which merged over time. The original BRDA basin is not lined but is underlain by the low permeability estuarine soils. The Phase 1 BRDA Extension basin is composite lined, comprising a 2 mm thick HDPE geomembrane overlying a compacted clay liner.

The Phase 2 BRDA area is a southern extension of the Phase 1 BRDA and is merged into the south slope of the Phase 1 BRDA. The Phase 2 BRDA basin is composite lined, comprising a 2 mm thick HDPE geomembrane overlying a GCL and/or a compacted clay liner.

The Phase 2 BRDA was granted planning permission in 2007 and was commissioned in 2011. The maximum permitted elevation of the perimeter of the BRDA is 24 mOD (Stage 10) and the maximum permitted dome crown elevation is 32 mOD.

The eastern sector of the BRDA (Phase 1 BRDA Extension and the eastern sector of the Phase 2 BRDA) is constructed over a ridge of outcropping crop, sloping upwards from west to east, which had intermittent cover of till material in minor depths.

Preliminary works were undertaken on this ridge prior to the installation of the basal lining system; mechanical grading was undertaken for the Phase 1 BRDA Extension and blasting, and mechanical grading was carried out for the eastern sector of the Phase 2 BRDA. Further grading, shaping and surface dressing with a compacted layer of till (minimum 1m depth) was then carried out in both footprints to provide a subgrade for the installation of the composite lining system during construction (1996 - 1998 for the Phase 1 BRDA Extension, and 2010 - 2011 for the Phase 2 BRDA).

Unlike conventional tailings facilities or water retaining dams, the BRDA retains little to no surface water on the bauxite residue surface. The bauxite residue is discharged as a paste from several near central discharge points to form a dome which typically has the apex some 6m to 8m above the perimeter stack wall elevation.

The BRDA itself is built upwards in a series of upstream raised 2 m high berms known as 'stage raises'. The stage raises are constructed of processed limestone rock fill which is separated from the underlying bauxite residue by a layer of separation geotextile. Monitoring instrumentation comprising piezometers, extensometers and inclinometers are installed around the perimeter of the raise at designated stage raises and along designated sections in accordance with the Physical Stability Monitoring Plan for the BRDA (Golder 2021A).

Since 2009, the deposited bauxite residue has been 'farmed' and includes the bauxite residue in the Phase 1 BRDA from above Stage 6 (16 mOD) and all of the Phase 2 BRDA. The farming process consists of ploughing and aerating bauxite residue for a prolonged period (the process typically takes 5 to 6 months) to reduce the pH < 11.5, prior to placing the next layer.

The carbonation process during farming permits carbon dioxide in the atmosphere to react with the high pH hydroxide components of the bauxite residue, forming carbonates and thus reducing the pH of the bauxite residue.

### 10.6.4 Land Use within the Study Area

The BRDA, the SCDC and the Borrow Pit Extension footprints all sit within AAL facility's industrial site footprint.

The current land use for the area of the Proposed Development (including the extension of the BRDA and the construction of a new SCDC), is the existing BRDA; Corine (2018) land mapping identifies this area as 'industrial or commercial units'.

Corine (2018) identifies the land use for the proposed Borrow Pit Extension as 'land principally occupied by agriculture with areas of natural vegetation'. The land use for the permitted Borrow Pit site is referred to as 'industrial or commercial units'. No agricultural activities take place currently on the proposed Borrow Pit Extension site, rather it is a vegetated area within the wider AAL plant site.

The wider Study Area identifies several different land types within Aughinish Island and surrounding townlands (Island MacTeige, Glenbane West and Fawnamore). The predominant land use to the south of the Site is pastoral farming / agricultural, within which some areas may contain naturally vegetated areas (Corine, 2018).

- To the north of the Site is a small stretch of salt marsh.
- To the east of the Site is a noted mixed use of land with 'industrial or commercial units' denoting the main AAL facility to the north-east which transitions into agricultural land with areas of natural vegetation and pastureland further east.
- To the south of the Site is noted intertidal flats which transitions into mixed pastureland. An area of transitional woodland scrub is noted to the southeast of the Site. However, the central area in this zone is occupied by the Roadstone owned Barrigone Quarry which is an operational limestone quarry and may be considered a 'mineral extraction site' under the Corine land cover system.
- To the west of the Site, Corine 2018 mapping notes an area of mixed pastureland and industrial or commercial units around Foynes.
-

In addition to land areas in the Study Area, there are notable regions, which are occupied by waterbodies, and these surround the Site to the west and north and also occur further to the east.

The Shannon estuary is noted as 'estuaries', with 'intertidal flats' noted as occurring in the intertidal zones north, west and east of the Site (Corine, 2018).

A review of available aerial imagery in the area (Google Maps, Geohive) was undertaken to see if other designations are applicable. One-off housing or ribbon development is common in the area along the road network approaching the Study Area from the south-east and east (along the L1234 and L6064), in areas previously noted as pasture or agricultural with natural vegetation.

### 10.6.5 Bedrock Geology

#### *Site Area*

The mapped bedrock geology (GSI, 2021) comprises Waulsortian Formation limestones beneath the eastern sector of the BRDA and the in the area of the Borrow Pits and the Plant. The overlying Rathkeale Formation limestones and mudstones underlie the central and western sectors of the BRDA (Figure 10.5).

The Waulsortian Formation is characterised as a medium bedded to massive, fine to coarsely crystalline, blue grey limestone. The Rathkeale Formation is characterised as impure muddy limestones and shaley mudstones.

Aggregate potential mapping (GSI, 2021) classifies the BRDA site area as having 'low' or 'very low' potential as a source for extracting rock to crush, while the Borrow Pit sites are classified as having 'very high' potential,

Structurally no major faults have been identified by the GSI at the Site.

Bedding underlying the BRDA area dips gently to the west, while bedding near the Borrow Pit sites dips shallowly to the east indicating that the bedrock sequence is gently folded within this area with a fold axis striking NNE - SSW.

A broadly folded sequence was imprinted on the area during the Variscan (formerly Hercynian) orogeny. It is noted by Clark et al (1981) that Aughinish Island sits on the western limb of the Shannon Anticline, which plunges gently WSW along the estuary.

Borehole drilling has taken place on the BRDA site since the 1980s to install monitoring wells around the periphery of the BRDA to act as observation wells.

Bedrock was encountered at varying depths beneath the BRDA site with rock either at surface or up to 27 mbgl. Within the Application Site, bedrock is generally at or near surface for the eastern sector of the BRDA and the Borrow Pit Areas.

The greater depths to bedrock occur along the north-eastern flank (west of the SWP) and the western flank of the Phase 1 BRDA.

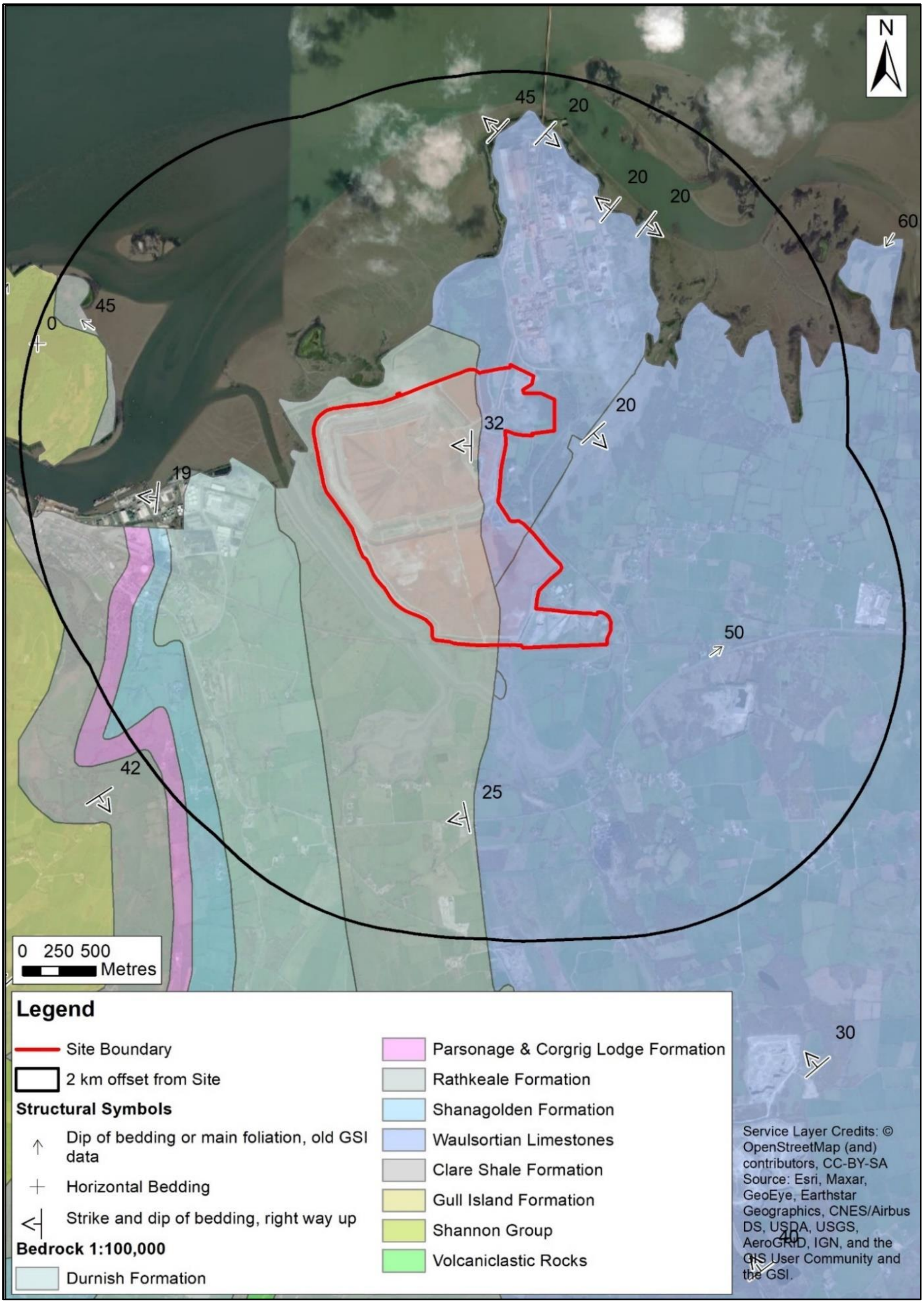



**Figure 10.5: Bedrock Geology 1:100,000 map (GSI, 2021)**

Beneath the Borrow Pit sites, the mapped bedrock geology (GSI, 2021) comprises Waulsortian Formation limestones beneath the Borrow Pit sites. Site investigations has been carried out in the vicinity and within the northern perimeter of the permitted Borrow Pit footprint , including borehole / monitoring well drilling and geophysical surveying (Figure 10.6 below).

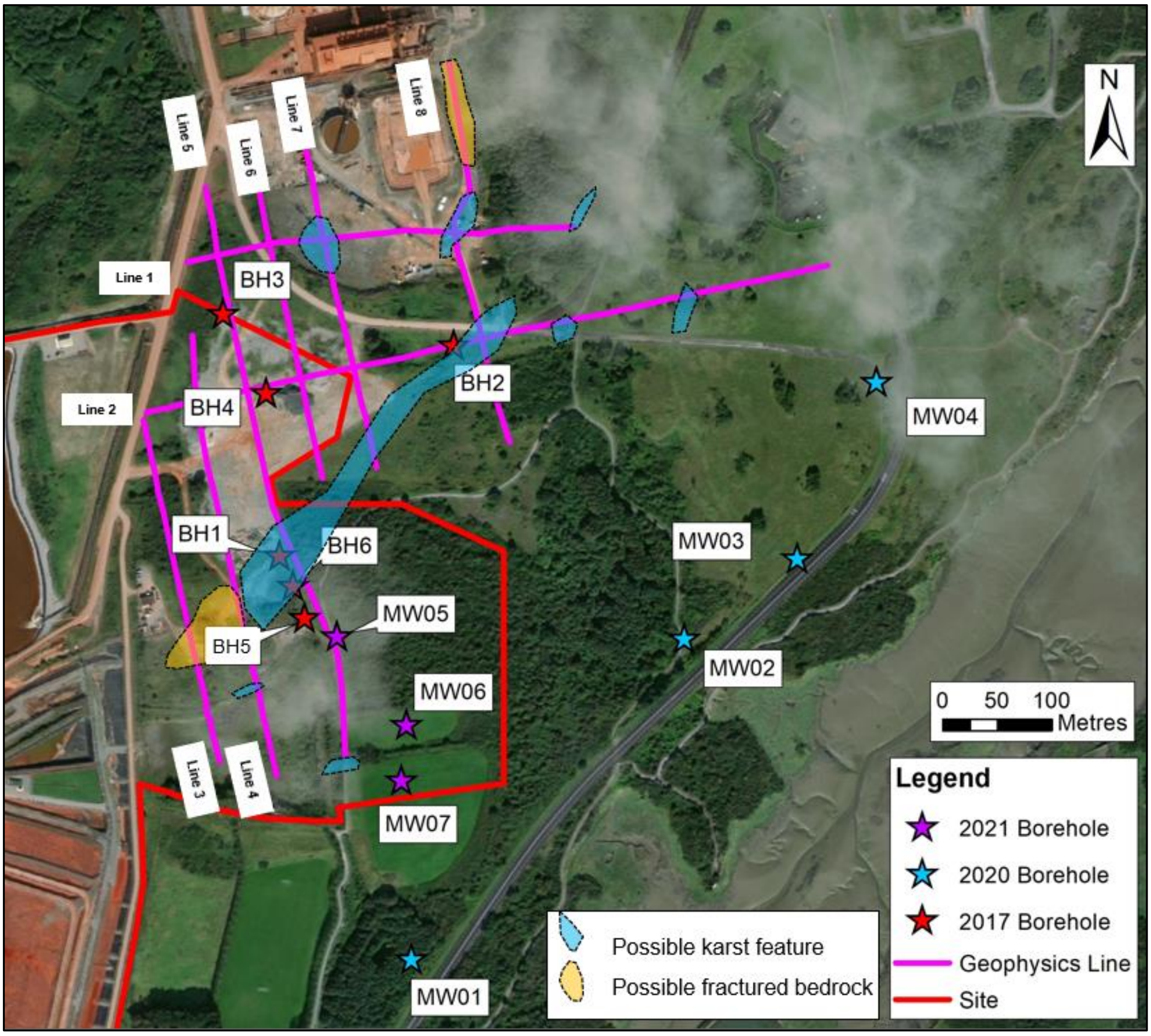



**Figure 10.6: Site Investigations (2017, 2020 and 2021) in the vicinity of the Borrow Pit sites**

Pseudo-sections indicate that the overburden thicknesses are shallow within the area (typically < 1m) and that discrete fracture zones / palaeokarst features are present.

A review of the borehole logs, which were drilled as part of site investigations for the permitted Borrow Pit, indicate that bedrock is a pale to medium grey, fine-grained limestone (Golder, 2017). Soil cover was absent in both BH4 and BH6, with soil encountered at depths between 0.2 mbgl and 1.1 mbgl in the remaining four boreholes. Bedrock was encountered at ground level in BH4 and BH6, and is composed of a pale to medium grey, fine-grained limestone. A thin soil cover (c. 0.2 mbgl) was present in BH5 and in BH3 (c. 0.3 mbgl) before a pale to medium grey fine-grained limestone was encountered. Bedrock was encountered at 1.1 mbgl in BH1. and was noted as compositionally the same as that in the other boreholes. Cavities were observed in all BH2, BH3, BH5 and BH6, including a 2 m cavity at a shallow depth (3 mbgl) in BH6.

Additional site investigation was carried out at, and in the vicinity of the proposed Borrow Pit Extension footprint, with the drilling of four (4) boreholes (MW01, MW02, MW03 and MW04) in October 2020 and three (3) boreholes (MW)5, MW06, MW07) in June 2021. Similarly, these boreholes all encountered fine grained Waulsortian Limestone with discrete fracture zones / palaeokarst features present. The boreholes were drilled to a depth of 15 m for MW01 to MW04 and to a depth of 20m for MW05 to MW07.

**Study Area**

The mapped bedrock geology (GSI, 2021) comprises several Carboniferous formations including the Clare Shale, Parsonage & Corgrig Lodge, Shanagolden, Durnish, Rathkeale and Waulsortian Limestone Formations (Figure 10.7).

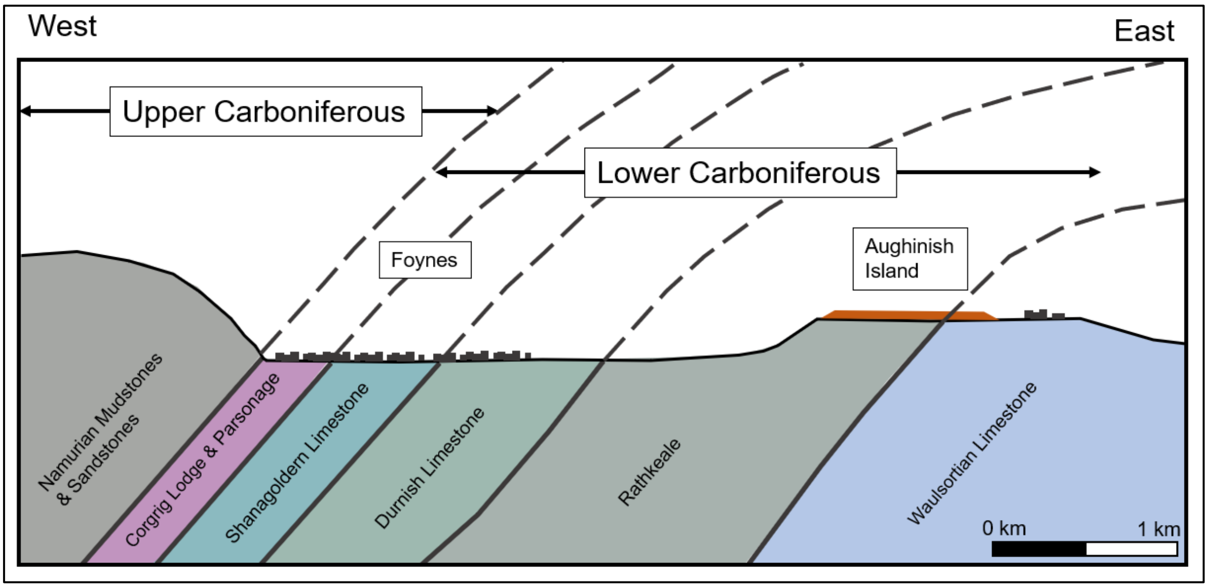



**Figure 10.7: Schematic geological section showing stratigraphy between Foynes and Aughinish Island (after Clark et al, 1981).**

Whilst no major geological faults have been identified by the GSI in the BRDA footprint, geological investigations in the area have previously identified several faults which trend northeast-southwest across the Plant area. These fault zones are highlighted by the presence of northeast-southwest trending valleys, which have been subsequently infilled with glacial drift and then limestone fill during construction of the facility in the 1970s.

Both primary and secondary altered limestones have been identified at the Plant area. Primary dolomitic limestones comprise light grey to crystalline rock, often with thin laminations of argillaceous material and chert (Golder, 2014). The alteration of limestone to primary dolomitic limestone is described by Clark et al. (1981) as having been formed by the inundation of brines soon after deposition; primary dolomitic limestone is identified in either lenses or entire basin areas. On the other hand, the alteration of limestone to secondary dolomitic limestone is described by Clark et al. (1981) to have been altered by the circulation of magnesium-rich fluid through fault and fracture zones. On the Plant Site secondary dolomitic limestones have been observed in linear zones up to 30 m wide and have been entirely altered to a yellow-brown or pink secondary dolomite.

Weathering of the primary and secondary dolomitic limestones in places has resulted in the formation of weathered profiles ranging from weak friable rocks to yellow-brown dolomitic sand depending on the increasing degree of weathering. Weathering of the dolomitic limestone in places has also caused the generation of karst-like features.

The grading process on the Plant area, which commenced in 1978 whereby c. 1.6 million $m^3$ of rock was blasted and removed, or redistributed, allowed for detailed site investigation work to be carried out on the bedrock geology (Clark *et al.,* 1981).

A geological model was developed from this work, which identified that bedrock on the Plant site exhibits a mound and basin structure. Mound areas are typically tens to hundreds of metres across and are represented by medium-bedded to massive, fine to coarsely crystalline, blue-grey limestone, which forms a major part of the island (Clark *et al*., 1981). The basin areas are the intervening areas or lagoonal areas, which favoured the formation of thinly bedded, finely crystalline, blue-grey limestone and in places a light grey, dolomitic limestone (Clark *et al.*, 1981).

**Palaeokarst**

Drilling during historical ground investigation work identified a number of minor palaeokarst features, i.e., infilled ('choked') cavities and fissures, in the Waulsortian Limestone in the vicinity of the Plant Site.

Similar features were encountered in boreholes drilled as part of investigations related to the Borrow Pit areas and the BRDA footprint (the eastern sector of the BRDA footprint is underlain by Waulsortian Limestone). As is the case with the Plant Site, the palaeokarst features intersected under the Borrow Pit Areas and BRDA were found to be 'choked' with sediment, usually consisting of sand sized grains of dolomite, indicating in-situ alteration of the host rock rather than transported material associated with collapse, or extensive cave systems.

Electrical Resistivity Imaging (ERI) surveys have previously been carried out on the downstream side of the BRDA footprint on Glenbane West and Fawnamore side of the facility to assist in the locating of monitoring wells W1 to W9. The results of the ERI surveys together with follow-up drilling indicated massive Waulsortian Limestone with little structure and no indication of palaeokarstic features.

### 10.6.6 Hydrology

#### *10.6.6.1 Regional Hydrology*

The regional area drains to the Shannon Estuary which is designated as a Special Area of Conservation (SAC).

Along a stretch of coast adjacent to the overall Aughinish Site, and within the wider Study Area, mudflats are exposed at low tide which are listed in the conservation objectives of the

SAC with the objective of maintaining a stable or increasing area of habitat, subject to natural processes.

Rivers within the Study Area drain predominantly to the Robertstown River before entering the Shannon Estuary further north. Rivers within the Study Area which flow in Foynes, drain directly into the Shannon Estuary.

The River Shannon and River Fergus Estuaries Special Protection Area (SPA) also cover the area of the Shannon Estuary adjacent to the Site and within the wider Study Area.

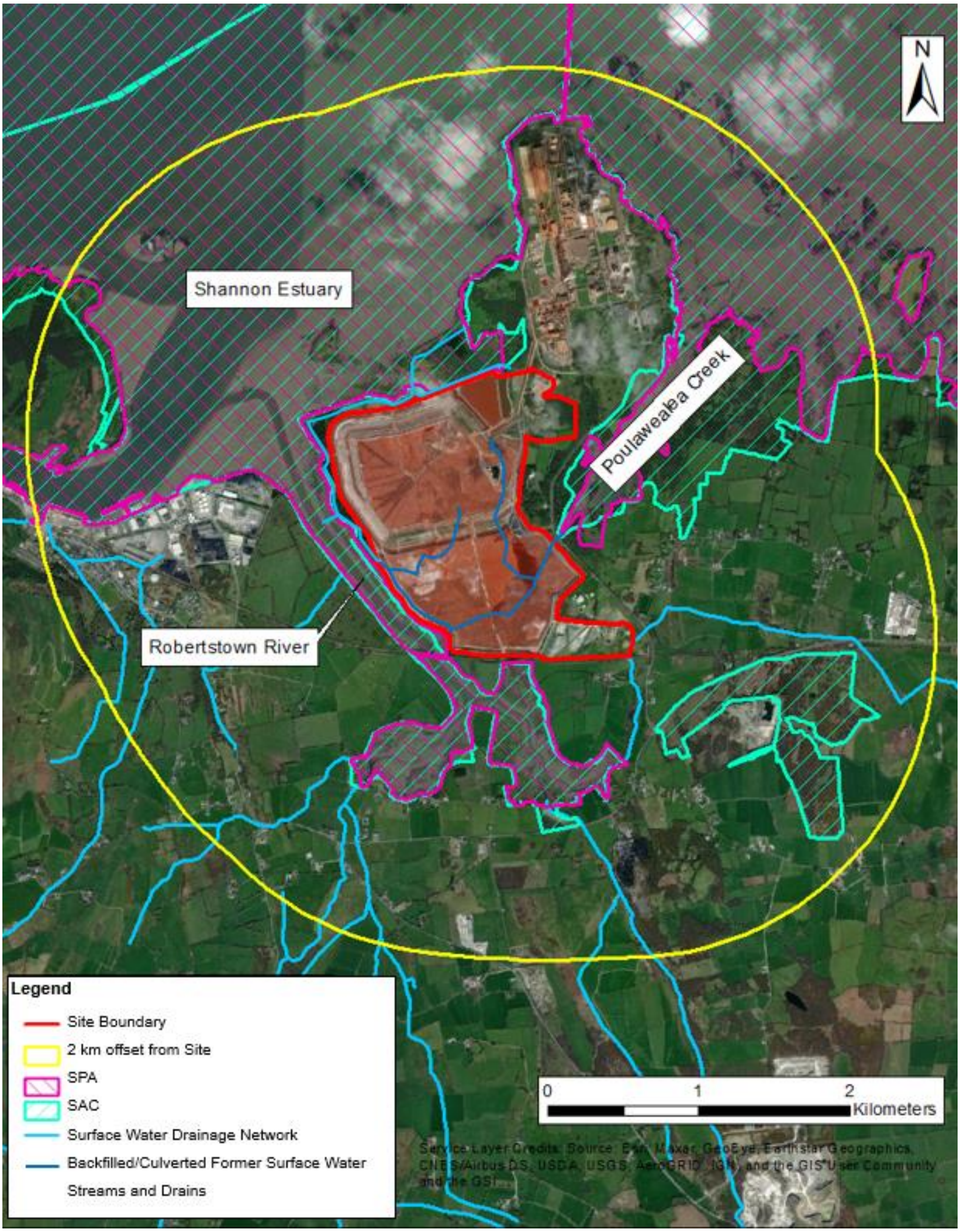



**Figure 10.8: Water Features at the Site and in the Study Area (NPWS and EPA 2021)** Aerial Photo Source – Bing Maps (2013)

#### *10.6.6.2 Local Hydrology*

The Proposed Development is located within the Irish River Basin District as per the 2nd cycle River Basin Management Plan published in April 2018 which replaces the 1st cycle river management plans (2009-2015).
Aughinish Island is within the Lower Shannon Estuary Transitional Water Body. The EPA data indicates that water quality in this transitional estuarine reach of the River Shannon is of "good" status. This is based on the EPA's assessment cycle 2013-2018.

The overall Aughinish Site is bounded to the north and west by the Shannon Estuary, to the east by Poulaweala Creek and to the southwest by the Robertstown River, to form Aughinish Island. The Poulaweala Creek, a former estuarine channel, which originally divided Aughinish Island from the 'mainland' to the south at Island MacTeige and Glenbane West, was partially culverted and infilled with coarse rock fill during the development of the Phase 2 BRDA.

On the island, eighteen (18) groundwater discharge points of measurable flow are identified. Sixteen (16) of the discharges, known as the Estuarine Streams (ES1 to ES16), are located around the perimeter of the Plant site. The locations of the springs generally correspond to areas that were infilled during the site regrading works (dominantly fracture zones). The springs are submerged during part of the tidal cycle and their flow varies significantly with seasonal fluctuations in rainfall.

Figure 10.9 below presents the surface water drainage pattern associated with the Site overlain on a recent aerial. No streams are present in the vicinity of the proposed Borrow Pit Extension site or the permitted Borrow Pit site.

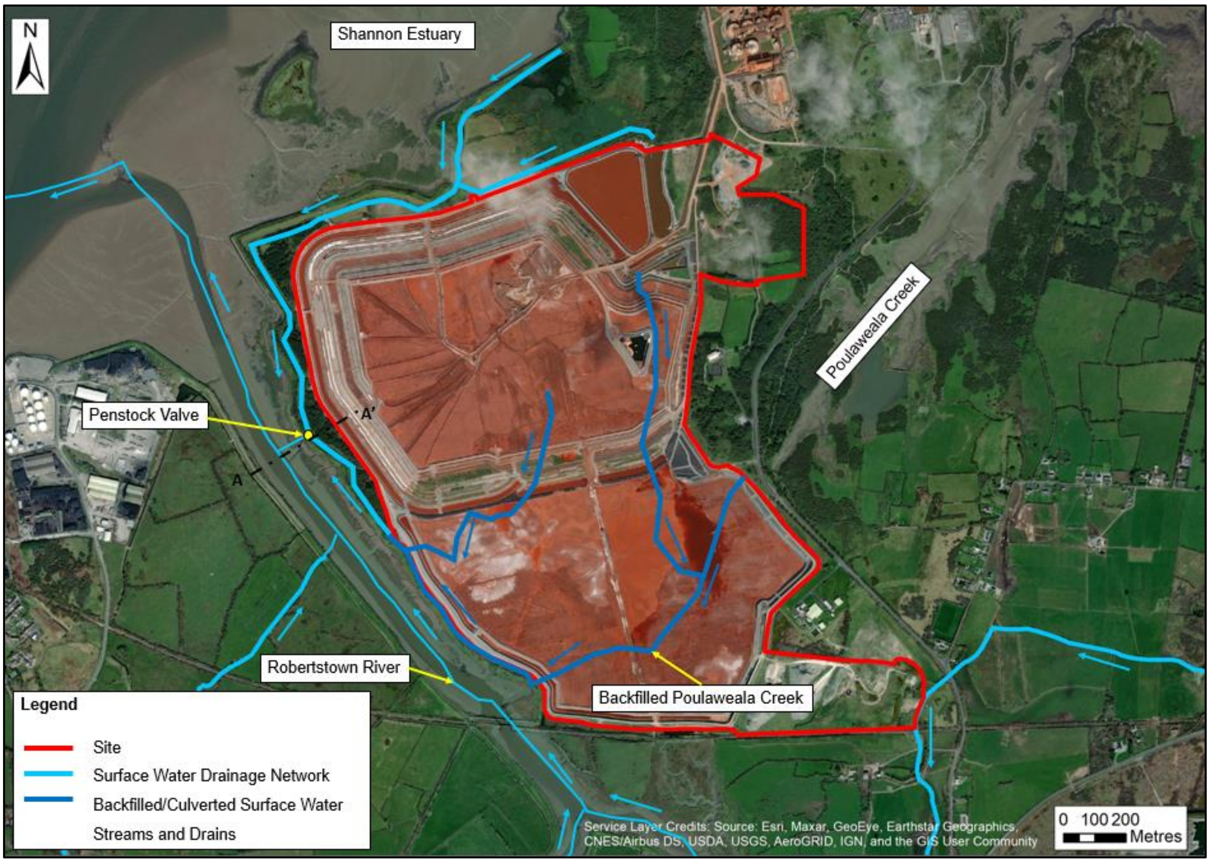



**Figure 10.9: Surface Water Drainage associated with the BRDA** Aerial Photo Source – Bing Maps (2013)

The BRDA is surrounded by PICs, which collect bleed water and runoff from the Phase 1 and Phase 2 facilities and convey it via pumps either to the Effluent Clarifier System (ECS) or to the SWP. The PIC is formed by the construction of the outer and inner perimeter embankment walls, with the inner embankment wall also being the starter stage raise, i.e., Stage 0.

Surface water runoff, bleed water, sprinkler water and seepage from the bauxite residue percolates through the rock fill stage raises and discharge into the encompassing PIC. The PIC is composite lined and transfers the free water by gravity and pumping to the SWP, which is also composite lined.

A Toe Drain is present offset from the downstream toe of the outer perimeter wall (OPW) for the north and west sectors of the Phase 1 BRDA leakages from the PIC or seepages passing beneath the PIC are captured by this Toe Drain and pumped back to the PIC.

A Perimeter Drain is present as the primary surface water drainage network for the low-lying area between the Toe Drain and the Flood Tidal Defence Berm (FTDB) and is offset from the north and west sectors of the BRDA (see Figure 10.9 and shown in schematic cross-section in Figure 10.10). Surface water in the Perimeter Drain is allowed to discharge into the Robertstown River only through a Penstock, located to the west of the Phase 1 BRDA (at Section A-A' on Figure 10.9), and via a Flap Valve during periods of low tide. This Penstock can be closed via a manual valve should contamination be identified in the Perimeter Drain or should a significant event occur, that may potentially impact on the water quality in the Perimeter Drain, neither of which have occurred.

Figure 10.10 below presents a schematic west-to-east cross section (A-A' on Figure 10.9) showing the two surface water drainage networks encompassing the BRDA:

- Toe Drain and PIC which return bauxite residue influenced waters to the SWP and subsequently to the Effluent Clarification System (ECS); and
- Perimeter Drain which discharges clean surface water from the low-lying area between the Toe Drain and the FTDB to the Robertstown River.

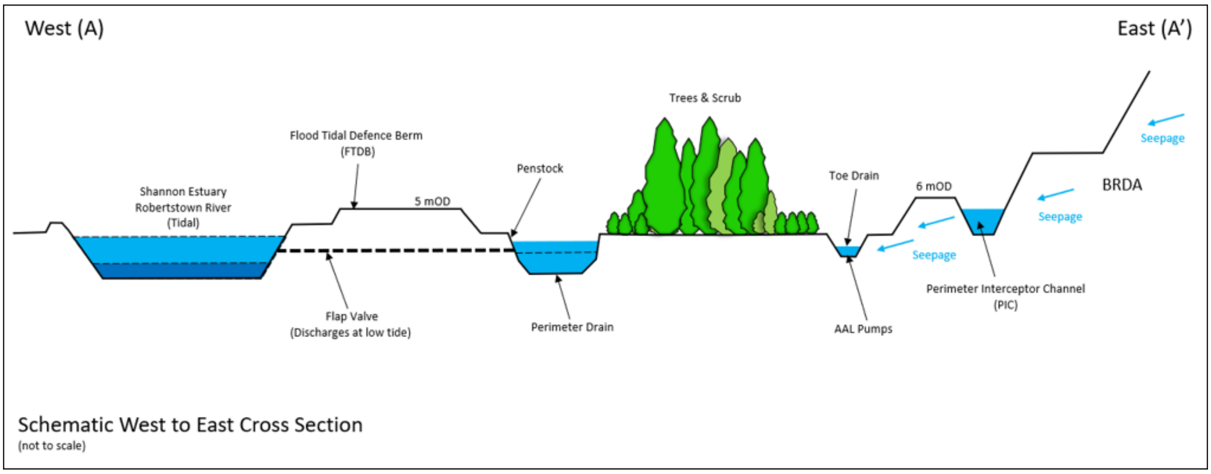



**Figure 10.10: Schematic Cross-Section A-A' showing surface water drainage to Robertstown River**

### 10.6.7 Flooding

The Office of Public Works (OPW) online resource www.floodmaps.ie was consulted to review if there is any evidence of historical flooding (both river and coastal).
Flooding events have occurred to the east and west outside of Aughinish Island (and are reoccurring flood events) but no flood events have been recorded at the AAL Plant or around the BRDA footprint.

The website does however indicate that the BRDA is located on lands which are defended by flood protection works. The BRDA footprint and surrounding catchment is defended by the OPW constructed flood protection works on the north bank (Shannon Estuary) and west bank (Robertstown River) of the Island, where a flood tidal defence berm (FTDB) is present.

The original FTDB is understood to have been constructed in the early 1900s and was subsequently raised and broadened by the OPW in the early 1960's. The crest elevation was increased to c. 5 mOD and a rock fill revetment was constructed at the toe of the upstream slope at this time.

The OPW have maintained the FTDB over the years and various repairs and improvement works have been conducted. AAL currently monitor and maintain the FTDB structure and improvement works to the upstream slope on the north bank have recently been undertaken by AAL.

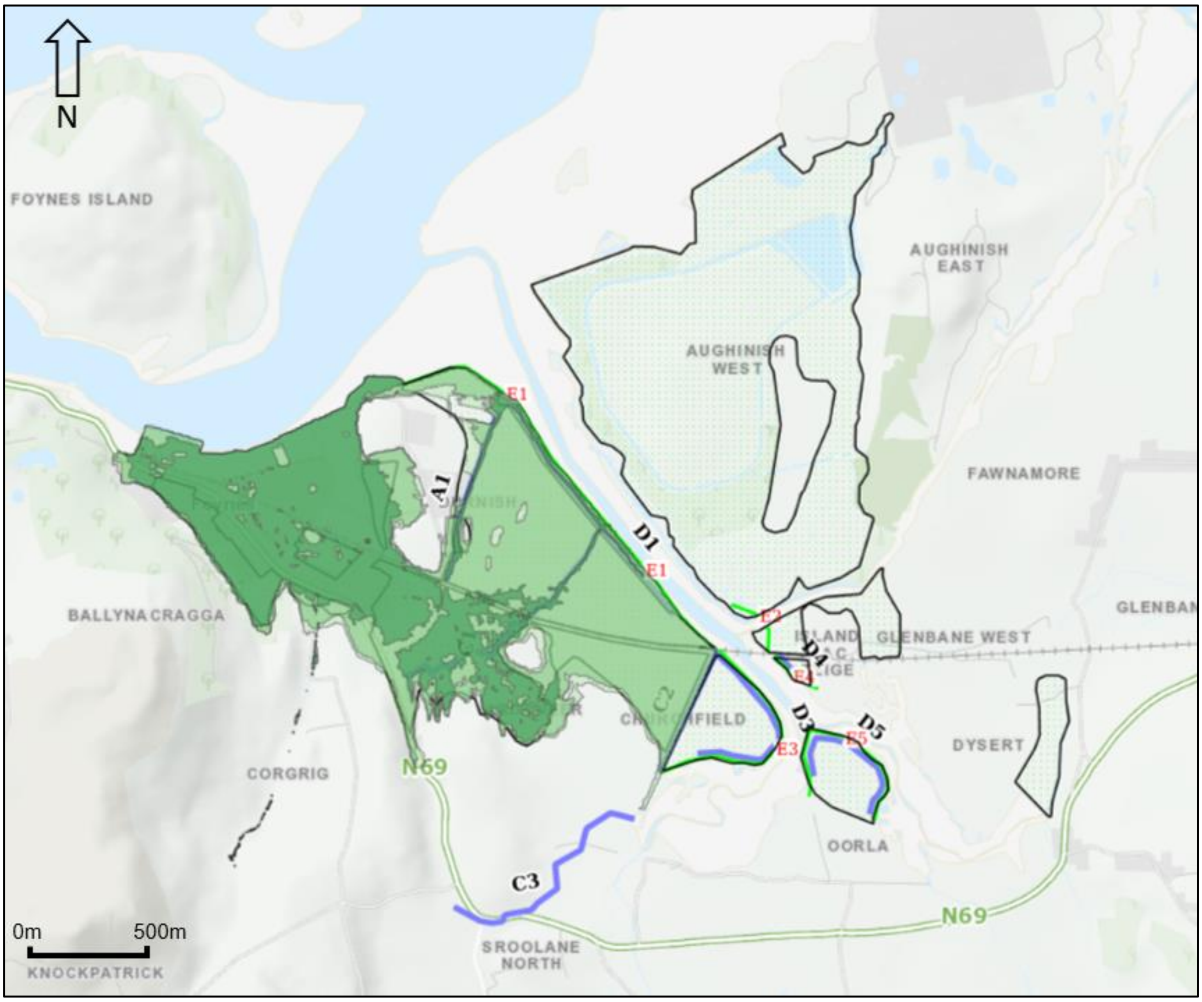



**Figure 10.11: Flood Protection Benefited Lands (outlined in black), embankments (bright green), channels (blue) Source: OPW flood mapping, 2021.**

Detailed flood mapping published by the OPW (Figure 10.11) outlines (in black) the extent of lands in the Foynes area which were drained as part of the Arterial Drainage Scheme. OPW mapping also identifies the predicted maximum extent of future coastal flooding in the event of a flood protection embankment breach on the western side of the Robertstown River, but no equivalent data has been published for a similar breach in the embankments on the eastern side of the river which currently protect the BRDA.

As part of the Catchment-based Flood Risk Assessment (CFRAM) programme the OPW developed Flood Risk Assessment (FRA) maps to highlight areas that may be at risk of flooding and may require further assessment. No such maps are available for Aughinish Island.

Chapter 16: Major Accidents and Disasters of this EIAR provides an assessment of the vulnerability of the Proposed Development to major accidents and/or disasters, including the potential for extreme storm, tidal surge and wave events.

### 10.6.8 BRDA Water Management

#### *10.6.8.1 General Overview*

The BRDA is surrounded by the composite lined PIC which collects water emerging from the BRDA (bauxite residue slurry bleed water, surface water runoff, sprinkler water and seepage) and transfers the free water by gravity to the pumping stations. The pumps convey the waters either to the ECS located in the Plant or to the SWP, which is also composite lined.

The current BRDA water management system is presented conceptually by the block flow diagram in Figure 10.12 below.

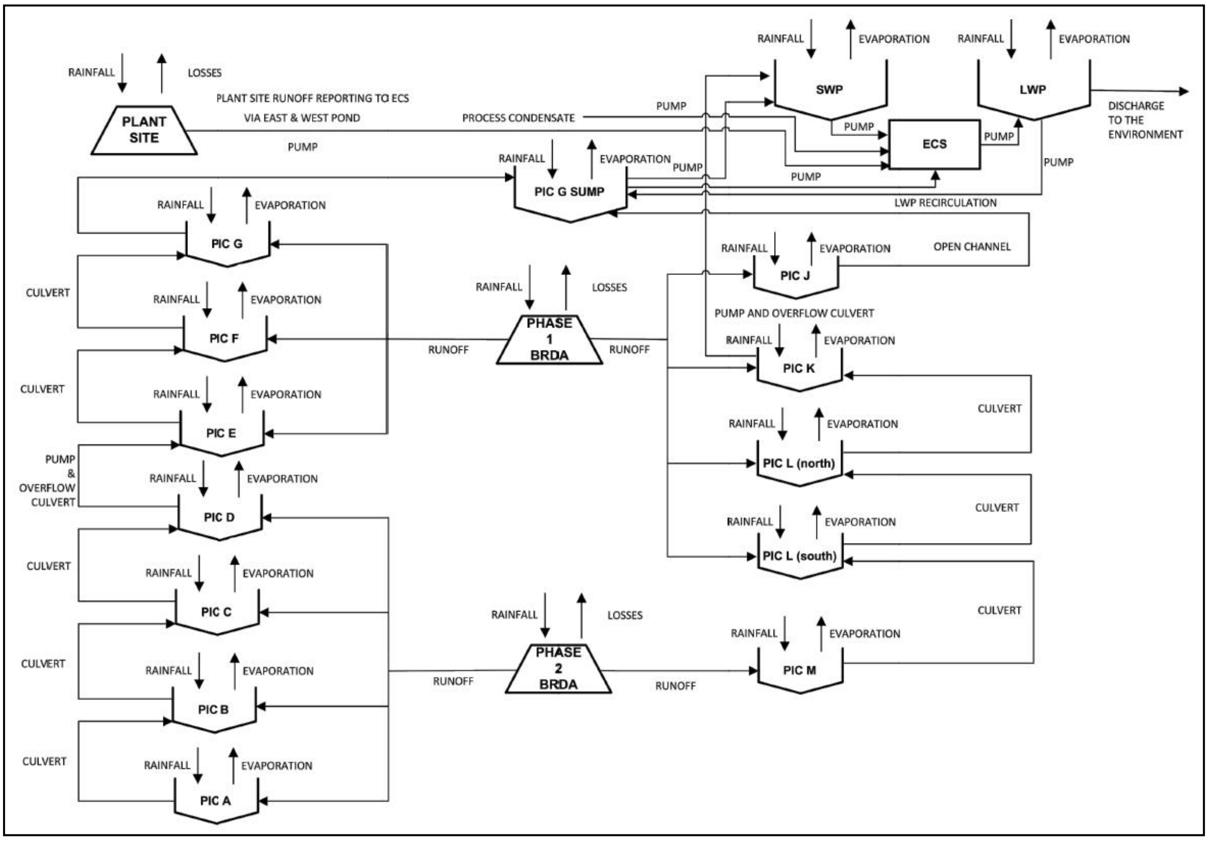



**Figure 10.12: BRDA Water Management System - Block Flow Diagram**

__Notes:__

1) *Catchment "Losses" presented in the flow diagram represent all hydrological losses from rainfall including evaporation, transpiration, infiltration, and losses due to surface depressions and ponding.*

The BRDA is progressively raised by the upstream method which involves constructing a permeable rock fill berm (stage raise) at the perimeter which is founded on the previously deposited and farmed bauxite residue. The stage raises are constructed in 2 m vertical lifts (4m crest width, side-slopes of 1.5(H):1(V) and typically offset from inner crest to starting toe by a 4 m wide bench), thus forming a supporting face to the overall structure, whilst also allowing the bauxite residue to drain. The slope of the stack wall or face of the BRDA is 6(H):1(V) for the upper and lower slopes which reduces to an overall slope of 6.3(H):1(V) when the width of the upper-level bench at Stage 5 (14 mOD) has been included.

Unlike other tailings facilities or water retaining dams, the BRDA retains little to no surface water on the surface. The bauxite residue is deposited centrally and grades at a slope of between 2% and 4% to the perimeter stage raises. The dome typically has the apex some 6 m to 8 m above the perimeter stage raise elevation. The final permitted elevation of the perimeter stack wall is 24 mOD at Stage 10, and the highest elevation of stacked residue for the dome will be 32 mOD, or some 30m above surrounding ground elevation.

The stage raises are constructed of permeable rock fill and allow the drainage of bauxite residue slurry bleed water, surface water runoff, sprinkler water and seepage through the raise and into the collection drain excavated at the downstream toe of the uppermost stage raise. The collection drain has a piped drainage system (300 mm and 450 mm OD twin-walled HDPE pipes at max. 100m centres) which fast track the flows directly to the encompassing perimeter interceptor channel (PIC).

There are no decant structures associated with the operational BRDA i.e., spillways, decant towers etc., other than the caustic recovery system constructed within the Salt Cake Disposal Cell (SCDC). The closure design for the BRDA will include spillways to channel flows from the dome directly to the PIC and spillways at the two breach locations for the perimeter interceptor channel (PIC).

#### *10.6.8.2 Perimeter Interceptor Channel*

The PICs are separated into PIC segments (PIC-A to PIC-G and PIC-J to PIC-M) that are separated by culverted ‘choke points’; these culverted sections provide vehicular access to the BRDA across the PICs.

There are 6 no. Phase 1 PICs segments that collect runoff from the **Phase 1 BRDA**.

- From the southwest corner of the Phase 1 BRDA, water flows clockwise through PIC-E, PIC-F and PIC-G, over a distance of ≈ 1,700 m, to a sump located at the eastern extent of PIC-G, where water is pumped to the ECS and/or to the SWP via Pump 15 and Pump 33 / Pump 34, respectively.
- The constructed clockwise Phase 1 PIC segments have an upper crest width varying from 21.5m to 26.0m and base channel widths of 6.0m to 7.0m. The base elevations vary from 1.8 mOD to 0.9 mOD, the crest elevation is 4.7 mOD, and the operating freeboard is 0.5m.
- From the southeast corner of the Phase 1 BRDA Extension, water flows counter-clockwise through PIC-L, PIC-K and PIC-J, over a distance of ≈ 1,130 m, to the sump located at the eastern extent of PIC-G.
- The constructed counter-clockwise Phase 1 PIC segments have an upper crest width varying from 20.0 m to 25.0 m and base channel widths of 4.0 m to 21.0 m. The base elevations vary from 15.7 mOD to 0.9 mOD, and the crest elevation varies from is 16.0 mOD to 4.7 mOD.
- The combined capacity of the constructed Phase 1 BRDA PIC is ≈ 116,500 $m^3$ at 0.5m freeboard and ≈ 155,500 $m^3$ at crest.

There are 5 no. Phase 2 PIC segments that collect runoff from the **Phase 2 BRDA**:

- From the north-east corner of the Phase 2 BRDA, water flows clockwise through PIC-A, PIC-B, PIC-C and PIC-D, over a distance of ≈ 2,140 m, to a sump located at the northern extent of PIC-D, where water is pumped via Pump 24 into the Phase 1 BRDA PIC at the southern extent of PIC-E. There are also three overflow culverts installed which permit gravity flow from PIC-D to PIC-E, in the event of pump failure. The IPW for PIC-A has only been constructed during 2020, as the bauxite residue deposited in this sector attained the design elevation for the base of the channel, and the culverted connection to PIC-B is scheduled to be constructed during Q3 2021.
- The constructed clockwise Phase 2 PIC segments have an upper crest width varying from 18.0 m to 27.0 m and base channel widths of 7.0 m to 15.0 m. The base elevations vary from 11.5 mOD to 1.0 mOD, the crest elevation varies from is 12.0 mOD to 5.0 mOD.
- At the northeast corner of the Phase 2 BRDA, PIC-M will flow counter-clockwise to connect with PIC-L, located at the southeast corner of the Phase 1 BRDA Extension. PIC-M is not yet constructed as the bauxite residue has not attained the design elevation of for the base of the channel. It is expected that PIC-M will be formed during 2022 / 2023.
- The design for PIC-M has an upper crest width of 13.5m and a base channel width of 5.5m. The base elevation varies form 13.5 mOD to 14.0 mOD, and the crest elevation varies from 16.0 mOD to 19.0 mOD.
- The combined capacity of the constructed Phase 2 BRDA PIC is ≈ 74,000 m$^3$ at 0.5m freeboard and ≈ 95,500 m$^3$ at crest.

#### *10.6.8.3 Storm Water Pond and Liquid Waste Pond*

Both the SWP and Liquid Waste Pond (LWP) are located in the north-east sector of the BRDA. The waters collected in the Phase 2 PICs are pumped into the Phase 1 PICs and subsequently to the ECS or to the SWP, depending on water level. Excess water from the PIC and SWP is pumped to the ECS at a maximum discharge capacity of 1,050 m$^3$/hr. The function of the SWP is two-fold:

- To provide surge capacity for surface water that cannot be immediately processed by the ECS; and
- To provide a continuous flow of water that is used for dilution or wash water within some parts of the alumina plant.
  **Note:** *The ECS / LWP discharge capacity is 1,250 m$^3$/hr but also includes 200 m$^3$/hr of process condensate from the Plant.*

The LWP is located adjacent to the SWP and receives treated water from the ECS and conditions this water (cooling and settlement) prior to discharging to one of the following:

- Controlled discharge into the River Shannon;
- Onto the surfaces of the BRDA by sprinkling during dry and windy weather, typically periodically during April to September; and/or
- Directly into the SWP if effluent quality is off-specification i.e., recirculation of treated water.

The current BRDA water inventory targets are presented below; AAL's Control Room Operator (CRO) is responsible for ensuring the inventory targets are met:

- Winter (October – March): 110,000 m3 to ensure water storage capacity for stormwater.
- Summer (May – August): 180,000 m3 to provide sufficient water storage for dust suppression.
- Transition Months (April and September): 150,000 m3.

**Note:** *The existing BRDA water inventory definition includes water stored in the PIC system and the SWP but does not include water stored in the LWP.*

#### 10.6.8.4 *Salt Cake Disposal Cell*

The existing Salt Cake Disposal Cell (SCDC) is an independently compositely lined cell located within the BRDA.

The waters inside the SCDC comprise dissolved salt cake (caustic liquor leachate) which diluted by the rainfall catchment of the cell. The drainage of its internal catchment i.e., inside the lined crest, is via the perforated decant tower located in the north-east corner of the existing SCDC. A decant pipe is located at the base of the decant tower, where the waters flow by gravity to the storage tank installation located to the north and at a lower elevation than the SCDC (to the south-west of the SWP). The waters are then pumped to the Plant for caustic recovery.

The drainage of its external catchment i.e., the areas downstream of the lined crest comprising the access ramp, the access roads on the crest of the dam walls, the crest of the tipping wall and the downstream slopes of the dam walls, emerges at the toe of the rock fill slopes onto the surrounding bauxite reside and follows the same trickle-down flow path (as for other waters emerging from the BRDA) through the rock fill stage raises or via the installed collector drainage pipes, to the PIC.

#### 10.6.8.5 *Existing Plant Site Surface Water Management System*

The Plant Site is the area where alumina refining activities are undertaken. The Plant Site does not form part of the Proposed Development; however, the water management system is partially linked (through the east and west catchment areas) with that of the BRDA site and so will be discussed briefly in this section. Hydrologically, the Plant Site is divided into three main areas as follows:

- **Northern Area**: surface water runoff from this Raw Materials & Produce Storage Area (Non-Process) area is uncontaminated and discharges directly off site;
- **East Catchment**: surface water runoff from this area is potentially contaminated and drains to the East Pond for storage / attenuation prior to being pumped to the ECS; and
- **West Catchment**: surface water runoff from this area is potentially contaminated and drains to the West Pond for storage / attenuation prior to being pumped to either the ECS or to the Phase 1 BRDA PIC.

Within the east and west catchments there are process area sub-catchments where surface water runoff is captured and used in the plant process system. Up to 10,000 $m^3$ of surface water runoff can be captured and used from these catchments during a storm event. There is also a small catchment area draining to the North Pond (or 'Containment Pond'), which is used to contain process water if there is an issue with the process system; otherwise, this pond typically remains unused. The North Pond can be used to provide additional storage / attenuation volume for surface water runoff if required. The East and West catchments are comprised of the following main land cover types:

- Greenfield Areas with grass cover;
- Hardstand Areas of various types, e.g., road paving, concrete, roofs etc.; and
- Process Areas where surface water runoff is collected in sumps and used in the Plant Site process system.

Runoff generated from the East and West catchments (with the exception of runoff from the process area sub-catchments) is routed to the East and West Ponds (respectively), via a complex gravity drainage system, comprising open channels, pipes and culverts.

The Plant Site water management system considered for the hydrological assessment is presented conceptually by the block flow diagram in Figure 10.13 below.

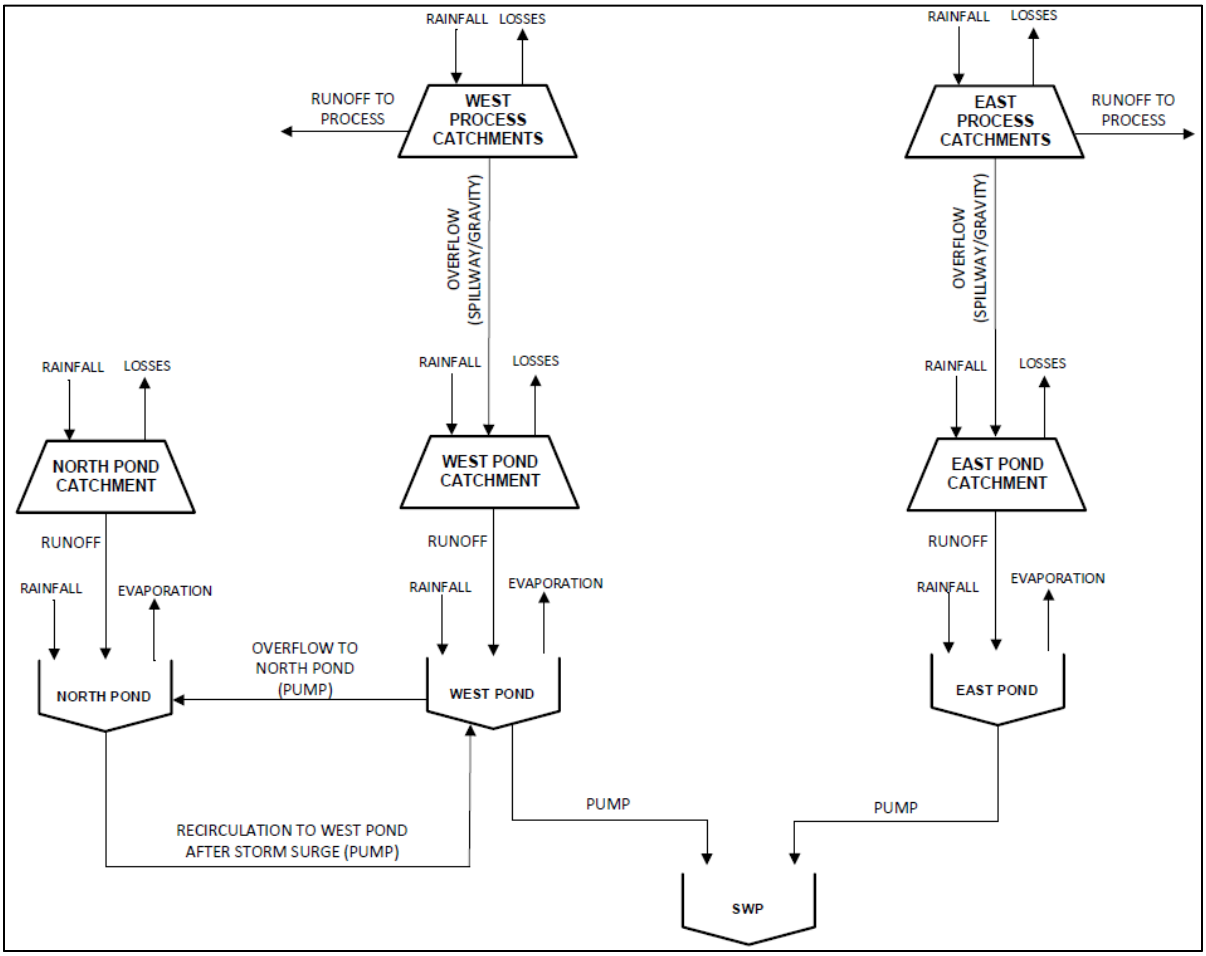



**Figure 10.13: Plant Site Water Management System - Block Flow Diagram**

**<u>Notes:</u>**

1) *The North Catchment is not presented in the flow diagram as this area discharges directly off site in accordance with the Licence.*
2) *Catchment "Losses" presented in the flow diagram represent all hydrological losses from rainfall including evaporation, transpiration, infiltration, and losses due to surface depressions and ponding.*
3) *The East Pond and West Pond discharge to the ECS and the Phase 1 BRDA PIC system (which ultimately discharges to the ECS directly or via the SWP). For the purposes of this hydrological assessment these ponds have been modelled as discharging to the SWP (which ultimately discharges to the ECS). This is due to:*
   i) *Limitations of the software used for the flood routing and storage capacity assessment; and*
   ii) *A recommendation outcome from this study, that future flows discharging from the Plant Site to the BRDA water management system are discharged to the SWP rather than the Phase 1 PIC. This is intended to reduce the volume of water discharging to the PIC during the IDF and reduce the overall PIC pumping capacity required to accommodate the IDF.*

### 10.6.9 Surface Water Monitoring at the BRDA

Surface water monitoring is carried out routinely for surface water bodies in the vicinity of the BRDA site in accordance with Schedule C.2.3 of the Industrial Emissions Licence (IEL) P0035-07. Three (3) licensed locations are currently monitored: Mangan's Lough, the Office of Public Works (OPW) Channel and Phase 2 West Robertstown Gate, as shown in Figure 10.14 below.

The parameters required to be monitored are pH, electrical conductivity and soda as well as a visual inspection. Analysis of metals was undertaken on 22 April 2021 and is provided in Table 10., below.

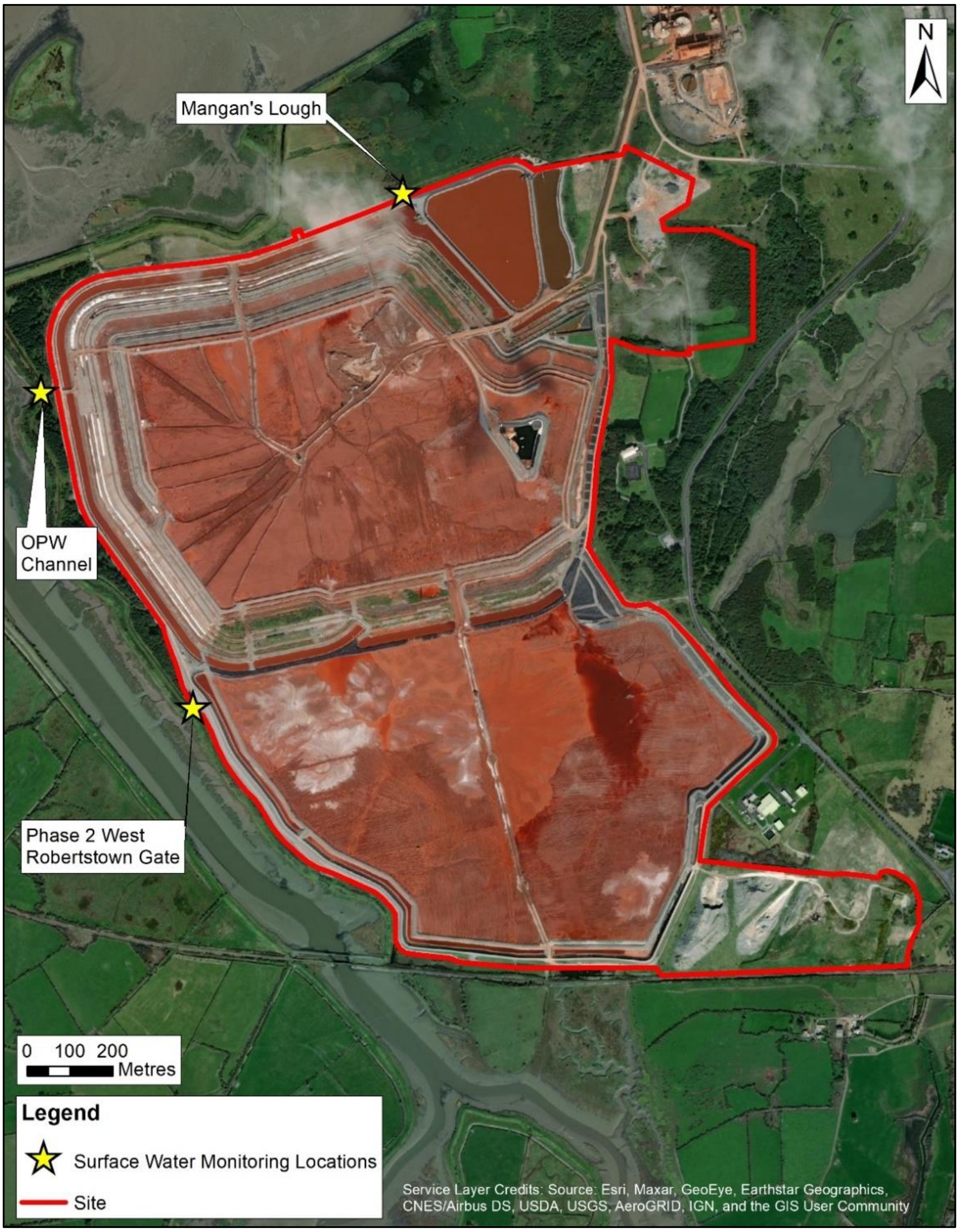



**Figure 10.14: BRDA Surface Water Monitoring Locations** Aerial Photo Source – Bing Maps (2013)

**Table 10.6: Surface Water Metal Analysis – 22 April 2021**

| Location | Date | Al | As | Cd | Cr | Cu | Fe | Pb | Mg | Hg | Ni | Ti |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | µg/l | µg/l | µg/l | µg/l | µg/l | µg/l | µg/l | mg/l | µg/l | µg/l | µg/l |
| **Mangan's Lough** | 22/04/2021 | 12 | 1 | < 10 | 1 | < 20 | 47 | < 10 | 7.3 | 0.09 | < 10 | < 50 |
| **OPW Channel** | 23/04/2021 | < 30 | 1 | < 10 | 1 | < 20 | 24 | < 10 | 53.6 | 0.08 | < 10 | < 50 |
| **Phase 2 West Robertstown Gate** | 24/04/2021 | < 30 | 1 | < 10 | 1 | < 20 | 17 | < 10 | 175.6 | 0.05 | 1 | < 50 |

Soda, pH and electrical conductivity are considered to be indicator parameters or substances that can identify impacts from activities at AAL facility, however, surface waters surrounding the BRDA are brackish from the nearby Shannon and Robertstown River estuaries and saline intrusion can also lead to interference in the results.

Saline intrusion from the surface waters can lead to interference with the electrical conductivity (naturally elevating it) and where this happens, analysis for soda may also experience interference. However, where pH, soda and electrical conductivity are all elevated, it is considered to be likely the result of onsite activities.

A review was undertaken of the annual averages for pH, soda and conductivity between 2008 – 2020 (data extracted from the AAL AERs). An average of the available monthly data for 2021 has also been included; this is an average of nine (9) months of data i.e., to September 2021. This data is presented in Figure 10.15, Figure 10.16 and Figure 10.17 below.

**Note:** *Phase 2 West Robertstown Gate was only added to the monitoring program in 2015.*

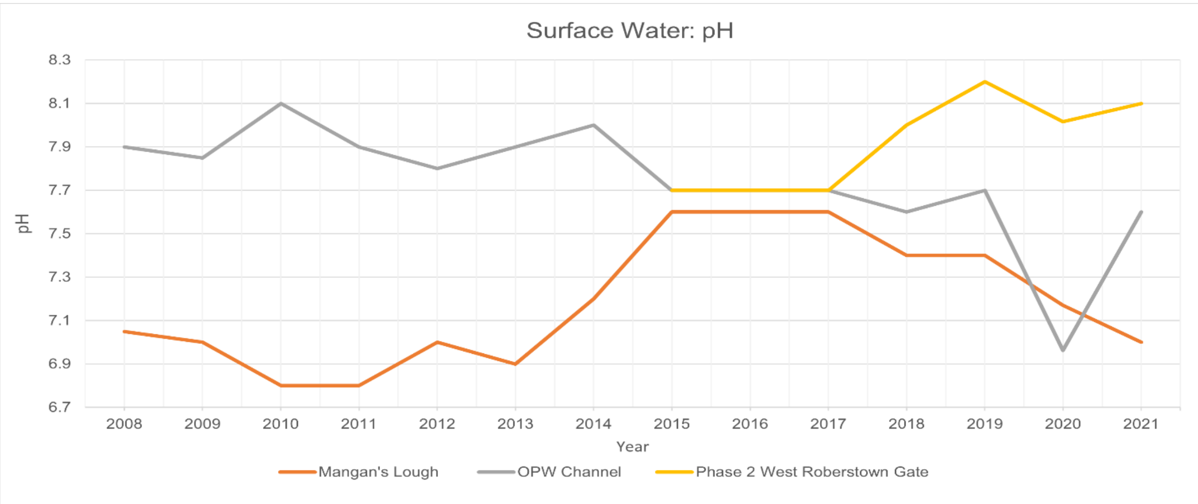



**Figure 10.15: Annual Averages for pH at the Surface Water Monitoring points between 2008 and 2021**

Annual average pH levels (Figure 10.15) for the surface water monitoring points between 2008 and 2020 have between within the range of 6.8 to 8.2 for all the data. While the Irish Surface Water Regulations (2009, as amended) have not set a threshold value on pH for transitional waters, a recommended threshold for rivers and lakes is under pH 9.0.

There was a slight increase in pH for Mangan's Lough and slight decrease in pH for the OPW Channel from 2013 to 2015 and both plateaued until 2017 before continuing in a steady downward trend. It is noted that a sustained downward trend in pH is continuing in the 2021 data for Mangan's Lough. OPW Channel is elevated compared to the 2020 level, however, this is not yet an annual average and the broad downtrend seen since 2017 continues.

The highest level was observed in OPW Channel for 2010 at 8.1 pH. pH annual averages for 2020 for OPW Channel was 6.96 while Mangan's Lough was 7.17.

Phase 2 West Robertstown Gate is a recent addition to the monitoring programme. Similarly, to the other two locations, Phase 2 West Robertstown Gate showed a stable pH between 2015 and 2017. Between 2017 and 2019, the annual average pH increased slightly from 7.7 pH to 8.2 pH before showing a downward trend in line with the other two surface water bodies pH since 2019 and averaged 8.01 pH for 2020.

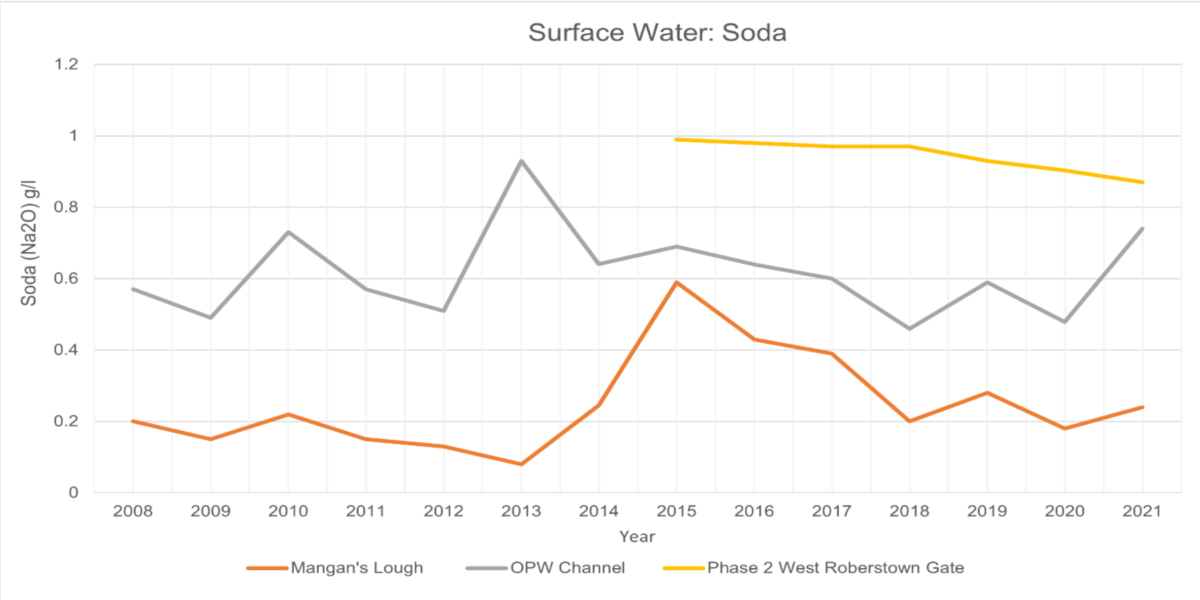



**Figure 10.16: Annual Averages for Soda at the Surface Water Monitoring points between 2008 and 2021**

Soda levels in Mangan's Lough and OPW Channel monitoring points have shown fluctuations in annual averages between 2008 and 2020. Between 2008 and 2013, Mangan's Lough maintained averages between 0.08 g/l and 0.22 g/l soda. From 2013 to 2015, an upward trend was observed for soda at Mangan's Lough, which coincides with a slight increase in pH over this time period.

Since 2015, a downward trend in soda has been observed at Mangan's Lough and soda averaged 0.18 g/l for 2020 which is in line with historical data. Soda levels in OPW Channel have varied between 2008 and 2020, although there appears to be a gradual decline in soda levels since 2013 to an average of 0.48 g/l for 2020.

The Phase 2 West Robertstown Gate monitoring point has shown a declining soda trend since monitoring began in 2015 and levels averaged 0.9 g/l for 2020. While the average pH increased in Phase 2 West Robertstown Gate between 2017 and 2019, soda levels decreased during this period.

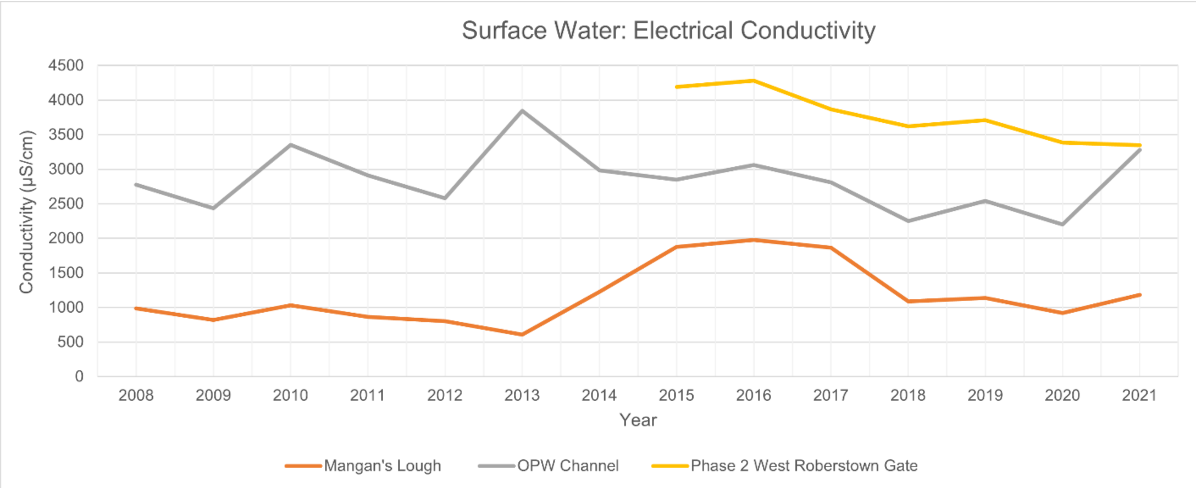



**Figure 10.17: Annual Averages for Electrical Conductivity at the Surface Water Monitoring Points between 2008 and 2021**

Electrical conductivity between 2013 and 2017 showed a slight elevation against normal levels at Mangan's Lough which follows a trend seen for both pH and soda during the same period at this location. Since 2017 electrical conductivity has steadily decreased to an average of 921 µS/cm for 2020 compared to an average of 985 µS/cm for 2008. At the highest, the average was 1977 µS/cm for 2016.

Electrical conductivity at OPW Channel has shown a similar trend to soda during the period 2008 and 2020, with elevated averages in 2010 and 2013 and a gradual decline in levels since 2013 to an annual average of 2,200 µS/cm for 2020.

Phase 2 West Robertstown Gate has shown a gradual decline in electrical conductivity since 2015 (of 4,190 µS/cm) to an average of 3388.17 µS/cm for 2020, this declining trend is also seen in soda, but pH has shown a slight lag, before decreasing since 2019.

## 10.6.10 Hydrogeology

### *10.6.10.1 Aquifers and their Properties*

The Site is underlain by two separate aquifer units, one is a Locally Important Bedrock Aquifer (Rathkeale Formation) and the other is a Regionally Important Karstified Bedrock Aquifer (Waulsortian Formation), see Figure 10.18.

The majority of the BRDA site is underlain by the locally important bedrock aquifer, while the SCDC, the permitted Borrow Pit site and the Borrow Pit Extension site sit within the regionally important karstified bedrock aquifer unit. No shallow gravel aquifers have been identified beneath the Application Site. The wider Study Area is divided broadly into the Locally Important Bedrock Aquifer on the Western side and the Regionally Important Karstified Bedrock Aquifer on the eastern side. A third aquifer type (a Poor Aquifer with bedrock which is generally unproductive) is found further west within the Study Area beneath Foynes town, see Figure 10.18.

The Regionally Important Karstified Bedrock Aquifer underlying the east side of the Aughinish site is an important water resource for County Limerick, as a consequence of enhanced secondary permeability from faulting and fracturing and enhanced primary permeability from dolomitization.

The interpretation of the hydrogeological conceptual model presented by Golder 2015 identified that the groundwater present beneath the Application Site generally comprises a freshwater lens that is both downgradient and isolated laterally from the mainland by being laterally hydraulically isolated by Poulaweala Creek and the Roberstown River and the underlying saline groundwater. It is noted that a portion of the Application Site in the southeast is within the mainland area of Glenbane West, however, groundwater flow in this area is west and north-westwards towards the Poulaweala Creek and the Robertstown River.

The Waulsortian Limestone bedrock has a very low primary permeability. As a consequence, flow of groundwater is dominated by the location of karstified fracture zones and valley infill. The depth at which groundwater is encountered across this unit is typically within 1.5 m to 10 m of ground level which implies that the fracture zones start from a relatively shallow depth, and that, in the centre of the unit, groundwater flows preferentially through the limestone rock fill used to level the valleys during the initial construction phase of the overall Aughinish Site.

The groundwater present in the Rathkeale Formation underlies the majority of the BRDA site, comprises a Locally Important Aquifer from bedrock that is moderately productive only in local zones. This reflects the presence of water bearing bands of marine argillaceous limestones within the mudstone.

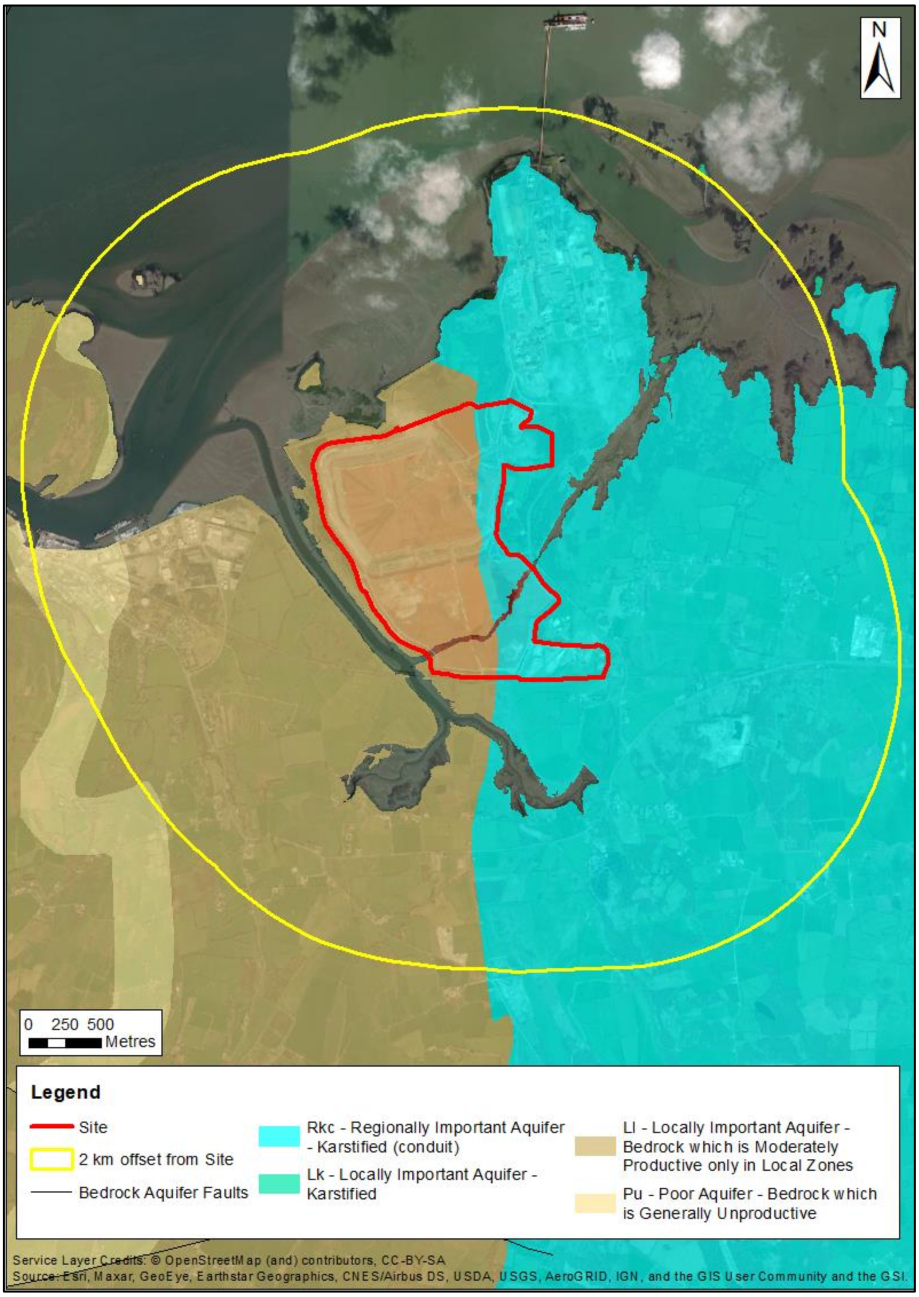



**Figure 10.18: Bedrock Aquifer details beneath the Site and wider Study Area**

#### *10.6.10.2 Groundwater Flow Direction*

Groundwater levels measured in groundwater monitoring boreholes across the overall Aughinish site indicates that groundwater flow is outwards from the central part of the 'Island' towards the coastline via springs (the Estuarine Streams) to the Shannon Estuary, Robertstown River and the Poulaweala Creek, see Figure 10.19 and Figure 10.20.

Flow direction is illustrated indicatively by presenting an arrow orientated at 90˚ to the contours. However, it is noted in a hydrogeological system that includes preferential flow paths comprising fractures, karstic features and valley infill, a more tortuous path may be taken by the groundwater in meeting the estuarine streams.

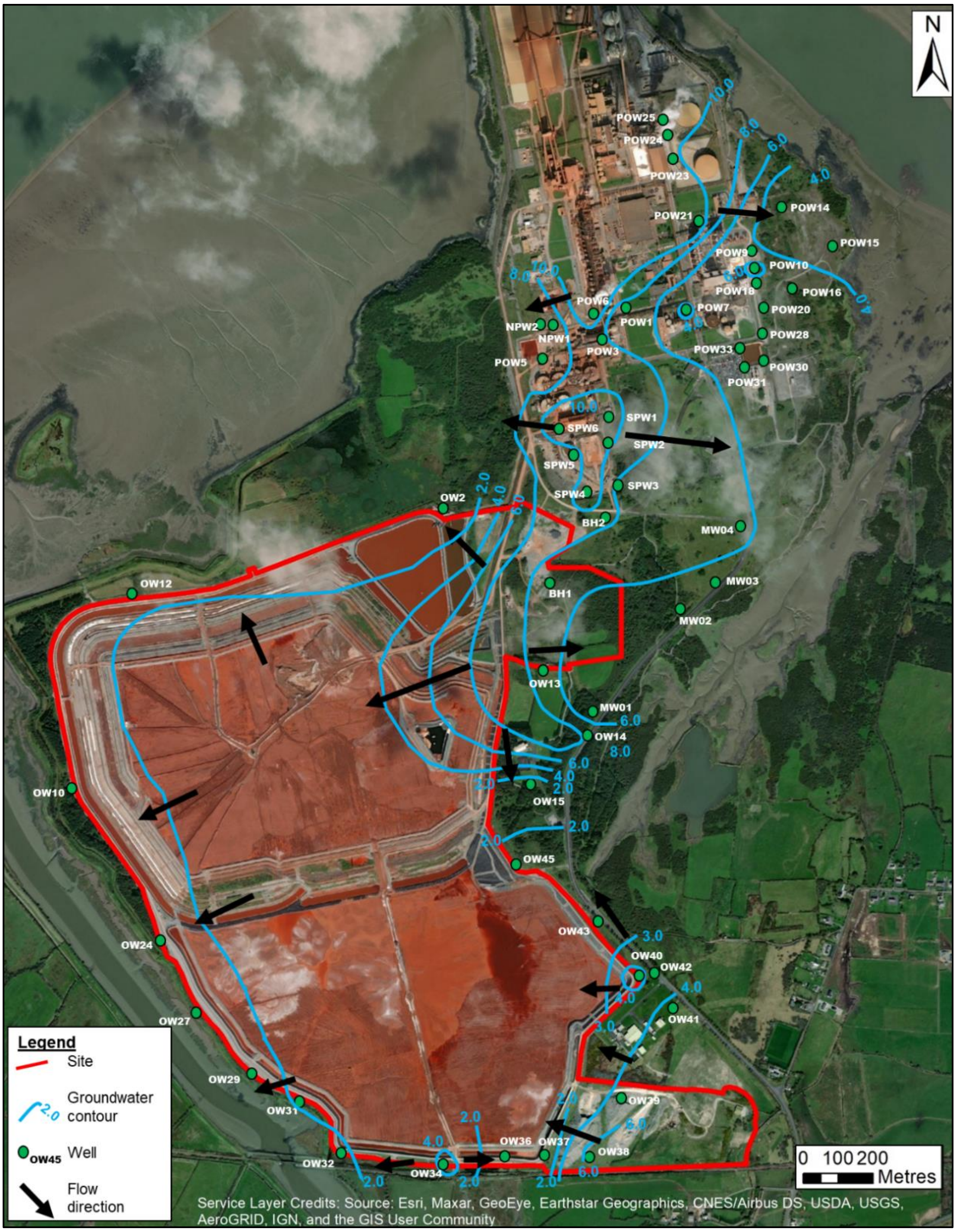



**Figure 10.19: Groundwater Contours (mOD) for the Site (January 2021)** Aerial Photo Source – Bing Maps (2013)

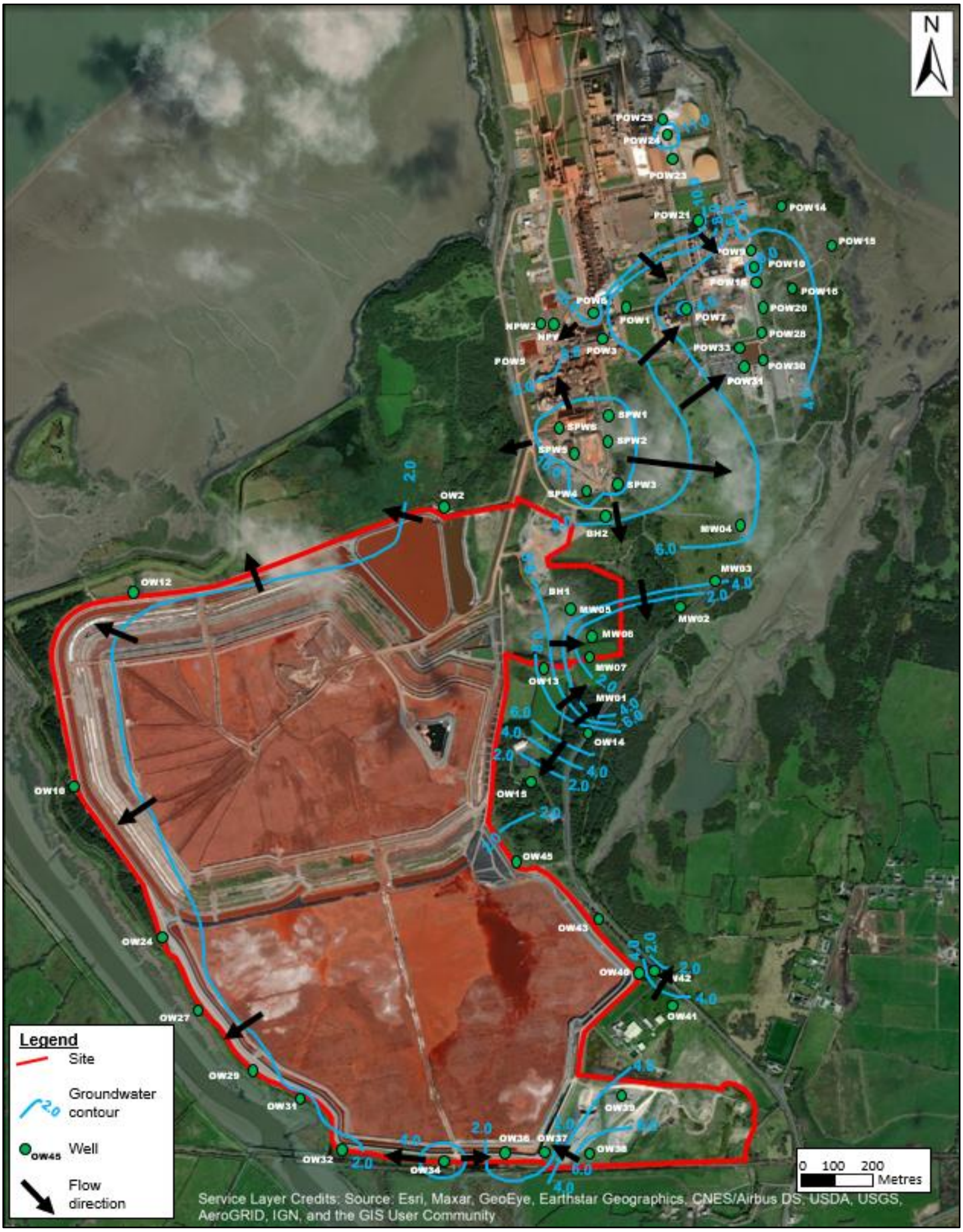



**Figure 10.20: Groundwater Contours (mOD) for the Site (July 2021)** Aerial Photo Source – Bing Maps (2013)

Groundwater flow to the west and south of the BRDA site is likely to be towards the Robertstown River through flow and run-off from estuarine deposits. Much of the shallow groundwater to the south and west of the BRDA is discharged to the estuary via the penstock which discharges at low tide to maintain a consistently low level beneath the BRDA (refer to Figure 10.9 and Figure 10.10 in Section 10.6.6).

In addition, monitoring data collected in the southeast corner of the BRDA (Golder 2015), indicates that groundwater flow in the underlying bedrock is towards the topographically lower areas of Poulaweala Creek and other low marsh areas adjacent to the Robertstown River.

A site investigation has previously been carried out at, and in the vicinity of permitted Borrow Pit footprint, with the drilling of six (6) boreholes (BH1, BH2, BH3, BH4 BH5 and BH6) during 2017 (Golder 2017A). These boreholes all encountered fine grained Waulsortian Limestone at ground level (0 m depth) to 1.1 m depth and were drilled to a depth of 15 mbgl. Only BH1 and BH2 maintained groundwater levels and were subsequently utilized as monitoring wells, see Figure 10.21 below.

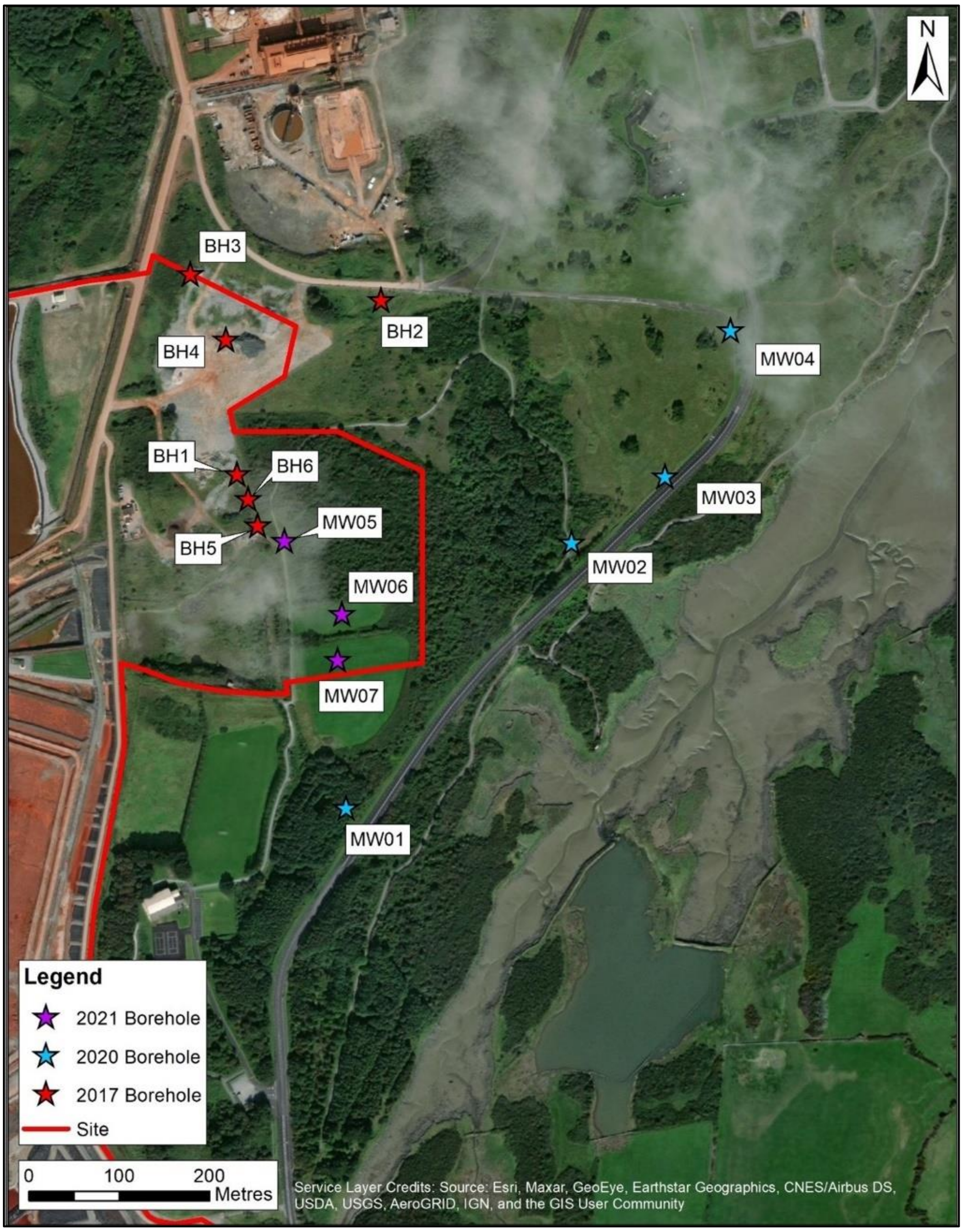



**Figure 10.21: Monitoring Well Locations (Red for 2017, Blue for 2020 and Purple for 2021) within and near the permitted Borrow Pit and the proposed Borrow Pit Extension footprints.**

Additional site investigation was carried out at, and in the vicinity of the proposed Borrow Pit Extension footprint, with the drilling of four (4) boreholes (MW01, MW02, MW03 and MW04) in October 2020 and three (3) boreholes (MW05, MW06, MW07) in June 2021. Similarly, these boreholes all encountered fine grained Waulsortian Limestone within 0.15 m to 0.40 m depth. All boreholes were subsequently utilized as monitoring wells, see Figure 10.21 above, and indicate groundwater elevations varying between 2 mOD and 6 mOD , with flow direction to the east and south-east.

Groundwater level monitoring was carried out for OW13, SPW3, SPW4, BH1, BH2 and BH4 in Q1 2017 and continued until Q2 2017. Monitoring was re-started in these wells in Q4 2020 with the addition of monitoring MW01 to MW04. Water level is generally consistent with that previously stated as occurring at shallow levels within the Waulsortian bedrock. Monitoring for MW05, MW06 and MW07 commenced in July 2021.

The available data suggests that a groundwater divide exists within or in close proximity to the Borrow Pit sites (see Figure 10.19, Figure 10.20 and Figure 10.22).

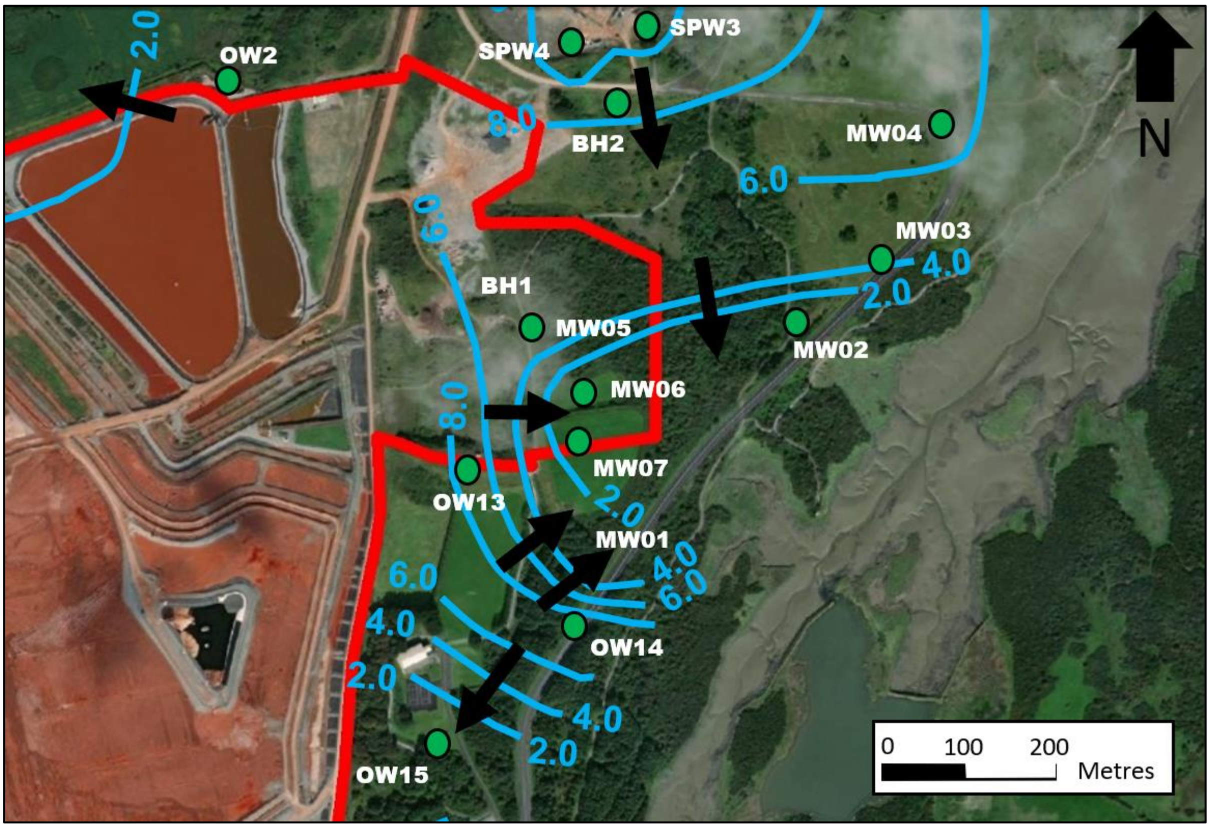



**Figure 10.22: Groundwater Contours (mOD) for the Site (July 2021)** Aerial Photo Source – Bing Maps (2013)

### *10.6.10.3 Groundwater Basin*

Groundwater basins have been defined by the EPA/GSI to determine the catchment areas and divides within areas, in a similar fashion to the river basins defined for surface water features. The Site occurs within a sub-basin, 'Industrial Facility' (IE_SH_G_252), see Figure 10.23 below, within the Askeaton Groundwater Body (GWB) (IE_S_G_010), which is characterized as having a status of 'poor', with the overall Groundwater Body being classified as 'good'.

**Note:** *The 'Industrial Facility' is labelled with the former IEL No. P0035-04 (EPA, 2021)*

The wider Study Area is composed of the remainder of the Askeaton Groundwater Basin to the east and the Shanagolden (IE_SH_G_203) and Ballylongford (IE_SH_G_030) Groundwater Bodies further west. All three (3) of these groundwater bodies were characterised as having a status of 'good' during the 2013 – 2018 analysis (EPA, 2021).

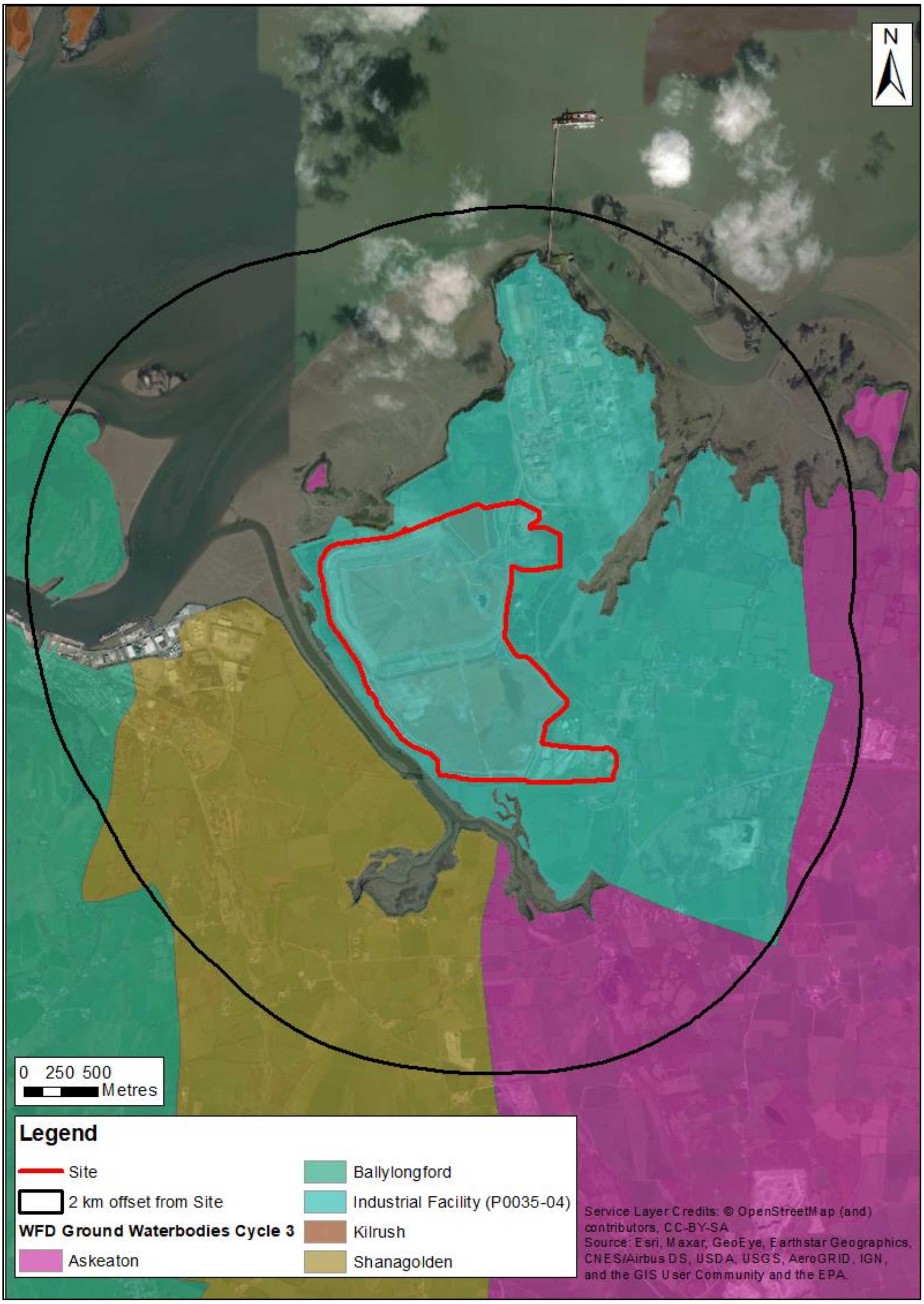



**Figure 10.23: WFD Groundwater Bodies (Cycle 3) within the Site and Study Area (EPA, 2021)**

The groundwater present beneath the Application Site generally comprises a freshwater lens that is both downgradient and isolated laterally from the mainland by being laterally hydraulically isolated by Poulaweala Creek and the Roberstown River. It is noted that a portion of the Application Site in the southeast is within the mainland area of Glenbane West, however, groundwater flow in this area is west and north-westwards towards the Poulaweala Creek and the Roberstown River.

#### *10.6.10.4 Groundwater Vulnerability*

Groundwater Vulnerability defines how easily groundwater may be contaminated by human activities. The following classification for groundwater vulnerability is stated by the GSI (1999):
'The vulnerability of groundwater depends on:
(i) the time of travel of infiltrating water (and contaminants);
(ii) the relative quantity of contaminants that can reach the groundwater; and
(iii) the contaminant attenuation capacity of the geological materials through which the water and contaminants infiltrate.

As all groundwater is hydrologically connected to the land surface, it is the effectiveness of this connection that determines the relative vulnerability to contamination. Groundwater that readily and quickly receives water (and contaminants) from the land surface is considered to be more vulnerable than groundwater that receives water (and contaminants) more slowly and in lower quantities. The travel time, attenuation capacity and quantity of contaminants are a function of the following natural geological and hydrogeological attributes of any area:
(iv) The sub-soils that overlie the groundwater;
(v) The type of recharge - whether point or diffuse; and
(vi) The thickness of the unsaturated zone through which the contaminant moves.

In summary, the entire land surface is divided into four vulnerability categories as detailed in the Table below:

| Vulnerability Rating | Hydrogeological Conditions | | | | |
|---|---|---|---|---|---|
| | Subsoil Permeability (Type) and Thickness | | | Unsaturated Zone | Karst Features |
| | High permeability (sand/gravel) | Moderate permeability (e.g. Sandy subsoil) | Low permeability (e.g. Clayey subsoil, clay, peat) | (Sand/gravel aquifers only) | (<30 m radius) |
| Extreme (E) | 0 - 3.0m | 0 - 3.0m | 0 - 3.0m | 0 - 3.0m | - |
| High (H) | >3.0m | 3.0 - 10.0m | 3.0 - 5.0m | >3.0m | N/A |
| Moderate (M) | N/A | >10.0m | 5.0 - 10.0m | N/A | N/A |
| Low (L) | N/A | N/A | >10.0m | N/A | N/A |

Notes: (1) N/A = not applicable.
(2) Precise permeability values cannot be given at present.
(3) Release point of contaminants is assumed to be 1-2 m below ground surface.

*Extreme* ***(E)****, High* ***(H)****, Moderate* ***(M)*** *and Low* ***(L)*** *- based on the geological and hydrogeological factors described above. This subdivision is shown on a groundwater vulnerability map. The map shows the vulnerability of the first groundwater encountered (in either sand/gravel aquifers or in bedrock) to contaminants released at depths of 1-2 m below the ground surface. Where contaminants are released at significantly different depths, there will be a need to determine groundwater vulnerability using site-specific data. The characteristics of individual contaminants are not taken into account*.

According to the GSI online mapping tool (GSI, 2021) the BRDA site is classified as having between Low and Extreme groundwater vulnerability, with rock at or near surface or karst. This classification is dependent on the bedrock geology and presence of either glacial drift or alluvial deposits. Under the permitted Borrow Pit and proposed Borrow Pit Extension sites the groundwater vulnerability is classified as Extreme with 'rock at or near surface or karst'.

Within the wider Study Area groundwater vulnerability is quite variable, although a broad generalisation can be seen in that the western area is predominantly Low to Moderate while the east is predominantly Extreme or rock at or near surface or karst. It can be seen that the vulnerability of the Application Site has been correlated with the sub-soils occurring at the Site (Figure 10.24).

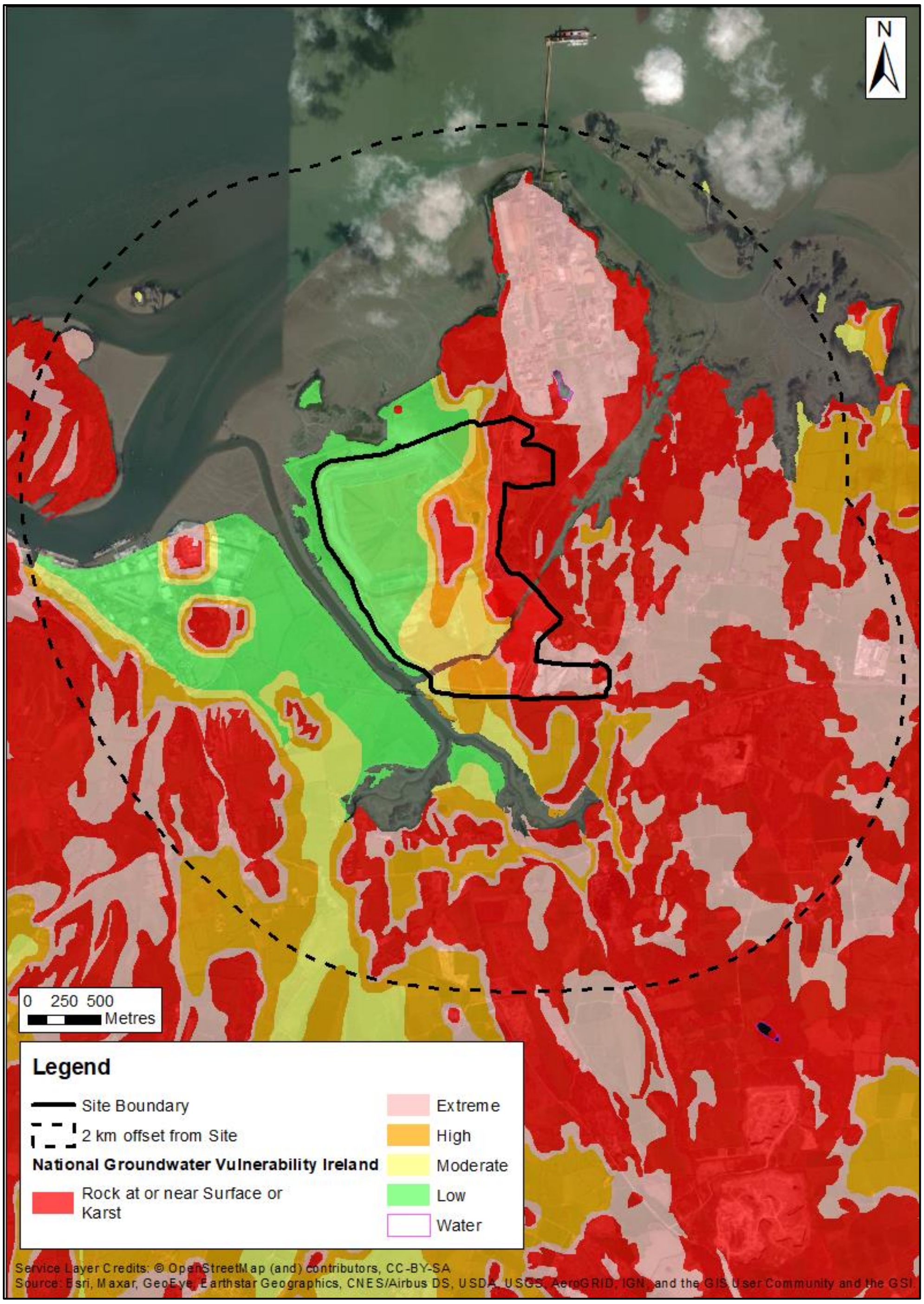



**Figure 10.24: Groundwater Vulnerability Map (Site Boundary in black), GSI 2021**

### *10.6.10.5 Groundwater Recharge*

GSI mapping (2021) indicates an effective rainfall of c. 518 mm/year across the Site. Sediments under the footprint of the BRDA are classified by the GSI website as being bedrock outcrop and subcrop with a potential recharge coefficient of 7.5 - 20%.

Whilst the recharge coefficient beneath the Borrow Pit and Borrow Pit Extension sites is 85% reflecting the shallow bedrock. The ability of the bedrock aquifers to accept all available groundwater recharge is variable, it is considered to be low (maximum 200 mm/yr) beneath the majority of the BRDA site while it is considered to moderate beneath the Borrow Pit sites (maximum 494 mm/yr). The Site groundwater recharge map is presented in Figure 10.25.

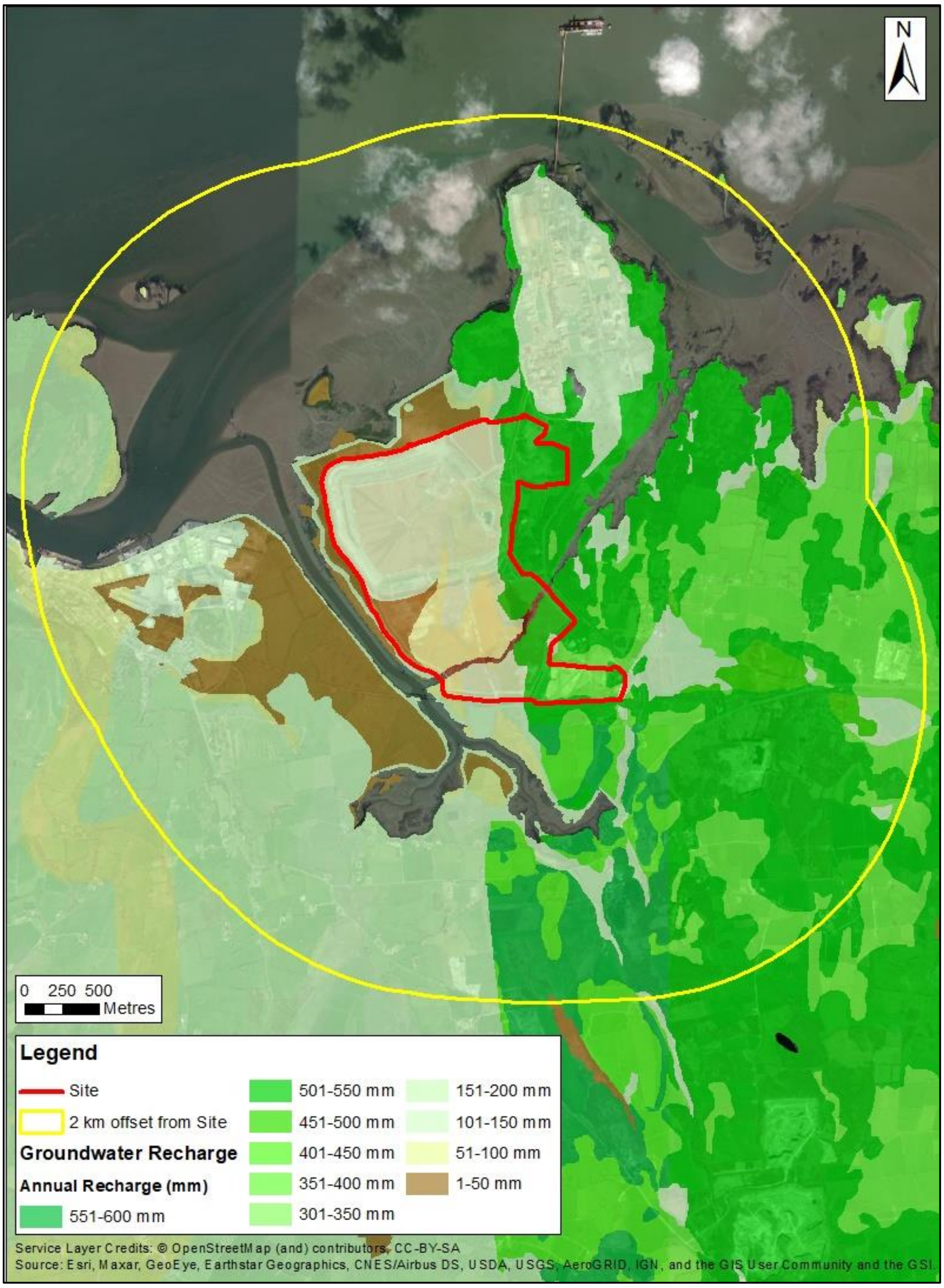



**Figure 10.25: Groundwater Recharge at the Site (GSI, 2021)**

Groundwater recharge within the western side of the wider Study Area is similar to the BRDA recharge in that it can be classified as low. The eastern side of the Study Area is similar to the Borrow Pit sites and has a more moderate groundwater recharge rate. It should be noted that the recharge map is derived from existing hydrogeological and meteorological data layers including annual rainfall, annual estimated actual evapotranspiration (AE), soil drainage, subsoil permeability, groundwater vulnerability, peat, sand/gravel aquifer and bedrock aquifer class (GSI, 2021). However, specific to the BRDA site, this does not account for the composite lining of the base of the BRDA, PIC, SWP and LWP, the low permeability of the residue and the numerous paved and concreted surfaces within the Plant result which would result in a much lower recharge to the groundwater than estimated by GSI.

#### *10.6.10.6 Karst Features*

A number of karst features have been identified by the GSI within the vicinity of the Site. In total, two karst features have been reported by the GSI, as shown in Figure 10.26 below. Both are outside the footprint of the Site (at c. 200m and 400m to the north of the BRDA).

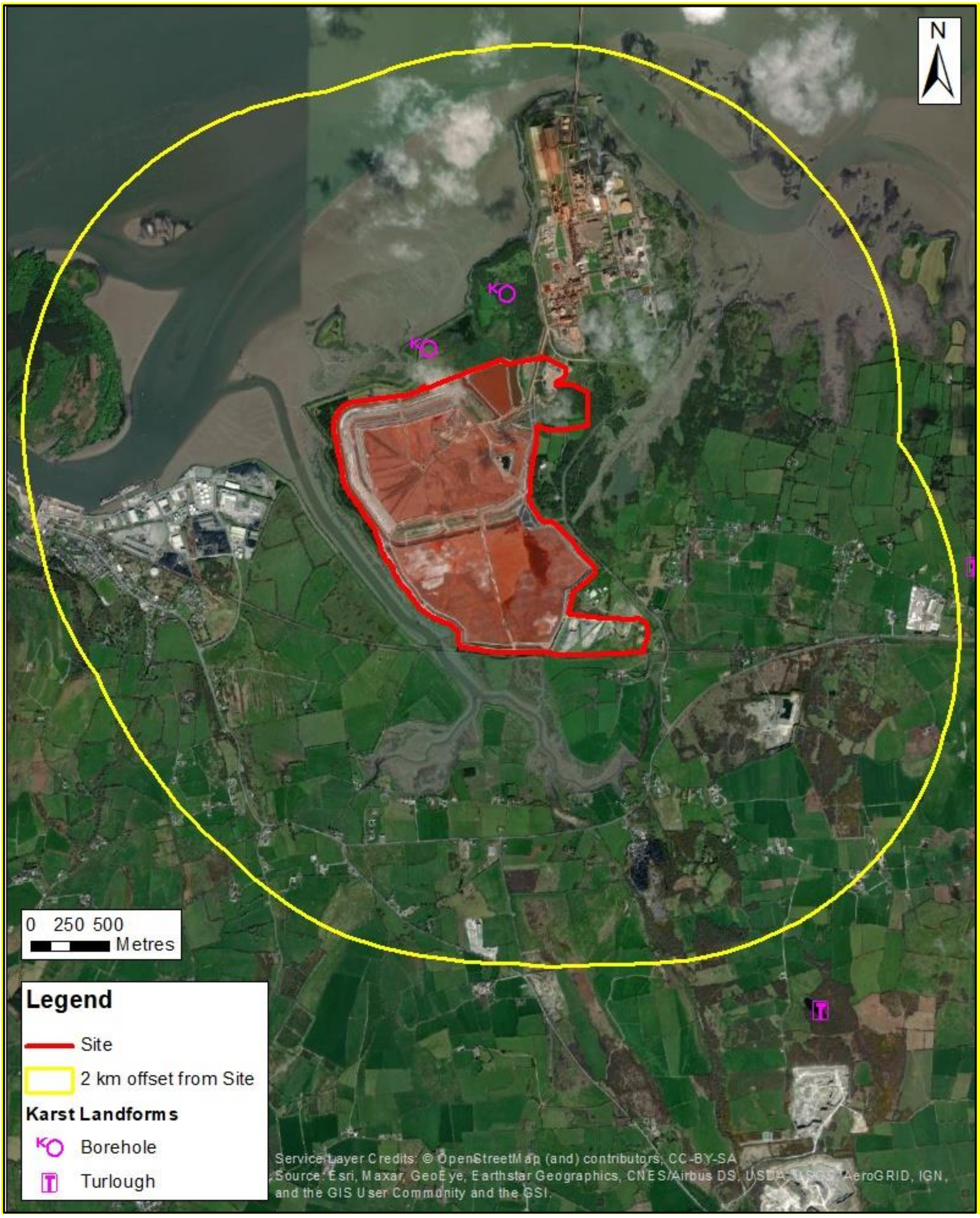



**Figure 10.26: Karst Features in vicinity of the BRDA (GSI 2021)** Aerial Photo Source – Bing Maps (2013)

However, the Waulsortian Limestone Formation is known to be commonly karstified, often with cavities infilled with sediments. As a consequence of the very low permeability of the Waulsortian Limestone which is to predominantly beneath the Borrow Pit and Borrow Pit Extension sites and the Plant site, flow of groundwater is dominated by the location of karstified fracture zones and valley infill. Given the shallow groundwater levels in the area (typically 1.5 – 10 mbgl) it is implied that the fracture zones start from a relatively shallow depth.

Resistivity surveying was undertaken by Golder during 2017 for the Borrow Pit site. Eight (8) lines of resistivity were surveyed in order to understand the potential for the presence of dolomitization or karstic features within the footprint of the now permitted Borrow Pit site. Given the Waulsortian Limestone has very low primary permeability, it was important to ascertain the presence of enhanced primary permeability from dolomitization or karst to examine the potential for the excavation to encounter permeable features that could connect either laterally to surface or groundwater bodies or vertically with the potential to flood the workings from groundwater.

Based on the interpretation of the geophysical survey presented in Appendix 8.4 of Chapter 8: Soils, Land and Geology, possible areas of fractured bedrock and karst were identified in the Borrow Pit area (Figure 10.27).

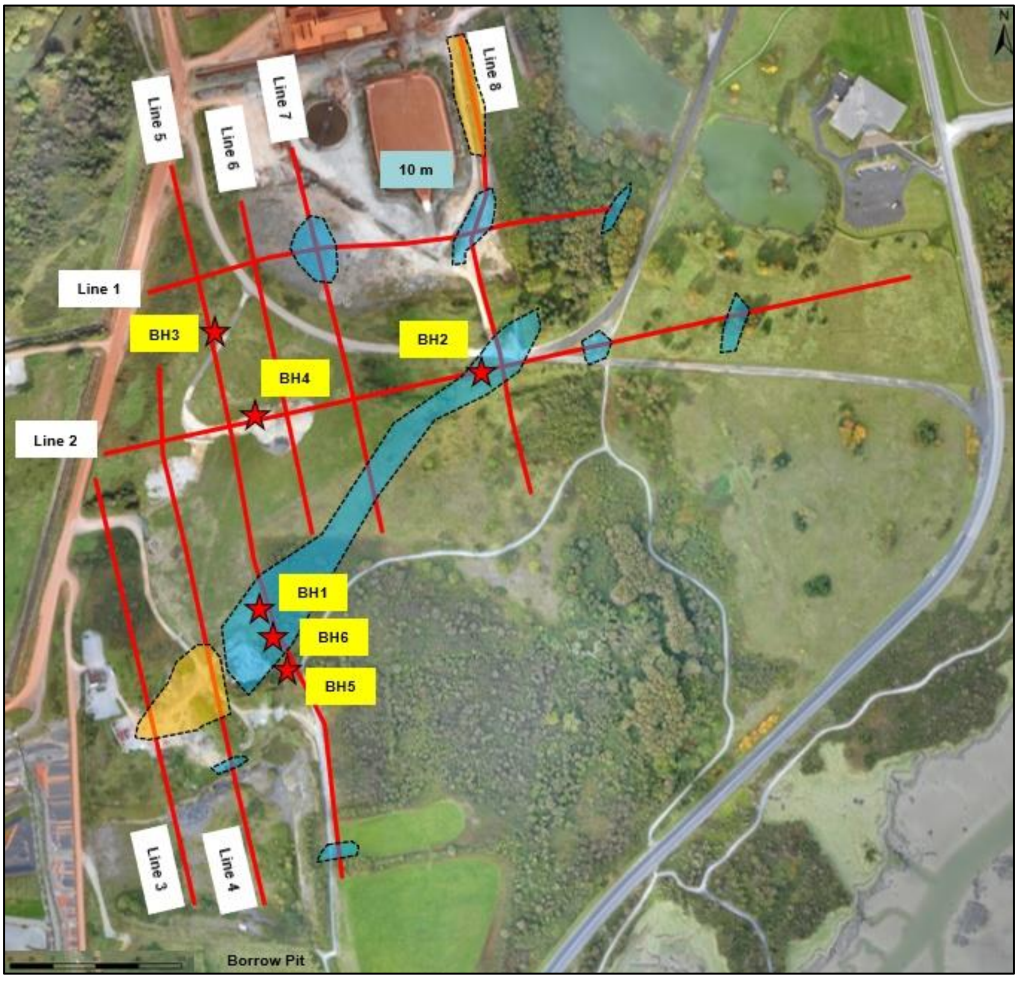



**Figure 10.27: Resistivity Lines and Borehole Locations (Golder 2017)**

As a consequence, these areas were targeted for investigation by the drilling of boreholes to identify whether the presence of karstic features could also include groundwater at a piezometric level that is above the proposed base of the excavation level (8.5 mOD) and in quantities that could be problematic to the excavation.

Based on the findings of the geophysical survey, six (6) boreholes were drilled to ≈ 15 m depth below ground level, which is deeper than the depth of the proposed workings. Borehole BH5 did not reach the target depth and was replaced by B6. Of the boreholes drilled, BH1, BH2, BH3, BH5 and BH6 encountered cavities within the limestone, whilst no cavities were observed in BH4. Water strikes during drilling were noted in BH1 and BH2 at elevations of 3.82 mOD rising to 7.32 mOD, and at 8.03 mOD respectively. No other water strikes were noted.

Following completion of drilling, the boreholes were developed and pumped in preparation for test pumping. The recovery of the water level was sufficiently slow that test pumping was not possible, thereby indicating that regardless of the presence of karst, the limestone was insufficiently transmissive to result in a rapid inflow of groundwater to the drilled boreholes in the areas considered.
Following the installation of the monitoring boreholes, the boreholes have been routinely monitored for groundwater level. BH3, BH4 and BH5 have been found to be dry. This indicates that either the elevation of groundwater is below the drilled depth, or the limestone is untransmissive locally at these locations. In boreholes BH3, BH4 and BH5 the base of the boreholes is reported as 1.09 mOD, 1.75 mOD and 10.50 mOD, respectively.

Based on the findings of the investigation, it has been interpreted that the Waulsortian Limestone in the area of the Borrow Pit sites has limited secondary permeability. Where groundwater was encountered, attempts to conduct pumping tests were made to facilitate a first-order calculation of groundwater inflow to the excavation. The groundwater recovery rates following pumping were sufficiently slow that a pumping test was not feasible.

On the basis of the findings for the site investigations, it is concluded that there are limited groundwater inflows and or isolated perched units of groundwater within the Borrow Pit and Borrow Pit Extension site areas. The lateral extent of isolated seepages is interpreted to be limited and the transmissivity of the formation is too small to measure by test pumping. Hence, it is interpreted that the accumulation of surface water and precipitation in the excavation could be larger than any isolated seepages of groundwater.

#### *10.6.10.7 Groundwater Quality*

#### 10.6.10.7.1 BRDA Site

The overall Aughinish site operates under an Industrial Emissions Licence (Reg. No. P0035-07) and carries out routine groundwater monitoring.

The principal contaminant of concern arising from the alumina production process is dilute sodium aluminate, which is characterised by elevated pH, elevated alkalinity and elevated aluminium relative to groundwater. Fluoride, a common element in bauxite ore, is also present in the sodium aluminate solution and so is a potential contaminant of concern.

Consideration has been given in the following section to the groundwater monitoring of the observation wells, which are installed around the perimeter of the BRDA. Wells are generally paired, with one well drilled into the overburden and its partner driller drilled into the limestone bedrock, refer to Figure 10.28 for a map of the well locations and refer to Appendix 8.1 of Chapter 8: Soils, Land and Geology for a copy of the logs. Parameters shown in graphs are annual averages between 2008 and 2020 and are an average of Q1, Q2 and Q3 data available from 2021.

The results of pH monitoring over the period 2008 – 2021 are considered below for the observation wells (OWs) installed around the Phase 1 and Phase 2 BRDA. Results presented in graphs are the annual averages for pH in the OWs and consist of 12 OWs around the Phase 1 BRDA and 18 OWs around the Phase 2 BRDA.

As the BRDA expanded over time and the Phase 2 BRDA merged with the south flank of the Phase 1 BRDA, the OW surrounding the southern side of the Phase 1 were capped and discontinued prior to the commencement of the Phase 2 BRDA; these wells have not been considered in this assessment as they were capped prior to 2011.

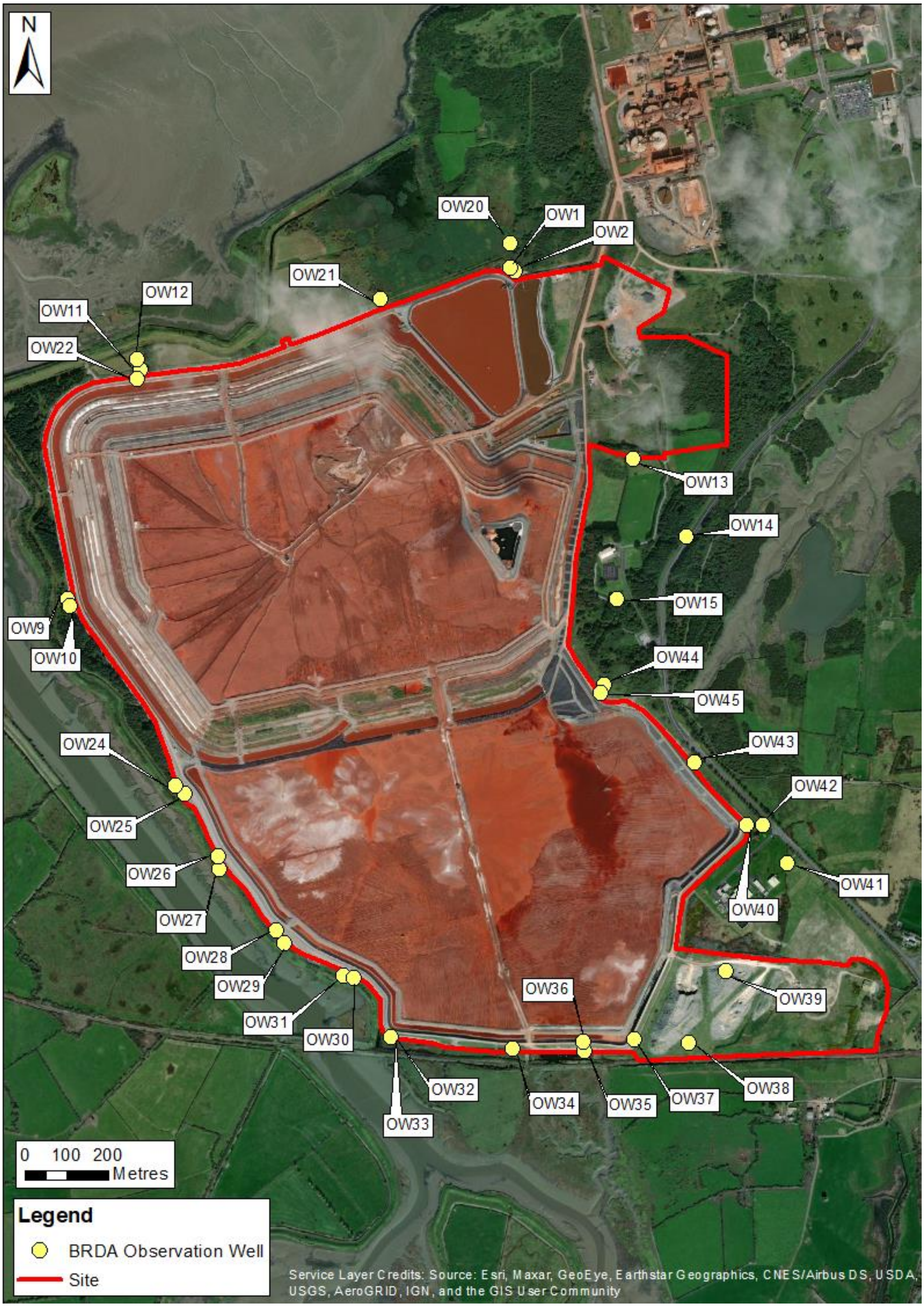



**Figure 10.28: Location of Observation Wells (OWs) around the perimeter of the BRDA** Aerial Photo Source – Bing Maps (2013)

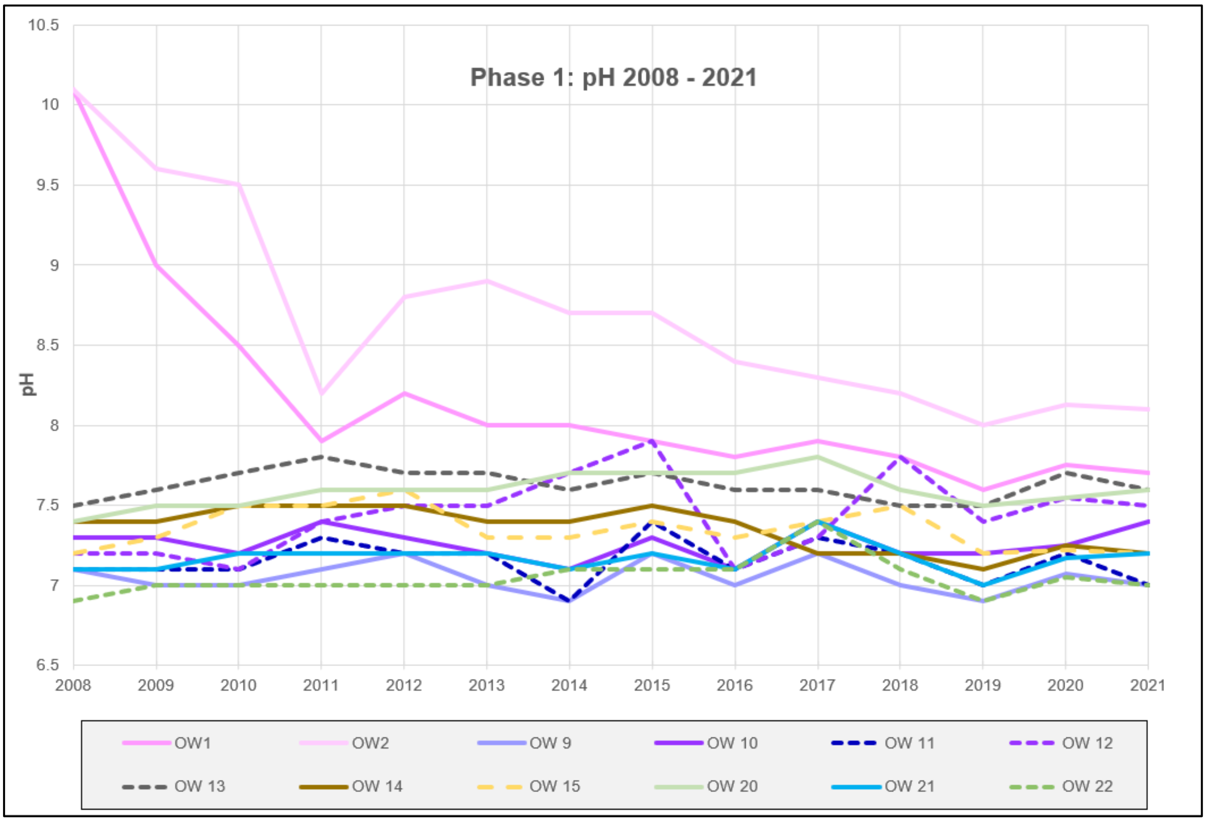



**Figure 10.29: Phase 1 BRDA Observation Well Results for pH between 2008 and 2021**

Figure 10.29 above shows that annual average pH levels in the majority of the Phase 1 OWs have remained consistently between 6.9 and 8.0 between 2008 and 2020, with the exception of OW1 and OW2 which showed elevated pH levels between 2008 and 2010 (pH between 9.0 and 10.0). 2021 data (an average of three quarters) is consistent with the overall trend in the data.

Since 2010, pH levels in these two OWs have steadily decreased, and all Phase 1 OWs currently have an average pH of below 8.2 and are below the Threshold Value set by the Groundwater Regulations (2010, as amended) for pH of 9.5 and the site target value of pH 6.0 to 9.0.

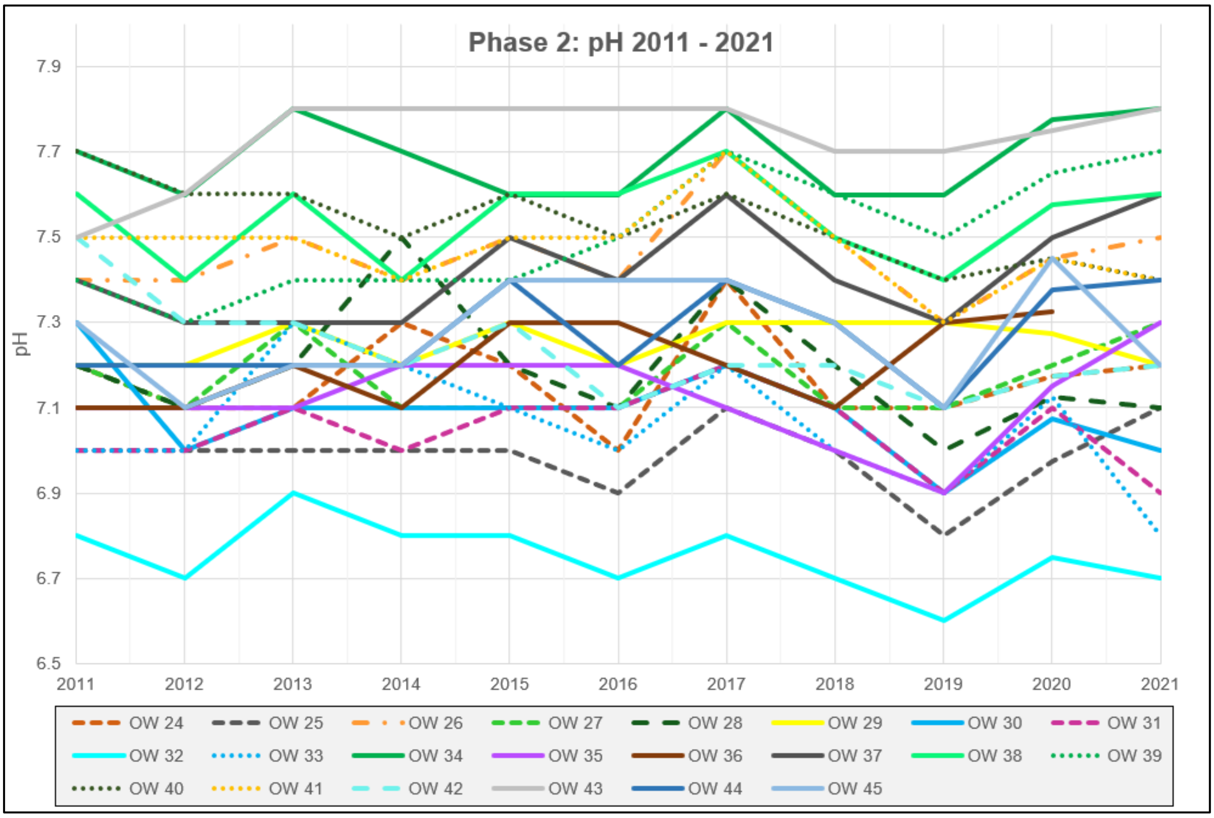



**Figure 10.30: Phase 2 BRDA Observation Well Results for pH between 2011 and 2021**

Figure 10.30 above shows the annual average pH levels for the Phase 2 BRDA, all of which were commissioned in 2011.

Results for all of the Phase 2 BRDA OWs show that pH for all the OWs is between 6.6 and 7.8 with slight fluctuations within this range observed in OWs over this period. These results are below the Threshold Value set by the Groundwater Regulations (2010, as amended) for pH of 9.5 and the site target value of pH 6.0 to 9.0.

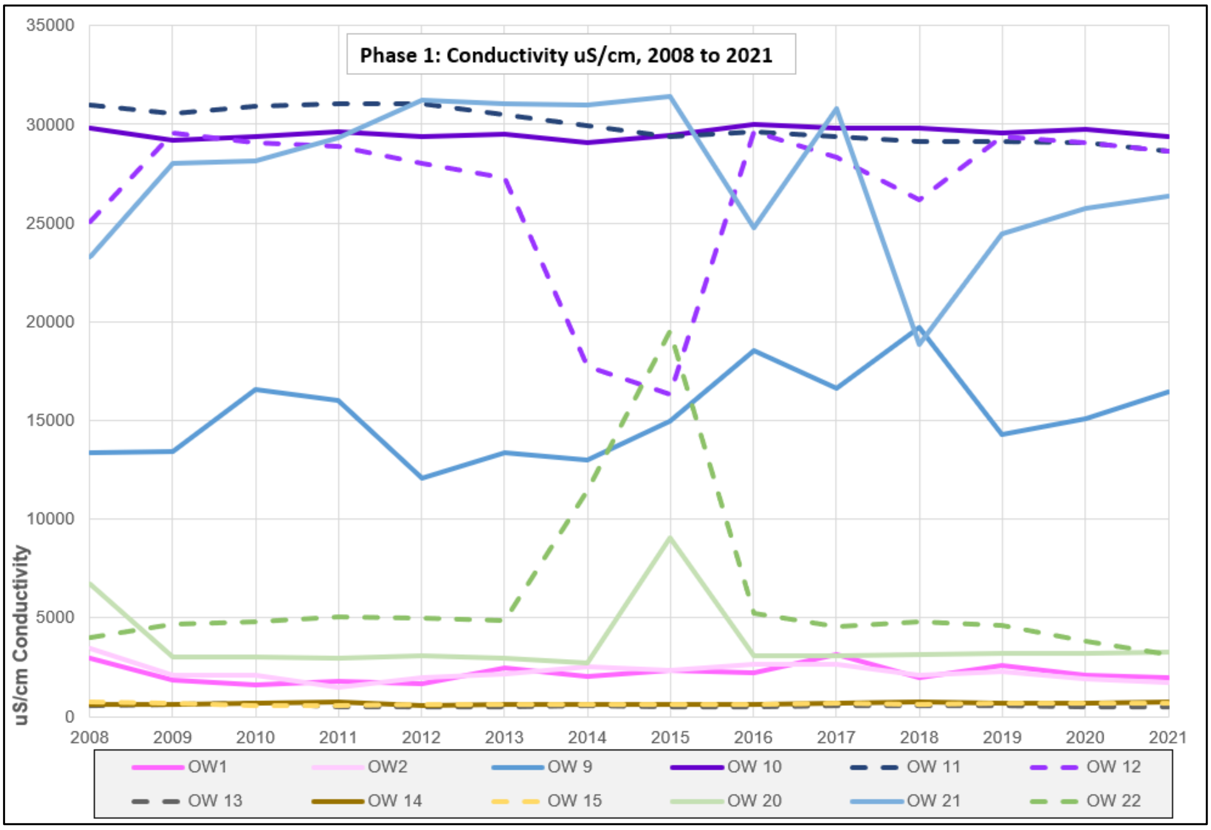



**Figure 10.31: Phase 1 BRDA Observation Wells Annual Average Electrical Conductivity between 2008 and 2021**

Figure 10.31 above presents annual average electrical conductivity values for the Phase 1 BRDA OWs between 2008 and 2020, 2021 is an average of three quarters. Values for the OWs indicate that there are three broad categories of wells;

- Those with a strong saline influence (OW21, OW10, OW11, OW12 and OW9) showing electrical conductivity averages between 12,068 µS/cm and 31,425 µS/cm. These five (5) OWs are located proximally to the estuary and comprise both bedrock and overburden wells.

- The second category of OWs also show elevated electrical conductivity in wells which are again located to the north of the Phase 1 BRDA and indicate the influence of brackish water in OW20, OW22, OW1 and OW2. Average electrical conductivity values have been in the range of 1,465 – 5,218 µS/cm with the exception of peaks of 19,550 µS/cm in OW22 and 9,030 µS/cm in OW20 in 2015. However, pH in these wells in 2015 and 2016 was 7.1 for OW22 and 7.7 pH for OW20; the pH values for these two (2) OWs would be expected to be elevated if it were due to onsite sources.

- The third category of OWs are wells which are found on the eastern and most inland part of the Phase 1 BRDA and have the least impact from saline intrusion; these are OW13, OW14 and OW15 (all bedrock wells). Electrical conductivity for these wells has averaged between 473 µS/cm (OW13 2011) and 762 µS/cm (OW14).

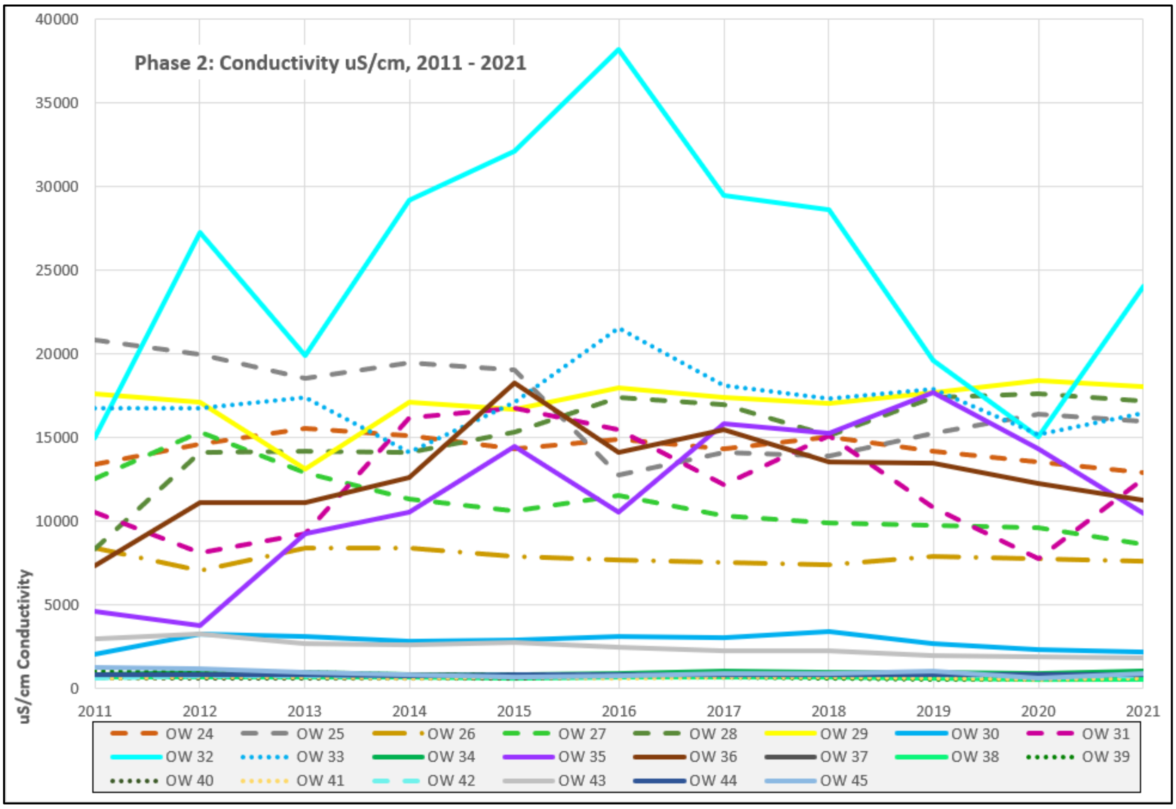



**Figure 10.32: Phase 2 BRDA Observation Wells Annual Average Electrical Conductivity between 2008 and 2021**

Figure 10.32 above presents annual average electrical conductivity values for the Phase 2 BRDA OWs between 2011 and 2020 and an average of three quarters from 2021. Similarly, to the Phase 1 OWs, there are wells which are influenced by saline intrusion, and which have a very high electrical conductivity and there are those wells, which are located along the south and eastern sides of the Phase 2 BRDA, which are less impacted by saline intrusion to varying degrees based on proximity to the transitional waterbodies. Observation Wells OW32, OW25, OW33, OW29, OW28, OW36, OW35, OW28, OW24, OW27, OW31, OW30, OW43 and OW26 all show varying degrees of saline intrusion and have high conductivity ranges between 1,906.75 µS/cm (OW43 2020) and 38,150 µS/cm (OW32 2016) between 2008 and 2021.

Whilst these OWs all have elevated electrical conductivity values compared with the Groundwater Regulation (2010, as amended) Threshold Value of 1,875 µS/cm, most wells are broadly consistent in levels throughout this period with the exception of OW32, OW35, OW36 and to a lesser extent OW31.
OW32 showed an upward trend in electrical conductivity up to 2016 (averaging 38,150 µS/cm for 2016) and from 2016 to 2020 onwards it has shown a strong downward trend (averaging 15,047.5 µS/cm in 2020). The current average for 2021 in OW32 is more in line with 2018 – 2019 data at present but still represents an overall downward trend. Comparatively, pH levels for OW32 have been consistently the lowest of all the BRDA wells, whilst soda has followed a similar trend to electrical conductivity in OW32 with an upwards trend to 2016 and a downwards trend since then.

OW31, OW35 and OW36 have all shown broad upward trends in electrical conductivity during this period. However, pH in comparison has not shown a strong upwards trend and remains below the Threshold Value of 9.5 for these three (3) wells.

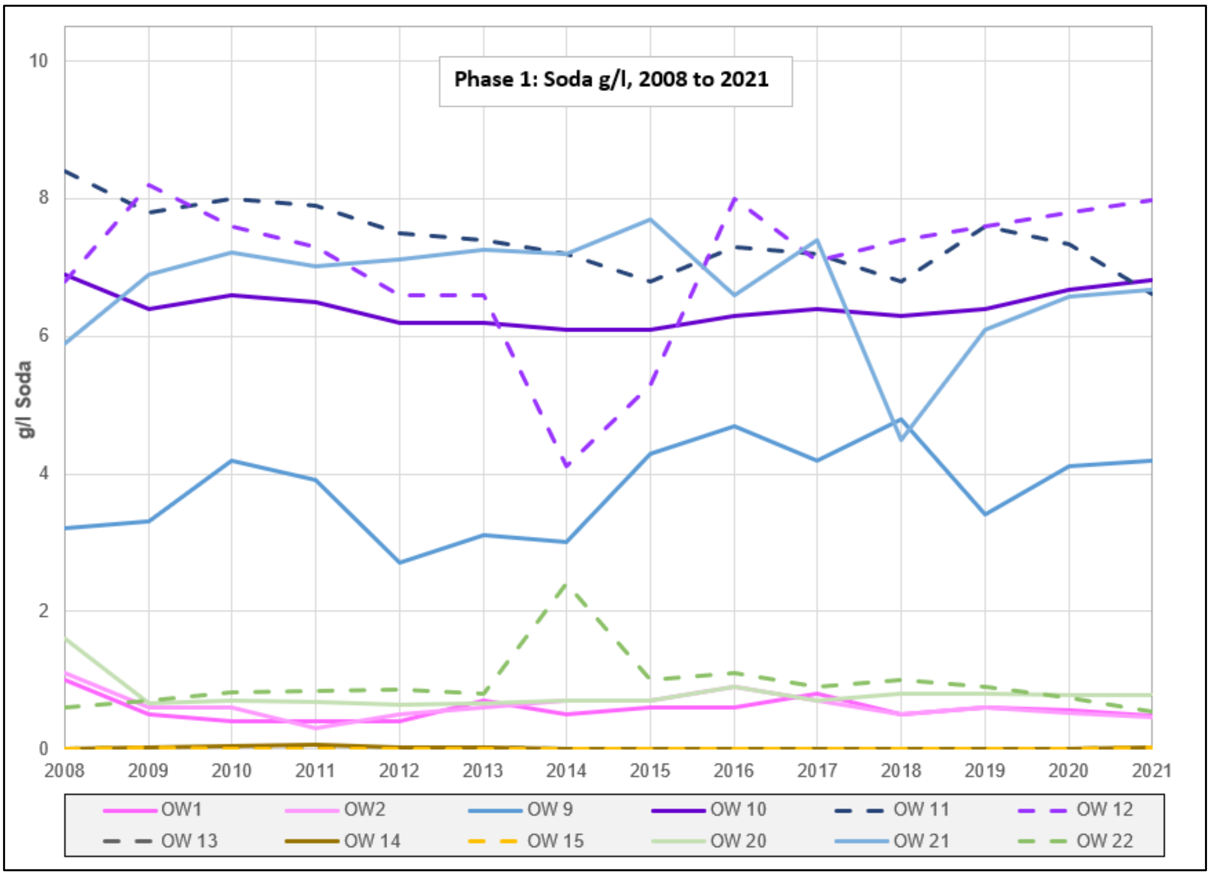



**Figure 10.33: Phase 1 BRDA Observation Wells Annual Average Soda Concentration between 2008 and 2021**

Figure 10.33 above shows the annual average concentration of soda in the OWs surrounding the Phase 1 BRDA between 2008 and 2020. The results show two broadly consistent categories of wells which are very similar to the trends seen for electrical conductivity in the wells.

The first are 7 wells (OW1, OW2, OW20, OW22, OW15, OW14 and OW13) which show levels generally < 0 g/l to 1.1 g/l soda. Slightly elevated levels have occurred in 2008 and 2014 of up to 2.4 g/l in OW22. Wells in this category lie generally to the east and north-northeast of the BRDA and ponds and consist of both overburden and bedrock wells. OW22 lies to the north-northwest of the Phase 1 BRDA.
The second category of wells is one with a slightly elevated soda level compared to the wells and greater fluctuations are seen in soda levels in general. Five wells are broadly in this trend: OW9, OW10, OW11, OW12 and OW21 and these are found along the north and west of the Phase 1 BRDA. Soda levels in this category have averaged between 2.7 g/l and 8.4 g/l between the period and wells are both overburden and bedrock.

These five (5) wells are more coastally located compared to the other seven (7) wells and are subject to saline intrusion, which is likely causing interference in the readings. Average pH levels within these wells have been consistently pH < 8 for all wells during this period, while electrical conductivity has been elevated.

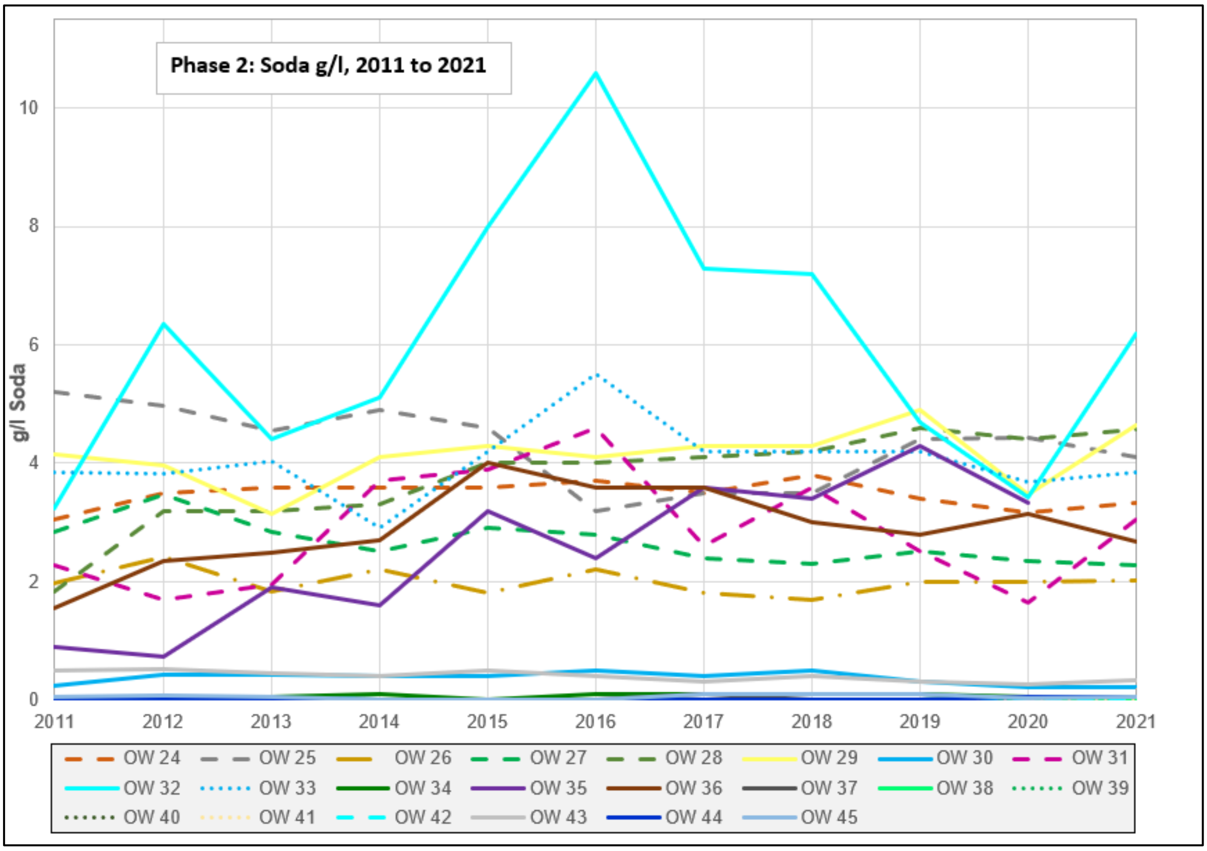



**Figure 10.34: Phase 2 BRDA Observation Wells Annual Average Soda Concentration between 2008 and 2021**

Figure 10.34 above shows the annual average concentration of soda in OWs surrounding the Phase 2 BRDA between 2011 and 2020.

Similarly, to the Phase 1 wells, there are two broad categories of wells; those with a relatively level soda concentration which is consistent and those with a slightly elevated concentration with more fluctuations.

Soda trends are also very similar to the electrical conductivity readings seen in the same wells. Eleven (11) wells sit in the latter category showing higher soda concentrations and more variability in results and are found on the western side of the Phase 2 BRDA, near to the Robertstown River.

Wells include both bedrock and overburden wells. With the exception of OW32, wells in this category have had annual average soda values between 0.72 g/l and 5.21 g/l. OW32, a bedrock well, had historically elevated levels of soda in 2016 with an average of 10.6 g/l but has shown a general decline in soda since then.

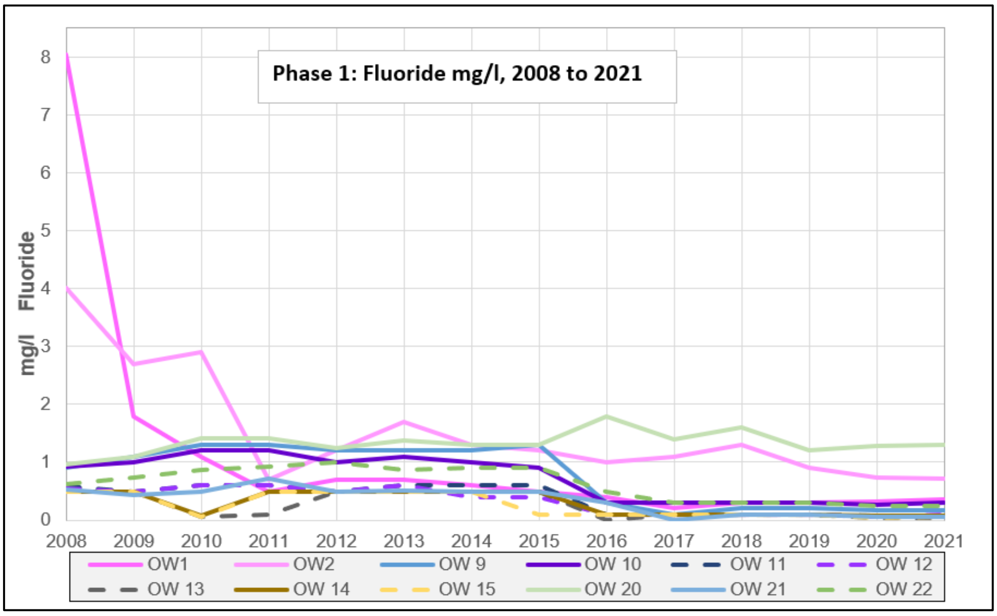



**Figure 10.35: Phase 1 BRDA Observation Wells Annual Average Fluoride Concentration between 2008 and 2021**

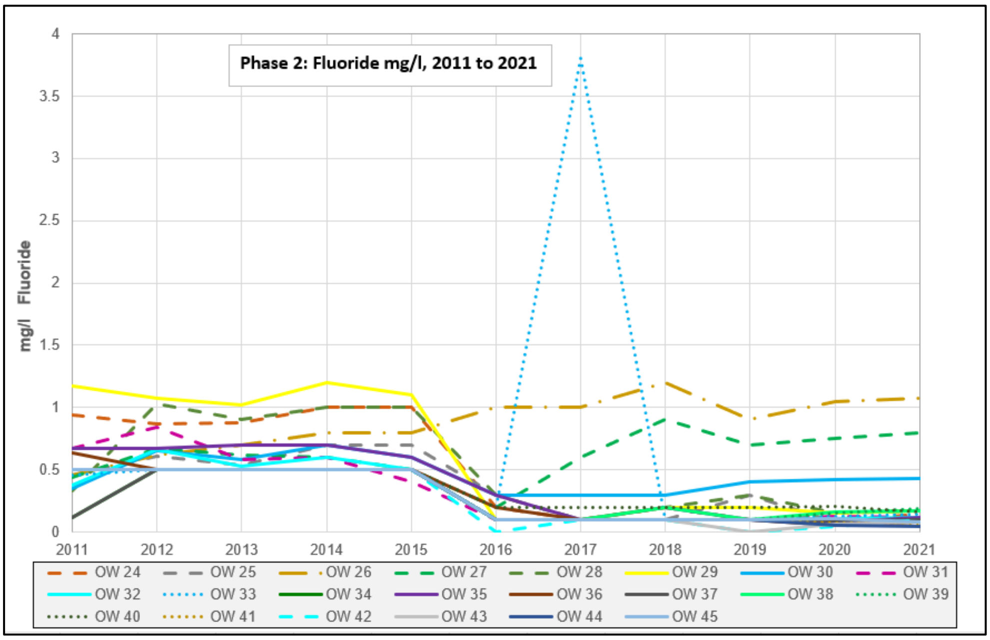



**Figure 10.36: Phase 2 BRDA Observation Wells Annual Average Fluoride Concentration between 2011 and 2021**

Fluoride annual average concentrations are presented in Figure 10.35 for the Phase 1 BRDA wells and in Figure 10.37 for the Phase 2 BRDA wells. An IGV Threshold Value of 1.0 mg/l has been set by the EPA (2003). Fluoride levels in the Phase 1 BRDA have historically shown elevations for wells OW1 and OW2 (peaking at 8.01 mg/l in OW1 for 2008) which coincide with elevated pH levels between 2008 and 2010, indicating impact from onsite activities at these wells. Against the IGV Threshold Values, only OW20 has been slightly elevated for 2020 at 1.29 mg/l. Comparatively, for the Phase 2 BRDA wells one well (OW26), has shown an average of 1.07 mg/l fluoride for 2021 while all other wells are below the Threshold Value. Historically, OW33 had a fluoride spike in 2017 of 3.8 mg/l average fluoride for the year.

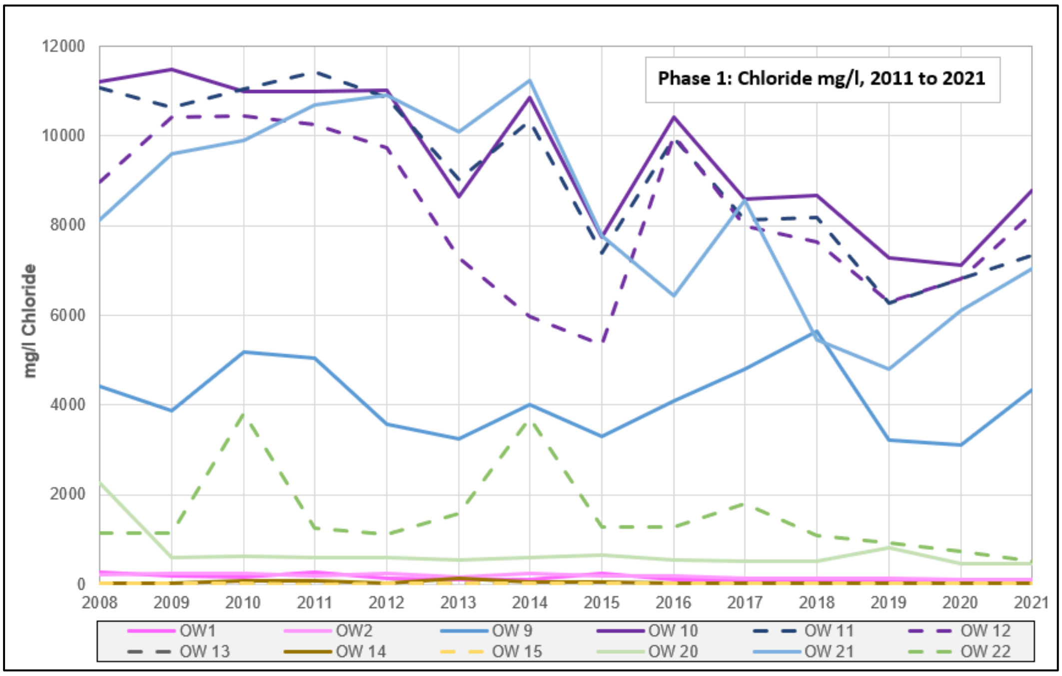



**Figure 10.37: Phase 1 BRDA Observation Wells Annual Average Chloride Concentration between 2008 and 2021**

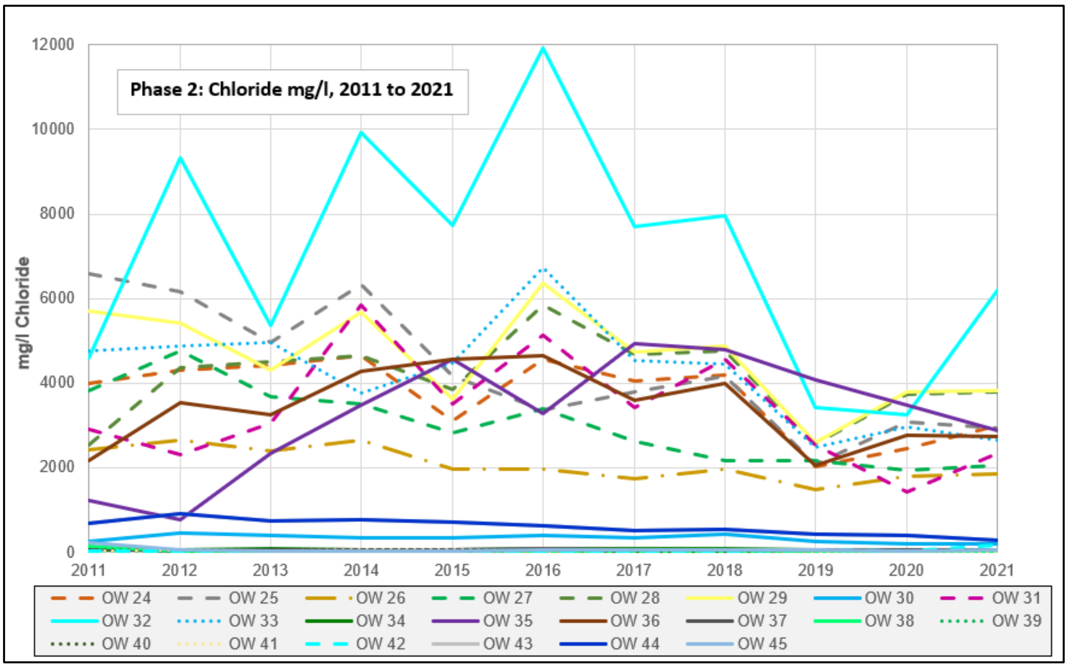



**Figure 10.38: Phase 2 BRDA Observation Wells Annual Average Chloride Concentration between 2011 and 2021**

Chloride annual average concentrations are presented in Figure 10.37 for the Phase 1 BRDA and in Figure 10.38 for the Phase 2 BRDA. Chloride values are very similar in trend to electrical conductivity trends which is expected given the strong saline influence in some OWs. The three (3) Phase 1 wells which are the furthest removed from saline intrusion (OW13, OW14 and OW15) all have shown averages between 17 and 137 mg/l chloride between 2008 and 2021.

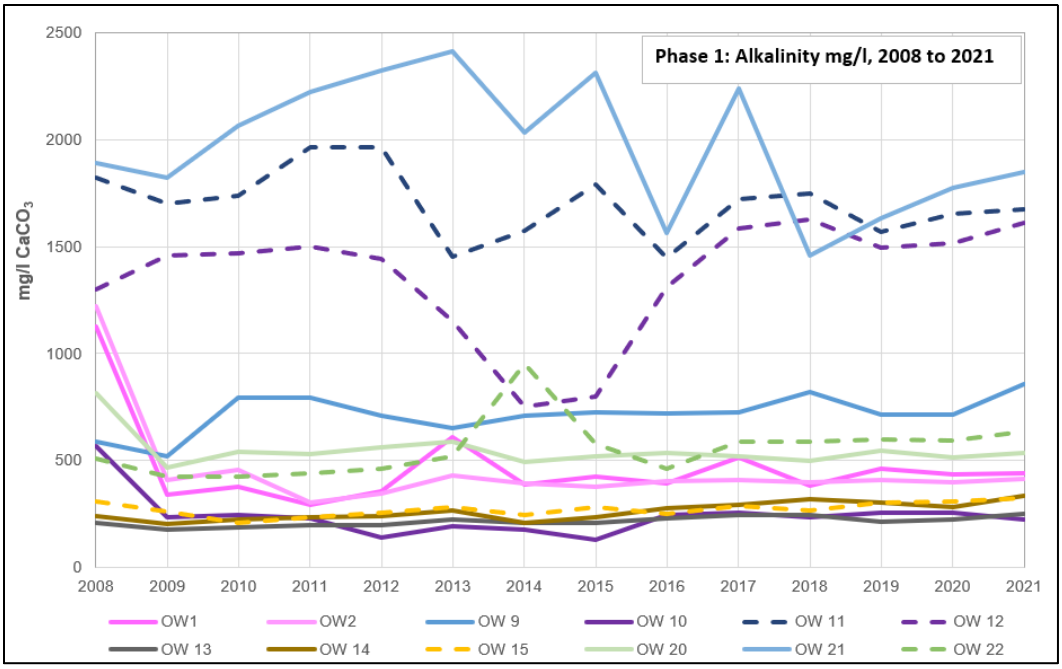



**Figure 10.39: Phase 1 BRDA Observation Wells Annual Average Total Alkalinity between 2008 and 2021**

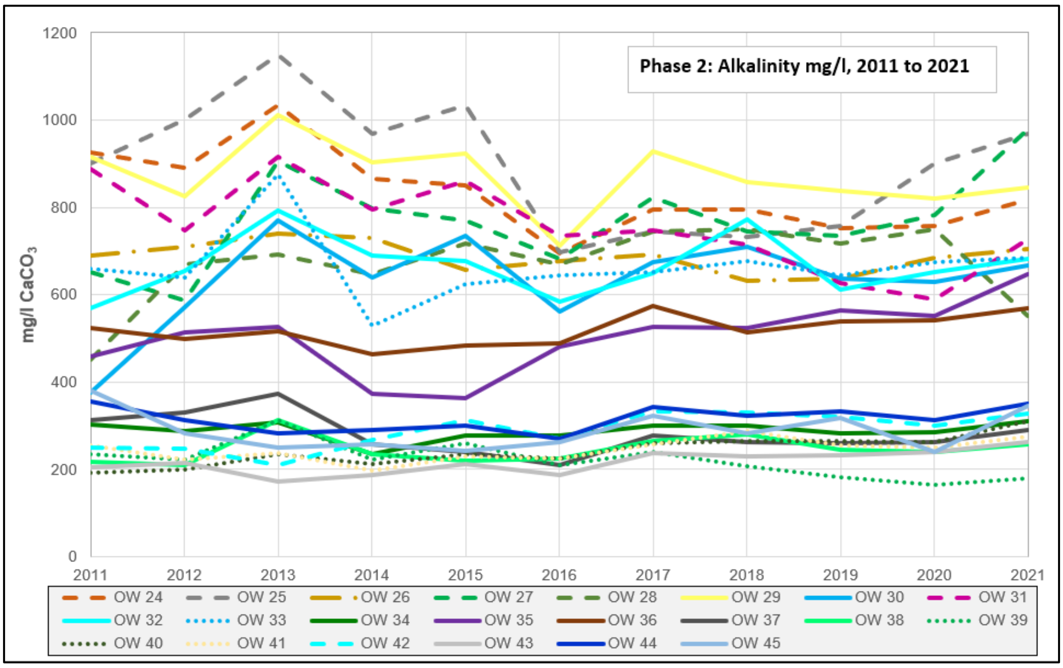



**Figure 10.40: Phase 2 BRDA Observation Wells Annual Average Total Alkalinity between 2011 and 2021**

Total alkalinity annual average concentrations are presented in Figure 10.39 for the Phase 1 BRDA wells and in Figure 10.40 for the Phase 2 BRDA wells.

Slight elevations in total alkalinity in wells OW9 and OW11, located on the north-west and west sides of the Phase 1 BRDA, coincide with slight elevations recorded in pH during 2015 and 2017. However, pH has averaged under 8.0 in these wells which is within threshold values. Total alkalinity in the Phase 2 wells has shown a broad downward trend in wells over time, particularly since 2014 onwards.

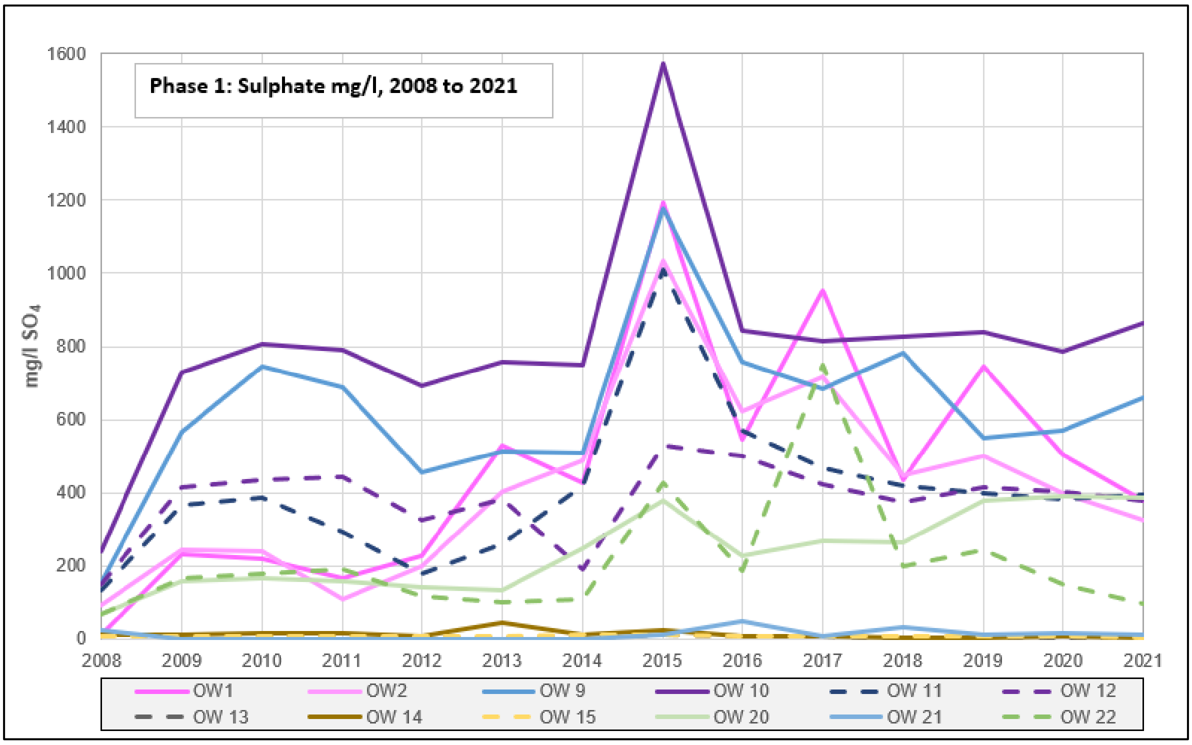



**Figure 10.41: Phase 1 BRDA Observation Wells Annual Average Sulphate Concentration between 2008 and 2021**

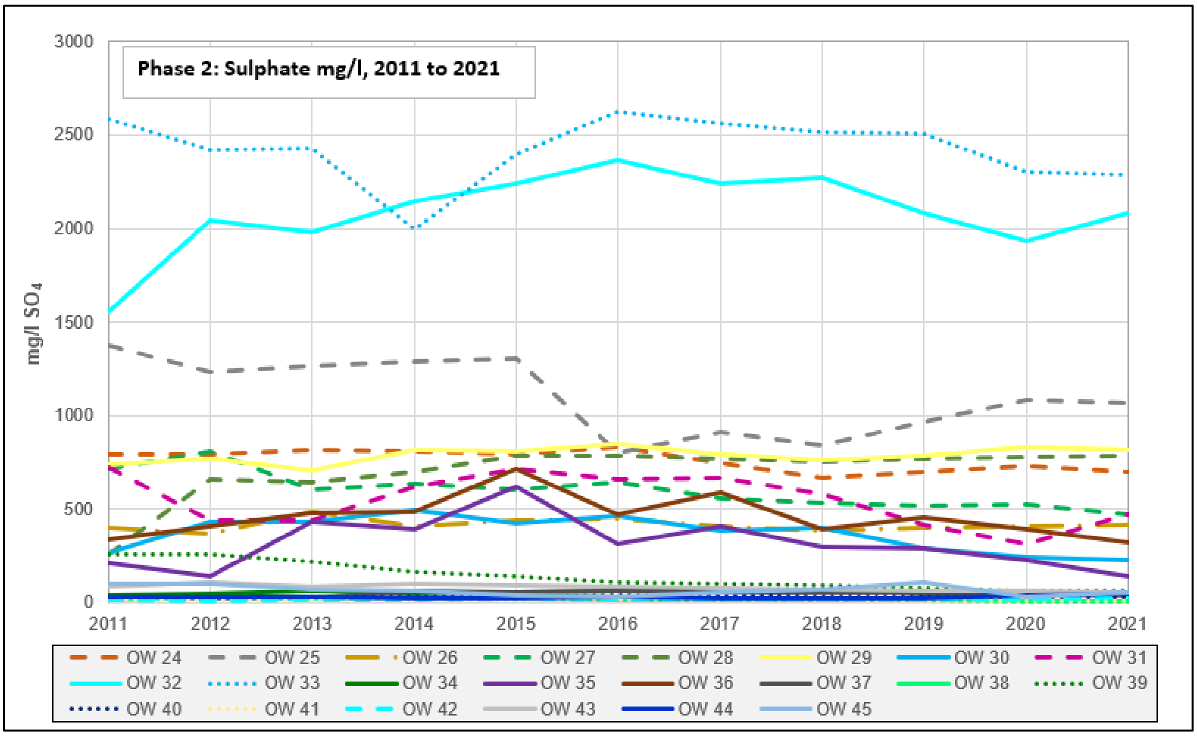



**Figure 10.42: Phase 2 BRDA observation wells annual average sulphate between 2011 and 2021**

Sulphate trends are shown in Figure 10.41 and Figure 10.42 for the Phase 1 BRDA and the Phase 2 BRDA, respectively. Wells which are more strongly influenced by saline intrusions show stronger elevations in sulphate. However, OW9, OW10 and OW11 along the western flank of the Phase 1 BRDA and OW1 and OW2 along the north-eastern flank of the Phase 1

BRDA all showed elevated sulphate during 2015, which coincided with slight elevations in pH in these wells during this period.

Table 10. below presents the results of the metal analysis undertaken in April 2021 and July 2021 for the observation wells surrounding the Phase 1 and Phase 2 BRDA.

Results for Aluminium (Al) in all of the OWs are below the Groundwater Regulation Threshold Value (2010, as amended) of 150 µg/l with the exception of OW13 on the 06 April 2021, which had a reading of 553 µg/l Al. OW13 is located to the east of the Phase 1 BRDA Extension, which is composite lined, and to the south of the Borrow Pit footprint. Subsequent testing of OW13 on 14 April 2021 and 19 July 2021 showed that Al was below the detection limit and under the Threshold Value. Hence, it is considered likely that the April 2021 reading was anomalous.

Magnesium (Mg) is elevated in several OWs when compared against the groundwater Threshold Value of 50 µg/l. However, this elevated concentration occurs predominantly within OWs along the northern and western flanks of the Phase 1 BRDA which is also parallel to the Shannon Estuary and Robertstown River, i.e., wells with stronger saline impact.

Iron (Fe) is elevated in a number of OWs when compared against the groundwater Threshold Value of 200 µg/l. The elevated readings are predominately along the west flank of the Phase 1 and Phase 2 BRDA, from OW9 to OW33. Significantly elevated readings (> 1,000 µg/l) at OW22, OW25, OW27, OW28, OW29 and OW31) along the west flank of the Phase 2 BRDA and a further high reading is recorded at OW41 at the south-east extent of the Phase 2 BRDA.

Zinc (Zn) is elevated in a number of OWs when compared against the groundwater Threshold Value of 75 µg/l. Elevated readings are recorded at OW1 and OW2, to the north-east of the Phase 1 BRDA but otherwise they predominately mimic the locations of the high Zinc wells i.e., along the west flank from OW9 to OW 35. Significantly elevated readings (> 6,000 µg/l) are recorded at OW10, located to the west of the Phase 1 BRDA. All other elevated readings are in the 75 to 220 µg/l range.

**Table 10.7: Water Quality Metal Analysis for the Phase 1 and Phase 2 BRDA (April and July 2021)**

| | Well ID | Parameter | Al µg/l | As µg/l | Cd µg/l | Cr µg/l | Cu µg/l | Fe µg/l | Pb µg/l | Mg mg/l | Hg µg/l | Ni µg/l | Ti µg/l | Zn µg/l |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Groundwater Regulations Threshold Value | 150 | 7.5 | 3.75 | 37.5 | 1,500 | - | 7.5 | - | 0.75 | 15 | - | 75 |
| | | EPA Interim Guidance Values | | | | | | 200 | | 50 | | | - | |
| Phase 1 BRDA | OW1 | 14/04/2021 | <80 | 2 | <10 | <20 | 2 | <80 | <10 | 13.4 | 0.54 | 1 | <50 | 23 |
| | OW1 | 19/07/2021 | <80 | 2 | <10 | <20 | 1.7 | <80 | <10 | 15.9 | 0.40 | <10 | <50 | 212.9 |
| | OW2 | 14/04/2021 | 15 | 2 | 1 | <20 | 2 | 8 | 1 | 18 | 0.37 | 1 | <50 | 348 |
| | OW2 | 19/07/2021 | <80 | 1.4 | <10 | <20 | 1.4 | <80 | <10 | 18.6 | 0.30 | <10 | <50 | 220.1 |
| | OW9 | 14/04/2021 | <80 | 13 | 1 | <20 | 1 | 3,549 | 1 | 422.7 | 0.38 | 15 | <50 | 48 |
| | OW9 | 19/07/2021 | <80 | 4.5 | <10 | <20 | 3.8 | 1,151.5 | <10 | 465.5 | 0.30 | 8.5 | <50 | 80.9 |
| | OW10 | 14/04/2021 | <80 | 10 | 8 | 7 | 13 | 1,375 | 7 | 793 | 0.24 | 29 | <50 | 6,232 |
| | OW10 | 19/07/2021 | 29 | <10 | <10 | <20 | 8.7 | 30.6 | <10 | 793.2 | 0.20 | 15.2 | <50 | 9,821 |
| | OW11 | 14/04/2021 | <80 | 3 | <10 | 3 | 1 | 11 | <10 | 671.7 | 0.45 | 1 | 5 | 9 |
| | OW11 | 19/07/2021 | 20.4 | 4.4 | <10 | 3.2 | 1.1 | 14.4 | <10 | 628.3 | 0.20 | <10 | 10 | 14.1 |
| | OW12 | 14/04/2021 | <80 | 1 | <10 | 2 | <10 | 40 | <10 | 687.6 | 0.19 | 2 | <50 | 5 |
| | OW12 | 19/07/2021 | <80 | 1.1 | <10 | 2.2 | <10 | 9.8 | <10 | 621.6 | 0.10 | <10 | <50 | 6.6 |
| | OW13 | 06/04/2021 | 553 | <10 | <10 | <20 | <10 | 22 | <10 | 6.9 | 0.46 | <10 | <50 | 100 |
| | OW13 | 14/04/2021 | <80 | <10 | <10 | <20 | 1 | <80 | <10 | 7.6 | 0.22 | 1 | <50 | 10 |
| | OW13 | 19/07/2021 | <80 | <10 | <10 | <20 | <10 | <80 | <10 | 7.4 | 0.20 | 3.1 | <50 | 13.8 |

| | Well ID | Parameter | Al µg/l | As µg/l | Cd µg/l | Cr µg/l | Cu µg/l | Fe µg/l | Pb µg/l | Mg mg/l | Hg µg/l | Ni µg/l | Ti µg/l | Zn µg/l |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **Groundwater Regulations Threshold Value** | **150** | **7.5** | **3.75** | **37.5** | **1,500** | **-** | **7.5** | **-** | **0.75** | **15** | **-** | **75** |
| | | **EPA Interim Guidance Values** | | | | | | **200** | | **50** | | | **-** | |
| | OW14 | 14/04/2021 | <80 | 6 | 5 | 5 | 5 | 11 | 4 | 8.1 | 0.22 | 9 | <50 | 115 |
| | OW14 | 19/07/2021 | <80 | 1.2 | <10 | <20 | 2.6 | 1,021 | <10 | 7.7 | 0.2 | <10 | <50 | 49.4 |
| | OW15 | 14/04/2021 | <80 | 2 | <10 | <20 | 1 | 27 | <10 | 8.3 | 0.18 | 3 | <50 | 9 |
| | OW15 | 19/07/2021 | <80 | 1.9 | <10 | <20 | <10 | 302.4 | <10 | 9 | 0.20 | 2.7 | <50 | 7.7 |
| | OW20 | 14/04/2021 | <80 | 4 | <10 | <20 | 2 | 23 | <10 | 65.1 | 0.21 | 6 | <50 | 11 |
| | OW20 | 19/07/2021 | <80 | 3.8 | <10 | <20 | 8.8 | 15.5 | <10 | 56.9 | 0.20 | 8.3 | <50 | 14.6 |
| | OW21 | 14/04/2021 | <80 | 8 | <10 | 2 | 1 | 73 | <10 | 573.6 | 0.17 | 3 | <50 | 9 |
| | OW21 | 19/07/2021 | <80 | 1.3 | <10 | <20 | 1.9 | 79.8 | 1.4 | 741.8 | 0.10 | <10 | <50 | 57.7 |
| | OW22 | 14/04/2021 | <80 | 1 | <10 | <20 | 1 | 9 | <10 | 42 | 0.16 | 6 | <50 | 8 |
| | OW22 | 19/07/2021 | <80 | 3.4 | <10 | <20 | <10 | 4,244.8 | <10 | 61.7 | 0.10 | 5.9 | <50 | 13.6 |
| | OW24 | 14/04/2021 | <80 | 10 | 3 | 3 | 2 | 1,187 | 2 | 269.7 | 0.13 | 26 | <50 | 89 |
| | OW24 | 19/07/2021 | <80 | 13 | <10 | <20 | 1 | 355.5 | <10 | 285.5 | 0.10 | 15.2 | <50 | 59 |
| **Phase 2 BRDA** | OW25 | 14/04/2021 | 10 | 5 | 1 | 4 | 3 | 377 | 1 | 304.6 | 0.11 | 4 | <50 | 21 |
| | OW25 | 19/07/2021 | 11.6 | 2.2 | <10 | 2.5 | 4 | 1,452.7 | <10 | 303.7 | 0.10 | 3.2 | <50 | 32.5 |
| | OW26 | 14/04/2021 | <80 | 3 | <10 | <20 | 2 | 27 | <10 | 170.5 | 0.12 | 3 | <50 | 12 |
| | OW26 | 19/07/2021 | 22.3 | 2.7 | <10 | <20 | 5.2 | 8.1 | <10 | 169.5 | 0.10 | 2.1 | <50 | 12.4 |

| Well ID | Parameter | Al µg/l | As µg/l | Cd µg/l | Cr µg/l | Cu µg/l | Fe µg/l | Pb µg/l | Mg mg/l | Hg µg/l | Ni µg/l | Ti µg/l | Zn µg/l |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Groundwater Regulations Threshold Value** | **150** | **7.5** | **3.75** | **37.5** | **1,500** | **-** | **7.5** | **-** | **0.75** | **15** | **-** | **75** |
| | **EPA Interim Guidance Values** | | | | | | **200** | | **50** | | | **-** | |
| OW27 | 14/04/2021 | <80 | 12 | 2 | <20 | <10 | 1,252 | 2 | 194 | 0.11 | 9 | <50 | 74 |
| OW27 | 19/07/2021 | 8.7 | 1.9 | <10 | <20 | 2.2 | <80 | <10 | 200 | 0.10 | 6.4 | <50 | 130.8 |
| OW28 | 14/04/2021 | <80 | 4 | <10 | <20 | 1 | 1,609 | <10 | 389.6 | 0.09 | 9 | <50 | 9 |
| OW28 | 19/07/2021 | <80 | 1.9 | <10 | <20 | 3.7 | 23.8 | <10 | 401 | 0.10 | 10 | <50 | 6.8 |
| OW29 | 14/04/2021 | <80 | 12 | 2 | <20 | 1 | 5,146 | 3 | 411.4 | 0.09 | 15 | <50 | 62 |
| OW29 | 19/07/2021 | <80 | 3.6 | <10 | <20 | 8.9 | 45.5 | <10 | 383.2 | 0.10 | 9 | <50 | 49.4 |
| OW30 | 14/04/2021 | <80 | 1 | <10 | <20 | 1 | 13 | <10 | 61 | <0.08 | 3 | <50 | 16 |
| OW30 | 19/07/2021 | <80 | <10 | <10 | <20 | 2.9 | <80 | <10 | 62.9 | 0.10 | 2.8 | <50 | 16.9 |
| OW31 | 14/04/2021 | <80 | 7 | <10 | <20 | <10 | 2,713 | <10 | 417.8 | 0.09 | 8 | <50 | 7 |
| OW31 | 19/07/2021 | <80 | <10 | <10 | <20 | 2 | <80 | <10 | 61.7 | 0.10 | 3.7 | <50 | 9.8 |
| OW32 | 14/04/2021 | <80 | <10 | <10 | <20 | <10 | 197 | <10 | 991.1 | 0.22 | <10 | <50 | 2 |
| OW32 | 19/07/2021 | 8.5 | 4.7 | <10 | 2.7 | 2.6 | 164.7 | <10 | 294.5 | 0.30 | 7.1 | <50 | 126.4 |
| OW33 | 14/04/2021 | 9 | 4 | <10 | 3 | 2 | 2,609 | <10 | 555 | 0.16 | 5 | <50 | 15 |
| OW33 | 19/07/2021 | 8.1 | 3.7 | <10 | 2.7 | 3.5 | 163.1 | <10 | 474.6 | 0.20 | 4.9 | <50 | 18.2 |
| OW34 | 14/04/2021 | <80 | <10 | <10 | <20 | 1 | <8 | <10 | 29.3 | 0.16 | <10 | <50 | 8 |
| OW34 | 19/07/2021 | <80 | <10 | <10 | <20 | 1.5 | <80 | <10 | 30.5 | 0.10 | <10 | <50 | 6.1 |

| Well ID | Parameter | Al µg/l | As µg/l | Cd µg/l | Cr µg/l | Cu µg/l | Fe µg/l | Pb µg/l | Mg mg/l | Hg µg/l | Ni µg/l | Ti µg/l | Zn µg/l |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Groundwater Regulations Threshold Value** | **150** | **7.5** | **3.75** | **37.5** | **1,500** | **-** | **7.5** | **-** | **0.75** | **15** | **-** | **75** |
| | **EPA Interim Guidance Values** | | | | | | **200** | | **50** | | | **-** | |
| OW35 | 14/04/2021 | <80 | 1 | <10 | <20 | <10 | 35 | 1 | 220.6 | 0.12 | <10 | <50 | 492 |
| OW35 | 19/07/2021 | <80 | 3.5 | <10 | <20 | 8.8 | 45 | 1 | 275.2 | 0.10 | 1.7 | <50 | 204.9 |
| OW36 | 14/04/2021 | <80 | 5 | <10 | <20 | <10 | 13 | <10 | 227 | 0.11 | 5 | <50 | 109 |
| OW36 | 19/07/2021 | <80 | 2.6 | <10 | <20 | 1.2 | <80 | <10 | 227.8 | 0.10 | 5.1 | <50 | 12 |
| OW37 | 14/04/2021 | <80 | <10 | <10 | <20 | <10 | <80 | <10 | 14.4 | 0.13 | 1 | <50 | 10 |
| OW37 | 19/07/2021 | <80 | <10 | <10 | <20 | 1 | <80 | <10 | 14.5 | 0.1 | 1 | <50 | 6.9 |
| OW38 | 14/04/2021 | 8 | <10 | <10 | <20 | 1 | <80 | <10 | 6.5 | 0.13 | <10 | <50 | 8 |
| OW38 | 19/07/2021 | <80 | <10 | <10 | <20 | 1.6 | <80 | <10 | 6.6 | 0.10 | <10 | <50 | 5.7 |
| OW39 | 14/04/2021 | <80 | <10 | <10 | <20 | 1 | <80 | <10 | 7.2 | 0.09 | <10 | <50 | 8 |
| OW39 | 19/07/2021 | <80 | <10 | <10 | <20 | <10 | <80 | <10 | 8.6 | 0.1 | <10 | <50 | 5.6 |
| OW40 | 14/04/2021 | <80 | <10 | <10 | <20 | <10 | <80 | <10 | 19.9 | 0.10 | <10 | <50 | 10 |
| OW40 | 19/07/2021 | <80 | <10 | <10 | <20 | 1.4 | <80 | <10 | 9.7 | 0.10 | <10 | <50 | 6.8 |
| OW41 | 14/04/2021 | <80 | <10 | <10 | <20 | <10 | <80 | <10 | 8.2 | 0.09 | <10 | <50 | 10 |
| OW41 | 19/07/2021 | <80 | <10 | <10 | 2 | 12.9 | 2,052.9 | <10 | 9.3 | 0.10 | 3.6 | <50 | 7.6 |
| OW42 | 14/04/2021 | <80 | <10 | <10 | <20 | 1 | <80 | <10 | 8.8 | 0.08 | <10 | <50 | 8 |
| OW42 | 19/07/2021 | 22.2 | <10 | <10 | <20 | 1.2 | <80 | <10 | 27.1 | 0.10 | <10 | <50 | 7.1 |

| | Well ID | Parameter | Al µg/l | As µg/l | Cd µg/l | Cr µg/l | Cu µg/l | Fe µg/l | Pb µg/l | Mg mg/l | Hg µg/l | Ni µg/l | Ti µg/l | Zn µg/l |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **Groundwater Regulations Threshold Value** | **150** | **7.5** | **3.75** | **37.5** | **1,500** | **-** | **7.5** | **-** | **0.75** | **15** | **-** | **75** |
| | | **EPA Interim Guidance Values** | | | | | | **200** | | **50** | | | **-** | |
| | OW43 | 14/04/2021 | <80 | <10 | <10 | <20 | <10 | <80 | <10 | 29.9 | 0.09 | <10 | <50 | 8 |
| | OW43 | 19/07/2021 | <80 | <10 | <10 | <20 | 1.5 | <80 | <10 | 31.1 | <0.80 | <10 | <50 | 6.1 |
| | OW44 | 14/04/2021 | <80 | <10 | <10 | <20 | 1 | <80 | <10 | 18.3 | 0.08 | <10 | <50 | 8 |
| | OW44 | 19/07/2021 | <80 | <10 | <10 | <20 | 1.2 | <80 | <10 | 18.4 | <0.80 | <10 | <50 | 7.8 |
| | OW45 | 14/04/2021 | <80 | <10 | <10 | <20 | 1 | <80 | <10 | 15.7 | 0.08 | <10 | <50 | 11 |
| | OW45 | 19/07/2021 | <80 | <10 | <10 | <20 | 1.1 | <80 | <10 | 17.4 | <0.80 | 1.5 | <50 | 14.1 |

**Note**: *LODs increased due to matrix type*

### 10.6.10.7.2 Borrow Pit Extension Site

Groundwater quality monitoring is undertaken in the vicinity of the Borrow Pit and the Borrow Pit Extension sites at twelve (12) wells. Three (3) of these wells (MW5, MW6 and MW7) commenced monitoring in July 2021, following the installation of these wells in June 2021.

The data recorded from December 2020 to September 2021 is provided in Figures Figure 10.43 – Figure 10.48 and Table 10. below.

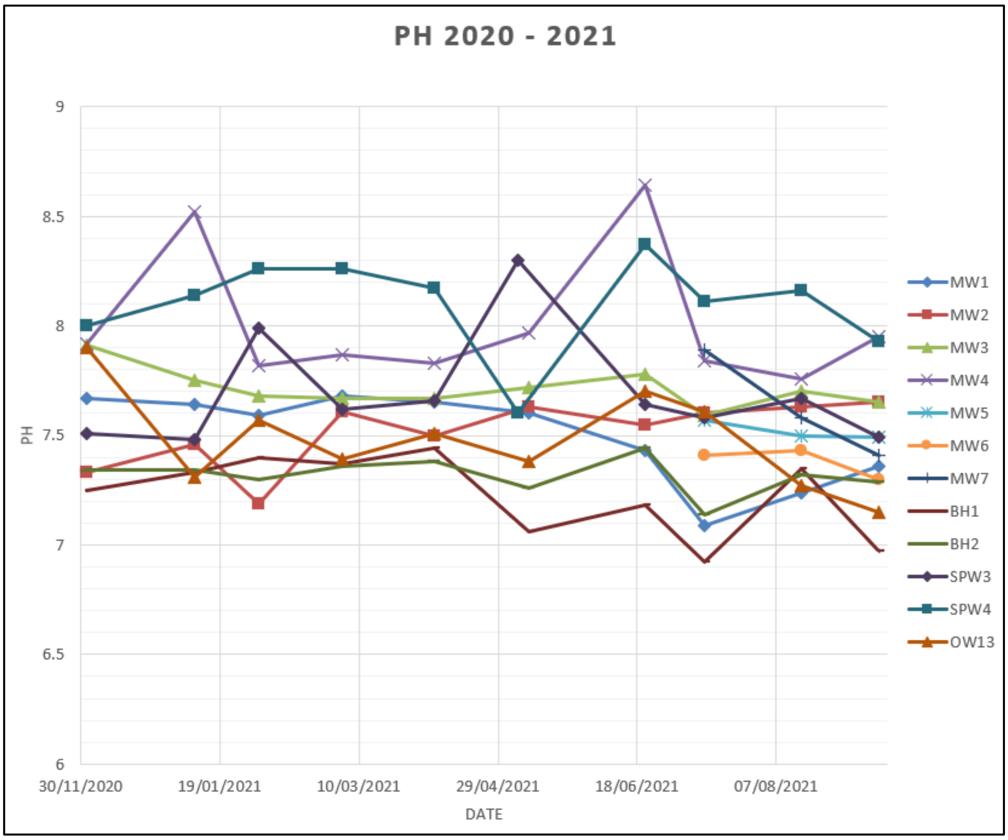



**Figure 10.43: Monthly pH data – Dec 2020 to Sept 2021 for wells near the Borrow Pit area**

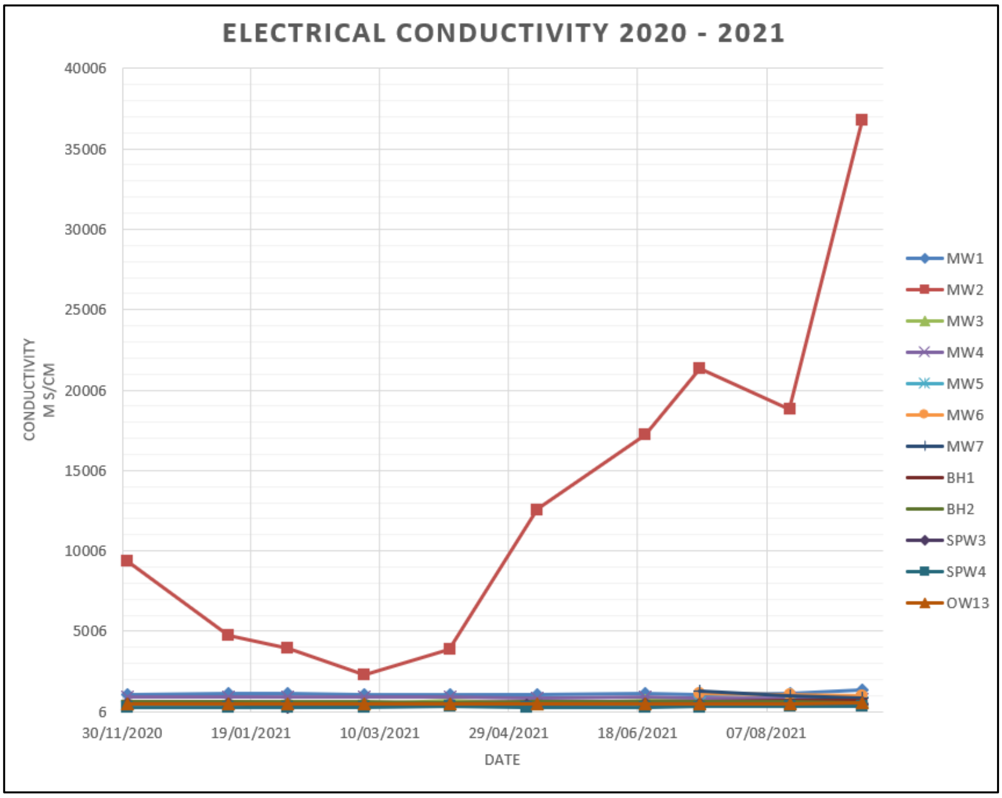



**Figure 10.44: Monthly electrical conductivity data – Dec 2020 to Sept 2021 for wells near the Borrow Pit area**

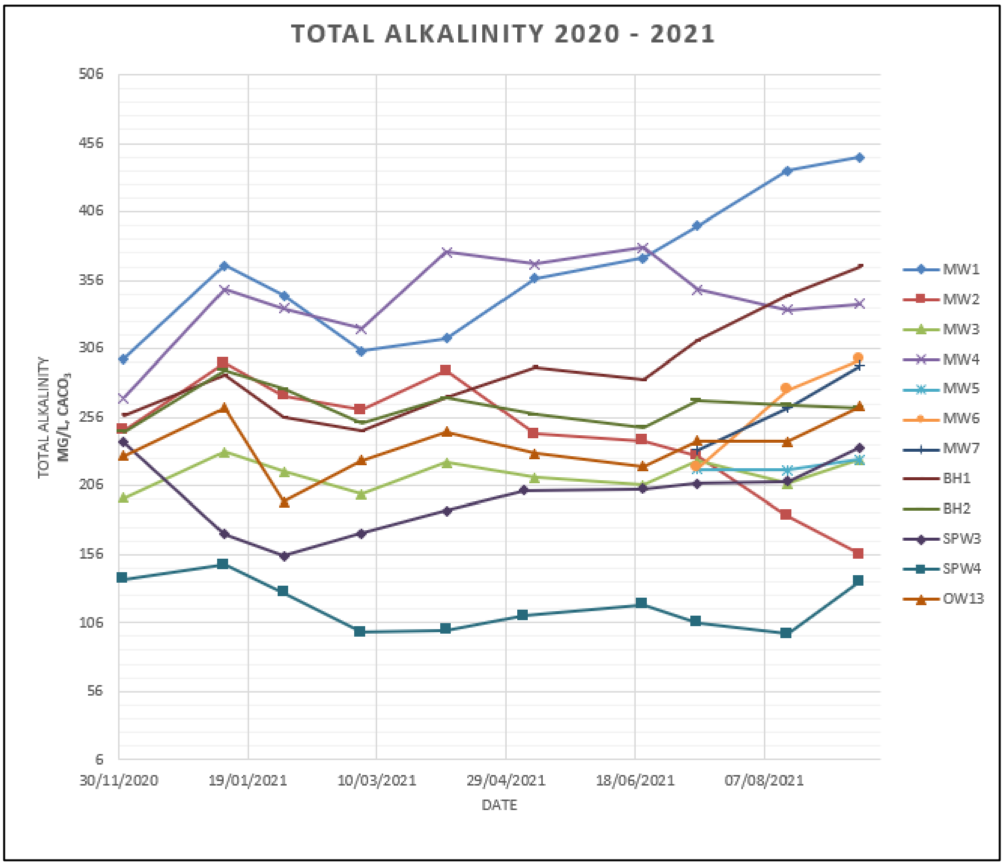



**Figure 10.45: Monthly total alkalinity data - Dec 2020 to Sept 2021 for wells near the Borrow Pit area**

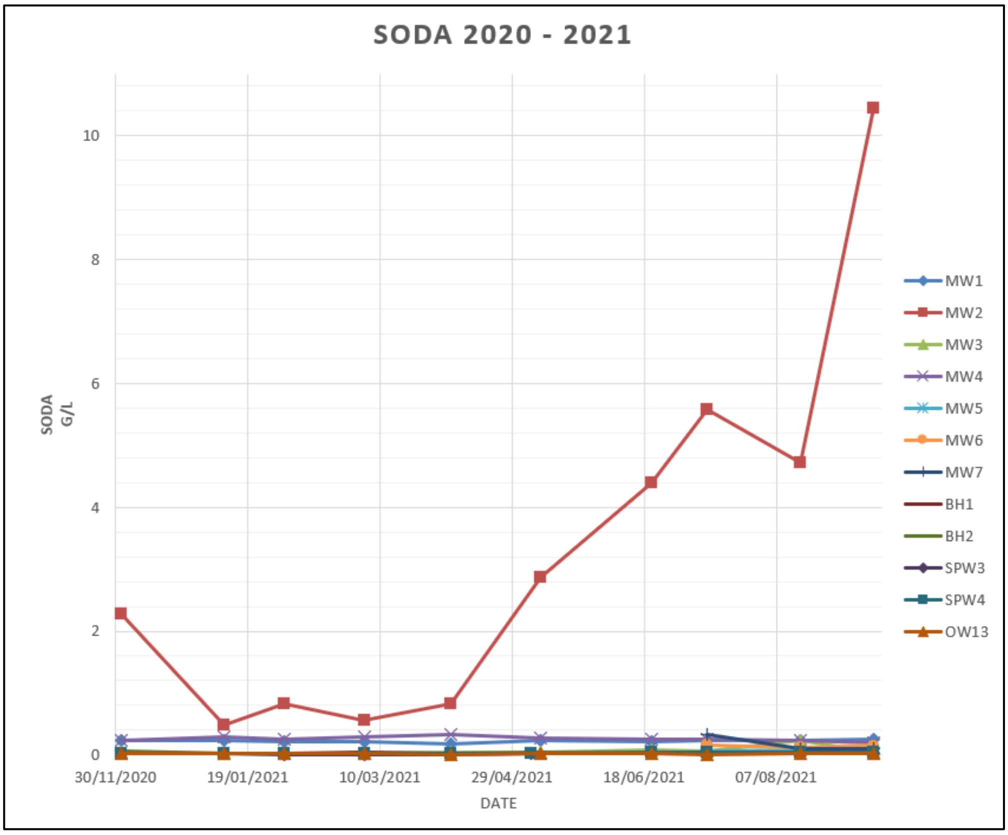



**Figure 10.46: Monthly Soda data – Dec 2020 to Sept 2021 for wells near the Borrow Pit area**

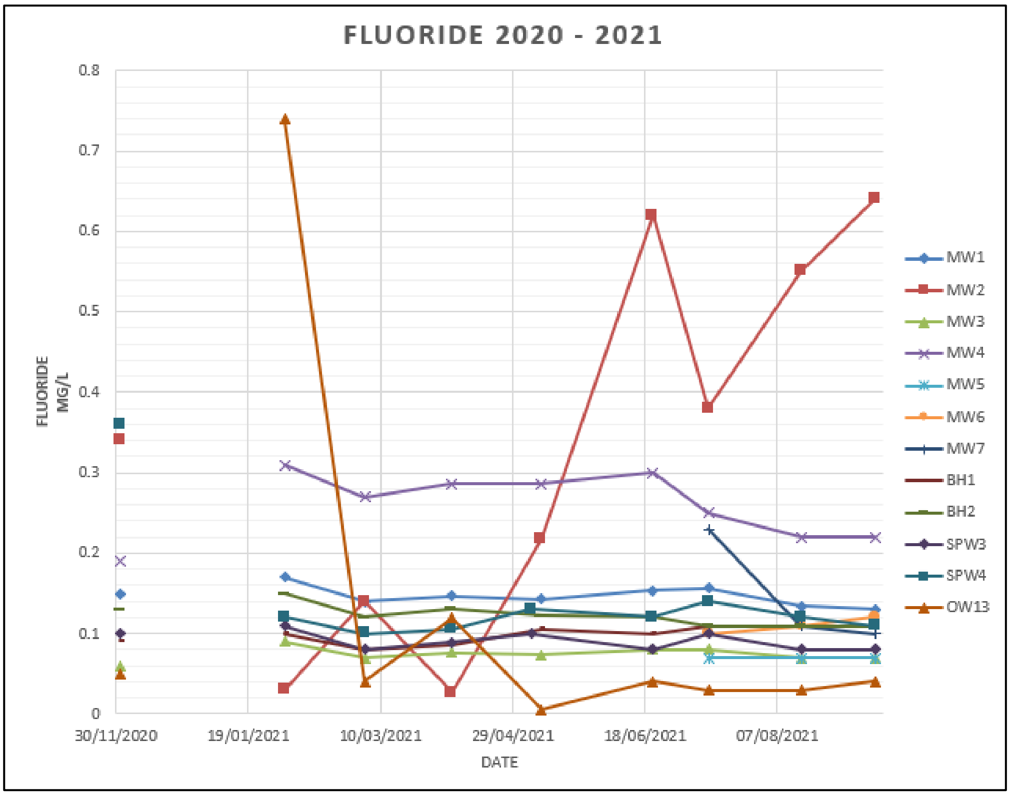



**Figure 10.47: Monthly fluoride data - Dec 2020 to Sept 2021 for wells near the Borrow Pit area**

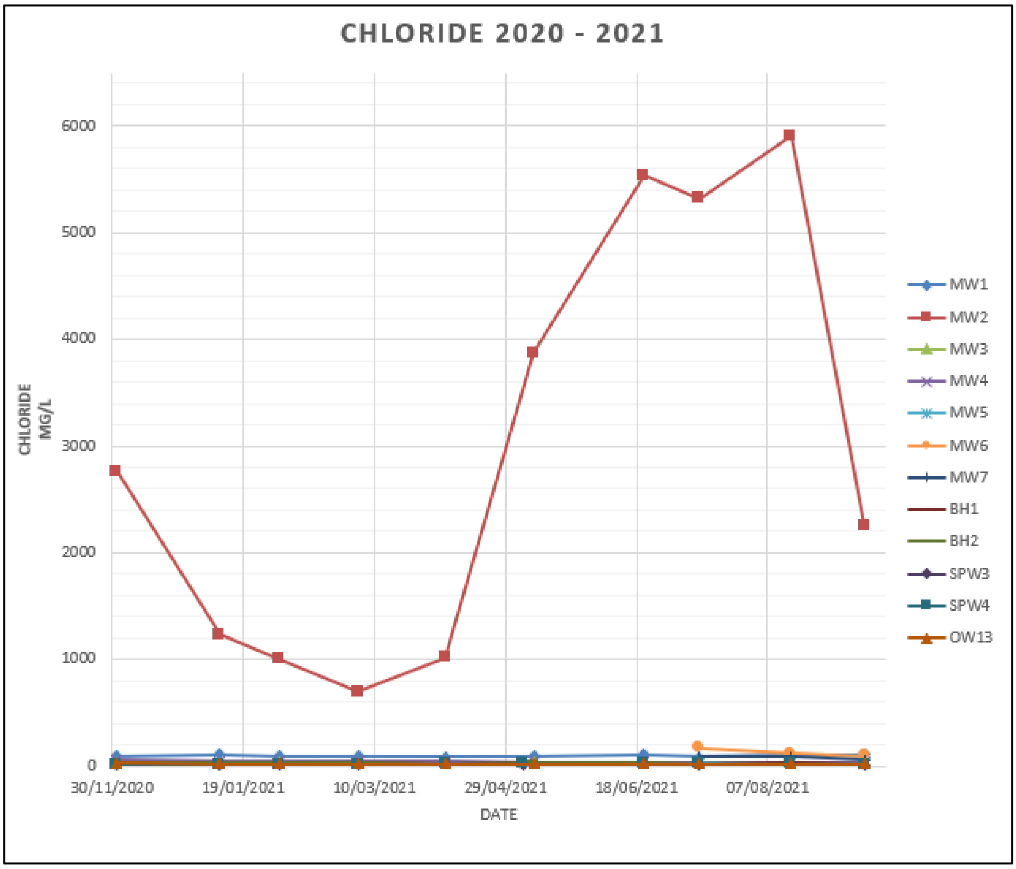



**Figure 10.48: Monthly chloride data – Dec 2020 to Sept 2021 for wells near the Borrow Pit area**

A summary of the data is provided below:

- pH levels during the monitoring period are within AAL facility Threshold level of 6.0 – 9.0 pH and within the Groundwater Regulations Threshold (2010, as amended) of 9.5 pH.
- Electrical conductivity is within the Threshold Value with the exception of MW2. MW2 has been consistently above the Groundwater Regulations Threshold (2021, as amended) of 1,875 µS/cm.
- Soda levels recorded in MW2 also mirror the conductivity plot and chloride is comparatively elevated.
- pH levels in this well (MW2) averaged 7.5 pH between December 2020 and September 2021 and total alkalinity is trending downwards.
- Notably aluminium is below the Threshold value of 150 µg/l during the monitoring period.
- MW2 is distally located from the industrial site, along the margin of Poulaweala Creek and is strongly influenced by saline intrusion, concentrations in MW2 are considered likely to be a result of this intrusion.
- Chloride levels have also been consistently above 24 mg/l in MW1, MW6, MW7, MW4 and MW3 in all rounds which indicates saline influence in these wells.

Table 10. shows metal results from the monitoring cycles conducted between April 2021 and August 2021. Results for most metals are below the groundwater Threshold Values (2010, as amended) for wells.

**Table 10.8: Dissolved Metal Results from Monitoring Wells near the Borrow Pit sites (April to August 2021)**

| Well ID | Date | Al µg/l | As µg/l | Cd µg/l | Cr µg/l | Cu µg/l | Fe µg/l | Pb µg/l | Mg µg/l | Hg µg/l | Ni µg/l | Ti µg/l | Zn µg/l |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Groundwater Regs Threshold Value | 150 | 7.5 | 3.75 | 37.5 | 1,500 | - | 7.5 | - | 0.75 | 15 | - | 75 |
| | EPA Interim Guidance Values | | | | | | 200 | | 50 | | | - | |
| MW1 | 06/04/2021 | 21 | 4 | <10 | <20 | <10 | 9 | <10 | 16.8 | 0.88 | <10 | <50 | 74 |
| MW1 | 10/05/2021 | 18.5 | 3.4 | <5 | <7 | 0.3 | 12.4 | <2 | 14.2 | 0.20 | 1.2 | <50 | 1.9 |
| MW1 | 21/06/2021 | 26.7 | 4.3 | <5 | <7 | 3.4 | 95 | 0.5 | 21.4 | 0.10 | 3.7 | <50 | 7.9 |
| MW1 | 12/07/2021 | 35.7 | 5.9 | <10 | <20 | 2.8 | 169.8 | <10 | 14.5 | 0.20 | 3.8 | <50 | 12.3 |
| MW1 | 16/08/2021 | 36 | 8 | <10 | <20 | 7.2 | 132.9 | 1.1 | 16.1 | 0.30 | 3.1 | <50 | 66 |
| MW2 | 06/04/2021 | 18 | 1 | <10 | <20 | <10 | <80 | <10 | 78.3 | 1.06 | <10 | <50 | 82 |
| MW2 | 10/05/2021 | 14.9 | 1 | <5 | <7 | 2.6 | 2.8 | <2 | 245.2 | 0.30 | 1.4 | <50 | 3.9 |
| MW2 | 21/06/2021 | 17.8 | 1.2 | <5 | <7 | 3.4 | 14.4 | 0.2 | 403.1 | 0.10 | 1.8 | <50 | 10.5 |
| MW2 | 12/07/2021 | 24.2 | 1.8 | <10 | <20 | 5 | 15.9 | <10 | 407.4 | 0.50 | 2.5 | <50 | 17.4 |
| MW2 | 16/08/2021 | <80 | 1.1 | <10 | <20 | 4.2 | <80 | <10 | 430.3 | 0.30 | 1.1 | <50 | 260.5 |
| MW3 | 06/04/2021 | 15 | <10 | <10 | <20 | 1 | <80 | <10 | 7.7 | 1.17 | <10 | <50 | 74 |
| MW3 | 10/05/2021 | 20.3 | 0.9 | <5 | <7 | 1.6 | 2.1 | <2 | 7.2 | 0.20 | 0.6 | <50 | 2.1 |
| MW3 | 21/06/2021 | 20.3 | 1 | <5 | <7 | 2.8 | 15.4 | 0.3 | 10.9 | 0.10 | 1.2 | <50 | 7.7 |
| MW3 | 12/07/2021 | 21.4 | 1.1 | <10 | <20 | 3.9 | 13.2 | <10 | 10.4 | 0.40 | 1.3 | <50 | 151.2 |
| MW3 | 16/08/2021 | <80 | 1 | <10 | <20 | 2.3 | <80 | <10 | 9 | 0.20 | <10 | <50 | 17.2 |
| MW4 | 06/04/2021 | 95 | 11 | <10 | <20 | 11 | 152 | 1 | 4.4 | 0.92 | 3 | 34 | 74 |
| MW4 | 10/05/2021 | 127 | 9.6 | <5 | 1.7 | 0.5 | 179 | 1 | 3.9 | 0.10 | 4.8 | 237 | 0.9 |
| MW4 | 21/06/2021 | 417.6 | 15.7 | <5 | 1.2 | 2 | 114.5 | 0.8 | 6.2 | 0.10 | 5.8 | 13 | 17.5 |
| MW4 | 12/07/2021 | 35.5 | 12.9 | <10 | <20 | 1.6 | 106.5 | <10 | 6.2 | 0.30 | 4.2 | 22 | 10.7 |
| MW4 | 16/08/2021 | 29.5 | 15.1 | <10 | <20 | <10 | 127.2 | <10 | 4.5 | 0.30 | 3.6 | 18 | 17.0 |
| MW5 | 12/07/2021 | 14.4 | 1.1 | <10 | <20 | 2.3 | 11.4 | <10 | 10.1 | 0.30 | 2.8 | <50 | 11.3 |
| MW5 | 16/08/2021 | <80 | <10 | <10 | <20 | <10 | <80 | <10 | 10.4 | 0.20 | 1.3 | <50 | 10.4 |
| MW6 | 12/07/2021 | 20.2 | 2.7 | <10 | <20 | 4.6 | 15.3 | <10 | 23.4 | 0.30 | 3.7 | <50 | 16.7 |
| MW6 | 16/08/2021 | <80 | 1.7 | <10 | <20 | 1 | 11.6 | <10 | 17.5 | 0.20 | 3.1 | <50 | 10.0 |
| MW7 | 12/07/2021 | 19 | 3.2 | <10 | <20 | 4.7 | 20.1 | <10 | 10.5 | 0.20 | 6.1 | <50 | 19.6 |
| MW7 | 16/08/2021 | <80 | 4.1 | <10 | <20 | <10 | 51.8 | <10 | 13.3 | 0.20 | 2.9 | <50 | 11.8 |

| Well ID | Date | Al µg/l | As µg/l | Cd µg/l | Cr µg/l | Cu µg/l | Fe µg/l | Pb µg/l | Mg µg/l | Hg µg/l | Ni µg/l | Ti µg/l | Zn µg/l |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Groundwater Regs Threshold Value** | **150** | **7.5** | **3.75** | **37.5** | **1,500** | **-** | **7.5** | **-** | **0.75** | **15** | **-** | **75** |
| | **EPA Interim Guidance Values** | | | | | | **200** | | **50** | | | **-** | |
| BH1 | 06/04/2021 | 104 | 1 | <10 | <20 | 6 | 36 | 1 | 7.1 | 0.90 | <10 | <50 | 81 |
| BH1 | 10/05/2021 | 8.9 | 0.9 | <5 | <7 | 0.2 | 147.5 | <2 | 9 | 0.20 | 2.1 | <50 | 1.7 |
| BH1 | 21/06/2021 | 18 | <4 | <5 | <7 | 5.4 | 17.9 | 0.3 | 11.1 | 0.10 | 1.9 | <50 | 16.5 |
| BH1 | 12/07/2021 | 10.3 | 7.6 | <10 | <20 | 1 | 144.9 | <10 | 10.8 | 0.20 | 12.8 | <50 | 11.4 |
| BH1 | 16/08/2021 | <80 | 1.2 | <10 | <20 | 1.1 | <80 | <10 | 10.3 | 0.20 | 5.5 | <50 | 6.3 |
| BH2 | 06/04/2021 | 2,009 | 1 | <10 | <20 | 2 | 13 | <10 | 7.1 | 0.71 | <10 | <50 | 78 |
| BH2 | 10/05/2021 | 6.2 | 0.5 | <5 | <7 | 1.1 | 2.5 | <2 | 8.2 | 0.10 | 0.6 | <50 | 3.8 |
| BH2 | 21/06/2021 | 18 | 0.4 | <5 | <7 | 1.8 | 14.8 | 0.2 | 10.1 | 0.10 | 1.1 | <50 | 13.1 |
| BH2 | 12/07/2021 | 12.6 | <10 | <10 | <20 | 1.3 | 14 | <10 | 9 | 0.10 | 1.6 | <50 | 11.3 |
| BH2 | 16/08/2021 | <80 | <10 | <10 | <20 | <10 | <80 | <10 | 7.8 | 0.20 | <10 | <50 | 5.8 |
| SPW3 | 06/04/2021 | 22 | <10 | <10 | <20 | 4 | 25 | <10 | 4.6 | 0.69 | <10 | <50 | 80 |
| SPW3 | 06/05/2021 | 6.8 | <4 | <5 | 1 | 0.6 | 5 | <2 | 5.8 | 0.10 | 1.4 | <50 | 5.2 |
| SPW3 | 21/06/2021 | 15.2 | 0.4 | <5 | <7 | 1.4 | 13.8 | 0.2 | 8.9 | 0.10 | 0.8 | <50 | 11.9 |
| SPW3 | 12/07/2021 | 5.2 | 0.6 | <5 | <7 | 1.8 | 3.4 | 0.3 | 6.8 | <1 | 0.4 | <50 | 6.9 |
| SPW3 | 16/08/2021 | 12.5 | <10 | <10 | <20 | 1.1 | <80 | <10 | 6.9 | 0.10 | <10 | <50 | 6.9 |
| SPW4 | 06/04/2021 | 46 | <10 | <10 | <20 | 1 | 10 | <10 | 4.2 | 0.60 | <10 | <50 | 80 |
| SPW4 | 06/05/2021 | 72.7 | 0.5 | <5 | 1.1 | 0.5 | 7.8 | <2 | 3.3 | 0.10 | <4 | <50 | 5.1 |
| SPW4 | 21/06/2021 | 55.6 | 0.5 | <5 | <7 | 1.2 | 10.8 | 0.2 | 5.3 | 0.10 | 0.8 | <50 | 6.1 |
| SPW4 | 12/07/2021 | 45.7 | 0.6 | <5 | <7 | 1.1 | 6.4 | <2 | 3.5 | <1 | <4 | <50 | 7.7 |
| SPW4 | 16/08/2021 | 36.8 | <10 | <10 | <20 | <10 | <80 | <10 | 3.7 | 0.1 | <10 | <50 | 5.7 |
| OW13 | 06/04/2021 | 553 | <10 | <10 | <20 | <10 | 22 | <10 | 6.9 | 0.46 | <10 | <50 | 100 |
| OW13 | 14/04/2021 | <80 | 1 | <10 | 2 | <10 | 40 | <10 | 7.6 | 0.19 | 2 | <50 | 5 |
| OW13 | 10/05/2021 | 4.8 | <4 | <5 | <7 | 0.5 | 1.8 | <2 | 6.5 | 0.10 | 1.1 | <50 | 5 |
| OW13 | 21/06/2021 | 8.5 | <4 | <5 | <7 | 1.2 | 10.7 | 0.2 | 8.7 | 0.10 | 0.9 | <50 | 10.2 |
| OW13 | 12/07/2021 | 1.9 | 0.5 | <5 | <7 | 0.7 | 3.5 | <2 | 7.4 | 0.20 | 3.1 | <50 | 13.8 |
| OW13 | 16/08/2021 | <80 | <10 | <10 | <20 | <10 | <80 | <10 | 7.2 | 0.10 | 3.2 | <50 | 11.3 |

**Note:** *LODs increased due to matrix type*

Cadmium (Cd) and chromium (Cr) are generally below the Limit of Detection (LOD) for all wells. Chromium when detected in wells remains below the Threshold Value of 7.5 µg/l.

Mercury (Hg) was detected as slightly elevated in all wells except OW13, SPW3, SPW4 and BH2 during the April 2021 round of monitoring. However, in the subsequent four (4) rounds of monitoring it has remained under the Threshold Value of 0.75 µg/l. MW2, MW3 and MW4 showed the highest elevations of mercury in April 2021 but are the furthest from onsite activities and are downgradient of SWP3, SPW4 and BH2 which are not showing elevated mercury during the monitoring period, and which are proximal to onsite activities. It is considered likely that the slightly elevated mercury in these wells was naturally occurring.

Aluminium (Al) was elevated against the groundwater Threshold Value (2010, as amended) of 150 µg/l in BH2 (2,009 µg/l) and in OW13 (553 µg/l) on 06 April 2021. Subsequent monitoring in OW13 resulted in a below LOD reading of <80 µg/l Al or a high of 8.5 µg/l in August 2021. Subsequent monitoring in BH2 also has detected aluminium as below detection limits or at the highest, 18 µg/l in June 2021. Subsequent monitoring rounds at both BH2 and OW13 indicate that the Al readings were anomalous.

Zinc (Zn) was slightly elevated in a number of the wells, most commonly during the first round (April 2021), when compared against the groundwater Threshold Value of 75 µg/l. Elevated readings are recorded at MW2, MW3, BH1, BH2, SPW3, SPW4 and OW13. The exceedances are in the range of 75 µg/l to 260 µg/l. With the exception of MW2 (discussed previously as strongly saline influenced) the readings appear anomalous.
Arsenic (As) is consistently elevated at MW4 when compared against the groundwater Threshold Value of 7.5 µg/l. The exceedances are in the range of 7.5 to 15.7 µg/l. BH1 also return a single value that was slightly above the threshold (7.6 µg/l).

In conclusion, the data from MW2 can be excluded due to saline intrusion influence. The other exceedances occur in isolation to other parameters i.e., just a single metal exceeding a threshold value in a round of readings (usually zinc or arsenic and sometimes mercury) and then are not present for future rounds and hence are considered to be natural.

### 10.6.11 Regulated Discharges and Emissions

There are no licensed discharges to surface water or groundwater from the BRDA.

However, there are two licensed discharges of treated effluent to the Shannon Estuary from the Plant. These are W1-1 and Sanitary Effluent discharge points. The former is treated industrial process effluent and the latter is treated sanitary effluent. Both discharge at the same outfall point W1-1, which is located close to the AAL Marine Terminal, c. 1.7 km from the Site boundary.

The Proposed Development does not comprise any change to the two current licenced discharges.

Annual mass emissions for measured parameters (BOD, suspended solids and oils, fats and greases) at W1-1 in 2020 were within licensed emission limit values (ELVs) for the period (AAL quarterly water EPA reports 2020). Annual mass emissions for measured parameters (BOD and suspended solids) at Sanitary Effluent in 2020 were within licensed ELVs for reporting period also (AAL quarterly water EPA reports 2020).
There are three (3) Section 4 Discharges within the wider Study Area, to the west of the Site and within the Foynes harbour area. These are licensed to Inver Energy Ltd. (reference number W121),

Atlantic Fuel Supply Company Ltd. (reference number W109) and to CPL Fuels Ireland Ltd. (reference number W119).

### 10.6.12 Local Water Users and Wastewater Systems

No groundwater is abstracted for domestic purposes at the Site or at the Plant Area. There are no source protection zones or preliminary source protection zones within the Site or the Study Area.


**Figure 10.49: Source Protection Zones in the Vicinity of the Site (GSI 2021), none identified.** Aerial Photo Source – Bing Maps (2013)

The nearest source protection area to the Proposed Development is located c. 11 km away, just north of Kilcolman. Two other source protection zones are located at Glin, located c. 22 km to the west and at Ardagh, located c. 19 km to the south of the Application Site, see Figure 10.49 above. The Group Water Scheme located to the south-east of the Study Area is upgradient of the Application Site.

Figure 10.50, below, shows the GSI's current database for wells and springs within the Site and Study Area. No springs are mapped within the area.

Location accuracy of the wells varies with some well location accuracy noted as within 50 m of the marked point and others within the 1 km diameter circles identified on Figure 10.50.

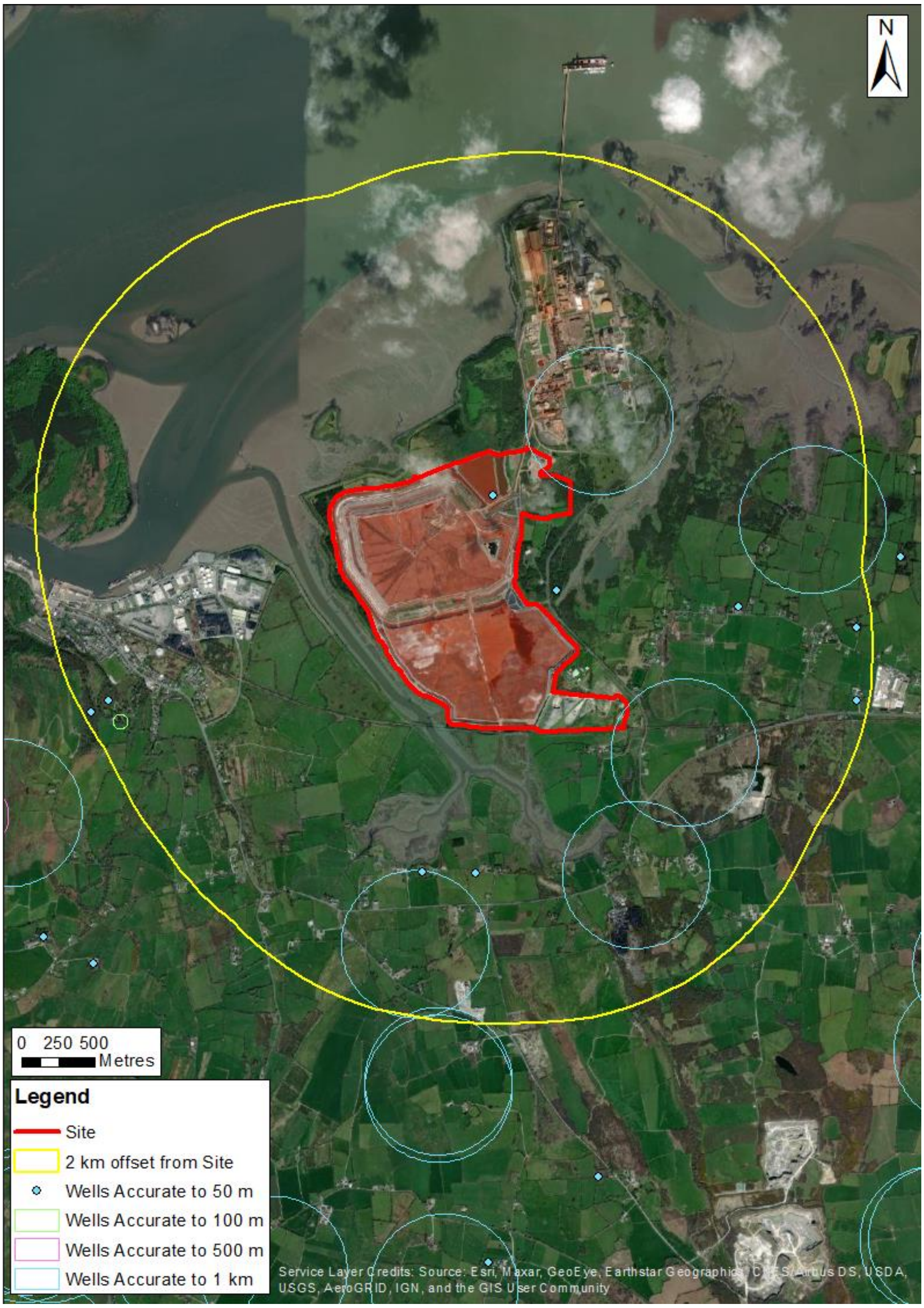



**Figure 10.50: Mapped Groundwater Wells in the Vicinity of the Site, (GSI 2021)**

One well is identified within the Site and is mapped as being below the footprint of the Storm Water Pond (SWP); this well is historical and currently defunct. A well dug in 1964 is identified within the Plant Area, this well is also historical and defunct. A third well is identified on Aughinish Island, in Aughinish East with a poor yield and has been confirmed by AAL to be no longer in use (Golder 2014).

There are twelve (12) wells identified beyond the Application Site and within the wider Study Area. There are also an additional two wells to the south which may be within the Study Area, this cannot be confirmed as their location accuracy is given by the GSI as within 1 km. However, they are included in the baseline description.

Of the fourteen (14) wells identified, only two (2) have a listed use, one as only domestic and the other is both agricultural and domestic use. The majority of these wells are from the 1960s and are predominantly drilled boreholes rather than dug by hand. All fourteen (14) wells have documented borehole depths as being between 4.9 mbgl and 147.5 mbgl. Bedrock depths are listed in eight (8) of the boreholes; these vary between 1.5 mbgl and 9.1 mbgl. Yields are identified for eleven (11) of the wells; three (3) have moderate yields between 54.5 $m^3$/day and 98.2 $m^3$/day, the other eight (8) wells have poor yields between 10.9 $m^3$/day and 28 $m^3$/day.

However, as the groundwater present beneath Application Site comprises a freshwater lens that is both downgradient and isolated laterally from the mainland by being laterally hydraulically isolated by Poulaweala Creek and the Robertstown River and the underlying saline groundwater, these fourteen (14) wells are not identified to be part of the same regional hydrogeological system. It is noted that a portion of the Application Site in the southeast is within the mainland area of Glenbane West, however, groundwater flow in this area is west and north-westwards towards the Poulaweala Creek and the Roberstown River.

### 10.6.13 Commentary on the Future Baseline and Climate Trends

Future climate change could alter the water environment at the Site by changing temperatures, recharge rates, changing flood risk and sea levels, and by affecting demand from public water supplies.

Predicted changes in average precipitation include decreases in average precipitation amounts during spring and summer months with likely reductions in rainfall ranging from 0% to 13% (medium to low emission scenario) and from 3% to 20% (high emission scenario) (EPA, 2015). Heavy precipitation events are also predicted to show notable increases of c. 20% over the year as a whole, and most notably in the winter and autumn months (EPA, 2015).

Sea level may change as a result of either change in the elevation of the sea, due to a change in the elevation of the land (isostatic change) or an increase/decrease in volume (eustatic change). Satellite observations of sea level rise around Ireland indicate a rise of c. 2 – 3 mm per year since the early 1990s which is consistent with global trends (Walthers, *et al*., 2021). Further discussion of climatic trends and potential impacts are presented in Chapter 11: Air Quality and Climate.

## 10.7 Selection of Sensitive Receptors

Taking account of the above and the receptor classification method described in Section **Error! Reference source not found.**, the receptors carried forward in this assessment and their assigned importance are presented in Table 10..

**Table 10.9: Water Receptors**

| Receptor | Importance and Reasoning |
|---|---|
| Groundwater | **Medium** (There is a combination of regionally and locally important aquifers underlying the Site but there is a limited future resource potential at the Site due to salinity issues as a drinking water source. There are groundwaters users in the area, but they are upgradient and not identified to be part of the same hydrogeological system as the Application Site. The groundwater present beneath the Application Site comprises a freshwater lens that is both downgradient and isolated laterally from the mainland by being laterally hydraulically isolated by Poulaweala Creek and the Robertstown River. Regulatory requirements to maintain water availability and quality status. |
| Surface water | **High** (There is connection to internationally designated areas i.e., Special Areas of Conservation (SAC) and Special Protection Areas (SPA), which have regulatory requirements to maintain water availability and quality status. In addition, there are protected surface water bodies in the vicinity of the Site.) |
| Humans | **High** (There are human receptors i.e., existing water users, which require maintenance of water availability and quality status.) |

With regard to existing water users, the likelihood of groundwater use for supply is very low due to the nature of the aquifers beneath the Site (variably salinity influenced), lack of connectivity with Site and the predominance of mains water supply in the vicinity of the Application Site.

However, as discussed in Section 10.6.12 there are data gaps around the use of the wells; if there are other unidentified wells in the area and if surface water is used as a source of supply. Therefore, it has been assumed that groundwater could be used as a local resource in the Study Area.

Where it is possible the impacts to the water environment study area could also impact ecological receptors, e.g., downstream designated sites that could have some water dependence, either on water quality or availability, for their qualifying species/habitats. This is discussed in Chapter 7: Biodiversity.

## 10.8 Characteristics of the Proposed Development

The Proposed Development involves the following three main elements:

- Proposed increase in height of the BRDA to accommodate the additional storage of bauxite residue at the Facility, equivalent to an additional circa 9-year capacity at the current rate of production;

- Proposed increase in height of the SCDC to accommodate additional storage of salt cake at the Facility (circa 22,500 $m^3$), equivalent to 3 years of storage at current rate of production; and
- Proposed eastern extension of the permitted Borrow Pit to provide additional rock (c. 380,000 $m^3$) to be used in the construction of the proposed BRDA and SCDC raises, and closure works.

### 10.8.1 Proposed BRDA Raise

It is proposed that the existing BRDA can facilitate an increase in height to Stage 16 (the BRDA is currently permitted to Stage 10) which would provide a perimeter elevation of 36 mOD and a maximum dome crown central elevation of 44 mOD. The Proposed Development will provide for the additional deposition of circa 0.9 million $m^3$ / year of bauxite residue and total of circa 8.0 million $m^3$ over the lifetime of the development.

The proposed method of raising the BRDA from Stage 10 to Stage 16 will be the upstream method, which is consistent with the construction methodology for the current permitted BRDA and involves the construction of rock fill embankments (Stages), offset internally and founded on the previously deposited and farmed bauxite residue, in 2 m high vertical lifts. This construction method is also consistent with Best Available Techniques (BAT) for the management of waste from extractive industries. The overall stack is raised systematically as the Stages are filled with bauxite residue, farmed, carbonated (reduction in pH through reaction with atmospheric carbon dioxide) and compacted, prior to deposition of the next layer. The upstream construction methodology is illustrated in Figure 10.51 and Figure 10.52 below.

**Figure 10.51: North and West Flanks of the Phase 1 BRDA (April 2021)**

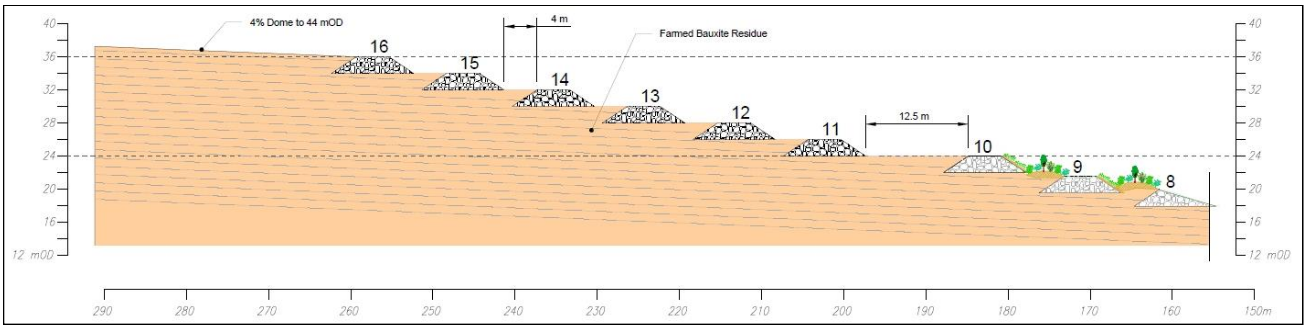



**Figure 10.52: Representative Section of BRDA Raise from Stage 11 to Stage 16 (landscaping omitted for clarity)**

The stability of the permitted BRDA to Stage 10 and the proposed BRDA to Stage 16 is discussed in detail in the Engineering Design Report for the BRDA Raise and a summary is provided in Chapter 8: Soils, Land and Geology.

### 10.8.2 Proposed SCDC Raise

The current SCDC is located in the north-east sector of the BRDA. The existing crest height of the SCDC is 29 mOD which is below overall permitted height for the BRDA (dome crest at 32 mOD). The Proposed Development comprises the vertical extension (downstream and centre-line methods) of the existing SCDC to a crest height of c. 31.25 mOD which will have a maximum overall height of c. 35.5 mOD when capped at its northern extent.

The cell walls shall be constructed of processed rock fill that is placed and compacted in layers over the existing cell walls and farmed bauxite residue deposited locally. Rock fill for construction of the SCDC Raise will be sourced from the development of the on-site Borrow Pit. The upstream side-slopes will be composite lined, comprising a 2 mm HDPE geomembrane overlying a geosynthetic clay lining (GCL), with engineered fill and non-woven protection geotextile layers placed, as appropriate.

### 10.8.3 Proposed Borrow Pit Extension

The permitted Borrow Pit is located to the east of the Phase 1 BRDA. It is proposed to extend the extraction area of the permitted Borrow Pit to c. 8.4 hectares (from c. 4.5 hectares) which would provide a total of c. 754,000 m³ of rock. The quantum of rock to be extracted from the permitted Borrow Pit and the proposed Borrow Pit Extension area will be processed and used in the construction of the proposed BRDA and SCDC raises, and the closure works.

The Borrow Pit Extension is proposed to be developed from surface to a maximum extraction elevation of 8.5 mOD and operated in accordance with the conditions for the current Borrow Pit (listed below) and any subsequent Conditions imposed for the Borrow Pit Extension.

- the development Conditions imposed by ABP Board Order ABP-301011-18 in November 2018 and subsequent Board Direction issued in February 2019; and
- the relevant conditions for Aughinish Alumina Limited (AAL) Industrial Emissions Licence (IEL), P0035-07, issued by the EPA in September 2021.

***Note:*** *AAL are aware that there is no guarantee that the same development and operational conditions would be applicable in the granting of permission or an IE licence for the proposed Borrow Pit Extension. The adoption of the current development and operational conditions permits the assessment of the impact and its significance.*

### 10.8.4 Proposed Water Management

No water management system is required for the proposed Borrow Pit Extension site or the existing Borrow Pit site as there is no interaction with the groundwater. The groundwater table varies between 2 mOD and 6 mOD beneath the footprint of the proposed Borrow Pit Extension and the design maximum depth of extraction is 8.5 mOD. No surface water bodies or streams are present in the vicinity of the proposed Borrow Pit Extension site or the existing Borrow Pit site.

A hydrological assessment for the existing BRDA water management system (Golder 2021) was conducted for the worst-case operational scenario i.e., final elevation of the Phase 1 and 2 BRDAs are increased to a dome crown of 44 mOD and a perimeter crest elevation of 36 mOD (Stage 16). In this scenario, there is no opportunity for storage of surface water on the topography of the BRDA, surface water runoff will report directly to the PIC segments and all of the waters are required to be managed within the water management system for the facility i.e., no emergency discharge permitted for the inflow design flood (IDF) event.

The design criteria for the BRDA water management system have been selected to be in accordance with the Canadian Dam Association (CDA) (2007) and (2014) Guidelines. The BRDA has been identified to have a "**High**" hazard potential classification (HPC) under the CDA Guidelines and therefore the Inflow Design Flood (IDF) will be 1/3 between the 1,000-year and the Probable Maximum Flood (PMF) events with a duration of 24 hours.

The Plant Site does not form part of the BRDA and the CDA guidelines for design rainfall events are not applicable to the Plant Site. The design flood event for the Plant Site water management system has been selected to be in accordance with the 'Flood Risk Management Plan – Shannon Estuary South' (OPW, 2018). The preferred standard of protection offered by flood protection measures for fluvial flooding in Ireland is the 100-year flood event. Storm water runoff discharging to the BRDA water management system from the Plant Site has been assessed for the 1 in 100-year +20% (climate change allowance) rainfall event with a duration of 24 hours.

The water balance model has been constructed at a daily time step, with daily rainfall and evaporation data utilised to estimate daily runoff volumes from the BRDA over a 27,394-day (75 years) duration. Runoff reports to the PICs and is conveyed through the PIC system before being pumped to the SWP or ECS; for modelling purposes it has been assumed that all water pumped from the PIC system is pumped to the SWP. From the SWP, water is pumped to the ECS for treatment before being discharged to the environment via the LWP.

A block flow diagram showing the conceptual water balance model is presented in Figure 10.53 below.

Water balance modelling was undertaken using GoldSim Monte Carlo simulation software. Water balance modelling was used to evaluate the water volumes in the BRDA water management system under normal operating and meteorological conditions.

The results of this modelling were used as initial conditions (PIC, SWP, and LWP water levels) in hydrologic / flood routing modelling under Inflow Design Flood (IDF) conditions.
The hydrological assessment for the BRDA estimated the peak runoff rates from the proposed Phase 1 and 2 to Stage 16 BRDA Raise Development during the IDF to the PIC system; this has included analysis of each PIC segment (divided by culverted 'choke points' in the PIC system) and its sub-catchment. Peak runoff rates to the PIC segments from the BRDA range from 0.074 $m^3/s$ (PIC-L North) to 1.115 $m^3/s$ (PIC-E).

The hydrological assessment for the Plant Site catchments and estimated pumping rates and runoff volumes corresponding to the 1 in 100-year +20% (climate change allowance) rainfall event with a duration of 24 hours; runoff volumes up to this magnitude of event will be pumped to the BRDA water management system and therefore have been incorporated in the hydrological assessment of the BRDA water management system. For rainfall events in the Plant Site in excess of this event, e.g., the BRDA IDF, the surplus runoff volumes are proposed by AAL to be retained and managed within the Plant Site up to the BRDA IDF rainfall event.

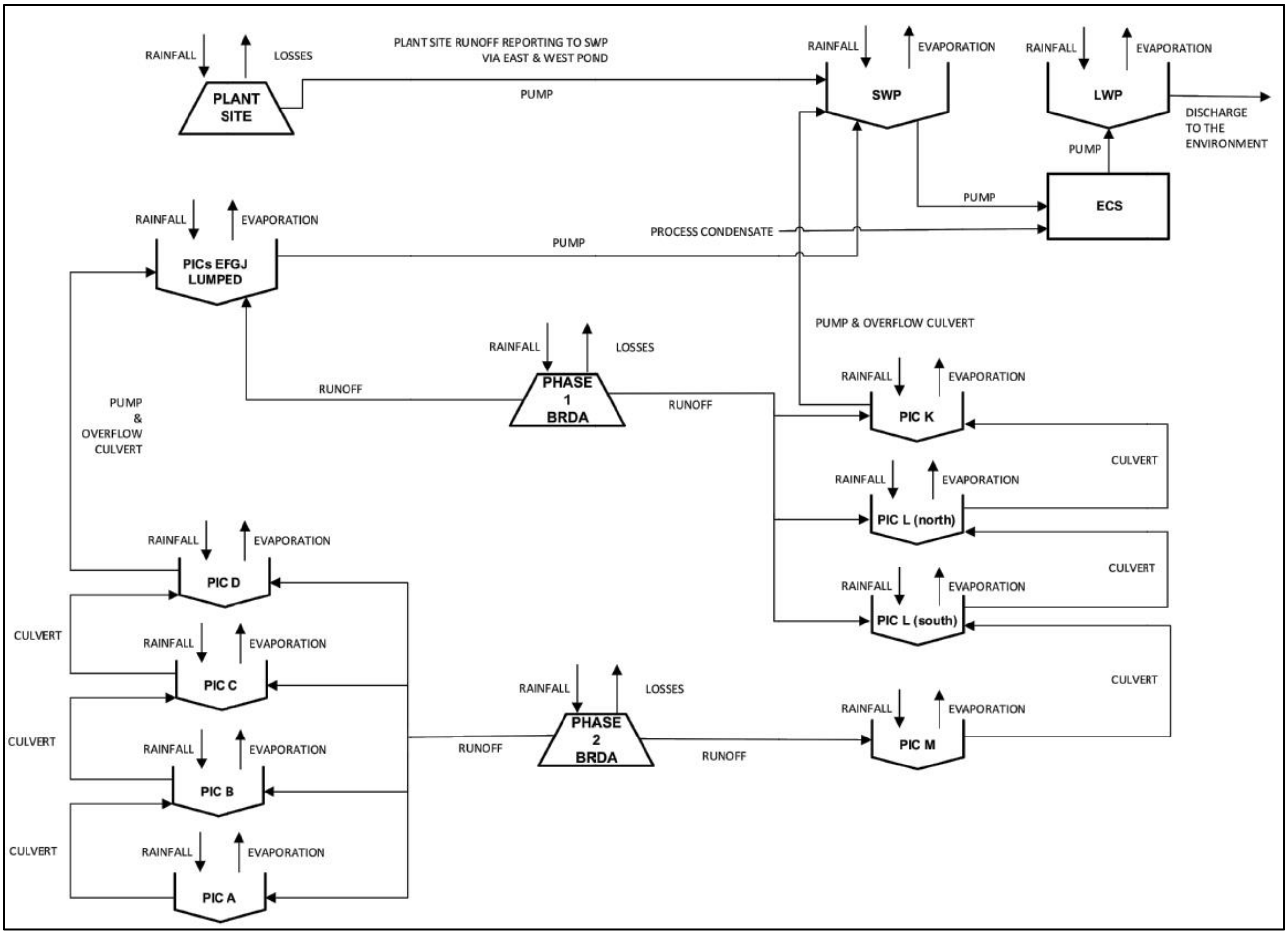



**Figure 10.53: Modelled BRDA Raise Development Water Management System**

**Notes:**

1) *Catchment "Losses" presented in the flow diagram represent all hydrological losses from rainfall including evaporation, transpiration, infiltration, and losses due to surface depressions and ponding.*

Improvements to the water management system for the proposed BRDA development will be implemented to allow for the existing PIC system, SWP and LWP to accommodate the IDF for the Proposed Development.

Improvements to be implemented include the following:

- Provision of additional culverts for several PICs;
- Increases to PIC crest elevations for several PICs;
- Construction of PIC-M;
- PIC pump arrangement upgrades for PICs G and K;
- Pumped flows from the Plant Site to discharge to the SWP rather than the PIC system. This is intended to reduce the volume of water discharging to the PIC during the IDF and reduce the overall PIC pumping capacity required to accommodate the IDF.

## 10.9 Potential Effects

The main potential impacts and associated effects considered in the assessment during the construction, operation and closure of the Proposed Development relate to the following:

- Mobilisation of leachate by operational works, e.g., earth movements, that could impact water quality and use;
- Changes in groundwater levels and flow regimes (and, therefore, water availability); and
- Activities that might impact water quality and use, e.g., increased suspended solids, leaks and spills from machinery or stored substances, or discharges – including drainage and waste-water discharges, leakages and seeps from the BRDA/SCDC and their potential impacts, and effects on water quality at the SACs/SPAs.

These potential impacts and associated effects are discussed and assessed in the following sections.

### 10.9.1 Construction and Operational Phase Impacts

Changes in the quality and/or availability of surface water or groundwater as a result of the Proposed Development could affect existing users and future resource potential and would not support the WFD objectives. The Proposed Development has the potential to introduce sources that on their own or in combination have the potential to impact water quality or availability. These are grouped together in the following section to describe the potential impact linkages to the selected receptors.

Impacts to surface water could occur directly or indirectly via surface flows or via groundwater. Impacts to groundwater are more likely to be indirect through the ground, but excavations into the sub-surface would reduce soil and sub-soil thickness, e.g., at the proposed Borrow Pit Extension site, and could result in an increased risk to aquifer water quality from contamination/pollution incidents on the surface.

There is also the potential for operational activities to create a new pathway for an impact to affect a receptor or increase the likelihood or magnitude of an impact.

There is potential for seepage to occur from the perimeter channel or from the storm water pond.

There is potential that increased height of the BRDA and thus a greater hydraulic head could potentially increase the risk for seepage through the base of the BRDA. However, the seepage assessment (Golder 2021) for the BRDA Raise concluded that there is negligible seepage through the base of the facility, either in the unlined or lined phases due to the underlying depth of bauxite residue, the characteristics of the underlying estuarine soils and the composite basal lining system (natural and geosynthetic).

The identification of potential sources of impact, that could result in a change in water quality, depends on the activities that will be undertaken during operations. The following potential sources have been identified through the project description and experience of similar construction activities:

- Refuelling leaks or spills could introduce hydrocarbons to the water environment at the Borrow Pit extension site;
- Seepage from the BRDA site;
- Leaks and spills of substances during storage, transport, use and/or disposal; and
- Operational activities such as excavations and earth movement represent potential sources of suspended solids.

Activities, systems and monitoring installations are already in place to manage and limit the potential impact from refuelling, seepage from the BRDA, and leaks and spills from stored and used substances. The proposed activities at the Site are all extensions to existing activities, systems and monitoring of groundwater and surface water quality in the vicinity of the Site are in compliance with the IEL requirements.

The BRDA and SCDC are existing structures which are compositely lined (or demonstrable equivalent), as would be the proposed raises to both.

The status of the nearby transitional waterbody (Lower Shannon Estuary) during the 2013 – 2018 monitoring period is given as ‘good’ by the EPA (2021). Water quality results for surface water features around the Site show parameters are within threshold values between 2008 and 2021.

Seepage modelling has been undertaken by Golder (Appendix H of the Engineering Design Report) for the BRDA at closure following the construction to Stage 16 and the construction of the dome and the capping and restoration works. The modelling has been used to estimate the potential volumes of seepage generated along the side slopes of the restored Stage 16 BRDA, as well as the surface water runoff from the dome. The results of the modelling indicated the following:

- Of the total water that accumulates in the PIC due to surface runoff and sidewall seepage, 93.7% arrives directly as surface water runoff from the dome and side slopes of the facility;
- The remaining 6.3% emanates from the facility slopes as sidewall seepage, and this is divided across four specific locations along the sidewalls – the Stage 5 bench, the Stage 10 bench and seepage directly into both the facility PICs from the Inner Perimeter Wall (IPW) and into the dome perimeter channels; and
- There is negligible seepage through the base of the facility, either in the unlined or lined phases.

With management in place, the predicted magnitude of impact is considered to be **low (adverse)** for groundwater quality and **low (adverse)** for surface water quality.

Changes in recharge to groundwater could occur on the proposed Borrow Pit Extension site due to the removal of superficial deposits and bedrock. This could, in turn, result in a change in groundwater resource availability. However, groundwater recharge potential is also likely to become increased as a result of the removal of overburden from the footprint of the Borrow Pit Extension site.

Given the Proposed Development design maximum depth of extraction to 8.5 mOD (circa 2.5m above the groundwater table) and the size of the proposed Borrow Pit Extension site compared to the lateral extent of the mapped geological units and the distance between this site and any potential groundwater users in the vicinity of AAL facility (c. 1.7 km east), the predicted impact on groundwater flows and levels is considered to be **negligible (adverse).**

Effects on the water can have secondary effects on human water users. The nearest mapped water borehole is located over 1.7 km from the Proposed Development and the area is known to have mains water supplies.
The magnitude of the predicted impact to water is discussed in the text above. With the Proposed Development design measures in place, the predicted magnitude of impact is considered to be **negligible (adverse).**

Secondary impacts to ecology as a result of changes to the water environment are addressed in Chapter 7: Biodiversity.

### 10.9.2 Closure Phase Impacts

The potential impacts during closure of the Site on the water environment would be similar to the operational impacts for the BRDA site. The Proposed Development would enable the BRDA to be constructed to Stage 16. Interim landscaping of the side-slopes takes place on a phased basis as the BRDA is raised.

The Closure Plan proposes that the BRDA side slopes would be capped with a rock fill capping containment layer which would provide a continuous rock fill blanket across the entire footprint of the BRDA side slopes. Hydroseeding of the downstream faces of the rock fill stage will be undertaken to allow for vegetation of these faces. A strip of the rock fill blanket (‘infiltration strip’) will remain exposed to allow surface water runoff to infiltrate into the rock fill blanket at each stage raise.

During the construction of the rock fill blanket, fuel and other substances could possibly be spilled or leak from plant and machinery during operations. There will be no underground tanks, no septic tanks, refuelling will take place using a mobile bowser fuelling plant and only in designated areas suitable for refuelling, there are no planned discharges to ground, and hazardous materials will be managed and stored appropriately.
Leachate leaking from the SCDC into the underlying groundwater aquifer is considered unlikely as the cell will be compositely lined and located within the BRDA, over a circa 18 m depth of very low permeability deposited bauxite residue, which is compositely lined at the base.

There is potential for leachate leakage from the BRDA after closure, however, it is likely that leakages would be minor and isolated and modelling completed by Golder (2021) indicates that water accumulating in the PIC at closure will be predominantly from surface water runoff, not from basal seepage. Active monitoring of the observation well field will be continued for a minimum of 5 years after closure and will identify any potential contamination at an early stage which can be remediated.

The monitoring is the passive after-care phase is expected to continue for a minimum of an additional 30 years.

The predicted potential impact on underlying groundwater aquifers or nearby surface water features is **low (adverse).**

Upon closure of the Borrow Pit areas, exposed faces will be battered down where necessary and other faces will be left exposed. This will help to reduce the potential pathway for contaminants into the bedrock beneath. Once restoration activities have taken place at the Borrow Pit sites, there will be limited plant or machinery required onsite and the area would be allowed to naturally revegetate, and it is unlikely there will be a source of contamination onsite. No surface waters are directly connected to AAL facility. Only limited access would be required to monitor nearby groundwater wells which are outside the footprint of the Borrow Pit sites.

The predicted magnitude of impact is **low (beneficial).**

Closure impacts on human water users in the area are likely to have minimal impact. The nearest mapped water borehole is located c. 1.7 km from the Proposed Development and the area is serviced by mains water supplies. There is limited potential for the mobilisation of contamination from the Site as the majority of the BRDA is within a separate groundwater aquifer to mapped wells and these wells are also upgradient. Capping of the BRDA and SCDC will also result in no additional storage of bauxite residue or salt cake on site and no surface water infiltration. Closure of the Borrow Pit sites will likely lead to low (beneficial) impact on groundwater quality and does not represent a likely future source of potential contamination to wells downgradient. The associated level of effect depends on the importance of the receptor.

With management in place, the predicted magnitude of impact is considered to be **negligible (beneficial).**

### 10.9.3 Evaluation of Initial Effect Significance

The evaluation of effects takes into account the predicted impact magnitude combined with receptor sensitivity.

The evaluation of effect significance from each of the operational and closure impacts (taking account of the Proposed Development design) discussed above is presented in Table 10..

As can be seen from Table 10.3, any negligible initial impact magnitude will result in a slight or imperceptible level of effect, both of which levels are '**not significant'**.

**Table 10.10: Evaluation of Initial Impacts and their Effect Significance**

| Project Phase | Receptor | Sensitivity | Source of Impact/Description of Change* | Impact Magnitude* | Level of Effect * |
|---|---|---|---|---|---|
| Construction and Operational | Groundwater | **Medium** | Mobilisation of leachate or activities impacting water quality or use, e.g., seepage, leaks and spills caused by bauxite residue and/or salt cake within the BRDA/SCDC or the unmanaged spillage of fuels or lubricants from plant or vehicles within the BRDA area or Borrow Pit sites. | Low (adverse), direct, long term, reversible (BRDA and SCDC)<br><br>Negligible (adverse) indirect, medium term, reversible (Borrow Pit sites) | Slight<br><br>Slight |
| | | | Changes in groundwater flows or levels within the Borrow Pit sites. | Negligible (adverse), direct, medium term, reversible | Slight |
| | Surface Water | **High** | Mobilisation of leachate or activities impacting water quality or use, e.g., seepage, leaks and spills caused by bauxite residue and/or salt cake within the BRDA/SCDC or the unmanaged spillage of fuels or lubricants from plant or vehicles within the BRDA area or Borrow Pit sites. | Low (adverse), indirect, long term, reversible | Slight |
| | Human water users | **High** | Mobilisation of leachate or activities impacting water quality or use (seepage, leaks and spills caused by bauxite residue and/or salt cake or the unmanaged spillage of fuels or lubricants from plant or vehicles) | Negligible (adverse), indirect, long term, reversible | Slight |

| Project Phase | Receptor | Sensitivity | Source of Impact/Description of Change* | Impact Magnitude* | Level of Effect * |
|---|---|---|---|---|---|
| Closure | Groundwater | **Medium** | Mobilisation of leachate or activities impacting water quality or use during closure activities, e.g., seepage, leaks and spills caused by bauxite residue and/or salt cake within the BRDA/SCDC or the unmanaged spillage of fuels or lubricants from plant or vehicles within the BRDA area or Borrow Pit sites. | Low (adverse), direct, long term, reversible (BRDA and SCDC)<br><br>Negligible (adverse) direct, medium term, reversible (Borrow Pit sites) | Slight<br><br>Slight |
| | | | Changes in groundwater quality after closure of the BRDA/SCDC, i.e., following restoration at Stage 16. | Low (beneficial), direct, permanent, reversible (BRDA and SCDC) | Slight |
| | | | Changes in groundwater flows or levels within the Borrow Pit sites. | Negligible (beneficial), direct, permanent, reversible | Slight |

| Project Phase | Receptor | Sensitivity | Source of Impact/Description of Change* | Impact Magnitude* | Level of Effect * |
|---|---|---|---|---|---|
| | Surface Water | **High** | Mobilisation of leachate or activities impacting water quality or use, e.g., seepage, leaks and spills caused by bauxite residue and/or salt cake within the BRDA/SCDC or the unmanaged spillage of fuels or lubricants from plant or vehicles within the BRDA area or Borrow Pit sites. | Low (adverse), indirect, long term, reversible (BRDA and SCDC)<br><br>Low (beneficial) indirect, permanent, reversible (Borrow Pit sites) | Slight<br><br>Slight |
| | | | Changes in surface water quality after closure of the BRDA/SCDC, i.e., following restoration at Stage 16. | Low (beneficial), direct, permanent, reversible (BRDA and SCDC) | Slight |
| | Human water users | **High** | Mobilisation of leachate or activities impacting water quality or use, e.g., seepage, leaks and spills caused by bauxite residue and/or salt cake within the BRDA/SCDC or the unmanaged spillage of fuels or lubricants from plant or vehicles within the BRDA area or Borrow Pit sites, either during closure activities or post-closure | Negligible (beneficial), indirect, permanent, reversible | Slight |

* Taking account of the Proposed Development Design

## 10.10 Mitigation and Management

The Proposed Development design comprises the project design principles and standards adopted to avoid or prevent adverse safety and environmental effects, with construction and operation undertaken to defined codes of practice and guidelines, and including fixed procedural commitments such as instrumentation and monitoring.
This measure provides the baseline for the impact assessment and determination of additional mitigation measures required to reduce and if possible offset likely significant adverse environmental effects, in support of the determined significance of effects.

### 10.10.1 Proposed Development Design

The elements of the Proposed Development design and good working practices that reduce the potential for impacts to the water environment include the following:

- Rock fill materials sourced from the proposed Borrow Pit site will be used for the construction of the BRDA and SCDC. No rock fill materials are anticipated to be needed to be imported for construction purposes.

- Soil and organic soil improver will be imported to implement the landscaping design for the Proposed Development These imported materials shall be of a suitable quality that will not lead to ground contamination. Any imported material will come from a suitable source where the quality of the material will have been confirmed prior to acceptance;

- There will be no septic tanks or underground storage tanks during construction or after-use that could result in leaks to ground and the water environment. Welfare facilities are provided on the main plant site;

- The BRDA and SCDC are existing structures which are compositely lined (or demonstrable equivalent), as would be the proposed raises to both;

- Surface water runoff, bleed water, sprinkler water and seepage from the bauxite residue will continue to percolate through the rock fill stage raises and discharge into the encompassing PIC;

- There will be no requirement for a connection to a water mains or abstraction from groundwater to enable the Proposed Development; and

- There are no planned discharges to groundwater during operations from the Proposed Development, which will reduce the potential for impacts to water quality.

### 10.10.2 Additional Mitigation / Management

Additional mitigation and/or management is intended to avoid, prevent, reduce or, if possible, offset any identified significant adverse effects on the environment.

The initial assessment of potential effects (taking into account the Proposed Development design) has not identified any significant adverse effects.
However, to further mitigate the initial effects associated with natural resources and built structures, the following additional mitigation procedures will take place:

- Adoption of the existing AAL Environmental Management System (EMS) and other procedures (including Health and Safety) for the Aughinish Site;

- A draft Construction Environment Management Plan (CEMP) has been developed which incorporates relevant mitigation measures for the management of surface and groundwaters during construction to ensure the Proposed Development is compliant with the licence requirements. Enforcement of the final CEMP and licence requirements will minimise potential for impact on the surface or groundwater environment;

- The management of construction works, to be conducted by external Contractors and internal AAL alliance Contractors, will be carried out in line and in accordance with all monitoring provisions identified in the final CEMP, with the IEL requirements, with the AAL Environmental Manual for Contractors (AAL, October 2016), and with any Conditions imposed by the planning authorities;

- Mobile plant and semi-static plant, i.e., crushers and screeners, (for all AAL plant, AAL alliance Contractors and external Contractors) will be refuelled by the current method which is an AAL operated mobile double skinned fuel bowser which drives around the BRDA. Drip trays with absorbent mats are utilized.

- Any mobile plant on the Application Site shall be regularly maintained, and where plant is damaged or leaking it will be fixed or replaced immediately, as part of the ongoing operational management of the borrow area to reduce the risk of leaks;

- Haul roads will be wetted down using a water bowser (using water sourced from the onsite LWP) regularly to reduce the deposition of dust material on the surrounding road network that could get into the water environment;

- All waste generated, whether from the operation of Plant or BRDA activity, or from construction activity in the Application Site during the construction or operation of the Borrow Pit Extension, the BRDA stage raises or the SDCC raise, is the responsibility of AAL as the originator in accordance with the licence. All transport of waste off-site is undertaken by AAL via licenced waste contractors and AAL is responsible for waste document control;

- Stockpiles will be managed and monitored by the Main Contractor to minimise erosion and input of suspended solids to the water environment;

- The Main Contractor (and sub-contractor) must obtain AAL approval for all chemicals used in advance of bringing the materials on site. Safety Data Sheets must be provided, and precautions taken for environmental protection. The unloading and loading of materials shall be carried out in areas protected against spillage and runoff; and

- An emergency spill kit (including absorbers) will be used in the event of an accidental spill;
- No storage of hydrocarbons will take place on the Application Site;
- Testing of the lining system for the SCDC will take place after construction to ensure the seams are air-tight and the panels have not been damaged to ensure the potential for leakages is reduced; and

In addition, good housekeeping during operations, by adhering to best construction practices within the development area, i.e., following the final CEMP, will mitigate against potential impacts on the surrounding environment.

Post passive aftercare phase licensee and subsequent occupiers of the Proposed Development will be responsible for managing their activities and applying for (and working within the constraints of) any environment authorisations or consents required for their operations. If the requirements of relevant regulations, licenses and permits, e.g., Industrial Emissions Licences, under The Environmental Protection Agency Act 1992 and the Protection of the Environment Act 2003) are adhered to, then it is considered that the magnitude of impact and likelihood will be reduced to acceptable levels.

## 10.11 Monitoring

The future monitoring programme at the Site will include regular monitoring of water levels within the proposed BRDA, SCDC and Borrow Pit areas. Regular visual inspections of the dam wall integrity by a suitably qualified engineer will be undertaken for both the Proposed Development and regular visual inspections of the faces in the proposed Borrow Pit Extension site.

Monitoring of piezometric levels will take place regularly to monitor the phreatic surface head in the bauxite residue stack. Regular water quality sampling in perimeter observation wells (OWs) and at the designated surface water locations to assess if there are any seepages.

## 10.12 Cumulative Effects

As a result of the design and mitigation measures implemented for the Proposed Development, it is considered that any impacts associated with the proposed activities will not contribute to cumulative impacts in association with the activities located in the vicinity.

The proposed activities onsite (raising of the BRDA and SCDC, and extension of the Borrow Pit) will supersede the existing BRDA, SCDC and permitted Borrow Pit.

The Proposed Development has been designed to integrate and complement the existing structures with the proposed structures, and no cumulative impacts are anticipated with the addition of the proposed extensions.

## 10.13 Residual Effects

The proposed activities onsite (raising of the BRDA and SCDC, and extension of the Borrow Pit) will supersede the existing BRDA, SCDC and permitted Borrow Pit.

The Proposed Development has been designed to integrate and complement the existing structures with the proposed structures, and no cumulative impacts are anticipated with the addition of the proposed extensions.

A summary of the sources of impact, predicted magnitudes of residual impact (accounting for the Proposed Development design and additional mitigation) and subsequent residual effect significance is presented in Table 10..

In all cases the residual effect is **Not Significant and not greater than Slight.**

**Table 10.11: Evaluation of Predicted Residual Impacts and their Effect Significance**

| Project Phase | Receptor (importance) | Potential Source of Impact | Direct or Indirect | Duration* | Reversible or Irreversible | Summary of Mitigation (Proposed Development Design and Additional Mitigation) | Residual Magnitude of Impact | Residual Effect Significance |
|---|---|---|---|---|---|---|---|---|
| Construction and Operational | Groundwater | Mobilisation of leachate or activities impacting water quality or use, e.g., seepage, leaks and spills caused by bauxite residue and/or salt cake within the BRDA/SCDC or the unmanaged spillage of fuels or lubricants from plant or vehicles within the BRDA area or Borrow Pit sites. | Direct | Long term | Reversible | Good practice pollution prevention measures and regular plant and equipment maintenance procedures. Waste management procedures. | Negligible | Not Significant / Slight |
| | | Changes in groundwater flows or levels within the Borrow Pit sites | Direct | Permanent | Reversible | Good practice pollution prevention measures and regular plant and equipment maintenance procedures. Waste management procedures. | Negligible | Not Significant / Slight |

| Project Phase | Receptor (importance) | Potential Source of Impact | Direct or Indirect | Duration* | Reversible or Irreversible | Summary of Mitigation (Proposed Development Design and Additional Mitigation) | Residual Magnitude of Impact | Residual Effect Significance |
|---|---|---|---|---|---|---|---|---|
| | Surface Water | Mobilisation of leachate or activities impacting water quality or use, e.g., seepage, leaks and spills caused by bauxite residue and/or salt cake within the BRDA/SCDC or the unmanaged spillage of fuels or lubricants from plant or vehicles within the BRDA area or Borrow Pit sites. | Indirect | Long term | Reversible | Good practice pollution prevention measures and regular plant and equipment maintenance procedures. Waste management procedures. | Negligible | Not Significant / Slight |

| Project Phase | Receptor (importance) | Potential Source of Impact | Direct or Indirect | Duration* | Reversible or Irreversible | Summary of Mitigation (Proposed Development Design and Additional Mitigation) | Residual Magnitude of Impact | Residual Effect Significance |
|---|---|---|---|---|---|---|---|---|
| | Human water users | Mobilisation of leachate or activities impacting water quality or use, e.g., seepage, leaks and spills caused by bauxite residue and/or salt cake within the BRDA/SCDC or the unmanaged spillage of fuels or lubricants from plant or vehicles within the BRDA area or Borrow Pit sites. | Indirect | Long term | Reversible | Good practice pollution prevention measures and regular plant and equipment maintenance procedures. Waste management procedures. | Negligible | Not Significant / Slight |

| Project Phase | Receptor (importance) | Potential Source of Impact | Direct or Indirect | Duration* | Reversible or Irreversible | Summary of Mitigation (Proposed Development Design and Additional Mitigation) | Residual Magnitude of Impact | Residual Effect Significance |
|---|---|---|---|---|---|---|---|---|
| Closure | Groundwater | Mobilisation of leachate or activities impacting water quality or use, e.g., seepage, leaks and spills caused by bauxite residue and/or salt cake within the BRDA/SCDC or the unmanaged spillage of fuels or lubricants from plant or vehicles within the BRDA area or Borrow Pit sites. | Direct | Long term (BRDA and SCDC site)<br><br>Medium term (Borrow Pit site) | Reversible | Good practice pollution prevention measures and regular plant and equipment maintenance procedures. Waste management procedures. Regular aftercare monitoring and inspection. Good closure practice. | Negligible | Not Significant / Slight |
| | | Changes in groundwater quality after closure of the BRDA/SCDC, i.e., following restoration at Stage 16 | Direct | Permanent | Reversible | Good practice pollution prevention measures, closure design, implementation and regular plant and equipment maintenance procedures. Waste management procedures. Regular aftercare monitoring and inspection. Good closure practice. | Negligible | Not Significant / Slight |

| Project Phase | Receptor (importance) | Potential Source of Impact | Direct or Indirect | Duration* | Reversible or Irreversible | Summary of Mitigation (Proposed Development Design and Additional Mitigation) | Residual Magnitude of Impact | Residual Effect Significance |
|---|---|---|---|---|---|---|---|---|
| | Surface Water | Mobilisation of leachate or activities impacting water quality or use, e.g., seepage, leaks and spills caused by bauxite residue and/or salt cake within the BRDA/SCDC or the unmanaged spillage of fuels or lubricants from plant or vehicles within the BRDA area or Borrow Pit sites. | Indirect | Long term | Reversible | Good practice pollution prevention measures and regular plant and equipment maintenance procedures. Waste management procedures. Regular aftercare monitoring and inspection. Good closure practice. | Negligible | Not Significant / Slight |
| | Surface Water | Changes in surface water quality after closure of the BRDA/SCDC, i.e., following restoration at Stage 16 | Indirect | Long term | Reversible | Good practice pollution prevention measures and regular plant and equipment maintenance procedures. Waste management procedures. Regular aftercare monitoring and inspection. Good closure practice. | Negligible | Not Significant / Slight |

| Project Phase | Receptor (importance) | Potential Source of Impact | Direct or Indirect | Duration* | Reversible or Irreversible | Summary of Mitigation (Proposed Development Design and Additional Mitigation) | Residual Magnitude of Impact | Residual Effect Significance |
|---|---|---|---|---|---|---|---|---|
| | Human water users | Mobilisation of leachate or activities impacting water quality or use, e.g., seepage, leaks and spills caused by bauxite residue and/or salt cake within the BRDA/SCDC or the unmanaged spillage of fuels or lubricants from plant or vehicles within the BRDA area or Borrow Pit sites. | Indirect | Long term | Reversible | Good practice pollution prevention measures and regular plant and equipment maintenance procedures. Waste management procedures. Regular aftercare monitoring and inspection. Good closure practice. | Negligible | Not Significant/ Slight |

* Maximum duration without intervention

## 10.14 'Do Nothing Scenario'

In the event that the Proposed Development does not progress there are unlikely to be impacts on the geological, land or soil environment in the area of the Site.
The existing BRDA and SCDC would be closed in accordance with the Closure, Restoration and Aftercare Management Plan (CRAMP) and covers both the Plant area and the BRDA and the facility would likely close subsequently.

The proposed Borrow Pit Extension area would not be developed, beyond the permitted footprint, and there would be no increased potential for contamination at this site as no removal of superficial or bedrock would occur, and it would remain a green field area within an industrial landholding

## 10.15 Major Accidents and Disasters

Environmental impact assessments are required to address the vulnerability of the proposed projects to major accidents and / or disasters.

These unforeseen and unplanned events are to be assessed on the risk of their occurrence, (likelihood and consequence) and are assessed in greater detail in Chapter 16: Major Accidents and Disasters.

In the context of water (hydrology and hydrogeology) the following would constitute a major accident or disaster:

- Large oil and fuel spills to ground which enter groundwater or surface water bodies;
- Large leachate leakage to ground which enter groundwater or surface water bodies; or
- Loss or irreversible degradation of designated public groundwater abstraction resources.

Given the lined nature of the proposed raise to the BRDA and SCDC and the operational procedures in place, the likelihood of a major accident and/or disaster to occur is very low from this site.

There is no bauxite residue storage at the Borrow Pit site, there is no risk from this as a contamination source and there is limited potential for fuel or oil spills onsite.

These risks will be further reduced should the mitigation measures outlined above are adhered to.

## 10.16 Difficulties Encountered

No particular difficulties were encountered in obtaining data and undertaking the assessment of hydrology and hydrogeology.

## 10.17 Summary and Conclusions

This assessment considers the potential direct and indirect significant effects that the Proposed Development may have on the water environment, during the construction, operation and closure of the Proposed Development.
The main receptors that were required to be assessed were groundwater, surface water and humans (specifically existing water users) that could be secondarily affected by changes to the water environment. The secondary effects on ecology and biodiversity are considered in Chapter 7: Biodiversity.

The assessment has concluded that the Proposed Development would not lead to significant effects during its construction, operational and closure phases.
There are no surface water features directly connected to the Application Site, however there are internationally designated sites in close proximity to the Application Site. These are unlikely to be affected either directly or indirectly by the Proposed Development.

There is no current or predicted flood risk (either pluvial or coastal) for the Site.
No water management system is required for the proposed Borrow Pit Extension site or the existing Borrow Pit site as there is no interaction with the groundwater. The groundwater table varies between 2 mOD and 6 mOD beneath the footprint of the proposed Borrow Pit Extension and the design maximum depth of extraction is 8.5 mOD. There are no surface water features present in the vicinity of the proposed Borrow Pit Extension site or the permitted Borrow Pit site. The quality and availability of surface water or groundwater are unlikely to be affected directly or indirectly by the Proposed Development.

The groundwater aquifer beneath the majority of the BRDA site is a locally important aquifer while the eastern sector of the BRDA, the SCDC and the Borrow Pit Extension areas overlie a regionally important groundwater aquifer. However, within the Application Site the groundwater aquifers are largely subject to saline intrusion and do not have a significant resource potential for the wider area.

The Proposed Development design measures were accounted for in an assessment of initial impacts and effects. Where additional mitigation measures could be incorporated to reduce the initial impacts and effects further, these were identified and included in an assessment of residual impacts and effects.

In summary, the significance of residual effects on water (and on human health from water) resulting from the different potential sources of impact are predicted to be no greater than **slight adverse** and, therefore, **not significant** in terms of this assessment.

## 10.18 References

An Foras Taluntais, Soils of Limerick, (Finch & Ryan, 1966), National Soil Survey of Ireland.

DELG/EPA/GSI 1999. Groundwater Protection Schemes. Published by Department of Environment and Local Government (DELG), Environmental Protection Agency (EPA) and Geological Survey of Ireland (GSI), 01 January 1999. ISBN 1-899702-22-9.

EC 2018, Environmental Impact Assessments of Projects Guidance on the Preparation of the Environmental Impact Assessment Report (Directive 2011/92/EU as amended by 2014/52/EU). European Commission 2018.

EPA, Environmental Protection Agency (EPA) interactive web maps (accessed 2021).

EPA 2015, Draft Advice Notes for preparing Environmental Impact Statements. Environmental Protection Agency, Johnstown Castle Estate, Co. Wexford, Ireland.

EPA 2017, Draft Guidelines on the information to be contained in Environmental Impact Assessment Reports (EIAR). Environmental Protection Agency, Johnstown Castle Estate, Co. Wexford, Ireland.

EU Environmental Impact Assessment Directive (Council Directive 2014/52/EU).

Geological Survey of Ireland website, www.gsi.ie; online mapping services (Accessed: 27/11/2018).

Golder 2005. Geotechnical Investigation and Borrow Assessment for the Phase 2 Bauxite Residue Disposal Area at Aughinish Alumina. 03511318.509 Golder Associates (UK) Ltd.

Golder 2015, Groundwater Conceptual Model, Risk Screening and Technical Assessment Report, 13514150608.504/A.4.

GSI, Geological Survey of Ireland interactive web maps.

GSI 1995, A Geological Description of The Shannon Estuary to accompany The Bedrock Geology 1:100,000 scale map series, Sheet 17, Clare and Limerick, Geological Survey of Ireland.

Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment, Department of Environment, Community and Local Government, 2018.

Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements. Institute of Geologist of Ireland, 2013.

Key Issues Consultation Paper - Transposition of 2014 EIA Directive (2014/52/EU) in the Land Use Planning and EPA Licencing Systems, 2nd May 2017.

MWEI BREF 2018, Best Available Techniques (BAT) Reference Document for the Management of Waste from Extractive Industries, in accordance with Directive 2006/21/EC; EUR 28963 EN; Publications Office of the European Union, Luxembourg, 2018; ISBN 978-92-79-77178-1; doi:10.2760/35297, JRC109657

National Roads Authority, 2009. Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes.

S.I. No. 9 - European Communities Environmental Objectives (Groundwater) Regulations 2010.

S.I. No. 389 - European Communities Environmental Objectives (Groundwater) (Amendment) Regulations 2011.

The National Guidelines on Quarries and Ancillary Activities for Planning Authorities. Department of Environment Heritage and Local Government, 2004.

Tom Philips & Associates (2017) Environmental Impact Assessment Report in Respect of Proposed Borrow Pit at Aughinish Alumina Ltd. Aughinish Island, Askeaton, Co. Limerick.

Walther C.A., Cámaro García and Ned Dwyer. Climate Status Report for Ireland 2020, 2021. Research 386: The Status of Ireland’s Climate, 2020.

# 11.0 AIR QUALITY

## 11.1 Introduction

AWN Consulting Limited has been commissioned by Tom Phillips and Associates on behalf of AAL to conduct an air quality impact assessment of the proposed development.

AAL operates a long-established alumina refinery, located on Aughinish Island on the southern side of the Shannon Estuary near the village of Foynes, Co. Limerick. The landholding extends to c. 338 ha. The application site is located towards the centre of the Applicants landholding at Aughinish Island, containing the BRDA, salt cake disposal cell (SCDC) and borrow pit.

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### 11.1.1 Ambient Air Quality Standards

Air quality significance criteria are assessed on the basis of compliance with the appropriate standards or limit values. The applicable standards in Ireland include the Air Quality Standards Regulations 2011, which incorporate EU Directive 2008/50/EC, which combines the previous air quality framework and subsequent daughter directives (see Table 11.1). Although the EU Air Quality Limit Values are the basis of legislation, other thresholds outlined by the EU Directives are used which are triggers for particular actions (see Appendix 11.1).

The concern from a health perspective is focussed on particles of dust which are less than 10 microns (µm) in diameter. EU ambient air quality standards (Council Directive 2008/50/EC transposed into Irish law as S.I. 180 of 2011) centres on $PM_{10}$ (particles less than 10 microns) as it is these particles which have the potential to be inhaled into the lungs and cause some adverse health impact. Council Directive 2008/50/EC also sets an ambient standard for $PM_{2.5}$ (particles less than 2.5 microns in diameter) which came into force in 2015 (see Table 11.1).

#### Dust Deposition Guidelines

With regard to larger dust particles that can give rise to nuisance dust, there are no statutory guidelines regarding the maximum dust deposition levels that may be generated during the construction phase of a development in Ireland.

With regard to dust deposition, the German TA-Luft standard for dust deposition (non-hazardous dust)[1] sets a maximum permissible emission level for dust deposition of 350 mg/($m^2$*day) averaged over a one-year period at any receptors outside the site boundary. Recommendations from the Department of the Environment, Health & Local Government[2] apply the TA Luft limit of 350 mg/($m^2$*day) to the site boundary of quarries. This limit value is considered appropriate in relation to the assessment of dust impacts from the proposed development. Licence P0035-07 specifically states under Conditions 5.8 and 6.18 that ambient monitoring of dust deposition be undertaken on a monthly basis at agreed locations.

**GOTHENBURG PROTOCOL**

In 1999, Ireland signed the *Gothenburg Protocol to the 1979 UN Convention on Long Range Transboundary Air Pollution*. The objective of the Protocol is to control and reduce emissions of Sulphur Dioxide ($SO_2$), Nitrogen Oxides ($NO_X$), Volatile Organic Compounds (VOCs) and Ammonia ($NH_3$). In 2012, the Gothenburg Protocol was revised to include national emission reduction commitments for the main air pollutants to be achieved in 2020 and beyond and to include emission reduction commitments for $PM_{2.5}$. In relation to Ireland, 2020 emission targets were 25 kt for $SO_2$ (65% on 2005 levels), 65 kt for $NO_X$ (49% reduction on 2005 levels), 43 kt for VOCs (25% reduction on 2005 levels), 108 kt for $NH_3$ (1% reduction on 2005 levels) and 10 kt for $PM_{2.5}$ (18% reduction on 2005 levels).

European Commission Directive 2001/81/EC, the National Emissions Ceiling Directive (NECD), has prescribed the same emission limits. Road traffic emissions of Nitrogen Oxides ($NO_X$) and Volatile Organic Compounds (VOCs) are important, accounting for 37% and 38% respectively of total emissions of these pollutants in Ireland in 2001[3,4] although $SO_2$ and $NH_3$ are minor emissions from road sources. A National Programme for the progressive reduction of emissions of these four transboundary pollutants has been in place since April 2005[9]. Data available from the EU in 2010 indicated that Ireland complied with the emissions ceilings for $SO_2$, VOCs and $NH_3$ but failed to comply with the ceiling for $NO_X$[5]. Directive (EU) 2016/2284 "*On the Reduction of National Emissions of Certain Atmospheric Pollutants and Amending Directive 2003/35/EC and Repealing Directive 2001/81/EC*" was published in December 2016. The Directive applies the 2010 NECD limits until 2020 and establishes new national emission reduction commitments which are applicable from 2020 to 2029 and from 2030 onwards for $SO_2$, $NO_X$, NMVOC, $NH_3$ and $PM_{2.5}$. In relation to Ireland, 2020-29 emission targets are for $SO_2$ (65% below 2005 levels), for $NO_X$ (49% reduction), for VOCs (25% reduction), for $NH_3$ (1% reduction) and for $PM_{2.5}$ (18% reduction). In relation to 2030, Ireland's emission targets are for $SO_2$ (85% below 2005 levels), for $NO_X$ (69% reduction), for VOCs (32% reduction), for $NH_3$ (5% reduction) and for $PM_{2.5}$ (41% reduction).

The data available from the EU in 2020[6] indicated that Ireland complied with the emissions ceilings for $SO_2$ in recent years but failed to comply with the ceilings for NMVOCs, $NH_3$ and $NO_X$.

| Pollutant | Regulation Note 1 | Limit Type | Value |
|---|---|---|---|
| Nitrogen Dioxide | 2008/50/EC | Hourly limit for protection of human health - not to be exceeded more than 18 times/year | 200 µg/m³ |
| | | Annual limit for protection of human health | 40 µg/m³ |
| | | Critical level for protection of vegetation | 30 µg/m³ NO + $NO_2$ |
| Sulphur dioxide | 2008/50/EC | Hourly limit for protection of human health - not to be exceeded more than 24 times/year | 350 µg/m³ |
| | | Daily limit for protection of human health - not to be exceeded more than 3 times/year | 125 µg/m³ |
| | | Critical limit for the protection of ecosystems | 20 µg/m³ |
| Particulate Matter (as $PM_{10}$) | 2008/50/EC | 24-hour limit for protection of human health - not to be exceeded more than 35 times/year | 50 µg/m³ |
| | | Annual limit for protection of human health | 40 µg/m³ |
| $PM_{2.5}$ | 2008/50/EC | Annual limit for protection of human health | 25 µg/m³ |
| Carbon Monoxide (CO) | 2008/50/EC | 8-hour limit (on a rolling basis) for protection of human health | 10 mg/m³ (8.6 ppm) |
| Dust Deposition | German TA-Luft | Annual average guideline for protection of nuisance and human health | 350 mg/(m²*day) |

**Table 11.1:** Air Quality Standards

In the absence of statutory standards, ambient air quality guidelines can also be derived from occupational exposure limits (OEL). Guidance has been issued by the UK Environment Agency entitled "IPPC Environmental Assessment for BAT" (Environment Agency, 2002)[(7)]. The guidance outlines the approach for deriving both short-term and long-term environmental assessment levels (EAL). In relation to the long-term (annual) EAL, this can be derived by applying a factor of 100 to the 8-hour OEL. The factor of 100 allows for both the greater period of exposure and the greater sensitivity of the general population. For short-term (1-hour) exposure, the EAL is derived by applying a factor of 10 to the short term exposure limit (STEL). In this case, sensitivity of the general population need be taken into account with no additional safety factors in terms of the period of exposure. Where STELs are not listed then a value of 3 times the 8-hour time weighted average occupational exposure limit may be used.

The applicable heavy metal ambient air quality guidelines and standards for the protection of human health and the environment are set out in Table 11.2.

| Metal | Long-Term EAL (Annual) | Regulation |
|---|---|---|
| Cd | 0.005 μg/m³ | EU[1] / EAL[2] |
| Ti | 40 μg/m³ | EAL[2] |
| Inorganic Mercury (as Hg) | 1 μg/m³ | WHO[3] |
| Al | 20 μg/m³ | EAL[2] |
| As | 0.006 μg/m³[1] | EU[1] / EAL[2] |
| Pb | 0.5 μg/m³ | EU[1] |
| Cr (except VI) | 5.0 μg/m³ | EAL[2] |
| Cr (VI)[4] | 0.0002 μg/m³ | EAL[2] |
| Fe | 10 μg/m³ | EAL[2] |
| Mg | 100 μg/m³ | EAL[2] |
| Cu (dust & mists) | 10 μg/m³ | EAL[2] |
| Zn | 50 μg/m³ | EAL[2] |
| Ni (inorganic) | 0.020 μg/m³[1] | EU[1] |

(1) Council Directive 2004/107/EC
(2) Environmental Agency (2003) "IPPC H1 - Environmental Assessment & Appraisal of BAT"
(3) WHO (2000) Air Quality Guidelines for Europe

**Table 11.2:** Heavy Metal Ambient Air Quality Standards & Guidelines for the Protection of Human Health and the Environment

## 11.2 Methodology

The air quality assessment has been carried out in line with the guidance outlined in the European Commission publication "*Environmental Impact Assessment of Projects – Guidance on the preparation of the Environmental Impact Assessment Report*"[8] and the EPA publication "*Guidelines on the Information to be Contained in Environmental Impact Assessment Reports – Draft August 2017*"[9] and using the methodology outlined in the guidance documents published by the United States Environmental Protection Agency (USEPA)[10-12] and the EPA[13].

### 11.2.1 Dispersion Modelling Methodology

In order to assess the impact of the proposed development beyond the facility, and at specific sensitive locations, air dispersion modelling was undertaken. Modelling using the USEPA new generation dispersion model AERMOD[10] (version 19191) was used. The EPA[13] have recommended this model for assessing air quality emissions from industrial facilities. The model is a steady-state Gaussian plume model used to assess pollutant concentrations associated with industrial sources including dust emissions from area sources. The model has been designated the regulatory model by the USEPA for modelling emissions from industrial sources in both flat and rolling terrain[10]. The AERMET meteorological pre-processor[12] was used to generate hourly boundary layer parameters for use by AERMOD. The air dispersion modelling input data consists of detailed information on the physical environment (including land use and terrain features), emission rate information and a full year of meteorological data. Using this input data, the air dispersion model predicts ambient ground level concentrations for each hour of the modelled meteorological year. The model post-processes the data to identify the location and maximum value of the worst-case ground level concentration in the applicable format for comparison with the relevant limit values. The worst-case concentration is then added to the existing baseline concentration, where relevant, to give the worst-case predicted ambient concentration level of the relevant pollutants.

The modelling incorporated the following features:

- A receptor grid was created at which concentrations would be modelled with a greater density of receptors in the area surrounding the AAL facility. In addition, boundary receptors around the site were input into the model giving a total of 998 calculation points for the model.

- Detailed terrain has been mapped into the model using Shuttle Radar Topography Mission (SRTM) data with 30m resolution. The site is located in an area of gently rolling terrain. All terrain features have been mapped in detail into the model using the terrain pre-processor AERMAP[14].

- Hourly-sequenced meteorological information has been used in the model. Meteorological data for Shannon Airport year 2020 was used in the model (see Figure 11.1). The wind speed information is used to derive the dust emission factors which are then correlated with the $PM_{10}$ and dust deposition monitoring data.

- The source and emission data have been incorporated into the model.

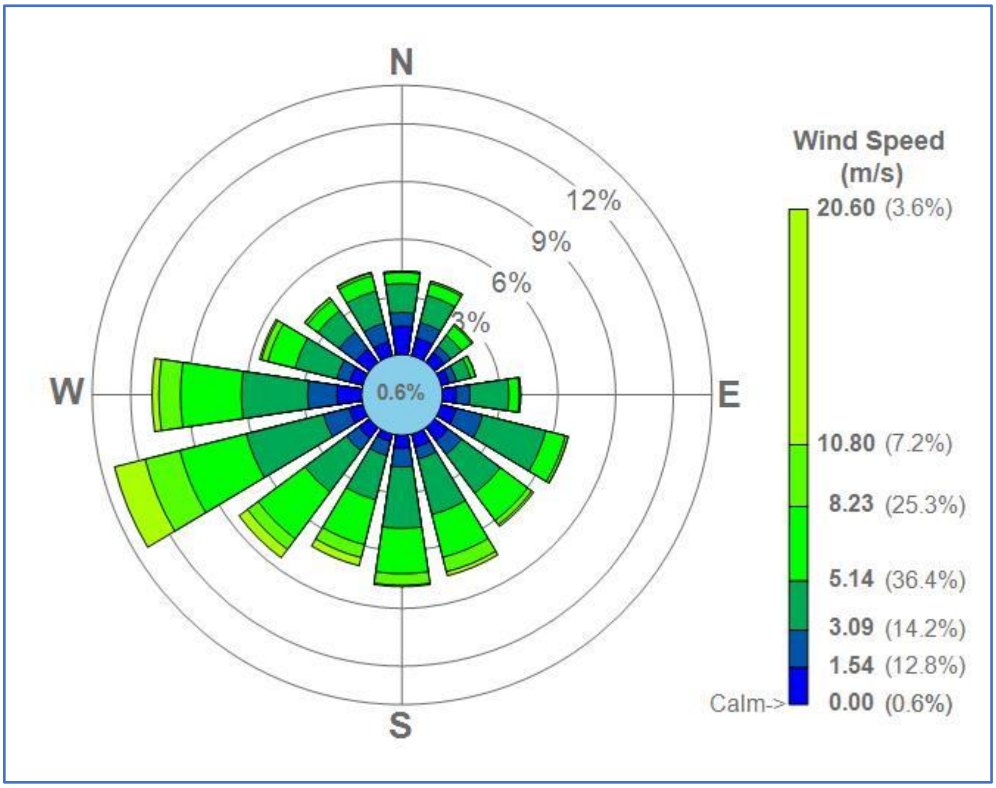



**Figure 11.1:** Windrose for Shannon Airport 2020 (Met Eireann, 2021).

### 11.2.2 Terrain

The AERMOD air dispersion model has a terrain pre-processor AERMAP(14) which was used to map the physical environment in detail over the receptor grid. The digital terrain input data used in the AERMAP pre-processor was obtained from SRTM. This data was run to obtain for each receptor point the terrain height and the terrain height scale. The terrain height scale is used in AERMOD to calculate the critical dividing streamline height, $H_{crit}$, for each receptor. The terrain height scale is derived from the Digital Elevation Model (DEM) files in AERMAP by computing the relief height of the DEM point relative to the height of the receptor and determining the slope. If the slope is less than 10%, the program goes to the next DEM point. If the slope is 10% or greater, the controlling hill height is updated if it is higher than the stored hill height.

In areas of complex terrain, AERMOD models the impact of terrain using the concept of the dividing streamline ($H_c$). The air dispersion plume is the flow in the atmosphere of the pollutant mass emitted from a source. As outlined in the AERMOD model formulation(12) a plume embedded in the flow below $H_c$ tends to remain horizontal; it might go around the hill or impact on it. A plume above $H_c$ will ride over the hill. Associated with this is a tendency for the plume to be depressed toward the terrain surface, for the flow to speed up, and for vertical turbulent intensities to increase.

AERMOD model formulation states that the model "captures the effect of flow above and below the dividing streamline by weighting the plume concentration associated with two possible extreme states of the boundary layer (horizontal plume and terrain-following). The relative weighting of the two states depends on: 1) the degree of atmospheric stability; 2) the wind speed; and 3) the plume height relative to terrain. In stable conditions, the horizontal plume "dominates" and is given greater weight while in neutral and unstable conditions, the plume traveling over the terrain is more heavily weighted"(12).

The terrain in the region of the facility is complex in the sense that the maximum terrain in the modelling domain peaks at 141m which is above the release height of the emissions. However, in general, the region of the site has gently sloping terrain particularly in the immediate vicinity of the facility.

### 11.2.3 Surface Characteristics

AERMOD simulates the dispersion process using planetary boundary layer (PBL) scaling theory(10). PBL depth and the dispersion of pollutants within this layer are influenced by specific surface characteristics such as surface roughness, albedo and the availability of surface moisture. Surface roughness is a measure of the aerodynamic roughness of the surface and is related to the height of the roughness element. Albedo is a measure of the reflectivity of the surface whilst the Bowen ratio is a measure of the availability of surface moisture.

AERMOD incorporates a meteorological pre-processor AERMET(12) to enable the calculation of the appropriate parameters. The AERMET meteorological pre-processor requires the input of surface characteristics, including surface roughness ($z_0$), Bowen Ratio and albedo by sector and season, as well as hourly observations of wind speed, wind direction, cloud cover, and temperature. The values of albedo, Bowen Ratio and surface roughness depend on land-use type (e.g., urban, cultivated land etc.) and vary with seasons and wind direction. The assessment of appropriate land-use type was carried out to a distance of 10km from the meteorological station for Bowen Ratio and albedo and to a distance of 1km for surface roughness in line with USEPA recommendations[12,13].

In relation to AERMOD, detailed guidance for calculating the relevant surface parameters has been published. The most pertinent features are:

- The surface characteristics should be those of the meteorological site (Shannon Airport) rather than the installation;
- Surface roughness should use a default 1km radius upwind of the meteorological tower and should be based on an inverse-distance weighted geometric mean. If land use varies around the site, the land use should be sub-divided by sectors with a minimum sector size of 30º;
- Bowen ratio and albedo should be based on a 10km grid. The Bowen ratio should be based on an un-weighted geometric mean. The albedo should be based on a simple un-weighted arithmetic mean.

AERMOD has an associated pre-processor, AERSURFACE[15], which has representative values for these parameters depending on land use type. The AERSURFACE pre-processor currently only accepts NLCD92 land use data which covers the USA. Thus, manual input of surface parameters is necessary when modelling in Ireland. Ordnance survey discovery maps (1:50,000) and digital maps such as those provided by the EPA, National Parks and Wildlife Service (NPWS) and Google Earth® are useful in determining the relevant land use in the region of the meteorological station. The Alaska Department of Environmental Conservation has issued a guidance note for the manual calculation of geometric mean for surface roughness and Bowen ratio for use in AERMET[16]. This approach has been applied to the current site.

### 11.2.4 Operational Emissions

*Operational Phase Site Activity*

During the operation phase of the BRDA the existing activities will continue, however, the phasing of the BRDA raise over time will result in a higher elevation above ground level where these activities will take place. The salt cake cell will also be raised as part of the proposed BRDA raise. However, the saltcake, due to the high moisture content of approximately 45%, will not be a significant source of dust. For the purposes of this assessment the following stages of the BRDA development have been assessed:

- Current (Scenario 1),
- Phase 1 at Stage 10; Phase 2 at Stage 4 (Scenario 2),
- Phase 1 at Stage 12; Phase 2 at Stage 8 (Scenario 3),
- Phase 1 at Stage 14; Phase 2 at Stage 12 (Scenario 4),
- All at Stage 16 with restoration (Scenario 5).

There will be no increase in light vehicle trips, however there will be a small increase in heavy vehicle trips projected on the external road network, specifically associated with the importation of soil and soil improver associated with the proposed raising of the BRDA. The closest residential dwellings to the site are located at a distance greater than 900m from the boundary.

In relation to the BRDA and Borrow Pit, the construction and operational phases are considered together in the air dispersion modelling assessment given that the operation of the BRDA will also involve the construction of each stage elevation which in turn will require the extraction of material from the Borrow Pit. Thus, dust / $PM_{10}$ / $PM_{2.5}$ emissions from the BRDA were assumed to coincide with an emission of dust from the Borrow Pit in all modelling scenarios outlined in the assessment.

During both the operational and construction phase, which are considered together, the potential sources of dust / $PM_{10}$ / $PM_{2.5}$ are those associated with the raising of the BRDA, the Borrow Pit extraction and internal site vehicle movements to the BRDA area where the phasing will see the height of the existing BRDA increase from Stage 10 to Stage 16.

Activity within the Borrow Pit will include occasional blasting to remove rock, on site breaking and crushing of the rock and excavator and dump truck movements to stockpile the materials. On the BRDA there will be a range of excavators and other equipment for residue farming. The nearest dust sensitive location is greater than 500m from the BRDA as shown in Figure 11.3.

The footprint of the BRDA and SCDC will remain unchanged. The proposed development will increase the lifespan of the AAL facility. There will be a small increase in heavy vehicle trips projected on the external road network, specifically associated with the importation of soil and soil improver associated with the proposed raising of the BRDA. The activities currently permitted within the borrow pit will continue to occur within the extended Borrow Pit footprint.

*Borrow Pit Dust Generation Rates*

Dust generation rates depend on the site activity, particle size, the moisture content of the material and weather conditions. Dust emissions are dramatically reduced where rainfall has occurred due to the cohesion created between dust particles and water and the removal of suspended dust from the air. It is typical to assume no dust is generated under “wet day” conditions where rainfall greater than 0.2mm has fallen(17).

Dust particles are generally in the size range from about 1 to 100 µm in diameter, and they settle slowly under the influence of gravity. Large particle sizes (greater than 75 microns) fall rapidly out of atmospheric suspension and are subsequently deposited in close proximity to the source. Particle sizes of 1 - 75 microns are of interest in this assessment as they can remain airborne for greater distances and give rise to potential dust nuisance at nearby sensitive receptors. This size range would broadly be described as silt. Emission rates are normally predicted on a site-specific particle size distribution for each dust emission source. In the absence of such information, the particle size distribution outlined in AP-42 Appendix B.2.2 for Category 3 (mechanically generated aggregate)(25) has been used and is outlined in Table 11.3. The moisture content of limestone has been estimated at 2.1%, which is based on a literature review(17).

| Cumulative % ≤ Stated Size | Particle Size, µm | Minimum Value | Maximum Value | Standard Deviation |
|---|---|---|---|---|
| 4 | 1.0 | - | - | - |
| 11 | 2.0 | - | - | - |
| 15 | 2.5 | 3 | 35 | 7 |
| 18 | 3.0 | - | - | - |
| 25 | 4.0 | - | - | - |
| 30 | 5.0 | - | - | - |
| 34 | 6.0 | 15 | 65 | 13 |
| 51 | 10.0 | 23 | 81 | 14 |

**Table 11.3:** Category 3 Mechanically Generated Aggregate – Particle Size In Microns Taken From AP-42[(17)]

Dust deposition typically occurs in close proximity to the dust-generating source. The proposed borrow pit extension is located within the main AAL site and therefore the nearest sensitive location beyond the AAL boundary is greater than 500m from the sources of potential dust generation. Generally, the potential for dust impacts is greatest within 100 m of dust generating activities, though residual impacts can occur for distances beyond 100 m.

*BRDA Dust Generation Rates*

Dust emissions from wind erosion are dependent on a range of factors including wind velocity, soil moisture, vegetation cover, surface roughness and particle size. A key parameter is the wind threshold velocity which corresponds to the minimum wind speed necessary to initiate the erosion process[(18)]. Once the critical wind threshold velocity is breached, the dust emission flux increases with wind speed. The actual relationship between dust emissions and wind speed (in excess of the threshold velocity) has been the focus of much research over the last 30 years.

The removal of soil or dust particles from the ground and movement through the air due to wind can be divided into creep (> 1mm) and horizontal flux (between 0.1 – 1mm) which describes most dust particle movement, also referred to as saltation, and the vertical flux of particles which is generally limited to particles less than 20 microns[(19)]. Research has found that the initial entrainment of dust into the atmosphere occurs due to lifting forces on smaller particles. However, once a few particles begin to move downwind, subsequent entrainment becomes dominant due to the impact of the saltating particles[(20)]. The threshold velocities for soil movement occur when the aerodynamic forces are sufficient to dislodge particles from the soil and initiate movement. Experimental studies have shown that there is a minimum friction velocity that will produce motion in particles of diameter of around 100 microns with larger particles requiring greater wind speed while smaller particles require larger pressure fluctuations to initiate movement[(19)]. A schematic of the three main mechanisms for dust movement is shown in Figure 11.2.

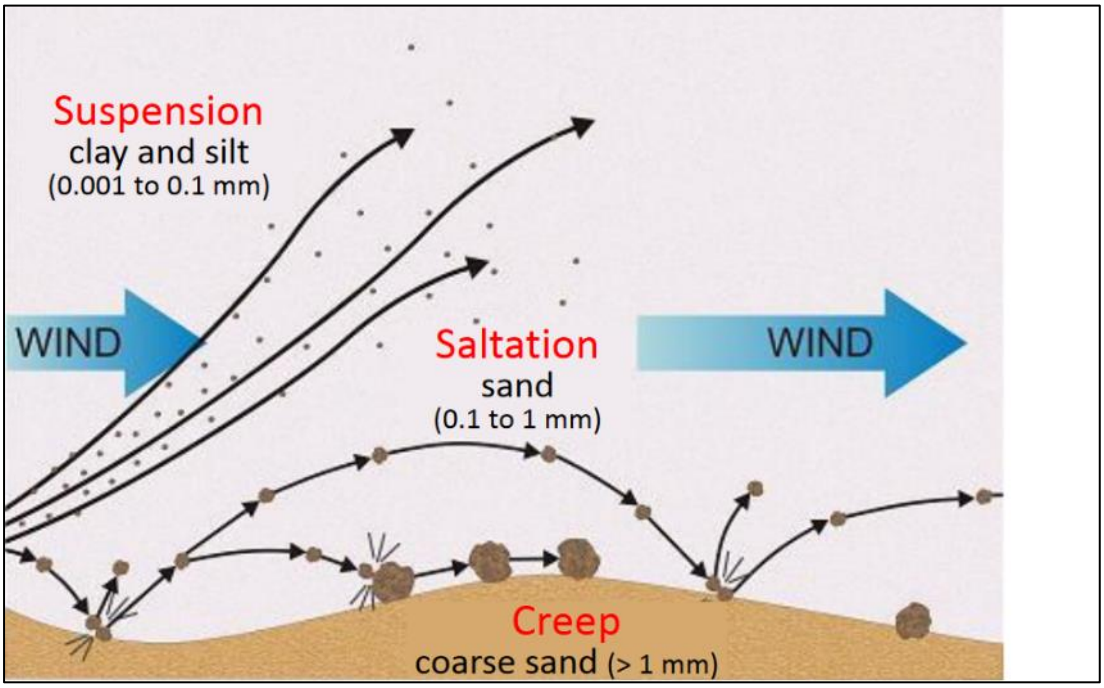



**Figure 11.2:** Principal Mechanisms of Dust Particle Movement (Source: https://extension.arizona.edu/sites/extension.arizona.edu/files/attachments/0920-0950_Walworth_Dust_Conference_2016_Talk_1.pdf).

In addition, the relationship between the threshold friction velocity and particle size is non-linear and thus the particle size distribution is also an important factor. A second important factor is the degree of disturbance of the soil. Research from a range of authors has found that the average percent reduction in threshold friction velocity due to disturbance effects is 55% (±25%)[(21)]. Surfaces with a modest fraction of plant cover have significantly reduced dust emissions. Research from Owens Lake, CA, USA indicates that at 18% plant cover there was a 95% reduction in sand transport rate compared to rates in the absence of vegetation[(21)].

Over the last few decades many studies on threshold friction velocities and dust erosion formulations have appeared in the literature. Many of the studies report a non-linear relationship typically with the dust emission flux (F) relationship proportional to $u_*^3$ or $u_*^4$. Nickling & Gillies[(22)] conducted experimental measures on vertical dust fluxes in a range of locations using a large portable wind tunnel. The paper presented the results from two mines in Arizona, USA, amongst other locations. The Arizona study[(22)] outlined threshold friction velocities and roughness heights for 13 sites which have been reproduced in Table 11.4.

| Location | Threshold Friction Velocity (m/s) | Roughness Height (cm) | Threshold Wind Velocity at 10m Above Ground Level (m/s) |
|---|---|---|---|
| Mesa – Agricultural Land | 0.57 | 0.0331 | 16 |
| Glendale – Construction site | 0.53 | 0.0301 | 15 |
| Maricopa – Agricultural Land | 0.58 | 0.1255 | 14 |
| Yuma – Disturbed desert | 0.32 | 0.0731 | 8 |
| Yuma – Agricultural site | 0.58 | 0.0224 | 17 |
| Algodones – Dunes flats | 0.62 | 0.0166 | 18 |
| Yuma – Scrub desert | 0.39 | 0.0163 | 11 |
| Santa Cruz River Tuscon | 0.18 | 0.0204 | 5 |
| Tuscon – Construction site | 0.25 | 0.0181 | 7 |
| **Ajo – Mine** | **0.23** | **0.0176** | **7** |
| **Hayden – Mine** | **0.17** | **0.0141** | **5** |
| Salt River, Mesa | 0.22 | 0.0100 | 7 |
| Casa Grande – Agricultural Land | 0.25 | 0.0067 | 8 |

**Table 11.4:** Threshold Friction Velocities – Arizona Sites (USEPA, 1989)(22)

As indicated in Table 11.4, mines have one of the lowest threshold friction velocities (between 0.17 – 0.23 m/s) which correspond to a threshold wind velocity at 10m of between 5 – 7 m/s. The USEPA in contrast typically assumes a threshold wind speed of between 10 – 25 m/s at 10m(23) depending on the soil material. Initial modelling results indicated that the roughness height ($z_0$) lead to unrealistically high results.

Alfaro and Gomes(24) study derived empirical emissions flux formulae for particular types of soils. In relation to the silty soils, the empirical formula derived from the studies was:

$$\boldsymbol{F = 2.45x10^{-6}u_*^{3.97}} \qquad \textbf{(1)}$$

Where:

$F$ = vertical dust flux
$u_{*t}$ = threshold friction velocity
$u_*$= friction velocity

The threshold friction velocity was derived using the relationship between threshold friction velocity and aerodynamic roughness length developed by Marticorena(25, 26):

$$\boldsymbol{u_{*t} = 0.31e^{7.44x(Zo)}} \qquad \textbf{(2)}$$

Where:

$u_{*t}$ = threshold friction velocity
$Zo$= aerodynamic roughness length.

In order to estimate a dust emission rate from the BRDA (the salt cake dust emissions will be negligible due to a moisture content of approximately 45%), a conservative approach was adopted. The aim of the approach was to ensure that the dust emission rate was conservatively estimated by adopting worst-case assumptions wherever possible as outlined below:

- As a first step, the friction velocity for the BRDA was determined for Phase 1 and Phase 2 with a conservative surface roughness used in the dust emission rate calculation.

- The BRDA was assumed initially to have no surface water to suppress dust emissions but to consist of a bare surface. The finding of this assessment found that the results were generally overly pessimistic and thus additional modelling was undertaken based on water suppression. USEPA AP42[17] database recommends an abatement efficiency of 84% for water suppression. A site specific abatement efficiency was selected for this study based on a review of the monitoring vs modelling correlations.

- The BRDA residue was assumed to have no additional moisture content and devoid of vegetation.

- For calculating the dust emission factor, all precipitation was ignored. Guidance from the USEPA indicates that dust emission rates should be assumed to be zero during precipitation events (> 0.2mm) and that re-initiation of wind erosion after a precipitation event ranges from 1 to 10 days depending on soil type, season of the year, and rainfall amounts[17].

- It is assumed that dust emissions may occur every hour of the year including periods of frost and snow.

To minimise dust generation, AAL have installed an extensive network of automatic water sprinklers to manage the surface of the BRDA. The system uses treated BRDA run-off water which is distributed to separate sprinkler rows each with fixed point sprinkler heads. The rows operate one at a time, in sequence on timed cycles, with each head able to rotate to deliver 360-degree water coverage. The entire BRDA surface is (re)wetted every 4 hours in one complete sprinkling system sequence.

This measure is defined as best available technology (BAT) (BAT 49 a – Water or water-based solutions spraying) as outlined in the European Commission publication "*Best Available Techniques (BAT) Reference Document for the Management of Waste from Extractive Industries in accordance with Directive 2006/21/EC*" [27].

Emission rates have been derived from the site-specific particle size distribution for bauxite residue which is outlined in Tables 11.5 and 11.6. Table 11.5 particle size breakdown was used in the modelling of dust from the BRDA whilst Table 11.6 particle size breakdown was used to model $PM_{10}$ / $PM_{2.5}$ from the BRDA for all scenarios.

| Particle Size, µm | Fraction In Each Category | Particle Density (kg/m³) |
|---|---|---|
| 63 | 0.20 | 2.3 |
| 34 | 0.02 | 2.3 |
| 24 | 0.03 | 2.3 |
| 15 | 0.04 | 2.3 |
| 9 | 0.05 | 2.3 |
| 6 | 0.06 | 2.3 |
| 5 | 0.10 | 2.3 |
| 1 | 0.50 | 2.3 |

**Table 11.5:** Particle Size Breakdown and Density of Bauxite Residue for the Dust Modelling

| Particle Size, µm | Fraction In Each Category | Particle Density (kg/m³) |
|---|---|---|
| 10 | 0.07 | 2.3 |
| 6 | 0.085 | 2.3 |
| 5 | 0.14 | 2.3 |
| 1 | 0.705 | 2.3 |

**Table 11.6:** Particle Size Breakdown and Density of Bauxite Residue for the $PM_{10}$ / $PM_{2.5}$ Modelling

## 11.3 Receiving Environment

### 11.3.1 Meteorological Data

Selection of the appropriate meteorological data has followed the guidance issued by the USEPA and the EPA(11,13). Shannon Airport meteorological station, which is located approximately 15 km north-east of the site, collects data in the correct format and has a data collection rate of greater than 90%. Long-term hourly observations at Shannon Airport meteorological station provide an indication of the prevailing wind conditions for the region (see Figure 11.1). Results indicate that the prevailing wind direction is from westerly to south-easterly in direction in 2020. The mean wind speed is approximately 4.7 m/s over the period 1981-2010. Both Shannon Airport and onsite meteorological data for 2020 was reviewed with Shannon Airport used in the detailed assessment as the data gave a better correlation with the dust deposition and $PM_{10}$/$PM_{2.5}$ monitoring data for the facility.

### 11.3.2 Background Concentrations

Air quality monitoring programmes throughout Ireland have been undertaken in recent years by the EPA and Local Authorities(28,29). The most recent annual report on air quality "Air Quality Monitoring Annual Report 2019"(28, 29), details the range and scope of monitoring undertaken throughout Ireland.

As part of the implementation of the Framework Directive on Air Quality (1996/62/EC), four air quality zones have been defined for air quality management and assessment purposes in Ireland (29). Dublin is defined as Zone A and Cork as Zone B. Zone C is composed of 23 towns with a population of greater than 15,000. The remainder of the country, which represents rural Ireland but also includes all towns with a population of less than 15,000 is defined as Zone D. In terms of air monitoring, the area surrounding AAL is categorised as Zone D(29) which is the Zone representative of the cleanest air quality in Ireland.

<u>$PM_{10}$</u>

Long-term $PM_{10}$ monitoring was carried out at the urban Zone D locations of Castlebar, Enniscorthy and Claremorris over the period 2015 – 2019 and the rural location of Kilkitt, County Monaghan(29). The annual average results over the last five years suggests an upper average of 9 µg/m$^3$ at rural Zone D locations as an annual average background concentration as shown in Table 11.7 and 18 µg/m$^3$ for the urban sites.

| Year | Castlebar | Kilkitt | Claremorris | Enniscorthy |
|---|---|---|---|---|
| 2015 | 13 | 9 | 10 | 18 |
| 2016 | 12 | 8 | 10 | 17 |
| 2017 | 11 | 8 | 11 | - |
| 2018 | 11 | 9 | 12 | - |
| 2019 | 16 | 7 | 11 | 18 |
| **Average** | **12.6** | **8.2** | **10.8** | **17.7** |

**Table 11.7:** Annual Mean $PM_{10}$ Background Concentrations in Zone D Locations 2015 – 2019 (µg/m$^3$)

$PM_{10}$ monitoring carried out at five stations owned and operated by AAL, which are in the vicinity of the facility and thus representative of baseline conditions, are shown in Table 11.8

with the results for 2020 compared to the ambient air quality standards. The monitoring data, undertaken using Turnkey Ltd Osiris monitors are calibrated annually by a third party with results reported to the EPA on an annual basis. Results are all five stations are low with annual averages ranging from 7.9 – 10.3 µg/m$^3$. Maximum 24-hr levels (as a 90$^{th}$%ile) are also well below the ambient air quality standard peaking at 47% of the limit value.

| $PM_{10}$ | NE of Plant | LCCC WTP | SW of Plant | Foynes | Ballysteen | EU Directive Limit Values |
|---|---|---|---|---|---|---|
| Annual Mean | 10.3 | 8.6 | 9.8 | 9.6 | 7.9 | 40 µg/m$^3$ |
| 90%tile of 24-hr Means | 15.8 | 13.5 | 23.5 | 16.3 | 14.8 | 50 µg/m$^3$ |

**Table 11.8:** $PM_{10}$ Concentrations At Aughinish Alumina monitoring stations – 2020 (µg/m$^3$)

Taking into account both the measured levels at the AAL stations and background stations reported by the EPA, a conservative estimate of the current background $PM_{10}$ concentration in the region of the proposed development is 10 µg/m$^3$.

$PM_{2.5}$

Similarly, $PM_{2.5}$ monitoring carried out at five stations owned and operated by AAL are shown in Table 11.9 with the results for 2020 compared to the ambient air quality standard. The monitoring data, undertaken using Turnkey Ltd Osiris monitors are calibrated annually by a third party with results reported to the EPA on an annual basis. Results from all five stations are low with annual averages ranging from 5.0 – 7.4 µg/m$^3$ peaking at 30% of the limit value.

| $PM_{2.5}$ | NE of Plant | LCCC WTP | SW of Plant | Foynes | Ballysteen | EU Directive Limit Value |
|---|---|---|---|---|---|---|
| Annual Mean | 7.4 | 6.0 | 6.5 | 6.6 | 5.0 | 25 µg/m$^3$ |

**Table 11.9:** $PM_{2.5}$ Concentrations At Aughinish Alumina monitoring stations – 2020 (µg/m$^3$)

Continuous $PM_{2.5}$ monitoring carried out at the Zone D location of Claremorris showed $PM_{2.5}/PM_{10}$ ratios ranging from 0.50 – 0.60 over the period 2015 – 2019. Taking into account both the measured levels at the AAL stations and background stations reported by the EPA , a conservative ratio of 0.7 was used to generate a background $PM_{2.5}$ concentration in the region of the proposed development of 7.0 µg/m$^3$.

Dust Deposition Levels

Dust is present naturally in the air from a number of sources including weathering of minerals, and pick-up across open land and dust generated from fires. A study by the UK ODPM(30) gives estimates of likely dust deposition levels in specific types of environments. In open country a level of 39 mg/(m$^2$*day) is typical, rising to 59 mg/(m$^2$*day) on the outskirts of town and peaking at 127 mg/(m$^2$*day) for a purely industrial area.

Results of dust deposition monitoring at 35 locations within the AAL boundary from January 2019 to December 2020 are summarised in Table 11.10 and shown in Figure 11.3. The average dustfall levels measured at the locations were within the TA Luft limit value of 350 mg/(m$^2$*day) over the years 2019 and 2020, which is the limits set in the EPA Licence for the facility, with a maximum annual average of 69 mg/(m$^2$*day) at DG19 in 2019. The monthly average across each site ranges from 1 to 190 mg/(m$^2$*day). Overall, dustfall levels are low, with the annual average across all sites reaching at most 20% of the TA Luft limit value. An appropriate background level for the area, in the absence of local sources, indicates a value of 20 mg/($m^2$*day).

<u>Odour</u>

In terms of the existing environment, the bauxite residue which is deposited in the BRDA is not odorous nor is the saltcake deposited in the saltcake cell. Activities associated with the quarry are also not odorous with limestone itself being non-odorous.

Process effluent from the BRDA is slightly alkaline containing traces of sodium aluminate and sodium carbonate. Process effluent from the BRDA results predominantly from the rain that falls on the BRDA, which is diverted to the Perimeter Interceptor Channels (PICs) and Storm Water Pond (SWP), where it is collection prior to transfer to the Effluent Neutralisation and Clarification area for treatment. This treatment system also treats process effluent from the refinery plant area, which is similar in nature to the effluent from the BRDA. Concentrated sulphuric acid is employed to neutralise the process effluent. The resulting water stream reports to the Liquid Waste Pond (LWP) where it is discharged to the estuary, via licensed emission point W1-1, or for use at the BRDA in the automated sprinkler system.

The underflow sludge from the effluent clarifier is recycled back into the acid neutralisation tank to seed and densify the fresh precipitate. On a daily basis, a portion of this sludge is transferred to the Alumina production process to keep the recycling sludge inventory in the effluent neutralisation unit in balance. At the target recycling rate of ~20:1 the sludge density can be controlled at 15-20% solids but the recycling inventory is normally maintained below this to prevent odour generation problems.

As mentioned above the LWP receives the overflow stream from the process effluent treatment and clarification system. On a day to day basis the liquid waste pond is not odorous. The facility has a series of process measures in place to ensure odour is minimised on an ongoing basis.

Very occasionally there may be odours due to exceptional environmental or process circumstances. In 2021, the annual cleanout of the liquid waste pond was delayed due to COVID-19 National restrictions leading to higher levels of solids in the pond. This led to a raised level of odour for a short period of time, coinsiding with an elevated number of odour complaints. It is expected that events such as this will be very infrequent and odour from the LWP will not occur.

| | DG1 | DG2 | DG3 | DG4 | DG5 | DG6 | DG7 | DG8 | DG9 | DG10 | DG11 | DG12 | DG13 | DG14 | DG15 | DG16 | DG17 | DG18 | DG19 | DG20 | DG21 | DG22 | DG23 | DG24 | DG25 | DG26 | DG27 | DG28 | DG29 | DG30 | DG31 | DG32 | DG33 | DG34 | DG35 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Jan | 20 | 18 | 9 | 10 | 10 | 12 | 10 | 12 | 10 | 13 | 4 | 9 | 6 | 14 | 15 | 23 | 34 | 33 | 43 | 9 | 12 | 9 | 8 | 7 | 4 | 4 | 8 | 3 | 8 | 7 | 5 | 5 | 3 | 14 | 5 |
| Feb | 99 | 52 | 16 | 20 | 16 | 33 | 16 | 18 | 12 | 7 | 18 | 16 | 19 | 20 | 11 | 21 | 32 | 54 | 16 | 55 | 36 | 13 | 13 | 18 | 11 | 11 | 17 | 9 | 8 | 9 | 12 | 5 | 8 | 5 | 5 |
| Mar | 67 | 31 | 28 | 14 | 21 | 25 | 26 | 34 | 11 | 11 | 25 | 17 | 10 | 4 | 26 | 37 | 65 | 75 | 76 | 30 | 30 | 20 | 15 | 14 | 1 | 14 | 36 | 41 | 9 | 49 | 31 | 12 | 30 | 62 | 40 |
| Apr | 70 | 165 | 56 | 75 | 43 | 64 | 98 | 65 | 40 | 20 | 57 | 88 | 14 | 26 | 29 | 40 | 63 | 34 | 25 | 20 | 32 | 36 | 9 | 20 | 73 | 59 | 20 | 19 | 23 | 21 | 36 | 13 | 25 | 50 | 89 |
| May | 60 | 77 | 31 | 36 | 19 | 65 | 40 | 75 | 28 | 29 | 31 | 86 | 16 | 48 | 25 | 169 | 63 | 44 | 116 | 62 | 39 | 18 | 13 | 14 | 27 | 32 | 16 | 9 | 46 | 23 | 26 | 16 | 18 | 137 | 16 |
| Jun | 19 | 23 | 20 | 20 | 2 | 15 | 14 | 4 | 5 | 79 | 44 | 12 | 4 | 3 | 6 | 20 | 13 | 29 | 47 | 123 | 28 | 23 | 16 | 11 | 5 | 12 | 2 | 12 | 1 | 2 | 2 | 10 | 1 | 12 | 7 |
| Jul | 76 | 56 | 22 | 83 | 32 | 26 | 36 | 29 | 60 | 24 | 30 | 24 | 10 | 12 | 27 | 50 | 39 | 43 | 93 | 46 | 21 | 39 | 38 | 17 | 36 | 30 | 51 | 47 | 20 | 52 | 28 | 39 | 64 | 68 | 77 |
| Aug | 74 | 37 | 28 | 25 | 16 | 30 | 17 | 11 | 13 | 14 | 15 | 36 | 4 | 9 | 28 | 37 | 106 | 47 | 120 | 90 | 60 | 64 | 10 | 34 | 39 | 35 | 22 | 14 | 14 | 21 | 14 | 20 | 17 | 10 | 32 |
| Sep | 37 | 67 | 25 | 25 | 32 | 30 | 9 | 29 | 16 | 18 | 16 | 7 | 3 | 9 | 31 | 17 | 30 | 53 | 108 | 28 | 33 | 16 | 12 | 41 | 58 | 12 | 57 | 33 | 7 | 46 | 12 | 1 | 7 | 22 | 20 |
| Oct | 57 | 10 | 23 | 13 | 13 | 14 | 23 | 10 | 23 | 17 | 12 | 10 | 3 | 8 | 5 | 22 | 28 | 15 | 41 | 19 | 38 | 9 | 12 | 13 | 11 | 21 | 4 | 11 | 9 | 10 | 35 | 10 | 6 | 15 | 17 |
| Nov | 55 | 31 | 2 | 19 | 18 | 15 | 36 | 5 | 11 | 12 | 34 | 23 | 12 | 11 | 12 | 1 | 5 | 13 | 52 | 2 | 10 | 7 | 3 | 1 | 25 | 12 | 7 | 6 | 2 | 24 | 7 | 2 | 4 | 2 | 4 |
| Dec | 54 | 30 | 20 | 19 | 25 | 12 | 12 | 24 | 13 | 11 | 28 | 11 | 6 | 10 | 5 | 21 | 15 | 62 | 94 | 22 | 16 | 24 | 10 | 14 | 13 | 5 | 7 | 14 | 45 | 13 | 10 | 3 | 2 | 10 | 10 |
| Jan | 134 | 117 | 54 | 61 | 38 | 87 | 17 | 17 | 124 | 129 | 95 | 110 | 131 | 145 | 104 | 94 | 113 | 128 | 160 | 140 | 61 | 59 | 64 | 122 | 94 | 11 | 138 | 87 | 114 | 112 | 110 | 77 | 39 | 56 | 30 |
| Feb | 89 | 35 | 50 | 20 | 20 | 22 | 40 | 31 | 32 | 34 | 153 | 50 | 36 | 11 | 21 | 62 | 89 | 190 | 0 | 65 | 22 | 15 | 17 | 12 | 19 | 38 | 18 | 24 | 5 | 23 | 26 | 27 | 22 | 111 | 93 |
| Mar | 67 | 43 | 23 | 15 | 26 | 60 | 31 | 21 | 21 | 62 | 64 | 43 | 51 | 18 | 26 | 2 | 13 | 50 | 30 | 21 | 14 | 1 | 9 | 14 | 11 | 8 | 16 | 5 | 4 | 38 | 15 | 16 | 31 | 47 | 43 |
| Apr | 44 | 87 | 39 | 60 | 39 | 39 | 31 | 21 | 23 | 25 | 37 | 23 | 13 | 11 | 15 | 14 | 24 | 26 | 50 | 21 | 16 | 17 | 13 | 17 | 76 | 22 | 15 | 27 | 18 | 21 | 1 | 55 | 12 | 48 | 27 |
| May | 19 | 40 | 51 | 48 | 15 | 22 | 20 | 19 | 41 | 24 | 49 | 12 | 8 | 11 | 27 | 22 | 24 | 33 | 47 | 50 | 16 | 27 | 34 | 26 | 38 | 25 | 27 | 28 | 23 | 18 | 23 | 17 | 18 | 36 | 46 |
| Jun | 35 | 60 | 33 | 40 | 36 | 13 | 27 | 20 | 18 | 23 | 46 | 20 | 31 | 48 | 41 | 19 | 35 | 40 | 98 | 72 | 62 | 59 | 26 | 20 | 135 | 49 | 34 | 73 | 28 | 58 | 16 | 68 | 23 | 25 | 70 |
| Jul | 14 | 26 | 16 | 29 | 14 | 37 | 13 | 39 | 5 | 29 | 17 | 23 | 18 | 15 | 22 | 15 | 10 | 23 | 32 | 27 | 19 | 18 | 13 | 29 | 18 | 31 | 17 | 45 | 11 | 27 | 38 | 10 | 17 | 50 | 101 |
| Aug | 66 | 56 | 64 | 22 | 38 | 30 | 41 | 21 | 23 | 20 | 32 | 29 | 22 | 32 | 42 | 26 | 55 | 45 | 99 | 66 | 76 | 43 | 22 | 36 | 43 | 60 | 35 | 119 | 27 | 34 | 44 | 30 | 18 | 31 | 29 |
| Sep | 5 | 29 | 9 | 22 | 28 | 14 | 30 | 30 | 17 | 12 | 20 | 13 | 13 | 21 | 37 | 10 | 17 | 11 | 17 | 10 | 9 | 7 | 6 | 7 | 21 | 9 | 51 | 63 | 5 | 48 | 37 | 11 | 20 | 44 | 57 |
| Oct | 25 | 29 | 20 | 12 | 17 | 37 | 42 | 21 | 35 | 12 | 28 | 21 | 23 | 12 | 17 | 17 | 24 | 42 | 53 | 15 | 40 | 17 | 11 | 11 | 44 | 10 | 28 | 19 | 17 | 8 | 14 | 5 | 9 | 11 | 6 |
| Nov | 30 | 4 | 10 | 1 | 2 | 49 | 4 | 4 | 1 | 3 | 5 | 5 | 24 | 6 | 3 | 13 | 1 | 5 | 25 | 13 | 7 | 4 | 3 | 6 | 12 | 12 | 9 | 5 | 5 | 14 | 4 | 6 | 7 | 7 | 7 |
| Dec | 12 | 23 | 17 | 12 | 23 | 23 | 24 | 20 | 10 | 22 | 40 | 35 | 36 | 37 | 54 | 38 | 16 | 35 | 35 | 21 | 36 | 14 | 9 | 26 | 10 | 18 | 17 | 14 | 24 | 12 | 16 | 15 | 13 | 43 | 31 |
| 2019 Ave | **57** | **50** | **23** | **30** | **21** | **28** | **28** | **26** | **20** | **21** | **26** | **28** | **9** | **15** | **18** | **38** | **41** | **42** | **69** | **42** | **30** | **23** | **13** | **17** | **25** | **21** | **21** | **18** | **16** | **23** | **18** | **11** | **15** | **34** | **27** |
| 2020 Ave | **45** | **46** | **32** | **29** | **25** | **36** | **27** | **22** | **29** | **33** | **49** | **32** | **34** | **31** | **34** | **28** | **35** | **52** | **54** | **43** | **31** | **24** | **19** | **27** | **44** | **24** | **34** | **42** | **24** | **35** | **29** | **28** | **19** | **42** | **45** |

**Note 1:** Limit value - TA Luft limit of 350 mg/m2*day

**Table 11.10 Dust Deposition Monitoring on AAL Landholding – Monthly Results Jan 2019 – Dec 2020 (mg/m$^2$*day)**

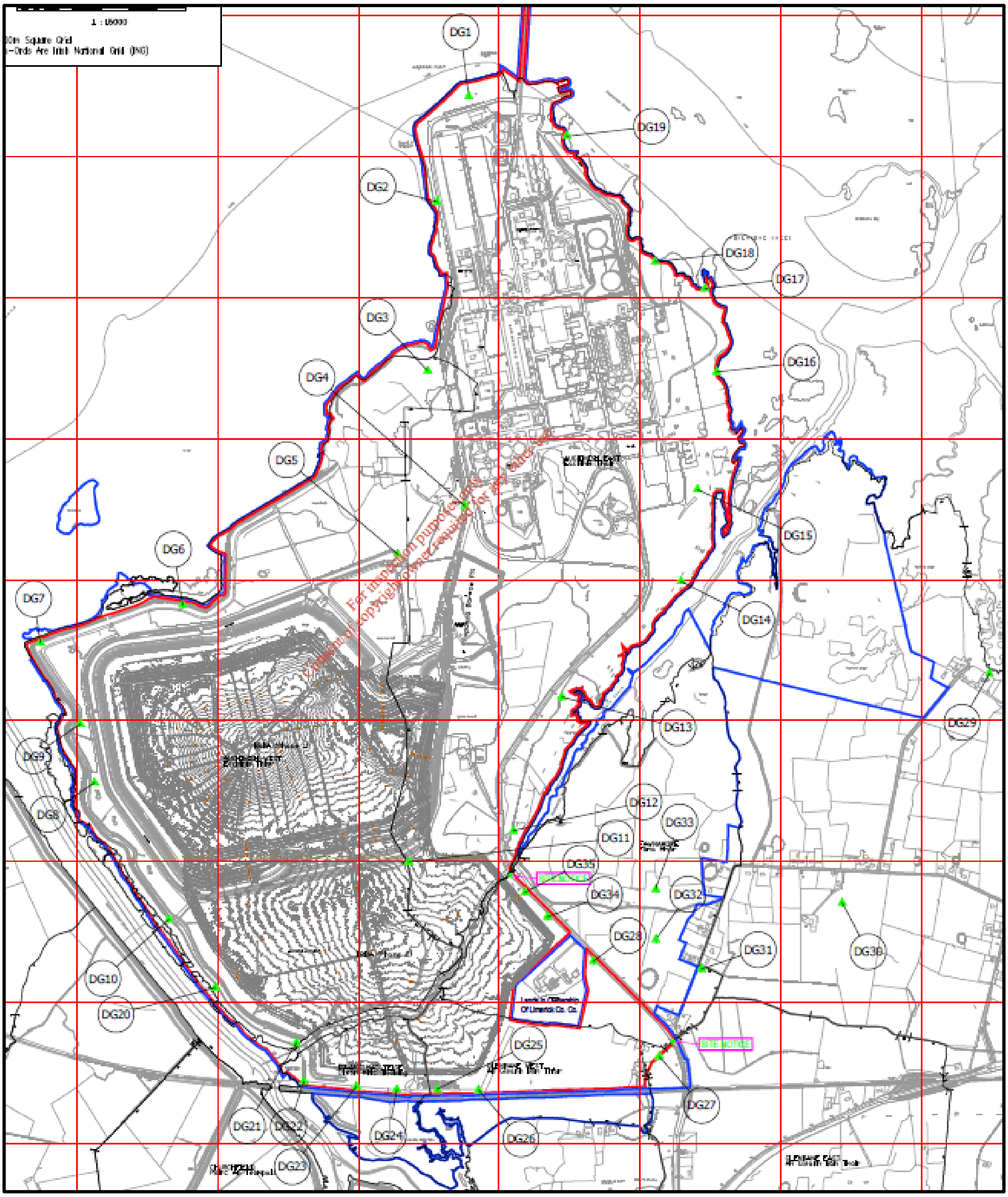



**Figure 11.3:** Map of Dust Deposition Monitors DG1-DG35 (the red line shown in this image is the EPA Licenced Site Boundary)

## 11.4 Likely Significant Impacts

During the operational phase, the potential sources of dust are those associated with the Borrow Pit extraction, wind erosion from the surface of the BRDA and internal site vehicle movements to the BRDA area where the phasing will see the height of the existing BRDA increase from Stage 10 to Stage 16. In addition, the salt cake cell will also be raised as part of the proposed BRDA raise.

AAL estimate there is a requirement for c. 50,000 m³ of rock (equates to c.90,000 tonnes) per year to provide for ongoing works associated with the BRDA over the lifetime of the permitted development at the site. The extracted rock will be used within the confines of the site and will not be transported off site.

### 11.4.1 Construction Phase Impact

Construction dust has the potential to cause local impact through dust nuisance at the nearest sensitive receptors. Construction activities such as excavation, quarrying activities at the borrow pit, earth moving and backfilling may generate quantities of dust, particularly in dry and windy weather conditions. The saltcake, due to the high moisture content of approximately 45%, will not be a significant source of dust. While dust from construction activities tends to be deposited within 200m of a construction site, the majority of the deposition occurs within the first 50m. The extent of any dust generation depends on the nature of the dust (soils, peat, sands, gravels, silts etc.) and the nature of the construction activity. In addition, the potential for dust dispersion and deposition depends on local meteorological factors such as rainfall, wind speed and wind direction. Vehicles transporting material to and from the site also have the potential to cause dust generation along the selected haul routes from the construction areas.

The TII publication "*Guidelines for the treatment of Air Quality During the Planning & Construction of National Road Schemes*"(31) outlines the approach for defining significance in terms of construction impacts. Under Section 4.2.6 Construction Impacts, the guidance document states that:

"*The significance of impacts due to vehicle emissions during the construction phase will be dependent on the number of additional vehicle movements, the proportion of HGVs and the proximity of sensitive receptors to site access routes. If construction traffic would lead to a significant change (>10%) in AADT flows near to sensitive receptors, then concentrations of nitrogen dioxide, $PM_{10}$ and $PM_{2.5}$ should be predicted using the approach described previously*"(38).

The construction phase of the "do-something" proposal will not lead to any increase in offsite traffic with the exception of approximately 13 trips per day associated with the importation of osil and soil improver and therefore the impact on sensitive receptors due to construction phase traffic is predicted to be long-term, reversible, and imperceptible. Moreover, due to the use of an onsite source for construction materials, there will be a reduction in offsite truck movements which would otherwise be required in the absence of the borrow pit.

Appendix 8 of the "*Guidelines for the treatment of Air Quality During the Planning & Construction of National Road Schemes*"(31) discusses construction phase impacts. Table 11.11 below shows the potential distance for dust soiling from source ranges from 25m to 100m and for the potential significant impact to $PM_{10}$, the distance ranges from 10m to 25m depending on the scale of the construction activity. Given that the façade of the nearest residence is greater than 500m from the nearest boundary, the guidance above would indicate that there is negligible potential for impacts from soiling, $PM_{10}$ and to vegetation and therefore, no significant impacts are expected when the mitigation measures outlined in Section 11.5.1 are taken into account. The impact due to construction dust at sensitive receptors is predicted to be long-term, reversible, and imperceptible.

| Source | | Potential Distance for Significant Effects (Distance from source) | | |
|---|---|---|---|---|
| **Scale** | **Description** | **Soiling** | **$PM_{10}$** | **Vegetation Effects** |
| **Major** | Large construction sites with high use of haul routes | 100m | 25m | 25m |
| **Mode rate** | Moderate sized construction sites with moderate use of haul routes | 50m | 15m | 15m |
| **Minor** | Minor construction sites with limited use of haul routes | 25m | 10m | 10m |

**Table 11.11: Assessment Criteria for the Impact of Dust Emissions from Construction Activities with Standard Mitigation in Place (Source**: Appendix 8: Assessment of Construction Impacts taken from "*Guidelines for the treatment of Air Quality During the Planning & Construction of National Road Schemes*" [38] **).**

### 11.4.2 Operational Phase Impact

Particulates – $PM_{10}$

Predicted $PM_{10}$ concentrations due to emissions from the BRDA plus the borrow pit and its associated traffic movements are below the ambient air quality standards at the worst-case boundary or off-site location.

During the operation of the BRDA, the phasing of the BRDA raise over time will result in the elevation increasing as each stage is completed. For the purposes of this assessment the following stages of the BRDA development have been assessed,

- Current,
- Phase 1 at Stage 10; Phase 2 at Stage 4,
- Phase 1 at Stage 12; Phase 2 at Stage 8,
- Phase 1 at Stage 14; Phase 2 at Stage 12,
- All at Stage 16 including the restoration activity.

Modelling has been undertaken for five phases of the BRDA raise and five scenarios have subsequently been carried out and investigated (see Table 11.12 and Figures 11.4 – 11.8). The predicted 24-hour 90$^{th}$ percentile (%-ile) and annual concentrations (excluding background) at the worst-case off-site location peak at 4.7 and 1.4 $\mu g/m^3$ respectively, with the peaks generally located at the site boundary. Based on a background $PM_{10}$ concentration of 10 $\mu g/m^3$ in the region, the combined annual $PM_{10}$ concentration including the emissions from the BRDA and borrow pit peaks at 11.4 $\mu g/m^3$. This predicted level equates to at most 28.5% of the annual limit value of 40 $\mu g/m^3$. The predicted 24-hour $PM_{10}$ concentration (including background) peaks at 14.7 $\mu g/m^3$ which is 29.4% of the 24-hour limit value of 50 $\mu g/m^3$ (measured as a 90.4$^{th}$ percentile). Concentrations at the worst-case sensitive receptor (such as the nearest residential receptors (shown in Figure 11.3)) are significantly lower than the worst-case off-site location.

Results are broadly similar for Scenarios 1 – 4 with a tendency to slightly decrease in ambient concentration as the BRDA is raised. Scenario 5 (all at stage 16 but still unvegetated) is lower as the surface area of the BRDA is significantly smaller at Stage 16 than for any of the other four scenarios.

| Pollutant / Phase | Averaging period | BRDA & Borrow Pit Contribution (µg/m³) | Annual mean background (µg/m³) Note 1 | Predicted environmental concentration (PEC) $PM_{10}$ (µg/m³) | EU Limit Value (µg/m³) | PEC as a %age of Limit Value |
|---|---|---|---|---|---|---|
| $PM_{10}$ / Scenario 1 | Annual mean | 1.4 | 10 | 11.4 | 40 | 28.5% |
| | 90.4$^{th}$%ile of 24-hr Means | 4.7 | 10 | 14.7 | 50 | 29.4% |
| $PM_{10}$ / Scenario 2 | Annual mean | 1.4 | 10 | 11.4 | 40 | 28.5% |
| | 90.4$^{th}$%ile of 24-hr Means | 4.7 | 10 | 14.7 | 50 | 29.4% |
| $PM_{10}$ / Scenario 3 | Annual mean | 1.3 | 10 | 11.3 | 40 | 28.3% |
| | 90.4$^{th}$%ile of 24-hr Means | 4.7 | 10 | 14.7 | 50 | 29.4% |
| $PM_{10}$ / Scenario 4 | Annual mean | 1.3 | 10 | 11.3 | 40 | 28.3% |
| | 90.4$^{th}$%ile of 24-hr Means | 4.6 | 10 | 14.6 | 50 | 29.2% |
| $PM_{10}$ / Scenario 5 | Annual mean | 0.50 | 10 | 10.5 | 40 | 26.3% |
| | 90.4$^{th}$%ile of 24-hr Means | 1.3 | 10 | 11.3 | 50 | 22.6% |

Note 1 S.I. 180 of 2011 and EU Directive 2008/50/EC

**Table 11.12:** Dispersion Modelling Results for $PM_{10}$

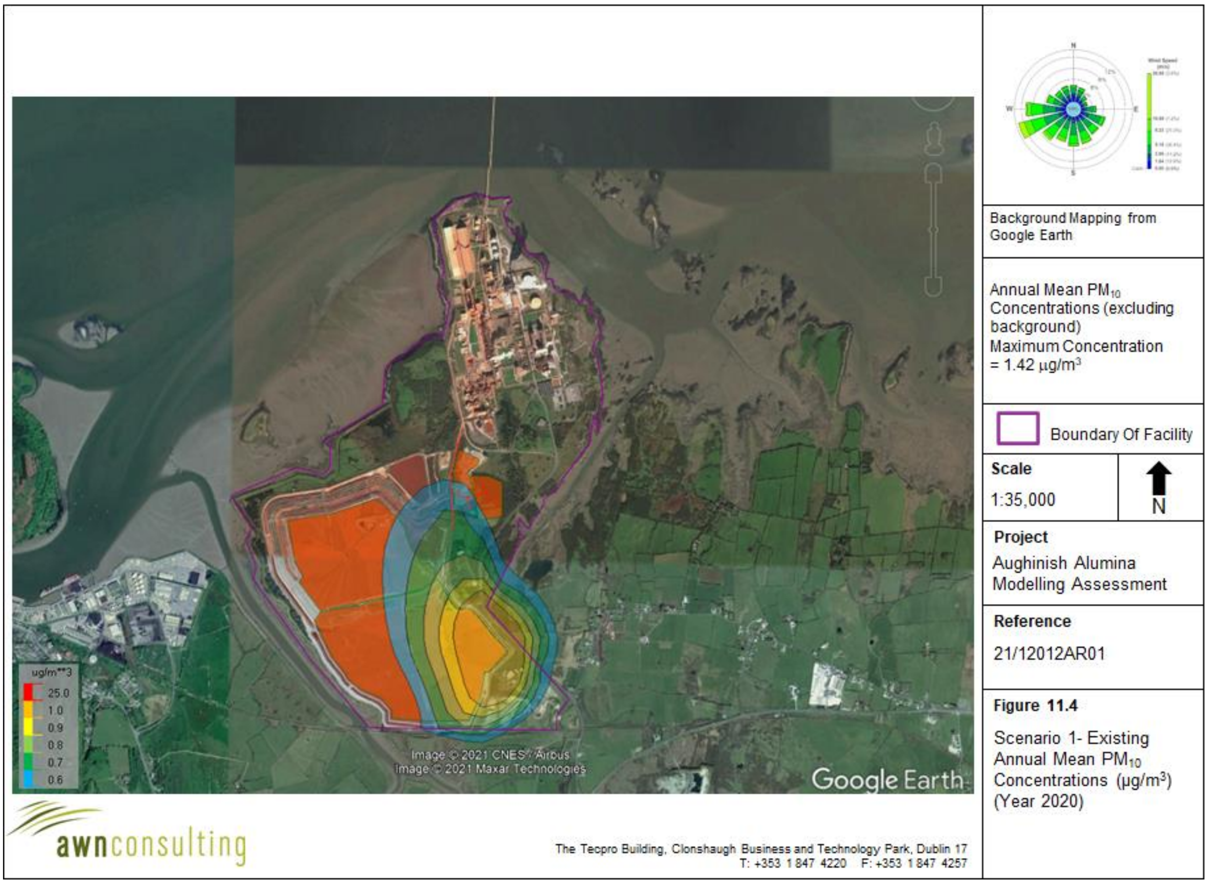



**Figure 11.4**: Scenario 1 Existing Annual Mean PM10 Concentrations year 2020

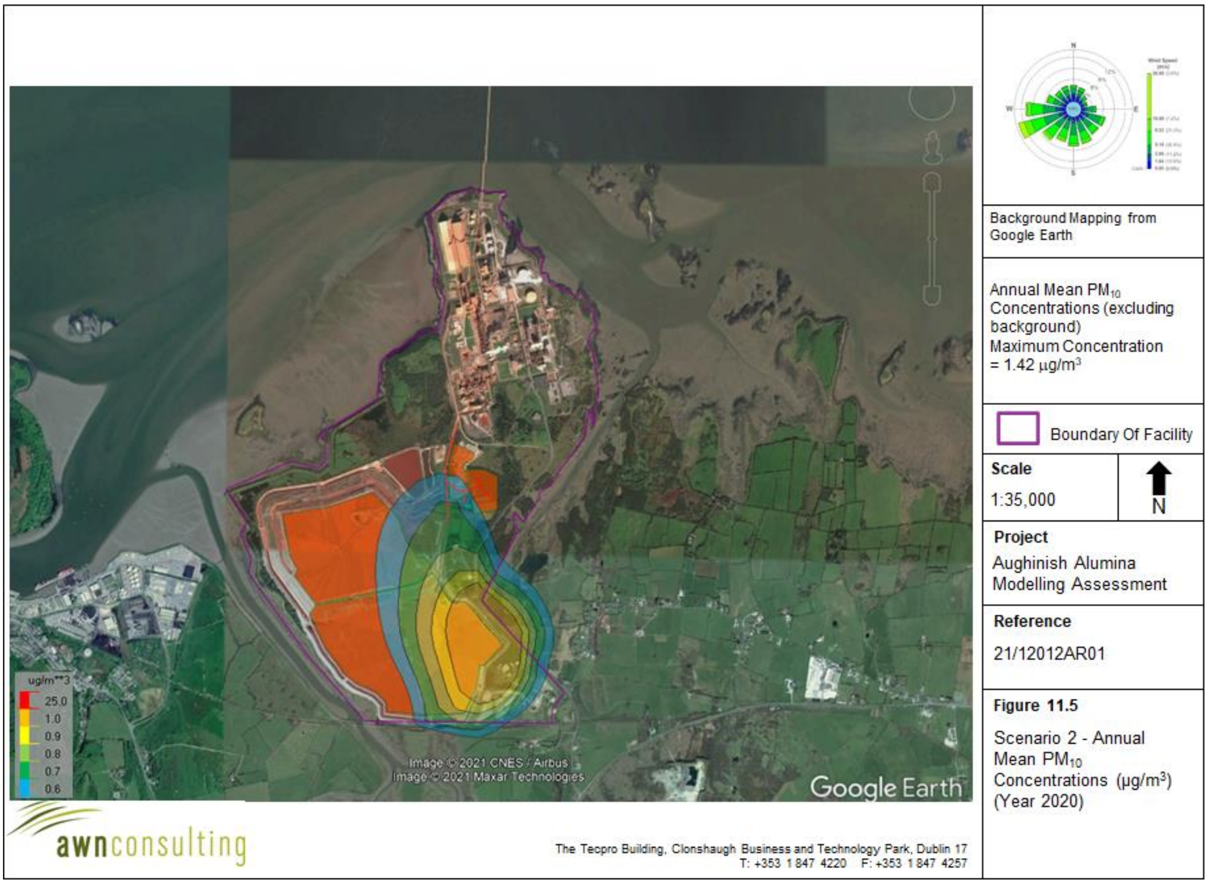



**Figure 11.5** Scenario 2 Annual Mean PM10 Concentrations year 2020

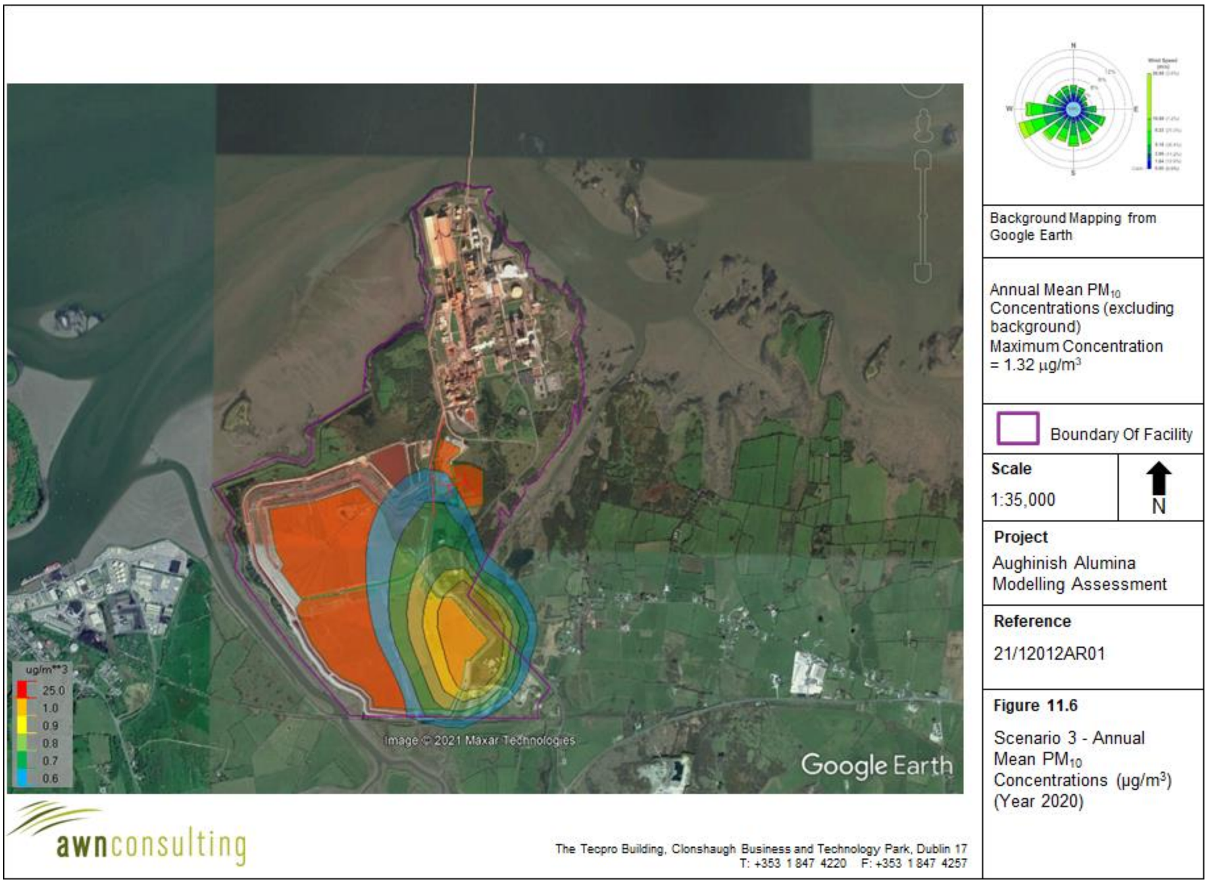



**Figure 11.6** Scenario 3 Annual Mean PM10 Concentrations

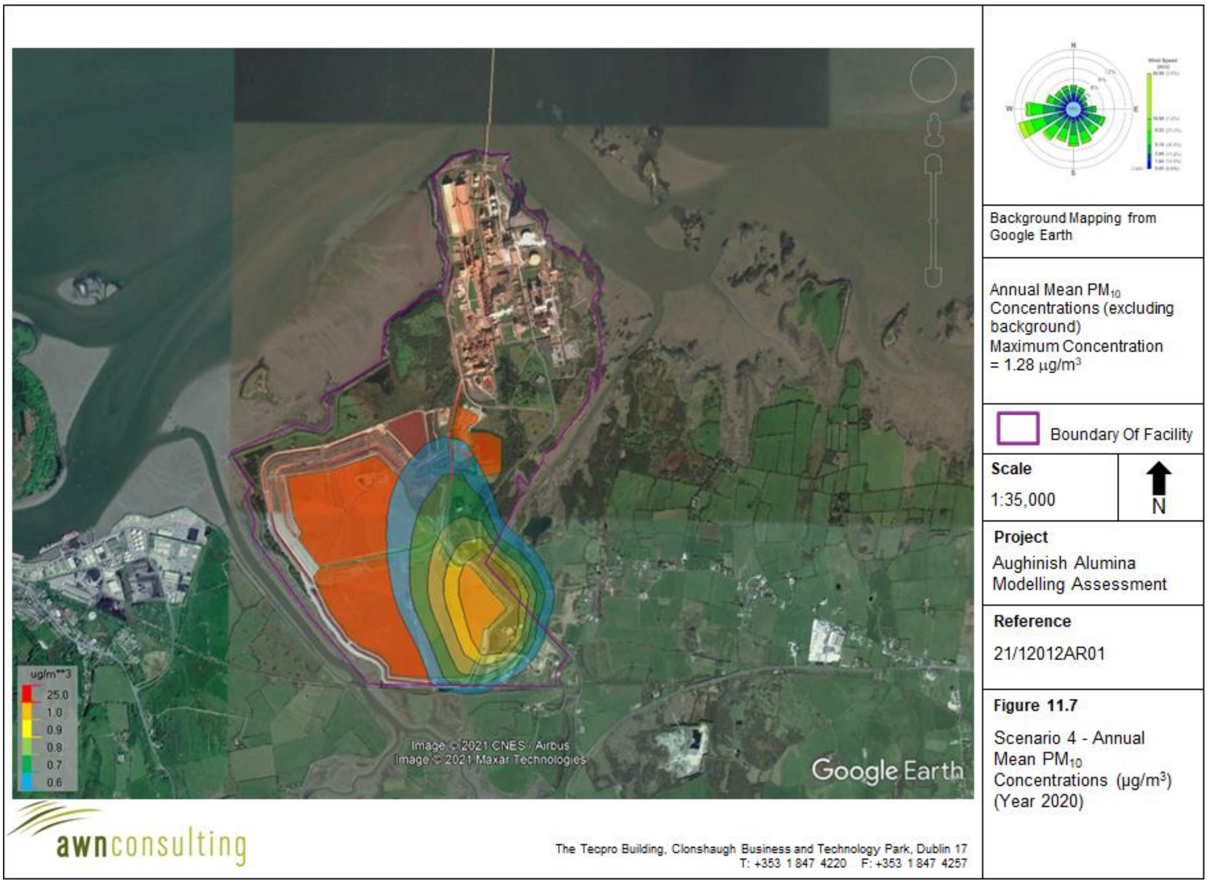



**Figure 11.7** Scenario 4 Annual Mean PM10 Concentrations year 2020

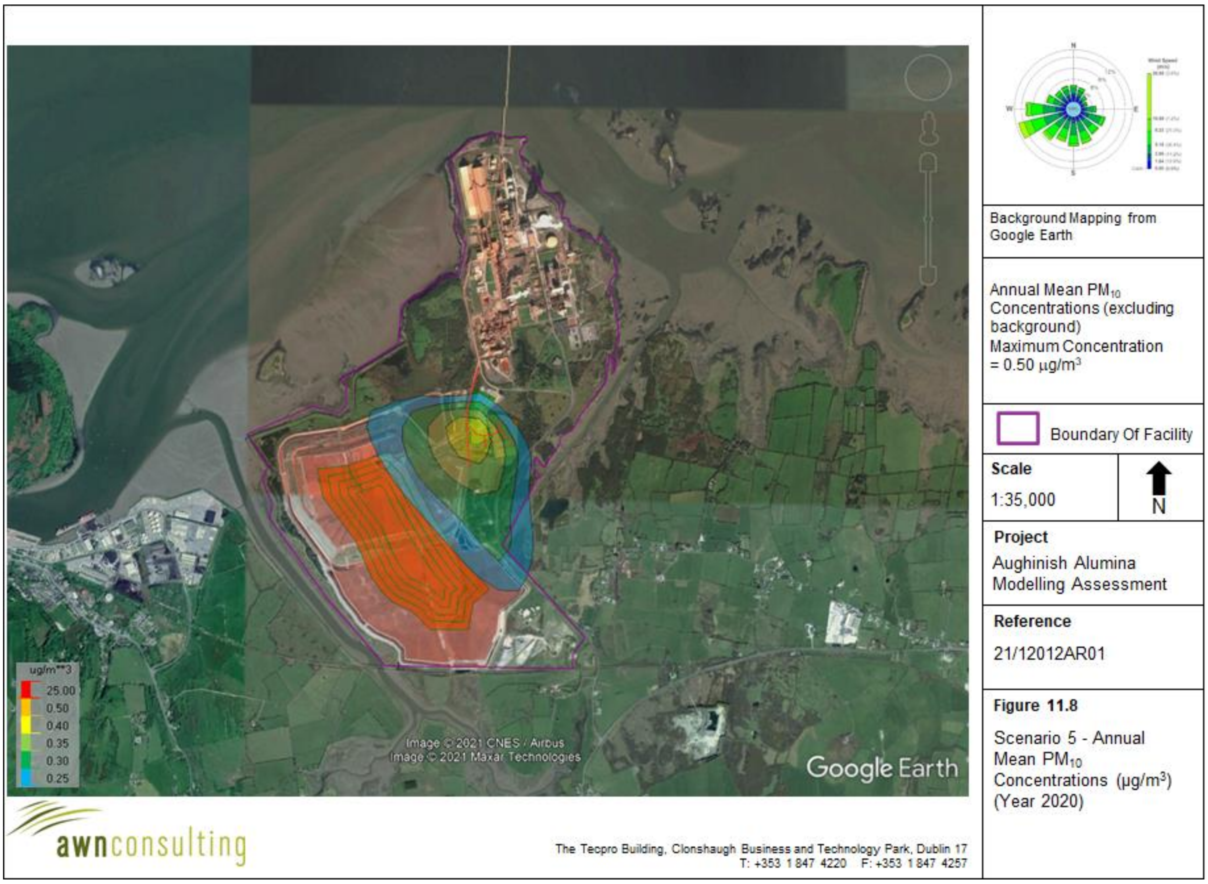



**Figure 11.8** Scenario 5 Annual Mean PM10 Concentrations year 2020

$PM_{2.5}$

Predicted $PM_{2.5}$ concentrations due to emissions from the BRDA plus the borrow pit and its associated traffic movements are below the ambient air quality standard at the AAL boundary and beyond the boundary of the facility. Modelling for each of the five scenarios has been investigated (see Table 11.13). The predicted annual concentration (excluding background) at the worst-case off-site location peaks at 1.4 µg/m$^3$ with peaks generally located at the site boundary. Based on a background $PM_{2.5}$ concentration of 7 µg/m$^3$ in the region, the combined annual $PM_{2.5}$ concentration including the emissions form the BRDA and borrow pit peaks at 8.4 µg/m$^3$. This predicted level equates to at most 34% of the annual limit value of 25 µg/m$^3$. Concentrations at the worst-case sensitive receptor are significantly lower than the worst-case off-site location.

Results are broadly similar for Scenarios 1 – 4 with a tendency to slightly decrease in ambient concentration as the BRDA is raised. Scenario 5 (all at stage 16) is lower as the surface area of the BRDA is significantly reduced compared to the other four scenarios.

| Pollutant / Scenario | Operational Contribution $PM_{2.5}$ (µg/m³) | Averaging Period | Annual Mean Background (µg/m³) | Predicted Concentration $PM_{2.5}$ (µg/m³) | Standard (µg/m³) Note 1 | PEC as a % of EU Standard |
|---|---|---|---|---|---|---|
| $PM_{2.5}$ / Scenario 1 | 1.4 | Annual Mean | 7 | 8.4 | 25 | 34% |
| $PM_{2.5}$ / Scenario 2 | 1.4 | Annual Mean | 7 | 8.4 | 25 | 34% |
| $PM_{2.5}$ / Scenario 3 | 1.3 | Annual Mean | 7 | 8.3 | 25 | 33% |
| $PM_{2.5}$ / Scenario 4 | 1.3 | Annual Mean | 7 | 8.3 | 25 | 33% |
| $PM_{2.5}$ / Scenario 5 | 0.34 | Annual Mean | 7 | 7.3 | 25 | 29% |

Note 1 S.I. 180 of 2011 and EU Directive 2008/50/EC

**Table 11.13:** Dispersion Modelling Results for $PM_{2.5}$

Dust Deposition

Dust deposition levels at the worst-case off-site location are significantly lower than the limit value of 350 mg/m$^2$/day (see Table 11.14 and Figures 11.9 – 11.13).

The predicted annual concentration (excluding background) at the worst-case off-site location peaks at 13.1 mg/m$^2$/day. Based on a background dust deposition level of 20 mg/m$^2$/day in the region, the annual dust deposition level due to emissions from the BRDA plus the borrow pit and its associated traffic moments peaks at 33.1 mg/m$^2$/day. This peak level equates to 9.5% of the annual guideline value for dust deposition. In addition, the dust deposition level at the worst-case sensitive receptor, located at the boundary of the AAL property, is significantly lower than the worst-case residential location as peak concentrations occur at the site boundary.

Again, results are broadly similar for Scenarios 1 – 4 with a tendency to slightly decrease in ambient dust deposition levels as the BRDA is raised. Scenario 5 (all at stage 16) is lower as the surface area of the BRDA is significantly smaller than for the other four scenarios.

| Pollutant / Scenario | Annual Mean Background (mg/m²/day) | Averaging Period | Operational Contribution Dust Deposition (mg/m²/day) | Predicted Dust Deposition Level (mg/m²/day) | Guideline (mg/m²/day) Note 1 | Predicted Dust Deposition Level as a % of Guideline |
|---|---|---|---|---|---|---|
| Dust Deposition / Scenario 1 | 20 | Annual Mean | 13.1 | 33.1 | 350 | 9.5% |
| Dust Deposition / Scenario 2 | 20 | Annual Mean | 13.1 | 33.1 | 350 | 9.5% |
| Dust Deposition / Scenario 3 | 20 | Annual Mean | 13.0 | 33.0 | 350 | 9.4% |
| Dust Deposition / Scenario 4 | 20 | Annual Mean | 12.9 | 32.9 | 350 | 9.4% |
| Dust Deposition / Scenario 5 | 20 | Annual Mean | 3.3 | 23.3 | 350 | 6.7% |

Note 1 TA Luft (2006)

**Table 11.14:** Dispersion Modelling Results for Dust Deposition

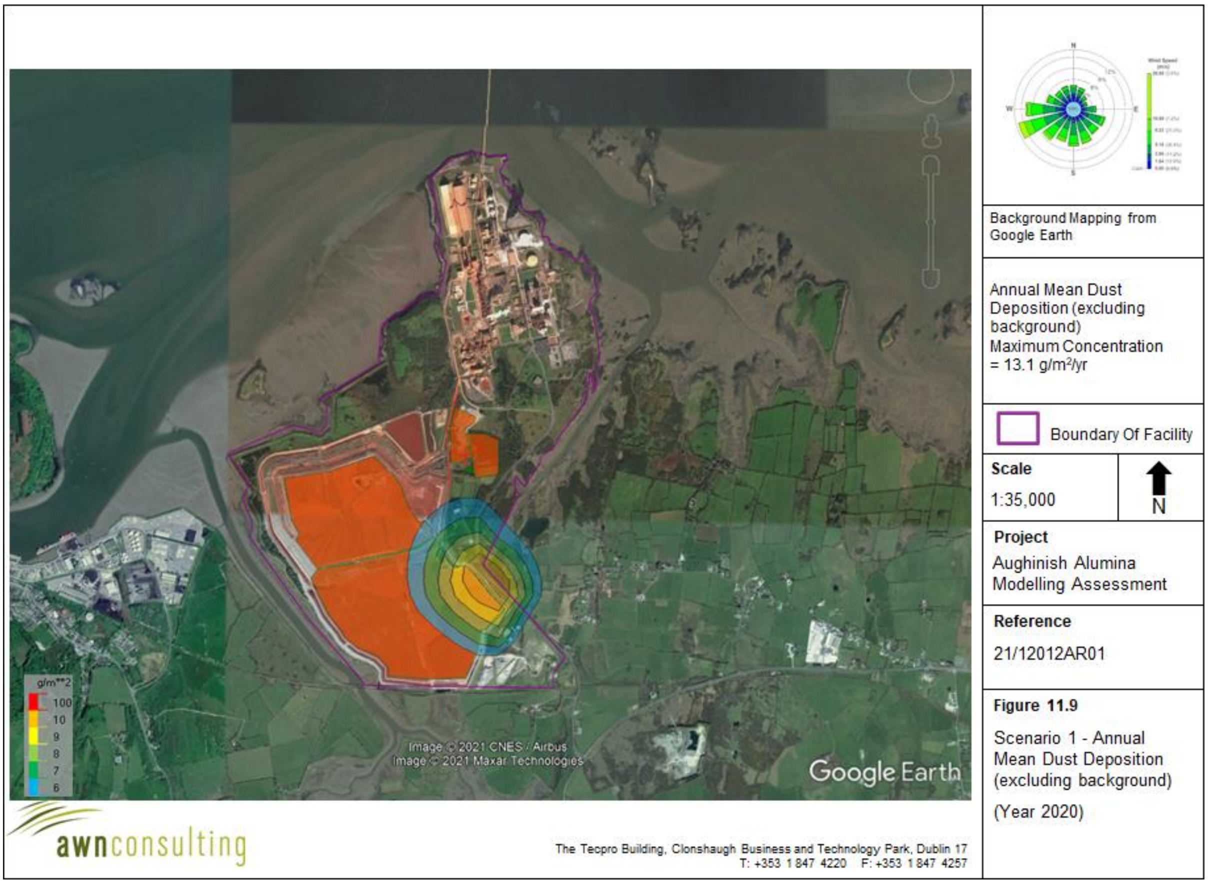



**Figure 11.9**: Scenario 1 – Annual Mean Dust Deposition (excluding background)

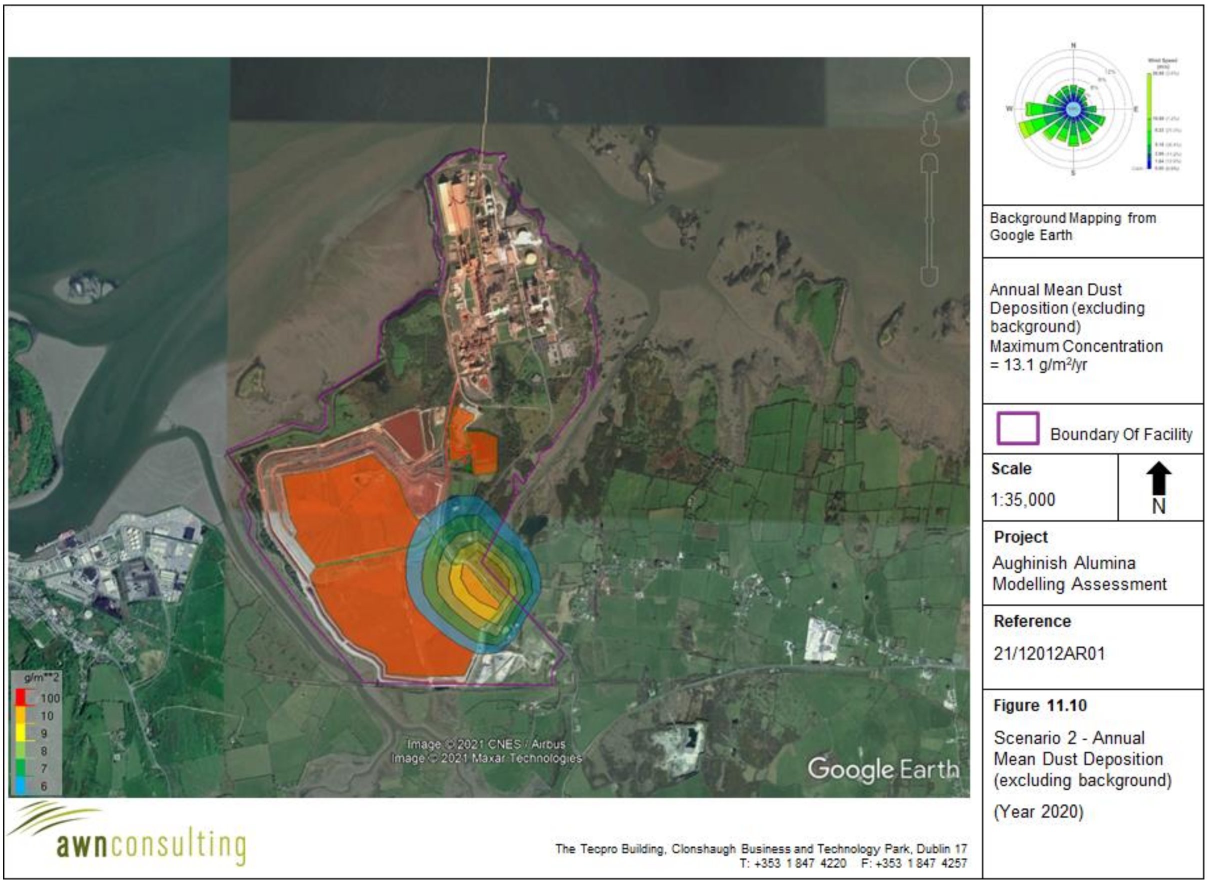



**Figure 11.10** Scenario 2 – Annual Mean Dust Deposition (excluding background)

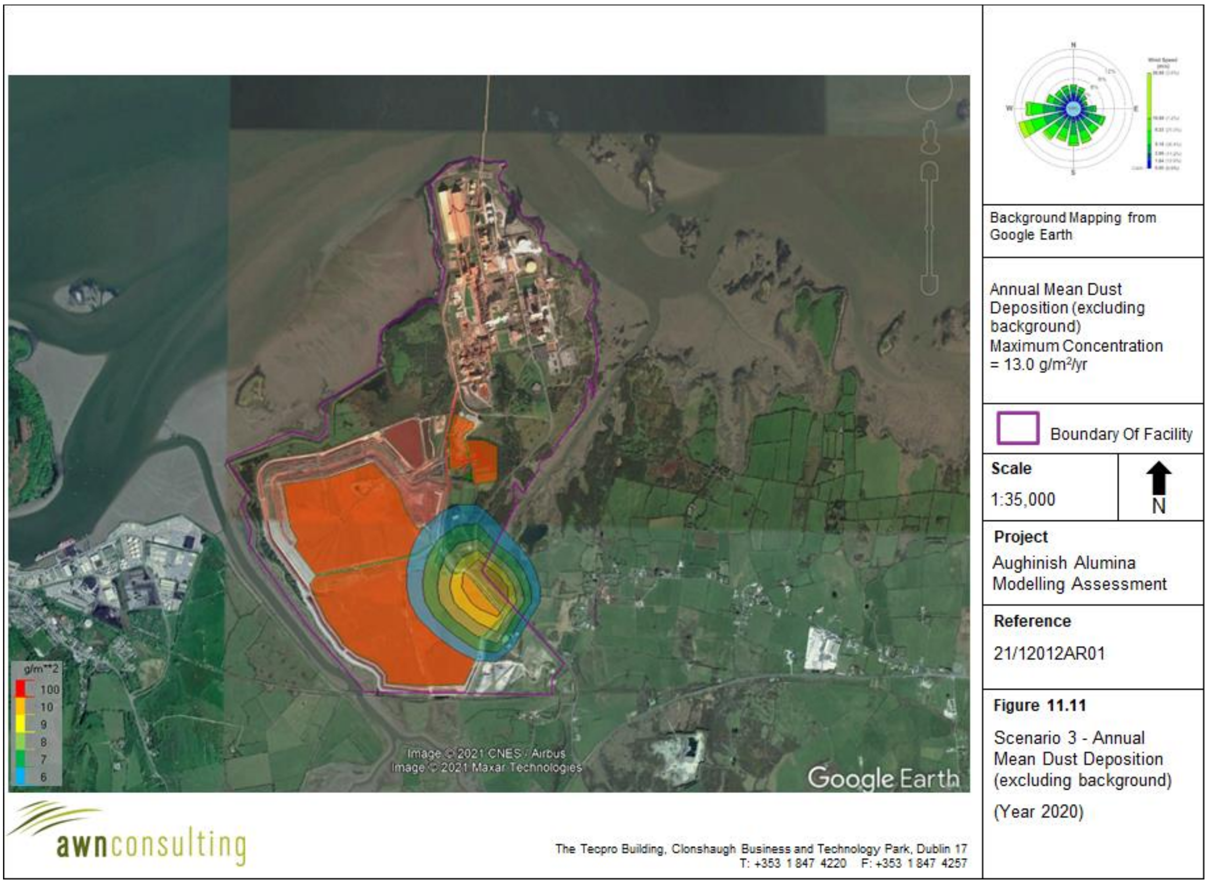
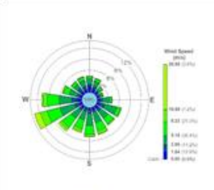



**Figure 11.11** Scenario 3 – Annual Mean Dust Deposition (excluding background)

Background Mapping from Google Earth

Annual Mean Dust Deposition (excluding background) Maximum Concentration = 12.9 g/m²/yr

Boundary Of Facility

**Scale** 1:35,000 N

**Project** Aughinish Alumina Modelling Assessment

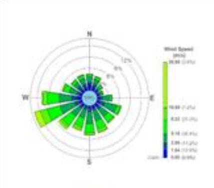
**Reference** 21/12012AR01

**Figure 11.12** Scenario 4 - Annual Mean Dust Deposition (excluding background) (Year 2020)

awnconsulting

The Tecpro Building, Clonshaugh Business and Technology Park, Dublin 17
T: +353 1 847 4220 F: +353 1 847 4257

**Figure 11.12** Scenario 4 – Annual Mean Dust Deposition (excluding background)

Background Mapping from Google Earth

Annual Mean Dust Deposition (excluding background) Maximum Concentration = 3.3 g/m²/yr

Boundary Of Facility

**Scale** 1:35,000 N

**Project** Aughinish Alumina Modelling Assessment

**Reference** 21/12012AR01

**Figure 11.13** Scenario 5 - Annual Mean Dust Deposition (excluding background) (Year 2020)

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**Figure 11.13** Scenario 5 – Annual Mean Dust Deposition (excluding background)

Heavy Metals

For the purposes of modelling, a worst-case assumption that the percentages of heavy metals identified in the sampling of the farmed bauxite residue in Year 2020 are also emitted into the atmosphere in the same ratio has been made in relation to the release of heavy metals from the facility. Atmospheric emissions of heavy metals from the BRDA are then assumed to be dispersed by the atmosphere in the same ratio.

Modelling was based on the average sample results for each heavy metal identified in the sampling over the one year period (Year 2020), as shown in Table 11.15. The predicted heavy metal concentrations are based on the maximum modelling $PM_{10}$ annual mean concentration ratioed to reflect the percentages of heavy metals in the dust.

Table 11.15 results are based on the abatement efficiencies which were derived for $PM_{10}$ using emission factors derived from Shannon Airport wind speed data. These efficiencies were then applied to the heavy metal emissions on the expected assumption that the heavy metal abatement efficiency was similar to the $PM_{10}$ abatement efficiency. The results indicate that based on the reported heavy metal concentrations over the period, all of the concentrations of heavy metals emitted to air are in compliance with the relevant ambient annual mean air quality standards.

Odour

In terms of the proposed development, the bauxite residue which will be deposited in the BRDA is not odorous nor is the saltcake deposited in the saltcake cell. Activities associated with the borrow pit are also not odorous with limestone itself being non-odorous.

There will be no changes to the operational processes associated with the process effluent arising from the Proposed Development. The number of odour complaints experienced at the facility over the last ten years has been very low and indicates that odour nuisance does not occur.

In 2021, the annual cleanout of the liquid waste pond was delayed due to COVID-19 National restrictions leading to higher levels of solids in the pond. This led to a raised level of odour for a short period of time. It is expected that events such as this will be very infrequent and odour from the LWP will not occur.

Thus, with the proposed development in place, the odour profile of the facility will remain unchanged.

The air and odour emissions associated with the Plant will continue regardless of the Proposed Development until c. 2030. The permitted BRDA provides a disposal area for Bauxite Residue at the Facility. It is anticipated that this storage area has sufficient capacity until c. 2030. The grant of permission for the Proposed Development will enable the Plant to continue operating after this date. The continued operation of the Plant post c. 2030 is an indirect effect of the Proposed Development.

In the event that the Plant was to shut after 2030, there will still be a global demand for Alumina which will be facilitated either at another Refinery or the development of a greenfield site to produce Alumina. In either scenario, the air emissions associated with the Plant adjoining the subject site would be displaced and emitted elsewhere in the (global) environment to provide for Alumina for the manufacture of Aluminium. It is submitted that these air emissions would be similar to those experienced at Aughinish at another refinery;

and, in that regard, (i) could be higher given they would be displaced from an Alumina Refinery (Aughinish) that is recognised as being a leading refinery in relation to the use of best available technology and energy efficiency and (ii) likely significantly higher at a greenfield site where the construction of the plant would also be required.

| 2020 / Shannon Airport | Al | As | Cd | Cr | Cu | Fe | Pb | Mg | Hg | Ni | Ti | Zn |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Farmed Residue Units** | mg/Kg | mg/Kg | mg/Kg | mg/Kg | mg/Kg | mg/Kg | mg/Kg | mg/Kg | mg/Kg | mg/Kg | mg/Kg | mg/Kg |
| **Average Farmed Residue Levels** | 18,907 | 1.35 | 0.01 | 200 | 8.50 | 10,263 | 13.5 | 148.7 | 0.01 | 1.55 | 9,218 | 8.47 |
| **Air Modelling Units** | $\mu g/m^3$ | $ng/m^3$ | $ng/m^3$ | $\mu g/m^3$ | $\mu g/m^3$ | $\mu g/m^3$ | $\mu g/m^3$ | $\mu g/m^3$ | ng/m3 | $ng/m^3$ | $\mu g/m^3$ | $\mu g/m^3$ |
| **Predicted Average Ambient Concentration** | 0.278 | 0.020 | 0.0001 | 0.003 | 0.0001 | 0.151 | 0.0002 | 0.002 | 0.0001 | 0.023 | 0.1 | 0.00012 |
| **Annual Limits ($\mu g/m^3$)** | 20 | 6 $ng/m^3$ | 5 $ng/m^3$ | 5 | 10 | 10 | 0.5 | 100 | 250 $ng/m^3$ | 20 $ng/m^3$ | 40 | 50 |
| **Predicted Concentration As % of Limit Value** | 1.39% | 0.33% | 0.003% | 0.06% | 0.001% | 1.51% | 0.04% | 0.002% | 0.0001% | 0.11% | 0.34% | 0.0002% |

**Table 11.15:** Heavy Metal Concentrations Based On Shannon Airport 2020 Based On Average Farm Residue Concentration (mg/Kg)

### 11.4.3 Do ‘Nothing’ Impact

AAL produces alumina from Bauxite using the Bayer process. The “do-nothing” scenario assumes that existing operations will continue in line with the conditions of the facilities’ Industrial Emissions licence (IE Licence P0035-07) (issued 28/09/2021).

The do-nothing scenario is unlikely to alter the current ambient environment and the current concentrations of particulates, dust deposition and heavy metals from the facility up to 2030. Similarly, the odour profile of the facility will remain unchanged in the “do-nothing” scenario.

## 11.5 Mitigation Measures

In order to sufficiently ameliorate the likely air quality impact, a schedule of air control measures has been formulated for the combined construction and operational phase associated with the proposed development which will continue throughout the life of the development.

### 11.5.1 Construction Phase - Air Quality

The greatest potential impact on air quality during the construction phase is $PM_{10}$/$PM_{2.5}$ emissions and the potential for nuisance dust.

In order to minimise dust emissions, a series of mitigation measures have been prepared in the form of a dust minimisation plan. This includes mitigation measures recommended in the Institute of Air Quality Management *Guidance on the Assessment of Dust from Demolition and Construction Version 1.1*[(32)] for sensitive receptors. Provided the dust minimisation measures outlined in the Plan (see Appendix 11.2) and site management plan are adhered to, the air quality impacts during the construction phase will not be significant.

In summary the measures which will be implemented will include:

- Hard surface roads will be swept while any un-surfaced roads will be restricted to essential site traffic.
- Furthermore, any road that has the potential to give rise to fugitive dust is regularly watered using tractor tower bowser tanks, as appropriate, during dry and/or windy conditions.
- Vehicles using site roads have their speed restricted, and this speed restriction will be enforced rigidly. The speed limit on the main access road is 50 km/hr whilst 30 km/hr is applied on internal site roads.
- Vehicles delivering material with dust potential use a dedicated wheel wash prior to leaving the site.
- Material handling systems and site stockpiling of materials are designed and laid out to minimise exposure to wind. Water misting or sprays is used as required if particularly dusty activities are necessary during dry or windy periods.

At all times, these procedures are strictly monitored and assessed. In the event of dust nuisance occurring outside the site boundary, movement of materials likely to raise dust is curtailed and satisfactory procedures implemented to rectify the problem before the resumption of operations.

### 11.5.3 Operational Phase – Air Quality/Dust

For the operational phase, the main BAT measures are the extensive network of automatic water sprinklers which mitigate against dust erosion from the BRDA and the extensive use of raised residue berms to reduce wind speed thus reducing the potential for dust migration off-site. The operation of the water sprinklers increases the moisture of the bauxite residue and thus reduce dust emissions. This mitigation measure is defined as best available technology (BAT) (BAT 49 – Water or water-based solutions spraying) as outlined in the European Commission publication "*Best Available Techniques (BAT) Reference Document for the Management of Waste from Extractive Industries in accordance with Directive 2006/21/EC*" [27].

In addition to the extensive network of automatic water sprinklers, activities in place include placement of residue berms on the residue surface, residue farming which roughens the surface, monitoring weather forecasts, managing residue placement and water levels as well as inspection and water washing of plant roads. In addition, there is ongoing tree and hedge planting and hydroseeding along the perimeter of the BRDA.

AAL have implemented an extensive monitoring programme of on-site emission points and ambient monitoring of $PM_{10}/PM_{2.5}$ and dust deposition as per their Industrial Emissions Licence No. P0035-07. They have recently introduced additional measures to monitor dust deposition and $PM_{10}/PM_{2.5}$ from the facility through increasing the number of monitoring locations. In addition, visual inspection patrols of the site are undertaken as part of the daily management programme.

AAL have a high compliance rate with monitoring records for $PM_{10}/PM_{2.5}$ and dust deposition, as submitted to the EPA, demonstrate continuing high compliance by AAL with the ambient standards / guidelines, with the concentrations of each of the parameter well below the relevant standard. The facility receives few complaints, and on the occasion of a dust complaint, AAL has a proactive approach to dealing with the complaint. Each complaint is carefully considered in line with a standard operating procedure to gather information and to determine the cause. The procedure includes compiling details of the complaint, a follow-up investigation and implementing any corrective actions identified.

A computational fluid dynamics (CFD) study commissioned by the facility found that the mitigation with the largest cumulative wind shadow is the application of raised berms across the site. The CFD modelling study favoured the use of raised residue berms based on the ability to have a large number of berms positioned in multiple directions to reduce wind speeds. It is the intention to continue with the use of residue berms to mitigate the potential for dust erosion from the BRDA.

The likelihood of effects from $PM_{10}/PM_{2.5}$ emissions, dust deposition and heavy metals emissions, after mitigation is applied, is low, and summarised in Table 11.16.

| Quality | Significance | Duration |
|---|---|---|
| Negative | Neutral | Long-term |

**Table 11.16:** Description of Effects of $PM_{10}/PM_{2.5}$, dust deposition and heavy metals emissions

After mitigation the direct and indirect effects of the Proposed Development arising from air emissions will be negative, long-term and neutral.

### 11.5.4 Odour

The process effluent treatment system at the AAL facility and the LWP in the BRDA area have a number of measures in place to mitigate against odour nuisance. The following measures are currently operational and will remain operational with the Proposed Development in place:

- An odour treatment agent and antifoam are dosed to the 35m clarifier overflow launder, which discharges into the LWP. Dosing is monitored regularly and adjusted as required. Furthermore, an odour prevention agent is added to the feedwell of the clarifier, which contains sulphide consuming bacteria.
- The LWP is cleaned out at regular intervals.
- The LWP level is managed to ensure that there is no potential to expose any solids at the base of the LWP.
- Additional biological odour control is added at regular intervals to the LWP.

In terms of the proposed development, the bauxite residue which is deposited in the BRDA is not odorous nor is the saltcake deposited in the saltcake cell. Activities associated with the quarry are also not odorous with limestone itself being non-odorous. Thus, with the proposed development in place, the facility will experience no change in the odour profile.

Indirectly, the AAL facility will continue to employ the extensive range of mitigation measures which are in place to control odour emitted from the facility. Where odour complaints are received, which do occur on an infrequent basis, the facility has developed a comprehensive complaints investigation procedure which is rapidly deployed to determine the source of the odour and, where necessary, implement corrective action.

After mitigation the direct and indirect effects of the Proposed Development arising from odour emissions will be negative, long-term and neutral

## 11.6 Cumulative Impact

There are 18 IE licensed air emission points at AAL. The facility is licensed under an Industrial Emissions Licence P0035-07 and has licensed air emission points from a number of sources within the facility. Air dispersion modelling of these main emission points has confirmed that dust particle levels are in compliance with the ambient air quality standards.

There are no nearby sources with emissions of $PM_{10}/PM_{2.5}$, dust, odour and heavy metals of sufficient magnitude to overlap with site emissions from the existing and proposed BRDA and borrow pit and thus therefore no offsite cumulative impacts are anticipated. With appropriate mitigation measures it is not predicted that any cumulative impacts will occur during the combined construction and operational phase due to $PM_{10}/PM_{2.5}$, dust, odour and heavy metals impacts.

## 11.7 Residual Impact

Modelled emissions associated with raising the BRDA, the extension to the operational area of the borrow pit and raising the salt cake will lead to ambient concentrations which are within the relevant ambient air quality standards for all pollutants modelled. There are no significant residual impacts on air quality or odour due the proposed development associated with raising the BRDA and the extension to the operational area of the borrow pit.

## 11.8 Interactions

The potential interaction between Air Quality and other Sections in the EIAR is primarily limited to *Population & Human Health* and *Traffic & Transportation*. This Air Quality Section has been prepared in consideration of and in conjunction with the relevant outputs of these Sections.

## 11.9 Monitoring

As part of the sites operational licence (IEL), there is a requirement for ongoing $PM_{10}/PM_{2.5}$ and dust deposition monitoring. This will continue to be the case following the construction of the proposed BRDA and Borrow Pit extension.

## 11.10 Difficulties Encountered In Compiling Information

No significant difficulties were encountered in the process of compiling the air quality chapter of the EIAR.

## REFERENCES


(1) German VDI (2002) Technical Guidelines on Air Quality Control – TA Luft
(2) DOEHLG (2004) Quarries and Ancillary Activities, Guidelines for Planning Authorities
(3) DEHLG (2004) National Programme for Ireland under Article 6 of Directive 2001/81/EC for the Progressive Reduction of National Emissions of Transboundary Pollutants by 2010
(4) DEHLG (2007a) Update and Revision of the National Programme for Ireland under Article 6 of Directive 2001/81/EC for the Progressive Reduction of National Emissions of Transboundary Pollutants by 2010
(5) EEA (2012) NEC Directive Status Reports 2011
(6) Environmental Protection Agency (2020b) Ireland's Air Pollutant Emissions 1990 – 2030
(7) UK EA (2003) IPPC Environmental Assessment for BAT
(8) European Commission (2013) Environmental Impact Assessment of Projects – Guidance on the preparation of the Environmental Impact Assessment Report
(9) EPA (2017) Guidelines On Information To Be Contained in Environmental Impact Statements
(10) USEPA (2018) AERMOD Description of Model Formulation and Evaluation
(11) USEPA (2017) Guidelines on Air Quality Models, Appendix W to Part 51, 40 CFR Ch.1
(12) USEPA (2018) User's Guide to the AERMOD Meteorological Preprocessor (AERMET)
(13) EPA (2020) Air Dispersion Modelling from Industrial Installations Guidance Note (AG4)
(14) USEPA (2018) User's Guide to the AERMOD Terrain Preprocessor (AERMAP)
(15) USEPA (2008) AERSURFACE User's Guide
(16) Alaska Department of Environmental Conservation (2008) ADEC Guidance re AERMET Geometric Means (http://dec.alaska.gov/air/ap/modeling.htm)
(17) USEPA (1986) Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition (periodically updated)
(18) Nickling, W (1988) The Initiation Of Particle Movement By Wind
(19) Gillette, D (1977) Chapter 4 – Environmental Factors Affecting Dust Emission By Wind Erosion, Saharan Dust Mobilisation, Transport, Deposition, Workshop, Gothenburg, 25-28 April 1979
(20) ENVIRON (2004) Final Report: Determining Fugitive Dust Emissions from Wind Erosion prepared for Western Governors' Association
(21) ENVIRON (2003) Task 1: Analysis of Wind Tunnel Study Results, Meteorological & Land Use Data, Determining Fugitive Dust Emissions from Wind Erosion prepared for Western Governors' Association
(22) Nickling & Gillies (1993) Dust Emission & Transport In Mali, West Africa, Sedimentology, 40, 859-868
(23) USEPA (1989) Hazardous Waste TSDF – Fugitive Particulate Air Emissions Guidance Document
(24) Alfaro et al (2004) Estimation Of PM20 Emissions By Wind Erosion: Main Sources Of Uncertainties, Geomorphology, 59, 63-74
(25) Marticorena et al (1997) Factors Controlling Threshold Friction Velocity In Semiarid and Arid Areas of the United States, J. Geophys. Res. 102:23277
(26) Maricopa County Air Quality Department (2011) 2008 Maricopa County $PM_{10}$ Emission Inventory
(27) European Commission (2018) Best Available Techniques (BAT) Reference Document for the Management of Waste from Extractive Industries in accordance with Directive 2006/21/EC
(28) Environmental Protection Agency (2019) www.epa.ie/whatwedo/monitoring/air/data
(29) Environmental Protection Agency (2020) Air Quality Monitoring Report 2019 (& previous annual reports 1997-2018)
(30) UK ODPM (2000) Controlling Environmental Effects: Recycled And Secondary Aggregates Production
(31) Transport Infrastructure Ireland (TII) (2011) Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes
(32) Institute of Air Quality Management (2016) Guidance on the Assessment of Dust from Demolition and Construction Version V1.1

# 12.0 NOISE AND VIBRATION

## 12.1 Introduction

AWN Consulting Limited has been commissioned by Tom Phillips and Associates on behalf of Aughinish Alumina Ltd (AAL) to conduct a noise and vibration impact assessment of the proposed development.

AAL operates a long-established alumina refinery, located on Aughinish Island on the southern side of the Shannon Estuary near the village of Foynes, Co. Limerick. The landholding extends to c. 601 ha. The application site is located at the western portion of the Applicants landholding at Aughinish Island, within the BRDA.

This chapter has been prepared by AWN Consulting Limited – Dr Stephen Smyth (BA BAI MIEI MIOA) and reviewed by Alistair Maclaurin (BScI PgDip MIOA).

Dr Stephen Smyth (Associate) holds a BAI and a PhD in Mechanical Engineering from TCD and is a member of Engineers Ireland and a Member of the Institute of Acoustics. He has experience in both environmental and building acoustics, and has coordinated the data capture survey of Northern Ireland's major road and rail networks and Belfast City in preparation of noise maps as required under the European Noise Directive.

Alistair Maclaurin (Senior Acoustic Consultant) has over seven years of experience in the field of Acoustics. He is a corporate member of the Institute of Acoustics (IOA) and has completed the IOA Diploma in Acoustics and Noise Control. He has extensive knowledge in construction noise and vibration as well as experience in building acoustics and environmental noise.

### 12.1.1 Proposed Development

The proposed development consists of works to the Bauxite Residue Disposal Area (BRDA) comprising of an expansion to increase its disposal capacity to accommodate additional bauxite residue arising from the continued operation of the permitted alumina refinery plant located on the wider AAL facility. The proposed increase in disposal capacity to the BRDA will result in a proposed increase in height of c.12m above the currently permitted stage 10 level (c. 32m OD) to a final stage 16 level (c. 44m OD). No increase to the existing footprint of the BRDA is proposed.

The proposed method of raising the BRDA will be the upstream method, consistent with the construction methodology for the current BRDA and involves the construction of rock fill embankments (Stages), offset internally and founded on the previously deposited and farmed bauxite residue, in 2 m high vertical lifts. The overall BRDAis raised systematically as the stages are filled with bauxite residue, farmed, carbonated and compacted, prior to deposition of the next layer.

Additional works proposed as part of this application include the following:

- A vertical extension to the existing Salt Cake Disposal Cell (SCDC) to accommodate further disposal of salt cake resulting in an increase in height of c.2.25m. The SCDC is located within the BRDA. A description of the SCDC and its function is provided in Chapter 2 of this EIAR.

- An extension of the existing borrow pit, located to the east of the BRDA, is also proposed. This extension proposes to increase the footprint of the borrow pit from c.4.5ha to c.8.4ha. This expansion will provide an additional 380,000m$^3$ of rock fill material which is needed to satisfy the requirements of the construction and operation of the BRDA.

- The continued use of an existing stockpile area at the south east of the subject site to store topsoil in order to satisfy the additional restoration requirements of the extended BRDA.

- Upgrades to the existing water management infrastructure to accommodate the BRDA development to Stage 16 which will also allow for greater Inflow Design Flood (IDF) capacity for the entirety of the BRDA.

Please refer to Chapter 3.0 of this EIAR and the Engineering Design Report (enclosed in Appendix A) for a more detailed description of the proposed development.

## 12.2 Methodology

The study has been undertaken using the following methodology:

- Baseline noise monitoring undertaken in the vicinity of the development site has been reviewed in order to characterise the receiving noise environment;
- A review of the most applicable standards and guidelines has been conducted in order to set a range of acceptable noise, vibration and air overpressure criteria for the proposed development;
- Predictive calculations have been performed to assess the potential impacts associated with the operation of the development at the most sensitive locations surrounding the development site;
- Assessment of potential cumulative impacts that may arise as a result of the proposed development and other permitted developments, and;
- A schedule of mitigation measures has been proposed to reduce, where necessary, the identified potential impacts relating to noise from the proposed development.

## 12.3 Receiving Environment

As part of AAL's operating licence (ref. Industrial Emissions Licence Reg No. P0035-07) the site is required to carry out annual noise monitoring with the results submitted to the EPA each year. The results of the 2017, 2018, 2019 and 2020 annual noise monitoring surveys have been used to define the baseline noise environment for the purposes of this assessment. The annual noise monitoring and associated reports were prepared by OES Consulting and these reports are publically available on the EPA website[1].

- 2017 noise monitoring was conducted on 4-5 July, 21 August and 18-19 September 2017.
- 2018 noise monitoring was conducted on 9-10 August, 21 August and 6-7 September 2018.
- 2019 noise monitoring was conducted on 1-2 August and 26-28 August 2019.
- 2020 noise monitoring was conducted on 25 June and 9-10 July 2020.

Measurements were conducted at five (5) nearby noise sensitive locations (NSL's) as defined in AAL's operating licence (ref. Industrial Emissions Licence Reg No. P0035-07) (See Figure 12.1) and described below.

- NSL 1 is located approximately 600m South East of the facility adjacent to Poulaweela Creek.
- NSL2 is located approximately 1,200m to the South East of the facility in the vicinity of a residential dwelling.
- NSL3 is located approximately 3km to the South of the facility in the townland of Oola.
- NSL4 is located approximately 2.6km to the South West. Located at the eastern end of Foynes Port.
- NSL5 is located 1.9km directly South of the facility in the vicinity of a residential building at a crossroads.

Noise measurements were conducted at each location for daytime, evening and night-time periods[2].

[1]Environmental Protection Agency (EPA)
https://epawebapp.epa.ie/licsearchdownload/CombinedFileView.aspx?regno=P0035-06&classification=Enforcement
(Accessed 24.11.21)

[2] Note that NSL1 is an amenity area not a dwelling. As a result it is only considered sensitive during daytime and evening time periods and is not surveyed at night.


**Figure 12.1:** Site Context and Noise Monitoring Locations

Noise surveys were conducted in accordance with ISO 1996-2:2017 *Acoustics -- Description, measurement and assessment of environmental noise -- Part 2: Determination of environmental noise levels* and following the procedures outlined in the EPA *Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities* (NG4), January 2016.

Results of noise measurements at NSL's are presented in the OES Annual Environmental Noise Survey 2017, 2018, 2019 and 2020 reports (ref. R1_1017_41 dated 27/9/2017, R1_1017_43 dated 24/9/2018, R1_1017_44 dated 08/10/2019 and R1_1017_45 dated 22/07/2020).

A summary of the baseline noise environment in the area of the proposed development is provided in Table overleaf.

| Location | Period | 2017 | | 2018 | | 2019 | | 2020 | | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Ambient Noise, dB $L_{Aeq}$ | Background Noise, dB $L_{A90}$ | Ambient Noise, dB $L_{Aeq}$ | Background Noise, dB $L_{A90}$ | Ambient Noise, dB $L_{Aeq}$ | Background Noise, dB $L_{A90}$ | Ambient Noise, dB $L_{Aeq}$ | Background Noise, dB $L_{A90}$ | |
| NSL1 | Day | 44 – 52 | 41 – 51 | 39 – 43 | 36 – 38 | 41 – 43 | 36 – 39 | 48 – 49 | 46 – 47 | Continuous sound from the AAL facility was audible. Intermittent muffled bangs and reverse beeping; non-impulsive were audible at times. Occasional local traffic and birdsong also contribute. |
| | Evening | 44 | 38 | 45 | 41 | 47 | 37 | 50 | 48 | |
| NSL2 | Day | 44 – 53 | 36 | 43 – 49 | 37 – 41 | 46 – 52 | 31 – 32 | 52 – 61 ± | 46 – 47 | Main sound from AAL facility is audible but not predominant. No sound audible from BRDA. Other sources noted are road traffic and birdsong. |
| | Evening | 54 * | 37 | 49 | 38 | 48 | 36 | 49 | 42 | |
| | Night | 32 | 24 – 25 | 41 – 43 | 32 | 32 – 33 | 19 – 20 | 39 – 40 | 37 – 38 | |
| NSL3 | Day | 49 – 52 | 41 – 42 | 45 – 51 | 39 – 40 | 38 – 47 | 31 – 32 | 49 – 50 | 40 – 45 | AAL facility audible at times but low and not predominant source. Frequent traffic on the N69 predominant constant noise source. |
| | Evening | 47 | 33 | 47 | 37 | 45 | 37 | 56 | 55 | |
| | Night | 35 – 36 | 25 | 38 – 39 | 31 – 32 | 35 – 38 | 19 – 20 | 35 | 31 | |
| NSL4 | Day | 55 – 62 α | 38 – 40 | 56 – 62 α | 46 – 50 | 53 – 56 | 35 – 39 | 44 – 50 | 38 – 42 | AAL facility audible at times but low and not predominant source. Port activities predominant. Traffic |
| | Evening | 34 | 30 | 44 | 40 | 35 | 26 | 56 | 55 | |

| Location | Period | 2017 Ambient Noise, dB $L_{Aeq}$ | 2017 Background Noise, dB $L_{A90}$ | 2018 Ambient Noise, dB $L_{Aeq}$ | 2018 Background Noise, dB $L_{A90}$ | 2019 Ambient Noise, dB $L_{Aeq}$ | 2019 Background Noise, dB $L_{A90}$ | 2020 Ambient Noise, dB $L_{Aeq}$ | 2020 Background Noise, dB $L_{A90}$ | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| | Night | 35 – 58 $^{\alpha}$ | 31 - 33 | 42 – 43 | 40 – 42 | 37 | 30 – 32 | 42 – 50 | 39 – 42 | on port spine road and birdsong also noted. |
| NSL5 | Day | 65 – 70 $^{\alpha}$ | 40 – 44 | 59 – 67 $^{\alpha}$ | 43 – 44 | 57 $^{\alpha}$ | 33 | 59 – 68 $^{\alpha}$ | 39 – 42 | BRDA sources audible at times but not predominant. Main plant generally not audible above traffic on access road. |
| | Evening | 55 $^{\alpha}$ | 40 | 54 $^{\alpha}$ | 37 | 55 $^{\alpha}$ | 34 | 56 $^{\alpha}$ | 37 | |
| | Night | 55 – 56 $^{\alpha}$ | 24 | 31 – 38 | 27 | 42 – 48 $^{\alpha}$ | 21 | 48 – 53 $^{\alpha}$ | 33 – 35 | |

**Table 12.1:** Summary of Baseline Data

* Vehicle passing into house close to meter influenced $L_{Aeq}$ measurement (non-site related noise). $L_{A90}$ values are more reflective of site noise.

± Note the higher range of noise levels measured was as a result of a higher number of vehicle pass-bys during this measurement period. Noise from AAL was noted to be similar to previous years and audible but not dominant.

$^{\alpha}$ Facility generally inaudible. Other non-site related noise dominated the $L_{Aeq}$ values. The $L_{A90}$ values are more reflective of site noise.

Noise sources that contribute to the measured noise levels include distant activity from the existing AAL facility as well as other noise sources such as traffic on the existing Local and National Road network, noise from the nearby Foynes port, birdsong, pedestrian voices, dog barking, occasional aircraft movements and some slight wind generated noise on nearby foliage.

The results of the annual noise surveys confirm that noise emissions from the existing AAL facility are in compliance with the sites noise emission limit values, as outlined in relevant License Conditions (i.e. daytime limit of 55 dB $L_{Ar\ (30minute)}$, Evening-time limit of 50 dB $L_{Ar(30\ minute)}$ and Night-time limit of 45dB $L_{Aeq\ (15\text{-}30\ minutes)}$), at specified noise sensitive locations.

## 12.4 Likely Significant Impacts

For a development of this nature the construction and operational phases are considered together. Traditional separation of construction and operational phases is not considered appropriate given that the operation of the BRDA, also including the construction and operation of the Salt Cake Cell, itself involves construction of each stage elevation, which in turn will require the extraction of material from the Borrow Pit. It is therefore proposed to assess the potential noise and vibration impacts of the proposed development against the operational phase noise and vibration limits specified in this Chapter.

During the operational phase, the potential sources of noise and vibration are those associated with the Borrow Pit extraction and internal site vehicle movements to the BRDA area where the phasing will see the height of the existing BRDA increase from Stage 10 to Stage 16. Activity within the Borrow Pit will include occasional blasting to remove rock, on site breaking and crushing of the rock and excavator, loading shovel and dump truck movements to stockpile the materials. On the BRDA there will be many excavators in operation in addition to a low ground pressure bulldozer, amphirol equipment and compactors for mud farming. Note that the proposed development will not generate additional vehicle movements on site and the development is continued operation of the BRDA up to Stage 16, construction and operation of the Salt Cake Cell and extending the borrow pit footprint. The same activity currently permitted within the borrow pit and BRDA will continue to be used within the proposed development.

The relevant impacts associated with the operational phases are addressed in the following sections. The significance of impacts has been assessed in accordance with the EPA *Draft Guidelines on the information to be contained in Environmental Impact Assessment Reports* (EIAR), Draft, August 2017, see Tables 12.2 to 12.4. With regard to the quality of the impact, ratings may have positive, neutral or negative applications where:

| Quality of Impact | Definition |
|---|---|
| Negative/adverse Effects | A change which reduces the quality of the environment (for example, lessening species diversity or diminishing the reproductive capacity of an ecosystem; or damaging health or property or by causing nuisance). |
| Neutral Effects | No effects or effects that are imperceptible, within normal bounds of variation or within the margin of forecasting error. |
| Positive Effects | A change which improves the quality of the environment (for example, by increasing species diversity; or the improving reproductive capacity of an ecosystem, or by removing nuisances or improving amenities). |

**Table 12.2:** Quality of Potential Impacts

The significance of an impact on the receiving environment are described as follows:

| Significance of Impact on the Receiving Environment | Description of Potential Impact |
|---|---|
| Imperceptible | An effect capable of measurement but without significant consequences. |
| Not Significant | An effect which causes noticeable changes in the character of the environment but without significant consequences. |
| Slight Effects | An effect which causes noticeable changes in the character of the environment without affecting its sensitivities. |
| Moderate Effects | An effect that alters the character of the environment in a manner that is consistent with existing and emerging baseline trends. |
| Significant Effects | An effect which, by its character, magnitude, duration or intensity significantly alters a sensitive aspect of the environment. |
| Very Significant | An effect which, by its character, magnitude, duration or intensity significantly alters most of a sensitive aspect of the environment. |
| Profound Effects | An effect which obliterates sensitive characteristics |

**Table 12.3:** Significance of Impacts

The duration of impacts as described in the EPA Guidelines are:

| Duration of Impact | Definition |
|---|---|
| Momentary | Effects lasting from seconds to minutes |
| Brief | Effects lasting less than a day |
| Temporary | Effects lasting less than a year |
| Short-term | Effects lasting one to seven years |
| Medium-term | Effects lasting seven to fifteen years |
| Long-term | Effects lasting fifteen to sixty years. |
| Permanent | Effects lasting over sixty years |

**Table 12.4:** Duration of Impacts

Noise and vibration emissions from the proposed development will vary both in terms of duration and magnitude. The following sections analyse the expected operational phase noise and vibration impacts both in terms of the proposed assessment criteria and the expected impacts in terms of the significance effects.

### 12.4.1 Operational Phase

#### 12.4.1.1 Criteria for Assessing Operational Noise Impacts

*Industrial Emissions Licence Noise Criteria*

The appropriate noise criteria for the operational phase of the proposed development is set out in Conditions and Schedules outlines in the AAL facility's Industrial Emissions Licence (IEL), registration number P0035-07, the relevant extracts are reproduced below.

> *4.5* *Noise*
> Noise from the installation shall not give rise to sound pressure levels ($L_{Aeq,T}$) measured at the specified noise sensitive locations (including those specified in *Schedule C.5 Noise Monitoring Locations*, of this licence) which exceed the limit value(s).

The noise sensitive locations outlined in Schedule C.5 are NSL's 1 to 5 (as indicated in Figure 12.1). Table 12.5 outlines the relevant noise criteria as outlined in Schedule B.4 *Noise Emissions* of the AAL Facility's IEL.

| Daytime dB $L_{Ar,T}$ (30 minutes) | Evening time dB $L_{Ar,T}$ (30 minutes) | Night-time dB $L_{Aeq,T}$ (15-30 minutes) |
|---|---|---|
| 55 | 50 | 45 Note 1 |

**Table 12.5: IEL Schedule B.4 Noise Emission Criteria (Operational Phase)**

Note 1: There shall be no clearly audible tonal component or impulsive component in the noise emission from the activity at any noise sensitive location

*Assessment of the Significance of a Change in Noise Level*

In order to assist with the interpretation of the noise associated with vehicular traffic on existing public roads, Table 12.6 offers guidance as to the likely impact associated with any particular change in traffic noise level (Source DMRB, 2019).

| Change in Sound Level (dB $L_{A10}$) | Subjective Reaction | Magnitude of Impact |
|---|---|---|
| 0 | Inaudible | No Impact |
| 0.1 – 2.9 | Barely Perceptible | Negligible |
| 3 – 4.9 | Perceptible | Minor |
| 5 – 9.9 | Up to a doubling of loudness | Moderate |
| 10+ | Doubling of loudness and above | Major |

**Table 12.6: Likely Impact Associated with Change in Traffic Noise Level**

Table 12.6 has previously presented the DMRB (2019) likely impacts associated with change in traffic noise level, the corresponding significance of impact presented in the '*EPA Guidelines on the information to be contained in Environmental Impact Assessment Reports* (EIAR), Draft, August 2017 is presented in Table 12.7 for consistency in wording and terminology for the assessment of impact significance.

| Change in Sound Level DMRB, 2011 (dB $L_{A11}$) | Subjective Reaction DMRB, 2011 | Impact Guidelines for Noise Impact Assessment Significance (Institute of Acoustics) | Impact Guidelines on the Information to be contained in EIAR (EPA) |
|---|---|---|---|
| 0 | No change | None | Imperceptible |
| 0.1 – 2.9 | Barely perceptible | Minor | Not Significant |
| 3.0 – 4.9 | Noticeable | Moderate | Slight, Moderate |
| 5.0 – 9.9 | Up to a doubling or halving of loudness | Substantial | Significant |
| 10.0 or more | More than a doubling or halving of loudness | Major | Very Significant, Profound |

**Table 12.7: Likely Impact Associated with a Change in Traffic Noise Level (updated)**

The criteria above reflect the key benchmarks that relate to human perception of sound. A change of 3 dB(A) is generally considered to be the smallest change in environmental noise that is perceptible to the human ear. A 11 dB(A) change in noise represents a doubling or halving of the noise level. The difference between the minimum perceptible change and the doubling or halving of the noise level is split to provide greater definition to the assessment of changes in noise level.

#### 12.4.1.2 Criteria for Assessing Operational Vibration Impacts

*Vibration during General Site Activity*

For general day-to-day activity within the Borrow Pit (i.e. excluding blasting) and on the BRDA, no perceptible level of vibration is expected at nearby sensitive locations given the distance between the development and nearby sensitive locations.

*Vibration during Blasting*

The EPA document *Environmental Management Guidelines Environmental Management in the Extractive Industry (Non-Scheduled Minerals)*, 2006, provides guidance in relation to vibration during blasting operations, as reproduced below.

> *"In relation to blasting activities within quarry development, it is recommended that the following vibration (and air overpressure) ELVs are adopted and applied at the nearest vibration and air overpressure sensitive location (e.g. a residential property):*
>
> > *Ground-borne vibration: Peak particle velocity = 12 mm/s, measured in any of the three mutually orthogonal directions at the receiving location (for vibration with a frequency of less than 40 Hz)".*

In accordance with this guidance, the IEL license sets a vibration limit of 12mm/s at the monitoring locations indicated within the IEL, namely NSL2, NSL5 and NV1[3].

As part of the original borrow pit application discussions were held between Aughinish Alumina and Gas Networks Ireland in relation to potential vibration emissions affecting a nearby Gas pipeline. A vibration limit of 50mm/s (PPV) that should not be exceeded at the pipeline during blasting was set. In this regard initial blasting and vibration monitoring at the pipeline will be carried out in order to ensure compliance with the agreed vibration limit.

#### 12.4.2.2 Assessment of Operational Impacts

During the operational phase of the proposed development, the potential noise and vibration impacts relate to the following:

- General Operational Phase Site Activity, and;
- Blasting.

Each is assessed in the following sections.

*Operational Phase Site Activity*

During the operation of the BRDA the existing machinery will continue to be used. However, the phasing of the BRDA raise over time will result in the elevation of this machinery increasing above ground as each stage is completed. Note that the Salt Cake Cell that is part of the development will be raised to its final height in one single phase and is not incrementally

[3] NV1 is located at 128958E, 151596N

raised like the BRDA. For the purposes of this assessment the following stages of the BRDA development have been assessed,

- Current
- Phase 1 at Stage 10; Phase 2 at Stage 4
- Phase 1 at Stage 12; Phase 2 at Stage 8
- Phase 1 at Stage 14; Phase 2 at Stage 12
- All at Stage 16 including the restoration activity

To assess the noise impact of the proposed development a 3D noise model of the developments has been developed. Brüel & Kjær Type 7810 Predictor is a proprietary noise calculation package for computing noise levels in the vicinity of noise sources. Predictor predicts noise levels in different ways depending on the selected prediction standard. The resultant noise level is generally calculated taking into account a range of factors affecting the propagation of sound, including:

- the magnitude of the noise source in terms of sound power;
- the distance between the source and receiver;
- the presence of obstacles such as screens or barriers in the propagation path;
- the presence of reflecting surfaces;
- the hardness of the ground between the source and receiver;
- attenuation due to atmospheric absorption, and;
- meteorological effects such as wind gradient, temperature gradient and humidity (these have significant impact at distances greater than approximately 400m).

Prediction calculations have been performed using Predictor in accordance with ISO 9613 (1996): Acoustics – Attenuation of sound outdoors – Part 2: General method of calculation.

For the purposes of the assessment the following activity has been included in the noise model. All source levels are taken from BS5228 – 2009+A1(2014): Code of practice for noise and vibration control on construction and open sites Part 1 – Noise.

<u>Borrow Pit</u>

- Tracked Crusher;
- Wheeled Loader;
- Dump Truck;
- Excavator Mounted Breaker, and;
- Excavator.
- Loading shovel

<u>BRDA</u>

- 9 no. excavators – 5 assumed to operate concurrently;
- 6 no. Tractors – 5 assumed to operate concurrently;
- 2 no. Amphirol vehicles – both assumed to operate concurrently;
- 1 no. bulldozer, and;
- 1 no. 40t Moxy Dump Truck.

The noise level generated by each plant item has been taken from manufacturers datasheets or where not available from BS5228-1. Table 12.8 details the sound power level associated with each item of plant. Activity within the BRDA and Borrow Pit only occurs during daylight hours and based on activity logs provided by AAL an on-time of 66% has been applied, i.e. equipment is assumed to be in operation for 66% of the time.

| Plant Item | Sound Power Level, dB $L_{w(A)}$ |
|---|---|
| Amphiroll | 111 |
| Excavator | 98 – 102 |
| Tractor | 108 |
| Moxy | 107 |
| Excavator Mounted Breaker | 118 |
| Wheeled Loader | 107 |
| Crusher | 110 |
| Dump Truck Dumping Stone in Borrow Pit | 108 |

**Table 12.8:** Sound Power Level of Each Plant Item

The noise level at the nearest sensitive locations has been predicted for each of the five stages of BRDA construction as described earlier. For the purpose of the noise assessment it is assumed that works are occurring either within the Phase 1 area or the Phase 2 area plus the extended borrow pit. Figure 12.2 identifies the nearest noise receiver locations to the development. Tables 12.9 presents the calculated noise level at each location for each of the five stages of the development for both the scenario where the activity occurs within the Phase 1 area of the BRDA and when the activity occurs with the Phase 2 area of the BRDA.

**Figure 12.2:** Nearest Receiver Locations (Aerial Photo taken from Bing Maps c 2013)

| Receiver | Calculated Daytime Noise Level, dB $L_{Ar,T}$ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Current BRDA | | Phase 1 at Stage 10; Phase 2 at Stage 4 | | Phase 1 at Stage 12; Phase 2 at Stage 8 | | Phase 1 at Stage 14; Phase 2 at Stage 12 | | All at Stage 16 with restoration | |
| | Works at Phase 1 Area | Works at Phase 2 Area | Works at Phase 1 Area | Works at Phase 2 Area | Works at Phase 1 Area | Works at Phase 2 Area | Works at Phase 1 Area | Works at Phase 2 Area | Works at Phase 1 Area | Works at Phase 2 Area |
| R001 | 40 | 40 | 38 | 42 | 39 | 42 | 36 | 41 | 38 | 41 |
| R002 | 35 | 39 | 32 | 39 | 32 | 42 | 32 | 41 | 33 | 36 |
| R003 | 34 | 39 | 32 | 39 | 32 | 39 | 32 | 41 | 32 | 36 |
| R004 | 33 | 39 | 32 | 39 | 32 | 38 | 31 | 38 | 32 | 35 |
| R005 | 37 | 43 | 37 | 44 | 35 | 43 | 35 | 42 | 35 | 37 |
| R006 | 34 | 38 | 32 | 38 | 32 | 38 | 32 | 37 | 33 | 36 |
| R007 | 38 | 44 | 38 | 45 | 38 | 45 | 36 | 43 | 36 | 40 |
| R008 | 39 | 46 | 40 | 46 | 38 | 46 | 37 | 44 | 37 | 41 |
| R009 | 40 | 45 | 40 | 47 | 38 | 46 | 38 | 44 | 38 | 40 |
| R010 | 40 | 46 | 40 | 47 | 38 | 47 | 38 | 45 | 38 | 41 |
| R011 | 41 | 49 | 41 | 50 | 39 | 49 | 39 | 45 | 39 | 42 |
| R012 | 42 | 49 | 42 | 51 | 39 | 50 | 39 | 46 | 39 | 42 |
| R013 | 42 | 48 | 42 | 48 | 41 | 48 | 41 | 44 | 41 | 43 |
| R014 | 43 | 48 | 43 | 49 | 41 | 48 | 41 | 45 | 41 | 43 |
| R015 | 43 | 48 | 43 | 49 | 42 | 48 | 41 | 45 | 42 | 43 |
| R016 | 43 | 47 | 43 | 47 | 43 | 47 | 42 | 45 | 43 | 44 |
| R017 | 43 | 47 | 43 | 48 | 43 | 48 | 42 | 45 | 43 | 44 |
| R018 | 43 | 47 | 43 | 47 | 43 | 47 | 42 | 45 | 43 | 45 |
| R019 | 43 | 47 | 44 | 47 | 44 | 47 | 42 | 45 | 44 | 45 |
| R020 | 43 | 47 | 44 | 47 | 44 | 47 | 42 | 45 | 44 | 46 |
| R021 | 44 | 47 | 44 | 47 | 44 | 47 | 42 | 45 | 44 | 46 |
| R022 | 44 | 47 | 44 | 47 | 44 | 47 | 43 | 45 | 44 | 46 |
| R023 | 44 | 46 | 44 | 47 | 44 | 47 | 43 | 45 | 44 | 46 |
| R024 | 44 | 47 | 44 | 47 | 44 | 47 | 43 | 46 | 44 | 46 |

| Receiver | Calculated Daytime Noise Level, dB $L_{Ar,T}$ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Current BRDA | | Phase 1 at Stage 10; Phase 2 at Stage 4 | | Phase 1 at Stage 12; Phase 2 at Stage 8 | | Phase 1 at Stage 14; Phase 2 at Stage 12 | | All at Stage 16 with restoration | |
| | Works at Phase 1 Area | Works at Phase 2 Area | Works at Phase 1 Area | Works at Phase 2 Area | Works at Phase 1 Area | Works at Phase 2 Area | Works at Phase 1 Area | Works at Phase 2 Area | Works at Phase 1 Area | Works at Phase 2 Area |
| R025 | 44 | 46 | 44 | 47 | 44 | 46 | 43 | 45 | 45 | 46 |
| R026 | 43 | 45 | 44 | 46 | 44 | 46 | 43 | 45 | 44 | 45 |
| R027 | 43 | 45 | 43 | 45 | 43 | 46 | 42 | 45 | 44 | 45 |
| R028 | 43 | 45 | 43 | 45 | 43 | 45 | 42 | 45 | 44 | 45 |
| R029 | 43 | 44 | 43 | 45 | 43 | 45 | 42 | 44 | 43 | 44 |
| R030 | 42 | 44 | 43 | 45 | 43 | 45 | 42 | 44 | 43 | 44 |
| R031 | 42 | 44 | 42 | 44 | 42 | 44 | 42 | 44 | 43 | 44 |
| R032 | 42 | 44 | 42 | 44 | 42 | 44 | 41 | 44 | 43 | 44 |
| R033 | 42 | 43 | 42 | 44 | 42 | 44 | 41 | 43 | 42 | 43 |
| R034 | 42 | 44 | 42 | 44 | 42 | 44 | 41 | 44 | 43 | 44 |
| R035 | 41 | 43 | 42 | 43 | 41 | 43 | 41 | 43 | 42 | 43 |
| R036 | 41 | 43 | 41 | 43 | 41 | 43 | 40 | 43 | 42 | 43 |
| R037 | 41 | 42 | 41 | 43 | 41 | 43 | 40 | 42 | 42 | 43 |
| R038 | 33 | 31 | 32 | 31 | 32 | 33 | 30 | 32 | 33 | 34 |
| R039 | 37 | 38 | 36 | 38 | 36 | 38 | 36 | 38 | 37 | 39 |
| R040 | 43 | 45 | 44 | 46 | 43 | 46 | 43 | 45 | 44 | 45 |
| R041 | 38 | 39 | 38 | 39 | 38 | 39 | 38 | 39 | 39 | 40 |
| R042 | 39 | 39 | 40 | 40 | 40 | 40 | 40 | 40 | 41 | 41 |
| R043 | 38 | 38 | 38 | 39 | 38 | 39 | 38 | 39 | 39 | 40 |
| R044 | 38 | 38 | 39 | 39 | 39 | 39 | 39 | 40 | 40 | 40 |

**Table 12.9 Calculated Noise Level at Each Receiver Location**

The assessment shows that the calculated noise level at all locations for all scenarios considered is below the daytime criterion of 55 dB $L_{Ar,T}$. Furthermore, the proposed BRDA raise to higher elevations will result in a reduction in noise level at some locations as a result of additional screening offered by the BRDA stage raise embankments.

It is also worth comparing the calculated noise levels to the baseline noise levels discussed in Section 12.3. Table 12.10 below compares the range of predicted noise levels at the model receiver closest to the monitoring locations.

| Measurement Location | Measured Daytime Noise Level, dB $L_{Aeq,T}$ | Equivalent Model Location | Calculated Noise Level, dB $L_{Ar,T}$ |
|---|---|---|---|
| NSL2 | 43 to 61 | R27 | 43 to 47 |
| NSL5 | 57 to 70 | R15 | 41 to 49 |

**Table 12.10: Comparison of Calculated Noise Levels to Measured Noise Levels**

Based on this comparison the noise emission from the general operation of the proposed development will not change the existing soundscape and no significant noise impact is expected.

*Additional Vehicular Traffic from Development*

The proposed development will generate a slight increase in heavy vehicle trips on the external road network specifically associated with the importation of soil and soil improver associated with the proposed raising of the BRDA. Table 14.8 of Chapter 14 presents the anticipated development traffic where it is anticipated that the additional number of heavy vehicle trips per day will be <13. This quantity of additional vehicles will not generate a significant noise impact at nearby sensitive locations.

Furthermore, it should be noted that the use of the Borrow Pit site to source crushed stone for use by site operations has the beneficial effect of removing truck movements from the local road network where previously crushed stone was imported from off site quarries.

*Blasting*

Blasting will be required within the Borrow Pit, up to 7 blasts will be required per year.

To assess the likely air overpressure from a blast the following inputs have been modelled,

- 35kg charge mass;
- Flat ground topography to assess a worst-case scenario;
- No screening due to environmental berm proposed, and;
- Blast at the south eastern corner of the extended borrow pit site and at grade.

Established scaling methods allow the pressure levels from a blast to be calculated from the relationship between the charge mass, distance and blast vibration levels. The following formula is used:

Air Overpressure (dB (Lin)) = $20 \cdot \log((K \cdot (D/\sqrt[3]{w}))-a)/P0)$

Where,

W = charge mass (kg)
D = distance (m)
K = site constant
a = site exponent
P0 = reference pressure (20 x 10-6 Pa)

Note that in this instance studies carried out by Golder Associates in relation to the vibration from blasts have identified the following site constants,

K = 300
a = 1.14

Table 12.11 presents the calculated air overpressure level for a range of distances from the blast.

| Distance from the Blast, m | Air Overpressure, dB (Lin) |
|---|---|
| 150 | 106 |
| 400 | 96 |
| 900 | 88 |
| 1300 | 84 |
| 1750 | 81 |

**Table 12.11: Calculated Air Overpressure at Distance**

The closest residential dwellings to the Borrow Pit site are located at a distance greater than 900m away. At this distance the air overpressure will be of the order of 88 dB (Lin) and well below the limit value of 125 dB(Lin).

To put the values in Table 12.11 into context air overpressure of the order of 120dB (Lin) is equivalent to the pressure felt from a 20mph wind. The effects due to air overpressure values presented in Table 12.11 as a result of blasting required at the proposed development are orders of magnitude less than this.

Similarly, in relation to vibration from blasting, using the same inputs as described above for the air overpressure assessment Golder have calculated the expected vibration levels from blasting. Figure 12.3 presents the predicted vibration contours due to Borrow Pit blasting.

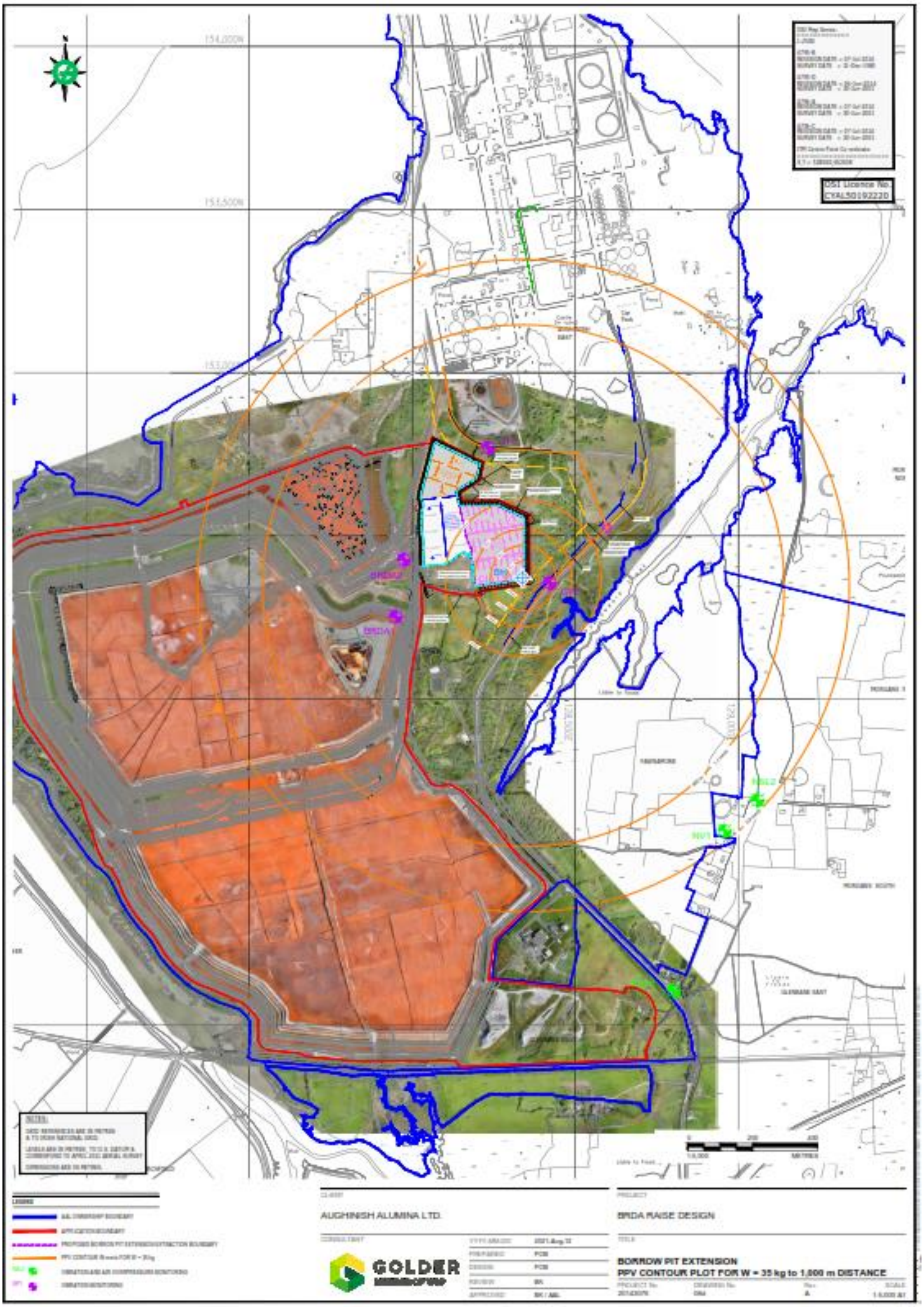


**Figure 12.3: Calculated Vibration Levels from Blasting at Distance**

Vibration levels during blasting are predicted to be less than 1mm/s at the nearest sensitive locations.

Notwithstanding the assessment here demonstrating that air overpressure and vibration are not predicted to exceed the specified limits some good practice measures to minimise both parameters are specified in Section 12.5.

With regards to airborne noise from blasting there is no agreed methodology for predicting the maximum instantaneous noise level that will be heard as a result of a blast. However, it is well established that sound pressure decays at a rate of 6dB per doubling of distance. Table 12.12 describes the attenuation of sound at a variety of distances from the blast site without considering any attenuation due to the borrow pit walls or soft ground cover between the borrow pit and receiver.

| Distance from the Blast, m | Reduction in Noise, dB |
|---|---|
| 100 | 40 |
| 250 | 48 |
| 500 | 54 |
| 750 | 58 |
| 1000 | 60 |
| 2000 | 66 |
| 4000 | 72 |

**Table 12.12 Calculated Attenuation of Blast Noise over Distance**

In this instance the nearest sensitive location to the borrow pit is over 900m away and therefore any blast noise will have attenuated by almost 60dB. It is concluded that this would reduce blast noise to a level that is insignificant in terms of impacts at the nearest sensitive locations. Blasts would be expected to be audible in terms of an instantaneous loud noise, however, once attenuation due to distance is considered the sound pressure level of the blast would not be so high as to constitute a significant impact.

## 12.5 Mitigation Measures

### 12.5.1 General Operational Phase Site Activity

Best practice control measures for noise and vibration during operation are taken from BS 5228 (2009 +A1 2014) Code of Practice for Noise and Vibration Control on Construction and Open Sites Parts 1 and 2. Whist noise and vibration impacts are expected to vary during the operational phase depending on the distance between the activities and noise sensitive buildings, best practice noise and vibration control methods will be used, as necessary in order to ensure impacts at off-site noise sensitive locations are minimised.

The best practice measures set out in BS 5228 (2009) Parts 1 and 2 includes guidance on several aspects of construction site mitigation measures, including, but not limited to:

- noise control at source;
- screening, and;
- liaison with the public.

Detailed comment is offered on these items in the following paragraphs. Noise control measures that will be considered include the selection of quiet plant, enclosures and screens around noise sources, limiting the hours of work and noise and vibration monitoring, where required.

*General Comments on Noise Control at Source*

If replacing a noisy item of plant is not a viable or practical option, consideration should be given to noise control "at source". This refers to the modification of an item of plant or the application of improved sound reduction methods in consultation with the supplier. For example, resonance effects in panel work or cover plates can be reduced through stiffening or application of damping compounds; rattling and grinding noises can often be controlled by fixing resilient materials in between the surfaces in contact.

BS5228 states that "as far as reasonably practicable sources of significant noise should be enclosed". In applying this guidance, constraints such as mobility, ventilation, access and safety must be taken into account. Items suitable for enclosure include pumps and generators. Demountable enclosures will also be used to screen operatives using hand tools and will be moved around site as necessary.

For rock breaking activity the following measures will be implemented,

- Fit suitably designed muffler or sound reduction equipment to the rock breaking tool to reduce noise without impairing machine efficiency.
- Use a dampened bit to eliminate ringing.

For the Borrow Pit crushing activity note the following measures to be implemented,

- The crusher will be located as far away from noise sensitive locations as practicable;
- Hoppers to the crusher will be lined with a resilient material to dampen impact noise of rocks being loaded into the crusher;

BS5228 makes a number of recommendations in relation to "use and siting of equipment". These are all directly relevant and hence are reproduced in full. These recommendations will be adopted on site.

"Plant should always be used in accordance with manufacturers' instructions. Care should be taken to site equipment away from noise-sensitive areas. Where possible, loading and unloading should also be carried out away from such areas."

"Machines that may be in intermittent use should be shut down between work periods or should be throttled down to a minimum. Machines should not be left running unnecessarily, as this can be noisy and waste energy."

"Plant known to emit noise strongly in one direction should, when possible, be orientated so that the noise is directed away from noise-sensitive areas. Attendant operators of the plant can also benefit from this acoustical phenomenon by sheltering, when possible, in the area with reduced noise levels."

"Acoustic covers to engines should be kept closed when the engines are in use and idling. The use of compressors that have effective acoustic enclosures and are designed to operate when their access panels are closed is recommended."

"Materials should be lowered whenever practicable and should not be dropped. The surfaces on to which the materials are being moved could be covered by resilient material."

All items of plant should be subject to regular maintenance. Such maintenance can prevent unnecessary increases in plant noise and can serve to prolong the effectiveness of noise control measures.

*Liason with the Public*

The operator or any sub-contractors will provide proactive community relations and will notify the public and sensitive premises before each blast within the borrow pit. The operation of borrow pit equipment such as crushers and rock-breakers shall be strictly controlled so as to minimise impact at noise sensitive locations. The operation of the rock breakers and crushers is prohibited during evening time, night-time, on Sundays and Public Holidays.

Any complaints will be logged and followed up in a prompt fashion. In addition, prior to particularly noisy activity, e.g. rock breaking, blasting, etc., the site should inform the nearest noise sensitive locations of the time and expected duration of the works.

### 12.5.2 Noise, Air Overpressure & Vibration from Blasting

Air overpressure and vibration can be controlled at source by careful attention to blast design. A method statement will be produced by the blasting contractor to ensure that the noise, vibration and air overpressure impacts of blasting operations are minimised. Monitoring of air overpressure levels will be carried out at three locations agreed with the EPA which are representative of the nearest residential dwellings during blasts to ensure that acceptable levels are not exceeded. The monitoring data will enable control of the blast noise, air-overpressure and vibration levels as the data will enable blast technicians to modify blasting techniques (i.e. charge sizes) if required. As air blast intensity is a function of total charge weight, then a reduction in the total amount of explosives used can also reduce the air overpressure value.

Other practical methods to reduce noise, air overpressure and vibration are set out below.

- There shall be no more than one blast per week at the Borrow Pit.
- Restriction of hours within which blasting can be conducted (08.00 to 18.00 hours Monday to Friday).
- A public information campaign undertaken before any work and blasting starts (e.g. 24-hour written notification).
- The firing of blasts at similar times to reduce the 'startle' effect.
- On-going circulars informing people of the progress of the works.
- The implementation of an onsite documented complaints procedure.
- The use of independent monitoring by external bodies for verification of results.
- Ensuring appropriate burden to avoid over or under confinement of the charge.
- A method statement for blasting operations will be submitted to the EPA for approval prior to commencement of blasting. The method statement shall include the noise, vibration and air-overpressure control measures.
- Initial blasts to assist in blast designs and identify potential zones of influence.
- Accurate setting out and drilling;
- Appropriate charging;

- Appropriate stemming with appropriate material such as sized gravel or stone chipping;
- Delay detonation to ensure small maximum instantaneous charges;
- Decked charges and in-hole delays;
- Blast monitoring to enable adjustment of subsequent charges;
- Good blast design to maximise efficiency and reduce vibration;
- Avoid using exposed detonating cord on the surface.

### 12.5.3 Additional Vehicular Traffic from Development

Noise mitigation measures with respect to traffic from the development are not deemed necessary.

## 12.6 Cumulative Impacts

AAL operates a long-established alumina extraction plant. The landholding extends to c. 601 ha. The facility is licenced, under IE Licence P0035-07, to emit noise within prescribed limits. Annual noise modelling has confirmed that levels are in compliance with the EPA license requirements. In addition, the overlap between the noise emissions from these licenced emissions points and from the BRDA / borrow pit is insignificant with annual noise levels not expected to change significantly as a result of the proposed development.

There are no nearby sources with significant emissions of noise or vibration to overlap with site emissions from the BRDA and borrow pit and thus therefore no offsite cumulative impact are relevant. With appropriate mitigation measures it is not predicted that any cumulative impacts will occur during the construction or operational phases due to noise or vibration impacts.

## 12.7 Residual Impacts

### 12.7.1 Operational Phase Building Services Plant & Machinery

The probability of effects from the operational phase of the developments is low and a description of effects is summarised in Table 12.13.

| Quality | Significance | Duration |
|---|---|---|
| Neutral | Imperceptible | Long-term |

**Table 12.13: Description of Effects of Proposed Operational Phase Building Services Plant**

### 12.7.2 Additional Vehicular Traffic on Public Roads

A small quantity of additional traffic will be generated by this development. A description of effects is summarised in Table 12.14.

| Quality | Significance | Duration |
|---|---|---|
| Neutral | Imperceptible | Long-term |

**Table 12.14: Description of Effects of Proposed Operational Phase Additional Traffic**

### 12.7.3 Air Overpressure from Blasting

The probability of effects from Air Overpressure from Blasting is low and a description of effects is summarised in Table 12.15.

| Quality | Significance | Duration |
|---|---|---|
| Negative | Slight | Momentary |

**Table 12.15: Description of Effects of Air Overpressure during Blasting**

### 12.7.4 Vibration from Blasting

The probability of effects from Vibration from Blasting is low and a description of effects is summarised in Table 12.16.

| Quality | Significance | Duration |
|---|---|---|
| Negative | Slight | Momentary |

**Table 12.16: Description of Effects of Vibration during Blasting**

## 12.8 Interactions

The potential interaction between Noise & Vibration and other Sections in the EIAR is primarily limited to *Population & Human Health* and *Traffic & Transportation*. This Noise & Vibration Section has been prepared in consideration of and in conjunction with the relevant outputs of these Sections.

Further interaction between Noise & Vibration and ecology occurred to ensure the relevant information was provided to the project ecologist to assess the potential for noise impacts on marine mammals.

## 12.9 Monitoring

It is required that the appointed blasting contractor monitor levels of noise, vibration and air-overpressure at GNI pipeline and three locations representative of the nearest noise sensitive locations during any blasting activity.

As part of the sites operational licence (IEL), there is a requirement for annual operational phase noise monitoring. This will continue to be the case in the ongoing development of the proposed BRDA raise and Borrow Pit extension.

## 12.10 Do-Nothing Scenario

The permitted BRDA provides a disposal area for Bauxite Residue at the Facility until c. 2030, at which time the Plant would be faced with shut down (based on the current disposal method) as there will no further permitted storage area. Having regard to the above, it is submitted that emissions associated with the Plant will continue regardless of the current proposal until c. 2030.

## 12.11 Difficulties Encountered In Compiling Information

No significant difficulties were encountered in the process of compiling the noise and vibration chapter of the EIAR.

## 12.12 Noise and Human Health

In terms of the noise exposure of construction workers and potential hearing damage that may be caused due to exposure to high levels of noise, the *Safety, Health and Welfare at Work (General Application) Regulations 2007* (Statutory Instrument No. 299 of 2007) provides guidance in terms of allowable workplace noise exposure levels for employees. The Regulations specify two noise Action Levels at which the employer is legally obliged to reduce the risk of exposure to noise.

The appointed contractor will be required to comply with the Regulations and provide appropriate noise exposure mitigation measures where necessary. The noise exposure level to off-site receptors during the construction phase will be below the lower Action Level and therefore the risk of noise exposure resulting in potential hearing damage to off-site receptors is minimal.

## 12.13 References

In preparing the noise and vibration chapter of the EIAR, reference is made to the following documents and Standards:

- BS 5228:2009+A1:2014 *Code of practice for noise and vibration control on construction and open sites – Part 1: Noise.*
- BS 5228:2009+A1:2014 *Code of practice for noise and vibration control on construction and open sites – Vibration.*
- BS8233:2014 *Guidance on sound insulation and noise reduction for buildings*
- ISO 1996-2:2017 Acoustics -- Description, measurement and assessment of environmental noise - Part 2: Determination of sound pressure levels.
- Design Manual for Roads and Bridges (DMRB, 2019); Highways England.
- Draft Guidelines on the information to be contained in Environmental Impact Assessment Reports (May 2017);
- Draft Advice Notes on Current Practice in the Preparation of Environmental Impact Statements (September 2015), and;
- *Guidance Note for Noise: License Application, Surveys and Assessment in Relation to Schedules Activities* (NG4) (EPA January 2016).
- ISO 9613 (1996): *Acoustics – Attenuation of sound outdoors – Part 2: General method of calculation.*
- BS 6472 (1992): *Guide to Evaluation of human exposure to vibration in buildings (1 Hz to 80 Hz).*
- Safety, Health and Welfare at Work (General Application) Regulations 2007 (Statutory Instrument No. 299 of 2007)

# 13.0 MATERIAL ASSETS - WASTE MANAGEMENT

## 13.1 Introduction

This Chapter of the Environmental Impact Assessment Report (EIAR) has been prepared by Golder Associates Ireland Ltd (Golder) and assesses the likely direct and indirect significant impacts and effects the preparatory, construction, operational and closure phases of the Proposed Development may have on external waste management infrastructure capacity.

The following assessment was prepared by Kevin McGillycuddy (BA (Mod), MSc). Kevin is an Environmental Consultant with 8 years of consulting experience and is also a Practitioner Member of the Institute of Environmental Management and Assessment.

The objective of the assessment is to ensure that these waste management infrastructure assets (landfills, municipal incinerators, etc.) are used in a sustainable manner, so that they will be available for future generations, after the delivery of the Proposed Development. An assessment is made of the likely impact of the waste produced and mitigation measures, in terms of appropriate waste management, are put forward to minimise the levels of waste generated in the first place and also to reduce the impact of the waste generated by the Proposed Development.

The overall AAL facility is the largest alumina refinery in Europe with an annual production capacity of 1.95 million tonnes per year of alumina via the Bayer process. The major waste stream of the Bayer process is bauxite residue. Farmed bauxite residue is the terminology applied by AAL to describe bauxite residue which has undergone a process of partial neutralisation. Within the Alumina Industry bauxite residue may also be termed ‘red mud’. Bauxite residue undergoes numerous stages of washing and filtration prior to discharge to the facility’s own waste management infrastructure, namely Bauxite Residue Disposal Area (BRDA). The BRDA also accepts the waste salt cake material, which is a by-product of the manufacturing process on-site. These wastes are managed in accordance with the Extractive Waste Directive (2006/21/EC), the Waste Management (Management of Waste from the Extractive Industries) Regulations 2009, as amended, (SI No. 566 of 2009), and the European Commission publication “Best Available Techniques (BAT) Reference Document for the Management of Waste from Extractive Industries in accordance with Directive 2006/21/EC. Environmental management of the waste and any potential associated effects are governed by the facility’s Industrial Emissions Licence (P0035-07) and overseen by the AAL facility’s Environmental Management System.

The BRDA does not import and accept waste from external sources and the AAL facility does not export bauxite residue wastes to other sites. The BRDA waste infrastructure is itself excluded from the assessment in this Chapter as the Proposed Development seeks to increase the capacity of the BRDA, to which this is (in part) the focus of this planning application and EIAR.

Material assets may be of either human or natural origin and the value may arise for either economic or cultural reasons. Aughinish Alumina Limited (AAL) is a waste producer and is required to to ensure that waste leaving the Site is sent to a suitably licensed facility for treatment or disposal. Therefore, the sensitive receptor for this assessment is identified as the waste management infrastructure capacity of external sites which may accept the waste streams generated during the construction and operation of the Proposed Development (the construction of raises to the BRDA and SCDC, as well as an extension to the Borrow-Pit).

## 13.2 Proposed Development

A general site layout of these individual features has been provided in Figure 13.1, and also includes the planning application boundary (red line) and the ownership boundary of AAL.

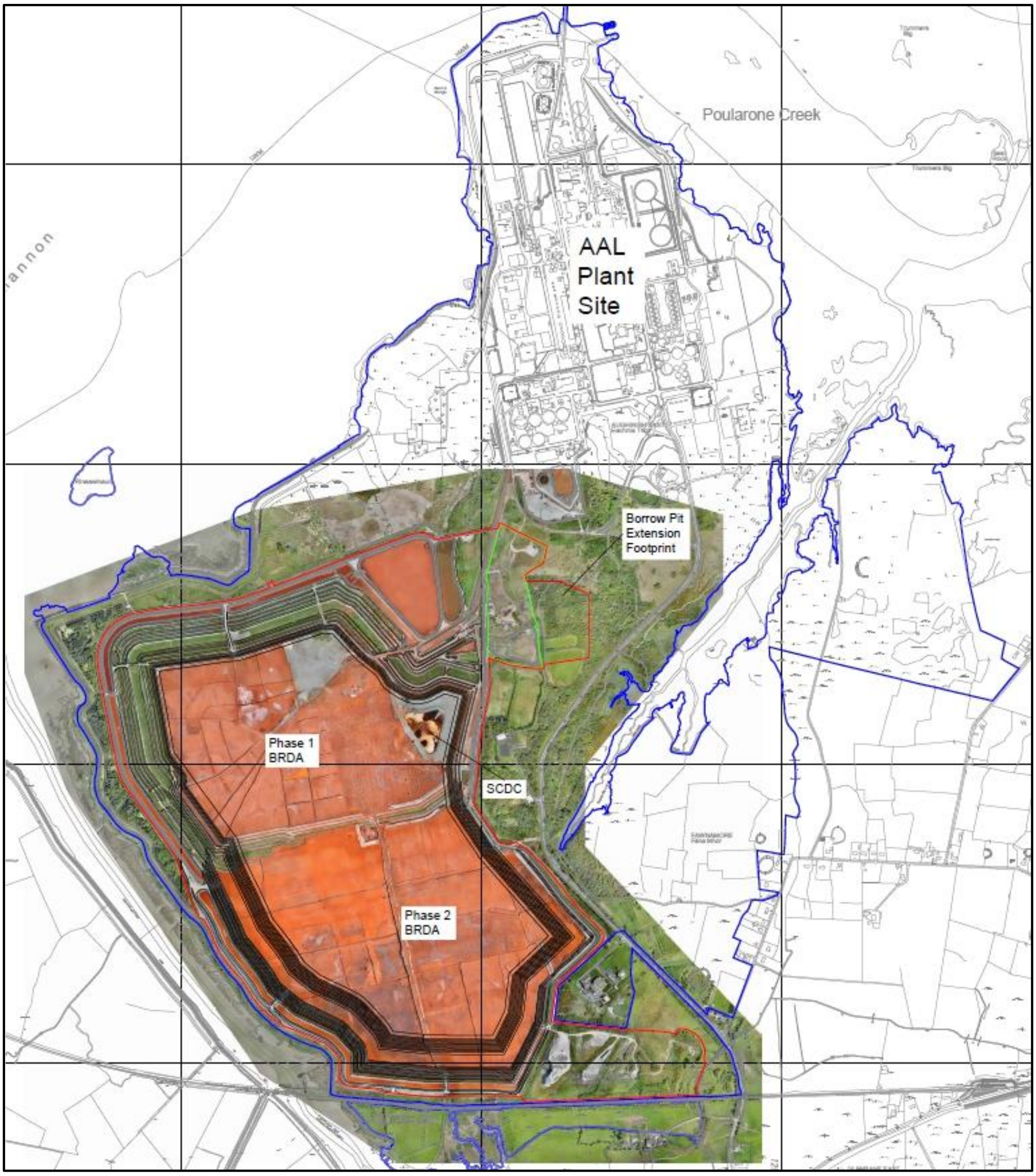


**Figure 13.1:** Site Location Map - Blue Line is the AAL Ownership Boundary, Red Line is the Application Boundary and Green Line is the permitted Borrow Pit Footprint

The proposed development consists of works to the Bauxite Residue Disposal Area (BRDA) comprising of an expansion to increase its disposal capacity to accommodate additional bauxite residue arising from the continued operation of the permitted alumina refinery plant located on the wider AAL facility. The proposed increase in disposal capacity to the BRDA will result in a proposed increase in height of c.12m above the currently permitted stage 10 level (c. 32m OD) to a final stage 16 level (c. 44m OD). No increase to the existing footprint of the BRDA is proposed.

The proposed method of raising the BRDA will be the upstream method, consistent with the construction methodology for the current BRDA and involves the construction of rock fill embankments (Stages), offset internally and founded on the previously deposited and farmed bauxite residue, in 2 m high vertical lifts. The overall stack is raised systematically as the stages are filled with bauxite residue, farmed, carbonated and compacted, prior to deposition of the next layer.

Additional works proposed as part of this application include the following:

- A vertical extension to the existing Salt Cake Disposal Cell (SCDC) to accommodate further disposal of salt cake resulting in an increase in height of c.2.25m. The SCDC is located within the BRDA. A description of the SCDC and its function is provided in Chapter 2 of this EIAR.

- An extension of the existing borrow pit, located to the east of the BRDA, is also proposed. This extension proposes to increase the footprint of the borrow pit from c.4.5ha to c.8.4ha. This expansion will provide an additional 385,000$m^3$ of rock fill material which is needed to satisfy the requirements of the construction and operation of the BRDA.

- The continued use of an existing stockpile area at the south east of the subject site to store topsoil in order to satisfy the additional restoration requirements of the extended BRDA.

- Upgrades to the existing water management infrastructure to accommodate the BRDA development to Stage 16 which will also allow for greater Inflow Design Flood (IDF) capacity for the entirety of the BRDA.

Given that the proposed BRDA Raise and the proposed SCDC Raise sit entirely within the footprint of the existing BRDA, where reference is made to the BRDA within the following text, this will refer to both the BRDA and the SCDC areas unless otherwise stated.

Please refer to Chapter 3.0 of this EIAR and the Preliminary Engineering Design Report (enclosed in Appendix A) for a more detailed description of the Proposed Development.

## 13.3 Legislative Requirements and Policy

### 13.3.1 EIA Directive and Transposition

The requirement for an Environmental Impact Assessment (EIA) process arises from European Union (EU) Directives required to be adhered to by member States and transposed into national laws.

The European Union Directive 85/337/EC required that certain private and public projects which are likely to have significant resultant environmental impacts are subject to a formalised EIA prior to their consent (see Chapter 1 of this EIAR). This Directive was subsequently amended by the EU through three amendments: 97/11/EC, 2003/4/EC and 2009/31/EC, which were then codified in Directive 2011/92/EU. Subsequently, on 16 April 2014, Directive 2011/92/EU was amended by Directive 2014/52/EU of the European Parliament and of the Council.

Article 5 of the Environmental Impact Assessment (EIA) Directive (Directive 2011/92/EU, as amended by Directive 2014/52/EU) sets down the minimum information to be supplied in an EIAR, including data and information to be included by the developer, as identified in Paragraphs 1 to 10 of Annex IV of the EIA Directive. Paragraph 5 of Annex IV requires:
*A description of the likely significant effects of the project on the environment resulting from, inter alia:*

> *(c) the emission of pollutants, noise, vibration, light, heat and radiation, the creation of nuisances, and the disposal and recovery of waste;*

The 2014/52/EU Directive was transposed into Irish law through EU (Planning and Development) (Environmental Impact Assessment) Regulations 2018 (SI No. 296 of 2018) which amended the Planning and Development Act, 2000, and the Planning and Development Regulations, 2001.

### 13.3.2 Waste Management Legislation

The main legislation that governs waste management in Ireland and relates to the construction and demolition (C&D) activities at the Proposed Development site are:

- Waste Framework Directive 2008/98/EC. The Waste Framework Directive (Directive 2008/98/EC) sets down basic requirements for all EU member states for the handling of waste, and it also defines what is meant by “waste”. To comply with the Directive EU member states must:
    - Ensure that the waste disposal does not present a risk to air, water, soil, plants, and animals;
    - Waste disposal must not be allowed to constitute a public nuisance, (e.g., through noise, unpleasant odours, or the degradation of places of special natural interest);
    - Prohibit uncontrolled disposal of waste or illegal dumping;
    - Establish an integrated and effective network of waste disposal plants,
    - Ensure a proper licence system for waste collection and disposal operations; and
    - Audit and inspect entities involved in waste collection and disposal.

- Landfill Directive 1999/31/EC. This Directive seeks to further the aims of the 1991 Directive in relation to the role of the landfill. It aims to prevent, or reduce as far as possible, the negative effects on the environment from landfilling waste. In order to achieve this, it seeks to:

- End co-disposal of hazardous and non-hazardous waste in landfill;
- Introduce rigorous technical requirements for landfills and waste;
- Phase in the prohibition of landfilling specific wastes including liquid hazardous waste, other hazardous waste, whole tyres, and shredded tyres;
- Oblige operators to pre-treat all hazardous waste and all other wastes; and
- Introduce phased targets for the reduction of biodegradable waste being landfilled in 2010, 2013 and 2020.

- Waste Management Act 1996 (No. 10 of 1996) as amended 2001 (No. 36 of 2001), 2003 (No. 27 of 2003) and 2011 (No 20 of 2011). Sub-ordinate and associated legislation include:
  - European Communities (Waste Directive) Regulations 2011 (S.I. No. 126 of 2011) as amended;
  - Waste Management (Collection Permit) Regulations 2007 (S.I. No. 820 of 2007) as amended;
  - Waste Management (Facility Permit and Registration) Regulation 2007 (S.I No. 821 of 2007) as amended;
  - Waste Management (Licensing) Regulations 2000 (S.I No. 185 of 2000) as amended;
  - European Union (Packaging) Regulations 2014 (S.I. No. 282 of 2014) as amended;
  - Waste Management (Planning) Regulations 1997 (S.I. No. 137 of 1997) as amended;
  - Waste Management (Landfill Levy) Regulations 2015 (S.I. No. 189 of 2015);
  - European Communities (Waste Electrical and Electronic Equipment) Regulations 2014 (S.I. No. 149 of 2014);
  - Waste Management (Batteries and Accumulators) Regulations 2014 (S.I. No. 283 of 2014) as amended;
  - Waste Management (Shipments of Waste) Regulations 2007 (S.I. No. 419 of 2007) as amended; and
  - European Communities (Transfrontier Shipment of Waste) Regulations 1994 (SI 121 of 1994).

- Environmental Protection Act 1992 (No. 7 of 1992) as amended;

- Litter Pollution Act 1997 (No. 12 of 1997) as amended; and

- Planning and Development Act 2000 (No. 30 of 2000) as amended.

These Acts and subordinate regulations enable the transposition of relevant European Union Policy and Directives into Irish law.

### 13.3.3 National Waste Policy

In September 2020, the Department of Communications, Climate Action and Environment published 'Ireland's National Waste Policy 2020-2025' (A Waste Action Plan for a Circular Economy). This new national waste policy informs and gives direction to waste planning and management in Ireland over the coming years. The policy shifts the focus from waste disposal and treatment to ensure that materials and products remain in productive use for longer. This

aims to prevent waste and supports reuse through discouraging the wasting of resources and rewarding circularity.
The policy document contains over two hundred (200) measures across various waste areas including C&D. C&D waste related goals of the policy are to:

- Revise the 2006 Best Practice Guidelines for C&D waste;
- Streamline by-product notification and end-of-waste decision making processes; and
- Working group to develop national end-of-waste applications for priority waste streams.

The policy outlines the significant projected contributions that tonnes of soil and stone make to the overall C&D wastes between 2020 and 2022. These projections are provided below in Table 13.1.

| | 2020 | 2021 | 2022 |
|---|---|---|---|
| Total tonnes C&D Waste | 6,410,000 | 6,570,000 | 6,930,000 |
| Tonnes of Soil and Stone | 5,000,000 | 5,130,000 | 5,410,000 |

**Table 13.1:** Construction and Demolition Projections (Source: 'A Waste Action Plan for a Circular Economy, Ireland's National Waste Policy 2020-2025).

The policy identifies the need to promote waste prevention in the first instance and the need to plan for C&D wastes at the earliest possible stage in a construction project.

### 13.3.4 Southern Region Waste Plan

The Proposed Development is located within the Southern Waste Region.

The Southern Region Waste Management Plan (2015-2021) provides a framework for the prevention and management of waste in a sustained manner. A subsequent plan has not been published by the region to date. The plan was developed in consultation with the Department of the Environment, Community & Local Government (DECLG), the Environmental Protection Agency (EPA), and other stakeholders.

Targets of the Southern Region Waste Management Plan include: a reduction of 1% per annum in the amount of household waste; achieve a 50% recycling rate of managed municipal waste by 2020; and reduce to 0% the direct disposal of unprocessed residual municipal waste to landfill (from 2016 onwards) in favour of higher value pre-treatment processes and indigenous recovery practices. The Proposed Development will have potential for a limited element of municipal waste arisings from general site activities and personnel needs.

In December 2020, an addendum to the Southern Region Waste Management Plan (2015-2021) was published. This document (Construction & Demolition Waste Soil and Stone Recovery / Disposal Capacity - Update Report 2020) provided an update to the national C&D soil and stone recovery / disposal capacity.

### 13.3.5 Limerick City and County Council Waste Policies

The Limerick County Development Plan 2010-2016 (as extended) outlines that a Waste Management Plan was developed for Counties Limerick, Clare and Kerry (this Waste Management Plan has since been superseded by the Southern Region Waste Management Plan 2015-2021, see above).

The Development Plan includes policies in relation to waste to ensure that they should be managed in a manner that minimises its generation, maximise recycling and recovery and protects the environment.

## 13.4 Relevant Guidance

The 'Guidelines on the Information to be contained in Environmental Impact Assessment Reports', were published in draft format by the EPA in August 2017, (Draft 2017 EIAR Guidelines) with a view to facilitating compliance with the amended EIA Directive.

The Draft 2017 EIAR Guidelines identify headings under which to arrange the assessment of material assets. It is suggested these can be arranged under built 'services', (see Chapter 15 of this EIAR), Roads and Traffic, (see Chapter 14 of this EIAR) and Waste Management. However, there is no specific Irish guidance for how to conduct the assessment of material assets (including waste) in the context of EIA.

In the absence of specific guidance for this assessment on assigning significance, professional judgement, national and local policy and recognised best practice have been used to objectively assess the impact of the Proposed Development.

## 13.5 Assessment Methodology and Significance Criteria

### 13.5.1 Receptor and Study Area

The methodology of this Chapter of the EIAR does not follow the typical methodology as is used for other aspects/disciplines of the EIAR.

The Applicant as a waste producer is legally obliged to manage waste arisings in accordance with the relevant regulations. The Applicant is also required to ensure that waste leaving the Site is sent to a suitably licensed facility for treatment or disposal. These facilities who will be transferring, treating, or disposing of the waste must be either permitted / licenced or apply for an exemption from a permit / licence. Impacts arising from the operation of these facilities are considered as part of their planning and permitting process. Waste collectors are required by the Waste Management (Waste Collection Permit) Regulations 2007, (as amended), to have, and comply with conditions of, a Waste Collection Permit. These permits are administered and controlled by the National Waste Collection Permit Office.

Therefore, the sensitive receptor for this assessment is identified as the waste management infrastructure capacity of sites which may accept the waste streams generated during the construction and operation of the Proposed Development, (consisting of constructed raises to the BRDA and SCDC, as well as an extension to the Borrow-Pit). The geographical study area of the receptors will extend nationally as appropriate to define suitable waste management facilities.

This Chapter of the EIAR describes the likely direct and indirect significant effects of the Proposed Development on the Material Assets – Waste in the vicinity of the Application Site, and is supported by the baseline condition information, the preliminary Construction Environmental Management Plan (CEMP) and the Proposed Development design.
The aim of establishing significance of impacts is to provide a measure of the risks of disturbance to, or undue burden on existing Material Assets – Waste.

The Proposed Development design is understood to comprise the project design principles and standards adopted to avoid or prevent adverse safety and environmental effects, construction and operation to appropriate codes of practice and guidelines, and including fixed procedural commitments such as instrumentation and monitoring. This measure provides the baseline for the assessment of impacts.

The sensitivity of the BRDA waste management infrastructure has not been assessed in this Chapter as the application relates to the increase in capacity of the existing BRDA facility to accommodate the facility's own bauxite residue (and salt cake material). The operation of the overall AAL facility is intrinsically linked to the consent and the capacity of the BRDA. The BRDA impoundment at the AAL facility only accommodates bauxite residue and salt cake waste material produced at the facility and does not import wastes from off-site sources. Therefore, there is no onus on the BRDA to accept waste from anywhere other than the on-site processes. Similarly, the AAL facility does not export these waste streams off-site to other facilities. Therefore, there is no pressure on external facilities to accept these wastes from the AAL facility. This link between the operation and the waste results in neutral effects on the BRDA waste management infrastructure.

A Do-Nothing scenario, where the Proposed Development is not permitted, would result in the eventual cessation of operations at the AAL facility in line with existing permission, the industrial emissions licence (IEL) and closure requirements. This cessation includes the production of bauxite residue and salt cake material.

## 13.6 Existing Environment

### 13.6.1 General Aspects of the Surrounding Environment

The AAL facility is located on the southern side of the Shannon Estuary, near the village of Foynes, Co. Limerick. This is approximately 6 km north-west of Askeaton and approximately 30 km west of Limerick City. The Application Site is located on Aughinish Island, Island MacTeige, Glenbane West and Fawnamore, within the property of the long-established alumina refinery facility operated by AAL on their circa 601 ha. landholding. Aughinish Island and the surrounding areas are predominantly rural in character with the remaining land usage comprising agriculture, single low density residential housing and protected habitats (wetlands and grasslands).

The current activities being undertaken at the Subject Site relate to EPA licenced waste management activity. It is the policy of AAL to achieve compatibility between the environment and the processes and products of its operations and waste is controlled and reported as an integral part of business.

As required by Industrial Emissions Licence P0035-07, AAL has developed a Waste Management Manual. This manual outlines the waste management principles applied at AAL and are intended to assist effective waste management.

The manual also provides details for the following aspects of waste management: types of waste generated, list of licensed waste disposal contractors, waste control forms for particular waste streams and waste management procedures. The principles of waste hierarchy, in accordance with the Waste Management Act (Section 21(A)) are applied as a priority order of:

1) Waste prevention;
2) Waste minimisation;
3) Waste recycling / reuse;
4) Waste recovery; and
5) Waste disposal

Examples of waste streams currently generated at the AAL facility, and those can be expected to be generated by the Proposed Development and how they are managed are detailed below:

- Waste oil from certain equipment is reused as lubricant for other equipment e.g., bauxite unloader, portal scraper, thereby minimising the quantity of waste oil generated at the site.

- Waste construction rubble, generated onsite, is used for road construction in the BRDA.

- Cardboard, paper, vegetable oils and greases, waste food and wood are segregated onsite for collection by a waste collection contractor and recycled off-site.

- Plastic containers and waste oil are collected by a waste collection contractor and recycled off-site for oil re-fining.

- The following waste streams are segregated onsite to allow for recycling, recovery or disposal offsite: batteries, cardboard, timber, aerosol cans, asbestos, canteen waste, clinical waste, fluorescent light tubes, plastic drums and containers, hazardous material, radioactive sources, oil filters, oily rags, plastic, rubber, printer cartridges and scrap metal.

The arising wastes from the Proposed Development will be managed and reported in line with existing waste management practices at the overall AAL facility, and in accordance with the waste records and reporting requirements of the facility’s IE Licence (P0035-07; Condition 11.13).

### 13.6.2 National Construction and Demolition Waste Arisings

The EPA’s construction and demolition waste statistics for Ireland, (data release date 22 September 2020), provide a breakdown of the respective waste streams for the latest reference year (2018).

| C&D Waste Type | Tonnage | Percentage of Total Tonnage |
|---|---|---|
| Soils, stones & dredging spoil | 4,786,162 * | 77.00% |
| Concrete, brick, tile & gypsum | 755,526 | 12.10% |
| Mixed C&D waste | 414,984 | 6.70% |
| Metal | 179,043 | 2.90% |
| Bituminous mixtures | 60,759 | 1.00% |
| Segregated wood, glass & plastic | 23,068 | 0.40% |
| **Total** | **6,219,541** | **100%** |
| *** The quantity of hazardous contaminated soil generated in Ireland in 2018 amounted to 93,645 tonnes** | | |

**Table 13.2:** Construction and Demolition Waste Composition for Republic of Ireland (EPA 2018).

Table 13.3 and Figure 13.2 below, identify the number of landfills and incinerators in the country which accept municipal wastes[1]. There has been a decrease in the number of landfill facilities in recent years with only three (3) landfills accepting municipal waste for disposal in 2020. These landfills and their annual waste disposal and recovery acceptance tonnages are provided in Table 13.4.

As noted previously, the Proposed Development will have potential for a limited element of municipal waste arisings from general site activities and personnel needs.

Although the wastes generated by the Proposed Development will predominantly consist of construction and demolition waste it is important to consider the decreasing landfill capacity available nationwide. Further data for the authorised capacity for other types of waste management infrastructure including material recovery facilities and construction and demolition waste treatment facilities were not summarised in the 2020 EPA data release.

| | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| No. of landfills accepting municipal waste for disposal | 29 | 31 | 28 | 28 | 21 | 18 | 11 | 9 | 6 | 7 | 5 | 5 | 4 | 3 |
| No. of municipal waste incinerators | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 |

**Table 13.3:** No. of Operational Municipal Landfills and Incinerators from 2007 to 2020 (EPA 2020).

[1] The ultimate option for location of waste disposal will be dictated by the licensed waste collection contractors.

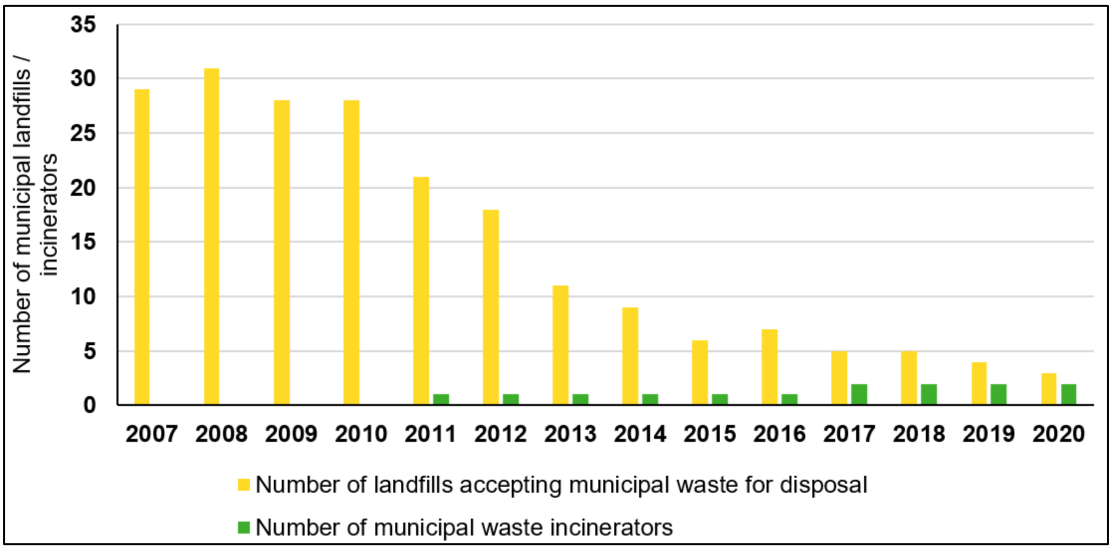


**Figure 13.2:** No. of Operational Municipal Landfills and Incinerators from 2007 to 2020 (EPA 2020).

| Authorisation / EPA Waste Licence Number | Facility Name and Location | Waste for Disposal (maximum tonnes per annum) | Waste Types for Disposal (maximum tonnes per annum) | Waste Types for Recovery (maximum tonnes per annum) |
|---|---|---|---|---|
| W0146 | Knockharley Landfill Co. Meath | 175,000 | 100,000 household 45,000 commercial 30,000 industrial | 25,000 construction & demolition, 70,000 inert waste |
| W0165 | Ballynagran Residual Landfill Co. Wicklow | 175,000 | 62,500 household 67,500 commercial 45,000 industrial | 28,000 construction & demolition |
| W0201 | Drehid Waste Management Facility Co. Kildare | 120,000 | 120,000 non-hazardous municipal, commercial and industrial wastes | No limit for inert waste, where used in landfill engineering |

**Table 13.4:** Operational Municipal Landfills in 2020 (EPA 2020).

## 13.7 Characteristics of the Proposed Development

### 13.7.1 Waste Management

A variety of waste streams are expected to be generated by the Proposed Development during its preparatory, construction, operational and closure stages.

All waste generated, whether from the operation of Plant or BRDA activity, or from construction activity in the Application Site during the construction or operation of the Borrow Pit Extension, the BRDA stage raises or the SDCC raise, is the responsibility of AAL as the originator in accordance with the licence. All transporting of waste off-site is undertaken by AAL via licenced waste contractors.

Therefore, contractors are only responsible for the sorting and internal transport to the designated internal waste transfer locations and notification to AAL of the appropriate units of construction waste generated within the Application Site.

The Main Contractor will be responsible for the development of a final construction and operational plan, and to develop final quantities of materials, and construction methodologies and approaches. Quantities of construction waste materials may vary depending on such methodologies. Therefore, the difficulty of estimating waste quantities is noted which depends on the approach of the appointed Main Contractor.

During construction/operation these quantities may be subject to change during the relevant phase. Their plans will incorporate the elements to promote sustainable waste management in line with the waste hierarchy, and also focus on integrating good site management practices to ensure efficiency and reduce potential for any other negative environmental effects.

An anticipatedlist of construction waste categories which may be generated during the construction phase of the Proposed Development have been identified below and the appropriate European Waste Catalogue (EWC) Code[2] for these wastes has been identified in Table 13.5. Overall, the waste arisings from any building works, demolition and development are referred to as 'Construction and Demolition Waste' in accordance with industry standards. The specific potential streams from the Proposed Development are set out below.

**Site Preparation Waste**

No waste soils are generated by the construction of the BRDA stages raises or by the raise of the SCDC. Bauxite residue removed by grading and levelling works during the preparation of the formation for the stage raise or the cell walls will be deposited locally in the BRDA.

Soils to be removed at the proposed Borrow Pit site are not categorised as waste; but are considered to be a material asset. The overburden consisting of the topsoil and subsoil at shallow depths ( > 1m) will be used for the creation of screening berms for the Borrow Pit.

These materials will be stockpiled at appropriate locations nearby or hauled directly for use in the construction of the screening berms. Any surplus soil materials will be hauled to the stockpile yard to the south east of the BRDA and will be available for future landscaping and/or restoration works, where the topsoil and subsoil are important materials for restoring the site successfully. It is essential that these materials are carefully handled and stored, in order to retain the productivity of the soil.

**Demolition Waste**

The Proposed Development activities will not generate demolition waste streams.

[2] These codes are referred to in reporting of waste generations to the EPA under IE Licencing arrangements for P0035-07)

**Construction and Operational Waste**

There is very little construction activity associated with the extraction of materials from the Borrow Pit Extension. As set out above, the overburden consisting of topsoil and subsoil will be stockpiled for future landscaping and restoration works associated with closure works. No overburden soils will be transported off site. The proposed extraction works are to be carried out above the groundwater table and therefore there will be no additional water generated at the Borrow Pit Extension site for disposal.

Limited construction and operational wastes are expected generated during the construction of the BRDA stages raises, the SCDC raise and the BRDA closure woks. The Borrow Pit materials (processed rock fill) will be used for the construction of the stage raises, the cell walls for the SCDC and in the construction of the capping containment and spillways.

Geosynthetic materials, including geotextile, geosynthetic clay liner (GCL), geomembrane and concrete canvas, will be used in the construction of the BRDA stage raises (geotextile separation layer placed beneath the rock fill), in the construction of the SCDC raise (geotextile separation layer beneath the rock fill and geotextile, GCL and geomembrane for the lining system) and in the BRDA closure works (concrete canvas for the lining of the spillways and dome perimeter channel). Scraps and offcuts from the geosynthetic materials, that are not of sufficient size for reuse, will be collected at work area and placed in the appropriate recycling area in the Plant. It is anticipated that the majority of limited wastes generated will be suitable for reuse, recovery or recycling and will therefore be segregated to facilitate the reuse, recovery and/or recycling, wherever possible.

Limited maintenance of site vehicles is undertaken within the Subject Site, and all maintenance wastes including lubricants are transported back to the waste transfer storage areas at the AAL facility for off-site disposal in compliance with the terms of the facility's IE Licence.

**Expected Non-Hazardous Waste Streams to be associated with the Proposed Development**

- Scrap and offcuts of geosynthetic materials (geotextile, GCL, geomembrane and concrete canvas)
- Scrap metal;
- Concrete;
- Cardboard and other packaging;
- Plastic including wrapping and packaging;
- Waste wood;
- Paper;
- Glass
- Tyres
- Sewage waste from onsite portable toilets
- Uncontaminated clean cloths and rags used in various site activities
- Mixed municipal general wastes; and
- Damaged materials.

**Expected Hazardous Waste Streams to be associated with the Proposed Development**

- Oily and contaminated rags from vehicle and plant maintenance;
- Batteries; and
- Waste oils, fuels and lubricants from machinery and equipment.

| Waste Material | LoW / EWC Code |
|---|---|
| Concrete, bricks, tiles and ceramics | 17 01 |
| Bricks | 17 01 01 |
| Mixture of concrete, bricks, tiles & ceramics | 17 01 07 |
| Wood, Glass and Plastic | 17 02 |
| Wood | 17 02 01 |
| Glass | 17 02 02 |
| Plastic | 17 02 03 |
| Metals (including their alloys) | 17 04 |
| Copper, Bronze, Brass | 17 04 01 |
| Aluminium | 17 04 02 |
| Lead | 17 04 03 |
| Zinc | 17 04 04 |
| Iron and Steel | 17 04 05 |
| Tin | 17 04 06 |
| Mixed Metals | 17 04 07 |
| Paper and Cardboard | 20 01 01 |
| Wood other than that mentioned in 20 01 37 | 20 01 38 |
| Hydraulic oils | 13 01 01* |
| Fuel oils and diesel | 13 07 01* |
| Aqueous liquid waste other than those mentioned in 16 10 01 (to be considered for portable toilet wastes) | 16 10 02 |
| Batteries – lead acid | 16 06 01* |
| Tyres | 16 01 03 |
| Absorbents, filter materials (including oil filters not otherwise specified), wiping cloths, protective clothing contaminated by hazardous substances | 15 02 02* |
| Absorbents, filter materials, wiping cloths and protective clothing other than those mentioned in 15 02 02 | 15 02 03 |
| Mixed municipal waste | 20 03 01 |
| Cesspit/septic tank sludge and chemical toilet waste | 20 03 04 |

**Table 13.5:** Typical C/D Waste Materials that have potential to arise during the Construction of the Proposed Development

## 13.8 Potential Effects

Limited tonnes of wastes will be generated from the maintenance of mobile plant and equipment associated with the extraction process at the Borrow Pit Extension, the construction of the BRDA stage raises, the SCDC raise and the BRDA closure woks. Any such waste generated will be appropriately managed and segregated on site and will be dealt with through permitted waste collectors and via licensed waste facilities.

The construction activities will mostly consist of the placement of extracted stone for the raise of the BRDA, the raise of the SCDC and the BRDA closure works. A summary of the construction and demolition waste streams that are anticipated to be exported from the Site has been provided in Table 13.6 below. Worst-case estimates of anticipated waste tonnages have been provided based on previous waste tonnages generated at the overall AAL facility and professional experience of similar sized developments and projects.

Wastes generated currently at the overall AAL facility include limited quantities generated at the ongoing construction of BRDA raises. Therefore, the quantities predicted reflect the waste quantities which can be expected to be generated at the Proposed Development. Various waste streams generated by the overall AAL facility are appropriately recycled and recovered.

However, in order to establish a worst-case scenario, it is assumed for the purpose of this assessment that all the wastes will be removed from site for disposal and not recovered or reused.

| Broad Categories of Waste Material | Anticipated annual tonnages for off-site disposal * (tonnes/year) |
|---|---|
| Scrap metal | < 1 |
| Scrap and offcuts from geosynthetic materials | < 2 |
| Cardboard and other packaging | < 1 |
| Plastic including wrapping and packaging | < 1 |
| Waste wood | < 1 |
| Paper | < 1 |
| Glass | < 1 |
| Damaged materials, e.g., geosynthetic materials | < 2 |
| Batteries | < 1 |
| Oils, fuels and lubricants from machinery and equipment | < 2 |
| Oily rags and cloths | < 1 |

**** The quantity waste generated will be dependent on Main Contractor work practices and methods. These quantities are based on a review of previous waste tonnages generated at the overall AAL facility between 2017 and 2019 and professional judgement of similar projects from which Golder has experience.***

**Table 13.6:** Expected Annual Waste Quantities to be produced from the Construction of the Proposed Development.

The estimated waste tonnages have been compared to the quantity of construction and demolition waste collected in Ireland in 2018. Taking these conservative assumptions of anticipated quantities, it is estimated that the annual amounts generated are approximately 0.0002% of the total national construction and demolition waste arisings (EPA 2018).

This impact is considered to be **'adverse'** and **'imperceptible'**, which is 'an effect capable of measurement but without significant consequences' based on terminology defined in the EPA's Draft 2017 EIAR Guidelines, (EPA, 2017).

## 13.9 Do-Nothing Scenario

There would be **negligible** impacts and **imperceptible** effects on waste management facilities should the Proposed Development not be constructed.

## 13.10 Mitigation and Management

The potential impacts associated with the waste management of the Proposed Development are expected to be imperceptible, therefore no additional mitigation measures are required.

Uncertainty in quantities have been primarily and appropriately addressed by making assumptions that have conservatively overestimated rather than underestimated potential effects, i.e., a precautionary assessment. Waste quantities estimated were based on previous quantities generated by the overall AAL facility for certain waste streams and furthermore, it was assumed that all wastes will be removed from site for disposal and no waste recovered or reused. Although this effect has been assessed as imperceptible, impacts would be further reduced as there is a realistic potential for waste to be recovered or reused. The level of recuse of recovery is impossible to determine at this stage and will be dependent on the detailed design and construction activities associated with the proposed development. The operations will continue to be operated in accordance with all applicable waste legislation and the conditions of the facility's IE Licence for the lifetime of the proposed development.

Monitoring would be used to address residual uncertainty by AAL and the Main Contractor evaluating the quantities of wastes generated by the Proposed Development. Best practice management measures to be applied on site are set out in Section 13.10.1 below

### 13.10.1 Waste Management Practice Measures

- All waste generated, whether from the operation of Plant or BRDA activity, or from construction activity in the Application Site during the construction or operation of the Borrow Pit Extension, the BRDA stage raises or the SDCC raise, is the responsibility of AAL as the originator in accordance with the licence. All transport of waste off-site is undertaken by AAL via licenced waste contractors and AAL is responsible for waste document control.

- The Main Contractor will implement the AAL waste management policies.

- The Main Contractor will be responsible for collecting, sorting and quantifying the wastes generated during the Proposed Development activities.

- The Main Contractor will be responsible for defining and maintaining temporary waste storage on a daily basis during the construction phase i.e., skips, bins or other appropriate waste containers. Waste materials gathered will be transferred on a daily basis by the Contractor to the designated waste transfer storage sites in the Plant Area which are managed by AAL. These designated waste transfer storage sites are secured and provide for appropriate segregation of waste materials.

- All waste materials which are required to be disposed off-site will be reused, recycled, recovered or disposed of at an appropriate facility which holds appropriate registration, permit or licence. AAL as waste originator shall hold copies of these registrations and will ensure that only operators with current (in date) authorisations are used.

- A waste collection docket must be issued to the waste collector by AAL. If being transported to another site, a copy of the waste permit or EPA Waste Licence for that site must be provided to AAL. As well as a waste collection docket, a receipt from the destination of the material will be kept by AAL as part of the onsite waste management records.

- All materials being transferred from the site, whether for recycling or disposal, will be subject to a documented tracking system which can be verified and validated. This information will include the below at a minimum:
    - Date and time of removal;
    - Waste type and description;
    - EWC Code;
    - Tonnage of waste;
    - Name of waste collection contractor;
    - Waste collection contractor’s permit number;
    - Waste collection receipt;
    - Vehicle registration number;
    - Driver’s details;
    - Destination of waste; and
    - Waste Permit / Licence number of destination facility.

- Training will be provided to all staff on waste management including prevention, segregation and best practice guidelines.

### 13.10.2 Monitoring

Waste generated will be monitored by AAL throughout the construction of the Proposed Development. Records will be kept by AAL of all waste moved from the Site.

Waste sources will be closely monitored by AAL to proactively minimise the amount of waste produced as a result of the Proposed Development.

Such monitoring supplemented by regular waste audits assist in determining the effectiveness of the site's waste management system and can be used to as one of the tools to continuously improve performance.

## 13.11 Residual Impacts

No residual impacts are anticipated. Following implementation of the best practice measures outlined the residual impact significance is considered to remain **'adverse'** and **'imperceptible'.**

## 13.12 Difficulties Encountered

As noted previously, quantities of construction waste materials may vary depending on final construction methodologies. Therefore, there was difficulty in estimating waste quantities which will be dependent on the approach of the appointed Main Contractor.
To resolve this, the quantities determined were based on professional experience of similar projects, a review of the wastes generated by the overall AAL facility and identification of waste streams that can be considered applicable to the ongoing construction of BRDA raises and the worst-case waste estimates assuming that the wastes will be removed from site for disposal and not recovered or reused.

No other particular difficulties were encountered in obtaining data and undertaking the assessment of Material Assets – Waste.

## 13.13 Summary and Conclusions

Due to the nature and minor quantities of the waste generated and the use of the AAL existing waste management procedures, there will be imperceptible impact on the receiving environment and waste management infrastructure as a result of the preparatory, construction, operational and closure phases of the Proposed Development.

## 13.14 References

Environmental Protection Agency. August 2017.Guidelines on the information to be contained in Environmental Impact Assessment Reports. Published in 'Draft'.

Environmental Protection Agency. September 2015. Advice Notes for Preparing Environmental Impact Statements'. Published in 'Draft'.

Southern Region Waste Management Plan 2015-2021 (Published: 2015).

Construction & Demolition Waste Soil and Stone Recovery / Disposal Capacity – Update Report 2020.

Eastern Midlands Region / Connacht Ulster Region / Southern Region Waste Management Plans 2015 – 2021

Department of Communications, Climate Action and Environment, 2020. Ireland's National Waste Policy 2020-2025 (A Waste Action Plan for a Circular Economy).

Government of Ireland / Eastern Midlands Region / Connacht Ulster Region / Southern Region, 2020.

Construction & Demolition Waste Soil and Stone Recovery / Disposal Capacity - Update Report 2020.

# 14.0 TRAFFIC AND TRANSPORT

## 14.1 Introduction

### 14.1.1 Background

Transport Insights has been commissioned by Tom Phillips and Associates on behalf of Aughinish Alumina Ltd (AAL) to prepare an Environmental Impact Assessment Report (EIAR) Traffic and Transport Chapter in support of a proposed development at Aughinish Alumina, Aughinish Island, Askeaton, Co. Limerick.

The refinery, operated by AAL, is a long-established alumina extraction plant, located on Aughinish Island. The industrial activity undertaken at the site comprises the processing of bauxite in order to extract alumina (aluminium oxide) which is required for the production of aluminium as well as having a number of other industrial uses.

### 14.1.2 Overview of Development Proposals

The proposed development consists of works to the Bauxite Residue Disposal Area (BRDA) comprising of an expansion to increase its disposal capacity to accommodate additional bauxite residue arising from the continued operation of the permitted alumina refinery plant located on the wider AAL facility. The proposed increase in disposal capacity to the BRDA will result in a proposed increase in height of c.12m above the currently permitted stage 10 level (c. 32m OD) to a final stage 16 level (c. 44m OD). No increase to the existing footprint of the BRDA is proposed.

The proposed method of raising the BRDA will be the upstream method, consistent with the construction methodology for the current BRDA and involves the construction of rock fill embankments (Stages), offset internally and founded on the previously deposited and farmed bauxite residue, in 2 m high vertical lifts. The overall stack is raised systematically as the stages are filled with bauxite residue, farmed, carbonated and compacted, prior to deposition of the next layer.

Additional works proposed as part of this application include the following:

- A vertical extension to the existing Salt Cake Disposal Cell (SCDC) to accommodate further disposal of salt cake resulting in an increase in height of c.2.25m. The SCDC is located within the BRDA. A description of the SCDC and its function is provided in Chapter 2 of this EIAR.

- An extension of the existing borrow pit, located to the east of the BRDA, is also proposed. This extension proposes to increase the footprint of the borrow pit from c.4.5ha to c.8.4ha. This expansion will provide an additional 380,000m$^3$ of rock fill material which is needed to satisfy the requirements of the construction and operation of the BRDA.

- The continued use of an existing stockpile area at the south east of the subject site to store topsoil in order to satisfy the additional restoration requirements of the extended BRDA.

- Upgrades to the existing water management infrastructure to accommodate the BRDA development to Stage 16 which will also allow for greater Inflow Design Flood (IDF) capacity for the entirety of the BRDA.

Given that the proposed BRDA Raise and the proposed SCDC Raise sit entirely within the footprint of the existing BRDA, where reference is made to the BRDA within the following text, this will refer to both the BRDA and the SCDC areas unless otherwise stated.

Please refer to Chapter 3.0 of this EIAR and the Engineering Design Report (enclosed in Appendix A) for a more detailed description of the proposed development.

### 14.1.3 AAL Traffic Characteristics

Traffic generation associated with the operation of the existing site predominantly consists of employee and permanent contractor car trips and HGV delivery trips. Internal site traffic movements are also required as part of the operation of the facility. Bauxite residue is deposited within the BRDA by way of piped infrastructure and is not transported by vehicle. The main source of internal transport movements to the BRDA from the main plant area relate to the transport of process sand (from the sand separation area) to the BRDA using a dumper truck and internal HGV trips transporting salt cake material from the organic removal facility with the plant area to the BRDA also using a dumper truck. Other internal trips primarily relate to the movement of vans onsite, with the exception of a large crane which travels across the site once per week.

The plant has a total of 482 no. permanent employees as well as 385 no. long-term contractors in a variety of administrative, maintenance and operational roles, with shift work patterns applicable for many employees. The site operates 24 hours per day 7 days per week, with employees of the facility working on a rolling shift basis.

External HGV trips on the local road network currently include those associated with the sourcing of rock material (c. 1,000 tonnes per day during a ca. 20 to 24-week period), and other plant activities such as importation of certain raw materials. These external HGV trips sourcing rock material for the ongoing construction of the BRDA will cease once the operation of the permitted Borrow Pit commences in April 2022.

### 14.1.4 Recent Relevant Planning History

Planning permission was granted for the expansion of the existing alumina production facility to produce 1.95 million tonnes per annum (mtpa) of alumina on 16th February 2007 (LCC Reg. Ref. 05/1836 ABP Ref. PL13.217976.) As part of the grant of that permission, it was proposed that rock required to facilitate ongoing production of alumina would be sourced from external quarries.

Planning permission was granted for the extraction of c. 374,000 m³ of rock on a site of c. 7 hectares (and extraction area of c. 4.5 hectares) adjoining the existing AAL plant on 13 November 2018. Works arising from this permission are due to commence in April 2022. In terms of traffic implications, a reduction in HGV traffic on the local road network would occur as a result of the implementation of this permitted development.

Planning permission for a new nature trail and upgrade of an existing nature trail, construction of a car park comprising 29 no. car parking spaces, and new vehicular access at Fawnamore & Aughinish East, Aughinish Island was granted by LCCC on 18 May 2021. This development is considered to represent formalisation of existing demand for car parking (which occurs adjacent to the local road at present) and thus the traffic impact of the development is considered to be negligible.

The proposed Foynes to Limerick Road (Including Adare Bypass) scheme is currently under review by ABP with the proposed scheme due to be decided by 26th November 2021 (ABP Ref. 306146; ABP Ref. 306199). This scheme is anticipated to result in lower levels of vehicular traffic on N69 following its completion.

### 14.1.5 Contents of this Chapter

The remainder of the Chapter is structured as follows:

- Section 14.2 outlines the methodology pursued in undertaking the study;
- Section 14.3 describes the receiving environment within the site and its locality;
- Section 14.4 outlines likely significant impacts arising from the development;
- Section 14.5 investigates potential mitigation measures;
- Section 14.6 presents any cumulative impacts;
- Section 14.7 addresses residual impacts
- Section 14.8 sets out interactions with other EIAR chapter authors; and
- Section 14.9 provides a summary of difficulties encountered in drafting this chapter.

## 14.2 Methodology

This study examines the operation of the existing road network and the potential traffic impacts of the proposed development. If necessary, suggested mitigation of identified development related impacts shall also be detailed.

This chapter has been prepared taking into account the following policy documents:

- Limerick County Development Plan 2010-2016 (as extended);
- EPA (2002) Guidelines on the Information to be Contained in Environmental Impact Statements;
- EPA (2003) Advice Notes on Current Practice in the Preparation of Environmental Impact Statements;
- EPA (September 2015) Advice Notes for Preparing Strategic Environmental Assessments;
- EPA (August 2017) Draft Guidelines on the Information to be Contained in Environmental Impact Assessment Reports;
- Transport Infrastructure Ireland's (TII) Traffic and Transport Assessment Guidelines (2014);
- TII (2017) Rural Road Link Design (DN-GEO-03031)
- TII (2016) Project Appraisal Guidelines for National Roads Unit 16.1 – Expansion Factors for Short Period Traffic Counts;
- TII (2019) Project Appraisal Guidelines for National Roads Unit 5.3 – Travel Demand Projections; and
- Other relevant TII Publications (Standards).

## 14.3 Receiving Environment

### 14.3.1 Introduction and Site Location

An assessment of the site's receiving environment was undertaken on Thursday 21st January 2021. Weather conditions on the day of the assessment were noted as being wet and cool. The local area is mostly agricultural in nature with a limited number of residential dwellings within the site's general vicinity. The application site's location is shown in Figure 14.1, which follows.

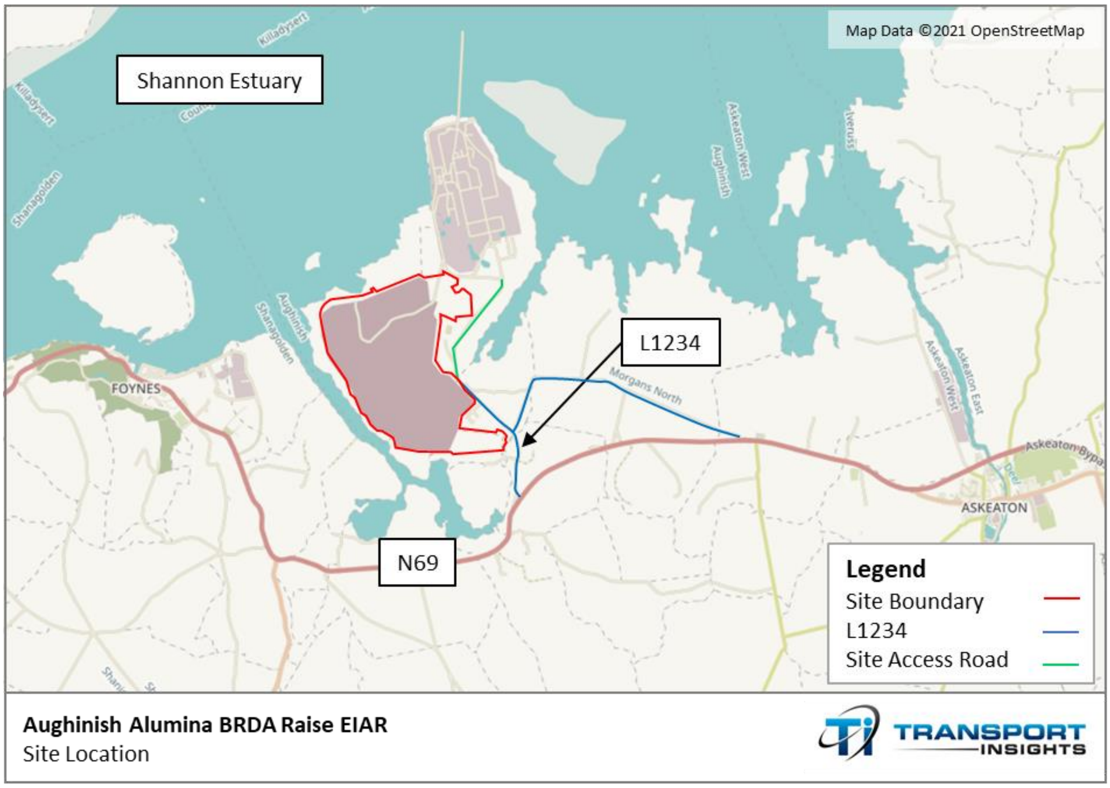


**Figure 14.1:** Site Location

### 14.3.1 L1234

L1234 is a two-way local road with one lane in each direction, and as illustrated in Figure 14.1, it connects the AAL site to the N69 at either Glenbane (east) and Toomdeely (east). The western section of the L1234, which represents the access road to Aughinish Island, runs in a north-south alignment, where it transitions into the site access road approximately 1.5 kilometres from its junction with the N69.

For the purposes of this EIAR Chapter and associated analysis, from this point onwards, all L1234 references relate to the section of road between N69 at Glenbane and the AAL site access road (i.e. L1234 references do not relate to the eastern section of the road, the latter of which has an inferior layout and alignment and predominantly serves a local access function to properties located along its length, and is not traversed by site-related HGV traffic).

L1234's carriageway is ca. 7.0 metres wide (although the road's width varies throughout its length from ca. 6.0 metres to ca. 8.0 metres between the site and N69), and was observed to have a gentle meandering horizontal alignment along sections of the road. Numerous slight changes to the road's vertical alignment were also noted.

A posted speed limit of 80 km/h is in operation on L1234, with a 50 km/h speed limit posted at the point where it transitions to the site access road. As a local rural road, no footpaths or street lighting are present on L1234.

L1234 was noted to operate satisfactorily during the site assessment, and both its alignment and operating conditions are deemed suitable for the nature and volume of traffic observed to use the road. Traffic volumes and speeds were both noted to be low. Low numbers of pedestrians and cyclists were observed during the assessment. It is noted however that such traffic demand observations (on Thursday 21 January 2021) may not have been representative of typical conditions due to potential COVID-19 related changes to traffic patterns. It should also be noted that a traffic survey was undertaken on L1234 during April 2021 with survey results set out within Section 14.3.5 of this EIAR.

The following Figure 14.2 illustrates L1324 facing southeast ca. 300 metres before L1234 transitions into the AAL site access road.

**Figure 14.2:** L1234 Aughinish Road

### 14.3.2 N69

N69 is a national secondary road that connects Limerick City with Tralee. N69 has one lane in each direction in the vicinity of the junction with L1234 at Glenbane East, however a dedicated right-turn lane provides access to L1234 for southwest bound traffic. N69 is approximately 7.0 metres wide, although both its width and alignment change significantly throughout its length. A 100 km/h speed limit is in operation on N69.

Based on the specification of N69, i.e. its type (single lane in each direction with a carriageway of ca. 7.0 metres), its edge treatment (hard strips and/ or hard shoulders at varying locations), and the access and junction treatments along the road (i.e. relatively few accesses and the provision of ghost islands at junctions where necessary), the theoretical capacity of the N69 had been conservatively estimated as 8,600 AADT[1] for Level of Service (LOS) D.

Figure 14.3 (overleaf) illustrates N69 in close proximity to the L1234/ N69 junction (to southwest of junction, facing southwest).

[1] Extracted from Table 6.1 Recommended Rural Road Layouts, from TII Publication Rural Road Link Design (DN-GEO-03031), 2017

**Figure 14.3:** N69 at Glenbane East

### 14.3.3 L1234/ N69 Junction

L1234 is connected to N69 via a priority (stop) controlled junction. A dedicated right-turn lane is provided for traffic accessing L1234 from N69 from the northeast. Additionally, separate left- and right-turn lanes are provided on the L1234 arm for traffic accessing N69 from the L1234. A local road connects the N69 to L1234 to the west of the junction, however due to its narrow width, it predominantly serves a local access function to properties located along its length.

It should be noted that a number of layout enhancements have been implemented at the N69/ L1234 junction during 2004 to improve its safety performance, including the provision of a right-turn lane on the N69 southwest-bound carriageway. Further minor signing and lining changes were implemented by LCCC following completion of a Stage 3 Road Safety Audit in October 2005 in support of the previous EIA for the site (Reg. Ref. 05/1836 ABP Ref. PL13.217976).

Figure 14.4 illustrates the L1234/ N69 junction with N69 in the foreground and L1234 in the background (right hand side) of the photograph.

**Figure 14.4:** L1234/ N69 Junction at Glenbane East

### 14.3.4 Survey Data Collection

An Automated Traffic Count (ATC) survey was undertaken on L1234, at the location where the L1234 transitions to become the site access road (thus capturing site traffic only), over a 24-hour period beginning at 00:00hrs on Tuesday 27 April 2021. The survey was undertaken in order to establish baseline traffic volumes associated with the AAL facility.

It should be noted that the traffic survey undertaken in April 2021 was compared with another identical survey (i.e. both surveys were ATC surveys located at the exact same point) undertaken in April 2017. The comparison of the surveys indicated slightly higher traffic associated with the April 2021 traffic survey, thus confirming the robustness of the survey and also confirming that the facility was fully operational, with traffic movements in and out of the site unaffected by COVID-19 pandemic travel restrictions.

A summary of the survey results for light vehicles (LVs) and heavy vehicles (HVs) is presented in the following Table 14.1 for the morning (07:00-07:59hrs) and evening (16:00-16:59hrs) peak hours respectively, and the full 24-hour survey period.

| Time Period | Southbound | | Northbound | | Two-way | |
|---|---|---|---|---|---|---|
| | LV | HV | LV | HV | LV | HV |
| 07:00hrs-07:59hrs | 37 | 1 | 342 | 3 | 379 | 4 |
| 16:00hrs-16:59hrs | 324 | 3 | 13 | 4 | 337 | 7 |
| 00:00hrs-23:59hrs | 734 | 63 | 739 | 63 | 1,473 | 126 |

**Table 14.1:** L1234 Traffic Survey Results (at Site Access Junction)

It should be noted that traffic survey results set out within the preceding Table 14.1 include HGV movements associated with the import of rockfill to serve the current construction requirements of the BRDA and this amounts to ca. 84,600 tonnes during 2021 and is envisaged to take place up until 1st quarter 2022 at which stage the permitted Borrow Pit is anticipated to be operational (see Section 14.4.2 Do Minimum Scenario for assessment of Borrow Pit traffic). At that stage, importation of rock material shall be replaced by the permitted Borrow Pit (and the proposed extension in future) negating the requirement for HGV trips associated with the transport of rock on the external road network.

Rockfill is currently transported via a mixture of articulated and rigid trucks with an average payload of 30 tonnes and 25 tonnes respectively. HGV trips specifically associated with the importation of rock, captured in the traffic survey in Table 14.1 above, are separately itemised in Table 14.2, which follows.

| Time Period | Southbound | Northbound | Two-way |
|---|---|---|---|
| 00:00hrs-23:59hrs | 37 | 37 | 74 |

**Table 14.2:** HGV Trips Associated with Importation of Rock

As can be seen from Table 14.2, a total of 74 no. two-way daily vehicle movements are associated with the importation of rock during periods when rock is imported onto site as was the case on the day of the traffic survey.

In addition to the ATC traffic survey on L1234 outlined above, TII's Traffic Counter (ref: TMU N69 020.0W) at Clondrinagh, between Askeaton and Foynes (ca. 3.1 kilometres to the east of the N69/ L1234 junction) has been used in assessing the traffic impact of the proposed development on the N69. Data for 2019 has been used as the basis for this assessment as it represents the last full calendar year not impacted by travel restrictions and the atypical traffic conditions arising from the ongoing COVID-19 pandemic. This data indicates that between 01 January 2019 and 31 December 2019 the annual average daily traffic (AADT) on the N69 was 5,026.

### 14.3.5 AADT Determination

In order to determine the impact of the development proposal on the road network within the site's general vicinity, it is first necessary to establish future levels of background traffic. The traffic survey data for L1234 set out in Table 14.1 was expanded in accordance with TII's *Project Appraisal Guidelines for National Roads Unit 16.1 – Expansion Factors for Short Period Traffic Counts* (2016), to derive AADT levels on L1234.

The following Table 14.3 outlines the factors used to expand the survey data.

| Variable | Day of Week | Month of Year |
|---|---|---|
| **Data Recorded** | **Tuesday** | **April** |
| Factor | 1.01 | 0.99 |

**Table 14.3:** AADT Factors

Based on the recorded two-way, 24-hour traffic flow, weekly average daily traffic (WADT) and AADT have been calculated using the factors in Table 14.3, above.

Based on the traffic survey data for the L1234 provided in Table 14.1 and expansion factors set out in Table 14.3, AADT data for the L1234 has been determined and it presented in the following Table 14.4. The equivalent AADT for N69 as determined from the TII traffic counter on that road (as per Section 14.3.5) is also included in this table.

| | Two-way N69 Traffic (2019) | Two-way L1234 Traffic (2021) |
|---|---|---|
| 24-Hour Traffic Flow | N/A | 1,599 |
| Weekly Average Daily Traffic (WADT) | N/A | 1,615 |
| Annual Average Daily Traffic (AADT) | 5,026 | 1,599 |

**Table 14.4:** N69 and L1234 AADT Data

### 14.3.6 Collision Data Analysis

A review of the Road Safety Authority's (RSA's) Road Collision Database for the period 2005 to 2016 inclusive (the most recent year data is available for) has been undertaken, with the findings presented in Figure 14.5 (overleaf). The database contains information on all reported collisions by severity of injury and year of collision. A review of the database identifies that no collisions have occurred on L1234 over this 12-year period.

A single minor collision was recorded in 2015 on the N69 in the vicinity of the L1234/ N69 junction. However, due the circumstances of this collision being recorded as "other", it cannot be determined from the available data if this collision is related to vehicle turning movements through the junction (rather than through traffic on the N69). A number of minor, serious and fatal collisions were recorded elsewhere on N69 over the 12-year period. Given the volume of traffic, road alignment and high posted speed limit (100 km/h) on N69, the findings of the collision data review do not indicate any site-specific road safety risks of relevance to the current proposed development.

Furthermore, following implementation of the planned Foynes to Limerick Road Scheme (outlined in Section 14.3.9), it is expected that traffic volumes on this section of the N69 (i.e. in the vicinity of the existing N69/ L1234 junction) will decrease. The scheme will also enhance the safety performance of the existing N69 road alignment due to reduced traffic volumes using it arising from the existence of an alternative and higher quality route. It is also anticipated that the existing N69 will be downgraded to regional road status, with an associated lower speed limit of 80 km/h following opening of the scheme.

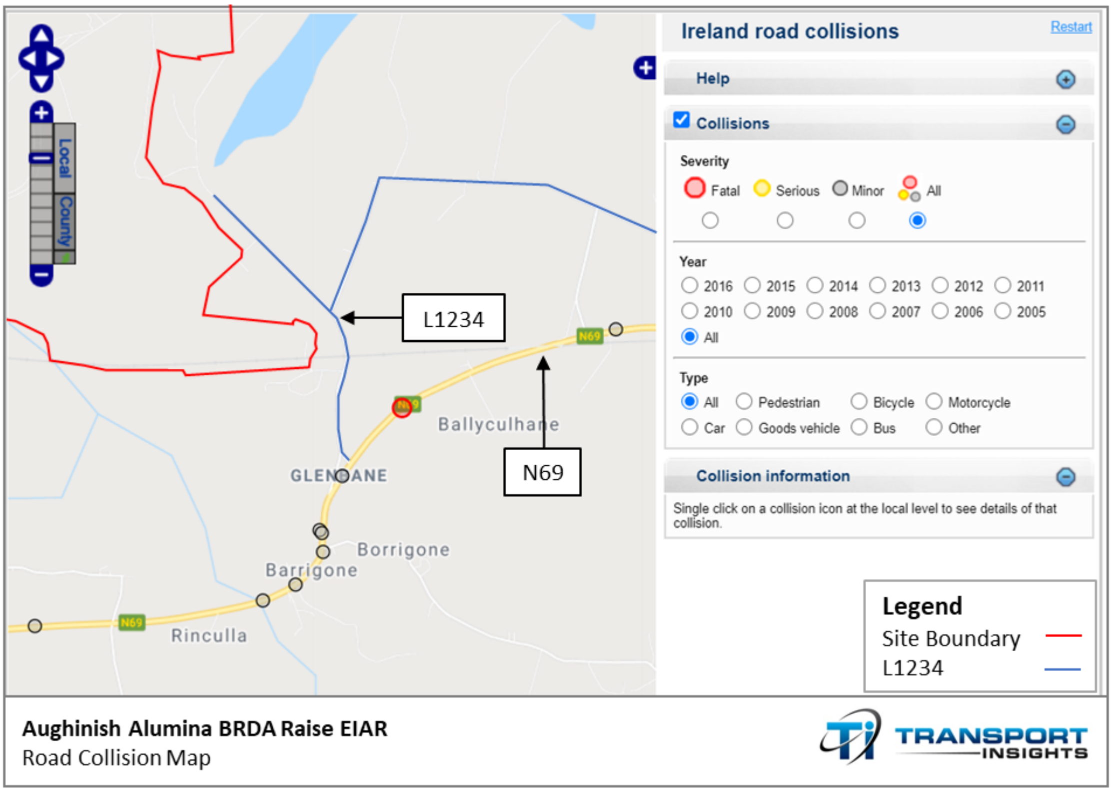


**Figure 14.5:** RSA Road Collision Map

### 14.3.7 Permitted Development

As set out within Section 14.1.4, a Borrow Pit development adjoining the existing AAL plant was granted planning permission by ABP in November 2018. The operation of the borrow pit due to commence in April 2022, however the development has been considered as part of the Do Minimum scenario set out within Section 14.4.2.

Permission was also granted for the development of a Nature Trail and associated car park to the south-west of the site (within the AAL landholding). The impact of this development is determined to be negligible as it represents formalisation of car parking to accommodate existing demand as outlined in Section 14.1.4

No other permitted development within the site's vicinity have been identified that would impact upon the development proposals, or the determination of its traffic impacts.

### 14.3.8 Foynes to Limerick Road (Including Adare Bypass)

As set out within Section 13.1.4, the proposed Foynes to Limerick Road (Including Adare Bypass) scheme is currently under review by ABP with the proposed scheme due to be decided by 26th November 2021. This scheme incorporates the Foynes to Rathkeale Protected Road Scheme, the Rathkeale to Attyflin Motorway Scheme and the Foynes Service Area Scheme under one overall scheme, the proposed alignment of which is presented in Figure 14.6 (overleaf).

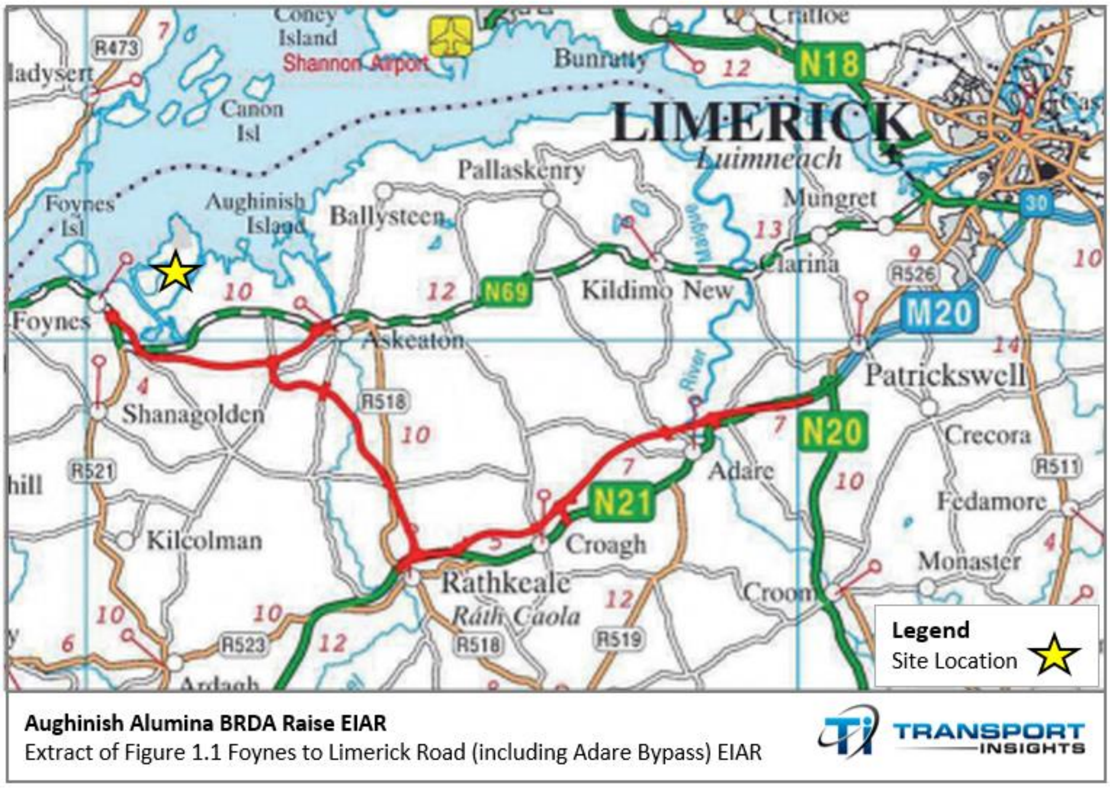


**Figure 14.6:** Route of the proposed road development – Extract from Figure 1.1 Foynes to Limerick Road (including Adare Bypass) EIAR NTS

The Foynes to Limerick Road (including Adare Bypass) scheme includes the upgrade and construction of various road types within Limerick County. Figure 14.7 (overleaf), which is an extract from the EIAR non-technical summary (NTS) of the proposed scheme, details the varying sections and road types of the project. These sections and road types are as follows:

- **Section A**: Foynes to Ballyclogh Junction – 6.3 kilometres of Express Road (Type 2 Dual Carriageway);
- **Section B**: Ballyclogh Junction to Askeaton – 1.9 kilometres of Express Road (Type 1 Single Carriageway);
- **Section C**: Ballyclogh Junction to Rathkeale Junction – 9.3 kilometres of Express Road (Type 2 Dual Carriageway); and
- **Section D**: Rathkeale to Attyflin – 17.5 kilometres of Motorway.

As illustrated in Figure 14.7, the proposed road scheme will provide a new high-quality route between Foynes and Askeaton to the west and east respectively of the proposed development site location. The scheme will also provide a high-quality alternative to the existing N69 alignment for traffic travelling from/ to Limerick City and the national road network, and Foynes and areas further west of the proposed development site. Traffic analysis carried out as part of the Environmental Impact Assessment for the road scheme has forecast that due to the implementation of the scheme, traffic volumes on the N69 at Ballyculhane between Foynes and Askeaton (in the vicinity of the L1234/ N69 junction) will decrease from 8,500 AADT in the 2024 (year of opening) do-minimum scenario (i.e. the scenario in which there are no changes to the road network) to 1,900 AADT in the 2024 do-something scenario). Similarly, the traffic analysis also forecast that the scheme will reduce traffic from 11,050 AADT to 2,400 AADT when the 2039 (year of opening + 15 years) do-minimum scenario is compared to the

2039 do-something scenario at this location. This equates to a ca. 78% reduction in AADT at the N69 at Ballyculhane between Foynes and Askeaton in both 2034 and 2039.


**Figure 14.7:** Sections of the proposed road development – Extract from Figure 4.1 Foynes to Limerick Road (including Adare Bypass) EIAR NTS

It should be noted that for the purposes of this assessment, as the proposed Foynes to Limerick Road (Including Adare Bypass) is still under consideration by An Bord Pleanála and awaiting a decision, its forecast traffic impact has not been factored into impact analysis set out in this Chapter. This assumption is deemed to provide a more robust and conservative basis for analysing the impact of the proposed development on the N69.

## 14.4 Likely Significant Impacts

### 14.4.1 Construction Phase Impact

No significant traffic related construction phase impacts are anticipated.

A small number of seasonal workers (required for 16 to 20 weeks per year when blasting occurs) will be needed to operate equipment at the expanded Borrow Pit and these would include 2 no. drill rig operators intermittently, 2 no. crusher and excavator drivers, a maintenance/breakdown fitter intermittently and a quarry manager (who would already work at the plant). Commuting trips associated with the 5-6 no. additional workers during the BRDA construction phases will have negligible impact on the local road network.

It should also be noted that these works will take place while the existing facility is fully operational, as the construction of the BRDA and extraction of rock from the Borrow Pit form part of the AAL facility’s ongoing operations.

Parking for 6 no. additional staff will be required for between 16 and 20 weeks per year as part of the 'Do Something' scenario. Existing car parking provision within the site will be adequate to accommodate the additional 6 no. cars, on the conservative assumption that 100% of staff drive to site.

### 14.4.2 Operational Phase Impact

**Assessment Scenarios**

Three assessment scenarios are set out within this section of the EIAR as follows:

- 'Do Nothing' scenario – continuation of the operation of the AAL refinery in accordance with its existing planning permission and excluding implementation of the permitted Borrow Pit;
- 'Do Minimum' scenario – continuation of the operation of the refinery in addition to implementation of the Borrow Pit development; and
- 'Do Something' scenario – implementation of the proposed development.

**Do Nothing Scenario**

In the 'Do Nothing' scenario AAL will continue to operate until such a point as the existing storage capacity within the BRDA is exhausted (assumed to be during 2030). At that point, alumina will no longer be produced on-site and the plant will cease to function with a resultant decrease in staff car and HGV traffic on the local road network. The following section quantifies expected 'Do Nothing' traffic levels.

**Existing Development Traffic**

To calculate 'Do Nothing' traffic, development traffic i.e. existing traffic associated with the operation of the site needs to be removed from background traffic in all future years beyond 2030.

**Trip Distribution**

Due to the location of the AAL facility to the west of Limerick City and the strategic road network, it has been conservatively assumed that 70% of the 1,599 trips (see Table 14.3) to and from the site arrive from and depart to the N69 in an easterly direction. The assumed 70% arrival/ departure assignment from/ to the east is deemed to provide a robust basis for assessing the development's traffic impact on the N69.

Of the 5,026 no. vehicles (AADT) on the N69 to the east of the L1234/ N69 junction in 2019, 1,119 no. (70% of 1,599) of these trips are therefore associated with operations at the AAL facility. As per Section 14.3.9, as the Foynes to Limerick Road (Including Adare Bypass) has not yet been granted planning permission, its forecast traffic impact has not been factored into the proposed development's traffic impact analysis, i.e. it has been excluded from all scenarios.

**Background Traffic Forecasting ('Do Nothing' Traffic Scenario)**

Background traffic at the site has been factored to reflect likely future traffic levels in accordance with Project Appraisal Guidelines for National Roads Unit 5.3 – Travel Demand Projections (PE-PAG-02017), 2019. A central growth scenario was deemed appropriate and has been used to assess future growth, with the light vehicle (LV) and heavy vehicle (HV) growth factors applied presented in the following Table 14.5.

| Link-Based Growth Rates: County Annual Growth Rates (excluding Metropolitan Area) – Limerick | | |
|---|---|---|
| **Year** | **LV** | **HV** |
| 2016-2030 | 1.0215 | 1.0323 |
| 2030-2040 | 1.0092 | 1.0130 |

**Table 14.5:** Traffic Growth Factors

Based on the above traffic growth factors, forecast background traffic levels have been derived for each of the assessment years, in accordance with TII's Traffic and Transport Assessment Guidelines (2014):

- year of opening (YoO), assumed to be 2023;
- year of opening + 5 years (YoO + 5), i.e. 2028; and
- year of opening + 15 years (YoO + 15) i.e. 2038.

Although not strictly required in TII's Guidelines, a year of closing (YoC) assessment year has also been included within subsequent analysis to reflect HGV traffic associated with closing the plant. Most of this traffic will occur in 2041 and 2042, with 2042 chosen as the YoC (for purposes of assessment). Background traffic for L1234 and N69 factored up for the above assessment years is presented in the following Table 14.6. It should be noted that any traffic associated with the operation of the AAL facility has not been factored up in determining future N69 traffic levels as it is not expected to increase based on the proposals to which this assessment relates.

| | | Do Nothing Scenario AADT | |
|---|---|---|---|
| **Year** | **Assessment Year** | **L1234** | **N69** |
| 2019 | Base Year | - | 5,026 |
| 2021 | Base Year | 1,599 | - |
| 2023 | YoO | 1,599 | 5,296 |
| 2028 | YoO + 5 | 1,599 | 5,790 |
| 2038 | YoO + 15 | 0* | 5,272 |
| 2042 | YoC | 0* | 5,480 |

**Table 14.6:** Forecast Traffic Figures
** no traffic is assumed to be associated with the existing development beyond 2031 in the 'Do Nothing' scenario*

**'Do Minimum' Scenario**

In the 'Do Minimum' scenario, it is assumed that the refinery shall continue operate as it currently does, however the permitted borrow pit application (set out within Section 14.1.4) shall also be in operation. This shall result in the removal of HGV trips on the local road network associated with the movement of rock i.e. HGV trips set out within Table 14.2 would no longer occur. The following Table 14.7 presents 'Do Minimum' traffic flows.

| | | Do Minimum Scenario AADT | |
|---|---|---|---|
| **Year** | **Assessment Year** | **L1234** | **N69** |
| 2023 | YoO | 1,529 | 5,224 |
| 2028 | YoO + 5 | 1,529 | 5,718 |
| 2038 | YoO + 15 | 0* | 5,272 |
| 2042 | YoC | 0* | 5,480 |

**Table 14.7:** 'Do Minimum' Traffic Figures
** no traffic is assumed to be associated with the existing development beyond 2031 in the 'Do Minimum' scenario*

As can be seen from Table 14.7, the 'Do Minimum' scenario represents a reduction in traffic in both the YoO and YoO +5 assessment years compared with the 'Do Nothing' scenario. In the YoO +15 years scenario, traffic volumes in both scenarios are identical, reflecting the fact that the refinery shall cease to operate beyond 2030 in the absence of the proposed development. It should be noted that the Borrow Pit results in a very small increase in light vehicle trips (4 no. one-way trips per day) associated with staff movements.

**'Do Something' Scenario**

In the 'Do Something' scenario, HGV traffic associated with the importation of rock shall be eliminated (as per the 'Do Minimum' scenario), with the abovementioned very small increase in light vehicle trips (4 no. one-way trips per day associated with operation of the Borrow Pit). However, compared with the 'Do Minimum' scenario there will be additional HGV trips anticipated on the external road network associated with the importation of soil, soil improver, and gypsum required for the proposed raising of the BRDA. Any other additional vehicle movements generated by site activities will be wholly internal to the site itself.

Traffic associated with the closure of the refinery has also been considered and includes HGV trips required to bring in additional soil, soil improver and gypsum to close the refinery and provide for final landscape restoration of the BRDA.

Trips associated with proposed development traffic and trips associated with the closure of the plant, are set out within Table 14.8 which follows.

| Development Trips (Imported Soil, Soil Improver, and Gypsum) and Closing Trips | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Material** | **Volume (m3)** | **Per Year** | **Density (tonnes /m3)** | **Total Tonnes/ year** | **Rigid Truck Capacity (tonnes)** | **Trips (two-way)** | **Trips (one-way)** |
| Duration: 8 Years During Operation (2028-2035) | | | | | | | |
| Soils to be Imported | 182,528 | 18,253* | 2.00 | 36,506 | 24 | 1,521 | 3,042 |
| Organic Soil Improver to be Imported | 23,122 | 2,312* | 0.60 | 1,387 | 28 | 50 | 99 |
| Gypsum to be Imported | 2,463 | 308** | 1.21 | 372 | 24.00 | 16 | 31 |
| | | | | | Total Trips | 1,586 | 3,172 |
| | | | | | Per Day*** | | 12.7 |
| Duration: 2 Years During Site Closing (2041-2042) | | | | | | | |
| Soils to be Imported | | 18,253* | 2.00 | 36,506 | 24 | 1,521 | 3,042 |
| Organic Soil Improver to be Imported | | 2,312* | 0.60 | 1,387 | 28 | 50 | 99 |
| Organic Soil improver for dome | 78,151 | 39,076**** | 0.60 | 23,445 | 28 | 837 | 1,675 |
| Gypsum to be Imported | 10,220 | 5,110**** | 1.21 | 6,183 | 24 | 258 | 515 |
| | | | | | Total Trips | 2,666 | 5,331 |
| | | | | | Per Day*** | | 21.3 |

**Table 14.8:** Development Traffic (Imported Soil and Improver)
* average over 10 years covering from 2028 to 2035 for development traffic and 2041-2042 for closing traffic
** average over 8 years from 2028 to 2035
*** assumes 250 days per year
**** average over 2 years from 2041-2042

The following Table 14.9 presents 'Do Something' AADT traffic figures for L1234 and N69 and presents changes in traffic over the 'Do Nothing' and 'Do Minimum' scenarios i.e. in % difference terms.

| Forecasted 'Do Something' AADT Traffic Figures | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Year** | **Scenario** | **L1234** | **Difference from 'Do Nothing'** | **Difference from 'Do Minimum'** | **N69** | **Difference from 'Do Nothing'** | **Difference from 'Do Minimum'** |
| 2019 | Base Year | - | - | | 5,026 | - | |
| 2021 | Base Year | 1,599 | - | | - | - | |
| 2023 | YoO | 1,529 | -4.58% | 0.00% | 5,224 | -1.38% | 0.00% |
| 2028 | YoO + 5 | 1,542 | -3.73% | 0.82% | 5,730 | -1.04% | 0.22% |
| 2038 | YoO + 15 | 1,529 | 100% | 100% | 6,318 | 16.55% | 16.55% |
| 2042 | YoC | 21 | 100% | 100% | 5,501 | 0.39% | 0.39% |

**Table 14.9:** 'Do Something' Traffic Figures

As can be seen from Table 14.9, compared with the 'Do Nothing' scenario, the 'Do Something' scenario will result in a decrease in traffic on L1234 in the YoO and YoO+5, however will result in an increase in traffic in the YoO+15 and YoC scenarios (due to a baseline of zero vehicles in those years as the development is envisaged to no longer operate beyond 2031 in the 'Do Nothing' and 'Do Minimum' scenarios). Compared with the 'Do Minimum' scenario, the proposed development shall have no increase in traffic on L1234 in the YoO, however will result in a slight increase in traffic in the YoO+5. There shall be a 100% increase in traffic in the remaining assessment years again due to the baseline of zero vehicles in these years in the 'Do Minimum' scenario. In the 'Do Something' scenario, the 2028 assessment year (YoO+5) includes HGV trips associated with importation of soil, soil improver as set out in Table 14.8, with these trips envisaged between 2028 and 2035 only.

In relation to the N69, in the 'Do Something' scenario the N69 shows a small reduction in traffic when compared to the 'Do Nothing' scenario in 2023 and 2028, representing the reduction in HGV trips associated with the importation of rock and a smaller number of additional HGV trips associated with the importation of soil, soil improver, and gypsum in 2028. Very small changes in traffic (between 0.0% and 0.22%) are envisaged on N69 between the 'Do Something' and Do Minimum scenarios in 2023 and 2028. There is anticipated be a 16.55% increase in traffic when compared to both the 'Do Nothing' and 'Do Minimum' scenarios in 2038, representing additional trips which are associated with the operation of the AAL facility. A very slight increase in traffic (+0.39%) is anticipated on N69 in the YoC when compared to both the 'Do Nothing' and 'Do Minimum' scenarios.

Furthermore, as shown in Table 14.9, the N69 is expected to carry 6,318 AADT in 2038 which is well below the theoretical capacity of this road, which has been conservatively estimated at 8,600 AADT (as per Section 14.3.3).

**Proposed Internal Layout**

The proposed development relates to both the raising of the existing BRDA and associated salt cake deposit cell and the expansion of the permitted Borrow Pit located to the northeast of the BRDA. The internal layout of the Borrow Pit is determined by its operations and will vary over time.

Permission was granted in 2018 under LCCC Reg. Ref. 17/714; ABP Ref PL91.301011 for the development of a 4.5 ha Borrow Pit. Operations at the Borrow Pit will commence in April 2022 following the recent issuance of an Industrial Emissions License (Ref. P0035-07) from the EPA, dated 28th September 2021.

As part of this permitted Borrow Pit, it was proposed that the blasting of the rock face would start at the existing south facing vertical face of the borrow pit, gradually moving northwards over the lifetime of the pit. The expanded Borrow Pit proposed as part of this development is located to the immediate east of the permitted Borrow Pit and blasting will start at its north-western boundary and gradually move east and then south over the lifetime of the pit.

An excavator will then remove the rock material from the base of the rock face and transport the rock to the initial stockpile area. The rockfill will be crushed and screened here and then deposited in segregated stockpiles according to particle size distribution. This processed rockfill material will be transported to the BRDA as required using dumper trucks, loaded at the stockpile area by an excavator.

Figure 14.8 illustrates the typical operation of the Borrow Pit. As can be seen from this figure, dumper trucks will travel into the Borrow Pit area, reverse to the processed stockpile area, and when filled with rock, will exit the Borrow Pit in forward gear.

Rock extracted from the Borrow Pit will then be deposited in the BRDA for use in the construction of the rock fill embankments (stages) in order to store the bauxite residue. The stages are filled with bauxite residue, farmed, carbonated and compacted, prior to deposition of the next layer. As part of the raising of the BRDA, the existing SCDC, which is located within the BRDA, will also be extended vertically to a height of c. 35.5 m OD (shaped dome, vertical extension to 31.25m OD). This will accommodate the disposal of an additional ca. 22,500 $m^3$ of salt cake. Figure 14.9 (overleaf) shows a typical route from the Borrow Pit to the BRDA.

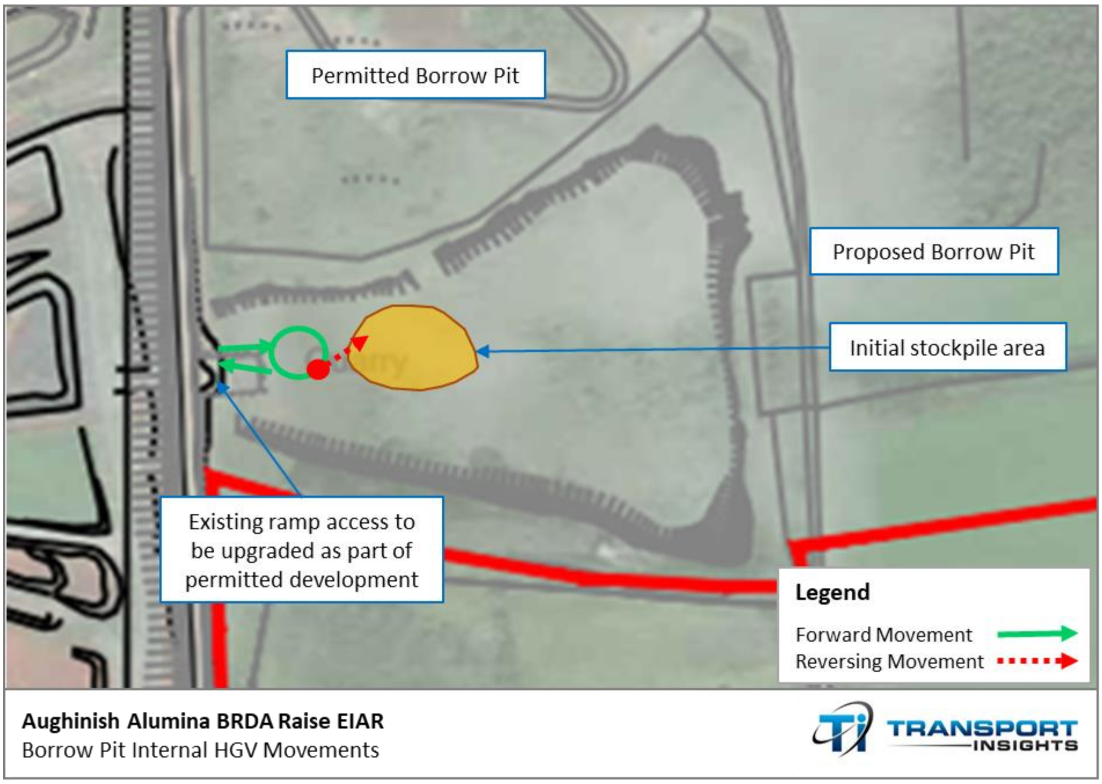


**Figure 14.8:** Borrow Pit Internal Traffic Movements

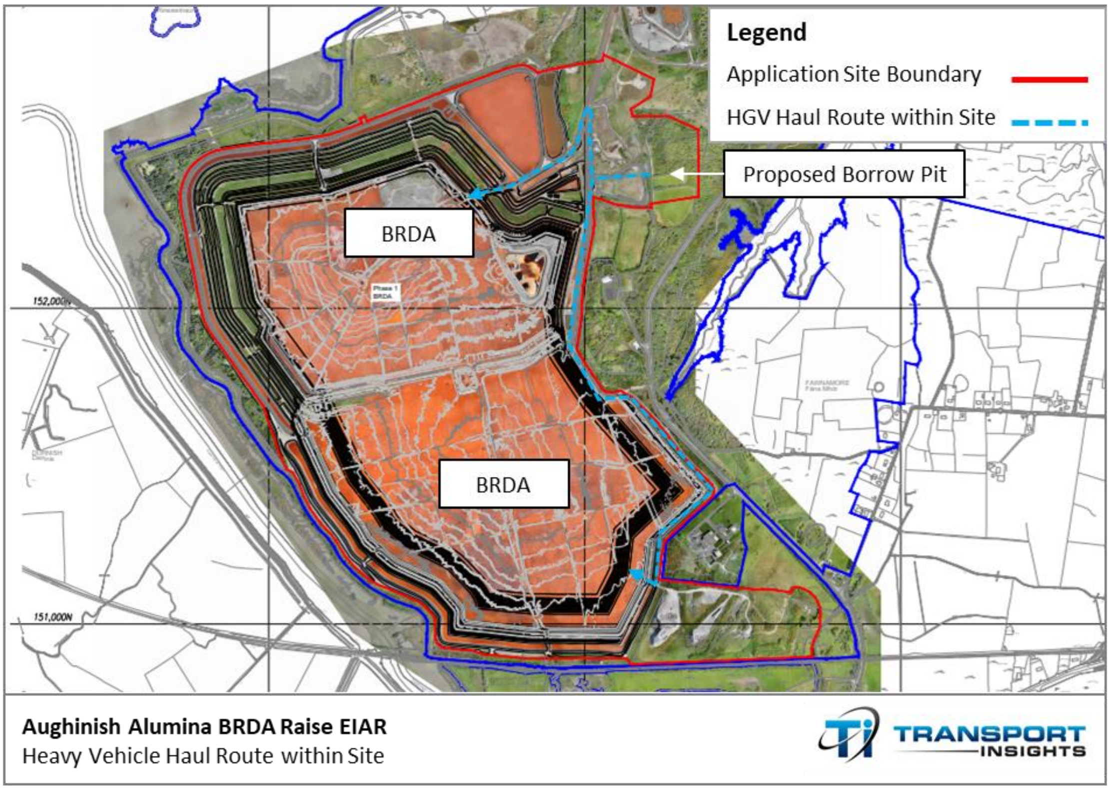


**Figure 14.9:** Typical HGV Traffic Route

**Car Parking**

No additional car parking is required to accommodate the operation phase of the proposed development. As noted above in Section 14.4.1, parking for 6 no. additional staff will be required during the construction phase however, existing car parking provision within the site is adequate to accommodate this demand.

## 14.5 Mitigation Measures

As the proposed development will have no material impact upon the operation of the local road network, no mitigation measures are proposed. Furthermore, it is noted that historic improvement works carried out at the L1234/ N69 junction (as noted in Section 14.3.4) appear to have mitigated previous safety issues and no further mitigation measures in this regard are deemed necessary.

It should be noted that sourcing of rock material on-site can be considered to mitigate potential impacts of the development on the local road network, with HGV movements concentrated on-site.

Furthermore, the proposed Foynes to Limerick (including Adare Bypass) scheme will provide an alternative high-quality route to the N69 between Foynes and Askeaton to the west and east of the proposed development site respectively. This scheme, which is anticipated to proceed to construction in the near future, has been forecast to produce a ca. 78% reduction in AADT on the N69 at Ballyculhane between Foynes and Askeaton (in the vicinity of the L1234/ N69 junction) in both its year of opening (2023) and year of opening + 15 years (2038).

### 14.5.1 Cumulative Impacts

As set out within Section 14.1.4, a Borrow Pit development adjoining the existing AAL plant was granted planning permission by ABP in November 2018. While this may represent a cumulative impact with regards to, for example, the length of operation of the AAL facility, in a traffic context the permitted Borrow Pit development, proposed expansion to the Borrow Pit and the raising of the BRDA do not represent a cumulative impact to the surrounding road network as there will be no material increase in traffic associated with the operation AAL facility as a result of these developments.

Another cumulative impact would be the Foynes to Limerick (including Adare Bypass) scheme. This will be a positive impact as it will decrease traffic volumes on N69, therefore increasing its safety performance. The scheme is currently under review by ABP with a decision on the scheme due by 26 November 2021.

## 14.6 Residual Impacts

Based on the level of traffic generated and taking into account the capacity of the local road network, no construction or operational phase residual impacts are predicted as a result of the proposed development.

## 14.7 Interactions

The analysis contained within this chapter interacts with the Noise Assessment contained within this EIAR.

## 14.8 Difficulties Encountered When Compiling

As outlined in Section 14.3.5, due to ongoing COVID-19 restrictions, traffic levels on the N69 national secondary road were understood to be lower than those that would have been present under pre-COVID circumstances. As a result, publicly available traffic data for the year 2019 (i.e. pre-COVID) from a local TII counter located on the N69 was used in determining typical traffic volumes and factored up to future year levels using TII growth factors. This factored traffic data provided the baseline from which the proposed development was assessed.

# 15.0 MATERIAL ASSETS – SITE SERVICES

## 15.1 Introduction

This Chapter of the Environmental Impact Assessment Report (EIAR) has been prepared by Golder Associates Ireland Limited (Golder) and addresses the likely direct and indirect significant impacts and effects of the Proposed Development on Material Assets – Site Services located in the vicinity of the Application Site.

Material Assets – Site Services in the vicinity of the Application Site comprise of built services and infrastructure such as electricity, gas, telecommunications, water supply infrastructure, surface water drainage and sewerage. Other material assets include roads and traffic, archaeology / cultural heritage and land and soils, which have been considered in depth in their respective Chapters of the EIAR.

The following assessment was prepared by Lynn Hassett (BSc (Hons), MSc) in conjunction with inputs from the wider EIAR team and chapter technical leads. Lynn is a Practitioner Member of the Institute of Environmental Management and Assessment and has more than 15 years' experience in environmental consultation.

### 15.1.1 Proposed Development

The proposed development consists of works to the Bauxite Residue Disposal Area (BRDA) comprising of an expansion to increase its disposal capacity to accommodate additional bauxite residue arising from the continued operation of the permitted alumina refinery plant located on the wider AAL facility. The proposed increase in disposal capacity to the BRDA will result in a proposed increase in height of c.12m above the currently permitted stage 10 level (c. 32m OD) to a final stage 16 level (c. 44m OD). No increase to the existing footprint of the BRDA is proposed.

The proposed method of raising the BRDA will be the upstream method, consistent with the construction methodology for the current BRDA and involves the construction of rock fill embankments (Stages), offset internally and founded on the previously deposited and farmed bauxite residue, in 2 m high vertical lifts. The BRDA is raised systematically as the stages are filled with bauxite residue, farmed, carbonated and compacted, prior to deposition of the next layer.

Additional works proposed as part of this application include the following:

- A vertical extension to the existing Salt Cake Disposal Cell (SCDC) to accommodate further disposal of salt cake resulting in an increase in height of c.2.25m. The SCDC is located within the BRDA. A description of the SCDC and its function is provided in Chapter 2 of this EIAR.

- An extension of the existing borrow pit, located to the east of the BRDA, is also proposed. This extension proposes to increase the footprint of the borrow pit from c.4.5ha to c.8.4ha. This expansion will provide an additional 380,000m$^3$ of rock fill material which is needed to satisfy the requirements of the construction and operation of the BRDA.

- The continued use of an existing stockpile area at the south east of the subject site to store topsoil in order to satisfy the additional restoration requirements of the extended BRDA.

- Upgrades to the existing water management infrastructure to accommodate the BRDA development to Stage 16 which will also allow for greater Inflow Design Flood (IDF) capacity for the entirety of the BRDA.

Given that the proposed BRDA Raise and the proposed SCDC Raise sit entirely within the footprint of the existing BRDA, where reference is made to the BRDA within the following text, this will refer to both the BRDA and the SCDC areas unless otherwise stated.

Please refer to Chapter 3.0 of this EIAR and the Engineering Design Report (enclosed in Appendix A) for a more detailed description of the proposed development.

## 15.2 Legislative Requirements

Article 3 of the EIA Directive (Directive 2011/92/EU, as amended by Directive 2014/52/EU) provides that the EIA shall identify, describe and assess, in an appropriate manner, in the light of each individual case, the direct and indirect significant effects of a project on identified factors, which include material assets.

Annex IV of the EIA Directive sets down the minimum information to be supplied in an EIAR and also makes specific reference to material assets as a factor that should be described if it is likely to be significantly affected by the project.

## 15.3 Relevant Guidance

There is no specific Irish guidance for the assessment of material assets in the context of EIA. The 'Guidelines on the information to be contained in environmental impact assessment reports', were published in draft format by the EPA in August 2017, (Draft 2017 EIAR Guidelines) with a view to facilitating compliance with the amended EIA Directive. Therefore, these Guidelines have been considered in the course of this assessment.

The Draft 2017 EIAR Guidelines state that material assets '*can now be taken to mean built services and infrastructure*'. They suggest headings under which material assets can be addressed within an EIAR as set out in Table 15.1 below.

The sub-topics listed under the heading of 'Roads and Traffic' have been dealt with in detail in Chapter 14: Traffic and Transportation. The sub-topics listed under the heading of 'Built Services' are assessed within this Chapter.

Elsewhere in the Draft 2017 EIAR Guidelines there is reference to the relative ambiguity of the meaning of 'Material Assets' in comparison to other factors, and the sub-topic of waste management is included within the overall prescribed environmental factor of material assets. It is stated within the Draft 2017 EIAR Guidelines that impacts such as those on agricultural land come under the factors of land and soil (see Chapter 8 of this EIAR).
Given the nature of the Proposed Development, waste management is considered in depth throughout this EIAR, and in particular within Chapter 13: Material Assets - Waste. That

assessment considers how management of day-to-day waste arisings will be facilitated within the Proposed Development.

| Prescribed Environmental Factor | Typical Headings under which Environmental Factors could be addressed in an EIAR | Typical Headings |
|---|---|---|
| Material Assets | Roads & Traffic | Construction Phase |
| | | Operational Phase |
| | | Unplanned Events (i.e., Accidents) |
| | Built Services | Electricity |
| | | Telecommunications |
| | | Gas |
| | | Water Supply Infrastructure |
| | | Sewerage |
| | Waste Management | Undefined |
| Notes: Extracted from Table 3.1 of the Draft 2017 EIAR Guidelines, (EPA 2017) | | |

**Table 15.1:** Sample Headings and Topics to Address Issues Arising for Material Assets

The Department of the Environment, Climate and Communications (DECC) has recently undertaken a Strategic Environmental Assessment (SEA) Scoping Report on its draft Policy Statement for Mineral Exploration and Mining in Ireland.

It is noted that the AAL is <u>not</u> a mining operation and does not hold a state mining lease or state mining licence. However, AAL does produce and store extractive waste material (tailings).
The purpose of the SEA process is to ensure that the protection of the environment and promotion of sustainable development is considered appropriately in the development of the Policy Statement. 'Material Assets' is one of a number of environmental topics that is put forward for consideration.

Under the heading of 'Material Assets', the following environmental issues have been highlighted:

- Impacts to potable water supplies;
- Impacts to commercial and agricultural activities adjacent to mines;
- Planning and development potential;
- Potential for land severance or land access to support exploration and/or mining;
- Competing with other offshore infrastructure under the National Marine Planning Framework;
- Potential risks and opportunities for mining wastes; and
- Change in land use based on risk to water quality, quantity and flooding thus reducing value of land either by limiting development potential or requiring a change in land use.

Where relevant, the above issues have been considered within the appropriate chapters of this EIAR. For example, the EIAR, as a whole, addresses the risks and opportunities for mining wastes, and Chapter 10 addresses the hydrological issues pertaining to the Proposed Development. This Chapter addresses the impacts on potable water supplies.

The Proposed Development relates to continued operations at the site, hence other issues such as the potential for land severance or competition with other land uses/ infrastructure are less relevant in this case.

## 15.4 Assessment Methodology and Significance Criteria

### 15.4.1 Technical Scope

This EIAR chapter aims to identify the likely direct and indirect significant effects that the Proposed Development may have on Material Assets – Site Services. These are discussed under the following headings:

- Electricity Network;
- Gas Infrastructure;
- Telecommunications;
- Potable Water Network; and
- Surface and Foul Water Network.

### 15.4.2 Prediction of Impacts and Effects

This Chapter of the EIAR describes the likely direct and indirect significant effects of the Proposed Development on the material assets – site services in the vicinity of the Application Site, and is supported by the baseline condition information, the preliminary Construction Environmental Management Plan (CEMP) and the Proposed Development design.
The aim of establishing significance of impacts is to provide a measure of the risks of disturbance to, or undue burden on existing Material Assets – Site Services.

The Proposed Development design is understood to comprise the project design principles and standards adopted to avoid or prevent adverse safety and environmental effects, construction and operation to appropriate codes of practice and guidelines, and including fixed procedural commitments such as instrumentation and monitoring. This measure provides the baseline for the assessment of impacts.

### 15.4.3 EIA Significance Terminology

For the assessment of material assets there is no topic specific guidance or forecasting method to identify and assess the significance of effects of the Proposed Development on the environment. In this instance a common framework of assessment criteria and terminology has been developed by Golder and is based on the EPA's Draft 2017 EIAR Guidelines.
This framework follows a 'matrix approach' to environmental assessment which is based on the characteristics of the impact (magnitude and nature) and the value (sensitivity) of the receptor. Descriptions for value (sensitivity) of receptors are provided in Table 15.2.

| Value (Sensitivity) of Receptor / Resource | Typical Description |
|---|---|
| High | High importance and rarity, national scale, and limited potential for substitution. |
| Medium | Medium or high importance and rarity, regional scale, limited potential for substitution. |
| Low | Low or medium importance and rarity, local scale. |
| Negligible | Very low importance and rarity, local scale. |
| Notes: The descriptions for magnitude of impact are provided in Table 15.3 below | |

**Table 15.2:** Environmental Value (Sensitivity) and Descriptions

It is considered that the value (sensitivity) of the Material Assets - Site Services in the vicinity of the Application Site is no greater than Medium**,** i.e., not of national scale, rarity or limited potential for substitution.

This sensitivity has been assign based on criteria listed in Table 15.2 and assessment of the importance of the assets to users surrounding the Proposed Development, and their sensitivity to potential disruption to the as-built service infrastructure.

| Magnitude of Impact / Change | | Typical Description |
|---|---|---|
| High | Adverse | Loss of resource and/or quality and integrity of resource; severe damage to key characteristics, features or elements. |
| | Beneficial | Large scale or major improvement of resource quality; extensive restoration; major improvement of attribute quality. |
| Medium | Adverse | Loss of resource, but not adversely affecting the integrity; partial loss of/damage to key characteristics, features or elements. |
| | Beneficial | Benefit to, or addition of, key characteristics, features or elements; improvement of attribute quality. |
| Low | Adverse | Some measurable change in attributes, quality or vulnerability; minor loss of, or alteration to, one (maybe more) key characteristics, features or elements. |
| | Beneficial | Minor benefit to, or addition of, one (maybe more) key characteristics, features or elements; some beneficial impact on attribute or a reduced risk of negative impact occurring. |
| Negligible | Adverse | Very minor loss or alteration to one or more characteristics, features or elements. |
| | Beneficial | Very minor benefit to or positive addition of one or more characteristics, features or elements. |

**Table 15.3: Magnitude of Impact and Typical Descriptions**

The approach followed to derive significance from receptor value and magnitude of impacts is shown in Table 15.4.

Where Table 15.4 includes two significance categories, the reporting of a single significance category is supported by rationale provided in supporting text.

| | | Magnitude of Impact (Degree of Change) | | | |
|---|---|---|---|---|---|
| | | Negligible | Low | Medium | High |
| Environmental Value (Sensitivity) | High | Slight | Slight or Moderate | Moderate or Large | Profound |
| | Medium | Imperceptible or Slight | Slight or Moderate | Moderate | Large or Profound |
| | Low | Imperceptible | Slight | Slight | Slight or Moderate |
| | Negligible | Imperceptible | Imperceptible or Slight | Imperceptible or Slight | Slight |
| **Notes:** A description of the significance categories used is provided in Table 15.5. | | | | | |

**Table 15.4: Significance Matrix**

The criteria and terminology in Table 15.5 has been based on and is consistent with the EPA's Draft 2017 EIAR Guidelines. The EPA's 'Significant Effects' and 'Very Significant' categories have been combined into one 'Large' category. Furthermore, the EPA's 'Not Significant' category has been combined with the 'Slight Effects' category. These substitutions provide conservatism by attributing a higher effects category to adverse effects. The removal of the 'significant' and 'not significant' terminology from the matrix stage of the method avoids confusion when an overall significance is attributed to the particular impact.

| Significance Category | Typical Description |
|---|---|
| Profound | An effect which obliterates sensitive characteristics. |
| Large | An effect which, by its character, magnitude, duration or intensity alters a significant proportion of a sensitive aspect of the environment. |
| Moderate | An effect that alters the character of the environment in a manner that is consistent with existing and emerging baseline trends. |
| Slight | An effect which causes noticeable changes in the character of the environment without affecting its sensitivities. |
| Imperceptible | An effect capable of measurement but without significant consequences. |

**Table 15.5:** Significance Categories and Typical Descriptions

Effects that are either Large or Profound alter environmental sensitivities and are therefore considered to be **Significant** based on professional judgement. Effects that are Moderate, Slight or Imperceptible are those which at their highest effect are consistent with existing and emerging baseline trends and are considered to be **Not Significant**.

### 15.4.4 Information Sources

Information for the assessment of potential impacts on the identified material assets was obtained by means of a desk-based review, and included the following sources:

- Plant mapping and information provided by AAL;
- ESB network utility plans;
- Gas Networks Ireland (GNI) utility plans;
- Correspondence between GNI and AAL/Golder in November 2016 and March 2017 in regard to pre-planning consultation for the Borrow Pit planning application (Limerick City & County Council, Planning Register Number 17/714);
- Eir utility mapping;
- Irish Water utility mapping; and
- Aerial and ordnance survey maps of the area.

### 15.4.5 Temporal Scope

Given the nature of the Proposed Development, which involves the sequential raising (construction) and filling (operation) of the BRDA, raising of the Salt Cake Disposal Cell (SCDC) and the extension of the permitted Borrow Pit for the extraction of rock fill materials, this assessment will consider the Proposed Development activities in one combined construction and operational phase.

Under the current programme, it is expected that the duration of the combined construction and operation of the Proposed Development will last until 2039 or an additional 9 years. The duration of the Proposed Development is therefore classified as '**Medium-term'** by the EPA's Draft 2017 EIAR Guidelines (7 to 15 years).

The Proposed Development will enter into an aftercare phase following the completion of the combined construction/operational phase. In accordance with Condition 10 of the EPA issued licence (IEL P0035-07), AAL are required to have an approved plan in place for the orderly closure, decommissioning and aftercare of the facility. This plan is called the Closure, Restoration and Aftercare Management Plan (CRAMP) and covers both the Plant area and the BRDA. The most recent update was conducted by AAL during 2019 and subsequently approved by the EPA in 2021 as part of the IEL approval.

Financial provisions for the CRAMP are deposited by AAL annually into a Secured Fund and a Parent Company Guarantee (PCG) is in place to match the balance for the Secured Fund target value in place. The CRAMP is funded for a minimum 30-year period following closure (5 years of active aftercare and 30 years of passive aftercare).

### 15.4.6 Geographical Scope

The EIAR directly covers the physical extent of the Application Site as shown in Figure 15.1 below.

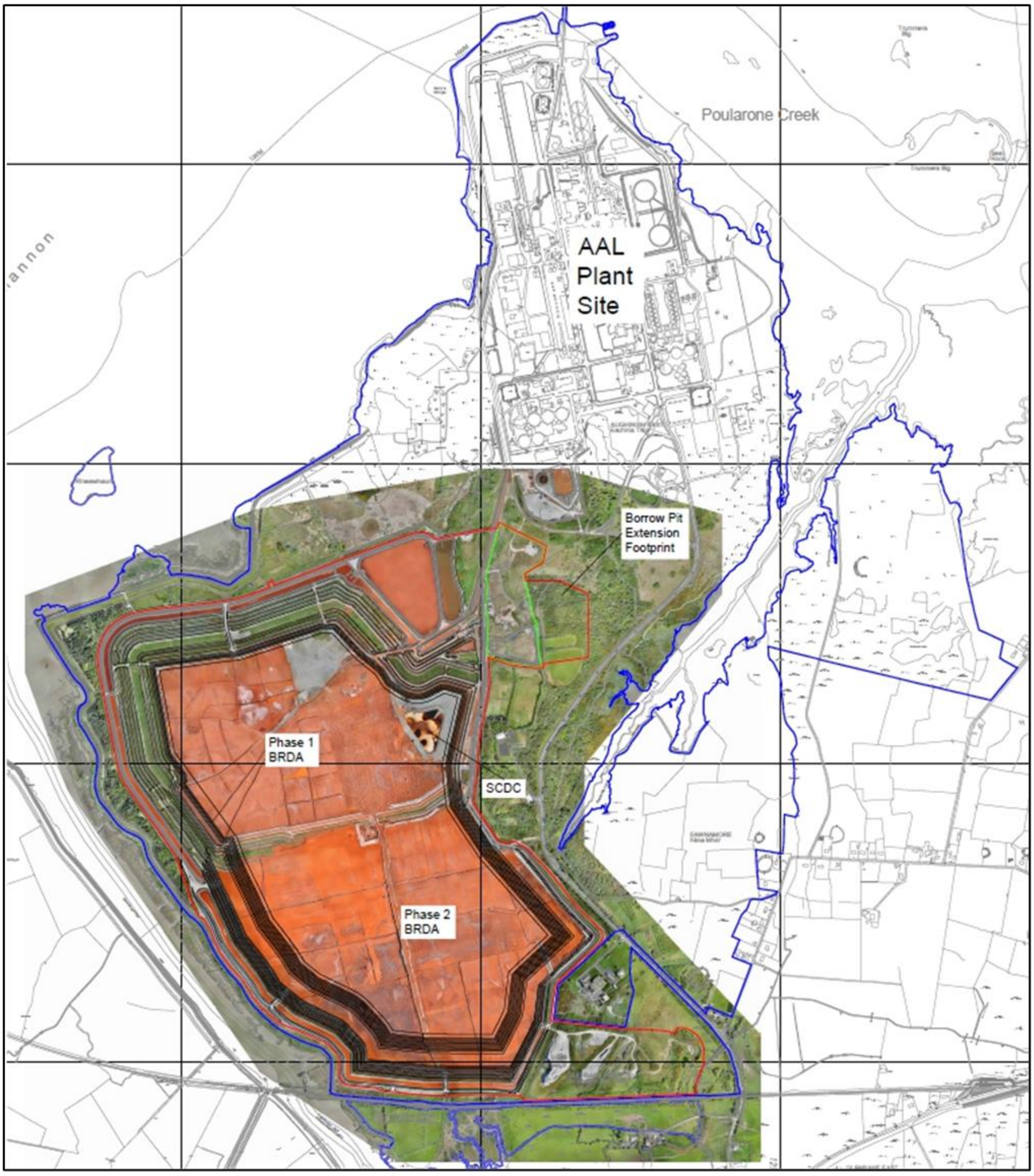


**Figure 15.1:** Site Location Map - Blue Line is the AAL Ownership Boundary, Red Line is the Application Boundary and Green Line is the permitted Borrow Pit Footprint

The Material Assets – Site Services that service the AAL facility and users in the vicinity of the Application Site are located largely outside the red line Application Site Boundary and within the blue line Ownership Boundary. Hence the assessment of Site Services that follows considers the extent within both the red and blue line.

## 15.5 Existing Environment

### 15.5.1 General Aspects of the Surrounding Environment

AAL is located on the southern side of the Shannon Estuary, near the village of Foynes, Co. Limerick. This is approximately 6 km north-west of Askeaton and approximately 30 km west of Limerick City. The Application Site is located on Aughinish Island, Island MacTeige, Glenbane West and Fawnamore, within the property of the long-established alumina extraction plant operated by AAL.

AAL own a circa 601 ha. landholding (the Site) on Aughinish Island and surrounding townlands which is shown by the blue line on Figure 15.1.

Aughinish Island and the surrounding areas are predominantly rural in character with the remaining land usage comprising agriculture, single low density residential housing and protected habitats (wetlands and grasslands).

The BRDA portion of the Application Site is located in the south-western sector of the landholding and is circa 184 ha. in size. The SCDC is located within the BRDA. The Borrow Pit Extension area is located towards the centre of the land holding. The Proposed Development seeks to extend the footprint of the Borrow Pit from circa 4.5 ha. to circa 8.4 ha.

The topography of the Application Site currently varies from approximately 22 mOD to 32 mOD in the Phase 1 BRDA, and from approximately 11 mOD to 20 mOD in the Phase 2 BRDA. The ground elevations at the downstream toe of the facility (pre-development ground elevations) vary from approximately 1 mOD in the north to approximately 6 mOD in the south. The BRDA portion of this Application seeks to raise the height of the existing BRDA, therefore the current baseline of the Proposed Development is located over the existing BRDA, which for the majority of the footprint has a base elevation of approximately 1 mOD.

The topography of the Borrow Pit Extension varies between 16 mOD and 20 mOD, with the higher ground located to the north-east of the footprint.

The permitted Borrow Pit area are lands which comprise previously disturbed ground which has been partly used as a compound area for an on-site Landscaping Contractor for AAL. The proposed Borrow Pit Extension area are lands that are undisturbed and adjoins to east side of the permitted Borrow Pit. As identified in the 2017 Application for the original Borrow Pit (LCCC Reg. Ref.: 17/714; ABP Ref. ABP-301011-18), the Landscaping Contractor has relocated to another area within the AAL landholding.

The southern portion of the permitted Borrow Pit area comprises a former Borrow Pit which was previously associated with the construction of the original plant. The extraction works within this former Borrow Pit area were completed in 1982 and it has since been left to naturally regenerate. There is a difference in height of approximately 9m between the floor of a former Borrow Pit (last operated in the early 1980s) and the rest of the Site surface due to the previous extraction.

## 15.6 Baseline Conditions

### 15.6.1 Electricity Network

Figure 15.2 below shows the ESB infrastructure in the vicinity of the BRDA and the proposed Borrow-Pit Extension and its relationship to the overall AAL site and wider area.

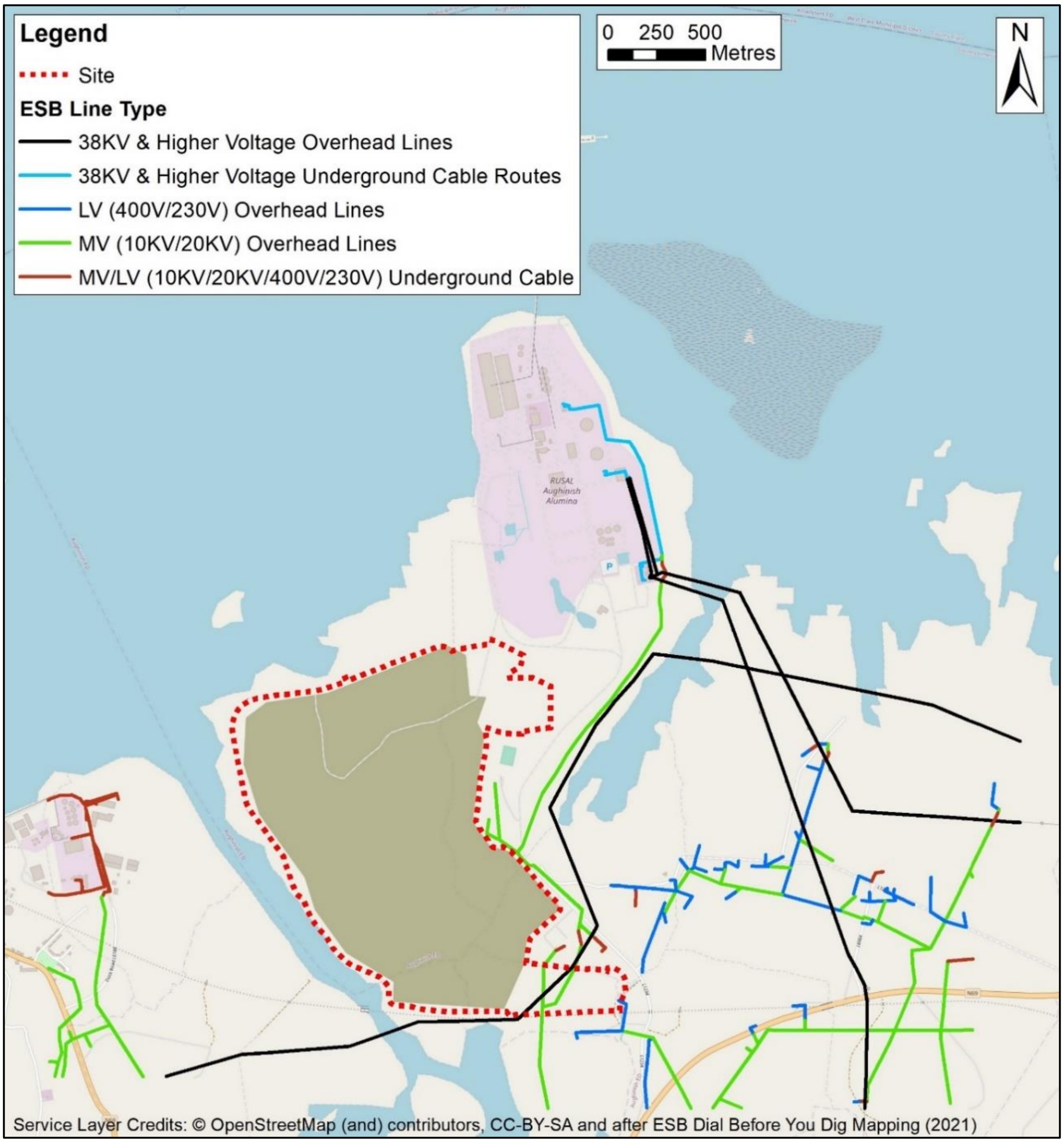


**Figure 15.2:** ESB Supply in vicinity of the Application Site

Figure 15.3 below shows a zoomed in of the ESB infrastructure from Figure 15.2 for the south-east sector of the Site boundary overlain on an aerial image (April 2021).

Mapping has been sourced from the ESB DBYD (Dial Before You Dig) online mapping request portal (07 May 2021).


**Figure 15.3:** Overhead ESB Lines in the south-east sector of the Application Site Boundary

The mapping shows some areas of 10 kV/ 20 kV/ 400V/ 230V underground cabling located outside of the south-east sector of the Site boundary, with the nearest cabling being greater than 150 m from the Site boundary.

The mapping shows two (2) 10 kV overhead lines and one (1) 38 kV overhead line passing through the south-eastern boundary of the Application Site.

One of the 10 kV lines progresses north to the LCCC Water Treatment Plant substation at the south-east boundary of the AAL Plant Site. The 38 kV line also progresses north towards the AAL Plant before turning off to the east (this line is known to feed Wyeth Nutritionals Ireland in Askeaton and is not part of AAL electrical transmission / distribution system) prior to exiting the AAL blue line landholding.

A LV (400V/230V) line enters the most south-easterly extent of the Site boundary and was a supply to a house that has been demolished (2013).

There is an ESB substation located at the south-east boundary of the AAL Plant Site which has local areas of 110 kV/ 20 kV/ 400V/ 230V underground cabling. Two (2) 110 kV overhead cables and one (1) 110kV underground cable runs north from the substation into the Plant Site. Two (2) 110 kV overhead cables run south-east from the substation and continue to the south-east and then east.

### 15.6.2 Gas Infrastructure

Mapping obtained from the GNI DBYD online mapping request portal (10 May 2021) indicates a gas transmission pipe originating from the south and travelling northwards to reach the Plant Site, see Figure 15.4 below.

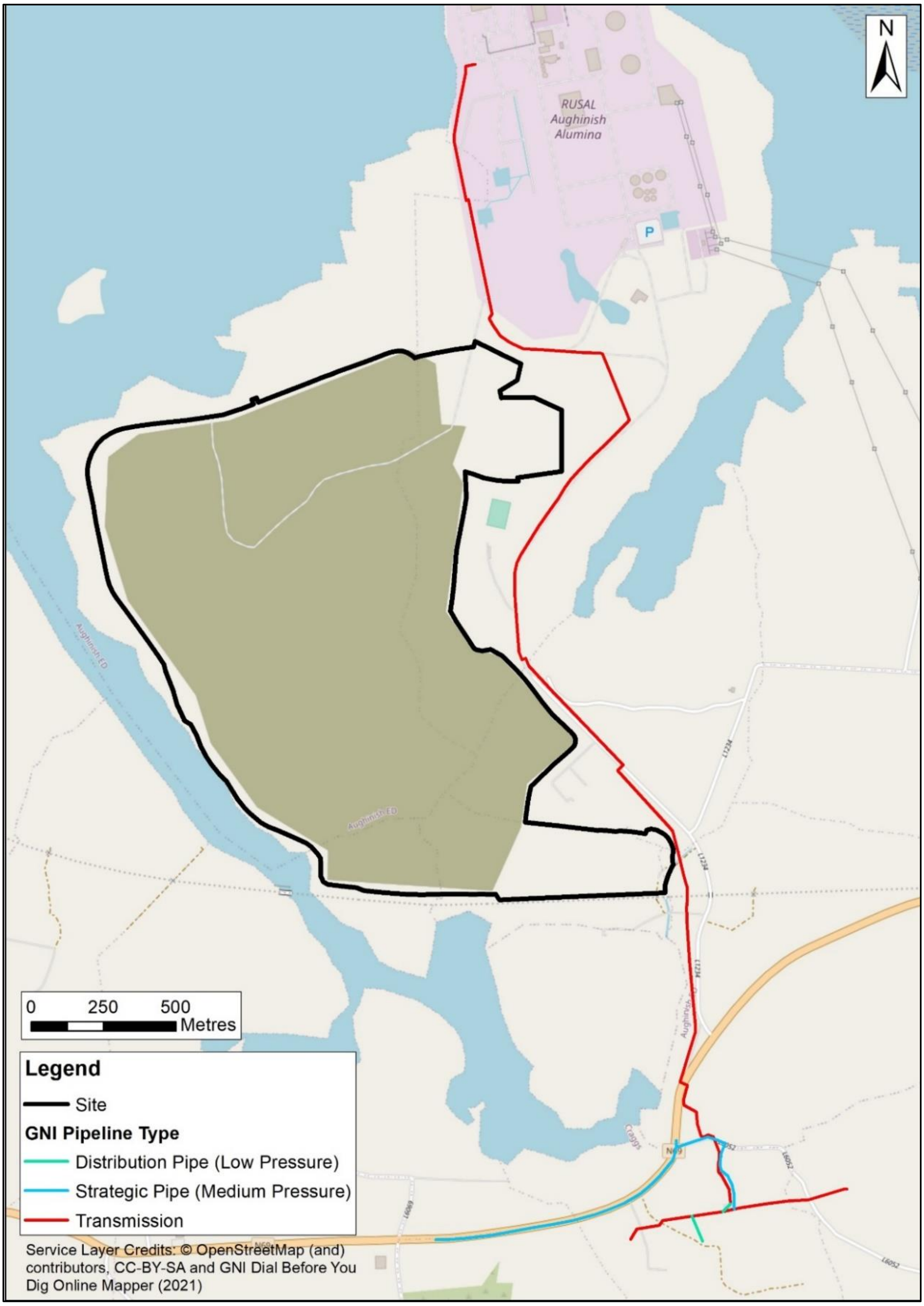


**Figure 15.4:** Gas Supply near the Application Site

This 300 mm diameter steel transmission pipe (design pressure of 85 bar, wall thickness of 11.91 mm) is situated underground and passes to the east and north permitted and proposed Borrow-Pit footprints. The closest distance from the proposed Borrow Pit Extension to the transmission pipe is at the south-east corner, where the 50m minimum distance agreed with GNI is maintained. Marker posts are positioned at regular intervals above the pipe.

The gas line feeds the Combined Heat and Power (CHP) plant at the main Plant Site, where its two gas powered turbines provide power and steam for plant processes. The CHP generates approximately 160 MW or electrical energy per annum, approximately 120 MW of which is supplied to the national grid.

Two gas fired boilers (102 MW each) also support overall AAL plant operations through their capacity for steam only generation.

### 15.6.3 Telecommunications

#### 15.6.3.1 Wired Telecommunications

The location of the existing telecommunications networks has been provided in Figure 15.5 below. Mapping has been sourced from the Eir CBYD online mapping request portal (10 May 2021).


**Figure 15.5:** Eir Service Layout surrounding the Application Site

It shows underground trenched cables running from the main N69 road, approximately 65 m to the east of the Application Site boundary at its nearest point. The cable connects with the AAL Plant Site.

#### 15.6.3.2 Microwave Link/Channel and Cellular Networks

Independent Site Management Limited (ISM) were commissioned to review and assess the Proposed Development in order to establish the potential effects on important telecommunication channels, (such as microwave links) in the vicinity of the Site.

Their assessment is included in Appendix A and did not identify any microwave links in the area of the Application Site that might have potential to be impacted by the Proposed Development. Radio coverage for the local geographic area is served by several cells at notable distances away from the development, as well as one located within the AAL Plant Site.

### 15.6.4 Potable Water Network

Mapping obtained from Irish Water (11 May 2021) indicates an Irish Water owned mains supply passing through the south-eastern extent and along the eastern edge of the Application Site where it extends northwards into the AAL facility (see Figure 15.6).

The mapping shows a 750mm diameter asbestos pipe passing to the south-east of the BRDA and through the stockpile area in the south-east sector of the Application Site. This 750mm diameter asbestos pipe enters the footprint of the Limerick City and County Council Water Treatment Plant (LCCC WTP) and two (2) 600mm diameter ductile iron pipe branches emerge; one going north towards the AAL Plant and the other going east. The 750mm diameter asbestos pipe then continues to the south-east.

The pipe passes to the east of Application Site alongside the constructed Phase 2 BRDA, offset approx. 20m at its closest point. The 600mm diameter ductile iron pipe follows north, alongside the west verge of the Access Road, to enter the AAL Plant. It continues further north and passes to the south-east and east of the proposed Borrow Pit Extension and has a minimum offset of 50m at its closest point to south-east corner of the Borrow Pit Extension footprint.

Prior to 2010, a 600mm diameter asbestos pipe ran north-west from the LCCC WTP to the Poulaweala Creek. This pipe served as an active sludge disposal line (scour line) and was buried beneath the composite basal lining system (pipe invert at 2m - 3m depth) of the south-east sector of the Phase 2 BRDA. The disposal line was made redundant in 2010 when LCCC WTP commissioned their sludge retention tank, and the pipe was no longer required. LCCC arranged for the 600mm diameter asbestos pipe to be cut and blanked at the upstream end, as shown in Figure 15.6 below.

The Irish Water raw water supply originates from the River Deel to the east, from where it is pumped via the Limerick City and County Council municipal water treatment plant and routed via ring main to AAL Plant.

The Borrow-Pit activity proposes extraction of rock above the water-table and there are no watercourses nearby.

The Application Site is noted not to be located within a Source Protection Area of a public water supply scheme.

### 15.6.5 Surface and Foul Water Network

Irish Water mapping does not contain details of any sewer network within the region of the Application Site. AAL operates a dedicated Wastewater Treatment Management System for both the BRDA and the Plant Site, which incorporates a surface water and storm runoff system.

There is no hydrological link with any water bodies. The main emission to waters from the installation is process effluent (which also includes the sanitary effluent) discharged at W1-1 to the Shannon Estuary following treatment at the on-site process Effluent Clarifier System (ECS) and the on-site sanitary effluent treatment plant, respectively. Further details of wastewater treatment are provided in Chapter 10: Hydrology and Hydrogeology.

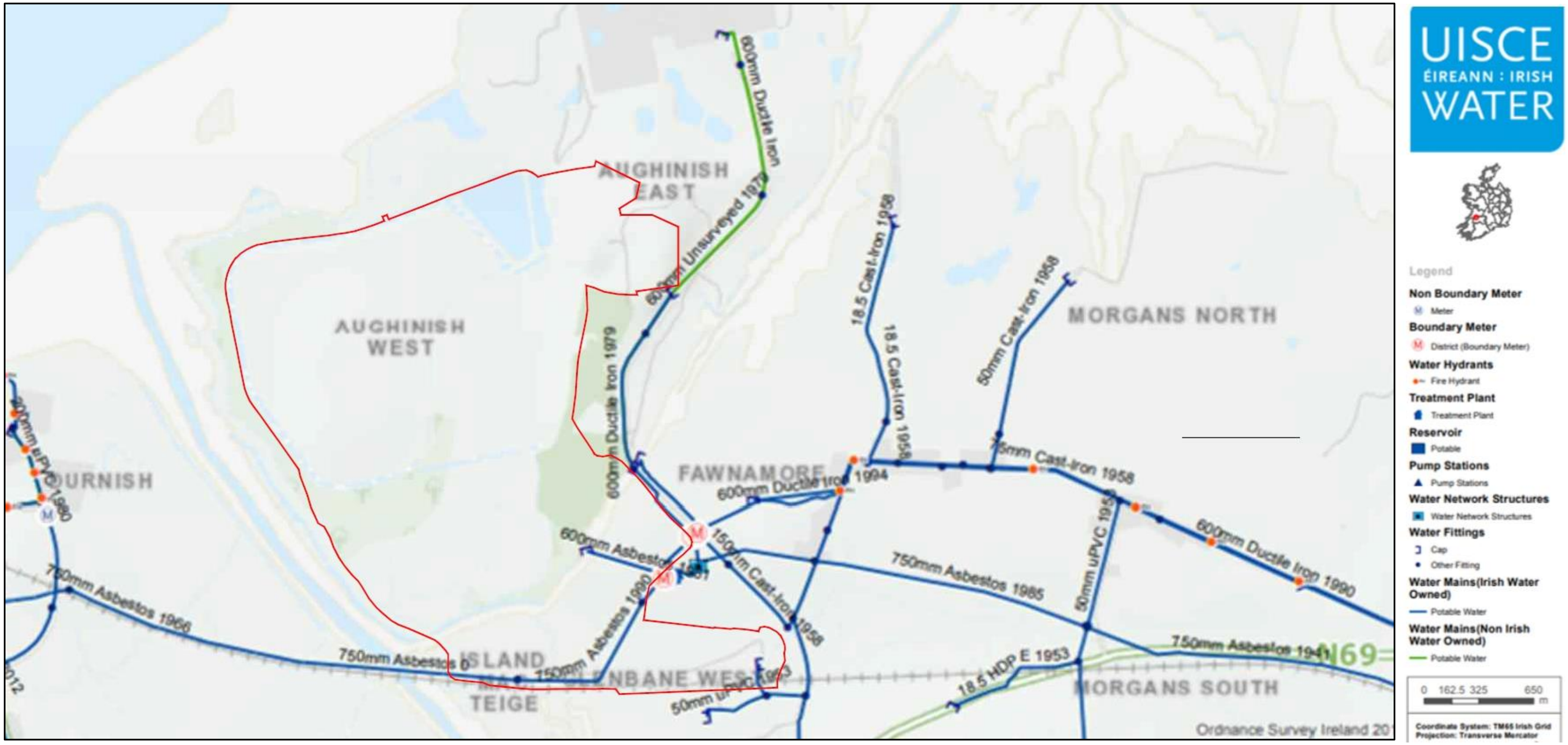


**Figure 15.6:** Water Mains Supply in vicinity of the Application Site (red line boundary)

## 15.7 Characteristics Of The Proposed Development

The Proposed Development relates to the extension of industrial activities that are currently being undertaken within the Application Site. There will be no new connections to existing utilities required.

The following are the main characteristics of the Proposed Development that have the potential to cause impacts:

- Ground disturbance through activities associated with extraction of rock from the Borrow Pit Extension;
- Increased height of the Salt Cake Disposal Cell (SCDC); and
- Increased height of the BRDA.

## 15.8 Potential Effects

This section considers the potential effects that may occur on surrounding material assets as a result of the Proposed Development during in one combined construction and operational phase as well as any potential effects in a 'Do Nothing' scenario if the Proposals were not to proceed. The occurrence of unplanned events (major accidents and disasters) has been considered in Chapter 16 of this EIAR.

### 15.8.1 Electricity Network

The Proposed Development will not result in any changes to the electricity network, nor is it expected to result in a substantial increase in electrical demand. The underground lines indicated on Figure 15.2 are considered to be of sufficient distance from the Application Site that they are not at risk of disruption from works.

Therefore, potential impacts on the local electrical network are likely to be **negligible**, resulting in effects that are brief/temporary and **imperceptible**.

### 15.8.2 Gas Infrastructure

There are no requirements for any new GNI connections to service the Proposed Development, and it is not anticipated that there will be substantial additional supply demands on the GNI network.
The transmission line identified on Figure 15.3 will be aligned no less than 50m away from the blasting face of the proposed Borrow-Pit extension.

Therefore, no changes or disturbance to the gas network are anticipated and it is considered that potential impacts that are **negligible**, resulting in effects that are brief/temporary and **imperceptible**.

### 15.8.3 Telecommunications

#### 15.8.3.1Wired Telecommunications

The telecommunications network is used at the AAL facility. The Proposed Development will not require any additional telecommunications connections. The Proposed Development will not require the movement or relocation of transmission lines or other infrastructure.

The impact on the telecommunications network will be **negligible** and the effects would be brief/temporary and **imperceptible**

#### 15.8.3.2Microwave Link/Channel and Cellular Networks

The assessment identified a small number of microwave links in the vicinity of the site, none of which require additional mitigation measures to be undertaken for their retention.

The proposed increase in elevation sought for the BRDA is well below the average heights utilised by microwave links, the potential impacts to microwave telecommunications channels are considered to be **negligible**, arising in brief/temporary and **imperceptible** effects.

Similarly, the extent of radio coverage that exists in the local area is considered sufficient to enable an assessment on impacts on radio transmission as a result of the Proposed Development to be **negligible**, with effects that are assessed as brief/temporary and **imperceptible**.

### 15.8.4 Potable Water Network

The Proposed Development will continue to use the existing water mains connection for potable water and no changes to demand are anticipated. There is no increase in built structures and the existing services within the Plant Site will be utilised by site personnel.

Therefore, the impact on the potable water network is considered to be **negligible** and the effects are assessed as brief/temporary and **imperceptible**.

### 15.8.5 Surface and Foul Water Network

Proposed upgrades to the dedicated Surface Water Management System for the BRDA are an element of the Proposed Development and are described in Chapter 10: Hydrology and Hydrogeology. The upgrades are proposed to improve the system’s ability to accommodate the Inflow Design Flood (IDF), essentially reducing the potential for unacceptable risks to the storm water containment infrastructure of the BRDA.

AAL manage internally all the surface and foul waters generated by the BRDA and the Plant Site via the dedicated Wastewater Treatment Management System. No changes to this System are proposed.

Therefore, the impact of the Proposed Development in relation to the surface and foul water network can be assessed as **Low** and **Beneficial**. The impact can be assessed as brief/temporary and **slight**.

## 15.9 Do Nothing Scenario

There would be **negligible** impacts and **imperceptible** effects on local built services, utilities or supplies should the Proposed Development not be provided.

## 15.10 Mitigation And Management

The elements of the baseline condition, the Proposed Development design and good working practices that reduce the potential for impacts to Material Assets – Site Services in the vicinity of the Application Site include the following:

- **Electricity Network** - In the stockpile area, located in the south-east corner of the red line boundary, two (2) overhead 10 kV lines cross from south to north (green lines shown in Figure 15.2 and Figure 15.3) and one (1) overhead 38 kV line crosses from south-west to north-east (black line shown in Figure 15.2 and grey line shown in Figure 15.3).
  These overhead lines currently have site protection measures in place in accordance with the ESB Networks Code of Practice for Avoiding Danger from Overhead Electricity Lines, which are maintained by AAL on a regular basis.

- **Gas Infrastructure** – The set-back distance and Peak Particle Velocity (PPV) limits have been agreed following consultation with GNI, as described in Chapter 8: Soils, Land and Geology.
  Works on and around the gas transmission lines will be conducted in accordance with the Main Contractor's final Construction Management Plan and the GNI '*Code of Practice for Working in the Vicinity of the Transmission Network*' as well as further close consultation with appointed GNI personnel.

- **Microwave Link/Channel and Cellular Networks -** AAL already possess an active telecommunication site within its property which, if required, has ample capacity to provide necessary mitigation measures should retention of any microwave links be required (subject to planning permission, if applicable).

- **Potable Water Network -** The set-back distance and Peak Particle Velocity (PPV) limits applicable for the gas transmission line are consistent for the 600mm diameter ductile iron pipe, as both services are installed adjacently to the east of the proposed Borrow Pit Extension.
  Works on and around the portable water network will be conducted in accordance with the Main Contractor's final Construction Management Plan and the Irish Water '*Code of Practice for Water Infrastructure*' as well as consultation with appointed Irish Water personnel.

The additional mitigation measures listed below will be undertaken:

- A project specific draft Construction Environmental Management Plan (CEMP) has been developed and is included with this EIAR. This final CEMP shall be adopted by the Contractors in the development of their Construction Stage Safety and Health documentation and Risk Assessment- Method Statements (RAMS) and be implanted during the works.

- Pre-construction consultation and authorisation will be achieved for all of the relevant infrastructure connections;

- Any works required to material assets on or around the Site will be carried out in conjunction with the relevant provider to ensure minimal disruption to the existing users;

- Any works required to material assets on or around the Site will be carried out strictly in accordance with the relevant provider's Code of Practices; and

- Efficiencies in water usage will be considered throughout the engineering design and construction phase of the Proposed Development.

### 15.10.1 Monitoring

Any monitoring associated with authorisation or consents, e.g., construction discharges or those associated with operational activities, will be incorporated into the Contactors RAMS and the CEMP and will be adhered to.

## 15.11 Residual Effects

Once the additional mitigation measures, appropriate design standards and operational infrastructure management plans are adhered to, it is considered that any impacts on the material assets surrounding the Proposed Development will be **negligible** and any effects **imperceptible**.

**Cumulative Residual Effects**

The magnitude of impacts of the Proposed Development with respect to material assets is **negligible** and the effects are considered to be **imperceptible and not significant**.

Therefore, **it is considered unlikely that there will be significant cumulative effects** with other developments as identified in Chapter 17: Interactions and Cumulative Impacts

## 15.12 Difficulties Encountered

No particular difficulties were encountered in obtaining data and undertaking the assessment of Material Assets – Site Services.

## 15.13 Summary and Conclusions

This assessment has considered the potential direct and indirect significant impacts and effects of the Proposed Development on Material Assets – Site Services located in the vicinity of the Application Site.

The main receptors identified through the baseline study and subsequently assessed were surrounding utilities, including gas, electricity, telecommunications, foul water, potable water and surface water infrastructures.

With effective design and management, the magnitude of impact on utilities is considered **negligible** and significance is assessed to be **imperceptible or slight** (see Table 15.4) and, therefore, **not significant** in terms of this assessment.

Overall, the Proposed Development is considered to have **imperceptible** implications (as defined in Table 15.5) for Material Assets – Site Services in the vicinity of the Application Site.

## 15.14 References

Environmental Protection Agency. August 2017.Guidelines on the information to be contained in Environmental Impact Assessment Reports. Published in 'Draft'.

Environmental Protection Agency. September 2015. Advice Notes for Preparing Environmental Impact Statements'. Published in 'Draft'.

Independent Site Management Limited (ISM), 12 May 2021. Letter Report on Microwave linkages impacts for the Aughinish Alumina BRDA Extension Development.

# 16.0 MAJOR ACCIDENTS AND DISASTERS

## 16.1 Introduction

This Chapter of the Environmental Impact Assessment Report (EIAR) has been prepared by Golder Associates Ireland Ltd (Golder). This Chapter presents an assessment of the vulnerability of the Proposed Development to major accidents and / or disasters, and the potential for the Proposed Development, if any, to cause major accidents and/or disasters. The discussion is supported by a risk assessment which considers the likelihood of major accidents or disasters occurring combined with the severity of their associated impacts.

The assessment has been prepared by Brian Keenan (C.Eng, BE, MSc) and Kevin McGillycuddy (BA (Mod), MSc) in conjunction with inputs from the wider EIAR team and EIAR Chapter technical leads.

Brian Keenan is a Chartered Engineer with Engineers Ireland and has over 20-years of experience comprising civil engineering construction, geotechnical engineering and mine waste consultancy. Kevin McGillycuddy is an Environmental Consultant with 8 years of consulting experience and is also a Practitioner Member of the Institute of Environmental Management and Assessment.

### 16.1.1 Proposed Development

The Proposed Development consists of works to the Bauxite Residue Disposal Area (BRDA) comprising of an expansion to increase its disposal capacity to accommodate additional bauxite residue arising from the continued operation of the permitted alumina refinery plant located on the wider AAL facility. The proposed increase in disposal capacity to the BRDA will result in a proposed increase in height of c.12m above the currently permitted stage 10 level (c. 32m OD) to a final stage 16 level (c. 44m OD). No increase to the existing footprint of the BRDA is proposed.

The proposed method of raising the BRDA will be the upstream method, consistent with the construction methodology for the current BRDA and involves the construction of rock fill embankments (Stages), offset internally and founded on the previously deposited and farmed bauxite residue, in 2 m high vertical lifts. The overall BRDA is raised systematically as the stages are filled with bauxite residue, farmed, carbonated and compacted, prior to deposition of the next layer.

Additional works proposed as part of this application include the following:

- A vertical extension to the existing Salt Cake Disposal Cell (SCDC) to accommodate further disposal of salt cake resulting in an increase in height of c.2.25m. The SCDC is located within the BRDA. A description of the SCDC and its function is provided in Chapter 2 of this EIAR.

- An extension of the existing borrow pit, located to the east of the BRDA, is also proposed. This extension proposes to increase the footprint of the borrow pit from c.4.5ha to c.8.4ha. This expansion will provide an additional 380,000m3 of rock fill material which is needed to satisfy the requirements of the construction and operation of the BRDA.

- The continued use of an existing stockpile area at the south east of the subject site to store topsoil in order to satisfy the additional restoration requirements of the extended BRDA.

- Upgrades to the existing water management infrastructure to accommodate the BRDA development to Stage 16 which will also allow for greater Inflow Design Flood (IDF) capacity for the entirety of the BRDA.

Given that the proposed BRDA Raise and the proposed SCDC Raise will sit entirely within the footprint of the existing BRDA, where reference is made to the BRDA within the text, this will refer to both the BRDA and the SCDC unless otherwise stated. A general site layout showing these individual features has been provided in Figure 16.1.

Please refer to Chapter 3.0 of this EIAR and the Engineering Design Report (enclosed in Appendix A) for a more detailed description of the Proposed Development.

### 16.1.2 Context of the Overall AAL Facility in Relation to the COMAH Regulations

It is noted that the AAL facility is not deemed to be an establishment subject to the Chemicals Act (Control of Major Accident Hazards involving Dangerous Substances) Regulations 2015 (S.I. No. 209 of 2015) (the 'COMAH Regulations'), i.e., it is not a Seveso site.

### 16.1.3 Operational Management

The overall AAL facility is subject to the terms of its Industrial Emissions Licence (IEL) P0035-07. A dedicated environmental management team supports the operation of the plant's Environmental Management System (EMS), which is certified to ISO 14001:2015. In addition, the AAL facility operates a Quality Management System (QMS), accredited to ISO 9001:2015; an Energy Management System accredited to ISO 50001:2011; and an International Safety Rating System (ISRS).

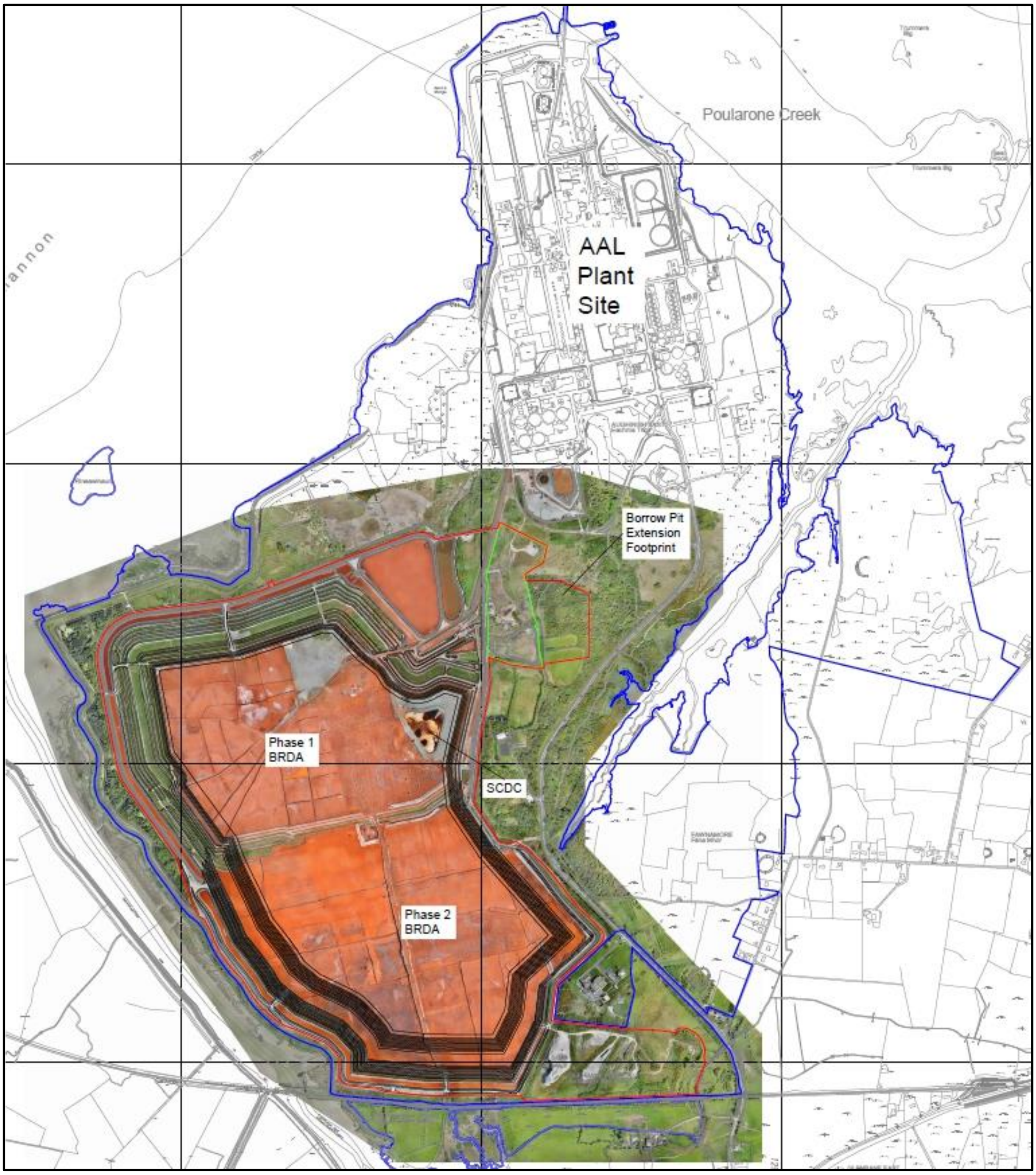


**Figure 16.1**: Site Location Map - Blue Line is the AAL Ownership Boundary, Red Line is the Application Boundary and Green Line is the permitted Borrow Pit Footprint

## 16.2 Legislative Requirements

Article 5 of the Environmental Impact Assessment (EIA) Directive (Directive 2011/92/EU, as amended by Directive 2014/52/EU) sets down the minimum information to be supplied in an EIAR, including data and information to be included by the developer, as identified in Paragraphs 1 to 10 of Annex IV of the EIA Directive. Paragraph 5(d) of Annex IV identifies that:

*A description of the likely significant effects of the project on the environment resulting from, inter alia:*
*(d) the risks to human health, cultural heritage or the environment (for example due to accidents or disasters).*

Furthermore, in Paragraph 8 of Annex IV:

*A description of the expected significant adverse effects of the project on the environment deriving from the vulnerability of the project to risks of major accidents and/or disasters which are relevant to the project concerned. […] Where appropriate, this description should include measures envisaged to prevent or mitigate the significant adverse effects of such events on the environment and details of the preparedness for and proposed response to such emergencies.*

The Waste Management (Management of Waste from the Extractive Industries) Regulations 2009, as amended, (SI No. 566/2009) ('The Waste Management Regulations') apply to the activities at the AAL facility.

These regulations define a '**major accident'**, as:

*'an occurrence on site in the course of an operation involving the management of extractive waste in any establishment covered by Directive 2006/21/EC [1], leading to a serious danger to human health and/or the environment, whether immediately or over time, on-site or off-site*.

These regulations do not provide a definition of a '**disaster**'.

In accordance with the requirements of the Waste Management Regulations AAL have put in place an Accident Prevention Policy (RUSAL Aughinish Accident Prevention Policy, February 2021), a Safety Management System for implementing it, and an Internal Emergency Plan, (RUSAL Aughinish, Emergency Response Plan, April 2017) which specifies the measures to be taken on site in the event of an accident.

The Internal Emergency Plan contains a general facility emergency plan and a specific BRDA emergency plan and relates to incidents that can be managed internally by AAL's own resources.

Correspondingly, and as required by the Waste Management Regulations, the local authority, Limerick City and County Council (LCCC), has drawn up an External Emergency Plan specifying the measures to be taken off-site in the event of an accident relating to the BRDA, (External Emergency Plan For Bauxite Residue Disposal Area, Aughinish Alumina Ltd., Askeaton, Co. Limerick, Version 2, August 2019).

## 16.3 Guidance

There is no specific Irish guidance available for the assessment of major accidents and disasters in the context of EIA. A number of alternative sources of guidance have been considered in the course of this assessment, these are identified below.

[1] *OJ L 102, 11.4.2006 p.15-34*

**HSE Emergency Management Area 3 Emergency Plan (Covering Geographical Areas of Counties Clare, Limerick and North Tipperary), January 2021**

This provides a framework for a co-coordinated response to major emergencies beyond that of the normal capabilities of the principal emergency services in the Geographical Area of Mid-West Community Healthcare. The AAL facility has been specifically identified within this HSE Plan during the 'Hazard Identification' process.

The HSE Plan has been prepared in accordance with Section 4.1 of the 'A Framework for Major Emergency Management' (2006), so that the plan is consistent with plans of other HSE Regions, other Principal Response Agencies, appropriate National Emergency Plans and other Site and Event Specific Plans, which may be activated at the same time.

**Major Accidents and Disasters in EIA: A Primer, Institute of Environmental Management and Assessment (IEMA) and ARUP, September 2020**

This Primer on the assessment of major accidents and disasters in the context of EIA was published by the IEMA in September 2020 with the main aim of increasing awareness of the major accidents and/or disasters EIA topic and its application. The document offers an assessment methodology based on known current UK practice and identifies key terminology that can be used in an assessment. The Primer was developed to generate comment and discussion, from which future guidance and institutional and regulatory change may evolve. Major accidents and disasters in the Primer are defined as:

- **Major Accidents**: Events that threaten immediate or delayed serious environmental effects to human health, welfare and/or the environment and require the use of resources beyond those of the client or its appointed representatives to manage. Whilst malicious intent is not accidental, the outcome (e.g., train derailment) may be the same and therefore many mitigation measures will apply to both deliberate and accidental events; and

- **Disaster**: May be a natural hazard (e.g., earthquake) or a man-made/external hazard (e.g., act of terrorism) with the potential to cause an event or situation that meets the definition of a major accident.

**LA 104 - Environmental Assessment and Monitoring, Design Manual for Roads and Bridges, Highways England, Revision 1, August 2020**

In the context of EIA there is no dedicated Irish guidance for the assessment of major accidents and disasters for projects. In the absence of such guidance this document has been referred to. This document was published by Highways England for assessing, reporting and monitoring the environmental effects of certain projects in line with the requirements of the EIA Directive.

In the context of major accidents and disasters the guidance identifies that the assessment shall be made with regard to:

- Vulnerability of the project to risks of major events; and

- Any consequential changes in the predicted effects of that project on environmental factors.

**Environmental Impact Assessment of Projects – Guidance on the Preparation of the Environmental Impact Assessment Report, European Commission, 2017**

The guidance note reviews the scope of the environmental factors covered by the EIA Directive, with a focus on those factors that were expanded in the 2014 amendments.

The guidance identifies key considerations on accidents and disaster risks and identified that EIARs should address issues such as:

- What can go wrong with a Project?
- What adverse consequences might occur to human health and to the environment?
- What is the range of magnitude of adverse consequences?
- How likely are these consequences?
- What is the Project's state of preparedness in case of an accident/disaster?
- Is there a plan for an emergency situation?

**Guidelines on the Information to be contained in Environmental Impact Assessment Reports (Draft), Environmental Protection Agency (EPA), August 2017**

The 'Guidelines on the information to be contained in environmental impact assessment reports', were published in 'draft' by the EPA in August 2017, (Draft 2017 EIAR Guidelines) with a view to facilitating compliance with the amended EIA Directive.
The assessment in this Chapter has had regard to the Draft 2017 EIAR Guidelines, which includes the requirement to describe the risk of accidents (with regard to substances or technologies used) in the characteristics of the project.

The Draft 2017 EIAR Guidelines states that the EIAR should attempt to identify a reasonably foreseeable worst-case scenario as a context for 'likely significant effects'. They furthermore note that to address unforeseen or unplanned effects, the EIA Directive requires that the vulnerability of the project to risk of major accidents and /or disasters relevant to the project concerned are taken into account, and that the EIAR explicitly addresses this issue. The extent to which the effects of major accidents and / or disasters are examined should be guided by an assessment of the likelihood of their occurrence, which can be supported by general risk assessment methods.

**Advice Notes for Preparing Environmental Impact Statements (Draft), Environmental Protection Agency (EPA), September 2015**

The 'Advice notes for the preparation of Environmental Impact Statements' was also published draft by the EPA. This document was produced after the publication of the EIA Directive in 2014 and prior to the transposition of the amended EIA Directive.

In the context of climate and flooding, the draft advice notes state that *'potential for damage to the environment, cultural heritage or human health as a result of an accident or disaster caused by flooding should be addressed where significant'*; and also *'the worst-case impact of the project should be described should all mitigation measures fail. This includes the risk of major accidents and/or disasters due to climate change which are relevant to the project concerned'*.

**Major Emergency Plan, Limerick City and County Council, June 2014**

The purpose of the Limerick City and County Council Major Emergency Plan is to establish arrangements which will enable the three Principal Response Agencies for the area, (Limerick City and County Council, An Garda Síochána and the Health Service Executive) to co-ordinate efforts in their response to major emergencies.

This Plan identifies that it has been prepared in accordance with the guidance issued by the Department of the Environment, Community and Local Government in relation to Major Emergency Management and that it is consistent with 'A Framework for Major Emergency Management' (2006).

**Guidance on Assessing and Costing Environmental Liabilities, EPA, 2014a**

This guidance presents a systematic approach for assessing and costing environmental liabilities associated with the closure and restoration/aftercare, and incidents for activities falling under the various EPA authorisation regimes including the Industrial Emissions Directive (IED), Integrated Pollution Prevention and Control (IPPC), waste, wastewater discharge and dumping at sea. The guidance is based on the assessment of the plausible worst-case scenario.

The guidance presents a systematic approach for risk/hazard identification and risk assessment (analysis and evaluation) and provides a matrix approach for the determination of risk on the basis of the likelihood of an event occurring and its associated consequences.
AAL update their Environmental Liabilities Risk Assessment (ELRA) in accordance with their IE Licence (P0035-07), the current ELRA was referenced in this assessment, (PM Group 2019).

**A Framework for Major Emergency Management, Government of Ireland, 2006**

This document establishes a framework which sets out common arrangements and structures for front-line public-sector emergency management in Ireland. One of the key objectives of the Framework is to set out the arrangements and facilities for effective co-ordination of the individual response efforts of the Principal Response Agencies to major emergencies, so that the combined result is greater than the sum of the individual efforts.
The document identifies that it:

> *'… sets out mechanisms for co-ordination at all levels of major emergency management - on site, at local level and at regional level, it defines a common language or terminology to make inter-agency working simpler and it introduces a system to immediately determine a lead agency in every emergency situation. It also provides for linking to national level emergency management.'*

**A Framework for Major Emergency Management, Guidance Document 1, A Guide to Risk Assessment in Major Emergency Management, Department of the Environment, Heritage & Local Government (DoEHLG), January 2010**

The DoEHLG Guide to Risk Assessment in Major Emergency Management supports the 2006 Framework described above and provides additional guidance on the risk assessment process.

## 16.4 Guidance for the Assessment of Tailings Dams

The BRDA is considered a tailings dam in accordance with Best Available Techniques (BAT) Reference Document for the Management of Waste from Extractive Industries in accordance with Directive 2006/21/EC (MWEI BREF 2018). It comprises a basin, a starter dam and subsequent stages raises constructed by the upstream method, thus increasing the elevation of the BRDA as bauxite residue is deposited.

There is no specific Irish standard or guidelines for the design and classification of tailings facilities (dams). MWEI BREF 2018 provides two (2) recommendations for international guidelines and good practice for tailings management facilities i.e., the Canadian Dam Association (CDA) guidelines and the International Commission on Large Dams (ICOLD).

In accordance with MWEI BREF 2018 (Section 4.2.1.3.4.3) and in the absence of a national or EN standard, AAL have selected to classify the BRDA and ancillary infrastructure in accordance CDA Guidelines (CDA 2013, CDA 2014) and to adopt the target level criteria for design parameters (inflow design flood, seismic event and factors of safety for static, pseudo-static and post-seismic stability) which are dependent on the consequence of failure and hence the dam classification.

**Canadian Dam Association, Dam Safety Guidelines (CDA 2013) and Technical Bulletin: Application of Dam Safety Guidelines to Mining Dams (CDA 2014)**
Classification of the BRDA and ancillary infrastructure is based on the criteria presented in Table 16.1 below, extracted from the Canadian Dam Association (CDA) Guidelines 2013 and 2014 (CDA 2013 and 2014).

| Dam Class | Population at Risk | Incremental Losses | | |
|---|---|---|---|---|
| | | Loss of Life | Environmental and Cultural Values | Infrastructure and Economics |
| **Low** | None | 0 | Minimal, short-term loss, no long-term loss | Low Economic losses, area contains limited infrastructure or services |
| **Significant** | Temporary Only | Unspecified | No significant loss or deterioration of fish or wildlife habitat, loss of marginal habitat only, restoration or compensation in kind highly possible | Losses to recreational facilities, seasonal workplaces and infrequently used transportation routes |
| **High** | Permanent | 10 or fewer | Significant loss or deterioration of important fish or wildlife habitat, loss of marginal habitat only, restoration or compensation in kind highly possible | High economic losses affecting infrastructure, public transportation, and commercial facilities |
| **Very High** | Permanent | 100 or fewer | Significant loss or deterioration of critical fish or wildlife habitat, loss of marginal habitat only, restoration or compensation in kind possible but impractical | Very high economic losses affecting important infrastructure or services (e.g., highway, industrial facility, storage facilities for dangerous substances) |
| **Extreme** | Permanent | More than 100 | Major loss of critical fish or wildlife habitat, restoration or compensation in kind impossible | Extreme losses affecting critical infrastructure or services (e.g., hospital, major industrial complex, major storage facilities for dangerous substances) |

**Table 16.1:** Canadian Dam Association Dam Classification. Source: Table 2-1 of CDA 2013.

Tailings dams are classified according to the consequence in the event of failure and takes into account the incremental loss of life, environmental impact and economic impact that a failure of the dam may inflict on downstream or upstream areas, or at the dam location itself. Incremental losses are those over and above losses that might have occurred in the same natural event or condition had the facility not failed. The CDA classification assigned to a dam is the highest rank determined among the incremental loss categories and the dam class range has five (5) categories of consequence: Low, Significant, High, Very High and Extreme. The classification assigned to a dam is the highest rank determined among the loss categories.

The project specific design criteria are based on the dam hazard potential classification (HPC). The classification assigned to a dam is the highest rank determined among the 'incremental losses' categories. Based on the criteria presented in Table 16.1, Golder has classified the BRDA, as a facility with a '**High**' HPC. This classification is based on the following factors:

- The population at risk is deemed to be 10 or fewer and is temporary. This risk would put the BRDA into the '**Significant**' HPC. The population at risk is confined to BRDA staff, subcontracted staff or third parties during its operation (40 hrs per week), subcontracted staff or third parties farming the land to the north of the BRDA (short period during summer months) and occasional attendance by inspection, monitoring or maintenance staff (subcontracted or third party) during its operation and following closure. There is no resident population downstream of the BRDA within the break-out zone.

- Even though a failure is likely to adversely affect wildlife habitat, the low mobility of the frictional granular flow and the consequence mitigating measures incorporated into the design of the facility will, in all likelihood, mean that restoration of the area is highly possible. There are no notable protected species of wildlife or plants and/or habitats that would be considered irreplaceable. This risk would put the BRDA into the '**High**' HPC.

- A failure of the BRDA will, in all likelihood, result in minimal economic losses to third parties i.e., beyond the footprint of lands owned by AAL and no impact to infrastructure or services. However, boundaries for special areas of conservation (SAC) and special protection areas (SPA) are present to the north and west of the BRDA and a failure of the BRDA has the potential to potential to impact on these areas. Significant costs may be associated with clean-up and restoration of affected area. This risk would put the BRDA in the **'Significant'** to '**High**' HPC.

The consequence category for the BRDA is classified as a **High** HPC to account for the clean-up and restoration costs of the adjacent SAC and SPA designated areas and for the potential for significant loss of important wildlife / fish habitat.

Based on the criteria presented in Table 16.1, Golder has classified the Storm Water Pond (SWP) as a dam having a "**Low**" HPC. It is deemed that the consequence of failure of the SWP is relatively low and that, should it occur, contains a relatively small volume of water, clean enough to be recirculated back to the Plant. A release would have a low impact on fish and wildlife habitat and pose a very low / no risk to people.

The Liquid Waste Pond (LWP) which stores water clarified in the plant, in excess to operational requirements, is also deemed to have a **"Low"** HPC.

The BRDA's Perimeter Interceptor Channel (PIC) accumulates, manages and transfers storm water around the perimeter of the facility and can be considered to be an elevated dam with a relatively small storage capacity. As a result, the PIC is considered to have a **'Low'** HPC.

## 16.5 Assessment Methodology and Significance Criteria

### 16.5.1 Assessment Aims

As identified above, the key objectives of this assessment are to assess:

- The vulnerability, if any, of the Proposed Development to potential major accidents or disasters, which includes both natural (e.g., earthquakes) and man-made disasters (e.g., technological hazards);
- The Proposed Development's potential, if any, to cause major accidents and/or disasters, (with explicit reference to considerations for human health, cultural heritage, and the environment); and
- The identification of control and/or emergency preparedness measures which are in place, or that may need to be implemented, to prevent or mitigate the likely significant adverse effects of such events on the environment.

### 16.5.2 Temporal Scope

Given the nature of the Proposed Development which involves the sequential raising (construction) and filling (operation) of the BRDA to Stage 16, the single phase raise of the SCDC (construction) and annual extraction of materials from the borrow pit extension, this assessment considers the Proposed Development activities in one combined construction and operational phase.

The assessment considers major accidents and disasters that may occur in this combined construction and operational phase and subsequent to the aftercare phases given the permanent nature of the Proposed Development.

Following closure, AAL will enter into a minimum 5-year active aftercare period during which time all the waters from the BRDA will be captured and returned to the effluent clarification system (ECS) at the plant for treatment and subsequently to discharge via their licenced discharge point (W1-1).

During this 5-year period, AAL will complete the remaining closure works for the side-slopes and the dome, construct the passive treatment wetlands in the PIC, construct the designated breach locations in the PIC and will allow time for the vegetation to establish sufficiently at each closure element.

AAL will continue to monitor the quality of the waters from the BRDA during the period, which is expected to improve significantly as the capping and closure works are completed and establish and will apply for a discharge to the environment via two (2) proposed PIC breach spillway locations and subsequently to the Robertstown River (see Figure 16.2) at appropriate water quality limits to be agreed with the EPA.
The BRDA will then enter a passive aftercare phase for a minimum of 30 years.

### 16.5.3 Geographical Scope

The geographical extent of the assessment of major accidents and disasters covers the physical extent of the subject site as shown by the red line boundary on Figure 16.1, and extended, as appropriate, to include the relevant sensitive receptors or developments which may be affected by the scenarios assessed.

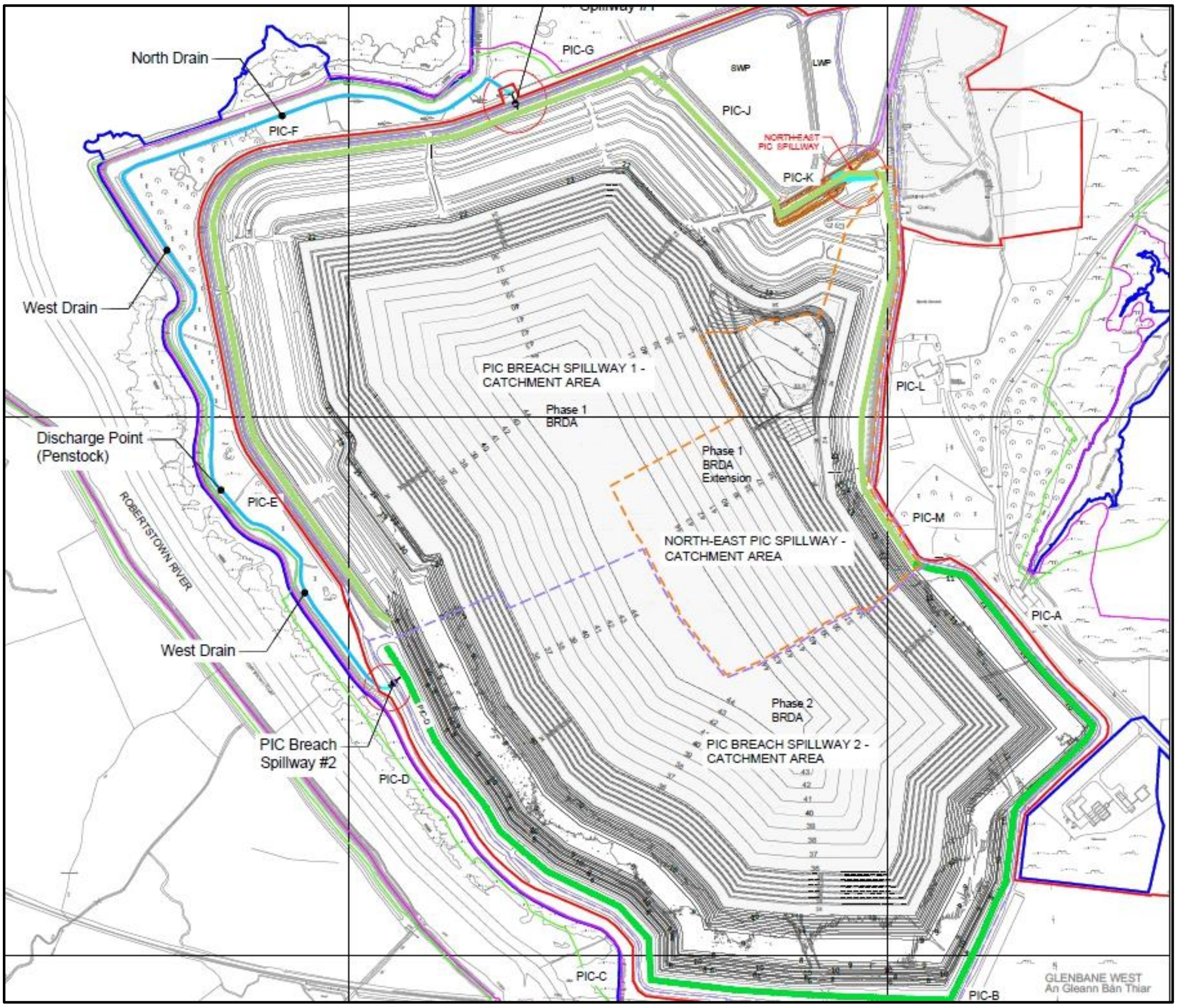

**Figure 16.2:** BRDA Location Map at Closure (extracted from Drawing 10a)

### 16.5.4 Technical Scope

This scope of this assessment of risk of major emergency scenarios has been informed by the conclusions and recommendations of the preceding technical Chapters of this EIAR, as appropriate, in addition to the guidance listed in Section 16.3. It has been undertaken on the assumption that all the relevant mitigation and monitoring measures outlined in the preceding Chapters will be implemented.

This assessment has been made with guidance from the Draft 2017 EIAR Guidelines. The assessment is supported by general risk assessment methods which are based on the DoEHLG Guide to Risk Assessment in Major Emergency Management.

The 2010 DoEHLG Guide to Risk Assessment in Major Emergency Management is intended to support the 2006 Government of Ireland Framework for Major Emergency Management. Under Regulation 6(3) of the Waste Management (Management of Waste from the Extractive Industries) Regulations 2009, as amended, (SI No. 566 of 2009), when local authorities are drawing up an external emergency plan, they are to take account of the provisions of the 2006 Framework. Therefore, the use of the 2010 DoEHLG Guide to Risk Assessment in Major Emergency Management is appropriate for the assessment of potential major emergency scenarios in this Chapter.

The assessment of potential effects has been undertaken using the method outlined below and is supported by the baseline condition information, the preliminary Construction Environmental Management Plan (CEMP) and the Proposed Development design. The Proposed Development design is understood to comprise the project design principles and standards adopted to avoid or prevent adverse safety and environmental effects, construction and operation to appropriate codes of practice and guidelines, and including fixed procedural commitments such as instrumentation and monitoring. This measure provides the baseline for the assessment of impacts.

This assessment also assumes that the Proposed Development (and wider AAL facility) will be designed, constructed and operated in line with best practice and thereby resulting in a low vulnerability of the Proposed Development to the hazards of major accidents and disasters.

The assessment process is qualitative, and it is an assessment of hypothetical situations. The criteria used have been selected to ensure that the assessment is both robust and consistent.

A Risk Assessment and Break-Out Study for the BRDA was conducted by Golder (Golder 2019). The risk of major accidents associated with the BRDA and SCDC (encompassed within the BRDA) have been assessed, and classification of likelihood and vulnerability based on existing assessments of the BRDA, and associated infrastructure has been determined (see Section 16.8**.** and Golder 2019). Appendix G Breach Analysis of the Engineering Design Report takes into account the raise to stage 16 for the Proposed Development.

AAL have recently undertaken an independent Dam Safety Review (DSR) of the BRDA (SLR 2019) which comprised an objective assessment of the design, performance and management of the BRDA and ancillary infrastructure to confirm whether they meet best practices for dam safety in accordance with CDA Guidelines (CDA 2013, 2014).

#### 16.5.4.1 Stage 1 – Establishing the Context of an Area

The objective Stage 1 of the assessment is to describe the characteristics of the area for which the risk assessment is being completed, as this will influence both the likelihood and the impact of a major accident or disaster. The context of the area will be established with reference to

- Social – surrounding population centres and local receptors;
- Environmental – Natura and vulnerable habitats and species;
- Infrastructure (including utilities) – major roads, rail, shipping and airport, water, electricity and gas supply networks.
- Hazardous sites (this risk assessment has included the consideration of nearby COMAH sites)

#### 16.5.4.2 Stage 2 – Hazard Identification

This stage of the assessment identifies potential major accident hazards and unplanned but credible events which could occur during the lifetime of the Proposed Development.

Similar types of risks will apply to Proposed Development during the active and passive aftercare phases. However, potential consequences are mitigated by the closure and capping containment works proposed for the side-slopes and dome of the BRDA and that AAL will no longer be required to retain and manage the waters generated by the BRDA.

In accordance with Condition 10 of the EPA issued licence (IEL P0035-07), AAL are required to have an approved plan in place for the orderly closure, decommissioning and aftercare of the facility. This plan is called the Closure, Restoration and Aftercare Management Plan (CRAMP) and covers both the Plant area and the BRDA. The most recent update was conducted by AAL during 2019 and subsequently approved by the EPA 2021 as part of the licence review. Financial provisions for the CRAMP are deposited by AAL annually into a Secured Fund and a Parent Company Guarantee (PCG) is in place to match the balance for the Secured Fund target value in place. The CRAMP is funded for a minimum 35-year period following closure (5 years of active aftercare and 30 years of passive aftercare).

The identification of possible major accident hazards/scenarios will consider both the Proposed Development's vulnerability to accidents and / or Disasters and the Proposed Development's potential to cause accidents and / or disasters.
The identification process has had regard to the risks assessment presented in the following:

- The Environmental Liabilities Risk Assessment (ELRA) undertaken by PM Group for the overall facility (Environmental Liabilities Risk Assessment, Aughinish Alumina Ltd, IE0310294-22-RP-0003, 17 April 2019), which is a comprehensive risk assessment conducted in accordance with the terms of the facility's IE Licence. This document assesses liabilities for the wider AAL facility and is the current agreed ELRA for the AAL facility.
  In relation to the area of the Proposed Development the key hazards identified were:
- Release of contaminated effluent from the Storm Water Pond (SWP), see Figure 16.2 ;
- Release of contaminated effluent from the Perimeter Interceptor Channel (PIC) see Figure 16.2; and
- Instability at the adjacent BRDA from blasting vibration at the borrow bit, see Figure 16.2.

The ELRA concluded that 'it has identified no risks that could potentially produce an environmental incident of major consequence'.

- External Emergency Plan For Bauxite Residue Disposal Area, Aughinish Alumina Ltd., Askeaton, Co. Limerick, Limerick City and County Council, Version 2.0, 02 August 2019. This document identified the most important hazards in the study to be:
- Displacement of alkaline water in the PIC (see Figure 16.2) as a result of wave surge without breaching the embankment wall and resulting displacement of the alkaline water in the SWP and the wastewater in the liquid waste pond (LWP); and
- Slope failure of the containment walls for the SWP, LWP and the Outer Perimeter Wall of the PIC (see Figure 16.2) under static load conditions.

It is noted that this document does not comment on the severity or likelihood of scenarios, rather identifies the scenarios and details emergency response arrangements should the scenario occur.

The document refers to the instrumentation present in the perimeter channels, the regular inspection throughout the day/night by the AAL staff, the presence of CCTV, and notes that any breach/failure would be identified soon after occurring.

- Risk Assessment and Break-Out Study for the Bauxite Residue Disposal Area (BRDA), Golder Associates Ireland Ltd, March 2019 (Golder 2019). This report assesses the risk of containment breach and associated bauxite residue release for the various zones within the BRDA. The failure mechanisms identified in this study include:

  - **Earthquake Event -** leading to slope failure or dynamic liquefaction.
  - **Tidal Surge or Wave Event (River Shannon) -** leading to erosion induced slope failure.
  - **Storm Event -** leading to erosion induced slope failure.
  - **Blast Event (Borrow Pit) -** leading to static liquefaction induced slope failure or dynamic liquefaction.
  - **Slope Instability** – as a result of either strength failure through the bauxite residue or erosion of the side-slopes.
  - **Static Liquefaction -** of the unfarmed bauxite residue **(**leading to lower or overall slope failure) or farmed bauxite residue (leading to upper slope failure). Trigger events such as rate of rise, excessive strain / creep within the bauxite residue, foundation creep or a storm event leading to erosion induced slope failure are potential mechanisms that could result in static liquefaction.
  - **Foundation Failure –** as a result of strength failure through the foundation soils leading to overall slope failure via static liquefaction.
  - **Overtopping Event (Discharged Bauxite Residue) -** leading to erosion induced slope failure.

The document concludes that the probability of BRDA failure resulting in containment breach and release of bauxite residue is in the range Very Unlikely to Almost Impossible.

- The presence of proximal Seveso sites in the wider area, as well as the adjacent AAL refinery facility
- The activities which are proposed to take place within the extended Borrow Pit area, and the layout and design of the excavation. This hazard and consequence identification process is based on professional judgement and includes:
- Potential spill events from plant and/or refuelling activities representing a threat of groundwater quality;
- Fire and explosion events due to plant and work activities causing borrow pit face collapse and representing a threat to groundwater quality;
- Inadequate borrow pit design causing borrow pit face collapse;
- Seismic events causing borrow pit face collapse; and
- Damage or rupture of the proximal gas transmission line causing fire or explosion event leading to borrow pit face collapse or third-party damage.

The likelihood and potential impacts of these scenarios have been assessed and documented in Section 16.8.

#### 16.5.4.3 Stage 3 – Risk Assessment

The likelihood of occurrence of each of the hazards identified is assessed in accordance with the criteria identified in Table 16.2. The assessment takes into account the Proposed Development's design in the form of the site's safety and management procedures and existing and proposed environmental controls. Therefore, the likelihood ranking allocated to each of the identified hazards assumes that all Proposed Development design measures, including the relevant safety and management procedures are in place, operational and are effective.

The lowest event likelihood ranking in the DoEHLG Guidelines categorises events which may occur once every 500 or more years. Tailings management facilities (TMFs) such as the AAL BRDA are structures that are required to be designed to withstand highly improbable events which are outside the design classification of other structures.

Such probability classifications range from such as events with likelihoods of 1 in 10,000 years to 1 in 100,000 years i.e., Probable Maximum Flood (PMF) and Maximum Credible Earthquakes. The CDA Guidelines for the classification of the BRDA, has guided the target level standard-based criteria applied to the BRDA.

The BRDA has been classified as a facility with a '**High**' HPC which requires the facility to be assessed for a flood event corresponding to 1/3 between 1 in 1,000-years and the PMF and a seismic event with a return period of 1 in 2,475 years.

For this assessment, the likelihood rankings derived from the DoEHLG Guidelines have therefore been supplemented to include these highly improbable scenarios to which tailings facilities and the AAL BRDA has been designed.

The additional likelihood ranking of 'Highly Improbably or Negligible' has been added to Table 16.2, Table 16.4 and Table 16.6.

| Ranking | Likelihood | Description |
|---|---|---|
| 1 | Highly Improbable or Negligible | May only occur in very exceptional circumstances; greater than between once every 2,475 and 10,000 or more years. |

| Ranking | Likelihood | Description |
|---|---|---|
| 2 | Extremely Unlikely | May occur only in exceptional circumstances; once every 500 or more years |
| 3 | Very Unlikely | Is not expected to occur; and/or no recorded incidents or anecdotal evidence; and/or very few incidents in associated organisations, facilities or communities; and / or little opportunity, reason or means to occur; may occur once every 100-500 years. |
| 4 | Unlikely | May occur at some time; and /or few, infrequent, random recorded incidents or little anecdotal evidence; some incidents in associated or comparable organisations worldwide; some opportunity, reason or means to occur; may occur once per 10-100 years. |
| 5 | Likely | Likely to or may occur; regular recorded incidents and strong anecdotal evidence and will probably occur once per 1-10 years |
| 6 | Very Likely | Very likely to occur; high level of recorded incidents and/or strong anecdotal evidence. Will probably occur more than once a year. |

**Table 16.2:** DoEHLG, 'A Guide to Risk Assessment in Major Emergency Management' (2010), Risk Likelihood Classification, including amendment with regard to design likelihood for tailings facilities

**Consequence**

The determination of severity or of consequences or impacts arising from the identified hazards are classified on a five-level scale from 'Minor' to 'Catastrophic' (Table 16.3) and assume that the threats associated with the identified hazards have materialised.

| Rank | Classification | Impact | Description |
|---|---|---|---|
| 1 | Minor | Life, Health, Welfare | Small number of people affected; no fatalities and small number of minor injuries with first aid treatment. |
| | | Environment | No contamination, localised effects |
| | | Infrastructure | <€0.5M. |
| | | Social | Minor localised disruption to community services or infrastructure (<6 hours). |
| 2 | Limited | Life, Health, Welfare | Single fatality; limited number of people affected; a few serious injuries with hospitalisation and medical treatment required.<br>Localised displacement of a small number of people for 6 - 24 hours.<br>Personal support satisfied through local arrangements. |
| | | Environment | Simple contamination, localised effects of short duration |
| | | Infrastructure | €0.5-3M |
| | | Social | Normal community functioning with some inconvenience. |
| 3 | Serious | Life, Health, Welfare | Significant number of people in affected area impacted with multiple fatalities (<5), multiple serious or extensive injuries (20), significant hospitalisation. |

| Rank | Classification | Impact | Description |
|---|---|---|---|
| | | | Large number of people displaced for 6-24 hours or possibly beyond; up to 500 evacuated.<br>External resources required for personal support. |
| | | Environment | Simple contamination, widespread effects or extended duration. |
| | | Infrastructure | €3-10M. |
| | | Social | Community only partially functioning, some services available. |
| 4 | Very Serious | Life, Health, Welfare | 5 to 50 fatalities, up to 100 serious injuries, up to 2000 evacuated. |
| | | Environment | Heavy contamination, localised effects or extended duration. |
| | | Infrastructure | €10 - 25M. |
| | | Social | Community functioning poorly, minimal services available. |
| 5 | Catastrophic | Life, Health, Welfare | Large numbers of people impacted with significant numbers of fatalities (>50), injuries in the hundreds, more than 2000 evacuated. |
| | | Environment | Very heavy contamination, widespread effects of extended duration. |
| | | Infrastructure | >€25M |
| | | Social | Serious damage to infrastructure causing significant disruption to, or loss of, key services for prolonged period.<br>Community unable to function without significant support. |

**Table 16.3:** DoEHLG, 'A Guide to Risk Assessment in Major Emergency Management' (2010), Risk Classification Table

### 16.5.4.4 Stage 4 – Risk Assessment

The identified hazards, taking into account their likelihood is combined with their associated consequences in a matrix to give an overall risk score for the particular major accident hazard or disaster, (Table 16.4). This matrix is a tool for visualising the overall risk picture according to the level of risks, i.e., as 'Low' risk, 'Moderate' risk and 'High' risk.

Where particular risk of major accidents or disasters is identified assessed as Moderate or High then the assessment shall consider whether additional mitigation is required.  Where a risk has been identified as Low, it is considered that the existing Proposed Development design is sufficient for the management of that risk.

As per the DoEHLG 2010 Guidance, those emergencies which have been classified as 'Serious', 'Very Serious' and 'Catastrophic' are deemed to be 'Major Emergencies'.

| | | Consequence | | | | |
|---|---|---|---|---|---|---|
| | | 1<br>Minor | 2<br>Limited | 3<br>Serious | 4<br>Very Serious | 5<br>Catastrophic |
| Likelihood | 6<br>Very Likely | Low | Moderate | High | High | High |
| | 5<br>Likely | Low | Moderate | Moderate | High | High |
| | 4<br>Unlikely | Low | Low | Moderate | Moderate | High |
| | 3<br>Very Unlikely | Low | Low | Low | Moderate | Moderate |
| | 2<br>Extremely Unlikely | Low | Low | Low | Low | Low |
| | 1*<br>Highly Improbable or Negligible | Low | Low | Low | Low | Low |
| DoEHLG 2010 Classification | | Normal Emergency | | Major Emergency | | |

** See Table 16.2 with regard to the inclusion of a likelihood classification appropriate to the design criteria of tailings storage facilities.*

**Table 16.4:** Risk Matrix

## 16.6 Baseline / Existing Environment and Context of Area

### 16.6.1 General Aspects of the Surrounding Environment

The AAL facility is located on the southern side of the Shannon Estuary, near the village of Foynes, Co. Limerick. This is approximately 6 km north-west of Askeaton and approximately 30 km west of Limerick City. The Application Site is located on Aughinish Island, Island MacTeige, Glenbane West and Fawnamore, within the property of the long-established alumina extraction plant operated by AAL. AAL own a circa 601 ha. landholding which is shown by the blue line on Figure 16.1.

Aughinish Island and the surrounding areas are predominantly rural in character with the remaining land usage comprising agriculture, single low density residential housing and protected habitats (wetlands and grasslands).

The subject site measures c.222ha with the BRDA portion measuring c.184 ha. in size, see Figure 16.2. The SCDC is located within the BRDA. The borrow pit extension area is located towards the centre of the land holding. The Proposed Development seeks to extend the footprint of the borrow pit from circa 4.5 ha. to circa 8.4 ha.

The topography of the Application Site currently varies from approximately 22 mOD to 32 mOD in the Phase 1 BRDA, from approximately 11 mOD to 20 mOD in the Phase 2 BRDA. The ground elevations at the downstream toe of the facility (pre-development ground elevations) vary from approximately 1 mOD in the north to approximately 6 mOD in the south. The BRDA portion of this Application seeks to raise the height of the existing BRDA, therefore the current baseline of the Proposed Development is located over the existing BRDA, which for the majority of the footprint has a base elevation of approx. 1 mOD. The topography of the Borrow Pit Extension varies between 16 mOD and 20 mOD, with the higher ground located to the north-east of the footprint.

The approved borrow pit area are lands which comprise previously disturbed ground which has been partly used as a compound area for an on-site Landscaping Contractor for AAL. The proposed Borrow Pit Extension area are lands that are undisturbed and adjoins to east side of the approved Borrow Pit. As identified in the 2017 Application for the original Borrow Pit (LCC Reg. Ref.: 17/714, ABP Ref. ABP-301011-18), the Landscaping Contractor has relocated to another area within the AAL landholding.

The southern portion of the approved Borrow Pit comprises a former Borrow Pit which was previously associated with the construction of the original plant. The extraction works within this former Borrow Pit area were completed in 1982 and it has since been left to naturally regenerate. There is a difference in height of approximately 9m between the base of the former Borrow Pit (last used in the early 1980s) and the rest of the Site surface due to the previous extraction.

### 16.6.2 Context of the Surrounding Area

**Social – Surrounding Population Centres**

The Proposed Development is located in a rural area. Within the surrounds of the Proposed Development the population receptors have been identified to the east and south-east with the closest receptor to be ca. 500 m away, (as identified in the Chapter 6: Population and

Human Health). Further one-off housing is located further to the east of the Proposed Development along local roads.

The nearest population centre or town is Foynes which is located ca. 2 km to the west of the Proposed Development. The population of the Foynes in the 2016 census was ca. 520 people. The next closest population centre is the town of Askeaton which is located ca. 5.5 km to the east. In the 2016 census the town of Askeaton had a population of ca. 1,150 people.

The alumina extraction plant operated by AAL provides direct employment for circa 485 people and a further 385 maintenance and installation contractors and considerable further employment for local service industries.

Employees work in varied shift patterns and therefore all employees would not be present on Site at any one time. Most of the personnel are working within the plant site to the north, however some teams work in other areas of the AAL facility including the area of the Proposed Development.

**Environmental Receptors – Protected Habitats and Species**

The Proposed Development area does not lie within any EU Natura 2000 or nationally designated conservation sites (see Chapter 6 of this EIAR).

The existing Phase 2 BRDA overlaps the Inner Shannon Estuary – South Shore pNHA (000435). In all, 6 Natura 2000 sites are located within 15km of the Proposed Development site. The closest of these are:

- **Lower River Shannon SAC (002165)** – 0.01 km from the Proposed Development site;
- River Shannon & River Fergus Estuaries SPA (004077) – 0.01 km from the Proposed Development site; and
- **Barrigone SAC (000432)** – 0.45km from the Proposed Development site.

All of the other Natura 2000 sites are located well over 5km from the Proposed Development site. There are 20 NHA and pNHA sites located within this 15km hinterland area

The potential impacts of the Proposed Development on Natura 2000 sites in the surrounding area are considered in detail in Chapter 6 of this EIAR in the Natura Impact Statement (under the EU Habitats Directive) which accompanies the planning application.

**Infrastructure including Utilities**

The N69 national road is located approx. 1 km to the south of the Site.

There is a rail line located immediately to the south of the Proposed Development. This rail line terminates in Foynes and is disused.

The Port of Foynes is located approx.1.3 km to the west of the Proposed Development. The port is one of six terminals operated by the Shannon Foynes Port Company. Shannon Airport is located approx. 12 km north-east of the Proposed Development. Shannon Airport is an international airport located in County Clare.

Mapping from Irish Water indicates a 750 mm watermain running east to west adjacent to N69 national road to the south of the Site. The watermain then diverges to supply the AAL facility to the north and local residential dwellings to the east. The supply entering the AAL facility decreases in size to a 600 mm pipe which passes to the east of the BRDA and proposed borrow pit extension footprint.

Mapping from Electric Ireland indicates a 10 kV and 38 kV line entering the AAL facility from the adjacent N69 national road to the south. The lines then travel northwards and pass to the east of the BRDA and proposed borrow pit extension.

Similar to the water and electrical supplies, the Gas Networks Ireland (GNI) pipeline is routed along the N69 national road and travels northward into the Site. The pipeline passes adjacent to the north-east of the BRDA and adjacent to the perimeter of the borrow pit. The pipeline runs no less than 50m (at its nearest point and as agreed with GNI) from the blasting face of the proposed borrow pit extension.

### 16.6.3 Large Industry and Seveso Sites.

As identified in Section 0, the AAL facility is not a Seveso classified site. There are two upper-tier Seveso sites and one lower-tier Seveso site located near Proposed Development. These are:

**Upper-Tier**

- Atlantic Fuel Supply Company Ltd. - Foynes Harbour, Durnish, Foynes, Co. Limerick – circa 850 m west of the Proposed Development; and
- Goulding Chemicals Ltd. - Morgans South, Askeaton, Co. Limerick – circa 2 km east of the Proposed Development.

**Lower-Tier**

- Exolum Shannon Ltd (formerly Interterminals Shannon) - Foynes Harbour, Foynes, Co. Limerick – circa 1 km west of the Proposed Development.

### 16.6.4 Major Accidents and Disasters in the Existing Environment, and Potential Effects

The AAL facility has been in operation since 1983. There have been no major events at the facility from 1983 to the present day.

The bauxite residue paste, and associated run-off water are alkaline in nature.

With regard to the vulnerability of environmental receptors, alkaline water released into the estuary or Robertstown Creek may impact on aquatic life. The communities most likely to be affected would be sessile sublittoral and littoral communities and benthic communities. This would include barnacles, mussels, oysters and shore crabs. Larger mobile species such as dolphins, salmon, otters and shore birds can easily move on to other areas away from the effects of any pollutant.

As identified in the External Emergency Plan For Bauxite Residue Disposal Area, Aughinish Alumina Ltd., Askeaton, Co. Limerick, (Limerick City and County Council, 2019), it is expected that the impact of alkaline water release would be minimal due to the assimilative capacity of the large water course and the tidal influence. Laboratory testing indicates that a ratio of 1:1, water with a pH of <11.5 (such as that contained in the PIC) and water with pH of 8.2 (estuary water) neutralises to a pH of 10. At a mixing ratio of 1:25 (PIC water: estuary water) the resulting pH would be 9.

A release of bauxite residue or alkaline water could also introduce increased suspended solids to the watercourse. This could result in increased siltation and a greater risk of smothering organisms and habitats.

In accordance with the terms of the site's IE Licence P0035-07 and as described in Section 16.5.4.2 above, AAL regularly reviews and update the ELRA for the overall Site, which includes those at the BRDA.

The operations management systems and associated inspection protocols, including the safety, environmental and quality management systems (described above) for the site reduce the potential for incidents and potential accident scenarios at the BRDA. These systems are presented in more detail in Section 16.7. Monitoring instrumentation has been installed on the side slopes of the BRDA. This measures settlement, lateral and downslope movement and piezometric elevation. These instruments are read, interpreted and audited at frequencies in accordance with the conditions of IE Licence P0035-07 and with the Physical Stability Monitoring Plan for the AAL BRDA (Golder 2021).

## 16.7 Characteristics of the Proposed Development

The overall AAL facility is operated in accordance with structured operations management systems including the SMS, EMS and QMS and the safety ratings system (ISRS) referenced above, and in compliance with the terms of the site's IE Licence P0035-07.

Further to the EMS the Site maintains a number of Emergency Management Procedures (EMPs), including the principal EMPs listed below:

- Rusal Aughinish, Emergency Response Plan, (Rusal Aughinish, April 2017);
- BRDA External Emergency Plan, (LCCC, August 2019);
- BRDA Procedure for High Wind, (AAL, 2019, Emergency Procedure No. P007.02.017);
- BRDA Severe Weather Frost, (AAL, 2019, Emergency Procedure No. P007.02.018);
- BRDA Containment Emergency Response, (AAL, 2019, Emergency Procedure No. P007.02.019);
- Environment Emergency Chemical Spillage, (AAL, 2016, Emergency Procedure No. P007.76.037)
- Heavy Fuel Oil (HFO) Diesel Petroleum Spillage Outside Bund, (AAL, 2016, Emergency Procedure No. P007.76.034);
- Environment Emergency Caustic Spillage Outside Bund, (AAL, 2016, Emergency Procedure No. P007.76.031); and
- Environment Emergency Acid Spillage Outside Bund, (AAL, 2017, Emergency Procedure No. P007.76.032).

The possible occurrence of a major emission, fire or explosion resulting from a proximate Seveso site has been considered in the below risk assessment.

Furthermore, the design of the Proposed Development is in line with international standards such as the Canadian Dam Association (CDA 2013, 2014) and Best Available Techniques (BAT) Reference Document for the Management of Waste from Extractive Industries in accordance with Directive 2006/21/EC (MWEI BREF 2018).

Given the highly maintained nature of the AAL facility, its IEL, and the on-going operational management (which is certified and maintained in accordance with international standards.

Given the location of the Proposed Development and the strong maritime influences the area/peninsula is prone to natural events such as storms, and tidal or wave surges.

AAL commenced mud-farming activities in 2009 when the Phase 1 BRDA was at ≈ 14 mOD (Stage 7) and prior to the construction of the Phase 2 BRDA. All bauxite residue deposited prior to 2009 comprised unfarmed bauxite residue which can be characterized as having a higher moisture content, lower density and lower strength parameters than the farmed bauxite residue. The liquefaction analyses for the bauxite residue for the design earthquake meets the minimum required Factor of Safety (FoS) against triggering liquefaction.

## 16.8 Potential Effects – Hazard Identification and Risk Assessment

### 16.8.1 Potential Major Accident (and Disaster) Hazards

The following sections presents:

- The <u>vulnerability of the Proposed Development</u> if any, to potential major accidents or disasters, which includes both natural (e.g., earthquakes) and man-made disasters (e.g., technological hazards); and
- The <u>Proposed Development's potential to cause</u>, if any, major accidents and/or disasters, (with explicit reference to considerations for human health, cultural heritage, and the environment).

For the purposes of this assessment, potential major accident or disaster hazards are categorised as 'natural hazards' or 'industrial hazards'.

Hazards considered are as follows:

- Natural Hazards:
- Seismic Event (Section 16.8.2.1; Risk Scenarios 1, 2 and 3);
- Storm Event (Section 16.8.2.2.; Risk Scenarios 4 and 5);
- Tidal Surge or Wave Event, including the climate change effects on such events (Section 16.8.2.3, Risk Scenario 6); and
- Significant karst features i.e., sinkholes, caves (Section 16.8.2.4**,** Risk Scenario 7).
- Industrial Hazards:
- Incidents at proximal industrial sites (Sections 16.8.2.5 and Section16.8.6, Risk Scenarios 8 and 9);
- Structural failure of the existing BRDA, including the failure of the proposed BRDA raises (Sections 16.8.3.1, Risk Scenario 10);
- Structural failure of the existing SCDC, including failure of the proposed SCDC raise (Sections 16.8.3.1, Risk Scenario 11);
- Fire / Explosion (Section16.8.3.2, Risk Scenario 12);
- Failure of Bauxite Residue Pipeline Transfer (Section 16.8.3.3, Risk Scenario 13);
- Contamination of underlying soils and groundwater from fuelling activities (Section 16.8.4, Risk Scenarios 14 and 15);
- Collapse of the borrow pit faces (Section 16.8.3.5, Risk Scenario 16); and
- Damage or rupture of proximal gas transmission pipeline (Section 16.8.3.6, Risk Scenario 17).

As noted previously in the Chapter, the AAL facility has been in operation since 1983. There have been no major events of the nature listed above at the facility from 1983 to the present day.

### 16.8.2 Vulnerability of the Proposed Development to Major Accidents and Disasters

#### 16.8.2.1 Potential Seismic Events (Risk Scenarios 1, 2 and 3; Table 16.5)

Ireland lies at the north-west margin of Europe, adjacent to the continental shelf and is characterised by very low levels of seismic activity. This lack of seismic activity in Ireland has been demonstrated by the low number of historical observations, regional seismic assessments and modern instrumental readings. Like Britain, Ireland lies on a relatively passive continental margin. Even so, it appears to be seismically quieter than Britain despite a similar geology.

A number of documents and seismic data sets were reviewed to assess the risk of a seismic event impacting the site. These included, but are not limited to, the following sources:

- Environmental Protection Agency Ireland: Summary Report 2: Baseline Characterisation of Seismicity (2014-W-UGEE-1) (EPA 2014b);
- Seismic data sets for the Republic of Ireland from British Geological Survey (BGS);
- Seismic Hazard Harmonization in Europe (SHARE) seismic data catalogue (SHARE 2013);
- Seismic Hazard: UK Continental Shelf, prepared by EQE International Ltd for the UK Health and Safety Executive (HSE 2002);
- USGS seismic data catalogue (for an area 200k on either side of the site, for seismic events with magnitudes of 1.5 or greater);
- Eurocode 8 seismic hazard zoning for the UK (Technical Report CR/07/125 Issue 3.0) (BGS 2007);
- Geological Survey Ireland (GSI) and Dublin Institute of Advanced Studies (DIAS); and
- Irish National Seismic Network (www.insn.ie)

Historically, only twenty-six (26) credible seismic events were recorded in Ireland in the interval 1500 to 1970 (EPA 2014). Of these twenty-six (26), thirteen (13) of these occurred in western Britain, were earthquakes magnitudes of around 5.0 ML (Magnitude Scale) and were widely felt across Britain and Ireland. The remaining thirteen (13) events occurred in Ireland and the immediate offshore area. Historical records suggest that these events in Ireland were small earthquakes with low intensities that were only felt over small areas, and it is deemed very unlikely that any significant earthquakes remain undiscovered. A magnitude is available for only one of these events, an earthquake in the Irish Sea in 1951, which had a magnitude of 4.4 ML. The historical earthquakes in Ireland correspond to three areas: east coast (Wicklow, Wexford and the Irish Sea), north (County Donegal), and south coast (around Cork).

The monitoring and recording of seismic events for Ireland was conducted by the BGS prior to 1978. The geophysics section within the Dublin Institution for Advanced Studies (DIAS) currently operates and maintains the Irish National Seismic Network (INSN) since 2018, with support from the Geological Survey Ireland (GSI).

The INSN has only operated since 1978 and currently comprises of twelve (12) permanent seismic stations. During 2018, the SEA-SEIS (Structure, Evolution and Seismicity of the Irish offshore) project deployed 18 no. Ocean Bottom Seismometers in the North Atlantic to the south-west, west and north-west of Ireland. The Institute of Marine Laboratory for Geosystems Research (iMARL) is a network of various types of ocean floor located sensors and is also hosted by DIAS Geophysics. It comprises broadband Ocean Bottom Seismographs (OBS), broadband acoustic sensors, and sensors for measuring absolute water pressure & temperature at the ocean floor. A system capable of detecting tsunamis also forms part of the infrastructure.

Since 1978, the largest seismic events recorded by the INSN are:

- the magnitude 5.4 ML, Wales earthquake of July 1984, about 400 km from the Aughinish site and was felt as a 1.1 ML by the INSN; and
- the magnitude 4.1 ML, 100km of the coast of Mayo in June 2012, about 250 km from the Aughinish site, which is the largest Irish event in the catalogue.

No earthquake in Ireland has produced a surface rupture, and typically fault rupture lengths for the largest British earthquakes have a length of 1 – 2 km, with a slip of 10 cm.

Golder has recently conducted an update to the seismic assessment of the Aughinish site (Golder 2019). Based on the CDA Guidelines 2014 criteria, Golder has classified the Aughinish BRDA, as a facility with a “High” HPC, which corresponds to an earthquake with an Annual Exceedance Probability for a return period of 1 in 2,475 years. The seismic assessment concluded that an earthquake of M=5.0 would be required within 1km epicentre of the Aughinish site to correspond to the return period of 2,475 years and a Peak Ground Acceleration of 0.05 g (50 cm/s$^2$), for which the BRDA has been assessed to be capable of withstanding.

In the methodology for this Chapter, the return period results in a likelihood of ‘**Highly Improbable or Negligible**’, (Table 16.2).

**Consequences of Seismic Events**

The consequences of a significant seismic event on the Proposed Development are:

- structural failure of the SCDC resulting in a breach of the SCDC, leading to salt cake discharge internally within the BRDA; or
- structural failure resulting in a breach of the BRDA and liquefaction of the bauxite residue leading to bauxite residue discharge externally; or
- structural failure resulting in a breach of the BRDA and the SCDC, and liquefaction of the bauxite residue leading to bauxite residue and salt cake discharge externally; or
- structural failure of the pit face of the borrow pit, leading to pit wall collapse.

The predominant mitigating factor present to alleviate / eliminate the impacts from seismic events is the structural design of the Proposed Development in accordance with the target level criteria for design parameters which are dependent on the dam classification (CDA 2014).

A seismic liquefaction study for the BRDA has been recently undertaken (Golder 2019). The liquefaction analyses for the BRDA for the design earthquake (1 in 2,475-year return period) meets the minimum required factor of safety (FoS) of greater 1.0 (CDA 2013, 2014).

Based on the probabilities interpreted from the calculated factors of safety, the Golder 2019 assessment identified that the likelihood of the unfarmed bauxite residue to liquify is generally in the 'Highly Improbable' to 'Almost Impossible or Negligible' range during the design earthquake (1 in 2,475 return period) and corresponds to a FoS range of 1.6 to 2.7 for the locations assessed. The likelihood of the farmed bauxite residue is wholly in the 'Highly Improbable or Negligible' potential to liquefy during the design earthquake (1 in 2,475 return period) and corresponds to a FoS range of 3.9 to 6.1 for the locations assessed.

Additional sensitivity assessments were undertaken to determine the factors of safety for larger earthquake events with greater return periods. It was concluded that a Peak Ground Acceleration (PGA) of 0.08g corresponding to a 1 in 7,000-year return period seismic event would be required to reduce the average factor of safety to 0.98, for the unfarmed bauxite residue. However, this PGA value would require an earthquake larger than a Magnitude 5.0. The HSE document, Seismic Hazard: UK Continental Shelf (HSE 2002) provides contour maps for UK and Ireland and a zonation model which lists the south-west coast of Ireland (zone A13) as an area with an earthquake magnitude observation threshold of 5.0.

- If the SDCC failed as a result of significant seismic event, the consequences are considered to be **Minor** (see Table 16.3). There would be no impact on 'Environment' as the salt cake would slowly remobilise into the surrounding BRDA, the encompassing PIC or the SWP further downstream, but remain confined within the BRDA. Furthermore, there would be no 'Life, Health, Welfare' impacts; there would be no 'Infrastructure' impacts, and there would be no 'Social' impacts to the local community services. The likelihood of a significant seismic event to result in a failure of the proposed SCDC raise or the existing SCDC, or both, is considered to be **Highly Improbable or Negligible** (Table 16.2).
- If the BRDA itself were to fail and lead to subsequent failure of the SCDC, bauxite residue and salt cake could remobilise offsite and enter the Lower River Shannon SAC and the River Shannon and River Fergus SPA to the north and west of the Phase 1 BRDA. The likelihood of a significant seismic event to occur corresponds to 1 in 7,000 years within 1 km of the Aughinish site and is considered to be **Highly Improbable or Negligible** (Table 16.2). The consequence of the event if the BRDA and the proposed SCDC raise and/or the existing SCDC were to fail is considered to be **Very Serious** (Table 16.3). This rating has been attributed to the likely significant impact on the 'Environment', from the heavy contamination of water bodies by the released bauxite residue with localised effects or extended duration. It is considered that the impacts to 'Life, Health, Welfare', 'Infrastructure', and 'Social' would be in lower consequence categories.
- In the extended borrow pit area, the likelihood of a significant seismic event to result in a failure of the pit face is considered to be **Extremely Unlikely**.
  Working practices within the borrow pit extension and the proposed phasing of pit will ensure that pit faces are managed in order to minimise the potential for hazardous rock faces. It is therefore considered that a significant seismic event may result in **Limited** consequences. This rating has been attributed to possible impacts on 'Life, Health, Welfare', since a pit face failure could result in serious injury of fatality to one or a small number of people. It is considered that associated impacts on 'Environment', 'Infrastructure', and 'Social' would be in lower consequence categories.

The overall risk, i.e., vulnerability of the Proposed Development, associated with seismic events is assessed to be **Low** (Table 16.4).

#### 16.8.2.2 Potential Storm (Extreme Rainfall) Events

**(Risk Scenarios 4 and 5; Table 16.5)**

The BRDA portion of the Proposed Development is located along western side of the Site and is currently approximately 23m above the surrounding ground elevation at the perimeter of the Phase 1 BRDA and approximately 11m above the surrounding ground elevation at the perimeter of the Phase 2 BRDA (both permitted to 24 mOD). The BRDA is surrounded by the Perimeter Interceptor Channels (PICs) which collect runoff from BRDA and convey it via pumps to either the Effluent Clarification System (ECS) and Liquid Waste Pond (LWP) located within the plant site to the north, or to the Storm Water Pond (SWP). Excess water from the SWP can be pumped to the ECS. Extreme rainfall events have the potential to lead to the impacts identified below.

- Extreme rainfall leading to erosion of the downstream slope of the BRDA to such an extent that it causes slope instability and static flow liquefaction of the bauxite residue, which may subsequently lead to a failure of the salt cake cells, is considered a failure mechanism; is assessed to be in the 'Highly Improbable' to 'Almost Impossible or Negligible' range of probabilities (Golder, 2019).

  The bauxite residue is deposited in a dome shape, high in the centre and grading towards the outer perimeter. The rock fill structures (stage raises) which retain the deposited bauxite residue at the perimeter are free draining above the level of bauxite residue deposited, i.e., they become effectively clogged over time due to draining of bauxite residue bleed water following deposition. The BRDA is not designed to retain water, nor does it have a retention storage capacity, and is essentially draining down all the time.

  Overtopping is not considered a significant concern for the BRDA as the starting point is no storage and surface water flows on the surface to the outer perimeter stage raises which allow drainage through the rock fill and down the side-slopes to the perimeter interceptor channel (PIC).

  In essence, the BRDA has no potential for overtopping and, as such, the operation and design of the facility significantly reduces the risk from this relatively common cause of accident and failure of tailings dams.

  The likelihood of the erosion of the BRDA downstream slope is deemed to be **Highly Improbable or Negligible**.

- The existing SCDC is an independent cell with its storm catchment defined by the crest footprint. The proposed SDCD raise is a vertical extension of the cell and similarly will have its storm catchment defined by the crest footprint.

  Overtopping of the SCDC leading to erosion induced slope failure of the SCDC walls is considered a plausible failure mechanism but assessed to be in the 'Highly Improbable' to 'Very Unlikely' range of probabilities, (Golder, 2019).

  There is a minimum freeboard of 1.0m maintained during the operation of the SCDC, and there is capacity to pump and/or decant from the cells into the caustic liquor recovery installation, the PIC and/or the SWP. The SCDC walls are constructed of free draining rock fill.

The likelihood of failure or breach of the SCDC walls as a result of erosion induced slope failure is considered to be **Highly Improbable or Negligible**.

- Overtopping in its typical denotation for tailings facilities is not considered as a plausible mechanism for failure for the BRDA as it does not store nor retain water. Overtopping as a failure mechanism is applicable for the ancillary structures that contain water such as the SWP, LWP and PICs. Overtopping of the PICs could lead to erosion of the inner and outer perimeter walls of the PICs and potentially lead to erosion reduced slope failure of the BRDA, which may subsequently lead to a failure of the SCDC.

  A review and update of the design storm rainfall and runoff rates for the BRDA has recently been undertaken (Golder 2019). This included updated estimates of the Inflow Design Floods and Probable Maximum Floods (PMFs) for the PICs and SWP which receive runoff from the BRDA, and an assessment of the performance of these water management structures under the Inflow Design Floods and PMF.

  Based on the CDA Guidelines 2014, the Phase 1 PIC, the Phase 2 PIC and the SWP are deemed to have “Low” HPC rating, which set the target level for the Inflow Design Flood as the 100-year (1 percent chance (or 1-in-a-100 chance) of occurring in any given year) flood event. However, the capacity of these structures together with the pumping system to the ECS had been originally designed to manage the 200-year (0.5 percent chance of occurring in any given year) flood event.

  Based on the CDA Guidelines 2014, the BRDA has a “High” HPC rating and subsequently the Inflow Design Flood (IDF) for the BRDA water management system is the 1/3 between the 1,000-year event and the PMF. The PMF is the runoff generated during the Probable Maximum Precipitation (PMP) event.

  The assessment (Golder, 2019) concluded that during the 200-year and the 1,000-year storm events, the system performs without overtopping or requirement to discharge to the ECS. The current BRDA water management system also performed without overtopping for the IDF durations of 6, 12 and 24 hours for the assumed initial water levels and pumping system characteristics.

  The likelihood of overtopping resulting in failure of the overall BRDA is deemed to be **Highly Improbable or Negligible**.

**Potential Impacts from Storm Events**

- The predominant mitigating factor present to alleviate / eliminate the impacts from storm events is the structural design of the Proposed Development in accordance with the target level criteria for design parameters which are applied according to the dam classification (CDA 2014).
- The BRDA water management system has been assessed to confirm that it can operate adequately during the 200-year, the 1,000-year and the 24-hour IDF (1/3 between 1,000-year event and the PMF) storm events, thereby preventing water management system failures which could result in significant adverse environmental impacts.
- If the water management system were to fail, there is potential for bauxite residue laden water to overtop or breach the SWP and/or the PIC, enter into the downstream toe drain and eventually discharge offsite, where it may enter the Lower River Shannon SAC and the River Shannon and River Fergus SPA to the north and west of the Phase 1 BRDA. The

consequence of the event is considered to be **Minor** (Table 16.3) given the presence of further infrastructure such as toe drains, the flood tidal defence berm (FTDB) and the penstock valve which can be shut. As a result, it is considered that there would be no impact on the Environment. Furthermore, there would be no 'Life, Health, Welfare' impacts; there would be no public 'Infrastructure' costs; and there would be no 'Social' impacts to the local community services.

- If the SCDC fails, the consequences are considered to be **Minor** as the salt cake would slowly remobilise into the surrounding BRDA, the encompassing PIC or the SWP further downstream and be confined within the BRDA boundary. There would be no impact on the Environment' due to the failure being retained within the surrounding BRDA; there would be no 'Life, Health, Welfare' impacts; there would be no public 'Infrastructure' impact; and there would be no 'Social' impacts to the local community services.

The overall risk posed by extreme rainfall during a storm event is assessed to be **Low** (Table 16.4).

#### 16.8.2.3 Potential Tidal Surge or Wave Events (Risk Scenario 6; Table 16.5)

The AAL facility (BRDA and Plant site) is located on the southern banks of the Shannon Estuary approximately 50 km upstream of the outlet to the North Atlantic. The Shannon Estuary is tidal; hence the water levels may be influenced by the tide wave development and storm surge events, tsunamis and sea level changes arising from climate change.

The SCDC is at an elevated location (base at approx. 19 mOD) within the BRDA and due to its elevation cannot directly be impacted by tidal, surge or wave events. For the SCDC to be impacted by these events, the BRDA itself would need to be impacted.

The BRDA is adjacent to the Shannon River estuary and to the Robertstown River and as such external erosion due to a tidal, surge or wave event breaching the Flood Tidal Defence Berm (FTDB), the outer perimeter wall (OPW) of the PIC and ultimately the inner perimeter wall (IPW) of the PIC (effectively the toe of the BRDA) is considered as a plausible mechanism for failure.

Such an event could erode the toe of the inner perimeter wall of the BRDA and expose the bauxite residue and lead to slope instability and the release of the bauxite residue.

The following hazards which could pose threats of such failures have been identified:

- Tidal surge events;
- Wave development and storm surge events;
- Tsunamis;
- Climate change leading to increase in sea level;
- Climate change increasing the frequency and magnitude of storm events; and
- Wave run-up i.e., topography and baseline measures in place at north and west faces of the BRDA.

An assessment of risk of the coastal setting of the BRDA was carried out in Golder 2019 update to the Risk Assessment and Break-Out Study for the Bauxite Residue Disposal Area. The study assessed the risk to the BRDA posed by tidal events, wave development and storm surges, plausible tsunami events and the potential increase in magnitude of these events and sea level due to climate change.

Three potential accident hazard scenarios for inundation of the BRDA were considered:

- Climate change leading to a significant increase in mean sea level (+0.6 m), combined with wave and storm events (+2.6 m) and a High Astronomical Tide event (2.8 mOD). This scenario suggests that a potential wave overtopping level of 6.0 mOD would need to be considered for the BRDA. This scenario, the combination of three extreme events is considered **Highly Improbable or Negligible**;
- Predicted extreme water level data for sea water elevation at the Aughinish site resulting from a 1,000-year combined tide and surge event (3.97 mOD) with the maximum wave height for the Shannon River (1.8m) which would require that a potential wave overtopping level of 5.8 mOD would need to be considered for the BRDA. This scenario is considered **Highly Improbable or Negligible**; and
- Modelling of various plausible tsunami sources suggests a range of 0.3 m to 0.5 m temporary increase in sea level for the Shannon Estuary. This increase would have no impact on the BRDA without the addition of a number of other events occurring at the same time. This combination of extreme events is considered **Highly Improbable or Negligible**.

**Potential Impacts from Tidal Surge or Wave Events**

There are a number of other mitigating factors present to alleviate / eliminate any impacts on the site from tidal surges or wave events:

- The Foynes Island protects the western flank of the Phase 1 BRDA;
- The northern and western flanks of the Phase 1 BRDA are protected by a Flood Tidal Defence Berm (FTDB), which has an elevation of approx. 5 mOD. This structure is regularly inspected and maintained;
- Storm waves have short wavelengths, break in shallow water and expend the energy stored. The northern, north-western and western sections of the BRDA have 50m to 100m stretches of open land at an elevation of 1 to 2 mOD between the BRDA and the Estuary. Should these areas become inundated by overtopping or breaching of the Flood Tidal Defence Berm (FTDB), they would represent shallow waters which would cause storm waves to break and thereby lessen any impact on the outer perimeter walls of the PICs, the SWP and the LWP; and
- During 2013, a gabion mattress revetment was installed on the side-slope of outer perimeter wall (OPW) for the PIC for the sections of the Phase 1 BRDA and the Phase 2 BRDA adjacent to the Robertstown and Shannon Rivers, i.e., estuary facing. The function of the revetment is to provide protection for the OPW, and subsequently the PIC and the inner perimeter wall (IPW), against erosion should the FTDB be overtopped.
  The revetment is 300mm in depth, filled with appropriately specified rock fill and installed to an elevation of 3.5 mOD and extends a minimum of 2m from the downstream toe. The gabion mattresses revetment will be raised to a minimum elevation of 5 mOD at closure.

The likelihood of inundation of the BRDA leading to erosion induced slope failure is considered to be **Highly Improbable or Negligible**.

- If the BRDA itself were to fail and lead to the subsequent failure of the SCDC, both bauxite residue and salt cake could remobilise offsite and enter the Lower River Shannon SAC and the River Shannon and River Fergus SPA to the north and west of the Phase 1 BRDA.
  The likelihood of a combination of events resulting in a failure of the BRDA is considered to be **Highly Improbable or Negligible** (Table 16.2). The consequence of the event (if the BRDA and SCDC were both to fail) is considered to be **Very Serious** (Table 16.3). This rating has been attributed to the greater consequences for the 'Environment', arising from heavy contamination of the rivers with released bauxite residue having localised effects or extended duration. It is considered that the impacts on 'Life, Health, Welfare', 'Infrastructure', and 'Social' would be in lower consequence categories.

The overall risk of overtopping or other failures causing the uncontrolled release of contaminated water and/or bauxite residue from a tidal surge or wave event is assessed to be **Low** (Table 16.4).

#### 16.8.2.4 Potential Sink Holes (Risk Scenario 7; Table 16.5)

Site investigations were undertaken prior to the development of the AAL BRDA facility in order to identify the relevant baseline ground conditions. No karst features have been identified directly under the footprint of the BRDA. Site investigations and construction quality assurance (CQA) activities during the preparation of the basin for the BRDA did not identify cavities, voids or sink holes of a nature which could impact the structure of the BRDA (see Chapter 8 of this EIAR).

- The BRDA is predominately underlain by the Rathkeale Formation, which is described as dark grey, argillaceous (muddy) limestone and shaley mudstone. This Formation was investigated at various times during the development of the BRDA between 1971 and 2004 and no karst features were identified.
  The Rathkeale Formation is described as being a lower carboniferous limestone, strong to very strong, medium to dark grey, medium to fine crystalline, fresh to faintly weathered, slightly argillaceous and thinly bedded, usually well jointed and sometimes fractured at the surface. It is considered highly unlikely for karst features to be present in a bedrock formation with these characteristics.
- The eastern sector of the Phase 1 BRDA (the Phase 1 BRDA Extension) and the eastern sector of the Phase 2 BRDA are constructed over a ridge of outcropping rock (Waulsortian Limestone), sloping upwards from west to east, with intermittent thin layers of till material. The Waulsortian Limestone continues to the east and north beneath the Plant Site, the borrow pit and borrow pit extension, and has undergone extensive testing in order to determine the design parameters for the foundations of the major structures in the Plant during the 1970s and 1980s.

  The Waulsortian Formation is characterised as a medium bedded to massive, fine to coarsely crystalline, blue grey limestone. A number of paleo-karst features or varying diameter were identified in the Plant area, (Clart *et al.* 1981) and discrete fracture zones / palaeokarst features were identified during the site investigations for the borrow pit (Golder 2017).

  The Waulsortian Limestone along the eastern flank of the BRDA is described as being strong, massive, grey, coarsely crystalline and generally fresh or faintly weathered. It was assessed as being well jointed and sometimes fractured, particularly at near surface. This ridge was excavated, shaped and surface dressed with a layer of till to permit the installation of the composite lining system for these sectors of the BRDA. No karst features have been identified during the construction quality assurance (CQA) activities for the preparation of the basin for the Phase 1 BRDA Extension and the Phase 2 BRDA

Since the Proposed Development only entails an increase in height of the BRDA, it will not result in changes to the underlying groundwater regime or cause any interaction with subsurface features. The likelihood of the presence of sink holes, cavities or voids which could influence the integrity of the BRDA is deemed to be **Extremely Unlikely**.

**Potential Impacts from Sink Holes**

The mitigating factors present to alleviate / eliminate any potential impacts arising from the presence of a sinkhole beneath the BRDA are:

- A palaeokarstic system is one in which the conditions which promote karstification are no longer present. The karstic features observed at the Plant site are palaeokarstic features and like the majority of karstic development in Ireland predates the ice age (about 15,000 years ago). Under certain circumstances a palaeokarstic feature may be reactivated:

- Increase in normal stress leading to consolidation of infilling material or collapse of a soil arch;

  The Aughinish area has been significantly stressed during the ice age and as such there would be a low probability of significant settlement of infill material as a result of additional loading resulting from the raising of the BRDA. Site investigation showed small depths of soils (<1m to 2m) if any, were present over the Waulsortian Limestone, so collapse of a soil arch over an open cavity is not possible, as it would have been identified during the construction period.
- Dewatering of groundwater resulting an increase of effective stress of the infilling or by migration of the infilling into an adjacent void;

  The construction of the BRDA has had little impact on the local groundwater flow and there have been no dewatering activities.
- Recharge due to hydrostatic loading by water ingress from such structures as unlined reservoirs.

  Recharge of a palaeokarst feature due to water leakage is unlikely as the BRDA is composite lined and the BRDA retains very little water in the PICs along the eastern ridge.

- A 2mm HPDE geomembrane liner is installed along the eastern flank of the BRDA i.e., beneath the Phase 1 BRDA Extension and the Phase 2 BRDA. 2mm HPDE geomembrane is a flexible material with a high yield elongation and a high yield strength. A large sink hole (>10m diameter) would have to be present underneath to stress the HPDE geomembrane enough to tear it.

The plausible worst-case scenario for the development of subsidence from a sink hole would be for a sink hole to be present adjacent to or directly under a dam wall (IPW) of the BRDA. This scenario may cause structural failure and breach of the BRDA resulting in the liquefaction of the bauxite residue and the potential subsequent failure of the SCDC. If the BRDA and the

SCDC both were to fail, there is a likelihood that both bauxite residue and salt cake could remobilise offsite and enter the Lower River Shannon SAC and the River Shannon and River Fergus SPA to the north and west of the Phase 1 BRDA.

The consequence of the BRDA and SCDC both failing is categorised as **Very Serious**. This rating has been attributed to the greater impact to the 'Environment', from the heavy contamination of the rivers with bauxite residue with localised effects or extended duration. It is considered that the impacts to 'Life, Health, Welfare', 'Infrastructure', and 'Social' would be in the lower consequence categories.

The overall risk of sink holes, cavities of voids causing failures leading to the uncontrolled release of contaminated water and/or bauxite residue is assessed to be **Low**.

#### 16.8.2.5 Potential Incidents at Proximal Seveso Sites (Risk Scenario 8; Table 16.5)

There are two upper-tier Seveso sites and one lower-tier Seveso site located in close proximity to the Proposed Development. The closest two are one upper-tier site and one lower-tier site located in Foynes Harbour, ca. 850 m to the west. The likelihood of a major accident or disaster at either site resulting in a significant negative impact on the Proposed Development is considered highly improbable.

All operators (this applies to both upper and lower-tier establishments) are required to prepare a major accident prevention policy (MAPP) document and submit it to the Central Competent Authority (The Health and Safety Authority). Upper-tier establishments include their MAPP in the safety report, which is a document which sets out Information on the management system and on the organisation of the establishment with a view to major accident prevention. These measures reduce the likelihood of such major accidents occurring.

Similarly, the conservative design of the BRDA minimises the likelihood of external major accidents posing a threat to the integrity of the BRDA and resulting in major consequences. It is considered nearly impossible that such an event could result in BRDA failure, i.e., likelihood of this scenario considered to be **Extremely Unlikely**. This event may even be classified as 'Highly Improbable or Negligible', however it should be noted that this category in the methodology is reserved for those scenarios assessed in the Golder 2019 report, (in conjunction with CDA 2014 methodologies).

**Potential Impacts from to Incidents at Proximal Seveso Sites**

The worst-case consequence for the BRDA would be slope damage and failure of the BRDA itself which may also lead to a failure of the SCDC. This could result in bauxite residue and salt cake remobilising offsite and entering the Lower River Shannon SAC and the River Shannon and River Fergus SPA to the north and west of the Phase 1 BRDA. These consequences are considered to be **Very Serious** (Table 16.3).

This consequence rating has been attributed to the greater impact on the 'Environment', from heavy contamination of the designated sites with bauxite residue, causing localised effects or extended duration. Impacts on 'Life, Health, Welfare', 'Infrastructure', and 'Social' from the BRDA failure would be in the lower consequence categories. Cumulatively, an incident at an off-site COMAH site may be of a higher consequence, however when assessing the vulnerability of the Proposed Development it is appropriate in this assessment to assess that vulnerability in isolation as opposed to cumulatively, (e.g., classifying the development's vulnerability and potential effects from an earthquake, as opposed to the classification of all potential effects from the earthquake).

The overall risk posed by a major accident at a proximal Seveso site is assessed to be **Low** (Table 16.4).

#### 16.8.2.6 Potential Incidents at the adjacent AAL Plant Area (Risk Scenario 9; Table 16.5)

Major industrial accidents involving dangerous substances pose a significant threat to humans and the environment, both on and off the site of the accident.

In Ireland, the COMAH Regulations lay down rules for the prevention of major accidents involving dangerous substances and seek to limit as far as possible the consequences for human health and the environment of such accidents.

The AAL refinery facility is a large industrial facility, but neither its processes nor its chemicals inventories are such that the site would be considered a SEVESO site (an establishment subject to the COMAH Regulations). Quantities of 'dangerous substances' stored within the site are below the lower and upper-tier Seveso site categories.

The activities within the overall AAL facility are conducted in accordance with the site's IE Licence (P0035-07).

AAL are required to regularly update an ELRA in order to consider the risk of unplanned events which could arise and detail the financial provisions required to cover the potential cost of the liabilities. The current active ELRA for the AAL facility was undertaken by PM Group in May 2018, a subsequent ELRA (2019) is under review by the EPA.

AAL operate a system of strict protocols and management provisions at the facility in order to minimise the risk of potential accidents. These measures have been summarised in Section 16.7 above. Also, the design of the BRDA minimises the likelihood of any accident hazard scenarios arising in the refinery to pose a threat to the BRDA's integrity and resulting in major consequences.

The likelihood of such scenarios is considered to be **Extremely Unlikely**

There are no dangerous substances stored in sufficient quantities to pose a credible major accident hazard and result in significant impacts on the BRDA or the borrow pit. Substances stored within the overall AAL facility in limited quantities, include petroleum products (heavy fuel oil, diesel, petrol and gasoline), liquid petroleum gas (LPG), oxygen and acetylene.

Protection measures employed to manage the hazards associated with these substances include:

- Tank level monitoring;
- Engineering controls such as shut-off valves, temperature monitoring and tanks designed for appropriate substances;
- Fire protection systems;
- Ignition source control, including control of mobile equipment, earthing tanks, hot work permit procedure;
- Frequent tank and bunding inspection programmes;
- Strict tank filling procedures; and
- Warning signs to identify potentially explosive atmosphere areas.

**Potential Impacts from a Major Accident at the Refinery Site**
Due to the limited quantities of dangerous substances handled and stored on the AAL plant site, and the distance of the plant site to the BRDA (over 700 m), it is considered that the consequences from such events, e.g., heavy fuel oil or diesel tank rupture, would be **Limited** in respect of the Proposed Developments.

The 'Environment' impacts within the Proposed Development would reside in the lower consequence categories, i.e., limited simple contamination, with localised effects and of short duration, (if any contamination at all). It is considered that the impacts to 'Life, Health, Welfare', 'Infrastructure', and 'Social' at the Proposed Development would reside in lower consequence categories.

The overall risk of an accident at the refinery site affecting the integrity of the BRDA or the borrow pit leading to any offsite effects is assessed to be **Low** (Table 16.4).

### 16.8.3 Proposed Development's potential to cause Major Accidents and Disasters

#### 16.8.3.1 Potential Structural Failure of the BRDA and SCDC (Risk Scenarios 10 and 11; Table 16.5)

Consideration has first been given to plausible structural failure mechanisms which may result in the failure of the Proposed Development in the two (2) scenarios described below:

- Failure of the BRDA leading to failure of the SCDC;
- Failure of the SCDC cell without failure of the BRDA.

Plausible structural failure mechanisms relating to industrial hazards (not including the natural hazards discussed in the preceding Sections) for the Proposed Development are:

- Slope instability or cell wall failure or crest settlement resulting from static slope failure;
- Slope instability or cell wall failure or crest settlement resulting from foundational failure;
- Slope instability or cell wall failure or crest settlement resulting from a blast event causing cyclic softening (reduction in strength following cyclical loading) of the bauxite residue; and
- Slope instability or cell wall failure or crest settlement resulting from internal erosion or external erosion. Internal erosion from piping or seepage may result from operational

damage to the SCDC lining system. External erosion may result from a burst bauxite residue discharge pipe, burst sprinkler line, poor operational practices for discharge of bauxite residue or diversion of surface waters during a storm event;

The plausible mechanisms for structural failure are mitigated and/or eliminated by:

- Design of the BRDA and the SCDC in accordance with the target levels for standards-based design criteria for tailings dams during Construction, Operation, Closure and Aftercare phases as determined from the tailings dam classification, which are based on the severity of the consequences in the event of failure;
- Mud-farming which reduces the moisture content and increases the dry density of the bauxite residue leading to improved strength parameters;
- Regular site investigation (≈ 4 years) to assess and verify the strength parameters of the deposited bauxite residue, comparing the results with the design criteria and the current best practice guidance and validation of the BRDA stability and factor of safety (FoS) at recurrent intervals;
- Geotechnical monitoring of movement and pore water pressures in the bauxite residue and the foundation soils within the BRDA (inclinometers and piezometers). Monitoring results are interpreted at regular intervals and compared with previous readings;
- Adherence to the AAL BRDA Operational, Safety and Maintenance Manual, the Physical Stability Monitoring Plan for the AAL BRDA and the conditions of the IE Licence in respect of monitoring, auditing, inspection and review;
- Initial blasts for borrow pit extension will take place at the furthest locations from the BRDA to allow for refinement of the charge sizes and other blast parameters. Strong motion accelerographs will be positioned locally on the BRDA to monitor the blast vibration and vibrating wire piezometers will be installed locally in the BRDA to monitor dynamic pore pressure. Threshold vibration limits have been set for Peak Particle Velocity (PPV) for the BRDA (25 mm/s), for the Gas Networks Ireland (GNI) transmission pipeline (50 mm/s) and for the designated monitoring points in accordance with the terms of the IE Licence. Air overpressure and vibration will be controlled at source by careful blast design.

The likelihood of any of the hazards identified above to trigger any of the two failure scenarios is considered **Highly Improbable or Negligible** (Table 16.2).

**Potential Impacts from Structural Failure of the BRDA and SCDC**

The proposed SCDC raise will be bordered to the north, south and west by the BRDA. In the event of a failure of the SCDC, or a local BRDA failure leading to a failure of the SCDC, the only pathway for any salt cake to mobilise is into the existing BRDA. No salt cake would be able to breach the confines of the BRDA in this scenario as the volumes of salt cake contained in the SCDC are insufficient to overtop the PIC or the SWP, which are located downstream of the SCDC.

The consequence is therefore considered to be **Minor** (Table 16.3). There would be no impact on the ‘Environment’ due to the salt cake being contained within the surrounding BRDA; and there would be no ‘Life, Health, Welfare’, ‘Infrastructure’ or ‘Social’ impacts.

The overall risk of structural failure of the SCDC independent of the BRDA is **Low**.

If the BRDA itself were to fail and lead to a subsequent failure of the SCDC, then it is possible that both bauxite residue and salt cake could remobilise offsite and enter the Lower River Shannon SAC and the River Shannon and River Fergus SPA to the north and west of the Phase 1 BRDA. The consequence is considered to be **Very Serious**. This rating has been attributed to the greater impact on the 'Environment', from the heavy contamination of the water courses by bauxite residue with localised effects or extended duration. It is considered that the impacts to 'Life, Health, Welfare', 'Infrastructure', and 'Social' would reside in lower consequence categories.

The overall risk of structural failure of the SCDC and/or the BRDA of is assessed to be **Low**.

#### 16.8.3.2 Potential Fire / Explosion (Risk Scenarios 12; Table 16.5)

The Proposed Development involves the deposition of bauxite residue and salt cake and the extraction and placement of rock. These are not flammable materials, nor do they present a fire hazard.

There is potential for fire to occur from e.g., vehicle collisions, or malfunctioning equipment or infrastructure in the course of the Proposed Development. The risks of fire are controlled through strict management protocols surrounding the use of vehicles, plant and machinery. Plant activities, vehicle movements and employee work practices are governed by the AAL Health and Safety Manual, the AAL Environmental Manual and by a series of stand-alone Standard Work Method (SWM) documents which are prepared, maintained and updated by AAL.

Plant and equipment are regularly maintained at the appropriate intervals. Vehicles are checked daily for obvious defects by the driver and are regularly serviced and maintained (in accordance with manufacturers' recommendations) by competent persons. Maintenance and repairs are undertaken by authorised persons only. Driver training, traffic management measures and speed limits are in place on site roads to minimise the likelihood of vehicle collisions. Also allowing for the potential for human error to occur the overall likelihood rating for a fire or explosion to pose a major accident threat to Proposed Development is considered **Unlikely**.

**Potential Impacts from Fire / Explosion**
Access to the BRDA is restricted by an electronic barrier. Vehicle use is restricted to dedicated Site vehicles, AAL management vehicles and approved Contractor vehicles. It is considered that the impacts in the event of a vehicle accident / collision will be **Limited** given that it would be a localised event and low number of persons potentially involved. There is potential for impact on Life, Health, Welfare, but limited to personnel located at the site of the accident with no potential for off-site impact. A vehicle collision may cause impact on the 'Environment' from spilled fuels resulting in simple contamination with local effects and short duration. It is considered that there would be no 'Infrastructure' or 'Social' impacts. Vehicle collisions within the BRDA would not result in the structural damage or failure of the BRDA.

Given the nature of the construction and operation of the Proposed Development, accidents associated with fire or explosion of malfunctioning equipment or plant would similarly result in **Limited** impacts.

The overall risk of a fire or explosion event posing a threat to the integrity of the Proposed Development and thereby be the cause of major off-site accidents is assessed to be **Low** (Table 16.4).

#### 16.8.3.3 Potential Failure of Bauxite Residue Transfer Pipeline (Risk Scenarios 13; Table 16.5)

The bauxite residue transfer pipeline facilitates the transfer of bauxite residue from the bauxite residue filtration and pumping buildings within the refinery to the BRDA. This pipeline is routed through the Site and adjacent to the trafficked internal site roads to and from the BRDA.

The integrity of the bauxite residue transfer line is protected by design and operational management including the design, construction and preventative maintenance of the line in accordance with appropriate codes and standards. The pipeline and associated pipework are made from carbon steel and constructed to the International Piping Code (ASME B31.3). The system is pressure rated to 124.9 bar and has undergone hydraulic testing upon installation. The bauxite residue pumps are on a monitored system with alarms going off at High pressure (90 bar) and High-High pressure at 99 bar. The system initiates a trip at 100 bar.

The control room operator has continuous visibility of pump and pipeline pressure throughout the duration of bauxite residue transfer. Annual pressure trip tests are conducted on pumps, and the pipeline and valves visually inspected every 30 days. In addition, operators patrol the area 24/7 while carrying out other duties. The pipeline is flushed out before any period of non-usage >1 week in order to prevent restrictions or blockages.

Significant loss of containment from the system is considered to be **Unlikely** and would be quickly identified and pumping stopped.

**Potential Impacts from the Failure of the Bauxite Residue Transfer Pipeline**
Failure of the pipe would be quickly identified, and pumping would cease, stopping the transfer of Bauxite residue. Impacts would be local to the failure location.

If a leak were to occur within the BRDA the consequences are considered to be **Minor** (see Table 16.3) as the bauxite would be contained within the BRDA, and the encompassing PIC or the SWP further downstream. Similarly, impacts on the ‘Environment’ are considered to be **Minor** given the nature of the material and the containment of the leakage. Failure of the bauxite residue transfer line would not result to impacts on ‘Life, Health, Welfare’, Infrastructure, or Social receptors

The overall risk of a failure of the bauxite transfer pipeline to pose a threat posing a threat to the integrity of the Proposed Development and thereby be the cause of major off-site accidents is assessed to be **Low** (Table 16.4).

#### 16.8.3.4 Potential Contamination of Underlying Soils and Groundwater from Fuelling Activities (Risk Scenarios 14 and 15; Table 16.5)

During refuelling operations for vehicles, plant and equipment there is potential for spillages to occur. Refuelling could take place at various locations within the Application site in the course of the Proposed Development.

Controls to minimise the risks of fuel spillages includes the restriction on storing diesel or other fuels in the BRDA and borrow pit. A mobile double skinned fuel bowser delivers diesel fuel daily from the storage facility in the Plant to the various mobile equipment in the development area. Elsewhere in the AAL facility a limited quantity of fuels and lubricants are stored securely and appropriately within bunded areas to ensure containment and prevent spillages. No fuels, chemicals or solvents will be stored outside such confines. Site management practices will also mitigate the likelihood of contamination occurring.

Refuelling activities are carried out by designated members of staff, and it is considered that spillages in the BRDA and the borrow pit will be **Unlikely** to occur in sufficient quantities for causing significant contamination.

**Potential Impacts from the Contamination of Underlying Soils and Groundwater from Fuelling Activities**

Due to the limited quantities of fuels involved the consequences from such a fuel spillage would be **Limited** (see Table 16.3). Such spillages would not result in injury or fatality impacts to 'Life, Health, Welfare', nor would they have off-site effects on communities. Fuel spillages may impact on the 'Environment' in the form of contamination with localised effects and short duration. It is considered that there would be no public 'Infrastructure' costs; and there would be no 'Social' impacts to the local community services.

The overall risk of refuelling accidents posing a threat to the integrity of the Proposed Development and thereby be the cause of major off-site accidents is assessed to be **Low** (Table 16.4).

### 16.8.3.5 Potential Falling Debris or the Collapse of Benches or Quarry Faces (Risk Scenarios 16; Table 16.5)

The Proposed Development requires that rock is blasted and extracted from faces of the borrow pit extension. The improper operational management of pit faces, and a potential subsequent failure may endanger, injure or fatally injure persons working in proximity to those faces.

Mitigating factors present to alleviate / eliminate the impacts from falling debris include the Proposed Development design and the operational management of the extraction activity. The phased excavation of the borrow pit Extension will be designed to ensure it can be developed without becoming a significant hazard both during its operational and restoration phases, (and during any subsequent after use). The maximum safe height of excavated faces is influenced by the geology and physical properties of the material, the size, height and type of machinery and working methods used. Based on the topographic survey and the proposed base of the borrow pit, the maximum height of the quarry face will not exceed 12m.

The borrow pit extension will be operated in accordance with requirements of the Safety, Health and Welfare at Work (Quarries) Regulations 2008 (S.I. No. 28 of 2008; as amended) and in accordance with the Health and Safety Authority's (HSA; 2020) 'Safe Quarry. Guidelines to the Safety, Health and Welfare at Work (Quarries) Regulations 2008'.

With the implementation of such design measures and management practices it is considered that the likelihood of such hazards occurring is **Very Unlikely**. Given the potential for greater than one fatality and less than five, and also the scale of the proposed borrow pit extension, the classification of the impact on 'Life, Health, Welfare' is considered to be **Serious**. The impacts to 'Environment', 'Infrastructure', and 'Social' would be in the lower consequence categories.

The overall risk of improper operational management of the borrow pit excavation works causing a borrow pit face failure or any other structural failure of the BRDA and SCDC and be the cause of a major accident or disaster is assessed to be **Low** (Table 16.4).

#### 16.8.3.6 Potential Damage / Rupture of the Gas Transmission Line from Borrow Pit Blasting Activities (Risk Scenarios 17; Table 16.5)

As noted above, the proposed borrow pit Extension requires that rock is blasted and extracted from faces. The improper management of blasting activities may have potential impacts on the Gas Networks Ireland transmission line routed at a minimum of 50m to the south and east of the proposed borrow pit Extension area.

Mitigating factors present to alleviate / eliminate the impacts from blasting activities include the strict design and management of each blasting event. Blast design is subject to the controls outlined in 16.8.3.1 above. Blasting activities will only be carried out by appropriately trained and qualified personnel. Strict protocols will be used on the Site to govern the use of explosives; these measures have been identified in Chapter 12 of this EIAR (Noise and Vibration). The operation of the borrow pit extension will be regulated by the site's IE Licence conditions.

Method statements produced by the blasting contractor will be put in place to ensure that the appropriate safety protocols are in place and adhered to during each blast event. Monitoring will be carried out to check and verify that that agreed thresholds / limits are not exceeded.

A minimum distance of 50m between the borrow pit extraction area and the GNI transmission pipe has been agreed and a maximum vibration peak particle velocity (PPV) of 75 mm/s established following consultation with Gas Networks Ireland (GNI). This PPV threshold has been further reduced to 50 mm/s by Golder.

It is considered that with the implementation of the proposed design and operational controls, there is adequate control of the risks associated with the blasting activities, therefore the likelihood of this activity to cause a major accident or disaster is **Very Unlikely**.

An uncontrolled accidental blast event with potential to rupture the gas transmission line may cause more than one fatality from either the blast itself or from events related to the gas pipeline failure. Consequences arising from this scenario are considered to be **Serious**. The impacts on 'Infrastructure' are considered to be in the range **Limited** to **Serious**, with a loss of electricity generation capacity at the AAL facility. Beyond the inconvenience of potential disruption of gas supply, there are no predicted 'Social' impacts. Any impacts on 'Environment' would be simple and localised with effects of short duration.

The overall risk of blasting within the borrow pit area rupturing the gas transmission pipeline and posing a threat of major accident or disaster is assessed to be **Low** (Table 16.4).

### 16.8.4 Summary of Major Accident and Disaster Risks

Table 16.5 below provides a summary of the assessment of the risk of major accidents and disasters associated with the Proposed Development.

As identified in Section 16.5.4 risk is expressed as the combination of the likelihood of a hazardous event and its potential impact, where a hazard is any phenomenon with the potential to cause direct harm to members of the community, the environment or to physical infrastructure, or being potentially damaging to the economic and social infrastructure, and the impact is the consequences of a hazardous event being realised, expressed in terms of a negative impact on human welfare, damage to the environment or physical infrastructure or other subsequent consequences.

Table 16.6 further below identifies where each of the risks identified falls within the risk matrix.

**Table 16.5: Major Accident and Disasters Risk Summaries**

| | Risk Scenario | Potential Cause | Effect | Likelihood Value (Table 16.2) | Basis of Likelihood | Conseq. Value (Table 16.3) | Basis of Consequence | Score Value |
|---|---|---|---|---|---|---|---|---|
| **Vulnerability to Seismic Events (Section 16.8.2.1.)** | | | | | | | | |
| **1** | Vulnerability of the SCDC to Seismic Events | Natural seismic activity. | Damage and breach of the SCDC with potential mobilisation of salt cake into the BRDA. | Highly Improbable or Negligible (1) | Vulnerability of the surrounding area to seismic events was assessed by Golder (2019) in line with the CDA Guidelines 2014 criteria. | Minor (1) | Without failure of the overall BRDA the salt cake would slowly remobilise into the surrounding BRDA. There would be no impact on receptors. | Low (1) |
| **2** | Vulnerability of the BRDA to Seismic Events | Natural seismic activity. | Damage and breach of the BRDA with potential mobilisation of bauxite residue off site impacting environmental receptors; damage to infrastructure including local water resources; injury, illness or loss of life. | Highly Improbable or Negligible (1) | Vulnerability of the surrounding area to seismic events was assessed by Golder (2019) in line with the CDA Guidelines 2014 criteria. | Very Serious (4) | Failure of the BRDA and subsequent failure of the SCDC may result in the remobilisation of bauxite residue and salt cake off site into the Lower River Shannon SAC and the River Shannon and River Fergus SPA. | Low (4) |
| **3** | Vulnerability of the borrow pit extension face to Seismic Events | Natural seismic activity. | Failure of the borrow pit extension face with potential impacts to personnel operating in the immediate area surrounding the face, including potential for a fatality. | Extremely Unlikely (2) | Vulnerability of the surrounding area to seismic events was assessed by Golder (2019) in line with the CDA Guidelines 2014 criteria. | Limited (2) | Work practices will ensure that faces are managed to reduce rock-fall. Further work practices will ensure staff work away from rock faces as far as practicable. | Low (4) |

| | Risk Scenario | Potential Cause | Effect | Likelihood Value (Table 16.2) | Basis of Likelihood | Conseq. Value (Table 16.3) | Basis of Consequence | Score Value |
|---|---|---|---|---|---|---|---|---|
| **Vulnerability to Storm (Extreme Rainfall) Events (16.8.2.2.)** | | | | | | | | |
| 4 | Overtopping of the BRDA ancillary structures | Extreme storm events, including cyclones, hurricanes, typhoons, storms and climate change. | Damage water management system structures. Potential for slope failure of the BRDA and SCDC ultimately effecting environmental receptors; damage to infrastructure including local water resources; injury, illness or loss of life. | Highly Improbable or Negligible (1) | Design of systems and capacity of system to accommodate various storm and flood events of decreasing likelihood in line with the CDA Guidelines 2014 criteria.<br><br>Vulnerability of the surrounding area to storm events was assessed by Golder (2019 | Minor (1) | Storm events have the potential (albeit highly improbable) to result in slope failure of the BRDA which may result in the remobilisation of bauxite residue and salt cake off site into the Lower River Shannon SAC and the River Shannon and River Fergus SPA. | Low (1) |
| 5 | Induced slope failure of the SCDC walls. | Extreme storm events, including cyclones, hurricanes, typhoons, storms and climate change. | Remobilisation of the salt cake into the BRDA. | Highly Improbable or Negligible (1) | Management maintains a freeboard of 1m in the cell. There is a capacity to pump and discharge from the cell. The cell is constructed of free draining rock fill. | Minor (1) | Without failure of the overall BRDA the salt cake would slowly remobilise into the surrounding BRDA. There would be no impact on receptors. | Low (1) |
| **Vulnerability to Tidal Surges or Wave Events (16.8.2.3)** | | | | | | | | |

| | Risk Scenario | Potential Cause | Effect | Likelihood Value (Table 16.2) | Basis of Likelihood | Conseq. Value (Table 16.3) | Basis of Consequence | Score Value |
|---|---|---|---|---|---|---|---|---|
| 6 | Tidal Surges or Wave Surges | Extreme storm events, including cyclones, hurricanes, typhoons, storms and climate change. | Damage to structures such as the erosion of the toe of the inner perimeter wall and exposing the bauxite residue and leading to slope instability and the release of the bauxite residue from the facility; impact to environmental receptors; damage to infrastructure including local water resources; injury, illness or loss of life. | Highly Improbable or Negligible (1) | Estimated increases in sea level, tidal events and surges have been assessed to be below the tolerance for overtopping of the BRDA perimeter infrastructure.<br><br>Vulnerability of the surrounding area to storm events was assessed by Golder (2019) in line with the CDA Guidelines 2014 criteria. | Very Serious (4) | Tidal and wave surge events have the potential (albeit highly improbable) to result in slope failure of the BRDA which may result in the remobilisation of bauxite residue and salt cake off site into the Lower River Shannon SAC and the River Shannon and River Fergus SPA. | Low (4) |
| **Vulnerability to Sink Holes beneath the BRDA (Section 16.8.2.4)** | | | | | | | | |
| 7 | Sink Holes | Sinkholes under the BRDA | Damage and breach of the BRDA with potential mobilisation of bauxite residue off site impacting environmental receptors; damage to infrastructure including local water resources; injury, illness or loss of life. | Extremely Unlikely (2) | Extensive site investigation and assessment of the BRDA footprint during the feasibility studies and the detailed design of the Phase 1 BRDA, the Phase 1 BRDA Extension and the Phase 2 BRDA.<br><br>Assessment of the underlying bedrock via direct exposure and by site investigation via boreholes and trial pits and geophysical testing. | Very Serious (4) | Failure of the BRDA and subsequent failure of the SCDC may result in the remobilisation of bauxite residue and salt cake off site into the Lower River Shannon SAC and the River Shannon and River Fergus SPA. | Low (4) |
| **Vulnerability to Incidents at Proximal Seveso Sites (Section 16.8.2.5)** | | | | | | | | |

| | Risk Scenario | Potential Cause | Effect | Likelihood Value (Table 16.2) | Basis of Likelihood | Conseq. Value (Table 16.3) | Basis of Consequence | Score Value |
|---|---|---|---|---|---|---|---|---|
| 8 | Incident at nearby Seveso site resulting in off-site environmental impact at the BRDA | Fire/explosion; failure of equipment or infrastructure | Injury or fatality; environmental contamination or damage to habitats. | Extremely Unlikely (2) | Strict safety protocols and management provisions to govern the assessment and treatment of major risks at the proximal Seveso sites. | Very Serious (4) | Accident events at the Seveso sites have the potential (albeit highly improbable) to result in slope failure of the BRDA which may result in the remobilisation of bauxite residue and salt cake off site into the Lower River Shannon SAC and the River Shannon and River Fergus SPA. | Low (8) |
| **Vulnerability to Incidents at the adjacent AAL Plant Area (Section 16.8.2.6)** | | | | | | | | |
| 9 | Incident at adjacent AAL plant area resulting in environmental impact at the BRDA | Fire/explosion; failure of equipment or infrastructure | Injury or fatality; environmental contamination or damage to habitats. | Extremely Unlikely (2) | Strict safety protocols and management provisions in place to govern the assessment and treatment risks at the AAL plant area. Proactive identification and management of hazards within the AAL plant area. | Limited (2) | The AAL facility stores quantities of dangerous substances below the lower and upper tier Seveso categories. Therefore, there are no dangerous substance storage of sufficient size which could result in significant impacts to the BRDA or the borrow pit. | Low (4) |
| **Potential to Structural Failure of the BRDA and SCDC (Section 16.8.3.1)** | | | | | | | | |

| | Risk Scenario | Potential Cause | Effect | Likelihood Value (Table 16.2) | Basis of Likelihood | Conseq. Value (Table 16.3) | Basis of Consequence | Score Value |
|---|---|---|---|---|---|---|---|---|
| 10 | Failure of the BRDA and proposed raises leading to failure of the SCDC | Static slope failure; foundational failure; blast event; internal erosion or external erosion; overtopping due to poor operational practices. | Damage and breach of the BRDA with potential mobilisation of bauxite residue off site impacting environmental receptors; damage to infrastructure including local water resources; injury, illness or loss of life. | Highly Improbable or Negligible (1) | Design of the BRDA in accordance with appropriate standards-based design criteria for tailings dams; mud-farming to thicken and densify the bauxite residue leading to improved strength parameters; on-going site investigation to confirm bauxite residue strength parameters; geotechnical monitoring instruments are installed in the BRDA to monitor deformation and pore water pressures in the bauxite residue and the foundation soils; adherence to the AAL BRDA OSM (Operational, Safety and Maintenance Manual) and the AAL BRDA Physical Stability Monitoring Plan; adherence to the licence conditions for monitoring, auditing, inspection and review; appointment of an Engineer of Record and undertaking of a DSR; and proximal blasting to be undertaken in accordance with defined blast parameters. | Very Serious (4) | Failure of the BRDA and subsequent failure of the SCDC may result in the remobilisation of bauxite residue and salt cake off site into the Lower River Shannon SAC and the River Shannon and River Fergus SPA. | Low (4) |

| | Risk Scenario | Potential Cause | Effect | Likelihood Value (Table 16.2) | Basis of Likelihood | Conseq. Value (Table 16.3) | Basis of Consequence | Score Value |
|---|---|---|---|---|---|---|---|---|
| **11** | Failure of the SCDC cell without failure of the BRDA. | Static slope failure; foundational failure; blast event; internal erosion or external erosion; overtopping due to poor operational practices. | Damage and breach of the SCDC with potential mobilisation of salt cake into the BRDA. | Highly Improbable or Negligible (1) | Design of the SCDC in accordance with appropriate design criteria for tailings dams; adherence to the AAL BRDA OSM (Operational, Safety and Maintenance Manual) and the AAL BRDA Physical Stability Monitoring Plan; adherence to the licence conditions for monitoring, auditing, inspection and review; proximal blasting to be undertaken in accordance with defined blast parameters. | Minor (1) | Without failure of the overall BRDA the salt cake would slowly remobilise into the surrounding BRDA. There would be no impact on receptors. | Low (1) |
| **Potential Cause of Fire / Explosion (Section 16.8.3.2)** | | | | | | | | |
| **12** | Fire / Explosion | Vehicle collision; failure of equipment or infrastructure; employee complacency or negligence. | Damage to vehicles equipment, injury or fatality of users, localised and simple contamination as a result of the damaged equipment. | Unlikely (4) | Level of management governance, protocols and practices in place. | Limited (2) | Limited potential for injuries or a fatality. Environmental contamination would be simple and localised. No anticipated damage or disturbance to the local community. | Low (8) |
| **Potential Failure of Bauxite Residue Pipeline Transfer (Section 16.8.3.3)** | | | | | | | | |

| | Risk Scenario | Potential Cause | Effect | Likelihood Value (Table 16.2) | Basis of Likelihood | Conseq. Value (Table 16.3) | Basis of Consequence | Score Value |
|---|---|---|---|---|---|---|---|---|
| **13** | Failure of Bauxite Residue Pipeline Transfer | Failure of equipment or infrastructure; employee complacency or negligence. | Localised and simple contamination as a result of the damaged equipment. | Unlikely (4) | Level of management protocols, shutdown provision, patrols and practices in place. | Minor (1) | Limited potential for injuries or a fatality. Environmental contamination would be simple and localised. No anticipated damage or disturbance to the local community. | Low (4) |
| **Potential Cause of Contamination of Underlying Soils and Groundwater from Fuelling Activities (Section 16.8.3.4)** | | | | | | | | |
| **14** | Fuel or other hydrocarbon spillages, leaks and releases at BRDA | Spillage and/or overflow of diesel from fuel tank or mobile plant during tank filling. Equipment/Infrastructure failure Human error or negligence | Contamination of ground water, surface water and land | Unlikely (4) | Level of management practices and shutdown provision in place. | Limited (2) | Environmental contamination would be simple and localised. No anticipated damage or disturbance to the local community. No anticipated potential for fatalities or injury. | Low (8) |
| **15** | Fuel or other hydrocarbon spillages, leaks and releases at borrow pit extension | Spillage and/or overflow of diesel from fuel tank or mobile plant during tank filling. Equipment/Infrastructure failure Human error or negligence | Contamination of ground water, surface water and land | Unlikely (4) | Level of management practices and shutdown provision in place. | Limited (2) | Environmental contamination would be simple and localised. No anticipated damage or disturbance to the local community. No anticipated potential for fatalities or injury. | Low (8) |
| **Potential to Cause Falling Debris or the Collapse of Benches or Quarry Faces (Section 16.8.3.5)** | | | | | | | | |

| | Risk Scenario | Potential Cause | Effect | Likelihood Value (Table 16.2) | Basis of Likelihood | Conseq. Value (Table 16.3) | Basis of Consequence | Score Value |
|---|---|---|---|---|---|---|---|---|
| **16** | Collapse of borrow pit extension face | Improper design and management of extraction progression. | Injury or fatality to persons working in close proximity. | Very Unlikely (3) | Designed and managed in accordance with the relevant best practice. Geotechnical assessments to be undertaken in accordance with relevant HSA requirements. | Serious (3) | Potential for greater than one fatality depending on the work scenario, however anticipated to be less than five. | Low (9) |
| **Potential to Cause Damage or Rupture of the Gas Transmission Line from Borrow Pit Blasting Activities (Section 16.8.3.6)** | | | | | | | | |
| **17** | Rupture of GNI gas transmission line | Improper design and management of blasting activities. | Rupture and damage to GNI gas transmission infrastructure, injury or fatality to persons in close proximity, localised and simple contamination as a result of the damaged infrastructure. | Very Unlikely (3) | Strict protocols surrounding blasting activities; blasting to be undertaken by appropriately trained personnel, in accordance with defined blast parameters. | Serious (3) | Potential for greater than one fatality depending on the blast scenario, however anticipated to be less than five. | Low (9) |

| | | Consequence | | | | |
|---|---|---|---|---|---|---|
| | | 1 Minor | 2 Limited | 3 Serious | 4 Very Serious | 5 Catastrophic |
| Likelihood | 6 Very Likely | | | | | |
| | 5 Likely | | | | | |
| | 4 Unlikely | 13 | 12, 14, 15 | | | |
| | 3 Very Unlikely | | | 16, 17 | | |
| | 2 Extremely Unlikely | | 3, 9 | | 7, 8 | |
| | 1* Highly Improbable or Negligible | 1, 4, 5, 11 | | | 2, 6, 10 | |
| DoEHLG 2010 Classification | | Normal Emergency | | Major Emergency | | |

** See Table 16.2 with regards to the inclusion of a likelihood classification appropriate to the design criteria of tailings storage facilities*

**Table 16.6:** Risk Matrix for Major Accident Hazards associated with the Proposed Development

The risk assessment process according to DoEHLG 2010 can place a potential hazard into either:

- The "normal" emergency zone; or
- The major emergency zone, at the extremities of which are delineated two specific areas;
- A Prevent or Mitigate area, where prevention/mitigation of hazards is required
- A Disaster / Extendibility area, where hazards are extremely/ very unlikely and do not therefore warrant specific preparedness but can be responded to by extending the inter-agency arrangements of the major emergency regime.

As can be seen from the summary above, it is considered that the prevention and Proposed Development design measures already included are sufficient, as none of the hazards identified lead to an associated high-risk rating.

For potential major emergencies with a lower likelihood, these do not warrant specific preparedness but can be responded to by extending the inter-agency arrangements of the major emergency regime. The emergency scenarios which entail a breach in the BRDA (Risks No.s 2, 6 and 10) have been identified and planned for in Limerick City and County Council External Emergency Plan for the Bauxite Residue Disposal Area (2019 version). It is therefore concluded that further mitigation is not required for these scenarios.

The remaining identified 'Major Emergencies' (7, 8, 16 and 17) fall within the DoEHLG 2010 'Planning and Preparedness' zone. AAL have emergency response procedures in place to manage these emergency scenarios within their facility.

A scenario where there is an incident at a proximal Seveso site (8) is identified in relevant authority emergency planning documents, which include the LCCC (2014) Major Emergency Management – Major Emergency Plan, and HSE (2021) Emergency Management Area 3 Emergency Plan (Covering Geographical Areas of Counties Clare, Limerick and North Tipperary).

The Seveso sites themselves are required to comply with the provisions of the COMAH Regulations which implemented the Seveso-III Directive (Directive 2012/18/EU); as such, the Seveso sites are required to prepare internal emergency plans which specify emergency preparedness systems and the appropriate response measures to be undertaken in the event of a major accident. Further to these plans the Shannon Foynes Port Company have also prepared an Onshore Emergency Plan (Shannon Foynes Port Company Harbour Offices, Foynes, Co. Limerick 2020, EHS/006 SFPC Onshore Emergency Response Plan. April 2020), which provides provision for notification in the event of an emergency situation involving a Seveso site. It is considered that further mitigation and additional 'planning and preparedness' by AAL is not warranted for this scenario.

Risks associate the failure of a face in the borrow pit extension (16) have been reduced by the Proposed Development design of the borrow pit extension and the existing and proposed comprehensive management practices that will govern works in the area. It is considered that no further mitigation and additional 'planning and preparedness' is required.

Risks associated with a scenario where the GNI gas transmission line ruptured due to blasting activities (17) has been reduced with the implementation of the strict management protocols surrounding each of the blasts. It is considered that no further mitigation and additional 'planning and preparedness' is required.

## 16.9 Do-Nothing Scenario

The AAL BRDA is an existing site which already engages in the storage and handling of bauxite residue and salt cake. A borrow pit area which is located closer to the BRDA than the borrow pit Extension footprint has already been approved for the extraction of rock by blasting.

The Proposed Development seeks to raise the BRDA and SCDC facilities, therefore the major accidents assessed in this Chapter are largely in keeping with a 'Do-Nothing' scenario for the Site which would entail the Site operating to c.2030 and implementing the final closure and restoration plan. These current and 'Do-Nothing' risks presented by the existing activities at the Site would continue to be managed by AAL in accordance with existing emergency management practices and protocols.

With regards to the borrow pit extension element of the Proposed Development, if this application were not granted then then major accidents and disasters associated with it would be eliminated as the proposals would not be implemented.

## 16.10 Mitigation and Management

Additional mitigation and/or management is intended to avoid, prevent, reduce or, if possible, offset any identified significant adverse effects on the environment.
The initial assessment of potential effects (taking into account the Proposed Development design) has not identified any significant adverse effects.
The proposed development will be designed and built-in line with the relevant best international current practice and, as such, has a low vulnerability to the hazards of major accidents and disasters.

However, to manage and to mitigate the effects associated with major accidents on Site, AAL are and will continue to maintain existing environmental and health and safety management protocols, best practice measures, relevant preventative measures, emergency preparedness provision, which will include:

- Periodic review and implementation of recommendations in the Site's ELRA;
- Periodic review and implementation of the recommendations in the Site's HAZID study (AWN 2015) to ensure compliance with the protocols for the storage / use of heavy fuel oil, diesel, petrol, liquid petroleum gas and other pressurised gas systems in the plant area
- Periodic review and implementation of the 'External Emergency Plan for Bauxite Residue Disposal Area, Aughinish Alumina Ltd., Askeaton, Co. Limerick', in conjunction with Limerick City and County Council;
- The presence of a 24-hour security and emergency response team on site with a full functioning fire, rescue and ambulance service; and procedures for teams in relation to external emergency assistance;
- Process pipelines, storage, containment and conveyance structures are subject to an existing preventative maintenance system which includes inspection and testing;
- AAL Environmental Management System (EMS), Quality Management System (QMS), Energy Management System and International Safety Rating System (ISRS) Advanced Level 8 Safety Management System, see Section 16.7; and
- AAL Emergency Management Procedures (EMPs), see Section 16.7.

### 16.10.1 Monitoring

There are no additional monitoring measures required above those already identified in this assessment. These monitoring measures specific to the prevention of major accidents and disasters include:

- Full implementation of the Physical Stability Monitoring Plan for the AAL BRDA (Golder 2021) to ensure that appropriate geotechnical monitoring instruments are installed in the BRDA (inclinometers and piezometers) to monitor deformation and hydrostatic pore water pressures in the bauxite residue and the foundation soils. These instruments are read and interpreted at recurrent intervals and compared with previous readings.

- The management of construction works, to be conducted by external Contractors and internal AAL alliance Contractors, carried out in line and in accordance with all monitoring provisions identified in the Construction Environmental Management Plan (CEMP), the IE Licence, the AAL Environmental Manual for Contractors (AAL, October 2016), and with any Conditions imposed by the planning authorities.

The monitoring system will be prepared in advance and in place prior to the commencement of any works and be implemented and assessed during the works.

### 16.11 Residual Risks

The risk of a major accident and/or disaster during the construction, operation, closure and aftercare of the Proposed Development is considered 'low' in accordance with the risk assessment methodology. It is considered that there will be no significant residual risks from the construction, operation, closure and aftercare of the Proposed Development.

### 16.12 Difficulties Encountered

No particular difficulties were encountered in obtaining data and undertaking the assessment of major accidents and disasters.

### 16.13 Summary and Conclusions

The scope and methodology of the assessment is based on the DoEHLG Guide to Risk Assessment in Major Emergency Management (2010) which has been supplemented to include the highly improbable scenarios to which tailings facilities and the AAL BRDA has been designed i.e., an additional ranking of 'Highly Improbably or Negligible' has been added to Table 16.2, Table 16.4 and Table 16.6

The scope and methodology are also centred on the understanding that the Proposed Development will be designed, built, operated and closed in line with best international current practice, along with approvals and agreements with the relevant local authorities and EPA.

This risk assessment methodology covers the identification of major accidents and disaster hazards and their likelihood and associated consequence. By their nature, major accidents and disasters have the potential to give rise to indirect effects such as effects on the economy, tourism, transport, human health etc. As such the DoEHLG classifies impacts under categories such as 'Life, Health, Welfare', 'Environment', 'Infrastructure' and 'Social'.

This assessment has considered:

- The vulnerability, if any, of the Proposed Development to potential major accidents or disasters, which includes both natural (e.g., earthquakes) and man-made disasters (e.g., technological hazards);
- The Proposed Development's potential, if any, to cause major accidents and/or disasters, (with explicit reference to considerations for human health, cultural heritage, and the environment); and
- The identification of control and/or emergency preparedness measures which are in place, or that may need to be implemented, to prevent or mitigate the likely significant adverse effects of such events on the environment.

Seventeen (17) risk scenarios were identified or the Proposed Development and all seventeen (17) returned a '**Low**' risk score in the evaluation matrix.

Five (5) 'Low' risk scenarios for the BRDA collapse were determined to have a Very Serious consequence, fitting into the Major Emergency classification, but all have a highly improbable or negligible likelihood.

Two (2) 'Low' risk scenarios for the borrow pit extension (collapse of pit face) and the GNI transmission line (rupture of pipe) were determined to have a Serious consequence, fitting into the Major Emergency classification, but had a very unlikely likelihood.

The remaining risk scenarios for the Proposed Development were determined to have Minor or Limited consequence, fitting into the Normal Emergency classification, and had likelihoods ranging from unlikely to highly improbable or negligible.

Existing geotechnical monitoring and design preventative measures are sufficient for the control of major accidents and disasters related to the BRDA and SCDC on the Site.

The management of construction works will be carried out in line and in accordance with all provisions identified in the CEMP, with the IEL requirements, with the AAL Environmental Manual for Contractors (AAL, October 2016), and along with any Conditions imposed by the planning authorities.

No additional mitigation measures are considered to be required.

## 16.14 References

Aughinish Alumina Limited 2019. Departmental Emergency Procedures, Unit: BRDA, Emergency: High Winds, No. P007.02.017, Issue No. 1, Revision No. 3. 04 November 2019.

Aughinish Alumina Limited 2019. Departmental Emergency Procedures, Unit: BRDA, Emergency: Severe Weather Frost, No. P007.02.018, Issue No. 1, Revision No. 3. 04 November 2019.

Aughinish Alumina Limited 2019. Emergency Procedure, BRDA Containment Emergency Response, No. P007.02.019, Issue No. 1, Revision No. 7. 04 March 2019.

Aughinish Alumina Limited 2016. Emergency Response Procedures, Unit: Environment, Emergency: Caustic Spillage Outside Bund, No. P007.76.031, Revision Date: April 2016.

Aughinish Alumina Limited 2017. Emergency Response Procedures, Unit: Environment, Emergency: Acid Spillage Outside Bund, No. P007.76.032, Issue No. 1, Revision No. 2, Revision Date: 09 November 2017.

Aughinish Alumina Limited 2016. Emergency Response Procedures, Unit: Environment, Emergency: HFO / Diesel / Petrol Spillage Outside Bund, No. P007.76.034, Issue No. 1, Revision No. 1, Revision Date: May 2016.

Aughinish Alumina Limited 2016. Emergency Response Procedures, Unit: Environment, Emergency: Chemical Spillage, No. P007.76.037, Issue No. 1, Revision No. 0, Revision Date: June 2016.

AWN Consulting 2015, AAL Identification of Major Accident Hazards, Consequence Analysis and Risk Assessment, MMcK/14/8196RR01, November 2015

BGS 2007, Musson, R.W., Sargeant, SL., Eurocode 8 – Seismic Hazard Zoning Maps for the UK, British Geological Survey, Technical Report, CR/07/125, 70 pp

CDA 2013, Canadian Dam Association, Dam Safety Guidelines 2007, Revised 2013

CDA 2014, Canadian Dam Association, Technical Bulletin 2014, Application of Dam Safety Guidelines to Mining Dams

Department of the Environment, Heritage & Local Government (DoEHLG), 2010. A Framework for Major Emergency Management, Guidance Document 1, A Guide to Risk Assessment in Major Emergency Management.

EPA 2014a, Guidance on assessing and costing environmental liabilities, Environmental Protection Agency, Johnstown Castle Estate, Co. Wexford, Ireland.

EPA 2014b, 2014-W-UGEE-1, Summary Report 2: Baseline Characterization of Seismicity. Environmental Protection Agency, Johnstown Castle Estate, Co. Wexford, Ireland.

EPA 2015, Draft Advice Notes for preparing Environmental Impact Statements. Environmental Protection Agency, Johnstown Castle Estate, Co. Wexford, Ireland.

EPA 2017, Draft Guidelines on the information to be contained in Environmental Impact Assessment Reports (EIAR). Environmental Protection Agency, Johnstown Castle Estate, Co. Wexford, Ireland.

European Commission 2017, Environmental Impact Assessment of Projects – Guidance on the preparation of the Environmental Impact Assessment Report.

Golder 2019, Golder Associates Ireland Limited, Risk Assessment and Break-Out Study for the Bauxite Residue Disposal Area (BRDA), 1897858.R01.A3, March 2019

Golder 2021, Golder Associates Ireland Limited, Physical Stability Monitoring Plan for the AAL BRDA, 21452853.TM06.A0, August 2021

Government of Ireland, 2006, A Framework for Major Emergency Management

HSE 2002, Seismic Hazard: UK Continental Shelf, 2002/005

Health Service Executive (HSE) 2021, Emergency Management Area 3 Emergency Plan (Covering Geographical Areas of Counties Clare, Limerick and North Tipperary), January 2021

Highways England, 2020, LA 104 - Environmental assessment and monitoring, Design Manual for Roads and Bridges, Revision 1.

Institute of Environmental Management and Assessment (IEMA) 2020, Major Accidents and Disasters in EIA: A Primer, September 2020

Limerick City and County Council 2014, Major Emergency Management – Major Emergency Plan, (June 2014), Version 1.0.

Limerick City and County Council 2019, External Emergency Plan For Bauxite Residue Disposal Area, Aughinish Alumina Ltd., Askeaton, Co. Limerick, Version 2.0, 02 August 2019

MWEI BREF 2018, Best Available Techniques (BAT) Reference Document for the Management of Waste from Extractive Industries, in accordance with Directive 2006/21/EC; EUR 28963 EN; Publications Office of the European Union, Luxembourg, 2018; ISBN 978-92-79-77178-1; doi:10.2760/35297, JRC109657
PM Group 2018, Environmental Liabilities Risk Assessment, Aughinish Alumina Ltd, IE0310294-22-RP-0001, 28 May 2018

PM Group 2019, Environmental Liabilities Risk Assessment – IEL Review Application, Aughinish Alumina Ltd, IEL Compliance Support, IE0310294-22-RP-0003, Issue B, 17 Apr 2019

SHARE 2013, Seismic Hazard Harmonization in Europe (SHARE) Project, ENV.2008.1.3.1.1, Development of a common methodology and tools to evaluate earthquake hazard in Europe, 2013

SLR 2019, Dam Safety Review, Bauxite Residue Disposal Area (BRDA), Aughinish Island, Co. Limerick, prepared for UC Rusal Aughinish Alumina Ltd., SLR Ref. 501.00618.00001, Version No. Final 3.0, June 2019.

Shannon Foynes Port Company Harbour Offices, Foynes, Co. Limerick 2020, EHS/006 SFPC Onshore Emergency Response Plan. April 2020.

Rusal Aughinish 2017, Emergency Response Plan, Revised April 2017.

# 17.0 CLIMATIC FACTORS

## 17.1 Introduction

AWN Consulting Limited has been commissioned by Tom Phillips and Associates on behalf of Aughinish Alumina Ltd (AAL) to conduct a climate impact assessment of the Proposed Development.

AAL operates a long-established alumina refinery, located on Aughinish Island on the southern side of the Shannon Estuary near the village of Foynes, Co. Limerick. The landholding extends to c. 601 ha. The application site is located towards the centre of the Applicants landholding at Aughinish Island, within the BRDA.

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Dr. Edward Porter is Director with responsibility for Air Quality with AWN Consulting. He holds a BSc from the University of Sussex (Chemistry), and a PhD in Environmental Chemistry (Air Quality) in UCD where he graduated in 1997 and is a Full Member of the Royal Society of Chemistry (MRSC CChem) with 25 years' experience. He specialises in the fields of air quality, odour and air dispersion modelling.

### 17.1.1 Climate Agreements, Policy & Guidelines

Ireland is party to the United Nations Framework Convention on Climate Change (UNFCCC) and to the Agreements made under the UNFCCC. The Paris Agreement, which entered into force in 2016, is an important milestone in terms of international climate change agreements and includes an aim of limiting global temperature increases to no more than 2°C above pre-industrial levels with efforts to limit this rise to 1.5°C. The aim is to limit global greenhouse gas (GHG) emissions to 40 gigatonnes as soon as possible whilst acknowledging that peaking of GHG emissions will take longer for developing countries. Contributions to GHG emissions will be based on Nationally Determined Contributions (NDCs) which will form the foundation for climate action post 2020. Significant progress was also made in the Paris Agreement on elevating adaptation onto the same level as action to cut and curb emissions(1-3).

In order to meet the commitments under the Paris Agreement, the EU enacted *Regulation (EU) 2018/842 on binding annual greenhouse gas emission reductions by Member States from 2021 to 2030 contributing to climate action to meet commitments under the Paris Agreement and amending Regulation (EU) No. 525/2013* (the Regulation)(3). The Regulation aims to deliver, collectively by the EU in the most cost-effective manner possible, reductions in GHG emissions from the Emission Trading Scheme (ETS) and non-ETS sectors amounting to 43% and 30%, respectively, by 2030 compared to 2005. Ireland's obligation under the Regulation is a 30% reduction in non-ETS greenhouse gas emissions by 2030 relative to its 2005 levels.

In 2015, the Climate Action and Low Carbon Development Act 2015 (No. 46 of 2015) was enacted (the 2015 Act)(4). The purpose of the 2015 Act was to enable Ireland '*to pursue, and* *achieve, the transition to a low carbon, climate resilient and environmentally sustainable economy by the end of the year 2050*' (3.(1) of No. 46 of 2015). This is referred to in the 2015 Act as the '*national transition objective*'. The 2015 Act makes provision for a national mitigation plan, and a national adaptation framework. In addition, the 2015 Act provided for the establishment of the Climate Change Advisory Council with the function to advise and make recommendations on the preparation of the national mitigation and adaptation plans and compliance with existing climate obligations.

The 2015 Act adaptation plan, referred to as the '*national climate change adaptation framework*', which is required to be submitted to Government for approval every five years, outlines a range of objectives to:

- Specify the national strategy for the adaptation measures in different sectors which reduces the vulnerability of the State to the negative effects of climate change and to avail of the positive effects of climate change that may occur; and

- Take into account any existing obligations of the State under the law of the EU or any international agreement.

In addition, the 2015 Act provided for the establishment of the Climate Change Advisory Council (hereafter referred to as the Advisory Council) with the function to advise and make recommendations on the preparation of the national mitigation and adaptation plans and compliance with existing climate obligations.

The 2019 *Climate Action Plan* (CAP) (Government of Ireland, 2019), published in June 2019, outlined the status across key sectors including Electricity, Transport, Built Environment, Industry and Agriculture and outlined the various broadscale measures required for each sector to achieve ambitious decarbonisation targets(5). The CAP also detailed the required governance arrangements for implementation including carbon-proofing of policies, establishment of carbon budgets, a strengthened Climate Change Advisory Council and greater accountability to the Oireachtas. The CAP set a built environment sector reduction target of 40 - 45% relative to 2030 pre-NDP (National Development Plan) projections.

In June 2020, the Government published the Programme for Government – Our Shared Future (Government of Ireland 2020)(6). In relation to climate, there is a commitment to an average 7% per annum reduction in overall greenhouse gas emissions from 2021 to 2030 (51% reduction over the decade) with an ultimate aim to achieve net zero emissions by 2050. Policy changes will include the acceleration of the electrification of the transport system, including electric bikes, electric vehicles and electric public transport, alongside a ban on new registrations of petrol and diesel cars from 2030. In addition, there will be a policy to ensure an unprecedented model shift in all areas by a reorientation of investment to walking, cycling and public transport.

Following on from Ireland declaring a climate and biodiversity emergency in May 2019 and the European Parliament approving a resolution declaring a climate and environment emergency in Europe in November 2019, the Government approved the publication of the General Scheme for the Climate Action (Amendment) Bill 2019 in December 2019(7). The General Scheme was prepared for the purposes of giving statutory effect to the core objectives stated within the CAP. The Climate Action and Low Carbon Development (Amendment) Act 2021 (the 2021 Climate Act) (No. 32 of 2021) was published in July 2021(8).

The purpose of the 2021 Climate Act is to provide for the approval of plans '*for the purpose of pursuing the transition to a climate resilient, biodiversity rich and climate neutral economy by no later than the end of the year 2050*'. The 2021 Climate Bill will also '*provide for carbon budgets and a sectoral emissions ceiling to apply to different sectors of the economy*'. The 2021 Climate Act removes any reference to a national mitigation plan and instead refers to both the Climate Action Plan, as published in 2019, and a series of National Long Term Climate Action Strategies. In addition, the Environment Minister shall request each local authority to make a 'local authority climate action plan' lasting five years and to specify the mitigation measures and the adaptation measures to be adopted by the local authority. The Bill has set a target of a 51% reduction in the total amount of greenhouse gases over the course of the first two carbon periods ending 31 December 2030 relative to 2018 annual emissions. The 2021 Climate Bill defines the carbon budget as 'the total amount of greenhouse gas emissions that are permitted during the budget period'.

The Climate Action and Low Carbon Development (Amendment) Act 2021 (No. 32 of 2021) outlines a series of specific actions including:

- To make a strategy to be known as the 'National Long Term Climate Strategy' not less than once in every five-year period with the first to be published for the period 2021 to 2035 and with each subsequent Strategy covering the next three five-year carbon budgets and also include a longer term perspective of at least 30 years;
- To adopt a system of carbon budgets which will be determined as part of a grouping of three five-year periods calculated on an economy-wide basis, starting with the periods 2021 to 2025, 2026 to 2030, and 2031 to 2035;
- To introduce a requirement for Government to adopt "sectoral emission ceilings" for each relevant sector within the limits of each carbon budget;
- To request all local authorities to prepare climate action plans for the purpose of contributing to the national climate objective. These plans should contain mitigation and adaptation measures that the local authority intends to adopt;
- Increasing the power of the Advisory Council to recommend the appropriate climate budget and policies;
- Requiring the Minister to set out a roadmap of actions to include sector specific actions that are required to comply with the carbon budget and sectoral emissions ceiling for the period to which the plan relates; and
- Reporting progress with the CAP on an annual basis with progress including policies, mitigation measures and adaptation measures that have been adopted.

In 2019, Limerick County Council published its "*Climate Change Adaptation Strategy 2019-2024"* [(9)] which outlined the strategy and actions which will be taken to mitigate and adapt to climate change. The document outlined responsibility for implementing the various adaptation actions, key indicators and targets for measuring outcomes and identified risk to the implementation of the actions.

The 2021 Climate Action Plan[(10)], published in November 2021, outlines the current status across key sectors including electricity, transport, built environment, industry and agriculture and outlines the various broadscale measures required for each sector to achieve ambitious decarbonisation targets. The 2021 CAP also details the required governance arrangements for implementation including carbon-proofing of policies, establishment of carbon budgets (which will be finalised in the coming months), a strengthened Advisory Council and greater accountability to the Oireachtas.

The ETS is an EU-wide system which regulates the GHG emissions of larger industrial emitters including electricity generation and heavy industry. The non-ETS sector includes all domestic GHG emitters which do not fall under the ETS scheme and thus includes GHG emissions from transport, residential and commercial buildings and agriculture. Ireland's obligation under the Regulations is a 30% reduction in non-ETS GHG emissions by 2030 relative to its 2005 levels. The ETS is a "*cap and trade*" system where an EU-wide limit, or cap, is set for participating installations. On an EU-wide basis, the ETS market in 2018 was approximately 1,655 million tonnes $CO_{2eq}$.

Following on from the recently published European Climate Law(11), and as part of the EU's "*Fit for 55*" legislative package where the EU has recently committed to a domestic reduction of net greenhouse gas emissions by at least 55% compared to 1990 levels by 2020, the Effort Sharing Regulation is proposed to be strengthened with increased ambition by the year 2030. The Effort Sharing Regulation relates to non-EU ETS sector emission. The proposal(12) for Ireland is to increase the GHG emission reduction target from 30% to 42% relative to 2005 levels whilst the ETS market will also have more stringent reductions from the currently proposed reduction of 43% by 2030 compared to 2005 to a 61% reduction by 2030 based on annual reductions of 4.2% compared to the previous annual reduction level of 2.2% per year(13). Thus, the overall EU ETS market will continue to have mechanisms in place to ensure that these emission targets are met.

## 17.2 Methodology

The climate assessment has been carried out in line with the guidance outlined in the European Commission publications "*Guidance on Integrating Climate Change and Biodiversity into Environmental Impact Assessment*"(14) and "*Environmental Impact Assessment of Projects – Guidance on the preparation of the Environmental Impact Assessment Report*"(15) and the EPA publication "*Guidelines on the Information to be Contained in Environmental Impact Assessment Reports – Draft August 2017*"(16).

In the absence of specific Irish or UK guidance in relation to industrial facilities, the guidance from the United Kingdom (UK) Highway Agency (UKHA) Design Manuals for Roads and Bridges (DMRB) - LA 114 Climate (hereafter referred to as LA 114 Climate)(17) has been consulted. LA 114 Climate advises that the assessment of a Proposed Development should describe the likely significant effects on the environment resulting from both the:

- Impact of a project on climate (GHG emissions); and
- Vulnerability of a project to climate change (adaptation).

The assessment methodology has been derived with reference to the most appropriate guidance documents relating to climate which are set out in the following sections of this Chapter. An overview of the methodology undertaken for the climate impact assessment is outlined below:

- A detailed baseline review of GHG emissions has been undertaken in order to characterise the baseline environment. This has been undertaken through review of available published GHG emission data;

- A review of the most applicable guidelines for the assessment of GHG emissions has been reviewed in order to define the significance criteria for the Construction and Operational Phases of the Proposed Development. These guidelines, outlined in Section17.2.1 describe appropriate methods for quantifying the emissions of GHG emissions from the Proposed Development;
- For a development of this nature the construction and operational phases are considered together in the GHG assessment given that the operation of the BRDA, also including the construction and operation of the Salt Cake Disposal Cell, will also involve the construction of each stage elevation which in turn will require the extraction of material from the Borrow Pit. Thus, GHG emissions from the BRDA were assumed to coincide with GHG emissions from the Borrow Pit in the assessment;
- Predictive calculations and impact assessments relating to the likely Construction Phase climatic impacts of the Proposed Development have been undertaken;
- Predictive calculations have been performed to assess the potential climatic impacts associated with the operation of the Proposed Development;
- An assessment of the vulnerability of the Proposed Development to climate change has been undertaken; and
- A schedule of mitigation measures has been incorporated where required to reduce, where necessary, the identified potential climatic impacts associated with the Proposed Development.

### 17.2.1 Relevant Guidelines, Policy and Legislation

The assessment has been undertaken with reference to the most appropriate guidance documents relating to climate which are set out in the following sections. In addition to specific climate guidance documents, the following guidelines were considered and consulted in the preparation of this Chapter:

- Environmental Protection Agency (EPA) Guidelines on the Information to be Contained in Environmental Impact Statements (EPA 2002);
- Advice Notes on Current Practice (in the preparation of Environmental Impact Statements) (EPA 2003);
- Draft Advice Notes for Preparing Environmental Impact Statements (EPA 2015a); and
- Draft Guidelines on the Information to be Contained in Environmental Impact Assessment Reports (hereafter referred to as the EPA Guidelines) (EPA 2017a).

The assessment has made reference to national guidelines, where available, in addition to international standards and guidelines relating to the assessment of GHG emissions and associated climatic impacts. These are summarised below:

- Climate Action and Low Carbon Development Act 2015 (Act. No. 46 of 2015) (hereafter referred to as the Climate Act);
- National Adaptation Plan (DCCAE 2018);
- Climate Action Plan 2019 (DCCAE 2019);
- Guidance on Integrating Climate Change and Biodiversity into Environmental Impact Assessment (EC 2013);
- Environmental Impact Assessment of Projects – Guidance on the preparation of the Environmental Impact Assessment Report (EC 2017);
- European Commission 2030 Climate and Energy Policy Framework (European Commission 2014);
- LA 114 Climate (UKHA 2019);

- Institute of Environmental Management & Assessment (IEMA) Assessing GHG Emissions and Evaluating their Significance (IEMA 2017);
- IEMA EIA Guide to: Climate Change Resilience and Adaptation (IEMA 2020a);
- IEMA GHG Management Hierarchy (IEMA 2020b);
- Climate Action and Low Carbon Development (Amendment) Act 2021 (No. 32 of 2021) and
- Climate Action Plan 2021 (hereafter referred to as the CAP) (DCCAE 2021).

### 17.2.2 Construction Emissions

The Construction Phase of the Proposed Development will result in GHG emissions from various activities undertaken in the borrow pit including the extraction of limestone, handling of the material by dumper trucks / excavators and transportation of the material to the BRDA. Detailed information including volumes of excavated materials which have been transported and associated fuel usage associated with the excavators / trucks were obtained from the design team.

### 17.2.3 Operational Emissions

*Operational Phase Site Activity*

During the operational phase of the BRDA the existing activities will continue, however, the phasing of the BRDA raise over time will result in a higher elevation above ground level where these activities will take place. The Salt Cake Disposal Cell will also be raised as part of the proposed BRDA raise. For the purposes of this assessment the following stages of the BRDA development have been assessed:

- Current (Scenario 1),
- Phase 1 at Stage 10; Phase 2 at Stage 4 (Scenario 2),
- Phase 1 at Stage 12; Phase 2 at Stage 8 (Scenario 3),
- Phase 1 at Stage 14; Phase 2 at Stage 12 (Scenario 4),
- All at Stage 16 with restoration (Scenario 5).

There will be no increase in light vehicle trips, however there will be an increase in heavy vehicle trips projected on the external road network, specifically associated with the importation of soil and soil improver associated with the proposed raising of the BRDA amounting to 12 trucks per day. Any other additional vehicle movements generated by site activities will be wholly internal to the site itself. Trips associated with the importation of soil and soil improver will average approximately 12 trucks per day over the period 2026 to 2035.

For a development of this nature the construction and operational phases are considered together in the GHG assessment given that the operation of the BRDA, also including the construction and operation of the Salt Cake Disposal Cell, will also involve the construction of each stage elevation which in turn will require the extraction of material from the Borrow Pit. Thus, GHG emissions from the BRDA were assumed to coincide with GHG emissions from the Borrow Pit in the assessment.

Activity within the Borrow Pit will include occasional blasting to remove rock, on site breaking and crushing of the rock and excavator and dump truck movements to stockpile the materials. On the BRDA there will be a range of excavators and other equipment for mud farming whilst there will be some dump truck/excavator movements associated with the raising of the Salt Cake Disposal Cell. In relation to the Salt Cake Disposal Cell raise, there will be a requirement for circa 27,000 $m^3$ of processed rock fill material to raise the height by 2.25m. This material will be sourced from the onsite Borrow Pit. The Proposed Development will make the trucking of rock from offsite locations unnecessary.

The Proposed Development will increase the lifespan of the BRDA, generating only an additional 12 trucks per day to and from the site on a day-to-day basis with the development adding storage capacity to the existing BRDA and extending the borrow pit footprint. The same activity currently permitted within the borrow pit will continue to be used within the extended footprint. The footprint of the BRDA will remain unchanged.

**Construction and Operational Phase Significance Criteria**

LA 114 Climate(17) outlines a recommended approach for determining the significance of both the construction and operation phases of a Proposed Development. The approach is based on comparing the 'Do Something' scenario and the net project GHG emissions (i.e. Do Something – Do Minimum) to the relevant carbon budgets, where available.

The Climate Action and Low Carbon Development (Amendment) Act 2021 (No. 32 of 2021) was published in July 2021 and allows for the production of sectoral carbon budgets for each sector. The 2021 Climate Action Plan has outlined this establishment of carbon budgets. The CAP states that the CAP "*will be updated annually, including in 2022 to align with the legally binding economy-wide carbon budgets and sectoral ceilings that we will adopt in the coming months*". When assessing significance, LA 114 Climate recommends that the assessment of projects as significant should only occur '*where increases in GHG emissions will have a material impact on the ability of Government to meet its carbon reduction targets*'.

For the purposes of this assessment, the EPA EIAR Guidelines (EPA 2017) have been used to determine whether combined construction and operational phase emissions of GHG emissions, due to the Proposed Development, are significant.

**Significance Criteria – Vulnerability of the Proposed Scheme to Climate Change**

IEMA EIA Guide to Climate Change Resilience and Adaptation(18) outlines an approach for undertaking a risk assessment where there is a potentially significant impact on the project receptors due to climate change. The approach to the assessment is based on the following steps:

- Identify potential climate change risk to a project;
- Assess these risks (potentially prioritising to identify the most severe); and
- Formulating mitigation actions to reduce the impact of the identified risks.

The risk assessment assesses the likelihood and consequence of the impact occurring, leading to the evaluation of the significance of the impact. The assessment of likelihood should include consideration of available climate projections data for the project(19).

The Operational Phase assessment, after identifying the hazards and benefits of the climate change impacts, has assessed the likelihood and consequences using the framework outlined in recent risk assessment publications(20, 21) as outlined in Tables 17.1, 17.2 and 17.3.

| Likelihood Category (Score) | Description (Probability and Frequency of Occurrence) |
|---|---|
| Very high (5) | The event may occur with a > 90% probability |
| High (4) | The event may occur with a 50% - 90% probability |
| Medium (3) | The event may occur with a 10% - 50% probability |
| Low (2) | The event may occur with a 0.1% - 10% probability |
| Very Low (1) | The event may occur with a <0.1% probability |

Note 1 Based on "Consistent Application of Risk Management for Selection of Engineering Design Options in Mega-Projects", Int. Journal of Risk & Contingency Management (Oct 2014)

**Table 17.1** Likelihood Categories

| Consequence of Impact (Score) | Description Note 1 |
|---|---|
| Very large adverse (5) | Very heavy contamination, widespread effects of extended duration |
| Large adverse (4) | Heavy contamination, localised effects of extended duration |
| Moderately adverse (3) | Simple contamination, widespread effects of short duration |
| Minor adverse (2) | Simple contamination, localised effects of short duration |
| Negligible (1) | No contamination, localised effects |

Note 1 Based on "Guidance to Licensees/COA holders on the Notification, Management and Communication of Environmental Incidents" (EPA, 2010)

**Table 17.2** Measure of Consequence

| | | **Measure of Likelihood** | | | | |
|---|---|---|---|---|---|---|
| | | **Very Low** | **Low** | **Medium** | **High** | **Very High** |
| **Measure of Consequence** | **Very Large** | 5 | 10 | 15 | 20 | 25 |
| | **Large** | 4 | 8 | 12 | 16 | 20 |
| | **Moderate** | 3 | 6 | 9 | 12 | 15 |
| | **Minor** | 2 | 4 | 6 | 8 | 10 |
| | **Negligible** | 1 | 2 | 3 | 4 | 5 |

Note 1 Based on "Consistent Application of Risk Management for Selection of Engineering Design Options in Mega-Projects", Int. Journal of Risk & Contingency Management (Oct 2014) (Red = high risk, Yellow = medium risk, Green = low risk)

**Table 17.3** Significance Matrix

## 17.3 Receiving Environment

Climate is defined by the IPCC[19] as the average weather over a period of time, whilst climate change is a significant change to the average weather. Climate change is a natural phenomenon but in the industrial age human activities, through the release of GHGs, have impacted on the climate[22]. The release of anthropogenic GHGs is altering the Earth's atmosphere resulting in a 'Greenhouse Effect'. This effect is causing an increase in the atmosphere's heat trapping abilities resulting in increased average global temperatures over the past number of decades. The release of $CO_2$ as a result of burning fossil fuels, has been one of the leading factors in the increase of the 'Greenhouse Effect'. The most significant GHGs are $CO_2$, methane ($CH_4$) and nitrous oxide ($N_2O$).

For the purposes of this assessment, the definition outlined in Council Directive 2009/28/EC on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC (hereafter referred to as the Renewable Energy Directive) for GHGs has been used. In Annex V, C. Methodology Point 5 of the Renewable Energy Directive the relevant GHGs are defined as $CO_2$, $CH_4$ and $N_2O$. $CO_2$ accounted for 63.7% of total GHG emissions in Ireland in 2018 while $CH_4$ and $N_2O$ combined accounted for 34.4%. The main source of $CH_4$ and $N_2O$ is from the agricultural sector. Perfluorocarbons are not relevant in the context of the Renewable Energy Directive as they are not emitted in significant quantities by energy sources.

GHGs have different efficiencies in retaining solar energy in the atmosphere and different lifetimes in the atmosphere. In order to compare different GHGs, emissions are calculated on the basis of their Global Warming Potential (GWPs) over a 100-year period, giving a measure of their relative heating effect in the atmosphere. The IPCC AR5 Synthesis Report: Climate Change 2014 of the Fifth Assessment Report (AR5) (IPCC 2015)(19) sets out the global warming potential for a 100-year time period (GWP100) for $CO_2$ as the basic unit (GWP = 1) whereas $CH_4$ has a global warming potential equivalent to 28 units of $CO_2$ and $N_2O$ has a GWP100 of 265. This approach is also maintained in the draft IPCC AR6 Technical Summary (IPCC 2021)(23).

### 17.3.1 Vulnerability of the Project to Climate Change

The Proposed Development study area for assessing a project's vulnerability to climate change should be based on the construction footprint / project boundary. Impacts as a result of climate change involve increases in global temperatures and increases in the number of rainfall days per year. Ireland has seen increases in the annual rainfall in the north and west of the country, with small increases or decreases in the south and east(24). The EPA have compiled a list of potential adverse impacts as a result of climate change including the following which may be of relevance to the Proposed Development:

- More intense storms and rainfall events;
- Increased likelihood and magnitude of river and coastal flooding;
- Water shortages in summer in the east;
- Adverse impacts on water quality; and
- Changes in distribution of plant and animal species.

The historical regional weather data for Shannon Airport which is representative of the current climate in the region of the Proposed Development is shown in Table 17.4(25). The region of the Proposed Development has a temperate, oceanic climate, resulting in mild winters and cool summers. The Met Éireann weather station at Shannon Airport, is the nearest weather and climate monitoring station to the Proposed Development that has meteorological data recorded for the 30-year period from 1981 to 2010. Shannon Airport meteorological station is located approximately 13 km north-east of the Proposed Development at the closest point. Meteorological data recorded at Shannon Airport over the 30-year period from 1981 to 2010 indicates that the wettest months were October and December, and the driest month on average was May. July was the warmest month with a mean temperature of 16.4°C.

The recent weather patterns and extreme weather events recorded by Met Éireann have been reviewed. A noticeable feature of the recent weather has been an increase in the frequency and severity of storms with notable events including Storm Darwin in February 2014, Storm Emma in March 2018, and Storm Ophelia in October 2018. The maximum wind gust for Shannon Airport for Storm Ophelia peaked at 122 km/hr with a 10-minute speed of 87 km/hr. Heavier historical rainfall events have also been recorded in recent years including heavy rainfall and flooding in the summer of 2008 and severe flooding in November 2009.

Future climate predictions undertaken by Met Éireann have been published in 'Ireland's Climate: the road ahead'(26) based on four scenarios (RCP2.6, RCP4.5, RCP6.0 and RCP8.5) which is named with reference to a range of radiative forcing values for the year 2100 (i.e. 2.6, 4.5, 6.0 and 8.5 W/$m^2$ (watts per square metre)) respectively with focus on RCP4.5 (medium-low) and RCP8.5 (high) scenarios. In terms of mean temperatures, it is predicted that increases of between 1°C to 3°C will occur under RCP4.5 rising to 2°C to 4°C under RCP8.5. Warm extremes are expected to rise by 2°C to 3°C (RCP4.5) but by up to 5°C under RCP8.5.

The EPA sponsored Report No.159 'Ensemble of regional climate model projections for Ireland'(27) which has projected significant decreases in mean annual, spring and summer precipitation amounts with extended dry periods. The decreases are largest for summer, with reductions ranging from 0% to 13% and from 3% to 20% for the medium-to-low and high emission scenarios, respectively. Conversely increases of heavy precipitation of up to 20% are projected to occur during the winter and autumn months. The number of extended dry periods is projected to increase substantially by mid-century during autumn and summer.

In relation to storms, 'Report No.159 – Ensemble of regional climate model projections for Ireland'(27) indicates that the overall number of North Atlantic cyclones is projected to decrease by 10% coinciding with a decrease in average mean sea-level pressure of 1.5 hectopascals (hPa) for all seasons by mid-century. Wind energy is also predicted to decrease for spring, summer and autumn with a projected increase in winter.

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Temperature (°C)** | | | | | | | | | | | | | |
| mean daily max | 8.8 | 9.2 | 11.1 | 13.3 | 16.0 | 18.3 | 19.8 | 19.6 | 17.7 | 14.3 | 11.1 | 9.0 | 14.0 |
| mean daily min | 3.2 | 3.2 | 4.5 | 5.7 | 8.2 | 10.9 | 12.9 | 12.7 | 10.8 | 8.2 | 5.5 | 3.6 | 7.4 |
| mean temperature | 6.0 | 6.2 | 7.8 | 9.5 | 12.1 | 14.6 | 16.4 | 16.2 | 14.2 | 11.2 | 8.3 | 6.3 | 10.7 |
| absolute ma17. | 14.8 | 15.5 | 18.3 | 23.5 | 27.2 | 30.2 | 30.6 | 29.8 | 26.1 | 22.3 | 17.6 | 15.3 | 30.6 |
| min. maximum | -2.4 | 0.9 | 3.5 | 5.4 | 8.0 | 11.8 | 13.8 | 13.0 | 11.1 | 7.0 | 0.8 | -6.0 | -6.0 |
| ma17. minimum | 11.8 | 12.3 | 11.7 | 13.0 | 15.3 | 17.8 | 19.4 | 19.3 | 17.8 | 16.3 | 13.4 | 12.9 | 19.4 |
| absolute min. | -11.2 | -5.5 | -5.8 | -2.3 | 0.2 | 3.6 | 6.7 | 4.4 | 1.7 | -2.0 | -6.6 | -11.4 | -11.4 |
| mean num. of days with air frost | 5.3 | 5.1 | 2.1 | 0.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.5 | 2.3 | 4.8 | 20.8 |
| mean num. of days with ground frost | 13.7 | 12.6 | 11.0 | 8.3 | 3.3 | 0.3 | 0.0 | 0.1 | 1.2 | 3.8 | 9.5 | 12.5 | 76.3 |
| mean 5cm soil | 4.5 | 4.6 | 6.3 | 8.9 | 12.7 | 15.9 | 17.2 | 16.4 | 13.8 | 10.2 | 7.1 | 5.2 | 10.2 |
| mean 10cm soil | 4.8 | 4.8 | 6.3 | 8.5 | 12.1 | 15.1 | 16.6 | 16.1 | 13.6 | 10.3 | 7.4 | 5.5 | 10.1 |
| mean 20cm soil | 5.5 | 5.6 | 7.0 | 9.2 | 12.3 | 15.1 | 16.8 | 16.6 | 14.5 | 11.4 | 8.4 | 6.3 | 10.7 |
| **Relative Humidity (%)** | | | | | | | | | | | | | |
| mean at 0900UTC | 87.1 | 87.0 | 85.0 | 79.8 | 76.3 | 76.8 | 80.0 | 82.1 | 84.7 | 87.0 | 88.9 | 88.4 | 83.6 |
| mean at 1500UTC | 80.5 | 74.6 | 70.5 | 64.4 | 63.3 | 65.1 | 68.0 | 68.2 | 69.2 | 75.2 | 80.5 | 83.1 | 71.9 |
| **Sunshine (Hours)** | | | | | | | | | | | | | |
| mean daily duration | 1.6 | 2.3 | 3.2 | 5.1 | 5.8 | 5.2 | 4.5 | 4.5 | 3.9 | 2.9 | 2.0 | 1.4 | 3.5 |
| greatest daily duration | 8.1 | 10.2 | 11.0 | 13.6 | 15.6 | 15.8 | 15.7 | 14.4 | 12.2 | 10.1 | 8.3 | 7.1 | 15.8 |
| mean no. of days with no sun | 9.2 | 6.4 | 5.7 | 2.4 | 1.9 | 2.0 | 2.4 | 2.3 | 2.9 | 5.5 | 7.8 | 11.1 | 59.8 |
| **Rainfall (mm)** | | | | | | | | | | | | | |
| mean monthly total | 102.3 | 76.2 | 78.7 | 59.2 | 64.8 | 69.8 | 65.9 | 82.0 | 75.6 | 104.9 | 94.1 | 104.0 | 977.6 |
| greatest daily total | 38.2 | 29.4 | 28.1 | 40.2 | 25.0 | 40.6 | 39.5 | 51.0 | 52.3 | 36.9 | 26.9 | 41.2 | 52.3 |
| mean num. of days with >= 0.2mm | 20 | 16 | 19 | 16 | 16 | 15 | 16 | 18 | 16 | 20 | 20 | 19 | 211 |
| mean num. of days with >= 1.0mm | 16 | 12 | 14 | 11 | 12 | 11 | 12 | 13 | 12 | 16 | 15 | 15 | 159 |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mean num. of days with >= 5.0mm | 8 | 5 | 5 | 4 | 4 | 4 | 4 | 5 | 4 | 7 | 6 | 7 | 63 |
| **Wind (Knots)** | | | | | | | | | | | | | |
| mean monthly speed | 10.3 | 10.2 | 10.0 | 9.0 | 8.9 | 8.5 | 8.5 | 8.2 | 8.4 | 9.2 | 9.1 | 9.4 | 9.1 |
| ma17. gust | 75 | 80 | 65 | 62 | 59 | 51 | 52 | 55 | 62 | 71 | 66 | 83 | 83 |
| ma17. mean 10-minute speed | 52 | 46 | 44 | 40 | 37 | 37 | 38 | 35 | 40 | 47 | 41 | 57 | 57 |
| mean num. of days with gales | 1.7 | 0.9 | 0.8 | 0.3 | 0.2 | 0.1 | 0.0 | 0.1 | 0.1 | 0.6 | 0.7 | 1.2 | 6.7 |
| **Weather (Mean No. Of Days With..)** | | | | | | | | | | | | | |
| snow or sleet | 2.3 | 2.3 | 1.4 | 0.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 1.3 | 8.0 |
| snow lying at 0900UTC | 0.6 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.9 |
| hail | 3.6 | 3.3 | 3.4 | 2.2 | 1.2 | 0.1 | 0.1 | 0.1 | 0.3 | 0.9 | 1.1 | 2.4 | 18.6 |

**Table 17.4** Shannon Airport 1981-2010

### 17.3.2 Existing GHG Emissions Baseline

LA 114 Climate[17] states that a baseline climate scenario should identify, consistent with the study area for the project, GHG emissions without the project for both the current and future baseline (Do Minimum scenarios).

Data published in 2020[27] predicts that Ireland will exceed its 2019 annual limit set under EU's Effort Sharing Decision (ESD) No 406/2009/EC by 6.98 million tonnes $CO_2$ equivalent (Mt $CO_{2eq}$). For 2019, total national greenhouse gas emissions are estimated to be 59.90 million tonnes carbon dioxide equivalent (Mt $CO_2$eq) with 45.71 Mt$CO_2$eq of emissions associated with the ESD sectors for which compliance with the EU targets must be met. Agriculture is the largest contributor in 2019 at 35.3% of the total, with the transport sector accounting for 20.3% of emissions of $CO_2$ as shown in Table 17.5. The sector with the highest emissions is agriculture at 35.3% of the total, followed by transport at 20.3%.

| Category | Kilotonnes (kt) $CO_{2eq}$ | % of Total GHG Emissions |
|---|---|---|
| **Waste** | 885 | 1.5% |
| **Energy Industries** | 9,445 | 15.8% |
| **Residential** | 6,527 | 10.9% |
| **Manufacturing Combustion** | 4,589 | 7.7% |
| **Commercial Services** | 891 | 1.5% |
| **Public Services** | 887 | 1.5% |
| **Transport** | 12,187 | 20.3% |
| **Industrial Processes** | 2,260 | 3.8% |
| **F-gases** | 1,075 | 1.8% |
| **Agriculture** | 21,151 | 35.3% |
| **Total** | 59,897 | 100.0% |

**Table 17.5** GHG Emissions In Ireland 2019

GHG emissions for 2019 are estimated to be 4.5% lower than those recorded in 2018. Emission reductions have been recorded in 6 of the last 10 years. However, compliance with the annual EU targets has not been met for four years in a row. Emissions from 2016 – 2019 exceeded the annual EU targets by 0.29 Mt$CO_2$eq, 2.94 Mt$CO_2$eq, 5.57 Mt$CO_2$eq and 6.98 Mt$CO_2$eq respectively. Agriculture is consistently the largest contributor to emissions with emissions from the transport and energy sectors being the second and third largest contributors respectively in recent years.

The EPA 2019 GHG Emissions Projections Report for 2019 – 2040[28] notes that there is a long-term projected decrease in greenhouse gas emissions as a result of inclusion of new climate mitigation policies and measures that formed part of the National Development Plan (NDP) which was published in 2018 and the Climate Action Plan (CAP) published in 2019 (this plan has now been replaced by the 2021 CAP). Implementation of these measures are classed as a "*With Additional Measures scenario*" for future scenarios. A change from generating electricity using coal and peat to wind power and diesel vehicle engines to electric vehicle engines are envisaged under this scenario. While emissions are projected to decrease in these areas, emissions from agriculture are projected to grow steadily due to an increase in animal numbers. However, over the period 2013 – 2020 Ireland is projected to cumulatively exceed its compliance obligations with the EU's Effort Sharing Decision (Decision No. 406/2009/EC) 2020 targets by approximately 13.4 Mt $CO_2$eq under the "*With Existing Measures*" scenario and 12.6 Mt $CO_2$eq under the "*With Additional Measures*" scenario[28].

## 17.4 Likely Significant Impacts

For a development of this nature the construction and operational phases of the BRDA and Salt Cake Disposal Cell are considered together. Traditional separation of construction and operational phases of the BRDA and the Salt Cake Disposal Cell is not considered appropriate given that the operation of the BRDA itself involves construction of each stage elevation, which in turn will require the extraction of material from the Borrow Pit. Note that the Salt Cake Disposal Cell that is part of the development will be raised to its final height in one single phase and is not incrementally raised like the BRDA. It is therefore proposed to assess the potential climatic impacts of the overall BRDA and Salt Cake Disposal Cell development in this Section.

During the operational phase, the potential sources of GHG emissions are those associated with the Borrow Pit extraction, vehicle activity on the BRDA and internal site vehicle movements to the BRDA area where the phasing will see the height of the existing BRDA increase from Stage 10 to Stage 16 and a small number of truck movements associated with the import of topsoil to the site. In addition, the Salt Cake Disposal Cell will also be raised as part of the proposed BRDA raise.

AAL estimate there is a requirement for c. 50,000 m³ of limestone (equates to c.90,000 tonnes) per year to provide for ongoing works associated with the BRDA over the lifetime of the permitted development at the site. The extracted limestone rock will be used within the confines of the site and will not be transported off site. The Proposed Development will make the trucking of limestone rock from offsite locations unnecessary.

### 17.4.1 Construction Phase

There is the potential for a number of greenhouse gas emissions to the atmosphere during the construction phase of the development. Greenhouse gas emitting sources such as construction vehicles, generators etc., have been considered and these will give rise to $CO_2$ and $N_2O$ emissions. However, as highlighted above, the construction and operational phases will occur in tandem and thus the sum of construction and operational impacts have been reported in this chapter. The combined construction and operational phase impacts are highlighted in Section 17.4.2.

#### 17.4.1.1 Impact of Climate Change on the Construction Phase

Appropriate flood risk measures and extreme weather events have been considered as part of the construction planning. However, the potential for changes to long-term seasonal averages as a result of climate change are not considered to be as significant. Thus, in line with the methodology outlined in Table 17.1, Table 17.2 and Table 17.3, the likelihood of extreme weather and flooding is assessed to be of either very low or low likelihood and with a moderate adverse effect leading to a finding of low risk and thus a non-significant impact.

### 17.4.2 Combined Construction & Operational Phase Impact

The construction and operational phases will occur in tandem and thus the sum of construction and operational impacts have been reported below.

The GHG emissions from the construction phase of the borrow pit have been calculated based on the *2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2: Energy – Chapter 3.2 Road Transportation*[29]. The equation is based on the estimated fuel sold using the country-specific carbon contents of the fuel sold in road transport which is a Tier 2 approach. There is no Tier 3 approach as it is not possible to produce significantly better results for $CO_2$ than by using the existing Tier 2. The formula is:

$CO_2$ Emission (kg) = (Fuel usage (TJ) x fuel emission factor (kg/TJ))

In the case of the from the construction phase of the borrow pit, the total fuel usage is approximately 4,000 litres over a two-month construction period (equivalent to 0.3 TJ) which equates to a construction phase $CO_2$ emission total of approximately 22 tonnes as shown below:

$CO_2$ Emission (kg) = (Fuel usage (TJ) x fuel emission factor (kg/TJ))
$CO_2$ Emission (kg) = (0.30 TJ x 73,300 (kg/TJ))
$CO_2$ Emission (kg) = 22,300
$CO_2$ Emissions from Borrow Pit Construction Phase = 22.3 tonnes

There will also be greenhouse gas emissions to atmosphere from the operation of the BRDA, Salt Cake Disposal Cell and borrow pit extension based on the range of vehicles in operation as outlined below. For the purposes of the assessment the following activities, provided by AAL Ltd, have been included in the assessment.

<u>BRDA</u>

- 9 no. excavators – 5 assumed to operate concurrently;
- 6 no. Tractors – 5 assumed to operate concurrently;
- 2 no. Amphiroll vehicles – both assumed to operate concurrently;
- 1 no . bulldozer, and;
- 1 no. 40t Moxy.

<u>Borrow Pit</u>

- Tracked Crusher;
- Wheeled Loader;
- Dump Truck;
- Excavator Mounted Breaker, and;
- Excavator.

<u>Salt Cake Disposal Cell</u>

- Dump Truck, and;
- Excavator.

The GHG emissions from the BRDA, Salt Cake Disposal Cell and the borrow pit have been calculated based on the *2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2: Energy – Chapter 3.2 Road Transportation*[29]. The equation is based on the estimated fuel sold using the country-specific carbon contents of the fuel sold in road transport which is a Tier 2 approach. There is no Tier 3 approach as it is not possible to produce significantly better results for $CO_2$ than by using the existing Tier 2. The formula is:

$CO_2$ Emission (kg) = (Fuel usage (TJ) x fuel emission factor (kg/TJ))

In the case of the BRDA and Salt Cake Disposal Cell, the annual fuel usage is approximately 370,000 litres/annum (equivalent to 14.0 TJ/annum) which equates to an annual $CO_2$ emission total of approximately 1,000 tonnes / annum as shown below:

$CO_2$ Emission (kg) = (Fuel usage (TJ) x fuel emission factor (kg/TJ))
$CO_2$ Emission (kg) = (14.0 TJ x 73,300 (kg/TJ))
$CO_2$ Emission (kg) = 1,026,000
$CO_2$ Emissions from BRDA & Salt Cake Disposal Cell Operations = 1,026 tonnes

In the case of the borrow pit, the annual fuel usage is approximately 42,000 litres/annum (equivalent to 1.6 TJ/annum) which equates to an annual $CO_2$ emission total of approximately 117 tonnes / annum as shown below:

$CO_2$ Emission (kg) = (Fuel usage (TJ) x fuel emission factor (kg/TJ))
$CO_2$ Emission (kg) = (1.6 TJ x 73,300 (kg/TJ))
$CO_2$ Emission (kg) = 117,000
$CO_2$ Emissions from Borrow Pit Operations = 117 tonnes

Thus, the cumulative GHG emissions from the construction phase and operational phase of the BRDA, Salt Cake Disposal Cell and borrow pit is 1,165 tonnes $CO_2$ / annum.

The overall combined operational phase GHG emissions, prior to mitigation, due to the combined Construction and Operational Phase of the Proposed Development will be negative, long-term and not significant.

In order to add context to this approach to significance, it is clear that there are many activities and sectors which are contributing to net GHG emissions in Ireland. Large industrial and power GHG emissions, including AAL, are captured in the context of the EU-wide ETS which has set defined targets which are being met due to the structure of the Cap-and-Trade mechanism which places a price on carbon to ensure that GHG emissions are reduced at least cost. Most other activities such as agriculture, transport, built environment, waste and smaller industry however are included in the Effort Sharing Regulations which has set a specific target for Ireland of a 30% reduction in GHG emissions by 2030. Any activities in these sectors are now considered relevant if they lead to a quantifiable increase in greenhouse gas emissions.

Furthermore, the annual GHG emissions due to the combined Construction and Operational Phase are equivalent to the construction of 23 3-bedroom houses(30) or four transatlantic return flights(31). Similarly, the combined Construction and Operational Phase GHG emissions are equivalent to the annual carbon footprint of 93 individuals(32).

#### 17.4.2.1Impact of Climate Change on the Operational Phase

Climate change has the potential to alter weather patterns, increase sea levels and increase the frequency of rainfall in future years. As a result of this there is the potential for flooding related impacts on site in future years. A detailed risk assessment, entitled "*Risk Assessment & Break-Out Study for the Bauxite Residue Disposal Area (BRDA)"* (Golder Associated Ireland Ltd 2019) and 2021 Engineering Design Report Appendix G Breach Analysis has been undertaken as part of this EIAR and is Included as part of Appendix A for a number of potential risks taking into account the impact of climate change on sea levels and increased rainfall amounts. The risk assessment found that, after allowing for the potential effects of climate change, the risk associated with a containment breach or red mud release was either highly improbable or very unlikely depending on the scenario.

In addition, Chapter 10 (Hydrology) has investigated the likelihood of flooding and has found that there is no current or predicted flood risk (either pluvial or coastal) for the Site. Thus, in line with the methodology outlined in Table 17.1, Table 17.2 and Table 17.3, the likelihood of extreme weather and flooding leading to a containment breach or red mud release was assessed to be of very low likelihood and with a moderate to high adverse effect leading to a finding of low risk and thus a non-significant impact.

### 17.4.3 'Do Nothing' Impact

The "do nothing" scenario assumes that existing operation of the BRDA will continue in line with the conditions of the facilities' Industrial Emissions licence (IE Licence P0035-06) (issued 12/01/2018) until 2030 and thereafter will cease to operate in line with capacity being reached at the BRDA. The do-nothing scenario is unlikely to alter the current ambient environment and the current GHG emissions from the facility up to 2031.

### 17.4.4 Indirect Impact

In the event that planning permission is granted, there will be a series of 'indirect' effects. The 'indirect' scenario assumes that existing operations will continue in line with the conditions of the facilities' Industrial Emissions licence (IE Licence P0035-07) (issued 28/09/2021) in line with the capacity that will be generated by the Proposed Development.

The permitted BRDA provides a disposal area for Bauxite Residue at the Facility until c. 2030, at which time the Plant would be faced with shut down (based on the current disposal method) as there will no further permitted storage area. Having regard to the above, it is submitted that air and GHG emissions associated with the Plant will continue regardless of the current proposal until c. 2030. It is therefore considered that the ongoing operation of the Plant, post 2030, should be considered as an indirect impact in the context of the assessment of the Proposed Development. In the event that the Plant was to shut after 2030, there will still be a global demand for Alumina which will be facilitated either at another Refinery or the development of a greenfield site to produce Alumina. In either scenario, the air emissions associated with the Plant adjoining the subject site would be displaced and emitted elsewhere in the (global) environment to provide for Alumina for the manufacture of Aluminium. It is submitted that these air emissions would be similar to those experienced at Aughinish at another refinery; and, in that regard, (i) could be higher given they would be displaced from an Alumina Plant (Aughinish) that is recognised as being a leading refinery in relation to the use of best available technology and energy efficiency and (ii) likely significantly higher at a greenfield site where the construction of the plant would also be required.

AAL operates under the ETS based on Permit Register Number IE-GHG038-10361-3 with an annual allocation in 2020 of 721,490 tonnes $CO_{2eq}$ and an estimated annual emission total of 1,450,000 tonnes $CO_{2eq}$ as stated in the permit although 2020 actual emissions were verified as 1,224,809 tonnes $CO_{2eq}$. If the BRDA raise occurs it is likely that GHG will continue to be emitted in line with BAT and under the conditions of the site's IE and ETS Licences.

If continued operations at the Alumina Plant are facilitated as a result of a grant of planning permission for the Proposed Development this, in turn, would result in GHG emissions arising from continued marine transportation to and from the Alumina Plant. However, as with the likelihood of displacement to elsewhere of Alumina Plant-related GHGs (in the event the Alumina Plant was to close), there is likely to be a similar displacement to elsewhere of maritime-related GHG emissions - as a result of re-located shipping of raw material (bauxite) and of finished alumina to and from location(s) other than Aughinish (again, in the event the AAL was to close).

As regards shipping-related GHG emissions, these are increasingly being subject to controls and regulation. While, currently, international shipping-related GHG emissions fall outside the direct framework of the UN climate regime (ie the UN Framework Convention on Climate Change and the Paris Agreement) they are the subject of a Reduction Strategy overseen by the International Maritime Organization (IMO). The IMO is a UN 'Special Agency'. The IMO's initial strategy on GHG reduction was adopted (via the IMO's Marine Environment Protection Committee) in 2018. The goal of the Strategy is to reduce emissions of global shipping by at least 50% (relative to 2008 levels) by 2050. From 1 January 2018 all large ships (above 5000 gross tonnage) loading or unloading cargo at ports in the European Economic Area (EEA) must monitor and report their $CO_2$ emissions and other GHG-related information under the EU's MRV (Monitoring, Reporting and Verification) Regulation (Regulation (EU) No. 2015/757). The European Commission tries to align its strategy with that of the IMO; however, the Commission's ambitious strategy is also looking at developing specific GHG reduction targets for the maritime transport sector and at developing market-based mechanisms such as extending the EU ETS so as to cover shipping-related emissions.

## 17.5 Mitigation Measures

In order to sufficiently ameliorate the likely climate impact, a schedule of mitigation measures has been formulated for the construction and operational phase associated with the Proposed Development.

### 17.5.1 Combined Construction & Operational Phase

Vehicle traffic is expected to be the dominant source of greenhouse gas emissions as a result of the combined construction and operational phases of the Proposed Development. Vehicles, generators etc., may give rise to some $CO_2$ and $N_2O$ emissions. A series of mitigation measures will be implemented which will mitigate GHG emissions including:

- All vehicles will be required to switch off engines when stationary (no idling);
- All vehicles will be serviced and maintained to ensure emissions are minimised;
- Limestone will be sourced from the onsite borrow pit thus minimising transportation distances for the construction phase of project.

In relation to indirect emissions, AAL operates a long-established alumina extraction plant. The facility is licenced, under IE Licence P0035-07, to produce alumina from bauxite using the Bayer process. AAL operates under the ETS based on Permit Register Number IE-GHG038-10361-3 with verified emissions of 1,224,809 tonnes $CO_{2eq}$ in 2020. If the BRDA raise does proceed the facility will continue to operate beyond 2030.

The do-something scenario will lead to indirect GHG emissions from the Alumina Plant continuing beyond 2030. However, the ETS market will have to meet a target of a 61% reduction by 2030 based on annual reductions of 4.2% compared to the previous annual reduction level of 2.2% per year(13) and thus it is likely that there will be a gradual reduction in GHG emissions from the facility under the facility's ETS Permit.

Under the EU ETS, AAL will continue to be regulated and will continue to pay gradually increasing carbon cost as there are no free allocations for power generators.

In relation to the impact of climate on the Proposed Development, if appropriate, additional measures, such as an increase in berms in the BRDA, to ensure the resilience of the Proposed Development to impacts during extreme weather events will be implemented for the construction phase.

The overall combined construction and operational phase GHG emissions, after mitigation, due to the direct and indirect operational phase of the Proposed Development will be negative, long-term and not significant.

## 17.6 Cumulative Impact

The list of permitted developments outlined in Appendix A of Chapter 18 has been reviewed and there are no nearby non-ETS sources with emissions of GHG emissions of sufficient magnitude to overlap with site emissions from the BRDA, Salt Cake Disposal Cell and borrow pit and thus therefore no offsite cumulative impacts are relevant. With appropriate mitigation measures it is not predicted that any cumulative GHG impacts will occur during the construction or operational phases.

AAL has a greenhouse gas emission permit which is regulated under the EU-wide Emission Trading Scheme (ETS). Similarly, other nearby facilities under the ETS are regulated on an EU-wide basis.

The geographical location of a given development within the EU is not relevant as there is only one EU-wide target which is applicable to the ETS and thus the cumulative direct and indirect climate assessment of relevance in this context is the GHG emissions associated with the EU under the ETS

## 17.7 Residual Impact

Thus, the overall combined direct construction and operational phase GHG emissions, after mitigation, due to the combined Construction and Operational Phase of the Proposed Development will be negative, long-term and not significant. For context, the GHG emissions are equivalent to the construction of 24 3-bedroom houses [(30)] or the annual carbon footprint of 93 individuals[(32)].

In relation to indirect emissions, AAL will continue to operate under IE Licence P0035-07, to produce alumina from bauxite using the Bayer process. The do-something scenario will lead to indirect GHG emissions from AAL continuing up to 2039. However, the ETS market will have to meet a target of a 61% reduction by 2030 based on annual reductions of 4.2% compared to the previous annual reduction level of 2.2% per year[(13)] and thus it is likely that there will be a gradual reduction in GHG emissions from the facility under the facility's ETS Permit.

## 17.8 Interactions

The potential interaction between Climate and other Sections in the EIAR is primarily limited to *Air Quality*, *Population & Human Health* and *Traffic & Transportation*. The Climate Section has been prepared in consideration of and in conjunction with the relevant outputs of these Sections.

## 17.9 Monitoring

As part of the sites ETS permit (Permit No: IE-GHG038-10361-3) there is a requirement to quantify GHG emissions from the facility. This will continue to be the case following the construction of the proposed BRDA and Borrow Pit extension.

## 17.10 Difficulties Encountered In Compiling Information

No substantial difficulties were encountered in the process of compiling the climate chapter of the EIAR.

## References


(1) Framework Convention on Climate Change (1999) Ireland - Report on the in-depth review of the second national communication of Ireland

(2) Framework Convention on Climate Change (1997) Kyoto Protocol To The United Nations Framework Convention On Climate Change

(3) European Parliament & European Council (2018) Regulation On Binding Annual Greenhouse Gas Emission Reductions By Member States From 2021 To 2030 Contributing To Climate Action To Meet Commitments Under The Paris Agreement And Amending Regulation (EU) No 525/2013, 2018/842

(4) Government of Ireland (2015) Climate Action and Low Carbon Development Act

(5) Government of Ireland (2019) Climate Action Plan 2019

(6) Government of Ireland (2020). Programme for Government – Our Shared Future

(7) Government of Ireland (2020a) Draft General Scheme of the Climate Action (Amendment) Bill 2019

(8) Government of Ireland (2021) Climate Action and Low Carbon Development (Amendment) Bill 2021

(9) Limerick County Council (2019) *Climate Change Adaptation Strategy 2019-2024*

(10) Government of Ireland (2021) Climate Action Plan 2021

(11) Regulation (EU) 2021/1119 of the European Parliament and of the Council of 30 June 2021 establishing the framework for achieving climate neutrality and amending Regulations (EC) No 401/2009 and (EU) 2018/1999 ('European Climate Law')

(12) COM(2021) 555 Final Proposal for a Regulation of the European Parliament and of the Council amending Regulation (EU) 2018/842 on binding annual greenhouse gas emission reductions by Member States from 2021 to 2030 contributing to climate action to meet commitments under the Paris Agreement (dated 14/07/2021)

(13) COM(2021) 551 Final Proposal for a Directive of the European Parliament and of the Council amending Directive 2003/87/EC establishing a system for greenhouse gas emission ra allowance trading within the Union, Decision (EU) 2015/1814 concerning the establishment and operation of a market stability reserve for the Union greenhouse gas emission trading scheme and Regulation (EU) 2015/757

(14) European Commission (2013) Guidance on Integrating Climate Change and Biodiversity into Environmental Impact Assessment

(15) European Commission (2017) Environmental Impact Assessment of Projects – Guidance on the preparation of the Environmental Impact Assessment Report

(16) EPA (2017) Guidelines On Information To Be Contained in Environmental Impact Statements

(17) UKHA (2019). Design Manual for Roads and Bridges Volume 11 Environmental Assessment, Section 3 Environmental Assessment Techniques, Part 14 LA 114 - Climate

(18) IEMA (2020a) EIA Guide to: Climate Change Resilience and Adaptation

(19) IPCC (2015). AR5 Synthesis Report: Climate Change 2014

(20) Consistent Application of Risk Management for Selection of Engineering Design Options in Mega-Projects, Int. Journal of Risk & Contingency Management (Oct 2014)

(21) EPA (2010) Guidance to Licensees/COA holders on the Notification, Management and Communication of Environmental Incidents

(22) EPA (2017b). What impact will climate change have for Ireland? [Online] Available at http://www.epa.ie/climate/communicatingclimatescience/whatisclimatechange/whatimpactwillclimatechangehaveforireland/

(23) IPCC (2021). Draft AR5 Technical Report: Climate Change 2021

(24) Met Éireann (2021). Historical Rainfall Data. Available from: https://www.met.ie/climate-ireland/1981-2010/shannon.html

(25) Met Éireann (2013). Ireland's Climate: the road ahead

(26) EPA (2015b). Ensemble of regional climate model projections for Ireland (Report No. 159)

(27) EPA (2021). Ireland's National Inventory Report 2021 - Greenhouse Gas Emissions 1990 – 2019

(28) EPA (2020). Ireland's Greenhouse Gas Emissions Projections 2019 – 2040

(29) IPCC (2006) 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2: Energy – Chapter 3.2 Road Transportation

(30) Monahan, J (2011). An embodied carbon and energy analysis of modern methods of construction in housing: A case study using a lifecycle assessment framework' January 2011, Energy & Buildings 43(1) 179-188

(31) ICAO (2021) https://www.icao.int/environmental-protection/Carbonoffset/Pages/default.aspx

(32) CSO (2020) https://www.cso.ie/en/releasesandpublications/ep/p-eii/environmentalindicatorsireland2020/greenhousegasesandclimatechange/

# 18.0 INTERACTIONS AND CUMULATIVE IMPACTS

## 18.1 Introduction

This Chapter of the EIAR has been prepared by Tom Phillips + Associates and deals with likely interactions between effects predicted as a result of the proposed development.

In addition to the requirement under the *Planning and Development Regulations 2001 (as amended)* to describe the likely significant effects of the proposed development on particular aspects of the environment, it is also required to consider the interaction between impacts on different environmental factors. As such, these are assessed below.

The interaction of effects within the Proposed Development in respect of each of the environmental factors, listed in Article 3(1) of the EIA Directive, has been identified and addressed in the respective chapters in this EIAR. This chapter presents an overview of these interactions of impacts, from the Proposed Development, between the various environmental factors.

This Chapter outlines the areas where potential interactions may arise as a result of the proposed development.

The potential cumulative impact of the proposed development with other existing and/or approved projects within close proximity of the subject site has also been assessed and is discussed further below.

As noted in Chapter 1, air and GHG emissions associated with the Plant will continue regardless of the Proposed Development until c. 2030. The ongoing operation of the Plant, post 2030, is addressed as an indirect effect in the context of the assessment of the Proposed Development.

## 18.2 Inter-Relationships/ Interactions

All aspects of the environment are likely to interact to some extent and to various degrees of complexity. The likely significant interactions between factors arising from the proposed development are set out in the matrix provided as Table 18.1 below.

**Table 18.1: Matrix of Interactions Between Environmental Factors**

| | Archaeology, Architectural & Cultural Heritage | Biodiversity | Population + Human Health | Soils, Land and Geology | Landscape & Visual | Hydrology & Hydrogeology | Air Quality | Noise & Vibration | Material Assets - Waste | Material Assets - Site Services | Traffic + Transportation | Climatic Factors |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Archaeology, Architectural & Cultural Heritage** | | | | ✓ | | | | | | | | |
| **Biodiversity** | | | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | | |
| **Population + Human Health** | | | | | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | |
| **Soils, Land & Geology** | | | | | ✓ | ✓ | | | | | ✓ | |
| **Landscape & Visual** | | | | | | | | | | | | |
| **Hydrology & Hydrogeology** | | | | | | | | | | | ✓ | |
| **Air Quality** | | | | | | | | | | | ✓ | |
| **Noise & Vibration** | | | | | | | | | | | ✓ | |
| **Material Assets - Waste** | | | | | | | | | | | ✓ | |
| **Material Assets - Site Services** | | | | | | | | | | | | ✓ |
| **Traffic & Transportation** | | | | | | | | | | | | |
| **Climatic Factors** | | | | | | | | | | | | |
| | | | | | | | | | | | | |

### 18.2.1 Interactions between *Archaeology, Architecture & Cultural Heritage* and impacts associated with *Soils, Land & Geology*

Chapter 8 of the EIAR relates to Soils, Land & Geology and outlines the proposed works associated with the extension of the borrow pit at the north east of the subject site. There is potential for the proposed extraction of rock in this area to impact on previously unrecorded archaeological assets, and to alter the special interests or qualities of the asset.

Targeted archaeological test-trenching will be carried out within the proposed borrow pit area of the subject site and any features will be appropriately preserved / recorded in accordance with National Monuments Service guidelines, thereby enriching the known archaeological heritage of the County. No significant adverse effects arising from interactions between Archaeology, Architecture & Cultural Heritage and Land & Soils are anticipated.

### 18.2.2 Interactions between *Biodiversity* and impacts associated with *Soils, Land & Geology*

Arising from the proposed expansion of the borrow pit into a current greenfield area and the importation of soils to be used for the progressive restoration of the BRDA, there may be potential interactions between biodiversity and Soils, Land & Geology. Mitigation measures included within Chapter 6 include ensuring that stockpiles of soil will be appropriately managed, that areas will be surveyed by a suitably qualified ecologist prior to vegetation clearance, and that escape ramps will be provided for fauna in areas where deep excavations have taken place. No significant adverse effects arising from interactions between Biodiversity and impacts associated with Soil, Land & Geology are anticipated.

### 18.2.3 Interactions between *Biodiversity* and impacts on *Landscape & Visual*

Potential interactions between Biodiversity and impacts on Landscape & Visual are discussed in Chapters 6 and 9 of this EIAR, respectively. The existing BRDA is of little ecological value, however landscaping measures including the progressive restoration and seeding of the BRDA will establish a hedgerow pattern consistent with the surrounding landscape which will be considerably more attractive for local fauna. No significant adverse effects arising from interactions between Biodiversity and impacts associated with Landscape & Visual are anticipated.

### 18.2.4 Interactions between *Biodiversity* and impacts associated with *Waste*

Potential interactions between Biodiversity and impacts associated with Waste are addressed in chapters 6 and 13, respectively. Improper management of wastes has the potential to negatively impact upon local biodiversity. Mitigation measures such as ensuring that all wastes will be stored and managed in an appropriate manner will minimise potential impacts associated with the interaction between waste and ecology in the area. No significant adverse effects arising from interactions between Biodiversity and impacts associated with Waste are anticipated.

### 18.2.5 Interactions between *Biodiversity* and impacts on *Hydrology & Hydrogeology*

The potential for interactions between Biodiversity and Hydrology & Hydrogeology is discussed in Chapters 6 and noted in Chapter 10.

The proposed development activities within the BRDA and SCDC, the extended borrow pit and the stockpile area have potential to cause increased sediment load in local water courses which can result in impacts on aquatic ecology. Inadequate design of drainage systems can result in failures, which could lead to the release of sediment laden water and hence have potential for impact on habitats and species.

The mitigation measures proposed in relation to water management will ensure that leakages and spills will be avoided and thus negative impacts on habitats of biodiversity value including the Lower River Shannon SAC and the River Shannon and River Fergus Estuaries SPA will not arise. Therefore, no significant adverse effects arising from interactions between biodiversity and hydrology & hydrogeology are anticipated.

### 18.2.6 Interactions between *Biodiversity* and *Air Quality* Impacts

The proposed project activities have potential to impact air quality, through e.g. dust emissions. Dust emissions have potential to affect habitat and species within and in the vicinity of the subject site. The potential for interactions between Biodiversity and Air Quality impacts are discussed in Chapters 6 and 11, respectively. The mitigation measures proposed to minimise impact on air quality (including dust monitoring and dust suppression measures) will further minimise the likelihood of potential impacts on the flora, habitats and fauna on or in the vicinity of the site. No significant adverse effects arising from interactions between biodiversity and air quality impacts are anticipated.

### 18.2.7 Interactions between *Biodiversity* and *Noise & Vibration* Impacts

Noise & vibration impacts associated with the proposed development have potential for interactions with impacts on species that are on or in the vicinity of the site. This is discussed in Chapters 6 and 12, respectively. It is considered within the biodiversity chapter that the mitigation measures proposed in the noise chapter (such as the reduced time window within which blasting is to take place) will be effective in addressing the potential impacts of noise & vibration on the species that occur in the receiving environment. Therefore, no significant adverse effects arising from interactions between biodiversity and noise & vibration factors are anticipated.

### 18.2.8 Interactions between *Population & Human Health* and *Landscape and Visual Impact*

Chapter 9 of this EIAR assesses the landscape and visual impacts of the proposed development. The effect of the proposed development on surrounding views including on residential receptors, amenity areas and scenic routes have been assessed. With regard to residential receptors (i.e. nearby populations), whose sensitivity is classed as high, it is anticipated that the progressive landscaping as the stages are raised plus the overall effect on completion and restoration of the development, mean that effects will be not significant, slight or moderate neutral in the long term. Therefore, no significant adverse effects arising from interactions between population and landscape and visual impact factors are anticipated.

### 18.2.9 Interactions between *Population & Human Health* and *Waste Management*

There is potential for improper waste management arising from the proposed development to result in negative effects on population and human health. However, as a result of the mitigation measures outlined within Chapter 13 (Waste) and the commitment to adhere to relevant waste disposal guidelines, no significant adverse effects arising from interactions between population and waste factors are anticipated.

### 18.2.10 Interactions between *Population & Human Health* and *Traffic* Impacts

Chapter 7 and Chapter 14 of this EIAR address population & human health and traffic, respectively. The traffic assessment finds that the proposed development will result in a minor increase in traffic levels in the surrounding area. It is noted that the forecasted traffic levels for the N69 (the main road in the surrounding area) will still be well below the theoretical capacity for this road. It is concluded that the proposed development will have no material impact upon the operation of the local road network and as such no significant effects are anticipated to occur in terms of traffic disturbances on the local population.

Increases in traffic movements within and outside of the site give rise to impacts on air quality which have potential to negatively affect human health. This is discussed below in Section 18.2.11.

### 18.2.11 Interactions between *Population & Human Health* and *Air Quality*

Chapter 7 and Chapter 11 of this EIAR address population & human health and air quality, respectively. The impact on air quality of the proposed development has been assessed and taking into account that the overall majority of traffic movements will be internal with the closest residential dwellings to the site located at a distance greater than 900m from the boundary, there is no potential for significant impact on Human Health from air quality impacts arising from vehicle movements on the site.

The mitigation measures outlined in Chapter 11 including dust monitoring and dust suppression efforts will ensure that dust generation is minimised and that good air quality standards are maintained at all times. As a result, no significant adverse effects arising from interactions between population and air quality factors are anticipated.

#### 18.2.12 Interactions between *Population & Human Health* and *Noise & Vibration* Impacts

Chapter 7 and Chapter 12 of this EIAR address population & human health and noise & vibration, respectively. There is potential for noise & vibration impacts from internal vehicle movements and machinery, and the proposed extended borrow pit activities to negatively impact upon the surrounding population. However, as a result of the mitigation measures (such as the very limited number of blasts per year) outlined within Chapter 12, no significant adverse effects on the local population as a result of noise & vibration impacts are anticipated.

#### 18.2.13 Interactions between *Population & Human Health* and *Hydrology & Hydrogeology* Impacts

Chapter 7 and Chapter 10 of this EIAR address population & human health and noise & vibration, respectively. There is potential for hydrological and hydrogeological impacts resulting from emissions water and groundwater from the BRDA, Salt Cake Disposal Cell and the borrow pit to negatively impact upon the surrounding population. However, as a result of the mitigation measures outlined within Chapter 10, no significant adverse effects on the local population as a result of hydrological and hydrogeological impacts are anticipated.

#### 18.2.14 Interactions between *Soils, Land & Geology* and *Hydrology & Hydrogeology* impacts

The interaction between Soils, Land & Geology and Hydrology & Hydrogeology impacts is detailed in Chapters 8 and 10. Operational activities such as excavations and earth movement represent potential sources of suspended solids and may result in impacts on water quality. The ongoing management of these activities are expected to minimise the potential for impact on water quality, and no significant effects are anticipated.

The lining of the BRDA and the ongoing ground water monitoring scheme ensure that there are no significant impact on groundwater arising from the proposed development. There is no extraction proposed below the groundwater table within the proposed borrow pit extension. No significant effects are anticipated.

#### 18.2.15 Interactions between *Soils, Land & Geology* and *Landscape and Visual Impacts*

The use of rock in the construction stage raises within the BRDA facilitates the increased height and provides the additional disposal capacity of the BRDA. This ongoing raising of the BRDA structure although somewhat mitigated through the gradual revegetation of the lower side slopes will have impact on the landscape i.e. visual impact. Likewise, the use of soils and the additional planting mitigation to be applied in the closure stages enables the revegetation of the surface of the BRDA, which again will have a direct impact on the landscape, as well as indirect positive impacts on biodiversity, in terms of landscape and visual impact.

#### 18.2.16 Interactions between *Soils, Land & Geology* and *Traffic & Transportation* Impacts

As outlined in Chapter 8 – Soils, Land & Geology, the proposed construction of the BRDA and SCDC stage raises will use rock sourced solely from the Borrow Pit areas (permitted and proposed). As this Borrow Pit is located on the subject site and directly adjacent to the BRDA, the transit of this material will not impact on the surrounding traffic network.

Imported soil materials required to facilitate the progressive restoration and closure of the proposed development are considered in Chapter 14 – Traffic & Transportation, which takes account of the soil quantities required in its traffic assessment. The traffic assessment concludes that the proposed development will have no material impact on traffic or the surrounding road network and there will as such be a neutral effect. Therefore, no significant adverse effects arising from interactions between Soils, Land & Geology and Traffic & Transportation impacts are anticipated.

### 18.2.17 Interactions *Hydrology & Hydrogeology* and *Traffic & Transportation* Impacts

There is potential for leakages and spills associated with traffic movements to have interaction impacts with hydrology & hydrogeology factors. Mitigation measures including vehicle loading controls and frequent maintenance of vehicles will ensure that such potential impacts are minimised. No significant adverse effects arising from interactions between hydrology & hydrogeology and Traffic & Transportation impacts are anticipate.

### 18.2.18 Interactions between *Air Quality* and *Traffic & Transportation* Impacts

Increases in traffic movements within and outside of the site give rise to potential impacts on air quality. The interaction between air and traffic is outlined in Chapter 11. It is noted that the proposed development will utilise rock fill from the permitted/proposed borrow pit area and will thus minimise required traffic movement distances. Additional mitigation measures including watering of access roads and the provision of wheel washes will minimise windblown dust arising from traffic movements. No significant adverse effects arising from interactions between Air Quality and Traffic & Transportation factors are anticipated.

### 18.2.19 Interactions between *Air Quality* Impacts and *Climatic Factors*

Chapter 17 of the EIAR addresses climatic factors and acknowledges that there is potential for interactions between climatic factors and air quality. Emissions associated with vehicle traffic during the construction and operation of the proposed development have the potential to result in impacts on climate. The environmental assessment of climatic factors included within Chapter 17 of this EIAR has taken account of such air quality emissions. No significant adverse effects arising from interactions between air quality and climatic factors are anticipated.

### 18.2.20 Interactions between *Waste* and *Traffic & Transportation* Impacts

There is potential for waste and traffic impact interactions to arise as a result of the proposed development. Were efforts not to be made to minimise waste on site, this would result in increased traffic movements associated with its disposal. However, and as noted in Chapter 13, residual waste generation associated with the proposed development will be minimised where possible and where it is not will be dealt with through permitted waste collectors and via licensed waste facilities. No significant adverse effects arising from interactions between waste and traffic & transportation factors are anticipated

### 18.2.21 Interactions between *Traffic & Transportation* impacts and *Climatic Factors*

It is noted that the operational traffic i.e. the operation of vehicles has been identified as the dominating source of greenhouse gas emissions associated with the proposed development. The environmental assessment of climatic factors included within Chapter 17 of this EIAR has taken account of potential interactions with traffic.

Mitigation measures include arrangements to ensure that vehicles are well maintained and do not idle. With the implementation of these measures, negative effects arising from traffic on climatic factors will be minimised. No significant adverse effects arising from interactions between air quality and climatic factors are anticipated.

### 18.2.22 Interactions between *Traffic & Transportation* impacts and *Noise & Vibration*

The movement of vehicles associated with the proposed development has the potential to result in noise and vibration impacts. The noise & vibration chapter has been prepared in consideration of an in conjunction with the information contained within the traffic & transportation chapter. No significant adverse effects arising from interactions between traffic & transportation and noise & vibration factors are anticipated

## 18.3 Cumulative Impact

The potential cumulative impact of the Proposed Development with other existing and/or approved projects has also been assessed. A survey of existing and/or approved projects in the area was undertaken to determine whether the nature and scale of each of these projects could be sufficient to generate cumulative impacts of significance on the environment. The projects identified as part of this survey are listed and shown in Appendix 18.1.

For the purposes of this survey, all planning applications which were recorded on the National Planning Applications Database (DoHPLG) with extant permissions or were otherwise under consideration as of August 2021 within a c. 15km radius of the Subject Development were included.

A record of relevant planning applications within c. 15km of the planning boundary was established in August 2021. These applications were determined to constitute new or recent development of a commercial, industrial, agricultural or residential nature, which may be of significance to the cumulative assessment given their size or proximity to the subject site. The following types of applications were excluded from the final listing:

- Minor change of use applications;
- Residential applications of less than 10 no. units located greater than c. 1.5km of the subject site;
- Minor amendments to permitted applications;
- Retention applications;
- Minor signage applications;
- ESB infrastructure (i.e. substations, switch rooms and towers);
- Minor utilities works including lighting and junction upgrades;

- Developments of a scale that would not exacerbate significant environmental effects (e.g. internal reorganisation, car parking of less than 20 spaces, continuance of use, etc.);
- Developments that have become operational by the time of writing (as they have been considered in the baseline); and
- Applications that were granted prior to February 2016 as it is assumed that these permissions will have lapsed, unless otherwise stated in the Grant of Permission.

The list of projects identified in Appendix 18.1 were distributed to the expert consultants undertaking each of the assessments of environmental factors. As outlined in Table 18.1, no significant cumulative impacts were identified by any of the expert consultants.

| Environmental Factor | Potential Cumulative Impact |
|---|---|
| Archaeological, Architectural & Cultural Heritage | No significant potential cumulative impact identified |
| Biodiversity | No significant potential cumulative impact identified |
| Population & Human Health | No significant potential cumulative impact identified |
| Soils, Land & Geology | No significant potential cumulative impact identified |
| Landscape & Visual | No significant potential cumulative impact identified |
| Hydrology & Hydrogeology | No significant potential cumulative impact identified |
| Air Quality | No significant potential cumulative impact identified |
| Noise & Vibration | No significant potential cumulative impact identified |
| Material Assets – Waste | No significant potential cumulative impact identified |
| Traffic & Transportation | No significant potential cumulative impact identified |
| Material Assets – Site Services | No significant potential cumulative impact identified |
| Major Accidents & Disasters | No significant potential cumulative impact identified |
| Climatic Factors | No significant potential cumulative impact identified |

**Table 18.1:** Potential Cumulative Impacts on Environmental Factors

Notable projects which are highlighted within the EIAR chapters as having the potential to result in cumulative effects include the capacity extension at Shannon Foynes Port and the Foynes to Limerick N69 road scheme.

With regard to the cumulative impacts upon flora, habitats and fauna arising from the proposed development and, as is noted within Chapter 6 that given the context of the existing site and considering the nature of the proposed works, it is unlikely that there will be any significant cumulative impacts arising.

With regard to the cumulative visual effects, it is confirmed within Chapter 9 that the proposed development will not result in any significant cumulative effects.

With regard to cumulative traffic impacts, the N69 Foynes to Limerick scheme is also referenced, it is noted that this will result in a positive impact as it will decrease traffic volumes on N69, therefore increasing its safety performance.

As noted above, the potential for cumulative impacts between the proposed development and the relevant projects within a 15km radius (identified in Appendix 18.1) have informed the assessments undertaken by each of the expert consultants contributing to this EIAR. No significant cumulative impacts have been identified within these expert assessments.

### 18.3.1 'Do Nothing' Scenario

If the proposed project does not proceed, there will be no cumulative impacts arising.

### 18.3.2 Mitigation And Monitoring Measures

No significant cumulative impacts will arise. Therefore, no mitigation measures are required to address cumulative impacts.

# 19.0 MITIGATION AND MONITORING

The chapters contained within this EIAR have been ordered in a grouped format by their relevant topic. This chapter summarises all mitigation measures proposed in order to provide a comprehensive overview of the full range of mitigation measures discussed within each chapter.

For clarity, the *EPA Guidelines (2017)* define mitigation measures as those *"measures envisaged to avoid, prevent, reduce or, if possible, offset any identified significant adverse effects on the environment and, where appropriate, of any proposed monitoring arrangements".*

## 19.1 Archaeology, Architectural & Cultural Heritage

A programme of targeted archaeological test-trenching will be carried out within the north-eastern, previously undisturbed, section of the planning application site. These works will be carried out under licence to the National Monuments Service. If any features of archaeological potential are discovered during the course of the works further archaeological mitigation may be required, such as preservation in-situ or by record and/or monitoring. Any further mitigation will require approval from the National Monuments Service of the Department of Housing, Local Government and Heritage (DoHLGH).

As there are no potential impacts associated with development in the western and south-eastern sections of the planning application site, no mitigation is deemed necessary in these areas.

The record (both geophysical survey and photographic) presented within this assessment is considered to be an appropriate record of the current setting and extent of recorded enclosure LI010- 108.

## 19.2 Biodiversity

The overall AAL facility currently has in place an extensive infrastructure and management system to contain and/or treat potential pollutants and to ensure that emissions are within the strict license limits set down by the EPA in the IEL (P0035-07). Environmental management systems are regularly audited and proven to be effective. The Environmental Management System (EMS) covers all operations at the site and this has been designed to ensure that there is no significant adverse impacts upon the local ecology, in particular the designated Natura 2000 sites.

The mitigation measures designed by the various specialists in relation to management of potential emissions to air and water and management of noise arising from the operation of the borrow pit are summarised in Chapter 18 of the EIAR. These measures will together with the measures presented below be effective in addressing the potential impacts on the flora, habitats and fauna that occur in the receiving environment.

Biodiversity has been and is an ongoing part of the management of the AAL facility. In May 2021 AAL introduced a 5-year Biodiversity Management Plan (BMP; Appendix 6.5) for lands under their control with the following stated objectives:

1. Identify habitats, areas of local biodiversity importance and ecological corridors.
2. Strengthen the knowledge base for conservation, management and sustainable application of biodiversity.
3. Increase awareness and appreciation of biodiversity and ecosystems services.
4. To conserve and/or enhance biodiversity and ecosystem services.

The BMP sets out targets and objectives which will carry out monitoring and will implement practical conservation measures across the site. These measures will be very useful in supplementing the project specific mitigation measures presented below.

- There will be no clearance of woody vegetation in the bird breeding season from March 1st to August 31st inclusive. Prior to any vegetation removal the areas will be walked in the period directly before vegetation removal to minimise the risk of disturbance or mortality of resting mammals.
- Prior to any vegetation clearance these areas will be surveyed to check for the presence/absence of any Third Schedule Invasive Plant species. If any Third Schedule species are present these will be treated by specialist contractors under the supervision of a suitably qualified ecologist before any vegetation clearance will progress.
- Stockpiles of rockfill and soil will be inspected annually to confirm that no invasive plant species are present. If invasive plant species are present these will be treated and eradicated prior to the transport and use of material elsewhere on site.
- The fencing of the borrow pit area will include standard mammal gates to permit mammals to commute through this portion of the site. Gates/openings will be provided at approximately 250m intervals along the borrow pit fencing.
- The activity at the artificial sett will be monitored in advance and during the initial stages of the development of the borrow pit. Trail cameras will be permanently deployed at the artificial sett and the recent sett activity will be reviewed by the project ecologist and the site wildlife ranger on an annual basis prior to the commencement of the blasting schedule.
- Blasting will only be permitted between April-September, outside of the primary overwintering period for migrant waterbird species. Blasting will be relatively infrequent with c. 7 blasts per year.
- All emissions (i.e. dust, noise) during the operational phase of the proposed development will be controlled/limited (in line with licence conditions) and as such there is no potential for adverse impacts on key faunal species of the nearby designated sites as a result of emissions from the proposed development.
- There will be no significant change in the current night-time lighting regimen at the BRDA. All new or replacement lights will be shielded and downward directed with light fittings with a colour temperature in the 2700-3000K range. This is a colour temperature that is less disruptive to bats (BCT 2010). There will no permanent night-time lighting of the proposed borrow pit or the rockfill and soil stockpile areas.
- Any pooled surface water that is observed in the borrow pit site (e.g. during construction) shall be checked in the period of February-March to record the presence of any breeding Frogs. If spawn and/or tadpoles are present in an area that may be disturbed by activity at the site then Frogs, spawn and tadpoles should be translocated (under licence) by a suitably qualified ecologist to suitable sites elsewhere on Aughinish Island.

- A minimum of 15 bat boxes, including two night-roosts for Lesser Horseshoe Bats will be installed on lands within the applicant's control. The location of these boxes will be selected by a suitably qualified ecologist. These boxes will be monitored and maintained on an annual basis during the operational life of the plant.
- A total of 15 bird nest boxes (woodcrete or recycled plastic) will be installed on lands within the applicant's control. At least on Barn Owl box will be installed on the lands in the applicant's control. The design of the nest boxes and the location of their deployment will be selected by a suitably qualified ecologist. These boxes will be monitored and maintained on an annual basis during the operational life of the plant.
- During operations within the application site, deep excavations or areas of pooled water will be assessed on an ongoing basis, to either provide escape ramps for fauna or adequate mammal-proof fencing of a minimum of 1.2m in height. Any temporary excavations will be checked on a daily basis during working periods to minimise the risk of animals becoming trapped.
- All edible and putrescible wastes will be stored and disposed of in an appropriate manner. Similarly, all construction materials will be stored and stockpiled at planned locations.
- The site BMP will be reviewed after every 5-year period and a biodiversity monitoring programme agreed and implemented. Ahead of closure, a BMP for the closure phase will be produced with detailed commitments to monitor the biodiversity at an in the vicinity of the application site for the 30 years post-closure.

## 19.3 Population, Human Health and Agriculture

### 19.3.1 Population

With regard to population, no additional mitigation measures are deemed necessary over and above those outlined elsewhere in this EIAR in respect of environmental factors.

### 19.3.2 Human Health

Mitigation measures to control dust are presented in the Air Quality Chapter 11. Mitigation measures to control noise, vibration and blasting are presented in Chapter 12. Mitigation measures to manage impacts to groundwater and surface water are presented in Chapter 10. No additional mitigation measures are required over and above these to protect human health.

### 19.3.3 Agriculture

The potential impacts arising out of the proposed development on agriculture and animal health are insignificant and no additional mitigation measures are required other than those proposed elsewhere in the EIAR (Hydrology and Hydrogeology, Soils Lands and Geology, Air Quality and Noise and Vibration).

## 19.4 Soils Land and Geology

The Proposed Development design is understood to comprise the project design principles and standards adopted to avoid or prevent adverse safety and environmental effects, construction and operation to appropriate codes of practice and guidelines, and including fixed procedural commitments such as instrumentation and monitoring.

This measure provides the baseline for the impact assessment and determination of additional mitigation / management measures required to reduce and if possible offset likely significant adverse environmental effects, in support of the determined significance of effects.

### 19.4.1 Proposed Development Design

The elements of the Proposed Development design and good working practices that reduce the potential for impacts to soils, land and geology include the following:

- The design of the Borrow Pit Extension follows the Health and Safety Authority's *'Guidelines to the Safety, Health and Welfare at Work (Quarries) Regulations 2008*, (as amended), and rock will be extracted in accordance with the proposed design;
- Security fencing will be installed at the Borrow Pit Extension boundary and the gate will be locked and controlled by the Site's management. The exposed edges in the quarry will be protected with safety berms;
- Installation of the additional pump upgrades and coordinate the operational procedures required for the BRDA water management system to perform effectively during the operational inflow design event;
- Site operations at the Borrow Pit Extension will be managed in accordance with relevant health and Safety legislation (Safety, Health & Welfare at Work Act (2005, as amended); and the Mines and Quarries Act (1965, as amended)) and subsequent Quarries Regulations relating to health and safety, training, and appropriate site management;
- Regular inspections, audits, stability assessments and daily walk-over condition and stability checks are and will be carried out on the proposed BRDA Raise, SCDC Raise and Borrow Pit Extension sites in accordance with the Physical Stability Monitoring Plan (Golder 2021) and the operating procedures for the BRDA are directed by the series of stand-alone Standard Work Method (SWM) documents which are prepared, maintained and updated by the AAL BRDA Engineering Team;
- The current AAL Physical Stability Monitoring Plan, AAL Emergency Plan, AAL BRDA Operational, Safety and Maintenance (OSM) Manual and the AAL Operating Procedures for the BRDA (SWMs) will be updated to include the Proposed Development; and
- Installation works to insert as per existing practice, the piezometers, inclinometers and settlement systems in the BRDA, as the facility increases in elevation.

### 19.4.2 Additional Mitigation / Management

Additional mitigation and/or management is intended to avoid, prevent, reduce or, if possible, offset any identified significant adverse effects on the environment. The initial assessment of potential effects (taking into account the Proposed Development design) has not identified any significant adverse effects. However, to further mitigate the initial effects associated with natural resources and built structures, the following additional mitigation procedures will take place:

- Adoption of the existing AAL Environmental Management System (EMS) and other procedures (including Health and Safety) for the Aughinish Site;

- A draft Construction Environment Management Plan (CEMP) has been developed which incorporates relevant mitigation measures for environmental protection during construction to ensure the Proposed Development is compliant with the licence requirements. Enforcement of the final CEMP and licence requirements will minimise potential for environmental impact;

- The management of construction works, to be conducted by external Contractors and internal AAL alliance Contractors, will be carried out in line and in accordance with all monitoring provisions identified in the final CEMP, with the IEL requirements, with the AAL Environmental Manual for Contractors (AAL, October 2016), and with any Conditions imposed by the planning authorities;

- Installation of gabion mattress protection on the downstream slope of the SWP and LWP and increase in the elevation of existing gabion mattresses installed on the downstream slope of the OPW for the PIC along the north and west flanks of the BRDA, as detailed in the Closure Restoration and Aftercare Management Plan (CRAMP). The most recent CRAMP update was conducted by AAL during 2018 and subsequently approved by the EPA in October 2018;

- Continued layered deposition and mud farming in accordance with the Conditions of the IEL. Regular validation of the strength parameters of the deposited bauxite residue in order to achieve the target FoS, as the BRDA is raised in elevation. This is proposed to take place at a minimum of every 4 years;

- Operational procedures to avoid water collecting in the perimeter interceptor channel along Sectors E and F, when constructed in future at downstream of Inner Stage 4 and Inner Stage 6, respectively, by providing sufficient gradient to allow surface water to runoff;

- Refuelling and the addition of hydraulic oils or lubricants to vehicles or generators will take place on-site using a mobile bowser fuelling plant (i.e., no bulk fuel storage tanks will be used). This will only take place in designated areas. The designated areas will have impermeable surfaces, any fuel/oils that enter the drains will be intercepted, and the refuelling areas will be equipped with easily accessible spills kits that staff have been trained to use;

- Any waste removal will be managed and undertaken by a competent Contractor according to best practice and disposed of accordingly by a licenced waste disposal Contractor (see Chapter 13: Material Assets - Waste Management of this EIAR);

- Groundwater monitoring of existing wells on the site will be undertaken on a regular basis (refer to Chapter 10: Hydrology and Hydrogeology); and

- The AAL Health and Safety Department will ensure compliance with relevant safety and statutory legislation and best practices.

Post passive aftercare phase licensee and subsequent occupiers of the Proposed Development will be responsible for managing their activities and applying for (and working within the constraints of) any environment authorisations or consents required for their operations. If the requirements of relevant regulations, licenses and permits, e.g., Industrial Emissions Licences, under The Environmental Protection Agency Act 1992 and the Protection of the Environment Act 2003) are adhered to, then it is considered that the magnitude of impact and likelihood will be reduced to acceptable levels.

### 19.4.3 Monitoring

The future monitoring programme at the Site will include regular monitoring of water levels within the proposed BRDA, SCDC and Borrow Pit areas. Regular visual inspections of the dam wall integrity by a suitably qualified engineer will be undertaken for both the Proposed Development and regular visual inspections of the faces in the proposed Borrow Pit Extension site.

## 19.5 Landscape and Visual Impact

Landscape mitigation will be progressive and will include preliminary treatment of rock stage lifts as they are completed by hydro seeding the sloped surfaces. Hydro seeding has been used effectively on completed slopes of the existing BRDA and provides a greener and more neutral appearance to the rock slopes than the bright freshly formed limestone rock material.

**Preliminary**

Hydro seeding will typically take place once a rock stage has been filled with bauxite residue and the next rock fill has been formed. As such, there will typically be no more than one or two stages of rock stage lifts presenting in bare rock. Additionally, the hydro seeded slopes below the upper rock slopes will appear progressively more mature as each subsequent stage downwards will have established for a longer period.

**Intermediate**

The BRDA, including the permitted and proposed, is visually subdivided into three layers. The lower two layers are the permitted BRDA with each layer comprising five rock stage lifts. The upper layer is the proposed extension and comprise six rock stage lifts and the final dome.
As each layer is completed and operations move to the next layer, final restoration proposals can be implemented on the completed layer so that landscape mitigation is also progressive.

Works associated with final restoration will include both engineering and landscaping works:

- Rock fill to a depth of 500mm will be applied over each of the terraces to establish a continuous permeable rock layer connecting the rock stage lifts. This provides a surface water drainage route from the side slopes to the existing perimeter interceptor channel.

- Spillways will be constructed at eight locations around the BRDA comprising either a 6.0m or 8.0m wide channel running perpendicular to the stage lifts and incorporating sloped side that tie in with adjoining stage lifts. Spillways will be constructed in concrete and finished in gabion mattresses and will provide direct surface water drainage from the side slopes to the perimeter interceptor channel. The spillways will subdivide and disrupt the continuous geometric appearance of the BRDA side slopes.

- Ameliorated soil will be applied to a minimum depth of 400mm over the terraces and feathering into the hydro seeded rock stage slopes.

- Provision of localised areas of landscape mounds on the completed terraces and slopes of the BRDA so as to disrupt the rhythmic and continuous appearance that is an inherent characteristic of the stage raises;

- Localised landscape mounds will be formed using ameliorated subsoil and topsoil fill. These will be organic forms of varying sizes and shapes spanning two or more stages. The landscape mounds will break up and disrupt the regularity of the terraces and provide adequate depth of soil for planting that will comprise grasses and low-level herbaceous vegetation around the edges of the mounds and leading to mixed ground cover and shrubs towards the centre of the mounds. Trees will also be planted within the central areas where the soil depth is greatest.

- Landscape mounds will provided to the undeveloped stages of the permitted BRDA so as to integrate both developments.

- The interface between the side slopes and spillways will be treated using a similar approach to the landscape mounds incorporating grass and shrubs so as to provide effective integration of the spillways within the overall restored BRDA feature.

- A number of access tracks will be maintained for maintenance purposes but similarly integrated with the landscaping.

## 19.6 Hydrology

The Proposed Development design is understood to comprise the project design principles and standards adopted to avoid or prevent adverse safety and environmental effects, construction and operation to appropriate codes of practice and guidelines, and including fixed procedural commitments such as instrumentation and monitoring.

This measure provides the baseline for the impact assessment and determination of additional mitigation measures required to reduce and if possible offset likely significant adverse environmental effects, in support of the determined significance of effects.

### 19.6.1 Proposed Development Design

The elements of the Proposed Development design and good working practices that reduce the potential for impacts to the water environment include the following:

- Rock fill materials sourced from the proposed Borrow Pit site will be used for the construction of the BRDA and SCDC. No rock fill materials are anticipated to be needed to be imported for construction purposes.
- Soil and organic soil improver will be imported to implement the landscaping design for the Proposed Development. These imported materials shall be of a suitable quality that will not lead to ground contamination. Any imported material will come from a suitable source where the quality of the material will have been confirmed prior to acceptance;
- There will be no septic tanks or underground storage tanks during construction or after-use that could result in leaks to ground and the water environment. Welfare facilities are provided on the main plant site;
- The BRDA and SCDC are existing structures which are compositely lined (or demonstrable equivalent), as would be the proposed raises to both;
- Surface water runoff, bleed water, sprinkler water and seepage from the bauxite residue will continue to percolate through the rock fill stage raises and discharge into the encompassing PIC;
- There will be no requirement for a connection to a water mains or abstraction from groundwater to enable the Proposed Development; and
- There are no planned discharges to groundwater during operations from the Proposed Development, which will reduce the potential for impacts to water quality.

### 19.6.2 Additional Mitigation / Management

Additional mitigation and/or management is intended to avoid, prevent, reduce or, if possible, offset any identified significant adverse effects on the environment.

The initial assessment of potential effects (taking into account the Proposed Development design) has not identified any significant adverse effects.
However, to further mitigate the initial effects associated with natural resources and built structures, the following additional mitigation procedures will take place:

- Adoption of the existing AAL Environmental Management System (EMS) and other procedures (including Health and Safety) for the Aughinish Site;
- A draft Construction Environment Management Plan (CEMP) has been developed which incorporates relevant mitigation measures for the management of surface and groundwaters during construction to ensure the Proposed Development is compliant with the licence requirements. Enforcement of the final CEMP and licence requirements will minimise potential for impact on the surface or groundwater environment;

- The management of construction works, to be conducted by external Contractors and internal AAL alliance Contractors, will be carried out in line and in accordance with all monitoring provisions identified in the final CEMP, with the IEL requirements, with the AAL Environmental Manual for Contractors (AAL, October 2016), and with any Conditions imposed by the planning authorities;

- Mobile plant and semi-static plant, i.e., crushers and screeners, (for all AAL plant, AAL alliance Contractors and external Contractors) will be refuelled by the current method which is an AAL operated mobile double skinned fuel bowser which drives around the BRDA. Drip trays with absorbent mats are utilized.

- Any mobile plant on the Application Site shall be regularly maintained, and where plant is damaged or leaking it will be fixed or replaced immediately, as part of the ongoing operational management of the borrow area to reduce the risk of leaks;

- Haul roads will be wetted down using a water bowser (using water sourced from the onsite LWP) regularly to reduce the deposition of dust material on the surrounding road network that could get into the water environment;

- All waste generated, whether from the operation of Plant or BRDA activity, or from construction activity in the Application Site during the construction or operation of the Borrow Pit Extension, the BRDA stage raises or the SDCC raise, is the responsibility of AAL as the originator in accordance with the licence. All transport of waste off-site is undertaken by AAL via licenced waste contractors and AAL is responsible for waste document control;

- Stockpiles will be managed and monitored by the Main Contractor to minimise erosion and input of suspended solids to the water environment;

- The Main Contractor (and sub-contractor) must obtain AAL approval for all chemicals used in advance of bringing the materials on site. Safety Data Sheets must be provided, and precautions taken for environmental protection. The unloading and loading of materials shall be carried out in areas protected against spillage and runoff; and

- An emergency spill kit (including absorbers) will be used in the event of an accidental spill;

- No storage of hydrocarbons will take place on the Application Site;

- Testing of the lining system for the SCDC will take place after construction to ensure the seams are air-tight and the panels have not been damaged to ensure the potential for leakages is reduced; and

- In addition, good housekeeping during operations, by adhering to best construction practices within the development area, i.e., following the final CEMP, will mitigate against potential impacts on the surrounding environment.

Post passive aftercare phase licensee and subsequent occupiers of the Proposed Development will be responsible for managing their activities and applying for (and working within the constraints of) any environment authorisations or consents required for their operations. If the requirements of relevant regulations, licenses and permits, e.g., Industrial Emissions Licences, under The Environmental Protection Agency Act 1992 and the Protection of the Environment Act 2003) are adhered to, then it is considered that the magnitude of impact and likelihood will be reduced to acceptable levels.

### 19.6.3 Monitoring

The future monitoring programme at the Site will include regular monitoring of water levels within the proposed BRDA, SCDC and Borrow Pit areas. Regular visual inspections of the dam wall integrity by a suitably qualified engineer will be undertaken for both the Proposed Development and regular visual inspections of the faces in the proposed Borrow Pit Extension site.

Monitoring of piezometric levels will take place regularly to monitor the phreatic surface head in the bauxite residue stack. Regular water quality sampling in perimeter observation wells (OWs) and at the designated surface water locations to assess if there are any seepages.

## 19.7 Air and Climate

In order to sufficiently ameliorate the likely air quality impact, a schedule of air control measures has been formulated for the combined construction and operational phase associated with the proposed development which will continue throughout the life of the development.

### 19.7.1 Construction Phase - Air Quality

The greatest potential impact on air quality during the construction phase is PM10/PM2.5 emissions and the potential for nuisance dust.

In order to minimise dust emissions, a series of mitigation measures have been prepared in the form of a dust minimisation plan. This includes mitigation measures recommended in the Institute of Air Quality Management Guidance on the Assessment of Dust from Demolition and Construction Version 1.1(32) for sensitive receptors. Provided the dust minimisation measures outlined in the Plan (see Appendix 11.2) and site management plan are adhered to, the air quality impacts during the construction phase will not be significant.

In summary the measures which will be implemented will include:

- Hard surface roads will be swept while any un-surfaced roads will be restricted to essential site traffic.
- Furthermore, any road that has the potential to give rise to fugitive dust is regularly watered using tractor tower bowser tanks, as appropriate, during dry and/or windy conditions.
- Vehicles using site roads have their speed restricted, and this speed restriction will be enforced rigidly. The speed limit on the main access road is 50 km/hr whilst 30 km/hr is applied on internal site roads.
- Vehicles delivering material with dust potential use a dedicated wheel wash prior to leaving the site.

- Material handling systems and site stockpiling of materials are designed and laid out to minimise exposure to wind. Water misting or sprays is used as required if particularly dusty activities are necessary during dry or windy periods.

At all times, these procedures are strictly monitored and assessed. In the event of dust nuisance occurring outside the site boundary, movement of materials likely to raise dust is curtailed and satisfactory procedures implemented to rectify the problem before the resumption of operations.

### 19.7.2 Operational Phase – Air Quality/Dust

For the operational phase, the main BAT measures are the extensive network of automatic water sprinklers which mitigate against dust erosion from the BRDA and the extensive use of raised residue berms to reduce wind speed thus reducing the potential for dust migration off-site. The operation of the water sprinklers increases the moisture of the bauxite residue and thus reduce dust emissions. This mitigation measure is defined as best available technology (BAT) (BAT 49 – Water or water-based solutions spraying) as outlined in the European Commission publication "Best Available Techniques (BAT) Reference Document for the Management of Waste from Extractive Industries in accordance with Directive 2006/21/EC" (27).

In addition to the extensive network of automatic water sprinklers, activities in place include placement of residue berms on the residue surface, residue farming which roughens the surface, monitoring weather forecasts, managing residue placement and water levels as well as inspection and water washing of plant roads. In addition, there is ongoing tree and hedge planting and hydroseeding along the perimeter of the BRDA.

AAL have implemented an extensive monitoring programme of on-site emission points and ambient monitoring of PM10/PM2.5 and dust deposition as per their Industrial Emissions Licence No. P0035-07. They have recently introduced additional measures to monitor dust deposition and PM10/PM2.5 from the facility through increasing the number of monitoring locations. In addition, visual inspection patrols of the site are undertaken as part of the daily management programme.

AAL have a high compliance rate with monitoring records for PM10/PM2.5 and dust deposition, as submitted to the EPA, demonstrate continuing high compliance by AAL with the ambient standards / guidelines, with the concentrations of each of the parameter well below the relevant standard. The facility receives few complaints, and on the occasion of a dust complaint, AAL has a proactive approach to dealing with the complaint. Each complaint is carefully considered in line with a standard operating procedure to gather information and to determine the cause. The procedure includes compiling details of the complaint, a follow-up investigation and implementing any corrective actions identified.

A computational fluid dynamics (CFD) study commissioned by the facility found that the mitigation with the largest cumulative wind shadow is the application of raised berms across the site. The CFD modelling study favoured the use of raised residue berms based on the ability to have a large number of berms positioned in multiple directions to reduce wind speeds. It is the intention to continue with the use of mud berms to mitigate the potential for dust erosion from the BRDA.

The likelihood of effects from PM10/PM2.5 emissions, dust deposition and heavy metals emissions, after mitigation is applied, is low, and summarised in Table 19.1

| Quality | Significance | Duration |
|---|---|---|
| Negative | Slight | Long-term |

**Table 19.1:** Description of Effects of $PM_{10}$/$PM_{2.5}$, dust deposition and heavy metals emissions

In relation to indirect emissions, AAL operates a long-established alumina extraction plant. The facility is licenced, under IE Licence P0035-07, to produce alumina from bauxite using the Bayer process. If the BRDA raise does proceed the facility will continue to operate until at least 2039.

The do-something scenario will lead to indirect air emissions from AAL continuing up to 2039.

The overall combined operational phase air emissions, after mitigation, due to the direct and indirect operational phase of the proposed development will be negative, long-term and slight.

### 19.7.3 Odour

The process effluent treatment system at the AAL facility and the LWP in the BRDA area have a number of measures in place to mitigate against odour nuisance. The following measures are currently operational and will remain operational with the Proposed Development in place:

- An odour treatment agent and antifoam are dosed to the 35m clarifier overflow launder, which discharges into the LWP. Dosing is monitored regularly and adjusted as required. Furthermore, an odour prevention agent is added to the feedwell of the clarifier, which contains sulphide consuming bacteria.
- The LWP is cleaned out at regular intervals.
- The LWP level is managed to ensure that there is no potential to expose any solids at the base of the LWP.
- Additional biological odour control is added at regular intervals to the LWP.

In terms of the proposed development, the bauxite residue which is deposited in the BRDA is not odorous nor is the saltcake deposited in the saltcake cell. Activities associated with the quarry are also not odorous with limestone itself being non-odorous. Thus, with the proposed development in place, the facility will experience no change in the odour profile.

Indirectly, the AAL facility will continue to employ the extensive range of mitigation measures which are in place to control odour emitted from the facility. Where odour complaints are received, which do occur on an infrequent basis, the facility has developed a comprehensive complaints investigation procedure which is rapidly deployed to determine the source of the odour and, where necessary, implement corrective action.

The overall combined operational phase odour emissions, after mitigation, due to the direct and indirect operational phase of the proposed development will be negative, long-term and slight.

## 19.8 Noise and Vibration

### 19.8.1 General Operational Phase Site Activity

Best practice control measures for noise and vibration during operation are taken from BS 5228 (2009 +A1 2014) Code of Practice for Noise and Vibration Control on Construction and Open Sites Parts 1 and 2. Whist noise and vibration impacts are expected to vary during the operational phase depending on the distance between the activities and noise sensitive buildings, best practice noise and vibration control methods will be used, as necessary in order to ensure impacts at off-site noise sensitive locations are minimised.

The best practice measures set out in BS 5228 (2009) Parts 1 and 2 includes guidance on several aspects of construction site mitigation measures, including, but not limited to:

- noise control at source;
- screening, and;
- liaison with the public.

Detailed comment is offered on these items in the following paragraphs. Noise control measures that will be considered include the selection of quiet plant, enclosures and screens around noise sources, limiting the hours of work and noise and vibration monitoring, where required.

*General Comments on Noise Control at Source*

If replacing a noisy item of plant is not a viable or practical option, consideration should be given to noise control “at source”. This refers to the modification of an item of plant or the application of improved sound reduction methods in consultation with the supplier. For example, resonance effects in panel work or cover plates can be reduced through stiffening or application of damping compounds; rattling and grinding noises can often be controlled by fixing resilient materials in between the surfaces in contact.

BS5228 states that “as far as reasonably practicable sources of significant noise should be enclosed”. In applying this guidance, constraints such as mobility, ventilation, access and safety must be taken into account. Items suitable for enclosure include pumps and generators. Demountable enclosures will also be used to screen operatives using hand tools and will be moved around site as necessary.

For rock breaking activity the following measures will be implemented,

- Fit suitably designed muffler or sound reduction equipment to the rock breaking tool to reduce noise without impairing machine efficiency.
- Use a dampened bit to eliminate ringing.

For the Borrow Pit crushing activity note the following measures to be implemented:

- The crusher should be located away from noise sensitive locations;
- Hoppers to the crusher should be lined with a resilient material to dampen impact noise of rocks being loaded into the crusher;

BS5228 makes a number of recommendations in relation to "use and siting of equipment". These are all directly relevant and hence are reproduced in full. These recommendations will be adopted on site.

*"Plant should always be used in accordance with manufacturers' instructions. Care should be taken to site equipment away from noise-sensitive areas. Where possible, loading and unloading should also be carried out away from such areas."*

*"Machines that may be in intermittent use should be shut down between work periods or should be throttled down to a minimum. Machines should not be left running unnecessarily, as this can be noisy and waste energy."*

*"Plant known to emit noise strongly in one direction should, when possible, be orientated so that the noise is directed away from noise-sensitive areas. Attendant operators of the plant can also benefit from this acoustical phenomenon by sheltering, when possible, in the area with reduced noise levels."*

*"Acoustic covers to engines should be kept closed when the engines are in use and idling. The use of compressors that have effective acoustic enclosures and are designed to operate when their access panels are closed is recommended."*

*"Materials should be lowered whenever practicable and should not be dropped. The surfaces on to which the materials are being moved could be covered by resilient material."*

All items of plant should be subject to regular maintenance. Such maintenance can prevent unnecessary increases in plant noise and can serve to prolong the effectiveness of noise control measures.

*Liason with the Public*

The operator or any sub-contractors will provide proactive community relations and will notify the public and sensitive premises before each blast within the borrow pit. The operation of borrow pit equipment such as crushers and rock-breakers shall be strictly controlled so as to minimise impact at noise sensitive locations. The operation of the rock breakers and crushers is prohibited during evening time, night-time, on Sundays and Public Holidays.

Any complaints will be logged and followed up in a prompt fashion. In addition, prior to particularly noisy activity, e.g. rock breaking, blasting, etc., the site should inform the nearest noise sensitive locations of the time and expected duration of the works.

### 19.8.2 Noise, Air Overpressure & Vibration from Blasting

Air overpressure and vibration can be controlled at source by careful attention to blast design. A method statement will be produced by the blasting contractor to ensure that the noise, vibration and air overpressure impacts of blasting operations are minimised. Monitoring of air overpressure levels will be carried out at three locations agreed with the EPA which are representative of the nearest residential dwellings during blasts to ensure that acceptable levels are not exceeded. The monitoring data will enable control of the blast noise, air-overpressure and vibration levels as the data will enable blast technicians to modify blasting techniques (i.e. charge sizes) if required. As air blast intensity is a function of total charge weight, then a reduction in the total amount of explosives used can also reduce the air overpressure value.

Other practical methods to reduce noise, air overpressure and vibration are set out below.

- There shall be no more than one blast per week at the Borrow Pit.
- Restriction of hours within which blasting can be conducted (08.00 to 18.00 hours Monday to Friday).
- A public information campaign undertaken before any work and blasting starts (e.g. 24-hour written notification).
- The firing of blasts at similar times to reduce the 'startle' effect.
- On-going circulars informing people of the progress of the works.
- The implementation of an onsite documented complaints procedure.
- The use of independent monitoring by external bodies for verification of results.
- Ensuring appropriate burden to avoid over or under confinement of the charge.
- A method statement for blasting operations will be submitted to the EPA for approval prior to commencement of blasting. The method statement shall include the noise, vibration and air-overpressure control measures.
- Initial blasts to assist in blast designs and identify potential zones of influence.
- Accurate setting out and drilling;
- Appropriate charging;
- Appropriate stemming with appropriate material such as sized gravel or stone chipping;
- Delay detonation to ensure small maximum instantaneous charges;
- Decked charges and in-hole delays;
- Blast monitoring to enable adjustment of subsequent charges;
- Good blast design to maximise efficiency and reduce vibration;
- Avoid using exposed detonating cord on the surface.

## 19.9 Waste Management

The potential impacts associated with the waste management of the Proposed Development are expected to be imperceptible, therefore no additional mitigation measures are required.

Uncertainty in quantities have been primarily and appropriately addressed by making assumptions that have conservatively overestimated rather than underestimated potential effects, i.e., a precautionary assessment. Waste quantities estimated were based on previous quantities generated by the overall AAL facility for certain waste streams and furthermore, it was assumed that all wastes will be removed from site for disposal and no waste recovered or reused. Although this effect has been assessed as imperceptible, impacts would be further reduced as there is a realistic potential for waste to be recovered or reused. The level of recuse of recovery is impossible to determine at this stage and will be dependent on the detailed design and construction activities associated with the proposed development. The operations will continue to be operated in accordance with all applicable waste legislation and the conditions of the facility's IE Licence for the lifetime of the proposed development.

Monitoring would be used to address residual uncertainty by AAL and the Main Contractor evaluating the quantities of wastes generated by the Proposed Development. Best practice management measures to be applied on site are set out in Section 13.10.1 below

### 19.9.1 Waste Management Practice Measures

- All waste generated, whether from the operation of Plant or BRDA activity, or from construction activity in the Application Site during the construction or operation of the Borrow Pit Extension, the BRDA stage raises or the SDCC raise, is the responsibility of AAL as the originator in accordance with the licence. All transport of waste off-site is undertaken by AAL via licenced waste contractors and AAL is responsible for waste document control.

- The Main Contractor will implement the AAL waste management policies.

- The Main Contractor will be responsible for collecting, sorting and quantifying the wastes generated during the Proposed Development activities.

- The Main Contractor will be responsible for defining and maintaining temporary waste storage on a daily basis during the construction phase i.e., skips, bins or other appropriate waste containers. Waste materials gathered will be transferred on a daily basis by the Contractor to the designated waste storage sites in the Plant Area which are managed by AAL. These designated waste storage sites are secured and provide for appropriate segregation of waste materials.

- All waste materials which are required to be disposed off-site will be reused, recycled, recovered or disposed of at an appropriate facility which holds appropriate registration, permit or licence. AAL as waste originator shall hold copies of these registrations and will ensure that only operators with current (in date) authorisations are used.

- A waste collection docket must be issued to the waste collector by AAL. If being transported to another site, a copy of the waste permit or EPA Waste Licence for that site must be provided to the AAL waste manager. As well as a waste collection docket, a receipt from the destination of the material will be kept by AAL as part of the onsite waste management records.

- All materials being transferred from the site, whether for recycling or disposal, will be subject to a documented tracking system which can be verified and validated. This information will include the below at a minimum:

    - Date and time of removal;
    - Waste type and description;
    - EWC Code;
    - Volume of waste;
    - Name of waste collection contractor;
    - Waste collection contractor's permit number;
    - Waste collection receipt;
    - Vehicle registration number;

- Driver's details;
- Destination of waste; and
- Waste Permit / Licence number of destination facility.

- Training will be provided to all staff on waste management including prevention, segregation and best practice guidelines.

### 19.9.2 Monitoring

Waste generated will be monitored by AAL throughout the construction of the Proposed Development. Records will be kept by AAL of all waste moved from the Site.

Waste sources will be closely monitored by AAL to proactively minimise the amount of waste produced as a result of the Proposed Development.

Such monitoring supplemented by regular waste audits assist in determining the effectiveness of the site's waste management system and can be used to as one of the tools to continuously improve performance.

## 19.10 Traffic and Transportation

As the proposed development will have no material impact upon the operation of the local road network, no mitigation measures are proposed. Furthermore, it is noted that historic improvement works carried out at the L1234/ N69 junction (as noted in Section 14.3.4) appear to have mitigated previous safety issues and no further mitigation measures in this regard are deemed necessary.

It should be noted that sourcing of rock material on-site can be considered to mitigate potential impacts of the development on the local road network, with HGV movements concentrated on-site.

Furthermore, the proposed Foynes to Limerick (including Adare Bypass) scheme will provide an alternative high-quality route to the N69 between Foynes and Askeaton to the west and east of the proposed development site respectively. This scheme, which is anticipated to proceed to construction in the near future, has been forecast to produce a ca. 78% reduction in AADT on the N69 at Ballyculhane between Foynes and Askeaton (in the vicinity of the L1234/ N69 junction) in both its year of opening (2023) and year of opening + 15 years (2038).

## 19.11 Site Services

The following embedded mitigation measures are present to mitigate the effects associated with the potential direct and indirect significant impacts and effects of the Proposed Development on material assets – site services located in the vicinity of the Application Site.

- Electricity Network - In the proposed stockpile area, located in the south-east corner of the red line boundary, two (2) overhead 10 kV lines cross from south to north (green lines shown in Figure 15.2 and Figure 15.3) and one (1) overhead 38 kV line crosses from south-west to north-east (black line shown in Figure 15.2 and grey line shown in Figure 15.3).

These overhead lines currently have site protection measures in place in accordance with the ESB Networks Code of Practice for Avoiding Danger from Overhead Electricity Lines, which are maintained by AAL on a regular basis.

- Gas Infrastructure – The set-back distance and Peak Particle Velocity (PPV) limits have been agreed following consultation with GNI, as described in Chapter 8: Soils, Land and Geology.

Works on and around the gas transmission lines will be conducted in accordance with the Main Contractor's final Construction Management Plan and the GNI '*Code of Practice for Working in the Vicinity of the Transmission Network*' as well as further close consultation with appointed GNI personnel.

- Microwave Link/Channel and Cellular Networks - AAL already possess an active telecommunication site within its property which, if required, has ample capacity to provide necessary mitigation measures should retention of any microwave links be required (subject to planning permission, if applicable).

The additional mitigation measures listed below will be undertaken:

- A project specific Construction Environmental Management Plan (CEMP) has been developed and is included with this EIAR. This CEMP shall be adopted by the Contractors in the development of their Construction Stage Safety and Health documentation and Risk Assessment- Method Statements (RAMS) and be implanted during the works.
- Pre-construction consultation and authorisation will be achieved for all of the relevant infrastructure connections;
- Any works required to material assets on or around the Site will be carried out in conjunction with the relevant provider to ensure minimal disruption to the existing users;
- Any works required to material assets on or around the Site will be carried out strictly in accordance with the relevant provider's Code of Practices; and
- Efficiencies in water usage will be considered throughout the engineering design and construction phase of the Proposed Development.

### 19.11.2 Monitoring

Any monitoring associated with authorisation or consents, e.g., construction discharges or those associated with operational activities, will be incorporated into the Contactors RAMS and the CEMP and will be adhered to.

## 19.12 Major Accidents and Disasters

There are no additional mitigation measures required above those already identified in this assessment. The proposed development will be designed and built-in line with the relevant best international current practice and, as such, mitigation against the risk of major accidents and disasters will be embedded through the design.

To manage and to mitigate the effects associated with major accidents on Site, AAL will maintain existing environmental and health and safety management protocols, best practice measures, relevant preventative measures, emergency preparedness provision, which will include:

- Periodic review and implementation of recommendations in the Site's ELRA;
- Periodic review and implementation of the recommendations in the Site's HAZID study to ensure compliance with the protocols for the storage / use of heavy fuel oil, diesel, petrol, liquid petroleum gas and other pressurised gas systems in the plant area
- Periodic review and implementation of the 'External Emergency Plan For Bauxite Residue Disposal Area, Aughinish Alumina Ltd., Askeaton, Co. Limerick', in conjunction with Limerick City and County Council;
- The presence of a 24-hour security and emergency response team on site with a full functioning fire, rescue and ambulance service; and procedures for teams in relation to external emergency assistance;
- Process pipelines, storage, containment and conveyance structures are subject to an existing preventative maintenance system which includes inspection and testing;
- AAL Environmental Management System (EMS), Quality Management System (QMS), Energy Management System and International Safety Rating System (ISRS) Advanced Level 8 Safety Management System, see Section **Error! Reference source not found.**; and
- AAL Emergency Management Procedures (EMPs), see Section **Error! Reference source not found.**

### 19.12.2 Monitoring

There are no additional monitoring measures required above those already identified in this assessment. These monitoring measures specific to the prevention of major accidents and disasters include:

- Full implementation of the Physical Stability Monitoring Plan for the AAL BRDA (Golder 2021) to ensure that appropriate geotechnical monitoring instruments are installed in the BRDA (inclinometers and piezometers) to monitor deformation and hydrostatic pore water pressures in the bauxite residue and the foundation soils. These instruments are read and interpreted at recurrent intervals and compared with previous readings.

- The management of construction works, to be conducted by external Contractors and internal AAL alliance Contractors, carried out in line and in accordance with all monitoring provisions identified in the Construction Environmental Management Plan (CEMP), the IE Licence, the AAL Environmental Manual for Contractors (AAL, October 2016), and with any Conditions imposed by the planning authorities.

- The monitoring system will be prepared in advance and in place prior to the commencement of any works and be implemented and assessed during the works.

## 19.13 Climatic Factors

In order to sufficiently ameliorate the likely climate impact, a schedule of mitigation measures has been formulated for the construction and operational phase associated with the proposed development.

### 19.13.1 Construction Phase

Construction traffic is expected to be the dominant source of greenhouse gas emissions as a result of the construction phase of the development. Construction vehicles, generators etc., may give rise to some $CO_2$ and $N_2O$ emissions. A series of mitigation measures will be implemented which will mitigate GHG emissions including:

- All vehicles will be required to switch off engines when stationary (no idling);
- All vehicles will be serviced and maintained to ensure emissions are minimised;
- Limestone will be sourced from the onsite borrow pit thus minimising transportation distances for the construction phase of project.

Nevertheless, GHG emissions after mitigation, due to the construction phase of the proposed development, will be negative, short-term and significant.

### 19.13.2 Operational Phase

Operational traffic is expected to be the dominant source of greenhouse gas emissions as a result of the operation of the development. Dump trucks, excavators, generators etc., may give rise to some $CO_2$ and $N_2O$ emissions. A series of mitigation measures will be implemented which will mitigate GHG emissions including:

- All vehicles will be required to switch off engines when stationary (no idling);
- All vehicles will be serviced and maintained to ensure emissions are minimised;
- Limestone will be sourced from the onsite borrow pit thus minimising transportation distances for the operational phase of project.

In relation to indirect emissions, AAL operates a long-established alumina extraction plant. The facility is licenced, under IE Licence P0035-07, to produce alumina from bauxite using the Bayer process. AAL operates under the ETS based on Permit Register Number IE-GHG038-10361-3 with verified emissions of 1,224,809 tonnes $CO_{2eq}$ in 2020. If the BRDA raise does proceed the facility will continue to operate until at least 2039.

The do-something scenario will lead to indirect GHG emissions from AAL continuing up to 2039. However, the ETS market will have to meet a target of a 61% reduction by 2030 based on annual reductions of 4.2% compared to the previous annual reduction level of 2.2% per year[12] and thus it is likely that there will be a gradual reduction in GHG emissions from the facility under the facility's ETS Permit. Indeed, AAL have plans in place which will lead to a reduction of 35% in GHG emissions by 2030.

On an EU-wide basis, where the ETS market in 2018 was approximately 1,655 million tonnes $CO_2$eq, the impact of the emissions, which are regulated under the ETS, associated with the AAL facility is less than 0.1% of the total EU-wide ETS market, based on 2020 emissions.

The overall combined operational phase GHG emissions, after mitigation, due to the direct and indirect operational phase of the proposed development will be negative, long-term and significant.

In order to place the emissions due to the direct operational phase in context, the GHG emissions associated with the BRDA are equivalent to the construction of 23 3-bedroom houses using traditional construction methods[(29)] or four transatlantic return flights[(30)]. Similarly, the total direct operational phase GHG emissions are equivalent to the annual carbon footprint of 91 individuals[(31)].

## 19.14 Interactions

It is not proposed that any additional mitigation or monitoring to those measures outlined above will be undertaken specifically for cumulative impacts.

# 20.0 DIFFICULTIES ENCOUNTERED

Difficulties encountered are noted within three of the EIAR chapters. These difficulties are outlined below.

***Archaeology***
A small area of the planning application site was unavailable during field inspection due to the dense vegetation occupying the north-eastern portion of the planning application site.

***Waste***
As noted previously, quantities of construction waste materials may vary depending on construction methodologies. Therefore, there was difficulty in estimating waste quantities which will be dependent on the approach of the appointed Main Contractor. To resolve this, the quantities determined were based on professional experience of similar projects, a review of the wastes generated by the overall AAL facility and identification of waste streams that can be considered applicable to the ongoing construction of BRDA raises and the worst-case waste estimates assuming that the wastes will be removed from site for disposal and not recovered or reused.

***Traffic***
As outlined in Section 14.3.5, due to ongoing COVID-19 restrictions, traffic levels on the N69 national secondary road were understood to be lower than those that would have been present under pre-COVID circumstances. As a result, publicly available traffic data for the year 2019 (i.e. pre-COVID) from a local TII counter located on the N69 was used in determining typical traffic volumes and factored up to future year levels using TII growth factors. This factored traffic data provided the baseline from which the proposed development was assessed.

Notwithstanding the above, no significant difficulties, in terms of technical deficiencies or lack of sources of information, were encountered in compiling the specified information contained in the EIAR.

References to published sources of information are acknowledged in the text. In addition, studies commissioned specifically for the purposes of this Environmental Impact Assessment Report are also referenced. A list of all consultants involved in the compilation of information for this Report is provided in Chapter 1.