1.0 INTRODUCTION

1.1 Background

This document comprises an Environmental Impact Assessment Report (EIAR), prepared in support of an application made by Shanoon Resources Limited (Applicant/Shanoon/SRL) to Kilkenny County Council (KCC) for permission to recommence the mining of zinc and lead at the former Galmoy Mine, Co. Kilkenny (hereafter to be known as the Garrylaun Mine Project (Project)).

The Site is located in the townlands of Garrylaun, Castletown, Rathreagh, Rathpatrick, Whiteswall, Moneynamuck (Stopford), Rathbane and Waterland in Co. Kilkenny and in the townland of Kyle, Co. Laois. The Application Site is accessed via the regional road R435 and is situated ca. 7 km north of Johnstown, Co. Kilkenny and ca. 7 km south of Rathdowney, Co. Laois. The village of Galmoy is situated ca. 3.5 km to the south-east of the Site (Figure 1.1).

The recommencement of mining at the former Galmoy Mine intends to refurbish and utilise a number of the previous structures located at the mine plant-site. Zinc and lead ore will be mined at the Site, and transported off-site to a licenced processing facility. As processing will take place off-site, no tailings will be produced at the Site.

The mine will produce zinc and lead ore as a raw material for smelting overseas. Zinc is primarily used for galvanising in the construction and automotive industries.

The proposed development at the Site will generate between ca. 35 and 40 direct jobs. Indirect site employment of ca. 10 personnel will be generated in terms of contract drillers, suppliers of products and services such as fuel, oil and machinery suppliers.

Given that Shanoon only intends to operate an underground mine and not a tailings storage facility the company has acquired the rights to ca. 55 ha of land (outlined in blue), including the Plant Site, certain lands overlying part of the G Orebody, the Goul outfall, necessary easements and wayleaves for the restoration, use, access and maintenance of the ventilation shafts and Goul Discharge Pipeline (Figure 1.2). The overall area of the red line – Application Boundary is ca. 439 ha, which includes lands overlying the orebodies and associated mineralisation.

Key areas of information presented within this EIAR concern the nature and extent of the proposed recommencement of mining activities at the Galmoy Mine (i.e. the extraction of zinc and lead ore from underground), the character of the receiving environment and likely interactions between the two that could result in significant environmental impacts. Information presented on the receiving environment identifies the intrinsic value and importance of potential impact receptors.

The objective of this EIAR is to predict any significant impacts of the proposed recommencement of mining activities on the environment and, where applicable, propose measures to avoid, reduce or remedy them.

The EIAR reports on the findings of the Environmental Impact Assessment Report (EIAR) process and informs the Planning Authority (Kilkenny County Council), statutory consultees, other interested parties and the public in general about the likely effects of the project on the environment.

This EIAR has been prepared by Golder Associates Ireland Limited (Golder), with the support of other consultancy advisors and SRL staff. A list of the main contributors to this EIARs provided in Section 1.9 below.

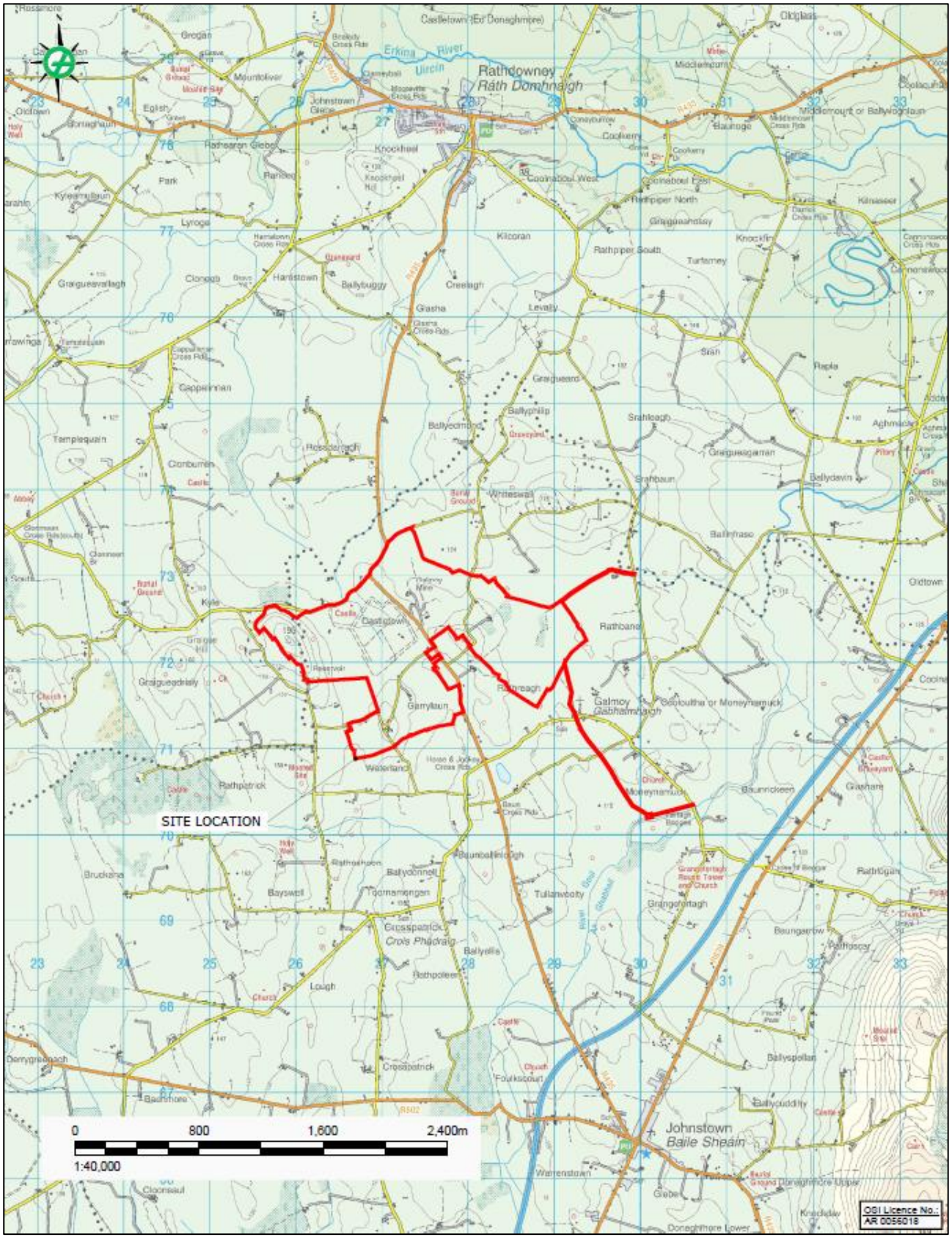

Figure 1.1: Site Location (in red)

1.2 Rationale for the Development

Shanoon Resources proposes to concurrently apply to Kilkenny County Council and Laois County Council for planning permission to recommence underground mining at the recently closed Galmoy Mine. The Kilkenny and Laois County Development Plans both support mining activities, subject to sustainable development principles, as part of each county's development strategy. It is noted that the proposed development site is located within an area of population decline as presented in both County Development Plans. As such, the recommencement of the development at the Site will create benefits to the local and national economies through the supply of jobs directly related to the operation as well as indirect benefits through the use of local suppliers and services. Based on the current economic and known mineral resources and mining reserves at Garrylaun, it is estimated that mining operations will be carried out over ca. 5 to 6 years from the recommencement of operations at the Site. The recommencement of mining and parallel continued mineral resource testing will identify any potential additional economic ore reserves that would extend the life of the proposed project. Figure 1.2 presents an aerial photograph of the mine site, showing the Application Site Boundary, lands under the control of the Applicant, easements/wayleaves and limit of current underground workings.

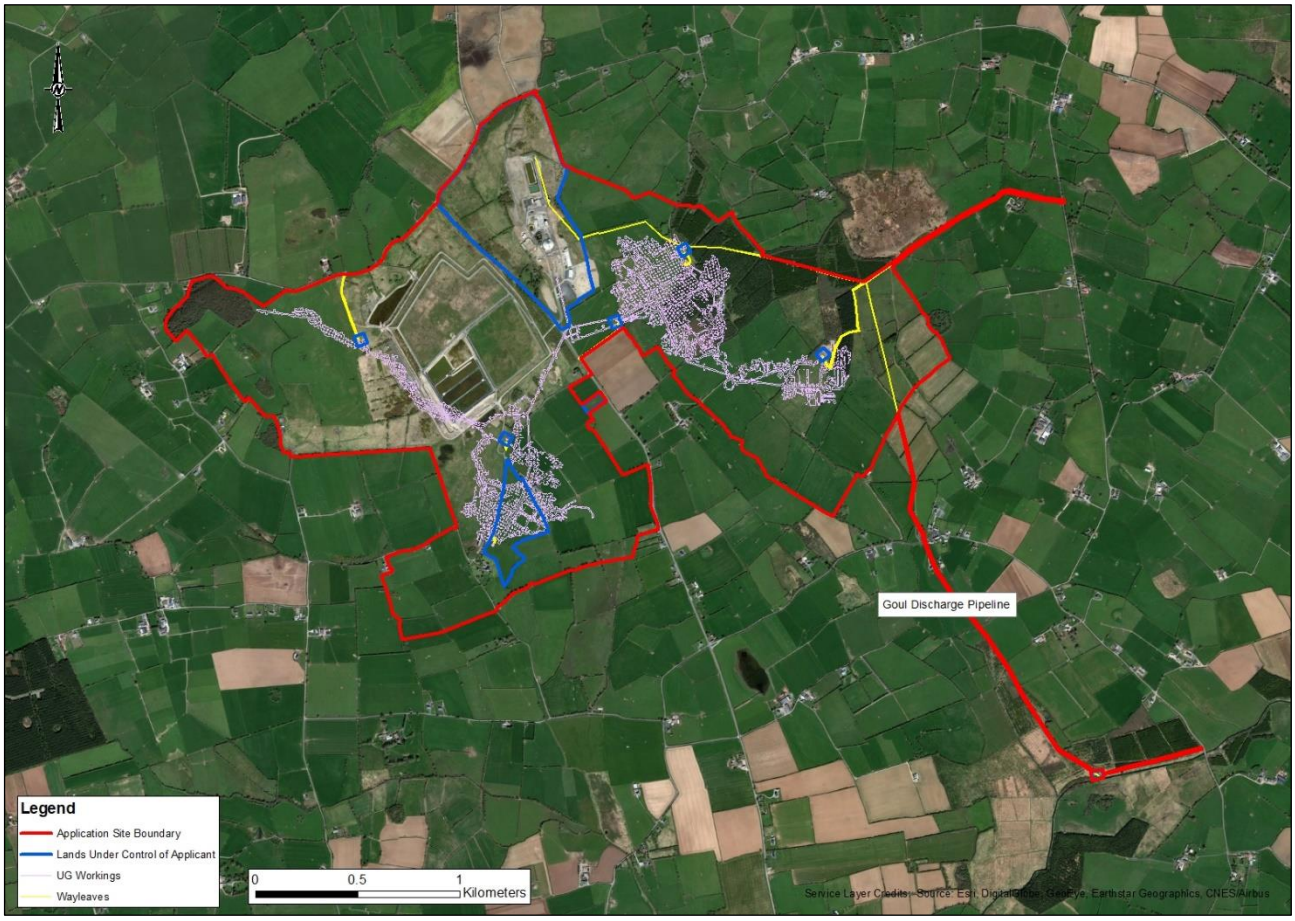

Figure 1.2: Aerial photograph showing the Application Site Boundary (red), lands under the control of the Applicant (blue), wayleaves/easements (yellow) and the limit of current underground workings

1.3 History of Mining Activity at the Site

Zinc is a commodity that is only found in sufficient quantity (and quality) in a number of locations around the globe and is currently in short supply in global terms, making the high quality zinc (and lead) found at the Site of primary importance to the economy of the country as a whole.

The underlying bedrock geology in the area comprises the Ballysteen Formation and Waulsortian Limestone Formation, both of Lower Carboniferous age. The Waulsortian plays host to the main zones of zinc and lead mineralization. Faulting in the area is complex and forms part of a regional fault trend known as the 'Rathdowney Trend' which hosts several other zinc and lead deposits in the Irish Midlands (including the Lisheen Mine ca. 9 km southwest of Garrylaun).

The predominant fault orientation is east-northeast, and both mineralization and dolomitisation are controlled by faulting. Previous exploration and mining work located several orebodies at Galmoy, including the CW, G, GE, K, K2 and R Zones. The orebodies were found between about 40 m and 150 m below ground level (bgl). While several zones were mined, premature closure combined with insufficient geological investigation and interpretation during mining has left significant resources unmined. Additional minable resources are available in the K2 (previously never mined) and in parts of the K, G and R Zones.

The proposed recommencement of mining activities at the Site for which the EIAR and Planning Application will be prepared is a fundamental part of the historic zinc and lead mining that has taken place at this location.

The original planning (and EIS) for the development of Galmoy Mine was submitted to Kilkenny County Council on 27 December 1992 (Pl. Ref. No: 92/884), with a decision for permission being granted on 27 July 1993.

An application (including EIS) to extend the underground workings was submitted on 30 September 1999 (Pl. Ref. No: 99/1371), with permission being granted on 7 May 2002.

A subsequent application (and EIS) to extend the existing underground mine was submitted on 22 May 2003 (PI. Ref. No: 03/804). Permission was granted on 01 June 2004.

An application (and EIS) to extend the underground workings into County Laois was submitted to Laois County Council on 6 March 2008 (PI. Ref. No: 08/294), with permission being granted on 7 October 2008.

Mining and processing of ore ceased at the Site in 2009, with the extraction of ore on a small scale commencing again in early 2010 before final cessation of mining in 2012 to an off-site processing facility. Planned flooding of the mine workings was completed in April 2014. The IPPC Licence Reg. No. P0517-02 for the mine was reduced in size to cover only the Tailings Management Facility (TMF) in 2015.

The previous operator of the mine at Galmoy, Galmoy Mines Ltd. held a total of five State Mining Licences (SML1, 6, 8, 8 and 10) over the life of the operation. These licences were relinquished in 2016 and a new application will be made by Shanoon.

1.4 Overview of Proposed Development

The proposed development known as the Garrylaun Mine is for the recommencement of underground mining of zinc and lead ore at the recently closed Galmoy Mine. It is intended that the works will initially be carried out within the currently known mining footprint and use facilities as previously constructed, a number of which will require refurbishment. The proposed development will involve the transportation of crushed ore off-site for processing.

The proposed extraction of ore will take place to a maximum depth of up to ca. 150 m bgl.

The design of the proposed development will continue to follow industry best practice and having regard to its underground design will adhere to the Mines and Quarries Act 1965 and all associated legislation. The preferred design will include the following:

- An up-to-date 3D topographical survey of the Mine Site in Irish Transverse Mercator;
- Re-opening of the existing portal and access decline;
- Refurbishment of the underground water pumping system and surface water treatment facilities;
- Refurbishment of the underground ventilation system, including ventilation shafts;
- Refurbishment of the surface and underground electrical supply system;
- Refurbishment and upgrading of the underground backfill system;

- Refurbishment of the existing backfill plant;
- Refurbishment of water treatment plant on surface including associated infrastructure and River Goul discharge pipeline;
- Refurbishment of the tepee; and
- Refurbishment of associated facilities and ancillary structures (both on surface and underground) for the running of an operational underground mine.

The operating processes involved in the mining of the ore will include:

- The extraction of ore from underground stopes and development drifts in a cyclical pattern using drill, blast and haul methods;
- Installation of ground support (including rock-bolts, cable-bolts, mesh and shotcrete);
- The transportation of ore by dump truck to surface along the existing decline for crushing and loading in the existing tepee; and
- Road transportation of the ore to an off-site processing facility.

Existing landscaping (including screening berms) on the Site will be left intact to mitigate against noise and potential dust emissions from operations, as well as to offer continued reduced visibility of the Site from the public road network and surrounding lands. A mine closure and restoration plan will be submitted with the EIAR.

1.5 Need for an Environmental Impact Assessment Report

Directive 2011/92/EU of the European Parliament and Council (the EIA Directive) requires the assessment of certain public and private projects which are likely to have significant effects on the environment.

Such projects by virtue of certain characteristics, such as their nature, size or location, are made subject to a requirement for development consent and an assessment with regard to these environmental effects. This process is termed an Environmental Impact Assessment (EIA).

As such the EIA, and resultant EIAR (formerly EIS), undertaken by the competent party, will include an integrated evaluation of potential impacts of a project on aspects of the natural environment, including man-made structures and amenities, and on the social environment.

The EIA Directives have been transposed into Irish law through the Planning and Development Acts, 2000 – 2016 and Part 10 of the Planning and Development Regulations, 2001 – 2015. It is noted that Directive 2014/52/EU was due to be transposed into Irish law by 16 May 2017, however this process has been delayed. Notwithstanding the above, regard has been had to this directive in the preparation of this Report and the Circular Letter Pl 1/2017 issued by the Department of Housing, Planning, Community and Local Government (15 May 2017) on the implementation of Directive 2014/52/EU.

The aim and approach of an EIAR is to:

- Identify and predict impacts of the proposed development;
- To describe the extent by which the impacts can be reduced or improved;
- To interpret and communicate information about these impacts; and
- To provide an input into the decision making and planning process.

1.6 Contents of the EIAR

The EIAR is made up of 13 chapters including this Chapter (1.0 Introduction), with tables and figures within each chapter, (additional figures are included at the end of the relevant chapters). The Non-Technical Summary is provided as a separate document.

The EIAR is to have a 'Grouped Format' structure. Each aspect of the environment will be dealt with as a separate chapter. The main volume of the EIAR will also include relevant appendices. Also included in the application will be the Planning Application Forms and Drawings.

The EIAR is divided into chapters as follows:

- **Chapter 1** forms an introduction by providing a background to the Applicant and the Site, together with outlining the structure and process of the EIA, and describing the scoping and consultation process;
- **Chapter 2** presents a description of the proposed underground mine and environs, describes the planning and policy context, and provides details on the phased operation and restoration of the mine;
- **Chapters 3 to 12** will refer to the existing environment, the development, likely impacts and mitigation measures for the development and will include details on the following:
  - Description of the receiving environment;
  - The data necessary to identify and asses the main effects which the development has on the environment;
  - Identification of likely significant adverse impacts during the development;
  - A description of the measures envisaged in order to avoid, reduce and, where possible, remedy significant adverse impacts;
  - Alternatives examined with reference to location, design and processes, as appropriate; and
  - Cumulative and residual Impacts remaining, if any.

Separate chapters referring to Interactions (**Chapter 13**) and a Non-Technical Summary (**NTS**) will also be provided.

Where appropriate, impacts arising from the existence of the development, the use of natural resources, the emission of pollutants, the creation of nuisances and the elimination of waste will be described as direct, indirect, secondary, cumulative, short, medium and long-term, permanent and temporary, positive and negative. Listed in Section 1.7 are the proposed chapter headings and contributors to same.

1.7 Structure

A pre-planning meeting and subsequent discussions were held with Kilkenny County Council on 14th December 2017 and in February and March 2018 respectively.

A pre-planning meeting was also held with Laois County Council on 22 March 2018.

The following structure and headings for the EIAR were discussed and agreed:

Chapter 1.0 Introduction;
Chapter 2.0 Project Description;
Chapter 3.0 Population and Human Health (including Agriculture and Traffic);
Chapter 4.0 Biodiversity;
Chapter 5.0 Soils and Geology;
Chapter 6.0 Water;
Chapter 7.0 Air Quality and Climate;
Chapter 8.0 Noise;
Chapter 9.0 Vibration;
Chapter 10.0 Landscape;
Chapter 11.0 Material Assets;
Chapter 12.0 Archaeology and Cultural Heritage; and
Chapter 13.0 Interactions.

1.7.1 Key Items to be addressed

A number of site visits and walkovers were conducted by the project team including; Ecologist, Archaeologist, Landscape Architect, Geologist, Mine Engineer, Engineering Geologist, Traffic Engineer and Hydrogeologist.

During these visits items of particular interest were focused on, including:

- Surface water and Groundwater;
- Traffic;
- Population and Human Health;
- Blasting and Vibration;
- Subsidence; and
- Biodiversity.

1.8 Methodology

The methods of assessment have regard to guidance documents published by the Environmental Protection Agency (EPA) and other relevant statutory bodies, namely:

- Circular Letter PL 1/2017 - Implementation of Directive 2014/52/EU on the Effects of Certain Public and Private Projects on the Environment (EIA Directive), 15 May 2017;
- Key Issues Consultation Paper - Transposition of 2014 EIA Directive (2014/52/EU) in the Land Use Planning and EPA Licencing Systems, 2 May 2017;
- Advice Notes on Current Practice in the preparation of Environmental Impact Statements (Environmental Protection Agency, 2003), and, Advice Notes for Preparing Environmental Impact Statements (Draft, Environmental Protect Agency, 2015);
- Draft - Revised Guidelines on the Information to be contained in Environmental Impact Statements. EPA 2015;
- Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment (Department of Environment, Community and Local Government, 2013);
- Environmental Management in the Extractive Industry: Guidelines for Regulators 2006;
- Department of the Environment, Quarries and Ancillary Activities, Guidelines for Planning Authorities 2004;
- Advice Notes on Current Practice in the preparation of Environmental Impact Statements (Environmental Protection Agency, 2003), and, Advice Notes for Preparing Environmental Impact Statements (Draft, Environmental Protect Agency, 2015);
- Guidelines on the Information to be contained in Environmental Impact Statements (Environmental Protection Agency, 2002), and, Revised Guidelines on the Information to be Contained in Environmental Impact Statements (Draft, Environmental Protect Agency, 2015);
- Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements (Institute of Geologist of Ireland, 2013); and
- Kilkenny County Development Plan 2014 – 2020.

Each of the 13 chapters of the EIAR follows the same general format, as follows:

- An Introduction describing the purpose of the chapter;
- A description of the Methodology used in the chapter;

- A description of the aspects of the Existing Environment relevant to the environmental topic under consideration;
- An assessment of the Impact resulting from the proposed activities at the Site;
- Recommendations for Mitigation measures to avoid, reduce, and where possible remedy any significant negative impacts identified;
- An assessment of the Residual / Likely Significant Effects which will remain assuming that the recommended mitigation measures are fully successfully implemented; and
- Cumulative Effects in relation to the proximity of other extractive industrial sites.

1.9 EIAR Study Team and Guarantee of Competency and Independence

The EIAR was completed by a project team led by Golder, 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 are provided with the relevant Appendices or Figures for each section immediately thereafter. A separate Non-Technical Summary of the EIAR is also enclosed within the inside cover.

In accordance with EIA Directive 2014/52/EU, we can confirm that experts involved in the preparation of the EIAR are fully qualified and competent in their respective field (see Section 1.9.1). Each has extensive proven expertise in the relevant field concerned, thus ensuring that the information provided herein is complete and of high quality.

The following team members were involved in the preparation of this EIAR and are included in Table 1.1 below:

Table 1.1: EIS Team Members

Chapter	Team Member
1.0 Introduction	Golder Associates
2.0 Project Description	Golder Associates & Planex
3.0 Population and Human Health (including Agriculture and Traffic)	Golder Associates & PMCE
4.0 Biodiversity	Golder Associates
5.0 Soils and Geology	Golder Associates
6.0 Water	Piteau Associates
7.0 Air Quality and Climate	Golder Associates
8.0 Noise	Golder Associates
9.0 Vibration	Golder Associates
10.0 Landscape and Visual Assessment	Macroworks
11.0 Material Assets	Golder Associates
12.0 Archaeology and Cultural Heritage	Dr Charles Mount - Heritage Services
13.0 Interactions of the Foregoing	Golder Associates

1.9.1 Description of EIAR Study Team's Background and Experience

Golder Associates

Golder is an employee-owned, global company, established in Canada in 1960, providing consulting, design, and construction services in our specialist areas of earth, environment, and the related areas of energy. One of the Golder key advantages to project delivery is the ability to provide integrated service packages by utilising multi-disciplinary teams of professionals who have the training, experience, and recognition in the fields of engineering, environmental science and information management. Golder Ireland provides a wide range of integrated service to the Extractive Industry and has been responsible for the management of site assessments, project due diligence, planning applications, environmental and social impact assessments, and closure and restoration plans. Golder Ireland provide such services to local, national, European and international projects.

Planex

A planning, economic, and environmental planning practice provided strategic planning and planning asset management services to the extractive industry, commercial sector, receivers and banking sectors.

Piteau Associates

Piteau Associates provides hydrogeological and geotechnical expertise for groundwater supply assessment and development, landfills, dam seepage, and construction dewatering. In response to ongoing high demand for geotechnical engineering and hydrogeology services on several major mine feasibility studies and operating mines, Piteau expanded its operations on a global basis, enabling Piteau to become a leader in hydrogeology, hydrology, and geochemistry.

PMCE Consultants

PMCE is an engineering consultancy which focuses on providing expert independent engineering advice in relation to Road Safety Engineering (Road Safety Audits, Historical Collision Analysis and Road Safety Inspections), Road Planning & Design and Traffic Analysis & Assessment. PMCE has extensive experience in Traffic Analysis and in preparing Traffic & Transportation Assessments (TTA), including planning applications and environmental impact assessments relating to proposed developments, continuation of existing operations, or for applications for licences in relation to quarry or waste-related sites.

Macroworks

Macro Works is a leading consultancy firm specialising in visual impact analysis and visual impact graphics. Macroworks has considerable experience in areas such as wind energy developments, civil engineering projects and the extractive industry. Macroworks has partnered Golder Associates on numerous environmental impact assessments concerning quarrying and mining related projects. Macroworks hosts a dedicated team of professionals to fulfil the key roles within their operations, including Landscape and Visual Impact Assessment, geographic information systems (GIS) and photo-simulation.

Dr Charles Mount

Dr Charles Mount is an archaeologist and environmental impact assessment consultant with more than 20 years' experience of Irish archaeology and cultural heritage. He has extensive experience of the commissioning and management of all types of archaeological services and is capable of assessing impacts on archaeology and cultural heritage at all stages of land use planning and development from site selection, through EIS/EIAR to planning condition compliance.

1.10 Consultation

In preparation for this EIAR and Planning Application, a number of written communications have been undertaken by Shanoon, Golder and its advisors. Table 1.2 below summarises the consultee list contacted in preparation of this EIS. Consultee responses have been included in Appendix 1.1.

Table 1.2: Consultee List

Duty Receptionist/Programme Officer Environmental Protection Agency (EPA) P.O. Box 3000 Johnstown Castle Estate Wexford	Development Applications Unit Department of Arts, Heritage, Regional, Rural & Gaeltacht Affairs Newtown Road Wexford
Irish Water PO Box 860 South City Delivery Office Cork City	Health & Safety Authority (HSA) The Metropolitan Building James Joyce Street Dublin 1
Department of Communications, Climate Action & Environment 29-31 Adelaide Road Dublin	Transport Infrastructure Ireland (TII) Parkgate Business Centre Parkgate Street Dublin
Kilkenny County Council John Street Kilkenny Co. Kilkenny	Laois County Council Planning Authority Aras an Chontae Laois County Council Portlaoise Co. Laois

1.11 Review of Alternatives

Consideration of Alternative Sites

Introduction

In order to consider possible alternatives to the proposed development, the key principles of sustainable development have been incorporated into this alternatives assessment, namely the consideration of social, environmental and economic factors. This provides a systematic approach to evaluate project alternatives in a robust manner, with the strengths and weaknesses of each option discussed under the principles of sustainability.

In considering alternative sites, it is a basic principle that minerals (with a defined Mineral Resource Estimate) can only be worked where they occur. As such, consideration of alternatives, can only be related to alternatives of detailed design and processing methods. As part of the EIA process, alternatives (i.e. methods) of detailed mine design and mineral processing will be considered, having regard to the specialist assessments constituting the EIAR, best practice, and principles of sustainability.

Summary of Alternatives

The proposed development and four alternatives (considered as substitute to the proposed development) are presented below:

- Alternative A (the current proposal) – The recommencement of zinc mining at the Galmoy Mine. Crushing of the extracted ore into transportable size fragments and the transfer to an off-site processing facility. The utilisation and refurbishment of existing infrastructure;
- Alternative B – The recommencement of zinc mining at the Galmoy Mine, including the resumption of a full processing and disposal operation at the mine site similar to mining practices prior to the mine's closure in 2009;
- Alternative C – Development of other established zinc resources in the locality with alternatives for ore transportation to an off-site processing plant and for on-site processing and disposal;
- Alternative D – The exploration and development of a greenfield site including ore processing and tailings disposal facility;
- Alternative E – Do nothing scenario.

Each alternative is considered below with regard to the principles of sustainability (social, environmental and economic considerations). Alternative A has been considered the preferred alternative and the proposal for this Application.

As minerals can be worked only where they occur, the extraction is geologically and geographically isolated to the proposed development site and no alternatives are viable for the location of the mine. The extraction methods chosen in this alternative will follow best practice and material will be extracted from underground stopes and development drifts in a cyclical pattern using standard drill, blast and haul methods. The ore will then be brought to the surface via dump trucks and crushed in the existing tepee.

Several methods for processing the extracted material have been considered. The preferred Alternative A is that the material will be processed at a licensed facility offsite. Alternative B, processing of the material onsite using a smaller processing plant than was historically in operation at Galmoy Mine was considered. Alternatives for storing the tailings at the Site included the reopening of the existing Tailings Management Facility (TMF), building a single cell at the plant site or pumping the tailings, mixed with cement, underground as backfill. As detailed below there was a number of criteria which appraised Alternative A as being the preferred option with less adverse environmental and more positive economic effects.

Social, Environmental and Economic Considerations of the Alternatives

Each alternative was considered with regard to the principles of sustainability (social, environmental and economic considerations). The following elaborates on this assessment of alternatives and their quality and significance of effects. Table 1.3 below provides a summary of the alternatives assessment.

Table 1.3: Assessment of Alternatives and Estimation of Magnitude of Impact

Description of Alternatives	Social Considerations	Environmental Considerations	Economic Considerations
Alternative A – Recommencement of zinc mining with processing at an off-site facility (Current proposal)	Slight adverse	Slight adverse	Significant positive
Alternative B – Recommencement of zinc mining with on-site processing and disposal	Slight adverse	Slight / Moderate adverse	Moderate positive
Alternative C – Development of other establish zinc mining operations	Slight adverse	Slight / Moderate adverse	Moderate / Significant adverse
Alternative D – Exploration and development of a greenfield site	Significant adverse	Significant adverse	Significant adverse
Alternative E – Do nothing scenario	Moderate / Significant adverse	Negligible	Significant adverse

Alternative A – Enable development of the Application Site and the recommencement of zinc mining with processing at an off-site facility (current proposal).

Social

The current proposal seeks to recommence the mining operations at the former Galmoy Mine with off-site processing of extracted ore and disposal of the resultant tailings. Social considerations for this scenario have been deemed to be *'Slight Adverse'* which is defined as an effect which will cause a noticeable change in the character without affecting sensitivities.

The Site is currently in a closure and restoration phase with limited activity. The duration of the current proposal is for a short-term (ca. 5 to 6 years) increase in activity in order for an available resource to be utilised. After this period it is proposed that the development would return to its restoration phase. The effects of the additional duration is deemed to be *'Slight'*.

Traffic and HGV movements will increase on current levels, and will be comparable to previous movements to/from the historic Galmoy Mine. Traffic is deemed to have *'Slight'* effects, as the proposed development will add additional traffic volumes to the road network, however the network is deemed to operate within its capacity during the development (Chapter 3.0).

Visual impacts will remain as they currently are on site. This proposal will utilise existing structures and refurbish any infrastructure as required. The visual impact of the development is deemed to be *'Imperceptible'*.

Environmental
The current proposal presents a low level of environmental impact as relevant mitigation measures, infrastructure and site practices which were successfully employed in the past will be utilised again to ensure activities do not have unanticipated and unwanted effects on the local environment. The proposed development will be operated and maintained to the same standard as was previously adopted at the Galmoy Mine. Activities on site will be strictly managed in accordance with ISO14001 and the Site will update and maintain an Environmental Management System (EMS). The overall environmental effects from this proposal are deemed to be *'Slight'*.

Economic
In the assessment of the economic considerations of the mining proposals it is important to acknowledge that mineral resources can only be worked where they naturally occur. The current proposal enables the recommencement of extraction operations at the Site to ensure the utilisation of a valuable local resource with good local access in terms of employment, its contribution to the local economy and revenue contributions to the local authority. As this is an established practice with existing infrastructure and markets, the magnitude of impact of this proposal has been deemed to be *'Significant'* and positive.

Alternative B – The recommencement of zinc mining at the Galmoy Mine, including the resumption of a full processing and disposal operation at the mine site similar to the mining practices prior to the mine's closure in 2009.

Social
The overall social considerations for this scenario have been deemed similar to Alternative A which is *'Slight Adverse',* which is defined as an effect which will cause a noticeable change in the character without affecting sensitivities.

Social considerations such as the duration of the development will remain as *'Slight',* as this aspect of Alternative B will be of a similar time-frame to Alternative A.

Traffic and HGV movements will increase compared to current levels. In comparison to Alternative A there will be no out-going truckloads of ore for off-site processing, however these would be replaced with HGV trips to and from the site for processing reagents and out-going zinc and lead concentrate. Traffic from Alternative B is deemed to have *'Slight'* negative effects.

This proposal will require the recommissioning of the tailings management facility or the development of a new tailings management facility. The effects of this options could be considered to range from *'Slight'* to *'Significant'* negative effects.

Environmental
Alternative B proposes to process ore and dispose of tailings on-site. All facets of this process would be managed to the highest degree and in compliance with all relevant environmental standards. However, by the nature of this proposal the significance of environmental effects could be considered to increase above Alternative A. It is considered that the alternative to process ore and dispose of tailings on-site represents *'Slight/Moderate'* negative environmental effects.

Economic
Similar to Alternative A, Alternative B also enables the recommencement of extraction operations at the Site to ensure the utilisation of a valuable local resource with good local access in terms of employment, its contribution to the local economy and revenue contributions to the local authority. However, the option for on-site processing and disposal would pose additional capital expenditure and operational costs throughout the project.

Alternative C – Development of other establish zinc mining operations.

Social
The social considerations of reopening another closed mine may be considered comparable to the current proposal (as described in Alternative A above). Therefore, the overall effects of Alternative C on the social considerations is deemed to be *'Slight'* adverse also.

Environmental
Similar to Alternative A, the scenarios to either export unprocessed ore to another off-site facility or to process ore and dispose of tailings on-site are considered to range between *'Slight'* and *'Slight/Moderate'*. Again, in these scenarios all activities would be operated in accordance with ISO 14001 and with an appropriate EMS.

Economic
Whether minerals can be worked sustainably and profitably depends on the grades of that mineral in the rock, and the trading price of the commodity at that time. Other local mines do not provide grades which would make their current extraction economically favourable. It is therefore considered that there is a *'Moderate/Significant'* adverse economic impact due to current metal prices.

Alternative D – Exploration and development of a greenfield site.

As mentioned previously, it is important to acknowledge that mineral resources can only be worked where they naturally occur. This consideration would dictate a number of social, environmental and economic factors.

Social
The alternative seeks to establish a mining operation in a greenfield site elsewhere. Social considerations for this scenario have been deemed to be *'Significant Adverse'* which is defined as an effect which, by its character, magnitude, duration or intensity alters a sensitive aspect of the environment.

Depending on the location of this greenfield site, the establishment of a mining operation in an area which may have no other industrial activities would be considered a *'Significant'* change in the character of the area. In more quieter/rural or tourism-centric areas the effects of establishing a mining operation could be considered *'Very Significant'* or even *'Profound'*.

As well as the extraction phase, the duration of this operation would include the construction phase of the processing area, tailings management facility, water treatment and discharge infrastructure and site compounds and office. The effects of this duration is deemed to be *'Significant'*.

The Alternative D scenario proposes to introduce a regular cycle of HGV movements to local roads at the new greenfield site which may be situated further away from existing linkages and motorway networks. It is assumed in this scenario that HGVs will be required to navigate local road networks prior to accessing national roads or motorways. If there is no existing industrial activities surrounding the new greenfield site than it is considered that this addition of HGV journeys would represent a *'Significant'* effect to the local roads.

Depending on the topography of the site the effects of the visual impacts can be quite variable. The adoption of good design and planting, screening and restoration measures can go a significant way towards reducing any adverse effects on visual impacts. As planting matures it would assist in the visual integration and screening of the working areas. With the correct implementation of the above mitigation measures the magnitude of visual impacts could be considered *'Slight/Moderate'* adverse. Within the immediate area of the greenfield site, there will be permanent change in Landscape, mostly due to the construction of a Tailings Management Facility. With the absence of other previous or ongoing extraction activities such a change in landscape character can be considered *'Significant'*.

Environmental
The proposal to develop a greenfield site presents a higher level of environmental impact than the recommencement of a recently closed mining operation as mitigation measures and infrastructure are currently established and in place.

Depending on the nature of the greenfield site, Alternative D could introduce nuisance sources of dust, noise and vibration.

All aspects of an activity developed at a greenfield site would be operated in accordance with ISO 14001 and an appropriate EMS. However the establishment of a new mining activity in an area which may have connectivity to a sensitive ecological receptor is considered to have *'Significant'* effects.

Economic
Through forgoing the potential at the Galmoy Mine and the pursuit of a new greenfield site it would require that the valuable resource proposed to be worked in 'Alternative A' would not be utilised.

The establishment of a new facility with associated infrastructure would be considerably more costly than 'Alternative A'. Significant cost would be incurred through the exploration for suitable deposits, the acquisition of new lands, and the generation of the relevant studies (geological, geotechnical, feasibility, environmental, ecological, social and planning). In addition, all of the economic factors would be effected by the location, size and accessibility of the underlying resource. With these considerations this proposal would result in *'Significant'* adverse economic effects.

Alternative E – Do nothing scenario.

Social
This Alternative scenario assesses a 'Do nothing scenario' where the mineral resource at the Galmoy Mine is not pursued. Overall, the effects of this Alternative on the social considerations is deemed to be *'Moderate'* adverse.

In this scenario the accessible and extractable resource of at the mine would not be utilised. This would result in a significant social loss of employment and service in the short term. The proposed development may have a relatively short operation duration however it is anticipated that the project would create ca. 35 jobs directly during the time and facilitate numerous indirect roles (contract transport drivers, suppliers of products and services such as fuel and oil suppliers, machinery suppliers and environmental monitoring). This is considered to be a *'Moderate/Significant Adverse'* social effect.

Environmental
This Alternative scenario assesses a 'Do nothing scenario' where the resource at the Galmoy Mine is not pursued. The current closure and aftercare regime would be continued and therefore the overall effects of this Alternative on the environmental considerations is deemed to be *'Negligible'*.

Economic
An accessible resource with existing associated infrastructure, such as that at the Galmoy Mine is rare. There would be a cost in not utilising and extracting the available resource given that the capital cost of setting up the site has already been incurred. The cumulative magnitude of economic impact on this alternative is deemed to be a *'Significant Adverse'* effect given the value of the resource available.

In addition, the loss of direct and indirect employment revenues is considered *'Significant Adverse'*.

Consideration of Alternative Mining Methods

The recommencement of mining at Galmoy is amenable to both open pit and underground mining methods. However, on the basis of technical, social and environmental grounds a continuation of underground mining using tried and tested extraction methods (i.e. room and pillar, drift and fill, and longhole open stoping, all in combination with backfill) at Galmoy were considered the most appropriate. Alternative underground mining methods were also considered including open stoping (with no backfilling) and caving. However, these methods were rejected for reasons of low extraction and certainty of subsidence respectively.

Access to the ore by way of existing mine infrastructure (and extension of same as required) was evaluated as being the most technically viable and economic option. Ore transportation by truck to surface was also considered to be the most economically and technically viable option, given the projected life of the mine. Alternatives rejected included a new surface decline and shaft access.

Various options with respect to ventilation were reviewed in order to minimise additional ventilation installations. As previously operated, all ventilation shafts will be utilised to ensure that there will not be an increase in emissions resulting from the proposed development. The refurbishment of the ventilation shafts will also provide a secondary means of egress from the underground workings.

Consideration has been given to the methods by which the mine will manage the collection, pumping and treatment of mine inflow water (Chapter 6.0). It is proposed to use probe-hole drilling to intersect clean mine water inflow in order that it can be segregated underground and pumped to surface as clean water.

1.12 Difficulties in Compiling the Specified Information

No difficulties were encountered in the preparation of this EIAR and planning application.

References

- EU Environmental Impact Assessment Directive (Council Directive 85/337/EEC).
- EU (2001). Guidance on EIA Scoping.
- Guidelines on the Information to be contained in Environmental Impact Statement. Environmental Protection Agency, Johnstown Castle Estate, Co. Wexford, Ireland. EPA. 2002.
- Advice Notes on Current Practice in the preparation of Environmental Impact Statements (Environmental Protection Agency, 2003).
- Department of the Environment, Quarries and Ancillary Activities, Guidelines for Planning Authorities 2004.
- Environmental Management in the Extractive Industry: Guidelines for Regulators 2006.
- Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment (Department of Environment, Community and Local Government, 2013).
- Institute of Geologist of Ireland (2013). Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements.
- Draft - Revised Guidelines on the Information to be contained in Environmental Impact Statements. EPA 2015.
- Advice Notes on Current Practice in the preparation of Environmental Impact Statements (Environmental Protection Agency, 2003), and, Advice Notes for Preparing Environmental Impact Statements (Draft, Environmental Protect Agency, 2015).
- Key Issues Consultation Paper - Transposition of 2014 EIA Directive (2014/52/EU) in the Land Use Planning and EPA Licencing Systems, 2 May 2017.
- Circular Letter PL 1/2017 - Implementation of Directive 2014/52/EU on the Effects of Certain Public and Private Projects on the Environment (EIA Directive), 15 May 2017.
- Laois County Council. Laois County Development Plan 2017 – 2023.
- Kilkenny County Council. Kilkenny County Development Plan 2014 – 2020.
- Kilkenny County Council. Appendix C – Landscape Character Assessment, Kilkenny County Development Plan 2008 - 2014.
- Archaeological Survey of Ireland Sites and Monuments Database: http://webgis.archaeology.ie/historicenvironment/. Accessed 10 January 2018.
- Environmental Protection Agency Envision Map Viewer:
- https://gis.epa.ie/EPAMaps/. Accessed 19 December 2017.
- Geological Survey of Ireland Datasets Public Viewer: http://dcenr.maps.arcgis.com/apps/MapSeries/index.html?appid=a30af518e87a4c0ab2fbde2aaac3c228 Accessed 19 December 2017.
- National Parks and Wildlife Service Mapviewer: http://webgis.npws.ie/npwsviewer/ Accessed 19 December 2017.

2.0 PROJECT DESCRIPTION

2.1 Company Background

Shanoon Resources Limited (SRL / Shanoon) (the Applicant) is an Irish registered company which was formed in 2016. The company is actively prospecting for and plans to develop Zinc-Lead projects in the Irish Base Metal Province. The company holds three prospecting licences along the Rathdowney Trend which includes the now closed Galmoy Mine (the 'Site' referring to the Plant Site, underground workings and associated infrastructure). The company has an experienced management team (ex. Lisheen Mine) with a proven track record in developing and operating base metal mines both in Ireland and overseas. SRL is well resourced and has access to the necessary skills and resources to develop and operate an underground mine. The Applicant has acquired, reviewed and applied the necessary environmental, geological, geotechnical, hydrogeological and other technical data for the successful development, operation and closure of the Garrylaun Project.

The Applicant commits to re-open and operate the mine in accordance with social responsibility and sustainability practices and current best practice for the mining industry, as set out in the Safety, Health and Welfare at Work (Extractive Industries) Regulations 1997 - S.I. No. 467 of 1997 (the Extractive Industries Regulations give effect to EU Directives on health and safety in the drilling industry and in mines and quarries. The regulations do not repeal any of the existing legislation but rather complemented it (Mines and Quarries Act 1965 and Safety, Health and Welfare at Work [Offshore Installations] Act 1987)), and the Safety, Health and Welfare at Work (General Application) Regulations 2007 - S.I. No. 299 of 2007 (however, some sections of these regulations do not apply to mining). The Applicant also commits to operate in accordance with the Guidelines on Environmental Management in the Extractive Industries published by the Environmental Protection Agency (EPA, 2006), and in compliance with the Guidelines to the Safety, Health and Welfare at Work (Quarries) Regulations 2008.

This chapter provides details on the proposed recommencement of mining at the Site, which entails the dewatering and re-opening of the underground zinc-lead mine (workings) at Galmoy through a previously developed portal/decline to access and recover unmined zinc and lead ore from a number of areas identified by Shanoon during a review of the property. This chapter also provides details on proposed extraction activities at the Site in the context of National, Regional and Local Planning policies and guidelines.

2.2 Site Location and Context

The Site is located in the townlands of Garrylaun, Castletown ('Plant Site'), Rathreagh, Rathpatrick, Whiteswall, Moneynamuck (Stopford), Rathbane and Waterland in Co. Kilkenny and in the townland of Kyle, Co. Laois, (Figure 2.1). The Site is accessed via the regional road R435.

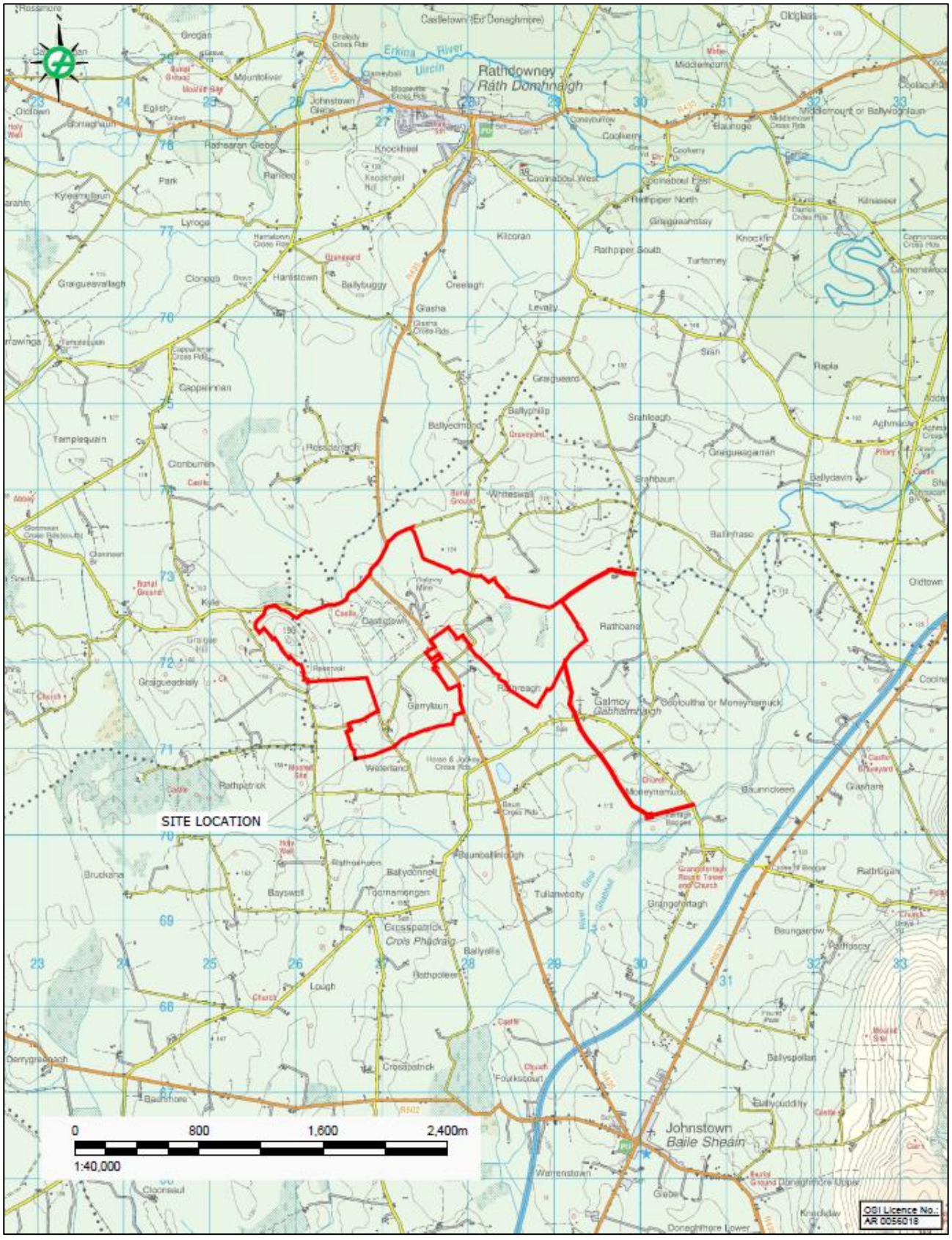

Figure 2.1: Site Location Plan (in red)

The ownership extent under Reg. Ref. 92/884 was ca. 216 hectares (ha) of which ca. 60 ha comprised the surface developments. Given that Shanoon only intends to operate an underground mine and not a tailings storage facility the company as acquired the rights to ca. 55 ha of land (outlined in blue), including the Plant Site, certain lands overlying part of the G Orebody, the Goul outfall, necessary easements and wayleaves for the restoration, use, access and maintenance of the ventilation shafts and Goul Discharge Pipeline (Figure 2.2). The recommencement of mining at Galmoy intends to refurbish and utilise a number of the previous structures located at the mine Plant Site. The overall area of the red line – Application Boundary is ca. 439 ha, which includes lands overlying the orebodies and associated mineralization.

The underlying bedrock geology in the area comprises the Ballysteen Formation and Waulsortian Limestone Formation, both of Lower Carboniferous age. The Ballysteen Formation is composed of dark, argillaceous bioclastic limestones and shales. The Waulsortian Limestone Formation is composed of a pale-grey massive limestone which is regionally dolomitised and is in faulted contact with the underlying Ballysteen Formation. The Waulsortian plays host to the main zones of zinc and lead mineralization. Faulting in the area is complex and forms part of a regional fault trend known as the 'Rathdowney Trend' which hosts several other zinc and lead deposits in the Irish Midlands (including the Lisheen Mine ca. 9 km to the southwest). The predominant fault orientation is east-northeast, and both mineralization and dolomitisation are controlled by faulting. Previous exploration and mining work located several orebodies ('zones') at Galmoy, including the CW, G, GE (Garrylaun), K, K2 and R orebodies (Figure 2.2). The orebodies occur between ca. 40 m and 150 m below ground level (bgl). While several zones were mined, premature closure left significant resources unmined, with additional minable resources available in the K2 (previously never mined) and in parts of the K, G and R orebodies.

Figure 2.2: Aerial photograph showing Application site area (red) and lands under control of the Applicant (blue line)

The mine will produce zinc and lead ore as a raw material for off-site processing and smelting overseas. Zinc is primarily used for galvanising in the construction and automotive industries. The zinc and lead ore will be transported off-site for processing at a licenced facility, with no processing of ore on-site to form concentrate (and therefore tailings).

The lands surrounding the Plant Site (i.e. the existing brownfield mine site, Figure 2.2) can be characterised as rural in nature, with land uses in the area being agricultural and single-house residential. The lands contiguous to the boundaries of the Plant Site are in agricultural use, predominantly pasture lands. There are scattered residential properties in the vicinity of the Plant Site, primarily concentrated along the Regional Road R435 and the local tertiary road network. The now closed Tailings Management Facility (TMF) and associated infrastructure is located immediately to the west of the Plant Site (across the R435, Figure 2.2).

According to the National Parks and Wildlife Service's (NPWS) database of designated nature conservation areas, the Site is located within 15 km of five SAC's (Special Area of Conservation) and one SPA (Special Protection Area). In addition, there are eight pNHAs (proposed Natural Heritage Area) within 10 km of the Site.

Topography in the vicinity of the Site is predominantly undulating with pronounced ridges running in a southeast-northwest direction interspersed with flat valleys and is best described as undulating '*lowland farmland',* which generally drains to the north towards the River Erkina catchment and south towards the River Goul catchment, with the Goul being a tributary of the Erkina and the Erkina in turn being a tributary of the River Nore. Topography is ca. 130 to 150 m OD at the Site and rises to 196 m OD in the west at Knockdrinnia Hill. Flat valley basins are a significant feature of the area, being drained by ditches and a stream network (including the Glasha Stream) flowing northwards which joins the River Erkina at Rathdowney. To either side of Knockdrinnia Hill the lands slope gently away to the flat valley basins which are a significant feature of both the Plant Site and the TMF. One basin forms part of a larger area of recently drained marshland pasture which extends to Whiteswall House and the county road to the east. The other valley basin is flanked to the west by the slopes of Knockdrinnia Hill. The low-lying area east of Knockdrinnia Hill is well drained by ditches constructed during the construction of the TMF.

2.3 General Description of Development

The proposed development to be known as the 'Garrylaun Mine/Project' is for the recommencement of underground mining of zinc and lead ore at the recently closed Galmoy Mine, from a number of areas including the K2 and R Orebodies, and the G East Zone (Garrylaun). It is intended that the works will initially be carried out within the existing mining footprint and use facilities as previously constructed, a number of which will require refurbishment. As mentioned previously, zinc and lead ore will be transported off-site to a licenced processing facility. As processing will take place off-site, no tailings will be produced at the Site.

Initially ca. 25,000 tonnes of soils and rock will be removed from the portal and decline to allow access into the mine workings. This material will be stockpiled on-site and used as future backfill material (i.e. backfilling of the entrance decline and portal) following cessation of mining.

Mining operations will be highly mechanised, consisting of drilling, blasting and transporting of ore to a crusher located on surface in the existing tepee. The equipment underground will include:

- Multi-boom drilling rigs;
- Load haul dump (LHD) units;
- Mine haulage trucks;
- Explosives loading vehicle; and
- Roof bolting machine, shotcreting machine and other production and service equipment (e.g. ancillary service and construction equipment, pump stations and electrical sub-stations).

Equipment servicing and repairs will be carried out on surface in a dedicated workshop, with routine consumable supplies stored in an adjoining warehouse. Mobile maintenance vehicles equipped with a crane, air compressor, welding machine and tools will carry out equipment repairs underground as required.

The majority of the workings will be backfilled with a combination of backfill and cement-rockfill. The backfill, together with pillars, rock bolts and shotcrete will provide ground support to the underground workings.

The proposed extraction of ore will take place to a maximum depth of up to ca. 150 m bgl.

The design of the proposed development will continue to follow industry best practice and having regard to its underground design will adhere to the Mines and Quarries Act 1965; the Guidelines to the Safety, Health and Welfare at Work (Quarries) Regulations 2008 and all associated legislation. The preferred design will include the following:

- Re-opening of the existing portal and access decline;
- Refurbishment of the underground water pumping system and surface water treatment facilities;
- Refurbishment of the underground ventilation system, including ventilation shafts (one of which will act as a secondary means of egress);
- Refurbishment of the surface and underground electrical supply system;
- Refurbishment of the existing backfill plant;
- Refurbishment and upgrading of the underground backfill system;
- Refurbishment of water treatment plant on surface including associated infrastructure and River Goul discharge pipeline. A second point of discharge is also planned to the north of the Site;
- Refurbishment of the tepee (i.e. the existing large covered storage area on surface where ore from underground will be sized and loaded into trucks for road transport to an off-site facility for processing); and
- Refurbishment of associated facilities (including offices, storerooms, workshops and mine change-house) and ancillary structures (both on surface and underground) for the safe running of an operational underground mine.

The operating processes involved in the mining of the ore will include:

- The extraction of ore from underground stopes and development drifts in a cyclical pattern using drill, blast and haul methods;
- Installation of ground support (including rock-bolts, cable-bolts, mesh and shotcrete);
- The transportation of ore by dump truck to surface along the existing decline for crushing and loading in the existing tepee; and
- Road transportation of the ore to an off-site processing facility.

Existing landscaping (including screening berms) on the Site (and around ventilation shafts) will be left intact to mitigate against noise and potential dust emissions from operations, as well as to offer continued reduced visibility of the Site from the public road network and surrounding lands.

The existing Closure, Restoration & Aftercare Management Plan (CRAMP) for the Galmoy Mine will be adapted, updated and agreed with the EPA for the recommencement of mining at the Site.

2.4 Employment & Operating Hours

An initial mining schedule has been developed for the Project using a JORC compliant mineral resource estimate of ca. 2.3Mt, providing a potential life-of-mine (LOM) of ca. 10 to 12 years (including a ramp-up and initial dewatering period of ca. 6 to 9 months), at a production rate of ca. 200,000 to 250,000 t/a.

Based on the LOM production estimate, the proposed development at the Site will generate ca. 35 to 40 direct jobs, including managerial/administrative, geological, mining, engineering, maintenance and support personnel. Indirect Site employment (typically 10 to 15) will be generated in terms of contract drillers, suppliers of products and services such as fuel, oil and machinery suppliers.

During the re-development and refurbishment phase of the project, on-site employment levels of up to 50 are anticipated over a ca. 6 month period.

The proposed operational hours for mining will be 2 x 12 hour shifts per day (with production shift change-over starting at 07:00 hrs and 19:00 hrs, commencing at 07:00 hrs Monday and finishing at 19:00 hrs Saturday). The mine proposes to operate for 6 days per week with maintenance scheduled on Sundays and Bank Holidays. There will be no blasting on Sundays. Mine dewatering and mine backfilling operations will be continuous throughout the LOM.

2.5 Rationale for the Development

Shanoon Resources proposes to concurrently apply to Kilkenny County Council and Laois County Council for planning permission to recommence underground mining at the recently closed Galmoy Mine herein referred to as the Garrylaun Mine/Project. The Kilkenny and Laois County Development Plans both support mining activities, subject to sustainable development principles, as part of each county's development strategy. It is noted that the proposed development Site is located within an area of population decline as noted in both County Development Plans. As such, the recommencement of the development at the Site will create benefits to the local and national economies through the supply of jobs directly related to the operation as well as indirect benefits through the use of local suppliers and services. Based on the current economic and known mineral resources and mining reserves at the Site, it is estimated that mining operations will be carried out over ca. 5 to 6 years from the recommencement of operations. The recommencement of mining and parallel continued mineral resource testing will identify any potential additional economic ore reserves that would extend the life of the proposed project.

Zinc is a commodity that is only found in sufficient quantity (and quality) in a number of locations around the globe and is currently in short supply in global terms, making the high quality zinc (and lead) found at the Site of primary importance to the economy of the country as a whole.

2.6 Mining

As minerals can be worked only where they occur, the extraction of ore is geologically and geographically isolated to the proposed development site and no alternatives are viable for the location of the mine. The extraction methods chosen for the recommencement of mining at Garrylaun will be the same as those previously used at the mine and will follow best practice, with material being extracted from underground stopes and development drifts in a cyclical pattern using standard drill, blast and haul methods. The ore will then be brought to the surface via dump trucks and crushed in the existing tepee prior to transportation to an off-site processing facility.

2.6.1 Mine Development - Mining Sequence

All mining at Garrylaun will be by underground means. The mine design is based on a detailed review, analyses and understanding of the previous mine design, mining methods, geotechnical support and water management systems previously used at the mine and at the nearby Lisheen mine. The resulting designs and controls proposed for the Project are in line with modern mine design practice and environmental requirements.

Access to the orebodies will be by means of the existing mine portal and access declines/ tunnels. Initially ca. 25,000 tonnes of soils and rock will be removed from the portal and decline to allow access into the mine workings. This material will be stockpiled on-site and used as future backfill material following cessation of mining.

As the water-table is drawn down, existing ground support will be reviewed, refurbished and upgraded as required to ensure both a safe working environment over the LOM and long-term stability of the underground workings following cessation of mining (and re-watering of the mine).

Water make from the underground workings will involve the development of separate 'clean' and 'dirty' water systems, where water will be segregated/collected underground prior to being pumped to surface. Dirty water (or contact water) is water that has interacted with ore or the floor of the mine workings, and acquired physical and chemical material that must be removed. Clean water is collected directly via horizontal wells or fissures in the rock and does not contact ore. Dirty water will be treated in the refurbished, pH controlled precipitation/clarification, Mine Water Treatment Plant (MWTP). 'Clean' water will be used to provide additional attenuation for the treated 'dirty' water prior to discharge.

As the water-table is further drawn down, electrical, water and ventilation systems will be installed, including the refurbishment/installation of ventilation shafts (including a secondary means of egress), pumping sumps/stations, electrical sub-stations, rescue stations and a backfill system.

Ground support for major development drives/areas will primarily be by rock bolts combined, when required, with steel mesh, shotcrete and/or cable-bolts.

During pre-production development, test holes ('probe holes') will be driven ahead of all development faces. The holes will be drilled to check for potential water inflows.

As part of the pre-production development, underground diamond drilling will be carried out to confirm the location and outline of mineralization, to upgrade mineable resources into higher categories and to obtain data for ground-support and optimise mine planning.

The K Zone will be accessed from the main G Orebody access as previous, with the K2 Zone being accessed via the main K Zone access drive. The G East area will be accessed by means of an existing access tunnel/drift from the main G Orebody access drive, with the R Zone being accessed from the CW Orebody as previously undertaken (Figure 2.3). In order to achieve the design requirement of ca. 200,000 to 250,000 t/a at an average resource grade for efficient processing, it is proposed to mine ore concurrently from a number of different areas throughout the mine.

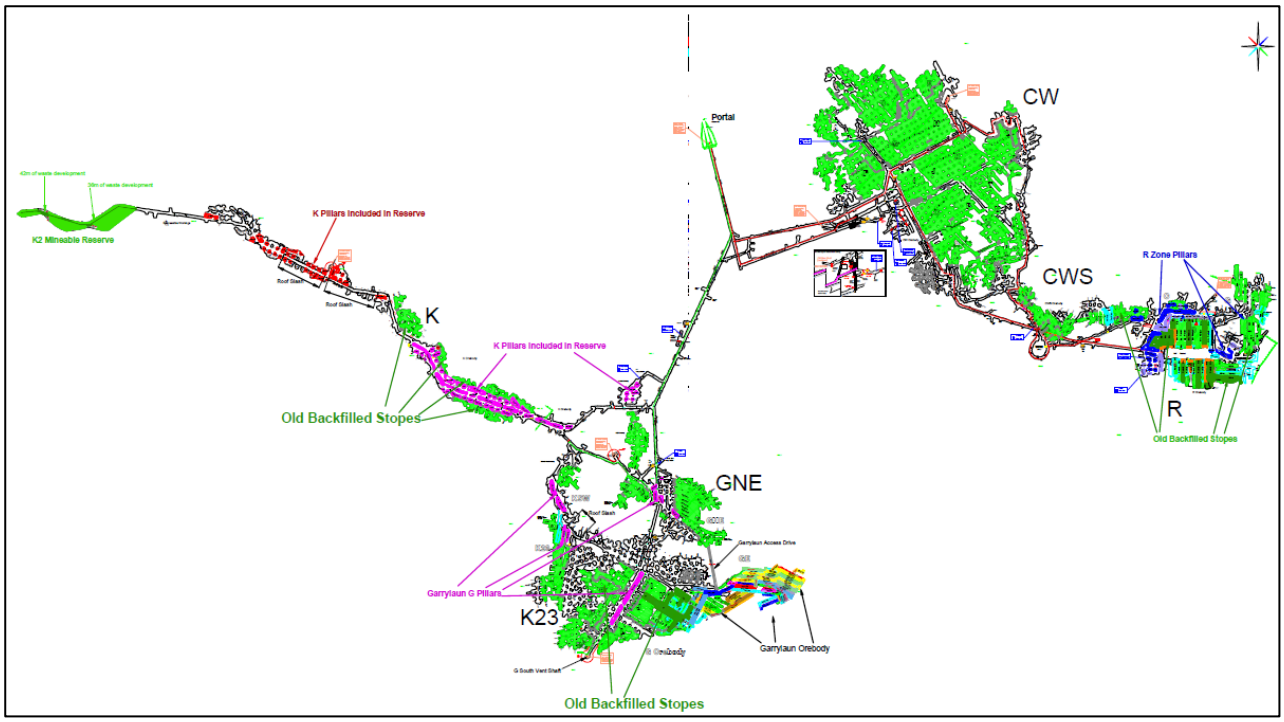

Figure 2.3: Underground workings showing areas to be mined

2.6.2 Mining Design - Mining Methods

The proposed mining methods (Figures 2.4 to 2.6) for the recovery of ore at Garrylaun are:

- Longhole Open Stoping (G East and R);
- Longhole Pillar Retreat (G East and R);
- Drift and Fill (K2); and
- Room & Pillar (G East, K, K2 and extensions to known ore).

A review of the mining methods and ground stability issues associated with the recommencement of mining at Galmoy was carried out by Avoca Geotech Limited (refer to Section 2.6.5).

Longhole Open Stoping

In the areas of thickest ore, typically greater than 15 m, open stoping with backfill is proposed. This method involves the mining of drifts along the upper, hangingwall contact and lower, footwall contacts. The upper drift is widened to 10 m and rows of vertical holes then drilled down from the top drift to the footwall contact or bottom drift. A free face is created at the end of the stope and the rows of holes then blasted in retreat. Mucking of the broken ore takes place by load-haul-dump (LHD) machines from a "drawpoint" at the lower level, with the final ore being cleaned using remote controlled LHDs. Details of this method are presented in Figure 2.4.

This method is carried out in a primary/secondary sequence with backfill being placed in primary stopes prior to mining of the adjacent secondary stopes.

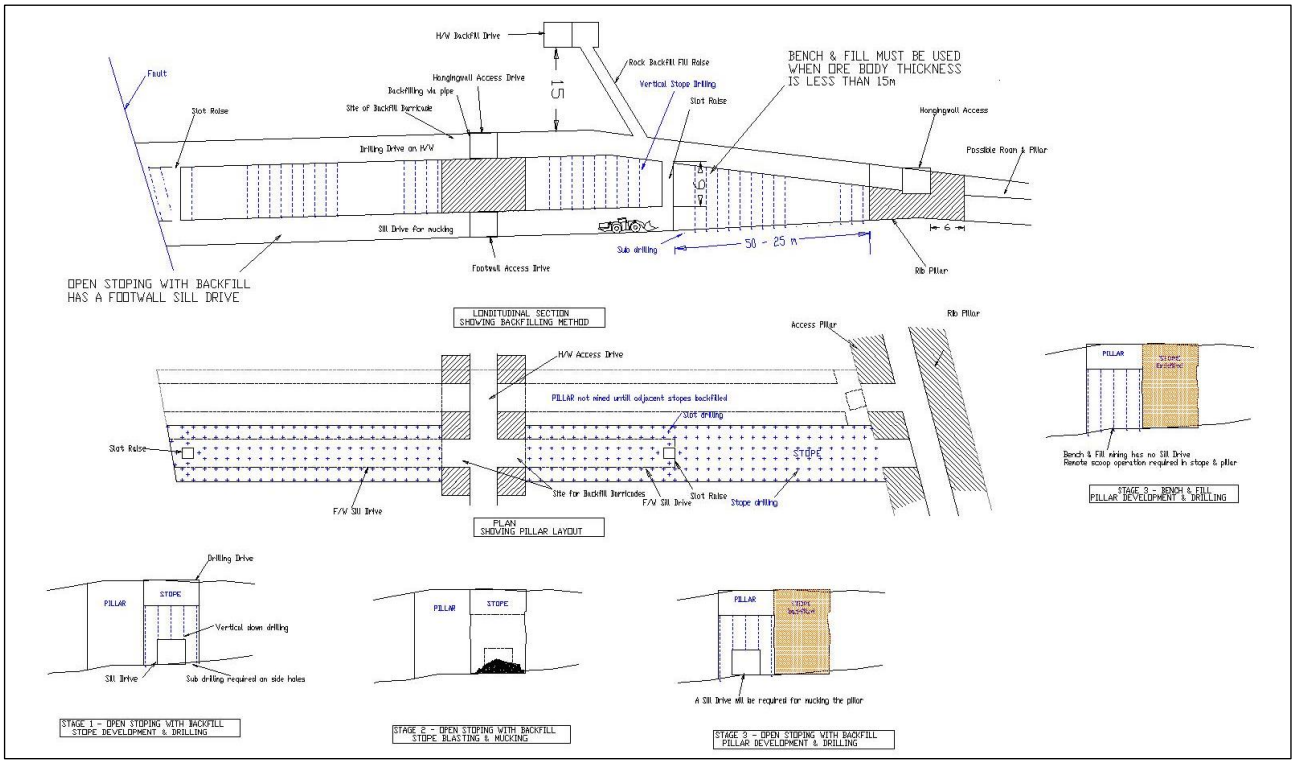

Figure 2.4: Longhole open stoping

Longhole Pillar Retreat

Where the ore is between 8 and 15 m thick, a variation of the open stoping method will be employed known as bench stoping. In this method an upper hangingwall drift only is mined. The ore is again extracted by vertical row of holes drilled down from the upper drift, but in this method the holes are drilled ‘blind’. The holes are sub-drilled to ensure all the ore is recovered. The broken ore is loaded by remote controlled LHD machines from a lower access as presented in Figure 2.4.

Mining is again carried out using a primary/secondary sequence, with backfilling taking place after each phase.

Drift and Fill

Where the ore is <less than 8 m thick and rock quality allows, the drift and fill mining method will be used. Figure 2.5 presents the stages of this method.

A series of parallel primary drifts, 5 m wide, are mined down dip from an access drive. On completion of the primary drives they are backfilled. Following curing of the backfill the 10 m wide temporary pillars between the primary drives are mined as secondary drifts. A 4 m wide drive is initially mined down the centre of the secondary pillar and the remaining ore then 'slashed' on retreat to the backfill. As each secondary drive is completed it is backfilled resulting in the whole stope block being backfilled.

Drift and fill is a commonly used mining method in higher value orebodies, and the dimensions selected for Galmoy are such that flexibility and changing to conventional room and pillar can be easily undertaken.

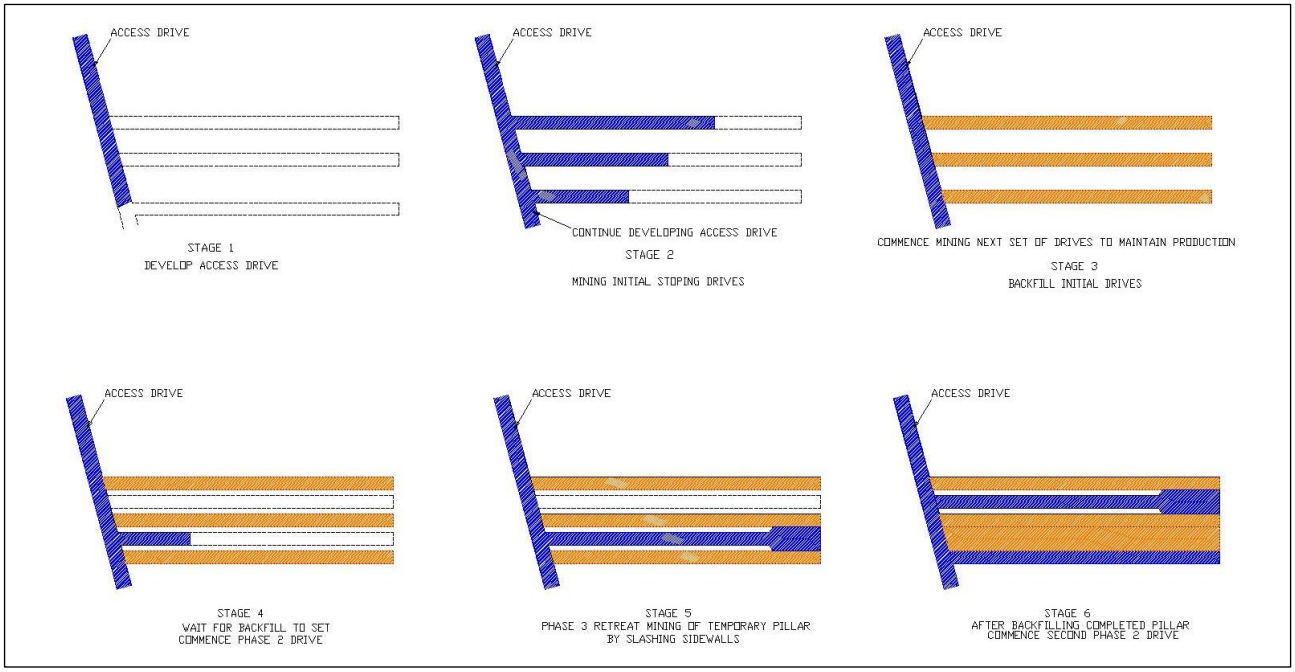

Figure 2.5: Drift and fill mining method

Room and Pillar Mining

Room and pillar mining (stoping) with integrated backfill will be the primary method used for mining the additional mineral resources in parts of G East, K and K2 zones. In accordance with good engineering practice, the mining methods will be continuously evaluated and may, on the basis of additional geotechnical information and operating experience, be modified without compromising the objectives of operating safety, control of subsidence, economics, or minimizing environmental impacts.

The room and pillar mining method will be used where the ore thickness is < 8 m. Where the ore thickness is 5 m or less the rooms will typically be limited to 10 m wide and the pillars will be 5 x 5 m.

Where the ore is > 5 m the pillar dimension will be based on an assessment of the rock quality and best practice geotechnical criteria. The various stages in room and pillar mining are shown in Figure 2.6.

Following the extraction of the ore from a room and pillar mining panel, the area will be backfilled, with the remaining pillars extracted upon retreat depending on ground conditions.

The following technical considerations have been applied in the selection of the proposed mining methods:

- Where ore is gently dipping and relatively thin (K, K2, parts of G East), the room and pillar, and drift and fill methods will be integrated with backfill to provide maximum support and long-term rockmass stability with respect to possible subsidence;
- Where ore is relatively thick (parts of G East and R), the long hole mining methods will be integrated with backfill to provide maximum support and long-term rockmass stability with respect to possible subsidence;

- The mining methods proposed are easily mechanized, and have previously been used extensively at Galmoy, Lisheen and Tara to successfully extract ore;
- Considerable experience exists within the vicinity of Galmoy (and Lisheen) in terms of experience specific to the mining methods proposed;
- The mining methods proposed are flexible and can be matched to varying ground conditions by varying room dimensions, pillar widths and ground support techniques;
- Previous experience at Galmoy (and Lisheen) proves that the proposed mining methods can been used safely and efficiently; and
- Control over surface subsidence has been demonstrated by the previous methods of extraction and ground support employed at Galmoy and neighbouring Lisheen Mine.

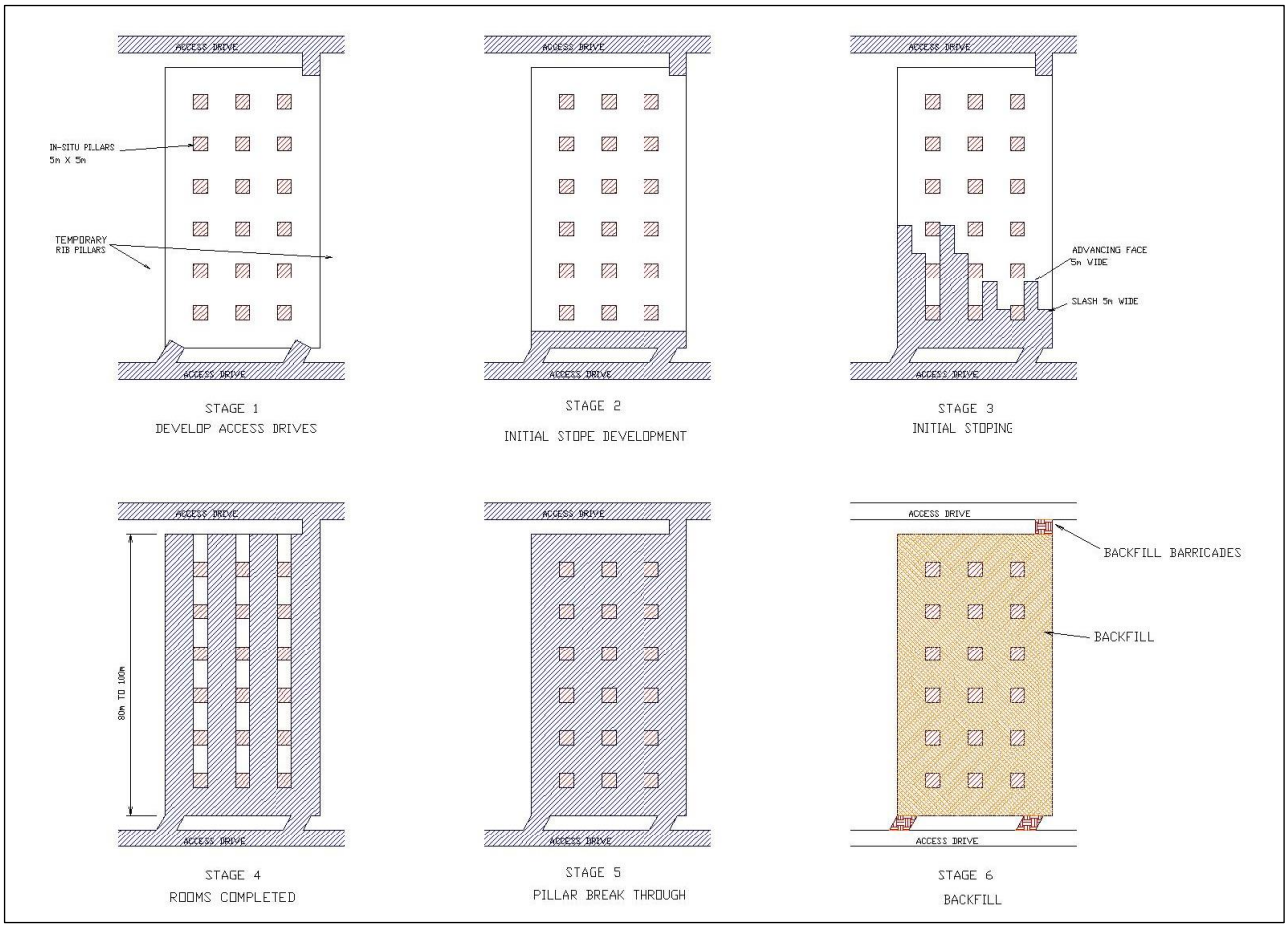

Figure 2.6: Room and pillar mining method

Mining from multiple areas within the mine will provide a blended, consistent and optimised feed (zinc and lead grade) for processing and will also provide flexibility and allow for varying rates of extraction and backfilling.

2.6.3 Blasting

Production and development blasts will be designed to ensure vibration levels (peak particle velocity (ppv) expressed as maximum peak particle velocity, in any plane, measured at foundation level) at the nearest private residence will not exceed the previous IPC Licence (P0517-02) requirements of 8 mm/sec for day time (08.00 hrs to 22.00 hrs) and 4 mm/sec for night time (22.00 hrs to 08.00 hrs).

Previous operating experience at the Site has shown that resultant peak particle velocities, blast noise, and air overpressure complied with EPA requirements. It is expected that no new impact(s) will arise from the proposed recommencement of mining at Galmoy.

Monitoring of all blasts will be carried out as part of the company's obligation under its IPC Licence (once granted) using permanent vibration monitors located at the monitoring stations proposed in Chapter 9.0 of this EIAR. The location of these monitoring stations is chosen based on their proximity to sensitive residences.

Explosives Storage

No explosive storage facility (Magazine or Reserve Station), on surface or underground will be utilised for the Project. Please refer to Section 2.7.16 for more details.

2.6.4 Mine Ventilation

Ventilation air will be drawn down the main access decline by means of ventilation fans located at the base of each ventilation shaft. Air will be directed, as required, throughout the underground workings by a combination of area ventilation fans, ventilation bulkheads, doors, brattices and ventilation ducting. Exhaust air will be upcast by means of the R, K and G ventilation shafts (Figure 2.7). Shafts vary in length from ca. 50 to 130 m and are 3.5 m x 3.5 m in cross-section (Figure 2.8).

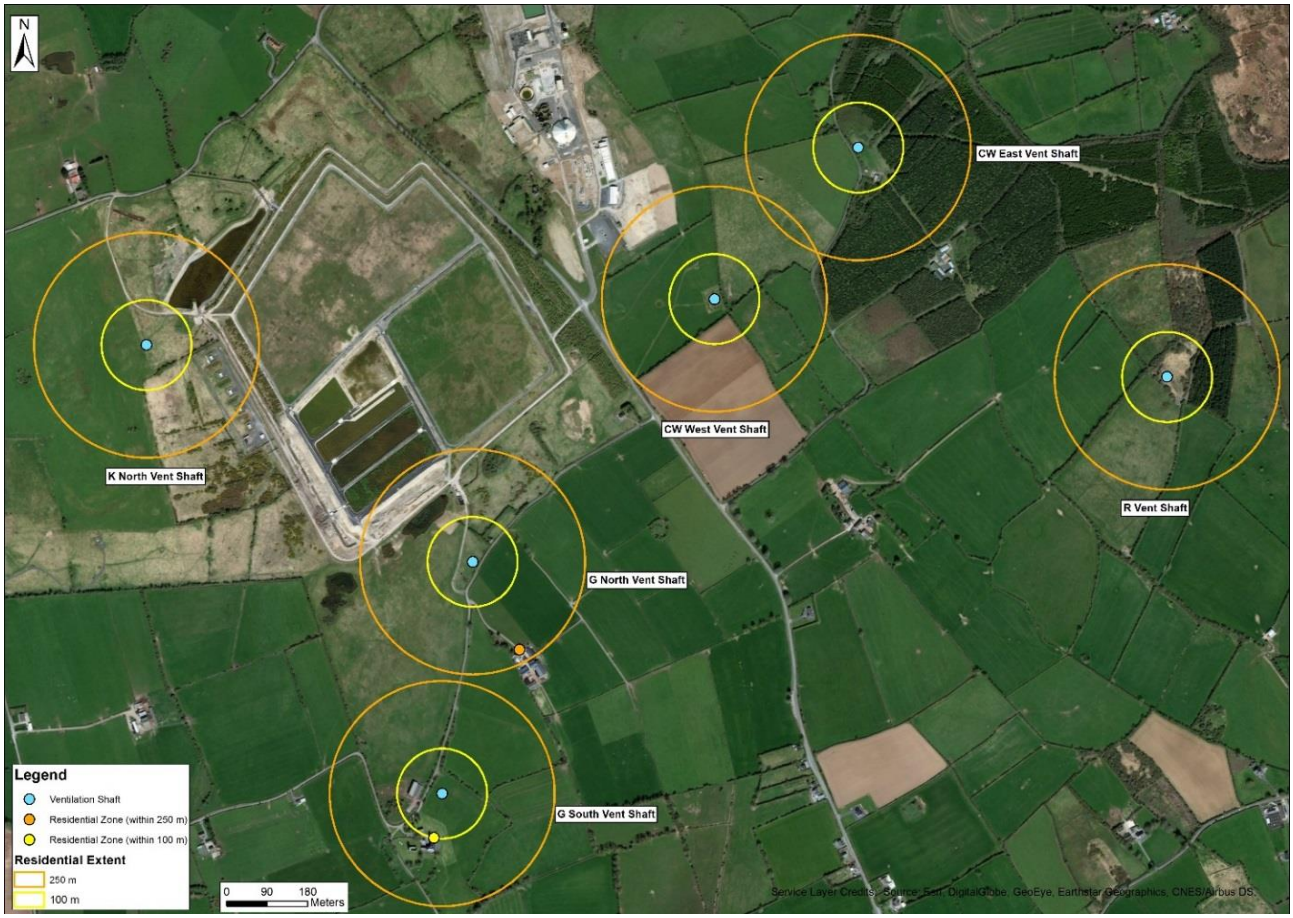

Figure 2.7: Location of ventilation shafts

Control of the main ventilation fans will be located close to the fans, with parallel controls at the surface within the surface housings. Back-up fans will also be provided at the surface to permit safe evacuation of the mine via the ventilation raises. A permanent manway will be installed on each ventilation raise with an emergency exit door in the surface breakthrough housing. These will be secured against any unauthorised entrance into the mine workings.

By redirecting the air flows in the mine, the combined quantity of air exhausted from the mine's ventilation shafts will not exceed 210 m^3/sec, the quantity stated in Schedule 1(i) Emissions to Atmosphere of the previous IPC Licence for the Site.

Dust concentrations in the ventilation system exhaust will be very low and it is anticipated that a level of 0.5 mg/m^3 will not be exceeded. For this reason, no dust suppression measures will be incorporated into the mine ventilation exhaust (refer to Chapter 7.0 for more details).

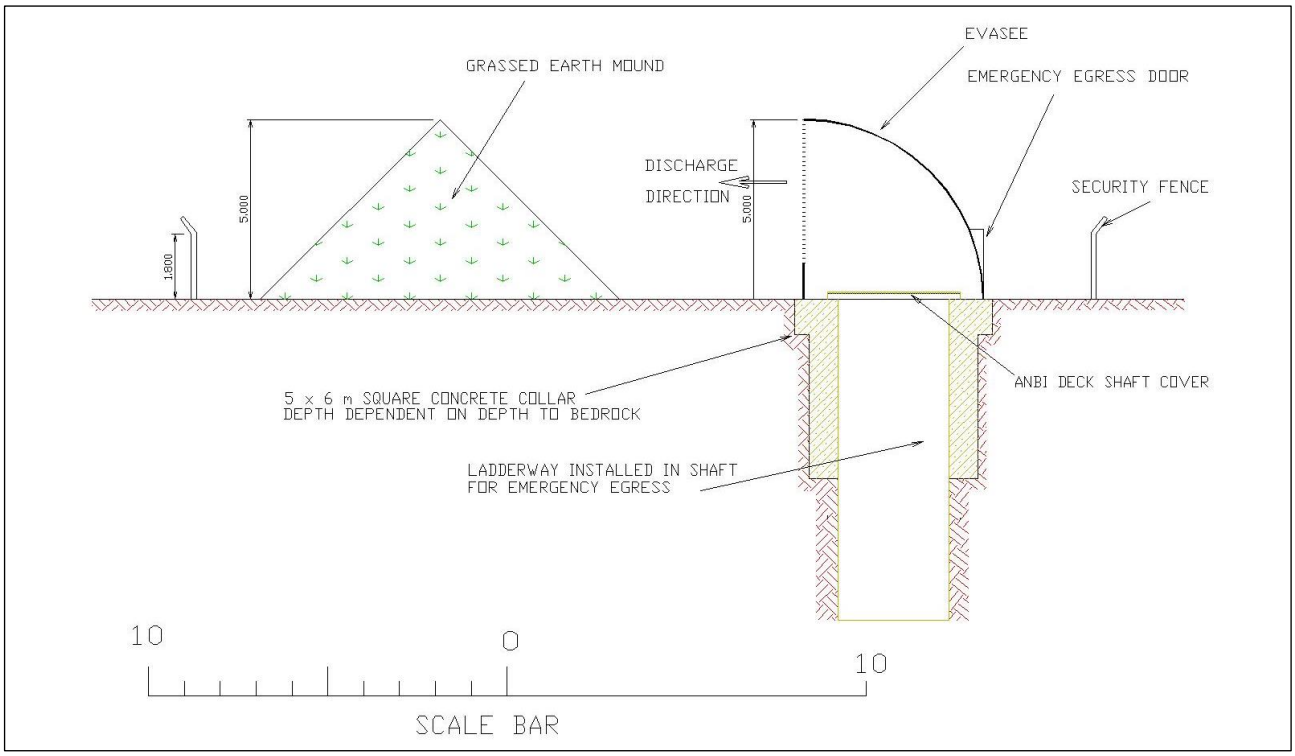

Figure 2.8: Cross-section through a typical ventilation shaft

2.6.5 Ground Stability and Support

An extensive network of subsidence monitoring stations was put in place by the previous mine operators and will be revised and updated in consultation with the relevant authorities and landowners. A new baseline set of the surface levelling measurements will be taken prior to dewatering the mine, with additional stations being put in place over the K2 and Garrylaun Zones.

The trends from the subsidence survey data over the life of the mine indicate that there is no subsidence on surface due to changes in the global stability of the mine workings within the orebodies.

Geotechnical studies, coupled with the mining methods, ground support and water management systems previously used at Galmoy Mine, enabled a robust review of the expected ground conditions to be undertaken for the proposed development by Avoca Geotech Ltd. Key findings from this review are:

- The overall stability of the Galmoy Mine at closure was good and that all the large stopes had been backfilled except for the R Access Pillar (RAP) which is located at depth in very good ground;
- The adherence to a robust 'Pillar Management System and Underground Failure Prevention Plan' developed with Golder ensured a safe closure of the mine maintaining its stability and integrity;
- The extensive database of face-mapping sheets available from the mine (recording both geology and ground conditions) provide valuable information on the behaviour of all rock types encountered, in particular the massive sulphide ore and should be utilised when re-entering mine workings and planning for ore extraction;
- As dewatering of the mine will impact both the characteristics of the ground and installed support, a rigorous examination of all re-exposed ground will be carried out by systematic testing of previous ground support systems and where necessary scaling or the application of additional support;

- Any open features encountered should be sealed with shotcrete leaving short lengths of water pipe in the opening to prevent water pressure build-up and provide drainage;
- Any loose shotcrete should be removed and replaced with synthetic fibre shotcrete to maximize support;
- Mining alongside any backfilled area will have to be undertaken with caution, with areas probe drilled to check for backfill integrity prior to mining; and
- A new baseline set of surface levelling measurements (subsidence) should be taken prior to dewatering of the mine. In addition, it is recommended that a remote sensing survey using Interferometric Synthetic Aperture Radar (InSAR) from satellites be carried-out (similar to that undertaken at the Lisheen Mine).

The selection of the correct support category will be chosen by the mine planning engineer on information from geology, mine operational staff, as well as a thorough assessment of the previously installed ground support.

The ore zone and immediate hangingwall rocks at Galmoy have been geotechnically evaluated as being 'fair' to 'very good' in strength using the universally accepted Q rock quality rating system. As the mining depth at Galmoy is less typically < 100 m below surface a low stress environment exists relating to the mine workings.

Ground support methods that have been used in the mine access ramps are a combination of rockbolting, meshing, shotcreting, and steel arches.

Within the mine workings sub-vertical weathered joints and fissures have been exposed, ranging in width from a few centimetres up to 8 m. Overbreak into the roof at these features has typically not been excessive. Usually rockbolts and shotcrete are sufficient to stabilise and support these features, and in no cases have they propagated upwards towards surface or laterally in any manner. Occasionally steel arches were used to supplement the above support elements. Some of these joints and fissures are water bearing when first intersected, but water inflow from them generally decreases rapidly or dries up completely as mining progresses past the joints and fissures.

Figure 2.9 shows general stoping/mining conditions at Galmoy (prior to backfilling), reflecting the very good stability of the mined rooms and pillars.

Figure 2.10 shows the ability to completely fill mined out stopes/areas with backfill which minimises rockmass movement.

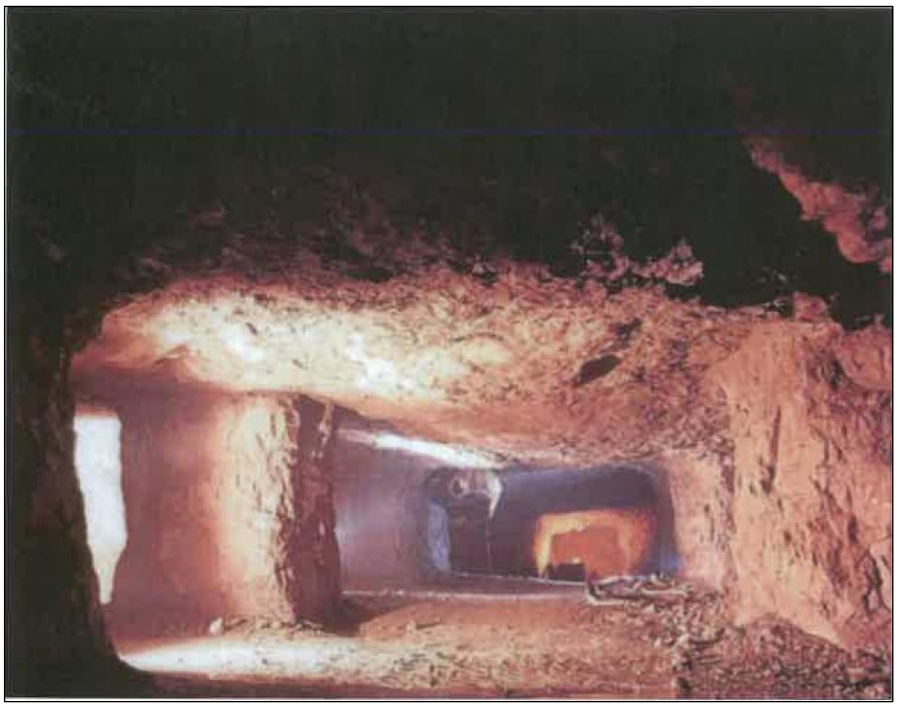

Figure 2.9: Typical rooms and pillars, Galmoy Mine prior to backfilling. The competent rock conditions shown are an example of good rockmass conditions expected in the K2, K and R zones.

Figure 2.10: Close-up of backfill in the G Stope, CW Orebody, showing the ability to fill the mined void providing tight contact between the backfill and roof of the stope

2.6.6 Backfilling

The majority of mined out areas in the Garrylaun Zone will be backfilled with placed support material. Cement will be added to the backfill to allow pillar extraction during mining operations. This will provide a low to medium (250-500 Kpa) strength backfill that is quick draining, free standing and has low shrinkage properties. The sequencing of mining and backfilling will be critical to ensure that any unsupported mined span is backfilled as tight and as soon as possible, with extra care taken to ensure that all voids on top of stopes are filled with 'topping up' by drilling extra filling holes when required.

In addition, it is proposed to use Waste-Rock Packing and/or Cemented Rockfill (CRF) in the K, K2 and R where the ore tends to be thinner (< 8 m) and there is greater rockmass stability.

The augmentation of cement with engineered concrete additives is now a proven technology in mine backfilling. The proportion of cement to be replaced will be determined by laboratory and full-scale tests designed to maintain the structural integrity of the backfill. Backfill will be transported underground where it will be pumped into the mined out voids.

Parameters to be used for the fill material at Garrylaun are targets that are standard in the mining industry. Full-scale tests will determine the fill strength and cement addition required to suit a cementitious type fill. In addition to laboratory tests on the backfill, instrumentation such as extension meters, strain gauges, pressure gauges, water content meters, etc. will be used to measure the effectiveness of fill in place.

Each longhole stope will be surveyed with a cavity monitoring system (CMS) to reconcile the backfill volume placement.

2.6.7 Mine Dewatering

The mine will be dewatered by a combination of the drilling of specific (temporary) dewatering wells in close proximity to the Access Decline, refurbishment of surface dewatering well (PW5A), pumping from ventilation shafts (where appropriate) and in-mine dewatering (from sumps/pump station located in the main access drives) (Figure 2.11). In-mine dewatering will be of two types:

- 'Clean' water drawn from horizontal / inclined wells and captured locally from fissures and joints within the mine workings; and
- 'Dirty' water bypassing the surface and in-mine wells that collects in the mine sumps.

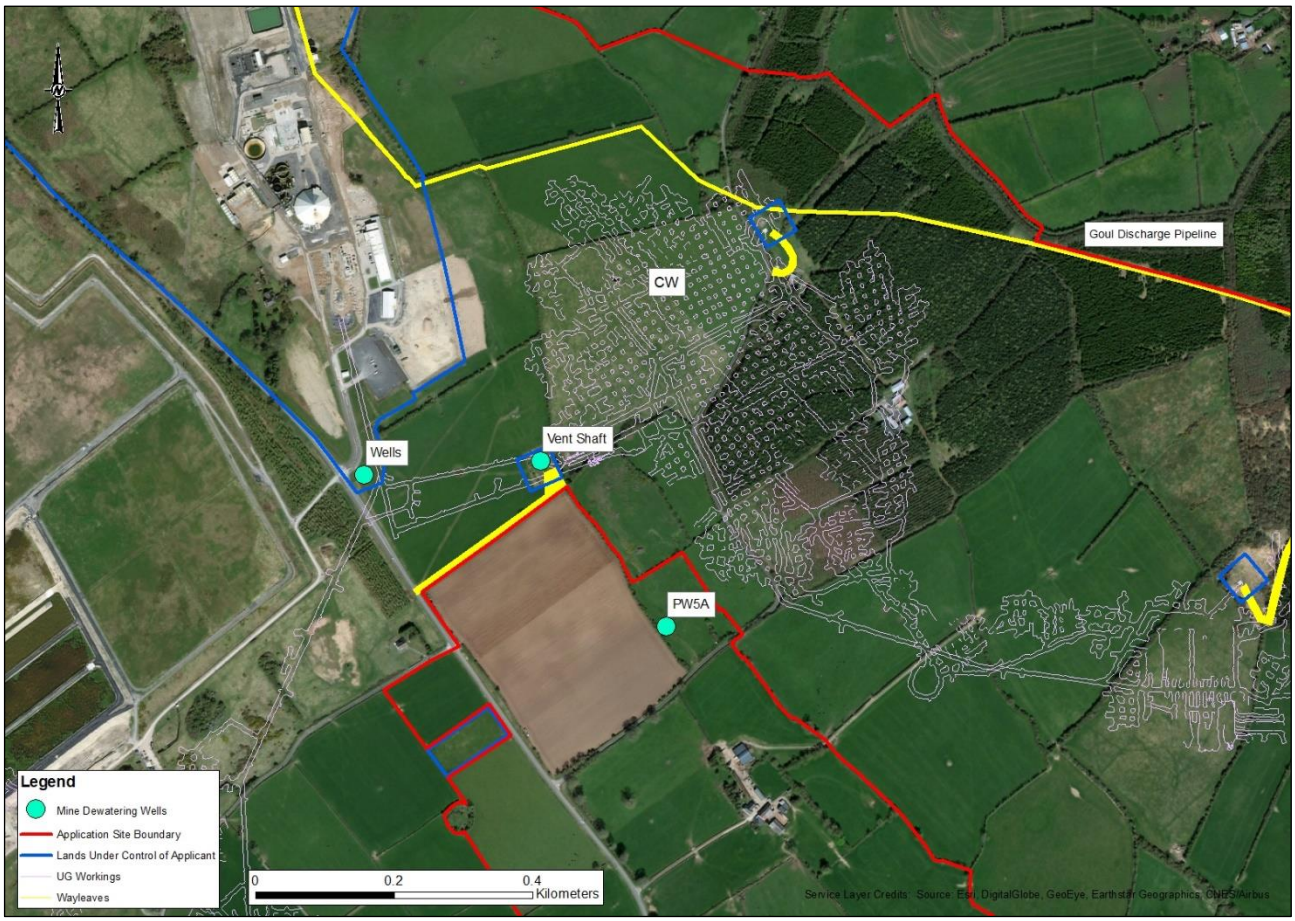

Figure 2.11: Mine dewatering wells

The primary purpose of the chosen mine dewatering method, incorporating surface and in-mine wells, is to remove from the immediate proximity groundwater that has not come into contact with the mine workings. In this manner, the majority of the water generated by the mine dewatering system will be clean and will require the minimum of treatment prior to its discharge to the environment. Local control methods will be used to ensure that total suspended solids are minimised from water that is present on the mining horizon.

Following the shutdown of the final remaining pumps in CW and R orebodies on 11 March 2013, the water-table at Galmoy Mine started to recover. The original predicted time for full recovery was 18 months. However, pre-mining (baseline groundwater) conditions became re-established in March 2014, about 12 months after dewatering ceased. The recovery time was quicker than expected due to the extremely high rainfall and groundwater recharge that occurred in January and February 2014, with local baseflow (groundwater discharge) to the Glasha Stream and its tributaries (to the north) becoming re-established.

Because the full area of the Galmoy 'block' is hydrologically interconnected, dewatering of the full block will be required, regardless of the footprint of future mining. The historical dewatering rate for the Galmoy block was mostly within the range ca. 10,000 m^3/d to 14,500 m^3/d (Figure 2.12). Once the initial groundwater storage within the block has been removed, a similar dewatering rate can be expected for the planned recommencement of mining.

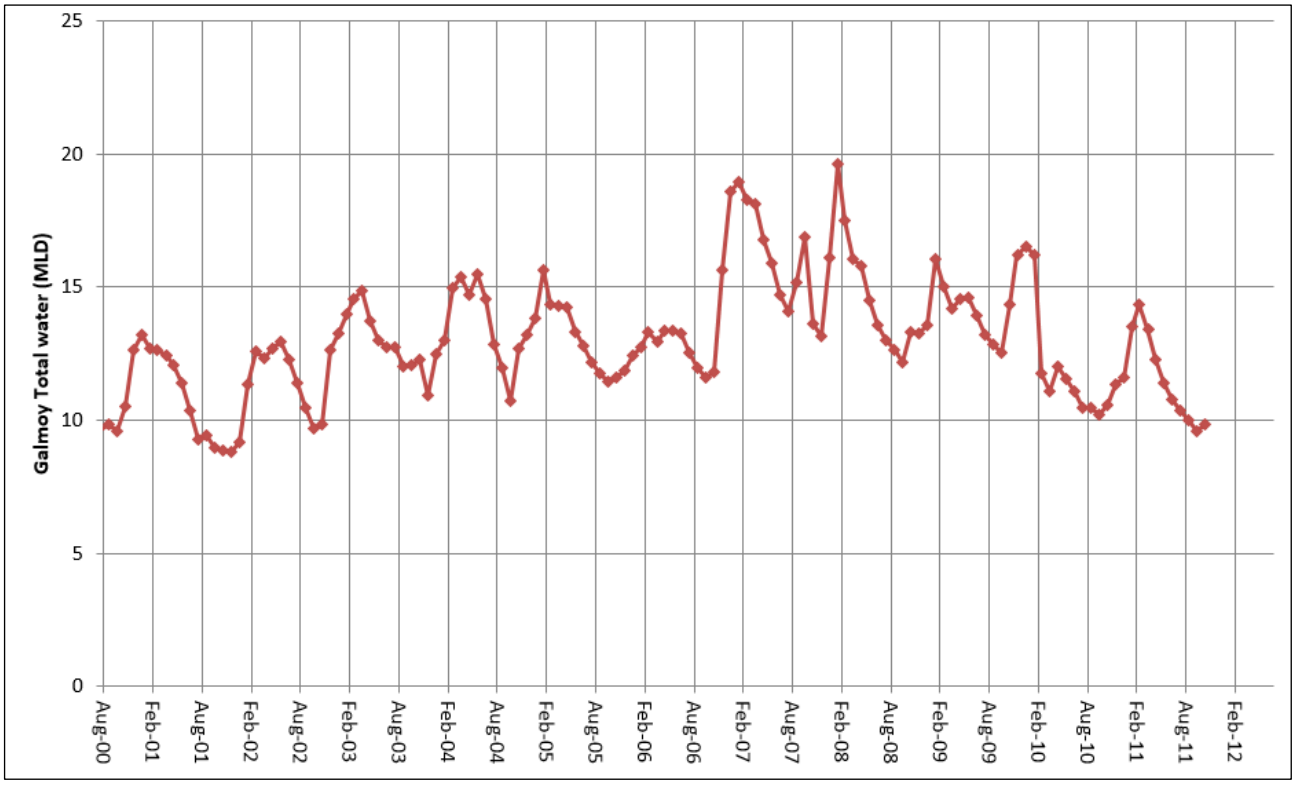

Figure 2.12: Historical pumping from Galmoy mine from 2000 to cessation of mining in 2012

The dewatering rate will be mostly a function of rainfall in the preceding 3 months. The maximum dewatering rate for the previous mining was ca. 19,000 m^3/d in early 2008. The dewatering rate fell below 10,000 m^3/d the summer of 2011. The normal "dry-year" dewatering rate for the Galmoy mine (baseflow rate 2004-2006) was about 12,000 m^3/d. A dewatering rate approaching 20,000 m^3/d can potentially be expected following periods of very high rainfall and recharge (the discharge limit allowed under the mine's previous IPC Licence).

For the recommencement of mining and it will be necessary to lower the water-table from its current elevation. To achieve this, there will be a need to remove groundwater storage in the Galmoy block in the vicinity of the mine, and also the water in the flooded underground workings, in addition to the on-going recharge.

Assuming the current void volume of the underground workings above the elevation of the Garrylaun workings is about 150,000 m^3, and that the volume of groundwater that requires removal from the Galmoy block is about 350,000 m^3 (both conservative), there would be a requirement to pump an additional 3,000 m^3/d of storage during mine re-opening. Thus, the volume of water associated with storage is within the natural range of fluctuation of recharge.

Sequence of Dewatering

The proposed sequence of dewatering the mine is as follows:

- Achieve initial dewatering using sump pumps as the decline is progressively developed, in conjunction with a temporary local dewatering wells which will be drilled close to the area of the workings in order to reduce the burden of pumping required from within the decline itself;

- Establish a permanent pumping station at a convenient location close to the bottom of the decline. The capacity of the pumping station will be about 300 Kw, so as to lift the water up the decline to the settling pond prior to pumping to the water treatment plant. Its operating capacity will be about 20,000 m^3/d, with a total dynamic head of about 90 m;
- Establish both a 'clean' and 'dirty' water line to the respective holding ponds on surface;
- Establish staged collector sumps as the workings are gradually extended outwards. The collector sumps would have low head transfer pumps to route the water to the permanent pumping station. It is likely that initial development will be towards G-North and G-South ventilation shafts, to allow a ventilation system to be set up as soon as possible; and
- Adopt a program of grouting for the K2 orebody.

The planned extraction of ore from the K2 orebody will extend the existing workings to the west of the K orebody (Figure 2.3). In order to ensure that drawdown in the area of the Replacement Water Supply Scheme (RWSS) wells remains low, and consistent with the previous period of mining activity, any new potential inflow zones will be grouted, to prevent the water from entering the workings. As the workings are extended to the west, cover drilling will be undertaken to identify the hydrogeological conditions prior to mining. If fracture zones that have the potential to carry groundwater into the workings are encountered, the fracture zones will be pressure grouted from underground, prior to advancing the workings.

The development proposes to re-commission the previous underground pumps and re-use the existing pipelines, holding ponds, water treatment plant and outfall pipeline (Figure 2.13).

Predicted Drawdown

The magnitude of drawdown in existing wells within the Galmoy block is expected to be similar to the drawdown already observed during the previous period of mining.

The previous period of mining impacted a number of the two bedrock springs within the immediate area of the mine. Both springs occur at a topographic elevation of about 130 m OD, and both formed part of the natural groundwater discharge system for the Galmoy block. It is predicted that both of these springs will also dry up during the proposed mining. As dewatering progresses, the water-table will drop below the invert level of the springs, so the groundwater discharge and spring flow will cease.

There were no other observed impacts to springs or bogs during the previous period of mining. There were no changes to Whiteswall Bog or to other wetland areas to the north and east of the mine. No impacts to other springs, wetlands or bogs are expected as a result of the proposed future mining operation.

The existing Group Scheme (RWSS) water supply wells WW1A and WW2B were operated throughout the entire period of previous mining. There was some drawdown due to the previous dewatering, but it did not significantly affect the operation of the wells. The same condition would be expected for the recommencement of mining because the future drawdown area and drawdown magnitude will be the same as for previous mining.

Groundwater monitoring during the previous period of mine operations and closure showed that the groundwater system in the area of the RWSS wells was separated from the immediate mine area by a hydrogeological boundary (a north-northwest trending fault/fracture zone), causing the groundwater flow to be compartmentalised (Chapter 6.0). Thus, no significant changes to the operation of the RWSS wells are expected in the future. Although mining of the K2 orebody is proposed as part of the future mine plan, cover grouting is planned in this area to prevent additional groundwater inflows, and thereby prevent any additional impacts to the groundwater system. The planned program of cover grouting will isolate underground mining activities from groundwater in the surrounding bedrock.

The two RWSS wells (WW1A and WW2B) are upgradient from the mine workings, both by approximately 500 m. Monitoring data for both wells through 2017 demonstrate that all chemical parameters continue to be stable and to comply with the Irish drinking water standards. No changes to water quality in the RWSS wells are expected as a result of the planning mining operation.

Mine dewatering is presented in more detail in Chapter 6.0 of this EIAR.

2.6.8 Control of Acid Rock Drainage

Acid Rock Drainage (ARD) refers to the natural oxidation and hydrolysis to acidic sulphate solutions that can occur to sulphide minerals when exposed to air and water. These acidic solutions are rapidly neutralised by reaction with carbonate minerals, and in situations where the carbonate minerals are in excess, there will be no net production of acidic water. The host rock of the Galmoy mineralisation is primarily calcium and magnesium carbonate (limestone) both of which have a high neutralisation potential. Even if acid is generated in microenvironments around sulphide grains it will rapidly be neutralized by calcium and magnesium carbonate to generate pH neutral conditions. This is the situation that exists in most of the Galmoy orebodies.

Sampling to date has shown that no Acid Rock Drainage has been produced on-site at Galmoy.

2.6.9 Environmental Protection Measures

Comprehensive environmental protection measures have been incorporated into the proposed development in-line with what went previously and in-line with Shanoon's Environmental Policy, including:

- Installation of crusher in the tepee to eliminate noise and dust impact at surface;
- Transport of ore to surface by truck to eliminate the visual impact of a conveyor and head frame;
- Blasting arranged and designed to ensure acceptable vibration limits at residences in the vicinity of the mine area;
- Mining methods selected to assure no significant surface subsidence; and
- 'Clean' and 'dirty' mine water separation underground designed to minimize the treatment of water prior to discharge to the River Goul and the Glasha Stream.

2.7 Site Infrastructure

This section provides a summary of the main aspects of the development's infrastructure (Figure 2.13) and cross-references the infrastructure with the relevant Planning Drawings.

Easements and wayleaves to the CW (west and east), G (north and south), K and R zone ventilation shafts, the River Goul outfall point (diffuser) and along the River Goul Pipeline route are presented on Figure 2.2.

2.7.1 Security Hut/Gatehouse and Weighbridge (Planning Drawing No. 7 & No. 8)

This building is a concrete block structure, cladded in pre-painted metal cladding, and is 6 m by 6 m by 4.2 m high. This building will house the mine's security staff and be the control point for the weighbridge.

2.7.2 Mine Change-house (Planning Drawing No. 9)

The existing mine change-house will be retained and refurbished, with offices, locker (wet and dry) and shower facilities, toilets and lunch room facilities being located in this building. The full workforce of ca. 35 persons will be provided for, as appropriate, in these facilities.

2.7.3 Bunded Fuel Tanks (Planning Drawing No. 10)

An existing bunded fuel tank for central heating to the Administrative Building (Planning Drawing No. 11) will be retained, with a new bunded fuel tank replacing the one that exists to the rear of the Change-house.

2.7.4 Administration Building (Planning Drawing No. 11)

Management, administration, survey, geology, engineering and other non-production personnel will be accommodated in the existing administration building over two levels. These will also include those engaged in accounting, personnel, environmental, warehouse, and health and safety, as well as mine rescue and training. This building is 84 m by 18 m by 11.7 m high and is constructed of a structural steel frame, concrete blocks and pre-painted metal cladding. Interior floors are of reinforced concrete construction, with internal partitions of concrete block or plaster board on steel studs. All stairs are of concrete construction.

All exits and escape routes will be equipped with battery-powered automatic emergency lighting to ensure safe evacuation of the building in the event of a power failure.

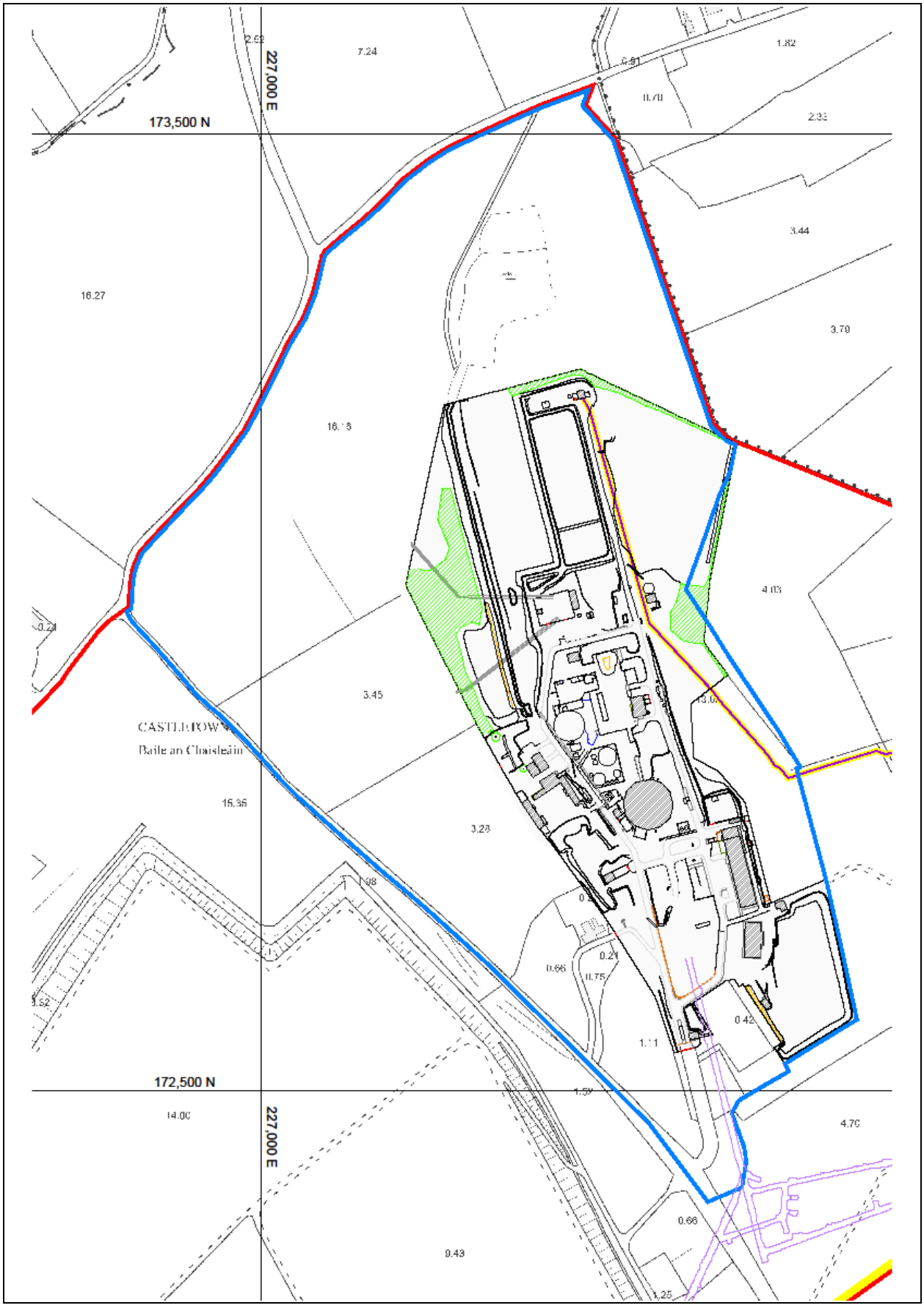

Figure 2.13: Plant Site layout showing main infrastructure

Laboratories

Laboratory facilities will include an environmental laboratory, within the administrative building.

Warehousing (Planning Drawing No. 11)

An indoor high bay warehouse area of ca. 200 m^2 is attached to the administration building. This will serve as a storage and distribution centre for mine maintenance, and for operational supplies with the exception of fuel, explosives and reagents. Additional outside storage will be provided, for large items, in a fenced area adjacent to the warehouse facilities.

Workshop – Services Building (Planning Drawing No. 11)

Routine maintenance and servicing of all mining equipment will take place on surface in a designated workshop adjacent to the warehouse. Oils and lubricants will be stored in adequately bunded containers with 'waste' oil being stored in similar containers, prior to been taken off-site for disposal with by a registered operator to a licenced disposal/recycling centre.

2.7.5 Fuel Storage and Dispensing (Planning Drawing No. 12)

Marked diesel fuel for plant and mine equipment will be the only petroleum-based fuel product to be stored on site. This will be contained in two capacity purpose-built tanks, of welded steel construction, installed within a protective bund, capable of retaining the full contents of the tank. Deliveries of diesel fuel oil will be from the oil companies serving the area by means of conventional fuel trucks. A metering and dispensing station will be located adjacent to the tanks to service mining vehicles on an existing hardstand area which has been fitted with a hydrocarbon interceptor.

Petrol-engine vehicles will be fuelled from local commercial petrol stations.

2.7.6 Coarse Ore Stockpile Building (Tepee) (Planning Drawing No. 13)

The coarse ore stockpile or tepee is a twelve-sided, conical-shaped structure designed to contain the crushed ore delivered from underground and is capable of holding ca. 6,000 t live capacity of ore. For this development, the tepee will be refurbished to house a crusher and loading facility, where ore brought from surface by truck will be crushed to 4" down before being loaded onto road going trucks (30 t capacity) for transport to an off-site processing facility. The structure is covered by a painted metal cladding which will be refurbished to ensure that the structure remains 'air-tight' at all times, preventing the emission of dust from the building. Access will be through a large door which will remain closed (with visqueen) during the crushing process to eliminate the emission of dust into the atmosphere. In addition to the ore being transported from underground as a wet/damp material, a designate dust suppression system will be put in place around the crushing system to mitigate against the creation of dust and noise. Any run-off water will be captured in a sump and recycled for use in dust suppression. The tepee will also be equipped with a dry dust collector.

General purpose lighting within this building will be by high bay fittings. Additional lighting will be provided at access points and surrounding hardstand areas. Exit routes and exit points will be equipped with automatic battery-powered emergency lighting to ensure safe evacuation of the building in the event of a power failure.

2.7.7 Water Treatment Plant (Planning Drawing No. 14)

Dirty water pumped from the mine will first passed through a tilting plate (Lamella) separator to remove the majority of the suspended solids. This treatment unit consists of mixing, flocculation and solids separation. Polyelectrolyte is added at the plant inlet followed by flash mixing, flocculation and then solids separation in the lamella separator. At the inlet the incoming flow is split between two parallel units using splitting weirs. The clarified water overflows from the lamella tank into a series of launders at the surface. The separated solids fall to the bottom of the unit and are removed through sludge pumps. This sludge will be periodically removed from the unit and reused underground as backfill material.

The clarified water flows from the lamella unit into the second stage of treatment which consists of reagent addition and mixing followed by clarification in a reactor clarifier. The reagents, which can be added at this stage, include polyelectrolyte and lime.

The purpose of this stage of the treatment plant is to remove residual suspended matter and to remove dissolved metals by pH adjustment using lime and precipitation in the clarifier as hydroxides.

pH monitors are installed in the mixing tank and clarifier with a control loop to regulate the addition by lime. The system operates within pre-determined set points which can be adjusted to achieve the optimum pH for metal hydroxide formation. The output from the pH probes and the status of all important aspects of the treatment plant will report continuously to the environmental DCS workstations. In the event of a malfunction or any parameter drifting outside of its pre-determined operating range an alarm will register on the workstations and alert the operator to the problem. The control centre will be manned around the clock. In this way the system is monitored on a continuous basis.

The clarified water is collected in radiating launders and discharged into a transfer tank from where it is pumped to the Water Treatment Pond on-site prior to discharge to the River Goul.

2.7.8 Plant Electrical Services Building (Planning Drawing No. 15)

Electrical switchgear, control equipment, heating and ventilation equipment for the now dismantled mill building was contained in the separate but adjacent services building, which is to be retained as part of this development.

2.7.9 Fire and Freshwater (Planning Drawing No. 16)

Fire and fresh water for the Site will be supplied from a dedicated source on-site, consisting of a control room and freshwater tank. A freshwater/firewater tank has a storage capacity of ca. 850 m^3 of which ca. 680 m^3 is retained for fire water purposes.

2.7.10 Domestic Sewage (Planning Drawing No. 17)

All domestic sewage arising on the site will be piped to a proprietary effluent treatment system (Appendix 2.1). The treated discharge will be pumped into the Water Treatment Pond on site as was previously undertaken. Typically, this system produces an effluent with a B.O.D. and suspended solids level of less than 10 mg/l.

2.7.11 Water Storage Ponds (Planning Drawing No. 18)

Two of the three holding ponds that were part of the mine water management system currently exist on the Site.

The largest of these, the Water Treatment Pond, will be used to store the treated mine water to discharge and has a capacity of ca. 8,500 m^3.

The smallest of the ponds, the Storm Water Pond, will be used to store run-off water from the Plant Site. It has a capacity of ca. 1,800 m^3 to facilitate settlement of suspended solids before overflowing into the Water Treatment Pond.

The largest of the ponds, the Groundwater (mine clean water) Conditioning Pond will be re-constructed and will have a capacity of ca. 17,200 m^3. Groundwater intercepted prior to entering the mine workings or 'falling' on the mine floor will be pumped into this pond over a cascade to oxygenate the water prior to discharge. Retention in this pond also helps with temperature equilibration and settlement of any suspended solids that may be present.

The two remaining ponds are constructed of earth embankments and are fully lined with impermeable HDPE liner. It is proposed that the Groundwater Conditioning Pond will be lined with a clay lining system.

Water Management and Control

Clean water from the mine will be pumped directly into the Groundwater Conditioning Pond from where it is discharged to the environment via the Goul pipeline. This water will be sampled daily to assess its quality prior to discharge. Apart from oxygenation and settlement of solids no treatment of this water will be required.

Treatment will be provided for other waters, such as mine 'dirty' and run-off from the Plant Site.

2.7.12 Goul Pumphouse (Planning Drawing No. 19)

A pumphouse containing pumps and associated infrastructure for the discharge of water to the River Goul is located to the north of the Site, adjacent to the Water Storage Ponds. It has overall dimensions 9 m by 11 m by 4 m high and is a concrete-block structure.

2.7.13 Main Substation (Planning Drawing No. 20)

The main substation consists of an outdoor 38kV switch and transformer yard, with an associated concrete block building containing the ESB's metering equipment and the Site's high voltage distribution switchgear. The outdoor compound, containing the ESB terminal poles, the ESB 38kV switchgear and the Site's transformers, is ca. 40 m by 30 m in area and is enclosed by a 2.5 m high security fence. The switchgear building is ca. 20 m by 7 m by 4 m high.

Access to both areas will be strictly controlled. Both the outdoor compound and the switchgear building have been constructed in accordance with best practice for such facilities in terms of security and emergency exits.

2.7.14 Backfill Plant (Planning Drawing No. 21)

The backfill plant will consist of storage tanks, silos and a cement addition system. This facility will be refurbished as part of the proposed development. The coarse product will be stored in two tanks, each of ca. 750 m^3 capacity. Materials drawn from the tanks and cement, which will be is stored in an adjacent tank (ca. 80 t capacity), will be added to produce a lean concrete mixture which will be is then pumped underground as backfill.

Fine sand/quarry dust or equivalent will be required as the coarse fraction in the backfill as no tailings will be produced on-site.

2.7.15 Workshops, Storage Buildings and Core Store (Planning Drawing No. 22)

A number of existing buildings, including old farmyard buildings will be retained as workshops and storage areas.

A building will be provided for storage of rock cores generated by the mine exploration drilling programme in one of the existing old farmyard buildings, which has a metal-clad roof. In addition to storage facilities, it will contain core splitting, office and equipment storage.

2.7.16 Emulsion Storage (Planning Drawing No. 23)

No explosive storage facility (Magazine or Reserve Station), on surface or underground will be utilised for the Project. Daily deliveries from the explosive supplier of detonators and boosters, sanctioned under S.I. NO. 423 of 2016 is the preferred explosive model due to the relatively low production profile over the life of mine. Daily deliveries using approved and licenced explosive (EX) vehicles, under Garda escort, will be transported to a dedicated hand over area in close proximity to the mine portal where they will be received and monitored using the 'Track and Trace' system for explosive control and security. A day box will be provided in a suitable and secure location underground with a 24 hr storage limit in accordance with guidelines from the Health and Safety Authority, Mines Inspector.

Bulk Emulsion will be the main explosive product utilised for both development and production blasting. The explosive is formed from two parts; a non-explosive emulsion matrix and a non-explosive gassing agent. These two parts will be carried in bulk on a mine vehicle equipped with a proprietary emulsion pump. The pump delivers measured quantities of each product to a charging hose and a specially designed nozzle then mixes the two products as they leave the hose within the drill hole. It is only following this mixing that the explosive mixture is formed. The product offers considerable safety, security, environmental and operational advantage. Using pumped emulsion offers a dramatic reduction in the transport and storage requirements of conventional explosives. Pumped emulsion is classified as ammonium nitrate blasting intermediate (ANBI) with on-site storage licenced under the Local Authority through the Local Fire Officer with assistance from the Department of Justice, Inspector of Explosives.

2.7.17 Mine Portal - Mine Access Decline (Planning Drawing No. 24)

The existing mine portal currently backfilled with overburden and soil will be excavated and refurbished as required.

Materials excavated from the portal and decline will be stored in a designated rock storage area located adjacent to the site's carpark (this area was previously used for such purposes). Materials stored will be used to backfill and close the mine portal and decline area following cessation of mining.

2.7.18 River Goul Outfall Diffuser (Planning Drawing No. 25)

The existing River Goul Diffuser (outfall) will be utilised as the outfall for waters pumped from the water treatment ponds at the mine site, through the existing Goul pipeline (Figure 2.2).

2.7.19 Ventilation Shafts (Planning Drawing No. 26)

The six existing ventilation raises will be refurbished as part of the proposed development. Where the ventilation raises reach the surface, a surface housing of sheet metal construction on a metal frame (an evasse) will be erected, approximately 5.5 m by 4 m by 5.5 m high. Steel doors will be set in the wall of this construction for access and emergency escape purposes. The installation will be surrounded by a 2.5 m high security fence. Existing screen planting and landscaping will be maintained or enhanced to minimise the visual impact of the surface housing. No unauthorised access to the mine through these installations will be permitted.

2.7.20 Dewatering Pump Stations (Planning Drawing No. 27)

It is proposed that one of the dewatering pump stations previously established around the CW orebody will be refurbished (PW5A), with power being supplied with a generator.

At PW5A, the existing well head, there is a small section of above ground delivery pipe with an isolating valve. This will connect to the main collection pipe at the pump station by an underground pipeline. The delivery pipe from the well will be equipped with metering equipment and additional valve equipment at the pump station before its connection to the main collection pipe.

Installations at the pump station will be contained within a fenced compound, typically 8.5 m by 6 m by 2.5 m high.

In addition to the refurbishment of PW5A, it is proposed to drill additional temporary dewatering wells adjacent to the main access decline from surface to aid in initial mine dewatering (Figure 2.11).

2.7.21 Site Services

Access to the Plant Site and around the main site buildings is by a 9 m wide asphalt road. The road surface is crowned to adjacent drains to permit retention of any run-off water within the Plant Site.

Employee and visitor parking will continue to be provided outside the main entrance to the Plant Site within the overall site boundary. The carpark can accommodate approximately 80 cars and 2 coaches. All vehicles visiting the Site will be parked within the curtilage of the Site.

Other site roads on the Plant Site are constructed with crushed, well-graded gravel, laid on a sub-base.

Yard and laydown areas provided around the Plant Site and portal are of a gravel surface.

Complete access to all surface buildings will be available for fire-fighting purposes.

2.8 Health and Safety

A comprehensive employee Health and Safety programme will be instituted and maintained by Shanoon. A strong emphasis on safety training and safety awareness will be included in the normal working routines and appropriate safety equipment and practices will be employed in all aspects of the operation.

Wearing of safety equipment, including safety hats and boots, will be mandatory in all operational areas with wearing of safety glasses, gloves and hearing protection being required in specific locations.

A fully equipped Mine Rescue Room and a separate First Aid Room will be provided in the administration building. Training of employees will be provided in both respects, with intensive training of volunteer mine rescue teams forming an essential part of the safety programme.

2.9 Maintenance

Maintenance of underground and surface facilities will be carried out by electrical, mechanical, instrumentation and general engineering personnel.

Routine maintenance and servicing of all mining equipment will take place on surface in a designated workshop.

When required, off-site repair services will be used. Such services will include motor rewinding, tyre rethreading and specialist machine work. Maintenance and upkeep of other facilities (land, grounds, fencing, building exteriors and landscaping) will also be carried out as necessary.

2.10 Electric Power

The anticipated maximum power demand for the recommencement of mining at the Site is approximately 2.6 MW. Electrical power for the mine will be delivered from the main site substation by underground cables at the standard site distribution voltage of 6.6kV. The plant substation will include 6.6kV switchgear, transformers, 380V switchboards, motor control centres, 220V and lower voltage distribution boards. Special purpose supplies at 110V single phase and 24V single phase will also be provided in the concentrator and services buildings. In addition, electrically powered mining equipment will be fed by 660V trailing cables.

A number of portable standby diesel generators will be made available in the event of failure of the electrical supply.

The following critical drives will be supplied with standby generators in the event of a power failure:

- Mine dewatering pumps;
- Mine sump pumps;
- Mine ventilation system; and
- Goul discharge water pumps.

2.11 Waste Disposal

Hazardous and non-hazardous waste generated by the operation will be deposited into specially designed skips located at prescribed locations on the Plant Site. These will be collected for off-site disposal at a licenced waste facility by a private contractor. Packaging for reagents, which cannot be recycled, will be disposed of through a licenced waste disposal contractor who will collect all such materials on a regular basis for off-site destruction. Non-reusable metal reagent drums will be thoroughly cleansed on site, with washings being passed through the water treatment system. Washed drums will be crushed and then disposed of as scrap metal.

A new sewage collection system will be installed, with treated effluent being directed into the Water Treatment Pond before being discharged. Solid material from this plant will be disposed of off-site by a licenced contractor.

A waste oil storage tank (ca. 20 m^3) will be provided adjacent to the maintenance workshops for collection and storage of used engine oil and oil products removed from oil/water separators. This will be regularly collected for recycling by a licenced oil recycling operator.

2.12 Security

Signage located at the mine entrance from the public road will be displayed and include contact details of the mine operator, mine manager and safety officer. In addition, warning and 'No Unauthorised Access' signs will be maintained along the perimeter fence providing notice of mining activities.

A 2.5 m high, chain link, security fence has been constructed around the entire perimeter of the surface Plant Site. Vehicular entry to the Plant Site will be controlled by a bar gate across the main entrance road. This gate will be activated by either company-issued access cards or via remote control by security personnel located adjacent to the barrier in the gatehouse.

The existing perimeter security fence will continue to be checked monthly and after any incident. Records of checking, maintenance and repairs of the fence will be maintained in the EMS. The mine has a remotely monitored CCTV system installed, with cameras monitoring the entrance gates to the Site.

The Plant Site security fence separates the employee car park from the operating facilities. All employees will be required to pass the gate house to gain entrance to the offices and mine area. Vehicle access to all areas of the surface facilities will be strictly controlled.

Within the surface Plant Site, additional security fencing is installed around the storage compound and storage and substation areas. Security fencing will also be provided around the water ponds, mine dewatering pump station, and ventilation raise surface structures.

Security personnel will be on duty on the mine property at all times.

2.13 Site Lighting

Site lighting will be provided to enable safe surface operations on the Plant Site to continue and to ensure that site security can be maintained after dark. This will consist, largely, of lighting along the entrance roadway, exterior light fittings at strategic locations on the principal buildings and operational lighting at such installations as the main entrance, the gatehouse, the fuel dispensing bay, the water ponds and the mine portal area.

2.14 Emergency Plan

Emergency plans will be developed by the Company to deal with serious safety incidents that may arise within the operation. These will specifically address the following potential situations:

- Surface or underground fires;
- Power failure;
- Flooding;
- Major accidents either on or off site; and
- Significant chemical spillages on or off site.

Close liaison with the appropriate statutory authorities and emergency services in drawing up, testing and implementing these plans will take place.

Hand-held fire extinguishers of the appropriate category will be strategically placed in all areas of the surface and underground facilities. Fire protection underground will be largely by means of fire extinguishers. All mobile equipment will be equipped with such units, in addition to which major items of mining equipment will have automatic fire detection and suppression systems installed on them.

An addressable fire alarm system will be provided, with its annunciator located on surface in the security office. This unit will respond to a drop-in fire-fighting water system pressure caused by opening of standpipe valves, or operation of sprinklers, actuation of smoke or heat detectors or actuation of manual alarm units.

Manual fire alarm points will also be provided at strategic locations underground and on surface.

Emergency escape provisions will be provided for all areas of the mine requiring a personnel presence. Multiple entrance and exit points for all principal surface buildings will be provided with emergency exit direction and location signs.

In the case of the underground mine workings, escape can be achieved either by means of the access declines or the ladder-ways in the ventilation raises. Parallel control of the main mine ventilation fans will be provided at the surface. Operation of these fans in an underground fire will be such as to enable safe evacuation of the mine workings either by means of the decline or the ventilation raises.

All personnel operating underground will be equipped with a battery-powered cap lamp and a self-rescuer (that can provide sufficient oxygen to allow an employee to get to safety). Refuge chambers with sufficient clean air to survive for ca. 40 hours will be located at strategic locations underground. Emergency lighting will be provided at the underground crusher station, in the access declines and lunch room areas.

2.15 Mine Closure

Legislation and Best Contemporary Practice require that a Mine Closure Plan (MCP) be prepared to facilitate a controlled exit from any redundant mine in order to minimise the long-term environmental liabilities. Adequate financial provision must be made for closure and the plan should incorporate both physical rehabilitation and socio-economic considerations. The MCP must be regularly reviewed and updated to meet new and revised regulations to ensure that an assessment of the environmental liabilities have sufficient financial security to address these liabilities. The objective of the MCP is to ensure that, after mining operations cease, the site does not present a hazard to public health and safety or an environmental liability as a result of physical and chemical deterioration.

The mine's previous operator, Galmoy Mines Ltd. produced a Mine Closure Plan (MCP) in line with legislative requirements linked to the original planning permission granted in 1994 and the IPPC Licence granted in 2002. A number of revisions were undertaken throughout the life-of-mine to reflect changes in legislative requirements, operational circumstances and new technologies.

In 2008, Galmoy Mines Ltd. entered into advanced discussions with all stakeholders (EPA, DCENR, KCC, Laois County Council (LCC), and South Regional Fisheries Board (SRFB)) to agree a planned and comprehensive closure of the mine by means of the non-statutory Mine Closure Committee. The criteria for successful rehabilitation were clearly outlined and were achieved through the Closure, Restoration and Aftercare Management Plan (CRAMP). Active and Passive Care periods have been completed with a clearly defined Monitoring Programme. Provision is being finalized by the current owner of the Site (including the TMF) for the longer term aftercare.

The overall objective of Mine Closure is to achieve stable physical and chemical environmental conditions and a land use compatible with the adjacent countryside. Specifically, it is Shanoon's intention that:

- The underground workings and infrastructure will be decommissioned (ensuring long-term mine stability);
  - Most plant and equipment will be removed from underground for scrap or resale. Any fixed plant left underground will be drained of oils and cleaned to remove any hydrocarbon residues. All services will be removed from the length of the decline and it will be sealed off and filled with clean demolition rubble.
- The major part of the Plant Site will be decommissioned and rehabilitated to a state where the site can be developed and used for other enterprises by;
  - Cleaning and removing plant; and
  - Removal of certain infrastructure/services.
- The mine portal will be sealed and backfilled;
- The ventilation shafts will be backfilled and sealed;
- Waste materials and residues will be removed off-site to a licenced facility; and
- Monitoring will be undertaken on a phased basis (i.e. active and passive, leading to long-term aftercare monitoring and securing of a mine closure certificate).

Figure 2.14 presents the proposed restoration plan for the Site once mining has ceased and the water-table has rebounded.

The existing Closure, Restoration & Aftercare Management Plan (CRAMP) for the Galmoy Mine will be adapted, updated and agreed with the EPA for the recommencement of mining at the Site.

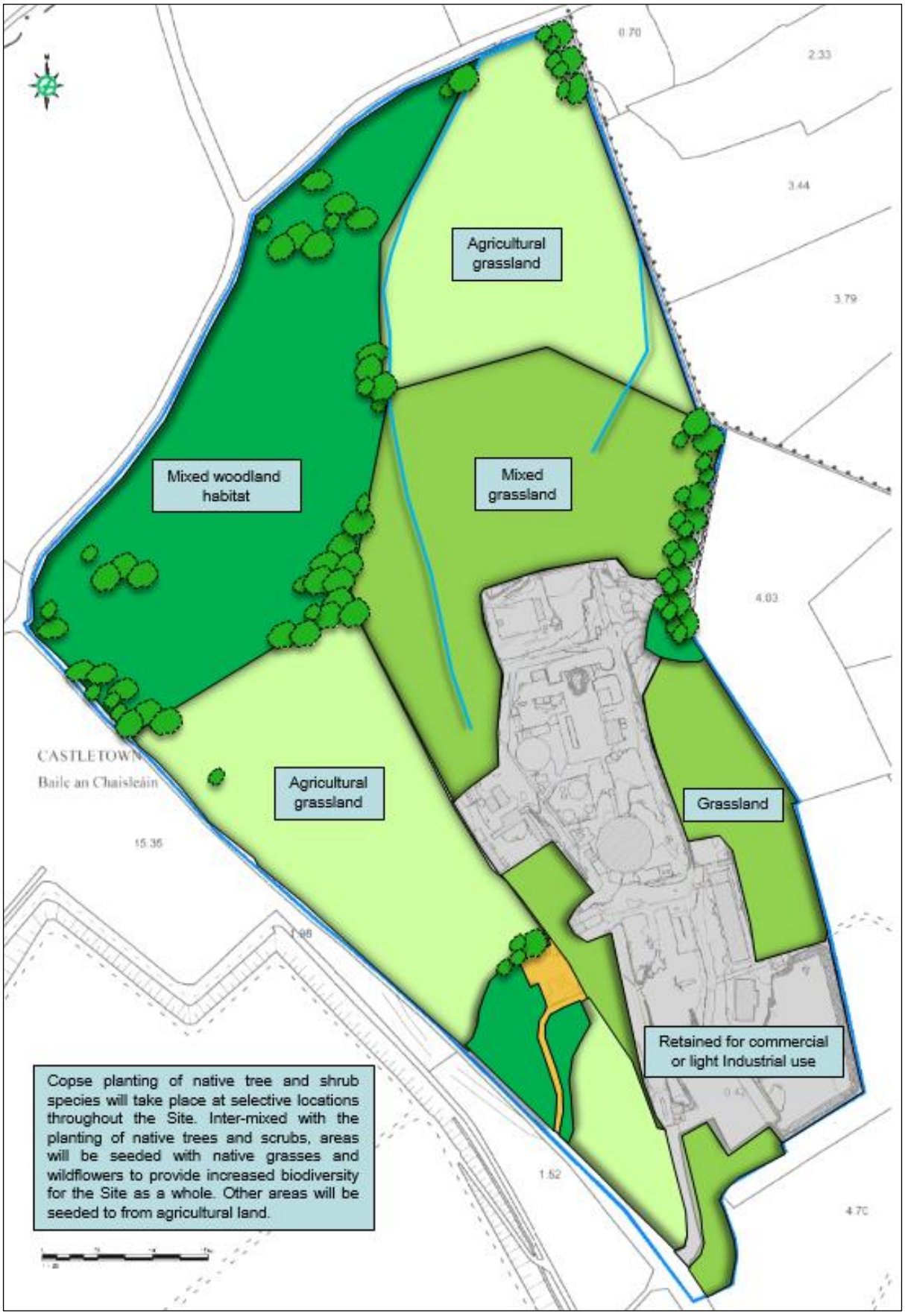

Figure 2.14: Proposed restoration plan for the mine Plant Site

2.16 Monitoring

An Environmental Management System (EMS) for the Site will be maintained and updated, with regular environmental monitoring of noise, vibration, dust, water quality and water discharge to ensure that they remain within permitted levels for the life of the mine. Figure 2.15 presents the location of the proposed monitoring points for the development.

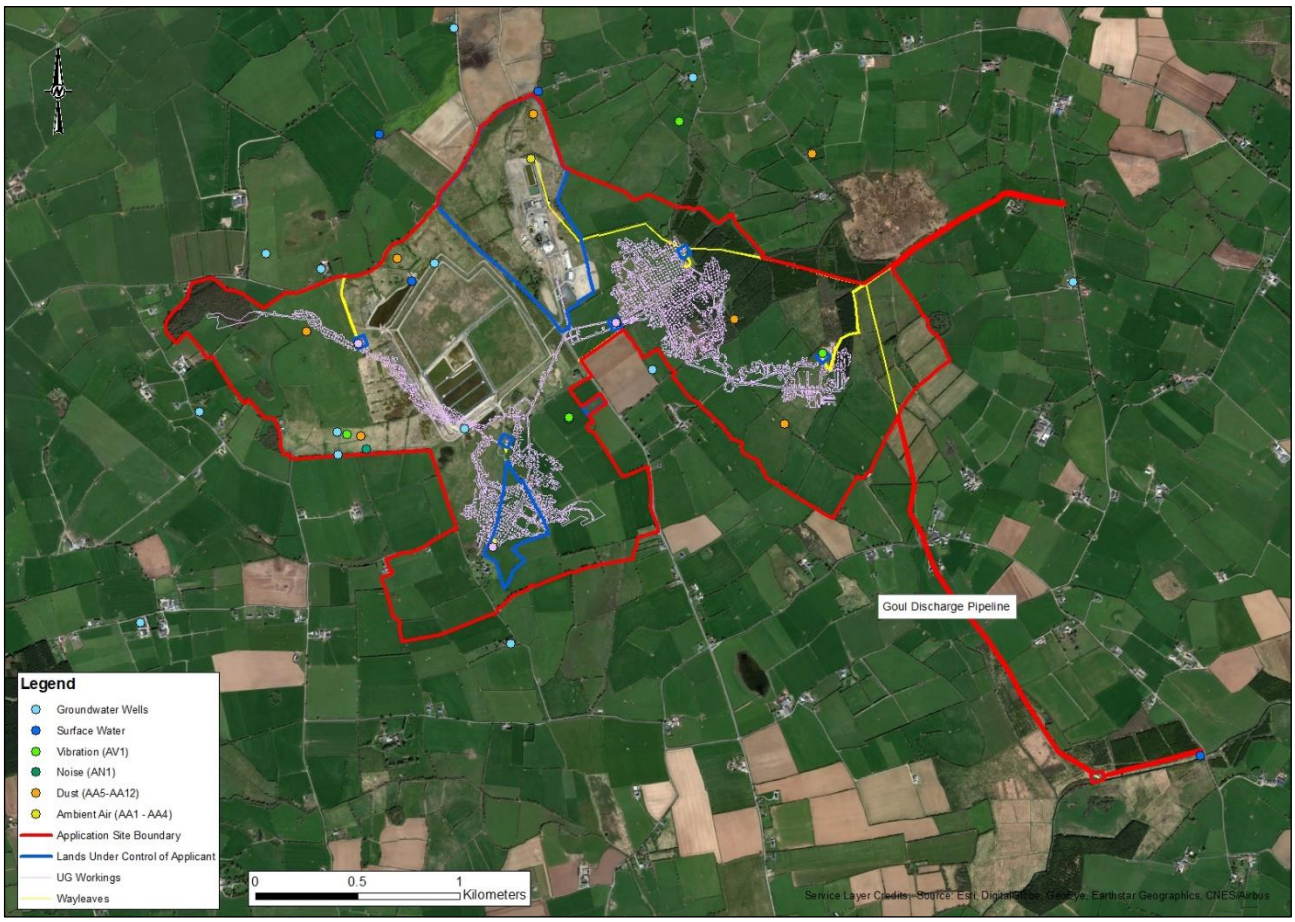

Figure 2.15: Proposed monitoring locations

Shanoon intends to apply for an Integrated Pollution Control Licence/Industrial Emissions Licence (IPCL/IE) from the Environmental Protection Agency (EPA). The environmental management and monitoring requirements defined in the Licence will be fully incorporated into the EMS.

Any complaints received will be logged in a Complaints Register which will be maintained on site as part of the EMS.

A comprehensive monitoring system will be put in place to provide monitoring of environmental parameters. The system will provide monitoring of:

- Dirty mine water volumes pumped for treatment;
- Status of the mine water treatment plant;
- Quality of the Water Treatment Pond, Groundwater Conditioning Pond and the discharge with respect to pH; conductivity; dissolved oxygen and temperature;
- Discharge rates from each of the ponds and the volumes pumped to the River Goul; and
- Quality (including composite sampling) and flow of the River Goul both upstream and downstream of the discharge point with respect to pH; conductivity, dissolved oxygen and temperature.

In addition to the monitoring data display and data storage functions the system will provide a control of all equipment associated with water flows, water treatment and discharges.

There are safety features built into the system for environmental protection purposes. The four parameters, pH, conductivity, dissolved oxygen and temperature, which are continuously monitored in the discharge have pre-programmed upper and lower limits. If the quality of the discharge drifts outside of these limits an alarm will register to alert the operator. During normal working hours the alarm will be responded to by environmental staff. At all other times the alarm will be responded to by security staff. In this way 24-hour coverage will be is provided.

An environmental laboratory will be provided in the administration building and will be equipped to meet all of the routine monitoring requirements at the mine and will utilise standard analytical techniques.

2.17 Planning context

2.17.1 Planning Permission

The original planning (and EIS) for the development of Galmoy Mine was submitted to Kilkenny County Council on 27 December 1992 (Pl. Ref. No: 92/884), with a decision for permission being granted on 27 July 1993.

An application (including EIS) to extend the underground workings was submitted on 30 September 1999 (Pl. Ref. No: 99/1371), with permission being granted on 7 May 2002.

A subsequent application (and EIS) to extend the existing underground mine was submitted on 22 May 2003 (Pl. Ref. No: 03/804). Permission was granted on 01 June 2004.

An application (and EIS) to extend the underground workings into County Laois was submitted to Laois County Council on 06 March 2008 (Pl. Ref. No: 08/294), with permission being granted on 07 October 2008. A summary table of planning applications and consents for developments associated with the Galmoy Mine in Counties Kilkenny and Laois is included in Appendix 2.2.

2.17.2 IPPC Licence

Mining and processing of ore ceased at the Site in 2009, with the extraction of ore on a small scale commencing again in early 2010 before final cessation of mining in 2012. Planned flooding of the mine workings was completed in April 2014. The IPPC Licence Reg. No. P0517-02 for the mine was reduced in size to cover only the Tailings Management Facility (TMF) in 2015.

The previous operator of the mine at Galmoy, Galmoy Mines Ltd. held a total of five State Mining Licences (SML1, 6, 8, 8 and 10) over the life of the operation (Figure 2). These licences were relinquished in 2016 and will be re-applied for.

2.17.3 Kilkenny County Development Plan Context

The County Kilkenny Development Plan 2014 - 2020 sets out Kilkenny County Council's strategy for the proper planning and sustainable development of the County. Section 6.4 of the plan, Extractive Industries, states that:

"The County had a large lead-zinc deposit at Galmoy, which was worked as Galmoy mines, but which is now closed. There are numerous sand and gravel and stone resources within the County currently in operation. The Council recognise the importance of extractive industries to the local and national economy as valuable sources of raw material for industry in general and the construction industry in particular and as an important source of employment. However, the industry can have serious detrimental impacts on the landscape and amenities generally, including traffic generation, vibration, dust, noise, water pollution and visual intrusion."

The development management standards presented in the plan for the Extractive Industry in the county states that:

- *"The Council will have regard to the following:*
  - *Quarries and Ancillary Activities, Guidelines for Planning Authorities;*
  - *The ICF Environmental Code;*

- *Environmental Management Guidelines, Environmental Management in the Extractive Industry;*
- *Undertaking non-energy extractive activities in accordance with Natura 2000 requirements;*
- *To NPWS Guidelines for the protection of Biodiversity within the Extractive Industry and the GSI's Geological Heritage Guidelines for the Extractive Industry; and*
- *The Archaeological Code of Practice agreed between the ICF and the National Monuments Division in Section 6.4.2 Development Management Standards.*

- *The Council will require adherence to the EPA Guidelines – Environmental Management in the Extractive Industry as a standard for the extractive industry in Kilkenny.*
- *Ensure that all existing workings shall be rehabilitated and that all future extraction activities will allow for extraction activities will allow for the rehabilitation of pits and proper land use management.*
  - *The Council may require that development is phased and that each phase is rehabilitated before the next phase is developed/commenced;*
  - *The Council shall require applicants to submit a restoration programme with their application on the manner and timing of restoration; and*
  - *The Council will consider the current land/quarry resource of the applicant and may seek that current quarries are restored before new sites are developed*.
- *To minimise environmental and other impacts of mineral extraction through rigorous application of licencing, development control and enforcement requirements for quarry and other associated developments including, but not limited to, consideration of visual impacts, methods of extraction, noise levels, dust prevention, protection of ground and surface waters, 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.*
- *Ensure that any extractive development does not significantly impact on existing public rights of way, walking routes, or tourist or recreational activities.*
- *The Council will consider the current land/quarry resource of the applicant and may seek that current quarries are restored before new sites are developed."*

2.17.4 Laois County Development Plan Context

The Laois County Development Plan 2017 - 2023 acknowledges that there is an increasing demand for aggregates and that new areas for extraction of aggregates and minerals will be needed in the county. To address this the Council notes that planning policies should be carefully constructed to avoid adverse effects on aggregate resources and related extractive industries. The Council refers to the *National Guidelines on Quarries and Ancillary Activities for Planning Authorities* (DOEHLG, 2004) as the guiding document for these developments. Section 3.7 (Extractive Industry) of the Landscape Character Assessment states the following;

"Mineral extraction is a significant industry and demand for aggregates is certain to continue notwithstanding the current economic recession. There are already a large number of quarries and pits in County Laois and large areas identified as having high aggregate potential, particularly in the south of the county. There are also the remnants of slag heaps associated with the now defunct coal mining industry centred on Wolfhill and Rossmore. Any future development must be carefully planned to avoid necessary adverse landscape impacts."

Section 4.2 (Infrastructure and Industry) of the Landscape Character Assessment highlights the following;

"The demand for aggregates will continue with increased development of the country. It is likely that quarries may be extended or new areas for mineral extraction created to meet demand."

The Council recognises that extractive industries contribute to the economy at national, regional and local levels but there is the potential for these industries to have a detrimental effect on the environment, heritage and landscape if they are not managed and designed appropriately. The Council further states that if the development is properly designed and managed, the environmental effects can be minimised, and the development can have a positive effect on the environment through habitat creation.

"Aggregate extraction can only take place where suitable resources exist; they are a 'tied' resource. It is considered, therefore, that planning policies should be carefully constructed to avoid adverse effects on aggregate resources and the related extractive industries and added value production that are essential for the built environment.

Like many forms of development, extractive industries have the potential to cause harm to the environment, heritage and the landscape if not appropriately designed and managed. However, aggregates are a necessary resource and are of great importance to the economy and society. In addition, well managed and designed sites minimise environmental effects. There is also the potential for habitat creation through the restoration of quarry sites following the cessation of operations."

The Council states that the following National Guidelines (as may be superseded and/or updated) should be complied with in relation to Mining and Aggregate developments:

- Environmental Management (EPA 2006);
- Quarries and Ancillary Activities: DOECLG Guidelines 2004);
- Environmental Code (ICF 2006);
- Geological Heritage Guidelines (ICF & GSI 2008);
- Archaeological Code of Practice (ICF & DOEECLG 2009); and
- Sections 261 & 261A Planning and Development Acts 2000 - 2013.

2.17.5 Policies

National, regional and local planning policies relevant to the proposed extraction at Garrylaun include:

- National Spatial Strategy for Ireland 2002 - 2020;
- South-East Regional Planning Guidelines for the South-East Region 2012 - 2022;
- Kilkenny County Development Plan 2014 - 2020;
- Laois County Development Plan 2017 - 2023; and
- Draft River Basin Management Plan for Ireland (2018 - 2021).

2.17.6 County Development Plan Designations and Context

The proposed development lies inside the administrative boundaries of Kilkenny County Council and Laois County Council. Therefore, in addition to the above mineral policies and objectives of both County Development Plans, the Plans' provisions in relation to land use zoning, landscape, natural and built designations and development management guidance will inform the EIAR.

References

- EU Environmental Impact Assessment Directive (Council Directive 85/337/EEC).
- EU (2001). Guidance on EIA Scoping.
- Guidelines on the Information to be contained in Environmental Impact Statement. Environmental Protection Agency, Johnstown Castle Estate, Co. Wexford, Ireland. EPA. 2002.
- Advice Notes on Current Practice in the preparation of Environmental Impact Statements (Environmental Protection Agency, 2003).
- Department of the Environment, Quarries and Ancillary Activities, Guidelines for Planning Authorities 2004.
- Environmental Management in the Extractive Industry: Guidelines for Regulators 2006.
- Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment (Department of Environment, Community and Local Government, 2013).
- Institute of Geologist of Ireland (2013). Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements.
- Draft - Revised Guidelines on the Information to be contained in Environmental Impact Statements. EPA 2015.
- Advice Notes on Current Practice in the preparation of Environmental Impact Statements (Environmental Protection Agency, 2003), and, Advice Notes for Preparing Environmental Impact Statements (Draft, Environmental Protect Agency, 2015).
- Key Issues Consultation Paper - Transposition of 2014 EIA Directive (2014/52/EU) in the Land Use Planning and EPA Licencing Systems, 2nd May 2017.
- Circular Letter PL 1/2017 - Implementation of Directive 2014/52/EU on the Effects of Certain Public and Private Projects on the Environment (EIA Directive), 15th May 2017.
- Laois County Council. Laois County Development Plan 2017 – 2023.
- Kilkenny County Council. Kilkenny County Development Plan 2014 – 2020.
- Kilkenny County Council. Appendix C – Landscape Character Assessment, Kilkenny County Development Plan 2008 - 2014.
- Archaeological Survey of Ireland Sites and Monuments Database: http://webgis.archaeology.ie/historicenvironment/ Accessed 10 January 2018.
- Environmental Protection Agency Envision Map Viewer:

  https://gis.epa.ie/EPAMaps/ Accessed 19 December 2017.
- Geological Survey of Ireland Datasets Public Viewer: http://dcenr.maps.arcgis.com/apps/MapSeries/index.html?appid=a30af518e87a4c0ab2fbde2aaac3c228 Accessed 19 December 2017.
- National Parks and Wildlife Service Mapviewer:

  http://webgis.npws.ie/npwsviewer/ Accessed 19 December 2017.

3.0 POPULATION AND HUMAN HEALTH

3.1 Introduction

This Chapter of the EIAR describes the human environment and identifies and assesses the potential impacts from the mining related activities proposed at the Application Site. The human environment is discussed under the following headings:

- Land-use and social considerations;
- Populations;
- Economic Activity and employment;
- Tourism, Recreation and Amenity;
- Traffic; and
- Health and Safety.

Interactions between population, human health and other facets of the environment are discussed under relevant sections of this EIAR. Headings under which the appropriate issues have been identified and considered include:

- Biodiversity (Chapter 4.0);
- Water (Chapter 6.0);
- Air Quality and Climate (Chapter 7.0);
- Noise (Chapter 8.0);
- Vibration (Chapter 9.0); and
- Landscape (Chapter 10.0).

3.2 Methodology

Information for the assessment of potential impacts on human beings was obtained by means of a desk-based review, and included the following sources:

- Census Returns (Central Statistics Office (CSO) 1991, 1996, 2002, 2006, 2011 and 2016 Census);
- Kilkenny County Council Development Plan (2014 - 2020);
- Field surveys of the Application Site;
- DCCAE Eircode maps; and
- Aerial and ordnance survey maps of the area.

The existing / past environment is described. Any impacts from the mining related activities at the Site are identified and assessed, and where possible mitigation measures are proposed. The EPA's '*Guidelines on the Information to be contained in Environmental Impact Assessment Reports'* (August 2017) has been considered in identifying the assessment environmental/human health linkages.

3.3 Environment

3.3.1 Land-use and Social Consideration

The location of the Application Site in a regional context is presented in Figure 3.1. The Application Site comprises lands previously used by Galmoy Mine for the mining of zinc and lead ore. The Galmoy Mine is currently in its closure and aftercare phase with no mining related activity currently taking place on site. The Application Site is located predominantly within County Kilkenny with a small area of the underground workings extending into County Laois. The Application Site traverses two Electoral Divisions and nine Townlands in total. The Application Site spans eight of the twelve townlands in the Galmoy electoral division and one of the nine townlands in the Kyle South electoral division. The relevant counties, electoral divisions and townlands are listed in Table 3.1 below.

Table 3.1: Application Site County, Electoral Divisions and Townlands

County	Electoral Division	Townland
Kilkenny	Galmoy	Castletown ('Plant Site')
		Garrylaun
		Moneynamuck (Stopford)
		Rathbane
		Rathpatrick
		Rathreagh
		Waterland
		Whiteswall
Laois	Kyle South	Kyle

The lands surrounding the Site are predominantly used for agricultural purposes, the dominant agricultural use is livestock grazing, either by cattle or sheep. There is some sparse residential housing in the area, however this is primarily concentrated to linear ribbon settlements along local roads and the R435. The Application Site is also accessed via the regional road R435.

Figure 3.3 highlights residences which lie within 250 m and 500 m of the Plant Site boundary (comprising 4 and 2 residences respectively). Figure 3.4 highlights the residences which lie within 250 m and 500 m of the above ground section of the ventilation shafts. One residential dwelling is located within 250 m of the G-South ventilation shaft and one other residence is located within 500 m of the G-North ventilation shaft.

Figure 3.5 identifies the residential dwellings that occur within the Application Site boundary, and within 250 m and 500 m of the boundary.

The number of residences is based on a review of the aerial photograph and dwellings identified by the Department of Communications, Climate Change and Environment mapping resources. Housing stocks within the two electoral divisions during the 2011 and 2016 censuses are listed in Table 3.2. It is noted that the housing stock has remained relatively consistent between 2006 and 2011, however small increases were noted between 2006 and 2011.

Table 3.2: Housing Stock in Galmoy and Kyle South Electoral Divisions during the 2006, 2011 and 2016 censuses.

Electoral Division	Housing Stock - 2006	Housing Stock - 2011	Housing Stock - 2016
Galmoy	106	114	112
Kyle South	97	101	102

There are five SAC's and one SPA within 15 km of the Site (Figure 3.1). In addition, there are eight pNHAs within 10 km of the Site (Figure 3.2). In terms of the proximity to the Site, the Galmoy Fen is situated closest at ca. 460m from the R ventilation shaft. Other statutory protected sites are situated > 3km from the red line Site boundary. The sites are:

- Galmoy Fen SAC and pNHA;
- Cullahill Mountain SAC and pNHA;
- Spahill and Clomantagh Hill SAC and pNHA;
- The Loughans SAC and pNHA;
- River Nore SPA;
- River Barrow and River Nore SAC;
- The Curragh and River Goul Marsh pNHA;
- Coolacurragh Woods pNHA;
- Grantstown Woods pNHA; and
- Cuffsborough pNHA

Further details regarding these ecological designations are included in Chapter 4.0 of this EIAR.

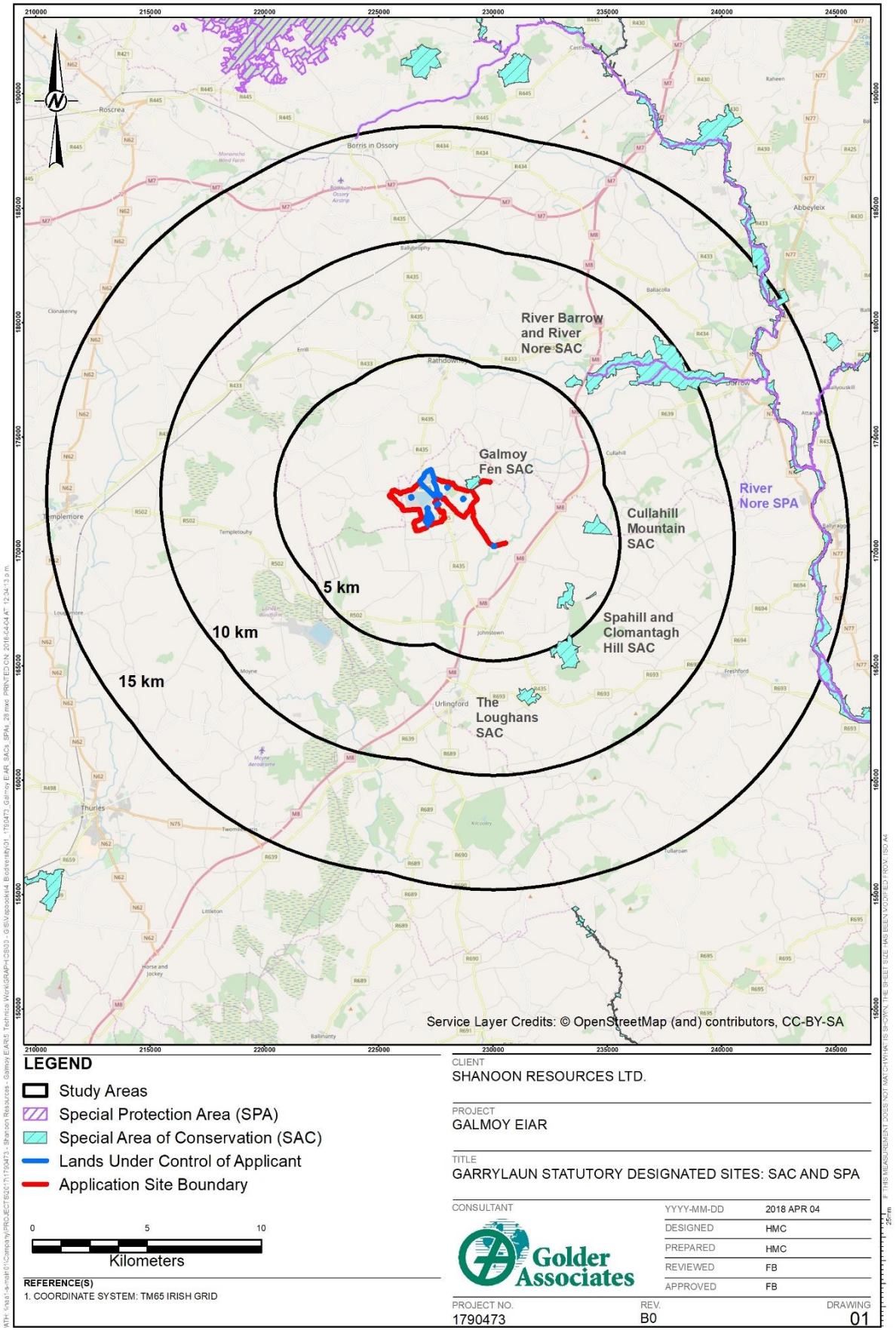

Figure 3.1: Garrylaun project in a regional context – SAC and SPA sites within 15 km of the Project Site.

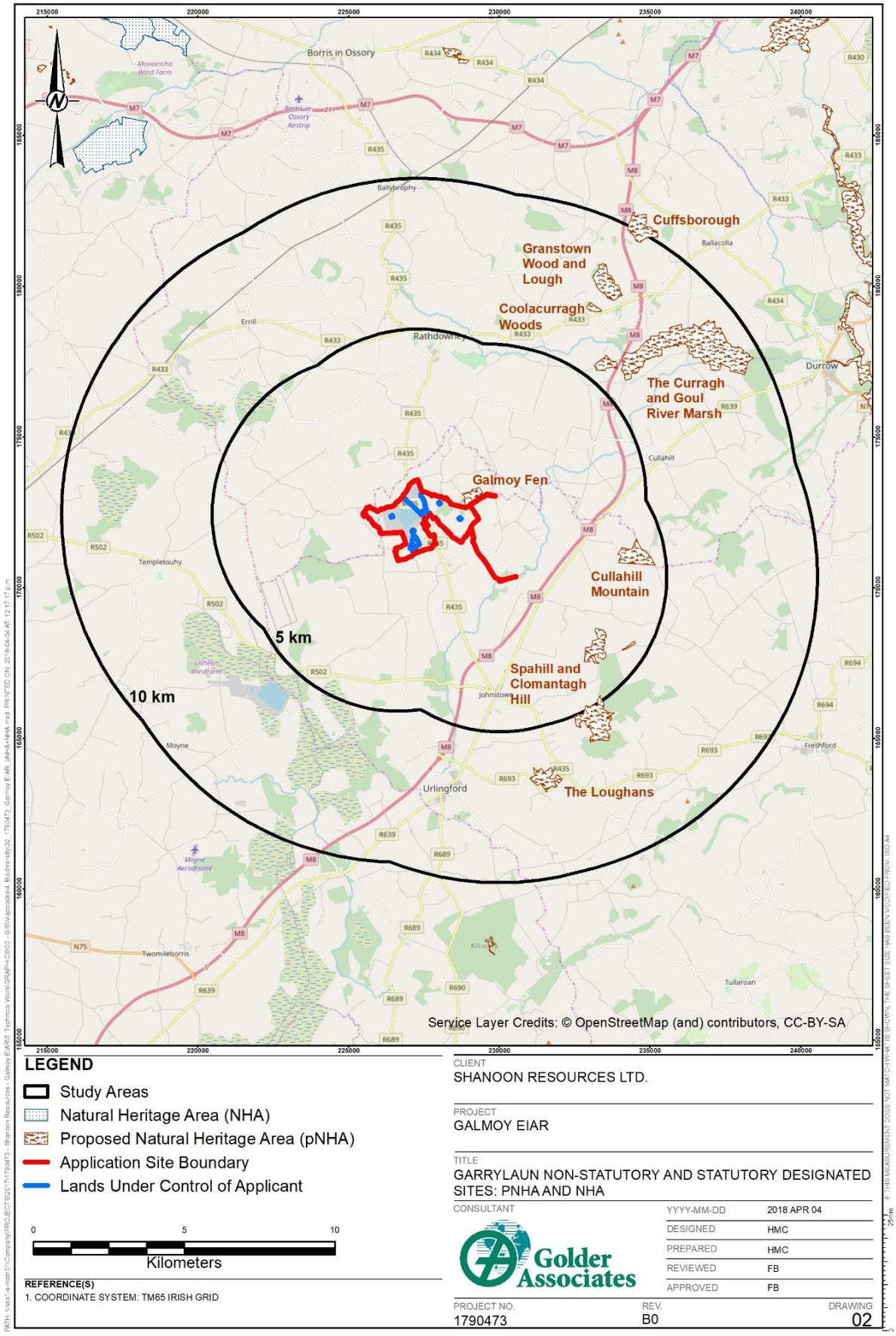

Figure 3.2: Garrylaun project in a regional context – NHA and pNHA within 10 km of the Project Site

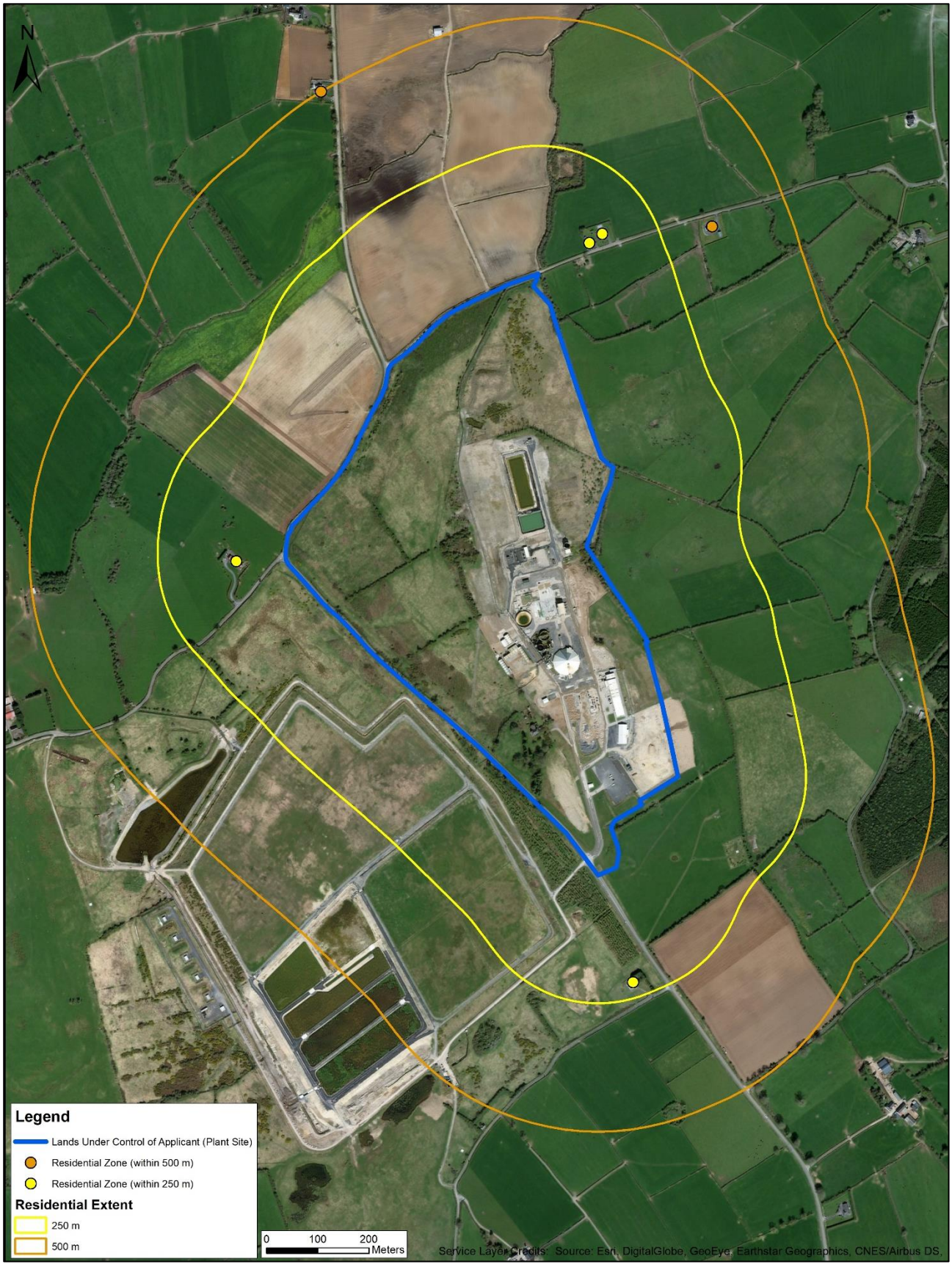

Figure 3.3: Residential dwellings which occur within 250 m and 500 m of the main Garrylaun Plant Site.

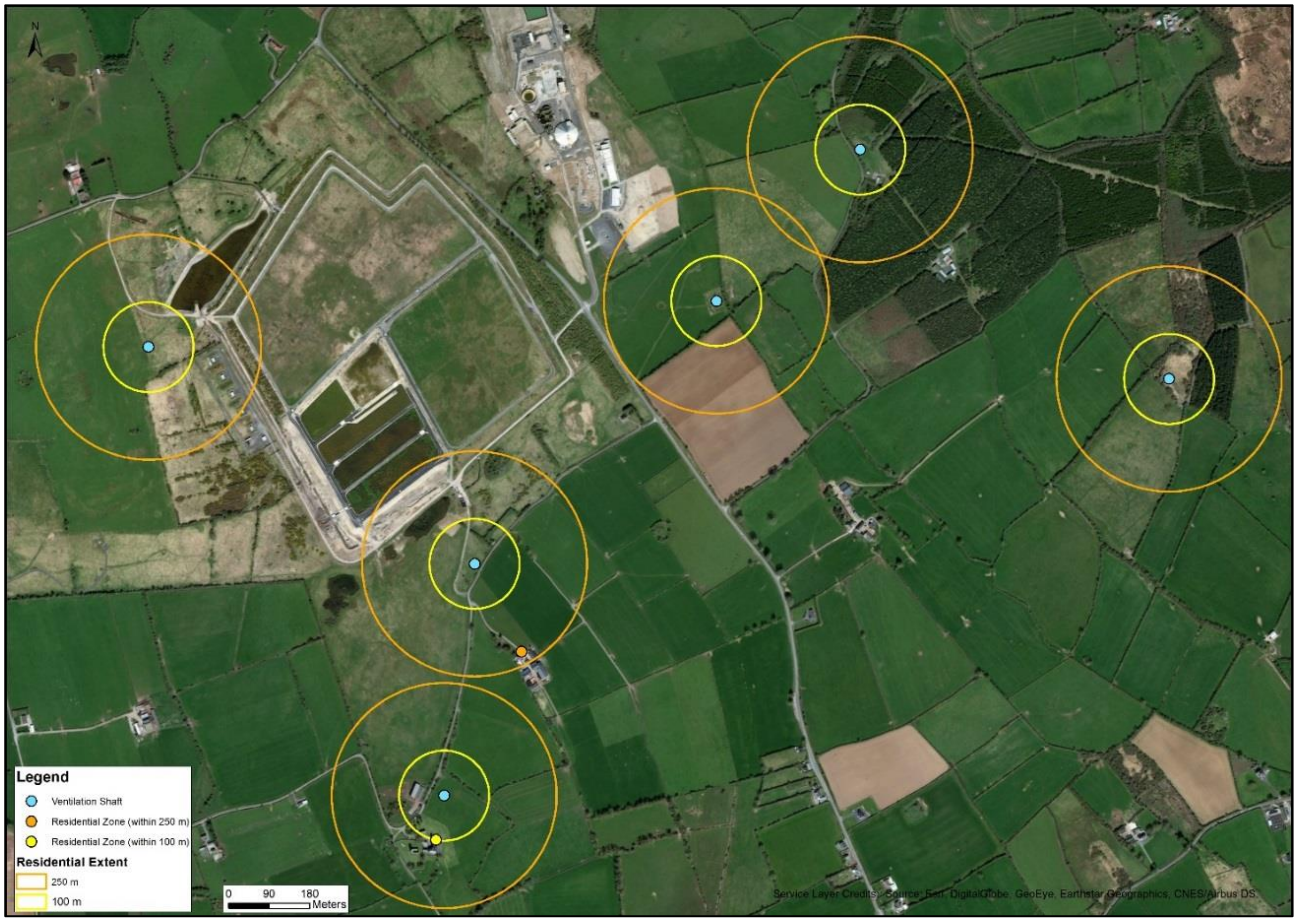

Figure 3.4: Residential dwellings which occur within 250 m and 500 m of the surface sections of the Garrylaun ventilation shafts.

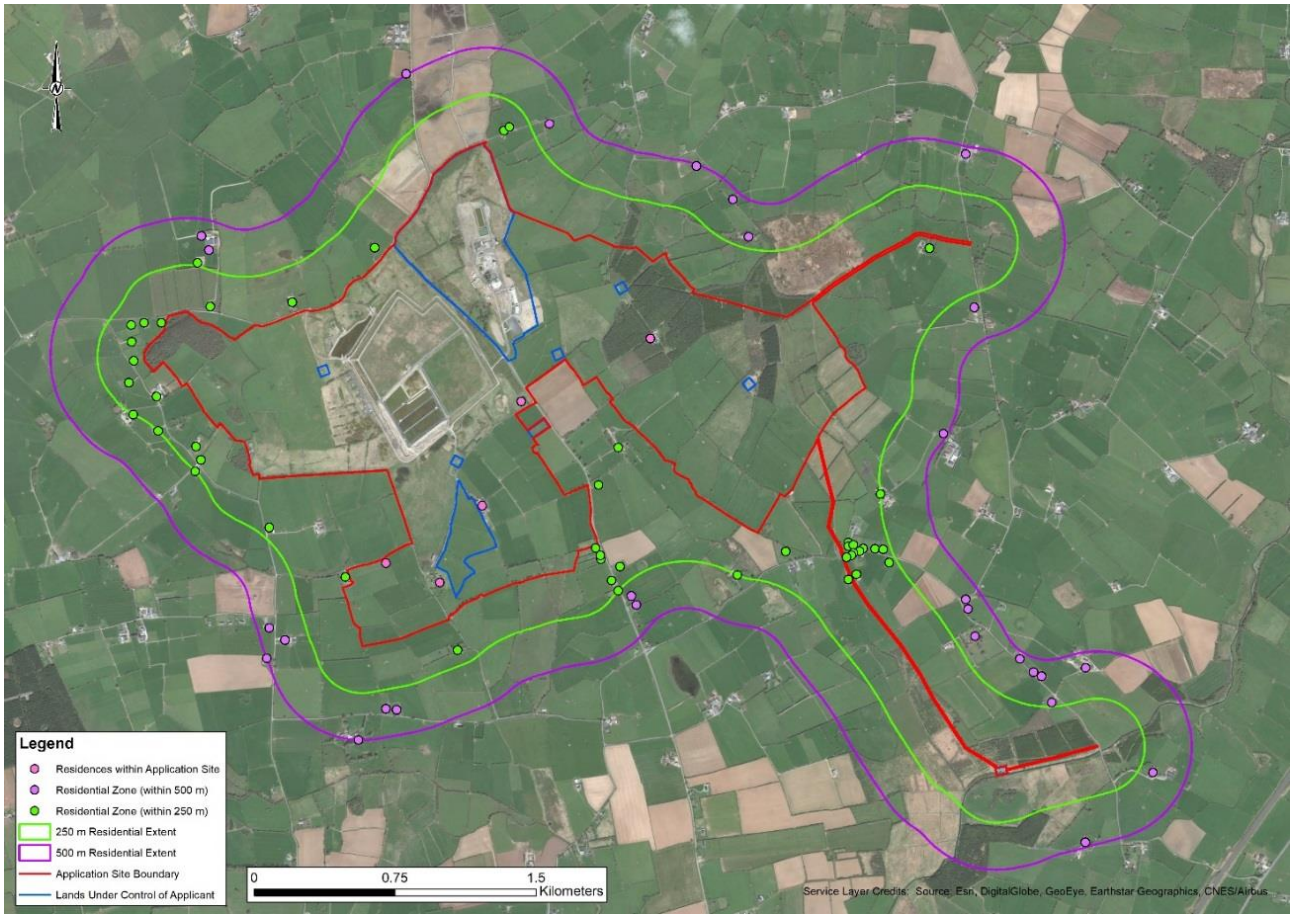

Figure 3.5: Residential dwellings which occur within the Application Boundary and within 250 m and 500 m of the Application Boundary.

3.3.2 Populations

The census reports for 1991, 1996, 2002, 2006 and 2011 produced by the Central Statistics Office (CSO) presents population figures in terms of district electoral divisions and their respective populations. The Applicant Site is located between two Electoral Division, Galmoy and Kyle South. Population statistics for these are presented in Table 3.3. The figures indicate that populations have remained relatively consistent with small increases and declines in population since 1991. Populations in the electoral divisions have remained relatively consistent from the 1991 to the 2016 census, which is in contrast to the increase populations seen in both Co. Kilkenny, Co. Laois and nationally. This suggests that the main population rises are within the larger county towns.

Table 3.3: Population Statistics for National, County and Electoral Divisions between 1991 and 2016

Year	1991	1996	2002	2006	2011	2016
Galmoy ED Population	329	280	283	286	304	312
Percentage Increase	-	*-14.89%*	*1.07%*	*1.06%*	*6.29%*	*2.63%*
County Kilkenny Population	73,635	75,336	80,339	87,558	95,419	99,232
Percentage Increase	-	*2.31%*	*6.64%*	*8.99%*	*8.98%*	*4.00%*
Kyle South ED Population	277	288	287	282	281	291
Percentage Increase	-	*3.97%*	*-0.35%*	*-1.74%*	*-0.35%*	*3.56%*
County Laois Population	73,635	75,336	80,339	87,558	95,419	99,232
Percentage Increase	-	*2.31%*	*6.64%*	*8.99%*	*8.98%*	*4.00%*
National Population	3,525,719	3,626,087	3,917,203	4,239,848	4,588,252	4,761,865
Percentage Increase	-	*2.85%*	*8.03%*	*8.24%*	*8.22%*	*3.78%*

3.3.3 Economic Activity

The Application Site is located along the R435 regional road, approximately 7 km south of Rathdowney, Co. Laois and approximately 7 km north of Johnstown, Co. Kilkenny. The town of Rathdowney would be the closest employment centre to the Application Site, however with the good road network in the area (including the M8 motorway) it is likely that residents travel to other centres in the regional. These economic centres would include Roscrea (ca. 20 km to the NW), Thurles (ca. 28 km to the SW), Portlaoise (ca. 39 km to the NE) and Kilkenny City (ca. 30 km to the SE).

When operational the former mining operation at Galmoy Mine contributed significantly to the local, regional and national economies. At the height of the operation the former mine provided employment for approximately 200 people on a full-time and seasonal basis through its mining activities and generated significant indirect employment in various service and supply industries.

Census 2016 statistics show the largest employment industry in the Galmoy ED is the agricultural industry totalling 30.6 % of the workforce (Table 3.4). This is followed by professional services and commerce and trade (both 16.9 %). A similar employment distribution was found in the Kyle South ED during the 2016 census with agriculture being the dominant sector followed by professional services and commerce and trade. A comparable division in employment sectors was also noted in previous censuses of 2011 and 2006 (Table 3.5). This distribution would be typical of electoral divisions in rural areas located away from large towns and cities.

Table 3.4: Employment Structure Classified by Broad Occupational Group for the Galmoy and Kyle South Electoral Divisions for the 2011 and 2016 censuses

Galmoy Industry	2011	%	2016	%
Agriculture, forestry and fishing	32	27.1	38	30.6
Building and construction	8	6.8	11	8.9
Manufacturing industries	18	15.3	10	8.1
Commerce and trade	25	21.2	21	16.9
Transport and communications	6	5.1	4	3.2
Public administration	3	2.5	5	4.0
Professional services	24	20.3	21	16.9
Other	2	1.7	14	11.3
Total	118	100	124	100
Kyle South Industry	**2011**	**%**	**2016**	**%**
Agriculture, forestry and fishing	32	27.8	29	24.4
Building and construction	6	5.2	4	3.4
Manufacturing industries	16	13.9	16	13.4
Commerce and trade	21	18.3	18	15.1
Transport and communications	2	1.7	4	3.4
Public administration	6	5.2	9	7.6
Professional services	23	20.0	28	23.5
Other	9	7.8	11	9.2
Total	115	100.0	119	100.0

Table 3.5: Employment Structure Classified by Broad Occupational Group for the Galmoy and Kyle South Electoral Divisions for the 2006 census.

Industry	Galmoy	%		Kyle South	%
Farming, fishing and forestry managers	31	23.8		36	26.3
Other agricultural workers	2	1.5		6	4.4
Manufacturing workers	16	12.3		18	13.1
Building and construction workers	10	7.7		10	7.3
Clerical and office workers	13	10.0		9	6.6
Administrative and Government workers	9	6.9		4	2.9
Transport workers	2	1.5		5	3.6
Sales workers	13	10.0		13	9.5
Professional workers	18	13.8		16	11.7
Service workers	7	5.4		10	7.3
Other workers	9	6.9		10	7.3
Total	130	100		137	100

Table 3.6 below presents the time travelled by the population of Galmoy and Kyle South EDs to school, college or work, obtained from the Central Statistics Office from Census 2016.

Table 3.6: Number of persons in Electoral Division population aged 5 years and over by journey time to work, school or college

Time	Galmoy	Kyle South
Under 15 mins	56	52
1/4 hour - under 1/2 hour	26	39
1/2 hour - under 3/4 hour	29	22
3/4 hour - under 1 hour	16	24
1 hour - under 1 1/2 hours	16	6
1 1/2 hours and over	11	11
Not stated	13	18
Total	167	172

Currently the Site employs ca. 30 persons in a variety of roles. Staffing levels at the Site have decreased since the cessation of mining in 2012.

The employment opportunities offered close to the area has resulted in a growing, family orientated area, where the population would be expected to stabilise, as has been the case between since 1991 where populations have remained relatively consistent in the area. The proposed development will help to increase local employment levels and also draw on the pool of people with previous mining experience from both Galmoy and Lisheen mines.

3.3.4 Agricultural Environment

As agriculture is the predominant land use in the overlying area in the vicinity of the mine and is also the main sector of employment for the two EDs, impacts on the agricultural environment will be considered separately in this assessment.

The proposed mining activities have the potential to impact local agricultural through dust emissions, effects on the local hydrogeological and hydrological regime, and through noise and vibration. Dust emission from mining operations can lead to possible contamination of soil and herbage, in turn leading to contamination of crops and animal feedstuffs. Changes in the hydrogeology and hydrology can effect soil quality and the availability of water. Nuisance noise and vibration can cause effects in animal health and, in particular to the area, milk yields in dairy cattle.

3.3.5 Tourism, Recreation and Amenity

Both the Kilkenny County Development Plan 2014-2020, and the Laois County Development Plan 2017-2023 outline the importance of the tourism sector to the internal economy of the counties and local areas.

Tourism makes an important contribution to the economy of the two counties with income derived from tourist activity being distributed across a wide range of economic sectors. Tourism can also be of particular significance in the diversification of the rural economy and in the regeneration of certain towns and villages. The Application Site falls within the 'Ireland's Ancient East' tourism region. This is a tourism initiative established by Bord Fáilte to promote the history and culture of the greater Leinster area.

The nearest population centres to the Site provide a variety of restaurants, pubs, hotels and B&Bs. Further tourism amenities in the locality include seasonal hunting, shooting and fishing. Additionally, hill walking and mountaineering opportunities exist in the Slieve Bloom National Park, the Galtee, Knockmealdown and Comeragh Mountains. Various attractions are found within the greater region and in particular Portlaoise and Kilkenny City.

3.3.6 Traffic

Effects of traffic on the local community are addressed in Section 3.4.6. A detailed Traffic and Transportation Assessment (TTA) has been undertaken for the Application Site; this is included in Appendix 3.1.

3.3.7 Public Health and Emergency Services

Primary health care is offered in a number of surrounding towns by general practitioners, dentists and district nurses. Health Centres located in the regional vicinity in Co. Laois include Abbeyleix, Borris-in-Ossory, Durrow and Rathdowney. Other regional Health Centres in Co. Kilkenny include Ballyragget, Castlecomer, Freshfor, Johnstown and Urlingofrd. District hospitals are located in Portlaoise and Kilkenny City, both of which provide accident and emergency services.

Fire and Rescue emergency services are located north of the Site in Rathdowney, Co. Laois and in Urlingford, Co. Kilkenny.

Garda Stations are also located in Rathdowney and Urlingford.

3.3.8 Health and Safety

The Site Manager will be responsible for safety management on site. The Applicant will develop an in-depth and robust Health and Safety policy prior to the development of mining operations. All employees will be carefully selected to ensure they have the competencies required to work safely. Shanoon will identify the training needs of all staff and ensure that adequate training is undertaken. Health and Safety standards will be maintained by regular training and sign-posting of safety information on site. Health and safety is a primary concern of the Applicant for all those to be employed on the Site. The Applicant's health and safety policy is to:

- Comply, at a minimum, with all applicable legislation and continually improve health and safety stewardship towards industry best practice;
- Ensure that employees and contractors respect health and safety imperatives;
- Ensure a healthy and safe workplace for its employees and contractors, and take due care of all customers and visitors at its locations; and
- Require all company employees and contractors to work in a safe manner as mandated by law and industry best practice.

The revised EIA Directive 2014/52/EU replaces the previous term 'Human Beings' with the term 'Population and Human Health'. This aligns the EIA Directive with terminology used in the SEA Directive. The Commission's guidance on this states '*The notion of human health should be considered in the context of the other issues mentioned in paragraph (f)*'. Paragraph (f) lists environmental factors which include water and air which are at the core of the scope of this EIAR. Health impacts are considered in this EIAR through the assessment of factors such as water, air quality, and noise. These are the pathways by which human health could be affected by operations at the Site.

Criteria for the assessments of potential impacts are based on the emissions standards and related emission limit values (ELVs) that set the conformance requirements which in turn determine whether anticipated environmental and associated health effects are likely to be acceptable or not. Parallel design work also identified the international best practice and best available techniques for the most reliable means of achieving these standards. The assessments of each of the relevant factors in Chapters 6.0, 7.0, 8.0 and 9.0 refer to these ELVs to determine whether any adverse effects or risks due to emissions could occur.

3.3.8.1 Air Quality

The impacts of the proposed development on the air quality of the surrounding environs has been considered in Chapter 7.0 (Air Quality & Climate). This assessment reviewed the monitoring which occurred during the previous mining operation which is noted to be a more intensive extraction operation.

Dust and metal deposition, ambient air and the mine's ventilation system emissions were monitored at various stages during the previous development's lifetime. Dust and metals deposition monitoring concluded that the deposition rates were generally very low and fell well below the respective IPPC limits. Air quality emissions from the proposed development will be less than the previous operation as the proposed production rate (ca. 200,000 to 250,000 t/a) will be less than the previous production rate (ca. 600,000 t/a).

Four ambient air monitoring stations were utilised at the previous mine between 1996 and 2013/2015. The studies noted that the operation had no exceedances of the IPPC Licence ELVs for airborne metals recorded against the annual average data for the monitoring period.

Mine ventilation systems emission monitoring data was available for two of the ventilation shafts during 2007. The principal emission from the ventilation shafts would be dust with trace quantities of diesel exhaust fumes, containing principally nitrogen oxides and carbon monoxide from the underground vehicles. Gaseous atmospheric emissions from underground workings and blasting activities in 2007 included the monitoring of CO, H_2S and NO_X. The results of the monitoring show no exceedances against the ELVs which were set out in the operation's IPPC Licence.

3.3.8.2 Noise and Vibration

The impacts of the proposed development on the noise and vibration quality of the surrounding environs has been considered in Chapter 8.0 (Noise) and Chapter 9.0 (Vibration).

Noise emissions from the proposed operation will vary in comparison to the former mining operation. Proposed operations within the Plant Site will be limited to the crushing and transfer of ore, whereas the former operations were more intensive and had a number of constant noise sources. Noise from the ventilation shafts will remain the same as the former operation.

The assessment of the former mine operation identified that the Ground Vibration and Air Blast (Air Overpressure) monitoring results were significantly lower than the limit values which were in place at the former operation.

3.3.8.3 Water

The proposed recommencement of mining will take place below the water-table and will to discharge to surface water via a water treatment plant. Mobile plant will use existing refuelling facilities (with oil interceptor) at the Plant Site for refuelling. The impact from the proposed development on the local hydrology and hydrogeology of the surrounding area has been assessed in Chapter 6.0 (Water). A comprehensive monitoring program was undertaken throughout the entire period of previous mining. The primarily objective was to determine the impacts to the surface and groundwater system, and to local receptors.

In order to supplement local private water supplies during the previous period of active dewatering at the former mine, two water supply scheme (RWSS – Replacement Water Supply Scheme) wells were installed, one to the west of the K Orebody and the second to the north (Chapter 6.0). Production water supply well (WW1A) and reserve water supply well (WW2B) were installed by Galmoy Mines Ltd in 1996 in compliance with planning conditions for the previous mining.

3.4 Assessment

3.4.1 Land-use and Social Considerations

Extraction activities have been undertaken at the property since the late 1990's / early 2000's. There has been change to the land use at this location as a result of the previous activities at the Application Site. These changes (e.g. the Plant Site/industrial area and tailings facility) are now established in the landscape. As the majority of the proposed operations will occur underground there will be negligible changes of land-use associated with the proposed development. With respect to social considerations, there has been little or no change to local activities as a result of the former Galmoy Mine activities. It is anticipated that the reduced activities in the proposed development would also have a negligible impact on social considerations of the surrounding area.

3.4.2 Populations

It is not anticipated that the development will result in any change in population as a result of the proposed activities at the Application Site. However, the previous Galmoy Mine operation employed people in its workforce who were living in the area. It is anticipated that staff at the proposed development would live locally to the area, and as such, this can be viewed as a slight positive impact.

3.4.3 Economic Activity

Staffing levels at the Application Site will increase with the grant of the proposed development. Once operational the Application Site is expected to employ ca. 35 - 40 people on a full-time basis. Approximately another 10 - 15 roles will be created through indirect employment. Future activities associated with restoration works may also contribute to a number of other employment rolls at the Site. The Application Site will provide ore to an off-site facility which will also assist in maintaining direct and indirect employment levels in those operations. It is therefore considered that the operation of the Application Site will have a positive impact on economic activity.

3.4.4 Agricultural Environment

A baseline survey of soils and herbage was undertaken in 1996 (prior to mining taking place), with subsequent surveys undertaken in the period 1997 to 2000. Surveys also examined agricultural practices, animal health and productivity of existing farms within a circular area of radius of ca. 3 km from the mine site. Additional surveys undertaken in 2005, 2009, 2010, 2011, 2014 and 2015 were carried out in compliance with the mine's IPC Licence, and focused primarily on the Tailings Management Facility (TMF) and trials for the growing of grass on its surface.

Some elevated results for zinc, lead, arsenic and cadmium where recorded for soils in the baseline survey of 1996. However, this is not unusual in close proximity to shallow mineralised deposits. Elevated concentrations of zinc in herbage were also noted, reflecting soil concentration of zinc.

The 2000 results indicated a very satisfactory state of animal health, with blood lead levels low when compared with published norms. Blood zinc levels were also normal in livestock. No evidence of elevated levels of zinc or lead were detected in milk and silage, farm productivity compared well with regional and national data and veterinary surgeons found no evidence of unusual diseases. Overall, the data indicated little change in animal health from that reported in the 1996 baseline survey.

All agricultural enterprises in the immediate vicinity of the mine were provided with water from the Replacement Water Supply Scheme (RWSS) constructed by the Company in 1995/1996. Farms outside the area of influence of the mine dewatering continued to use private wells for water supply as they had always done. The cone of depression resulting from the proposed recommencement of mining will be closely monitored as described in Chapter 6.0 (Water). Although 70 to 80 connections have been made to the scheme, many of them subsequently found that it wasn't necessary to be connected. Following the recommencement of mining, should

any existing water supplies be adversely affected by the proposed development a connection to the RWSS will be provided to ensure continuity of supply (or a well drilled).

The animal health monitoring and soil and herbage programmes covered a period of five years from 1996 (baseline study) to 2000 (subsequent annual monitoring). The results show that the mining operations at Galmoy during that period did not affect animal health in the area:

- Milk yields and animal health were normal throughout the five years and no evidence of elevated zinc or lead levels was found in the milk from any of the farms participating in the scheme;
- There were no complaints from farmers pertaining to animal thrive and animal health over the years;
- Analysis of silage confirmed lead and zinc levels were within the normal range; and
- Soil and herbage analysis indicated only marginal increases in lead and zinc values in fields close to the mine and no impact in fields further away from the mine.

The Applicant proposes that an updated baseline be undertaken prior to recommencement of mining at Galmoy.

Noise and vibration monitoring has been ongoing on a continuous basis since the start of mine construction in 1995. Vibration from mine blasting will, on occasion, be perceptible at the surface both in the open and in enclosed buildings. The vibration limit proposed for the mining operation at the nearest residence to the mining activity is 8 mm/s. Vibration levels did not previously exceed this directly above the mine workings in open fields and will continue to do so under the proposed development. To mitigate against any possible disturbance at milking time, the Applicant undertakes to schedule blasting outside these times in consultation with the relevant farmers.

Neither noise nor vibration have caused any disturbance to livestock in the vicinity of the development. Vibration levels measured at the surface are well below the limit of 8 mm/s. The proposed recommencement will not cause exceedances of this standard and therefore will not have an adverse impact on livestock. The absence of adverse impact is also illustrated by the results of the animal health and farm productivity monitoring undertaken in the area of the Mine Site in the years between 1996 and 2000.

A potential impact of significance to agriculture is dust emissions from the operation, leading to possible contamination of soil and herbage, in turn leading to contamination of crops and animal feedstuffs. However, as described in Chapters 2.0 and Chapter 7.0 of this EIAR, previous air emissions from the mine were not an issue, and as the total production from the recommencement of mining will be reduced from ca. 600,000 t/a, to between 200,000 and 250,000 t/a this will lead to reduced impact on the environment.

As no negative impact on agricultural activity or uses of water resulting from discharges to the surface water environment (i.e. River Goul) were recorded during previous mining activities at Galmoy, it is expected that no negative impacts will be experienced during the proposed development in relation to agriculture.

The potential impacts of atmospheric emissions (dust), aqueous emissions (water discharge), mine dewatering (water-table drawdown), and noise and vibration from the proposed recommencement of mining at Galmoy on agriculture in the surrounding area have been discussed. Of these, only mine dewatering will have any significant impact in that it will dry up a number of wells and reduce the volumes of water in some water courses. Connections to the existing RWSS will be accommodated by the Applicant to ameliorate such effects.

3.4.5 Tourism and Recreation

Local cultural heritage is discussed in Chapter 12.0 of this EIAR, nature conservation areas are discussed in Chapter 4.0, and scenic views and the landscape are discussed in detail in Chapter 10.0. Due to the nature of the proposed activity (underground mining) and established nature of the site, it is not anticipated that there will be any significant impacts on tourism, heritage, amenity and recreation in the area during the duration of the proposed development. The land use on site is well established and the proposed development will remain within the existing site and will not result in any additional impacts on the tourism, heritage, amenity and recreation of the surrounding area.

3.4.6 Traffic

A link capacity analysis was conducted of the R435 and R639 regional roads for assessment years 2018, 2019, 2024 and 2034. The analysis concluded that both regional roads will operate within capacity for each of the assessment years.

A junction capacity analysis was conducted for the mine access, R435/R502 T-Junction and Johnstown crossroads for assessment years 2018, 2019, 2024 and 2034. The analysis concluded that all junctions will operate within capacity for each of the assessment years.

The assessment indicates that the development will have a negligible impact on traffic flows on the existing road network as the proposed development traffic represents between 4.1% and 6.9% of the existing traffic on the road network.

3.4.7 Public Health and Emergency Services

No additional utilisation of the local health care facilities will arise from the recommencement of mining operations at the Application Site. It is not anticipated that there will be any negative impact on such services.

3.4.8 Health and Safety

3.4.8.1 Air Quality

Once appropriate mitigation measures used during the former operation are recommenced with additional measures proposed in the Air Quality chapter it is considered that there will be imperceptible adverse impacts on the ambient air quality of the local environment, and in turn there is no negative impacts on local human health.

3.4.8.2 Noise and Vibration

An assessment of the potential noise impacts from the proposed development at the closest noise sensitive locations has been carried out in Chapter 8.0. Noise impacts at these sensitive locations is considered to be slight. Additional noise attenuation and mitigation measures will be employed at the Application Site to reduce any impacts. Given the mitigation measures to be employed and the distances from the proposed development to the sensitive locations, the development will not impact adversely on the surrounding residential amenity.

Underground blasting practices will not differ from those of the former operation. It is considered that with the maintenance of these practices and the implementation of appropriate mitigation measures (Chapter 9.0) there will be no deterioration in amenity of the overlying lands as a result of vibration at the Application Site.

3.4.8.3 Water

As noted in Section 3.3.8.3, two water supply scheme wells were installed in the vicinity of the mine site during the former operation. The recommencement of mining in the proposed development will occur beneath the water-table. Groundwater entering the underground workings will be segregated into ‘clean’ water (includes inflowing water that does not come in contact with the floor of the workings or have the potential to pick up hydrocarbons, explosives residue and other substances introduced through the mining activity) and ‘dirty’ water (includes drill water, face prep water, inflowing water that does come in contact with the floor of the workings and have the potential to pick up hydrocarbons, explosives residue and other substances introduced through the mining activities). Clean and dirty water will be segregated underground before being pumped to surface for treatment and discharged to the River Goul (and/or north to the Glasha Stream pending issue of a discharge licence) via an existing discharge pipeline. The existing water management and treatment facilities on-site will be refurbished as part of the development.

A groundwater monitoring program has been proposed in Section 6.11, Chapter 6.0. This program will be maintained in order to ensure compliance with the appropriate standards and that the operation does not have any significant impacts on local receptors, including the supply schemes; thereby ensuring there are no consequential effects on human health from a deterioration in water chemistry.

3.4.8.4 Employee Health and Safety

A comprehensive employee Health and Safety programme will be instituted and maintained by Shanoon. A strong emphasis on safety training and safety awareness will be included in the normal working routines and appropriate safety equipment and practices will be employed in all aspects of the operation.

Wearing of safety equipment, including safety hats and boots, will be mandatory in all operational areas with wearing of safety glasses, gloves and hearing protection being required in specific locations.

A fully equipped Mine Rescue Room and a separate First Aid Room will be provided in the administration building. Training of employees will be provided in both respects, with intensive training of volunteer mine rescue teams forming an essential part of the safety programme.

Provisions for mine emergencies have been discussed in Section 2.14, Chapter 2.0 (Project Description). Emergency plans will be developed by the Company to deal with serious safety incidents that may arise within the operation. These will specifically address the following potential situations: surface or underground fires, power failure, flooding, major accidents either on or off site, and significant chemical spillages on or off site.

Close liaison with the appropriate statutory authorities and emergency services in drawing up, testing and implementing these plans will take place.

3.5 Mitigation

Mitigation measures which are required to address impacts of the proposed development on the human environment in relation to air quality, noise, vibration and visual impacts. These mitigation measures are described in Chapter 7.0 (Air Quality & Climate), Chapter 8.0 (Noise), Chapter 9.0 (Vibration), Chapter 10.0 (Landscape) and Chapter 11.0 (Material Assets). With the implementation of measures identified in this Chapter and the aforementioned chapters it is considered that there will be no significant effects on the population, human health and socio-economic environment in the vicinity of the Application Site.

3.6 Residual/Likely Significant Impacts

The Application Site will implement and adhere to all relevant standard health and safety legislation, including Safety, Health and Welfare at Work (Extractive Industries) Regulations 1997, (S.I. No. 467 of 1997) and Safety, Health and Welfare at Work (General Application) Regulations 2007, (S.I. No. 299 of 2007). In addition to this, the proposed development will adhere to all applicable environmental agency and local authority condition and standards. Therefore, it is considered that there will be no residual impacts from the proposed activities.

3.7 Cumulative Impacts

As there are no other extractive industry or large industrial sites located in the immediate vicinity of the proposed development and therefore there are no negative cumulative impacts on the environ surrounding the proposed development with regards to human health and population. It is noted that larger industries have developed and have been granted in areas further afield from the proposed development. Given the proximity of such industry through road linkages it can be considered that the increase in direct and indirect employment at the proposed development will have a slight positive impact on employment in the local area.

References

- Central Statistics office - www.cso.ie.
- Central Statistics Office. Census Returns 1991, 1996, 2002, 2006, 2011 and 2016 - http://www.cso.ie/en/census/ - Accessed: 22nd March 2018.
- Guidelines on the Information to be contained in Environmental Impact Assessment Reports. August 2017. Environmental Protection Agency.
- Kilkenny County Development Plan 2014-2020.
- Laois County Development Plan 2017-2023.
- National Roads Authority. 2014. Traffic and Transport Assessment Guidelines. National Roads Authority, St. Martin's House, Waterloo Road, Dublin 4.

4.0 BIODIVERSITY

4.1 Introduction

This assessment presents a summary of biodiversity features which are, or have the potential to be, biodiversity constraints to the proposed recommencement of mining activities at the former Galmoy Mine (the Garrylaun Mine (the Site/Project)). It evaluates the importance of the ecological and biodiversity resources present and defines the degree of significance of potential impacts resulting from the proposed recommencement of mining activities. The report also identifies appropriate mitigation measures and defines residual impacts.

An Appropriate Assessment (AA) (Stage 1) for Natura 2000 sites near the proposed development has been undertaken and is included with the Planning Application. The AA concluded that no significant impacts would occur to any Natura 2000 sites as a result of the proposed continuation of activities (Appendix 4.1).

4.1.1 Proposed Development

The proposed development known as the Garrylaun Mine is for the recommencement of underground mining of zinc and lead ore at the recently closed Galmoy Mine. It is intended that the works will initially be carried out within the currently known mining footprint and use facilities as previously constructed, a number of which will require refurbishment. The Project will involve the transportation of crushed ore for processing off-site.

The proposed extraction of ore will take place to a maximum depth of up to ca. 150 m below ground level (bgl). The design of the proposed development will follow industry best practice and having regard to its underground design will adhere to the relevant national regulations and guidelines as set out in legislation. The preferred design will include the following (refer to Chapter 2.0 for more details):

- Re-opening of the existing portal and access decline;
- Refurbishment of the underground water pumping system, surface water treatment and outfall facilities;
- Refurbishment of the underground ventilation system, including ventilation shafts;
- Refurbishment of the underground and surface electrical supply system;
- Refurbishment and upgrading of the underground backfill system;
- Refurbishment of the existing backfill plant;
- Refurbishment of water treatment plant on surface including associated infrastructure and River Goul discharge pipeline, A second point of discharge is also planned to the north of the Site;
- Refurbishment of the ‘tepee’; and
- Refurbishment of associated facilities (including offices, storerooms, workshops and mine change-house) and ancillary structures (both on surface and underground) for the safe running of an operational underground mine.

The operating processes involved in the mining of the ore will include:

- The extraction of ore from underground stopes and development drifts in a cyclical pattern using drill, blast and haul methods;
- Installation of ground support (including rock-bolts, cable-bolts, mesh and shotcrete);
- The transportation of ore by dump truck to surface along the existing decline for crushing and loading in the existing tepee; and
- Road transportation of the ore to an off-site processing facility.

Existing landscaping (including screening berms) on the Site (and around ventilation shafts) will be left intact to mitigate against noise and potential dust emissions from operations, as well as to offer continued reduced visibility of the Site from the public road network and surrounding lands. A mine closure and restoration plan will be submitted with the EIAR.

4.2 Assessment Methodology

4.2.1 Desktop Survey

A desktop review was conducted of available published and unpublished information, including a review of data available on the National Parks and Wildlife Services (NPWS) and National Biodiversity web-based databases was conducted in order to identify key habitats and species that may be present, particularly those protected by legislation.

4.2.2 Literature Review

The following environmental impact statements and chapters contained within this EIAR submission prepared for the Site have been reviewed as part of the baseline data gathering process.

- Galmoy Mine Project, Environmental Impact Statement. Prepared on behalf of Arcon Mines Ltd by EOLAS The Irish Science and Technology Agency. 1992;
- Environmental Monitoring of Rivers in the Galmoy Area. Report Number 21. AQUENS Ltd. December 2015;
- Galmoy Mine Extension, Environmental Impact Statement. Arcon Mines Limited. 2000;
- Galmoy Mine Underground Extension: R Zone. Arcon Mines Limited. 2003;
- EIS Appendix 2, Proposed EIS for a Bioenergy Facility, 7 June 2011;
- Hydrogeology (Chapter 6, Golder 2018) Garrylaun Project;
- EPA IPPC licence dated 22 January 2015; and
- Underground Extension; K2 Orebody, Environmental Impact Statement. Galmoy Mines Limited. 2008.

4.2.3 Designated Nature Conservation Site Assessment

Sites of international importance including Special Areas of Conservation (SACs) and Special Protection Areas (SPAs) are collectively known as Natura 2000 sites. These sites contain examples of some of the most important natural and semi-natural ecosystems in Europe. Designated sites also include Natural Heritage Areas (NHA's) and proposed Natural Heritage Areas (pNHAs). The designated search area was 15 km from the development for Natura 2000 and 10 km for NHA and pNHA sites.

There are five SAC's and one SPA within 15 km of the Site. In addition, there are eight pNHAs within 10 km of the Site. Table 4.1 below details the sites identified during the desk study and provides their proximity to the Site.

Table 4.1: Statutory and Non-Statutory Sites for Nature Conservation within the Desk Study Area.

Site	**Approximate distance from Application Site Boundary** (red line boundary)	**Approximate distance from nearest Blue Line** (Lands Under Control of the Applicant)
Galmoy Fen SAC & pNHA	Crosses red line – Red line marks a wayleave/easement	460 m - R vent shaft
Cullahill Mountain SAC & pNHA	3.5 km – Red line by Goul outfall	4 km - Goul outfall
Spahill and Clomantagh Hill SAC & pNHA (covers 3 areas on Figures 4.1 & 4.2)	3.5 km – Goul outfall	3.5 km - Goul outfall
The Loughans SAC & pNHA	6.3 km – Goul outfall	6.3 km – Goul outfall
River Nore SPA	11.9 km – Red line marks a wayleave /easement	13.2 km – R vent shaft
River Barrow and River Nore SAC	5.4 km – Red line marks a wayleave /easement	6.7 km - R vent shaft
The Curragh and River Goul Marsh pNHA	5.3 km – red line marks a wayleave/easement	6.7 km – R vent shaft
Coolacurragh Woods pNHA	6.7 km – Red line marks a wayleave/easement	7.9 km – R vent shaft
Grantstown Woods pNHA	7.5 km – Red line marks a wayleave/easement	8.7 km – R vent shaft
Cuffsborough pNHA	9.6 km – Red line marks a wayleave/easement	10.8 km – R vent shaft

Figures 4.1 and 4.2 presented below represent the statutory and non-statutory protected sites detailed in Table 4.1 and their relative proximity to the Project Site.

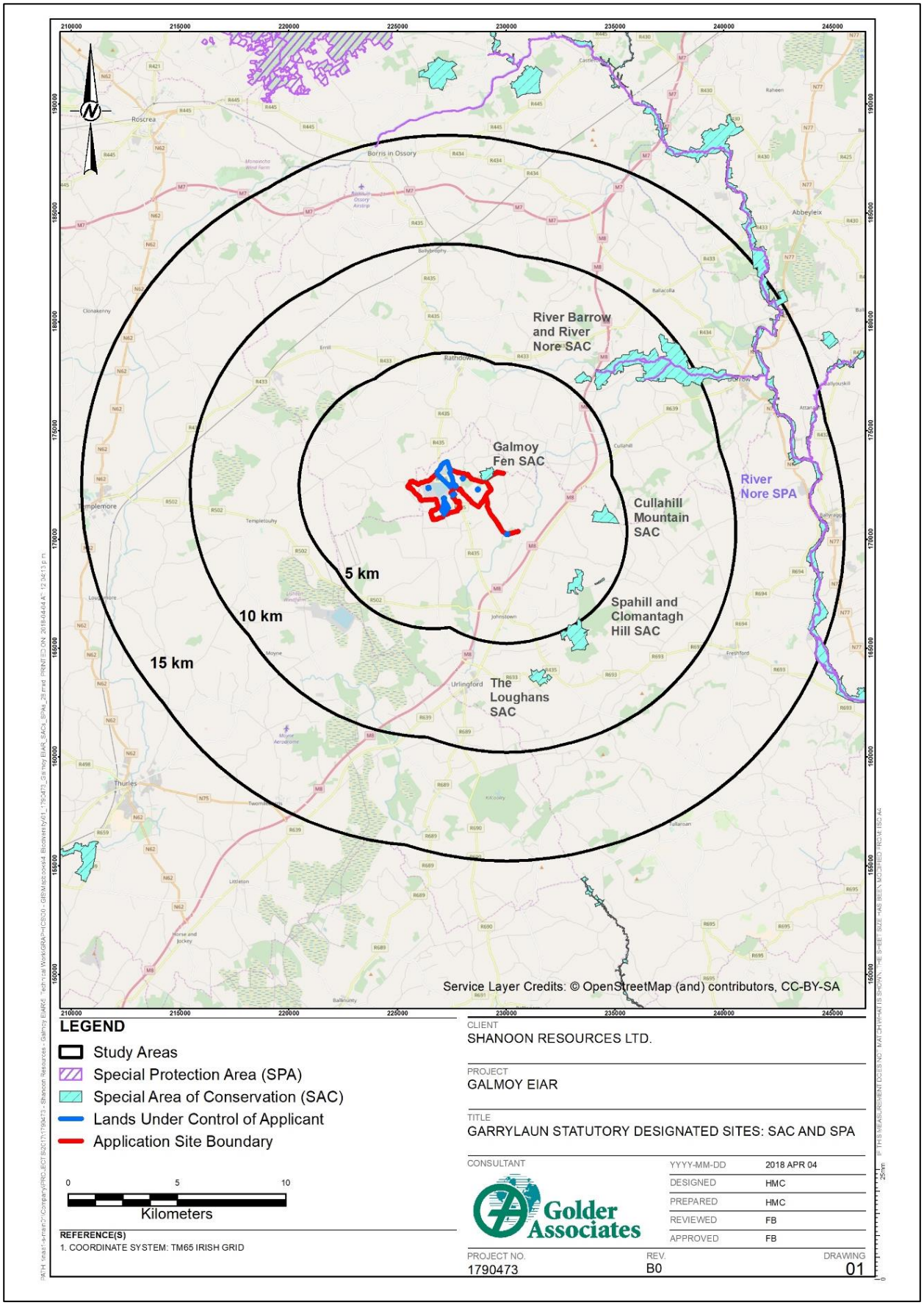

Figure 4.1: SAC and SPA sites within 15 km of the Project Site

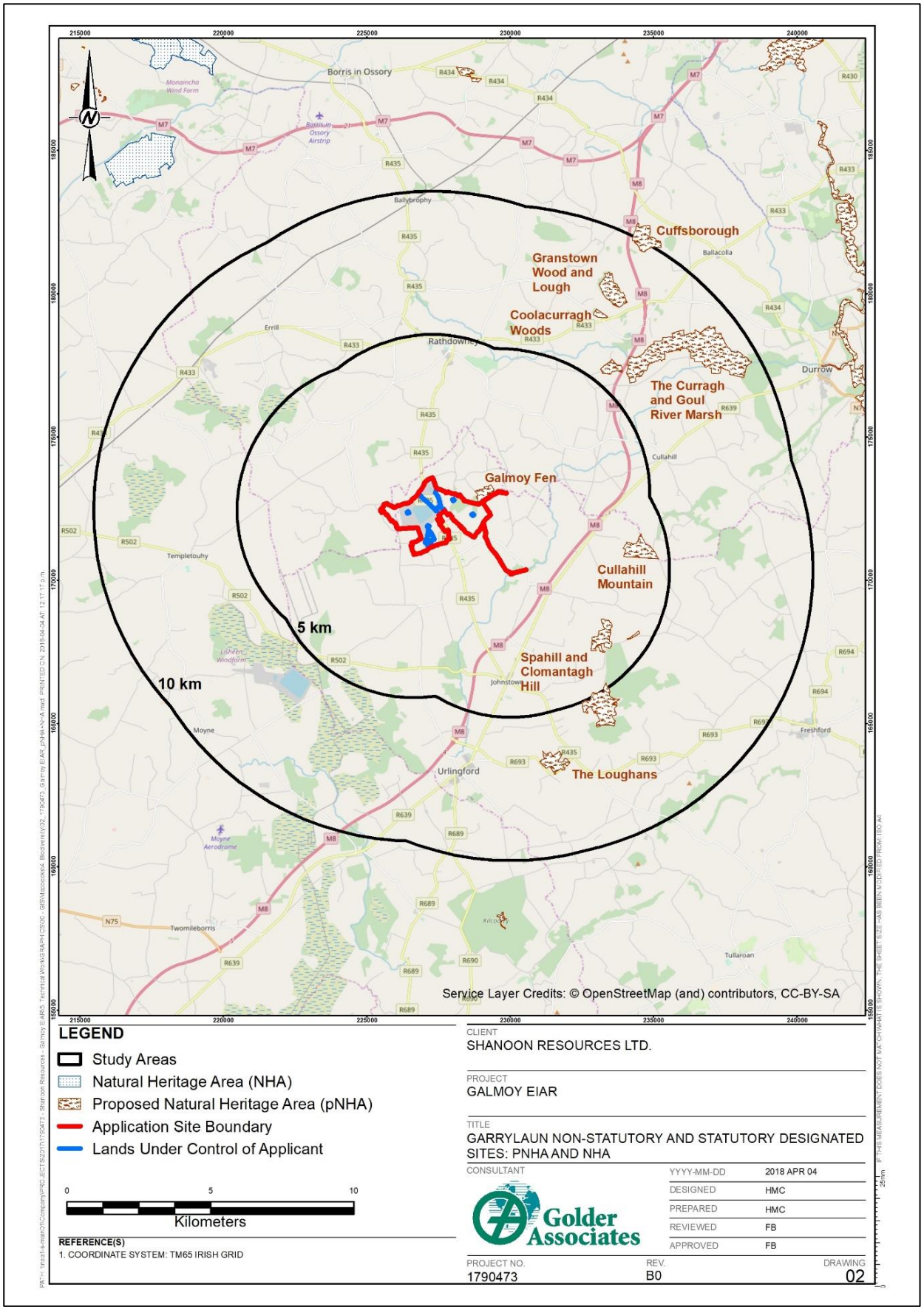

Figure 4.2: NHA and pNHA within 10 km of the Project Site

The AA screening report (Golder, 2018) provides further details on the assessment relative to the Natura 2000 designated sites (Appendix 4.1).

4.2.4 Ecological Survey

A walkover survey of the Site was conducted on the 7 February 2018 to record the habitats currently present on, and adjacent to the Site. Habitats are named and described following Fossitt (2000). Habitat Assessment follows the Joint Nature Conservation Committee (JNCC) Phase One Habitat Survey methodology (JNCC, 1990, revised 2010). Additionally, aerial photographs (satellite imagery) and Site mapping (including surface water) assisted the habitat survey where access did not occur.

4.2.5 Impact Assessment Method

Habitats and species were assessed in accordance with the guidance contained in the document *Guidelines for Ecological Impact Assessment for the United Kingdom and Ireland* (CIEEM, 2016) which recommends that the value of an ecological resource be determined within a defined geographical context (Figure 4.3).

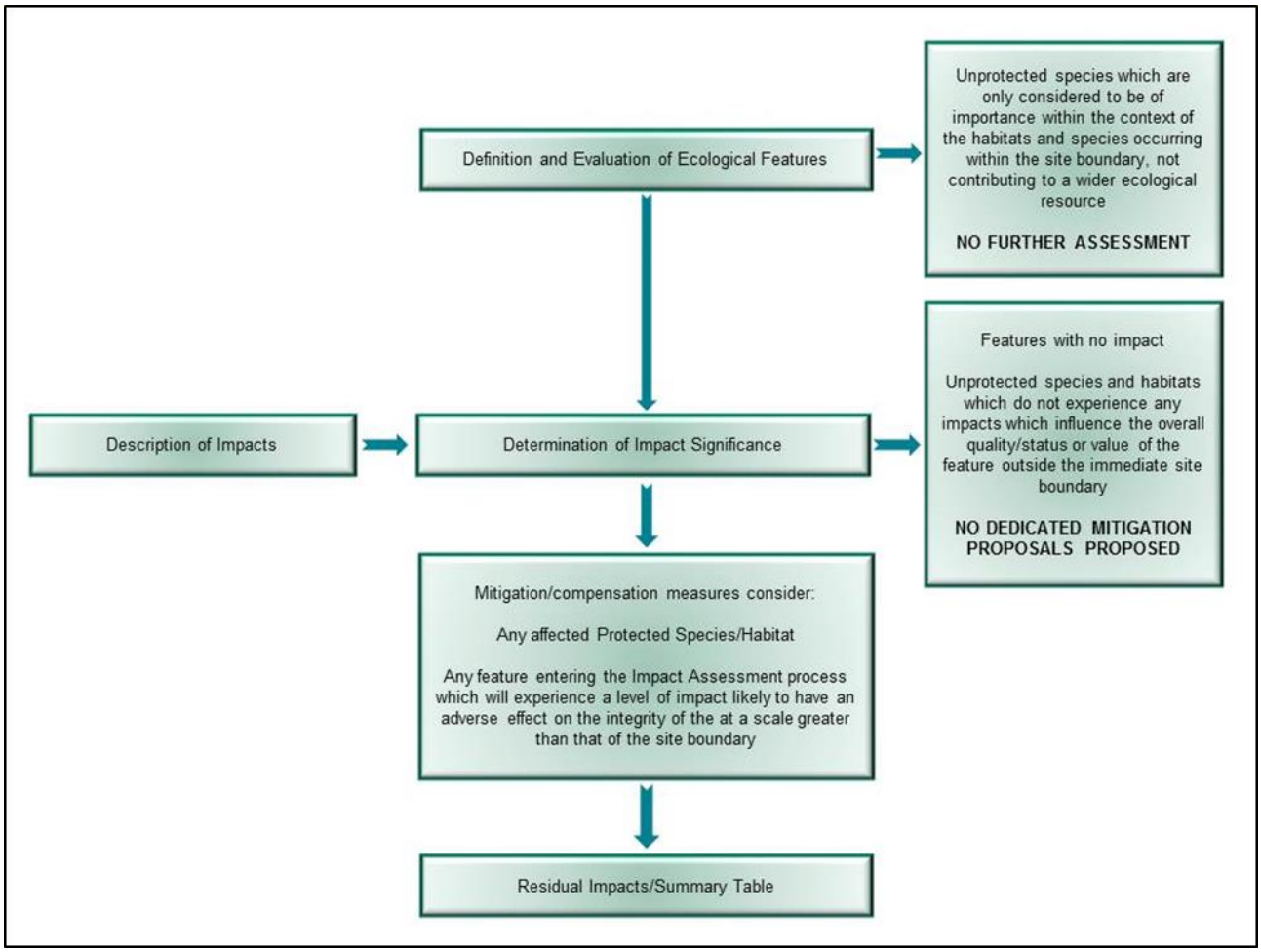

Figure 4.3: Impact Assessment Method

Defining Importance: The relative importance of each ecological feature has been defined on a geographical scale, from international importance, to having relevance only in the context of the Application Site boundary. The definitions employed for the basis of the evaluation are presented in Table 4.2. It should be noted that professional judgement has been employed in the allocation of a level of importance to each feature **as it occurs on the Application Site**. In other words, the value of the feature is presented in the context of its actual status within the Application Site. **Therefore, a single individual of a species which is protected under the EU Habitats Directive would not automatically be of European (international) Importance but would be evaluated in the context of its relationship to the overall population.**

Defining Impact: The impacts to ecological features are defined by their geographical significance in terms of the likely effect and the defined importance of the feature being affected. It is not possible in this system to have an impact greater than the overall geographical importance of the feature (e.g. the maximum possible impact to a feature of regional importance would be one which is of regional significance). Impacts which do not have significance beyond the immediate area (the Application Site) will be managed through the implementation of construction and habitat management plans. One exception to this is the case of impacts on Protected Species, where **any** impact would result in the implementation of mitigation measures.

Defining Magnitude of Change: Considering the potential for impacts as defined above**,** an assessment of the magnitude of change is arrived at. This is based on the table below and relies on professional subjective judgement in deciding the level of magnitude of change.

Table 4.2: Criteria for Assessing Magnitude of Change

Impact Level	Description
Severe Impact	Ecological effects of a scale or magnitude which would result in permanent, total loss of an irreplaceable species or habitat of international or national importance (occasionally of local importance), or which would result in the substantial loss of a protected/rare habitat or a population of a protected/rare species. They represent key factors in the decision-making process. Typically, mitigation measures would be unlikely to remove such effects.
Major Impact	These effects are likely to relate to permanent impacts at a regional or local level, or temporary impacts at an international or national level, and could be potential concerns to the project depending upon the relative importance attached to the issue during the decision making process. The effects are likely to be large in scale or magnitude and result in substantial medium term loss of protected/rare species or habitats. Mitigation and detailed design work are unlikely to entirely eliminate all ecological effects.
Moderate Impact	These effects are usually only at local or regional level, and may be short or medium term only, or temporary impacts on a small part of an international site. However, the cumulative effects of such issues may lead to an increase in the overall effect on ecological features. They represent issues where effects will be experienced, but mitigation measures and detailed design work may ameliorate/enhance some of the consequences upon affected interests, but some residual effects will still arise.
Minor Impact	These effects are likely to be local issues only; or small magnitude impacts at the regional and national level, they are usually temporary, and are unlikely to be of importance in the decision making process. However, they are of relevance in enhancing the subsequent design of the development and consideration of mitigation measures.
Not Significant/ No Impact	No perceivable impacts on ecological features (habitat or species). Impacts may be beneath levels of perception, within normal bounds of variation, within the margin of forecasting error, or impacting on exceptionally poor baseline conditions.
Beneficial/ Positive Impact	These effects are those, which through implementation, would be anticipated to benefit the ecology of the Site. They may advance the objectives of local, national or international species or habitats.

Outlining Mitigation, Compensation and Enhancement Measures: Receptors subject to significant impacts (those which have the potential to affect the ecological resource outside of the immediate Application Site boundary) are the focus of provision of mitigation measures which have been formulated according to the mitigation hierarchy (avoid, reduce / minimise, compensate). All proposed mitigation measures follow industry best practice. Those for protected species follow the prescribed regulatory protocols.

Defining Residual Impact: Following the application of mitigation measures, impacts to each ecological feature are reassessed, and any residual impacts are reported.

As stated by the CIEEM (2016), *'the value or potential value of a feature/receptor should be determined within a defined geographical context*'. Accordingly, each feature has been assessed based on the scale described in Table 4.3 below.

Table 4.3: Criteria for Establishing Receptor Sensitivity/Importance

Importance	Ecological Valuation
International	Sites, habitats or species protected under international legislation e.g. Habitats and Species Directive. These include, amongst others: SAC's, SPA's, Ramsar Sites, Biosphere Reserves, including sites proposed for designation, plus undesignated sites that support populations of internationally important species.
National	Sites, habitats or species protected under national legislation e.g. Wildlife Act 1976 and amendments. Sites include designated and proposed NHAs, Statutory Nature Reserves, National Parks, plus areas supporting resident or regularly occurring populations of species of national importance (e.g. 1% national population) protected under the Wildlife Acts, and rare (Red Data List) species.
Regional	Sites, habitats or species which may have regional importance, but which are not protected under legislation (although Local Plans may specifically identify them) e.g. viable areas or populations of Regional Biodiversity Action Plan habitats or species.
Local/County	Areas supporting resident or regularly occurring populations of protected and red data listed-species of county importance (e.g. 1% of county population), Areas containing Annex I habitats not of international/national importance, County important populations of species of habitats identified in county plans, areas of special amenity or subject to tree protection constraints.
Local	Areas supporting resident or regularly occurring populations of protected and red data listed-species of local importance (e.g. 1% of local population), Undesignated sites or features which enhance or enrich the local area, Sites containing viable area or populations of local Biodiversity Plan habitats or species, local Red Data List species etc.
Low Local	Undesignated sites or features, which enhance or enrich the wildlife resource at a Parish or neighbourhood level.
Within Site	Very low importance and rarity. Ecological feature of no significant value beyond the Site boundary.

4.3 Baseline Ecology

4.3.1 Statutory and Non-Statutory Nature Conservation Sites

There are five SAC's and one SPA within 15 km of the Site. In addition, there are eight pNHAs within 10 km of the Site.

- Galmoy Fen SAC and pNHA;
- Cullahill Mountain SAC and pNHA;
- Spahill and Clomantagh Hill SAC and pNHA;
- The Loughans SAC and pNHA;
- River Nore SPA;
- River Barrow and River Nore SAC;
- The Curragh and River Goul Marsh pNHA;
- Coolacurragh Woods pNHA;
- Grantstown Woods pNHA; and
- Cuffsborough pNHA.

In terms of the proximity to the Site, the Galmoy Fen is situated closest at ca. 460 m from the R vent shaft. Other statutory protected sites are situated > 3 km from the red line Site boundary. Citations[1] for the statutory protected sites within 15 km of the Site are provided below verbatim:

Galmoy Fen SAC

Galmoy Fen is situated 7 km north of Johnstown in Co. Kilkenny. It lies in a depression and is underlain by Carboniferous limestone. The central part of the site comprises an area of cutover raised bog with numerous peat-cuttings, resulting in a mosaic of dry peat banks and wet peaty pools. The pools have become flooded with base-rich groundwater and now support alkaline fen vegetation. A large area of fen vegetation surrounds the central part of the site; this area has a number of large pools that support calcicole species.

Other habitats present on the site include scrub, wet grassland, improved grassland, dry calcareous grassland and a small area planted with Picea sitchensis. A stream brings water to the site on its north-east side. Surrounding landuse is mainly agricultural.

The site contains a good example of alkaline fen vegetation that has developed partly due to cutting of a former raised bog. Fen habitat is rare in the region. The site contains a typical range of species, including Schoenus

nigricans and supports the Red Data Book species Rana temporaria and Lepus timidus hibernicus. – Priority habitats (7230, Alkaline Fens).

Cullahill Mountain SAC

This site is situated on a small limestone plateau on the western side of which is a steep escarpment. Soils are relatively shallow and exposed limestone outcrops are common in several areas of the site. The dominant vegetation comprises herb-rich dry calcareous grassland (Eu-Mesobromenion) in which the occurrence of five orchid species, and in particular the abundance of Orchis morio is notable. The western side of the site has Ash/Hazel woodland.

The site appears to contain a rich invertebrate fauna. The importance of this site lies in the presence of an unusually large area (for south-east Ireland) of unimproved, herb-rich calcareous grassland. On a national scale the extent of this habitat is, however, relatively small. The site boasts a large population of the scarce Green-winged Orchid, Orchis morio.

Spahill and Clomantagh Hill SAC

Spahill and the adjacent hills form part of an escarpment which links the Slieve Ardagh Hills with the Castlecomer Plateau in Co. Kilkenny. The hills are of limestone overlain by shales and/or sandstones, and so the surface geology is variable, with different rock types supporting different vegetation types. This particular site is mostly limestone, exposed as small ledges or as flat sheets. When the latter occurs it is often weathered into a pavement pattern, similar to that found in the Burren, Co. Clare. The hills are generally low and rounded - they rise relatively steeply from the central plain but drop south-eastwards more gently. Their surface is grassy in appearance but the soil is shallow, especially on the upper parts, and the rock breaks through frequently. The site is a Special Area of Conservation (SAC) selected for the following habitats [6210] Orchid-rich Calcareous Grassland

The Loughans SAC

The Loughans is a turlough situated in flat land about 3 km east of Urlingford, below the Slieve Ardagh Hills, in Co. Kilkenny. The basin is slightly undulating, with banks and hummocks of glacial drift around which the water rises. It has a level floor for the most part, but swallow holes and subsidence hollows are present. The turlough floods regularly, despite some drainage. In summer, it retains a permanent central pond and there are several subsidiary wet hollows at the eastern end.

The site is a Special Area of Conservation (SAC) selected for the following habitats and/or species listed on Annex I / II of the E.U. Habitats Directive (3180) Turloughs.

[1] https://www.npws.ie/protected-sites/sac/001858 accessed 21 March 2018

River Nore SPA

The River Nore SPA is a long, linear site that includes the following river sections: the River Nore from the bridge at Townparks, (north-west of Borris in Ossory) to Coolnamuck (approximately 3 km south of Inistioge) in Co. Kilkenny; the Delour River from its junction with the River Nore to Derrynaseera bridge (west of Castletown) in Co. Laois; the Erkina River from its junction with the River Nore at Durrow Mills to Boston Bridge in Co. Laois; a 1.5 km stretch of the River Goul upstream of its junction with the Erkina River; the Kings River from its junction with the River Nore to a bridge at Mill Island, Co. Kilkenny. The site includes the river channel and marginal vegetation. For a large part of its course the River Nore traverses Carboniferous limestone plains; it passes over a narrow band of Old Red Sandstone rocks below Thomastown. The site is a Special Protection Area (SPA) under the E.U. Birds Directive of special conservation interest for the following species: Kingfisher.

River Barrow and River Nore SAC

This site consists of the freshwater stretches of the Barrow and Nore River catchments as far upstream as the Slieve Bloom Mountains, and it also includes the tidal elements and estuary as far downstream as Creadun Head in Waterford. The site passes through eight counties – Offaly, Kildare, Laois, Carlow, Kilkenny, Tipperary, Wexford and Waterford. Major towns along the edge of the site include Mountmellick, Portarlington, Monasterevin, Stradbally, Athy, Carlow, Leighlinbridge, Graiguenamanagh, New Ross, Inistioge, Thomastown, Callan, Bennettsbridge, Kilkenny and Durrow. The larger of the many tributaries include the Lerr, Fushoge, Mountain, Aughavaud, Owenass, Boherbaun and Stradbally Rivers of the Barrow, and the Delour, Dinin, Erkina, Owveg, Munster, Arrigle and King's Rivers on the Nore. The site is a Special Area of Conservation (SAC) selected for the following habitats and/or species listed on Annex I / II of the E.U. Habitats Directive:

- [1130] Estuaries;
- [1140] Tidal Mudflats and Sandflats;
- [1170] Reefs;
- [1310] *Salicornia* Mud;
- [1330] Atlantic Salt Meadows;
- [1410] Mediterranean Salt Meadows;
- [3260] Floating River Vegetation;
- [4030] Dry Heath;
- [6430] Hydrophilous Tall Herb Communities;
- [7220] Petrifying Springs;
- [91A0] Old Oak Woodlands;
- [91E0] Alluvial Forests;
- [1016] Desmoulin's Whorl Snail (*Vertigo moulinsiana*);
- [1029] Freshwater Pearl Mussel (*Margaritifera margaritifera*);
- [1092] White-clawed Crayfish (*Austropotamobius pallipes*);
- [1095] Sea Lamprey (*Petromyzon marinus*);
- [1096] Brook Lamprey (*Lampetra planeri*);
- [1099] River Lamprey (*Lampetra fluviatilis*);
- [1103] Twaite Shad (*Alosa fallax*);
- [1106] Atlantic Salmon (*Salmo salar*);

- [1355] Otter (*Lutra lutra*);
- [1421] Killarney Fern (*Trichomanes speciosum*); and
- [1990] Nore Freshwater Pearl Mussel (*Margaritifera durrovensis*).

The Loughans SAC is situated some 6.3 km from the closest part of the Site (the Goul outfall). This turlough is situated on the opposite bank of the Goul from the Site and is also upstream of the Site outfall. Cullahill and Spahill SAC's are situated ca. 4 km and ca. 3.5 km from the Site respectively. These sites are protected semi-montane areas noted for their floral habitats and grassland composition. These sites, together with all of the pNHA's detailed (with the exception of Galmoy Fen) have no hydrological, hydrogeological or obvious terrestrial connectivity with the Project Site. Cumulatively, it is considered that no residual effects would be afforded to these sites and they are no longer discussed within this report. In contrast, the Galmoy Fen SAC, River Nore SPA and River Barrow and River Nore SAC do have the potential to be affected by Site operations and are appropriately assessed within this report.

4.3.2 Habitat Assessment

The habitats within the red line planning application boundary (the Site) are dominated by a patchwork of improved and semi-improved grassland fields bounded by hedgerows and occasional woodland (Table 4.4). Arable (cultivated) habitat occurs occasionally and areas of inundated wetland are also noted (Figure 4.4[2]). The River Goul is situated at the southern extent of the Site and flows in an east to west direction.

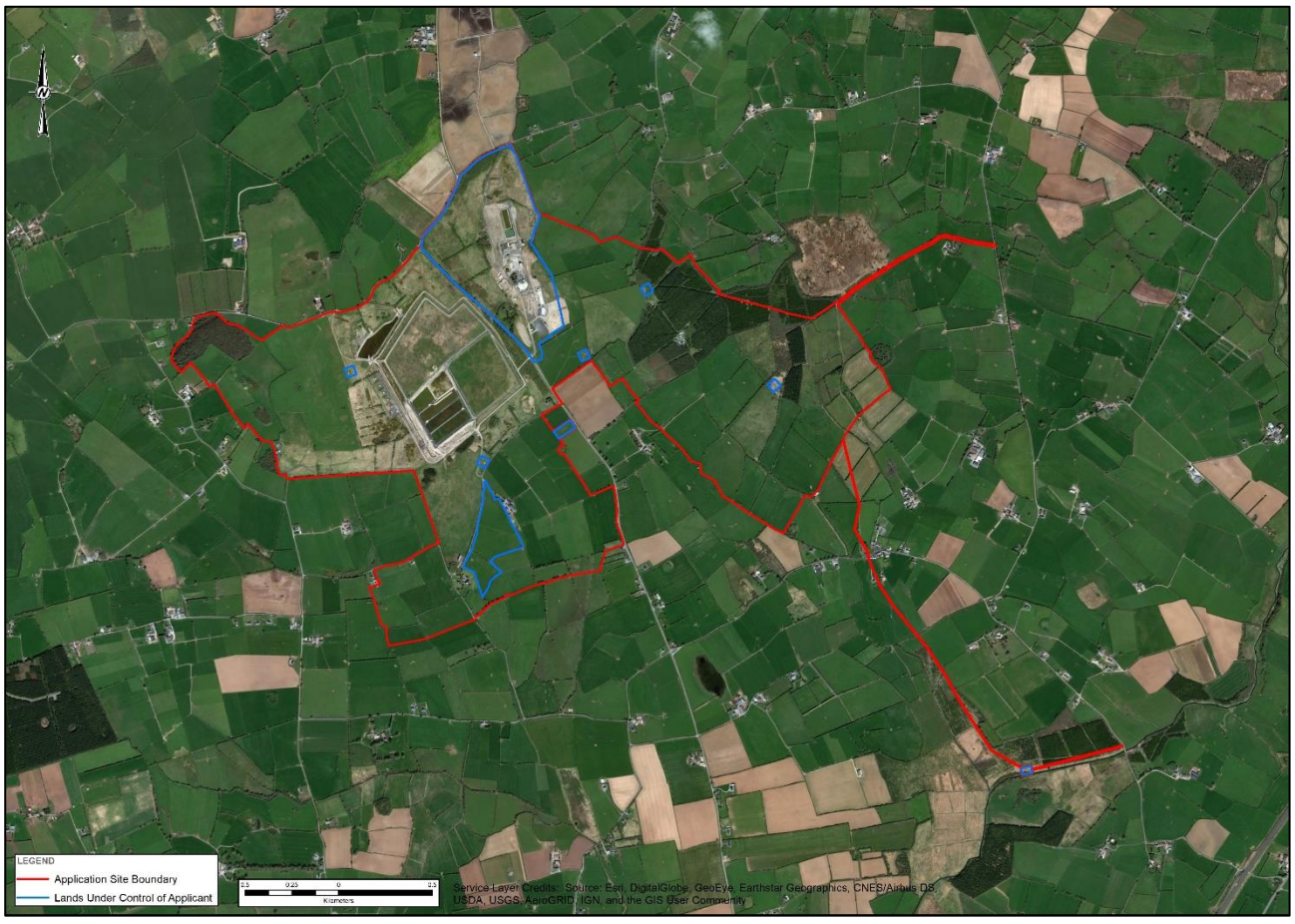

Figure 4.4: Habitat map

[2] This drawing uses GIS based satellite imagery to illustrate habitat composition.

Table 4.4: Habitats Recorded on Site (Fossitt, 2000)

Habitat	Habitat code	Location and prevalence
Buildings and Artificial Surfaces	BL3	Prevalent within the application Site where the main site office buildings and car park are located.
Artificial Lakes and Ponds	FL8	Associated with the tailings area adjacent to the Site.
Reed Bed	FS1	Associated with the tailings area adjacent to the Site.
Improved Grassland	GA	This habitat was noted within farmland that bordered the Site.
Wet Grassland	GS4	Situated in smaller undrained fields throughout the Site.
Scrub	WS1	Found throughout the Site.
Hedgerows	WL1	Species-poor intact and defunct hedgerows occur throughout the Site

Artificial Ponds (FL8)

Artificial waterbodies are located adjacent to the Application Site. Waterbodies associated with the reed-bed system near the tailings management area are well naturalised with reeds occurring in marginal areas of the features and scrub vegetation further back. Much of this habitat is damp and waterlogged in places with soft rush (*Juncus effuses*), gorse (*Ulex Europeaus*) and broom (*Cystisus scoparius*) scrub dominating the periphery.

Reed Bed (FS1)

Stands of species-poor herbaceous vegetation dominated by common reed (*Phragmities australis*) were recorded throughout the tailings management area. In addition, the River Goul was flanked by marginal and emergent vegetation in places.

Improved Grassland (GA)

Agricultural fields surround the Application Site boundary (Figure 4.5). Typically, these fields are managed as improved grassland used for grazing and appear to be dominated by a perennial ryegrass (*Lolium perenne*) and clover (*Trifolium repens*).

Figure 4.5: Improved grassland sward above the Garrylaun underground workings

Scrub (WS1)

Scattered and dense scrub occurs frequently near the Site margins and in areas where stockpiles have been allowed to recolonise over a period of decades. Species composition in these areas includes, gorse, bramble, broom and willow *Salix* spp.

Hedgerows (WL1)

Hedgerows occur as field boundaries within the areas throughout the Site. Most of the hedgerows contain occasional mature trees including oak, ash, elder, hawthorn and blackthorn. Connecting hedges in these areas will provide ecological connectivity.

4.3.3 Flora and Fauna Assessment (Desk Study)

The National Biodiversity Data Centre holds records of protected and notable species within the desk study search area (10 km grid square, S27[3]). These results are presented as Appendix 4.2. However, the freely available desk study results should not be considered definitive data sets for the desk study area. An absence of desk study data does not necessarily correspond that a site is absent of notable flora or fauna.

4.3.4 Aquatic Habitat – On and Off Site Receptors

Aquatic receptors are the key focus for this baseline and ecological impact assessment process. The Project will afford no new land take and the re-opening of the mine and any associated discharges to aquatic features are the drivers for this assessment from a biodiversity perspective.

The Water chapter (Chapter 6.0) indicates that '*the Site and broader area is drained by small headwaters streams that flow northward to the Glasha stream and eventually join the Erkina River. The local stream baseflows are mostly fed by groundwater, much of which is from the surficial alluvial deposits, but also from small bedrock springs in the project area and further to the north.*

[3] https://maps.biodiversityireland.ie/Map accessed 21 March 2018.

The south and east side of the project area is drained by the River Goul. The Goul flows through Counties Kilkenny, Tipperary and Laois from its source in the Slieveardagh Hills, approximately six kilometres south of Urlingford. It flows north between Johnstown and Galmoy into County Laois, where it joins the River Erkina, a tributary of the River Nore, several kilometres from Durrow. The River Nore extends for 141 km, draining an area of about 2,530 km^2, making it one of the major rivers in the South East'.

The existing mine outfall pipe is situated on the River Goul (Figure 4.6). The River Goul is not subject to statutory designations at this location. However, hydrological connectivity is noted with the River Nore downstream (ca. 5.4 km). The river Barrow and Nore at this location is designated as an SAC.

Figure 4.6: The River Goul at the Mine outfall site

The River Goul is typical of rivers in the local area. The baseline attribute of the river is understood as a consequence of the baseline monitoring that has been undertaken in association with the former Galmoy Mine commencing in 1995. These biological studies are well documented within, amongst other reports, the *'Environmental Monitoring of Rivers in the Galmoy Area. Report Number 21',* Aquens Ltd. (December 2015). The Aquens (2015) report indicates that '*ecological baseline surveys commenced in 1995 to establish the baseline ecological conditions prior to commencement of mining activities. Since then the same environmental monitoring has continued annually as part of IPC licensing requirements. The methodologies have been maintained to allow for direct comparisons to be made between each annual survey and to establish trends over time. The annual survey also ensured early detection of any possible contamination, due to the discharge of water from the Galmoy Mine, into the River Goul at Fertagh'.*

The monitoring of freshwater invertebrates described by Aquens (2015) indicates that the River Goul is afforded eutrophication impacts as evidenced by the specific presence or indeed absence of macroinvertebrate communities. These historical baseline results indicate that agricultural practice is likely to the major contributing factor to these results as control sites upstream of the Galmoy mine share similar result to downstream of the mine.

Bioaccumulation data described by Aquens (2015) addresses metal uptake in freshwater invertebrate tissue. Specifically, freshwater shrimp (Gammarus) genus individuals were captured and studied. '*The concentrations of metals recorded were predominantly within the ranges recorded in the past. There is no indication that the mine discharge is having an influence on the lead, zinc, copper, and cadmium concentrations in the gammarid tissue in relation to the mine discharge on the River Goul and Glasha. The zinc concentrations were lower than pre-mining conditions. There is no indication that the discharge point is causing a bioaccumulation of these metals in the tissues of the freshwater shrimp'* Aquens (2015).

4.3.5 Water Framework Directive

In response to the increasing threat of pollution and the increasing demand from the public for cleaner rivers, lakes and beaches, the EU developed the Water Framework Directive (WFD). This Directive is unique in that, for the first time, it establishes a framework for the protection of all waters including rivers, lakes, estuaries, coastal waters and groundwater, and their dependent wildlife/habitats under one piece of environmental legislation for all European member states.

The WFD (Directive 2000/60/EC) is a substantial piece of EU water legislation that came into force in 2000. The overarching objective of the WFD is for the water bodies in Europe to attain Good or High Ecological Status. The Environment Protection Agency (EPA) is the competent authority in Ireland responsible for delivering the WFD. River Basin Management Plans (RBMP) have been created which set out measures to ensure that water bodies in the country achieve 'Good Ecological Status'.

Good Ecological Quality will depend on the quality of the individual quality elements on which the Ecological status is scored; namely the Biological, chemical and morphological condition in a particular waterbody. Any reduction in any of these elements will result in a reduction of the overall ecological status.

4.3.5.1 Water Framework Directive Status and Objectives

The Site is situated within the South Eastern river basin district (RBD[4]). This RBD is one of Ireland's largest river basin districts. The population is high compared with the rest of Ireland and there are several large urban centres, the largest being Waterford City, but 80% of the district's population lives in small villages or one-off houses in rural areas. The objectives of the South Eastern RBD are to:

- Prevent deterioration and maintain a high status where it already exists;
- Protect, enhance and restore all waters with aim to achieve at least good status by 2015;
- Ensure waters in protected areas meet requirements; and
- Progressively reduce chemical pollution.

Regardless of their current quality, surface waters should be treated the same in terms of the level of protection and mitigation measures employed, i.e. there should be no negative change in status (refer below). Beyond 2015 for the 2nd Cycle of WFD delivery, the Eastern, South Eastern, South Western, Western and Shannon River Basin Districts will be merged to form one national River Basin District.

4.3.5.2 Surface Water Body Status

Monitoring of surface waters for WFD status includes ecological and chemical parameters and also water level and rate of flow. The river Goul at the Site is identified as IE_SE_15_196 (EPA's catchments.ie website) is currently classed as of 'Poor[5]' Ecological Status. This evaluation is determined via a classification of this waterbody having a macroinvertebrate status of poor, general physico-chemical status of moderate and an overall general ecological status of poor (Figure 4.7).

[4] http://www.wfdireland.ie/docs/1_River%20Basin%20Management%20Plans%202009%20-%202015/SERBD%20RBMP%202010/SERBD%20RBMP%202010.pdf

[5] http://watermaps.wfdireland.ie/NsShare_Web/Viewer.aspx?Site=NsShare&ReloadKey=True

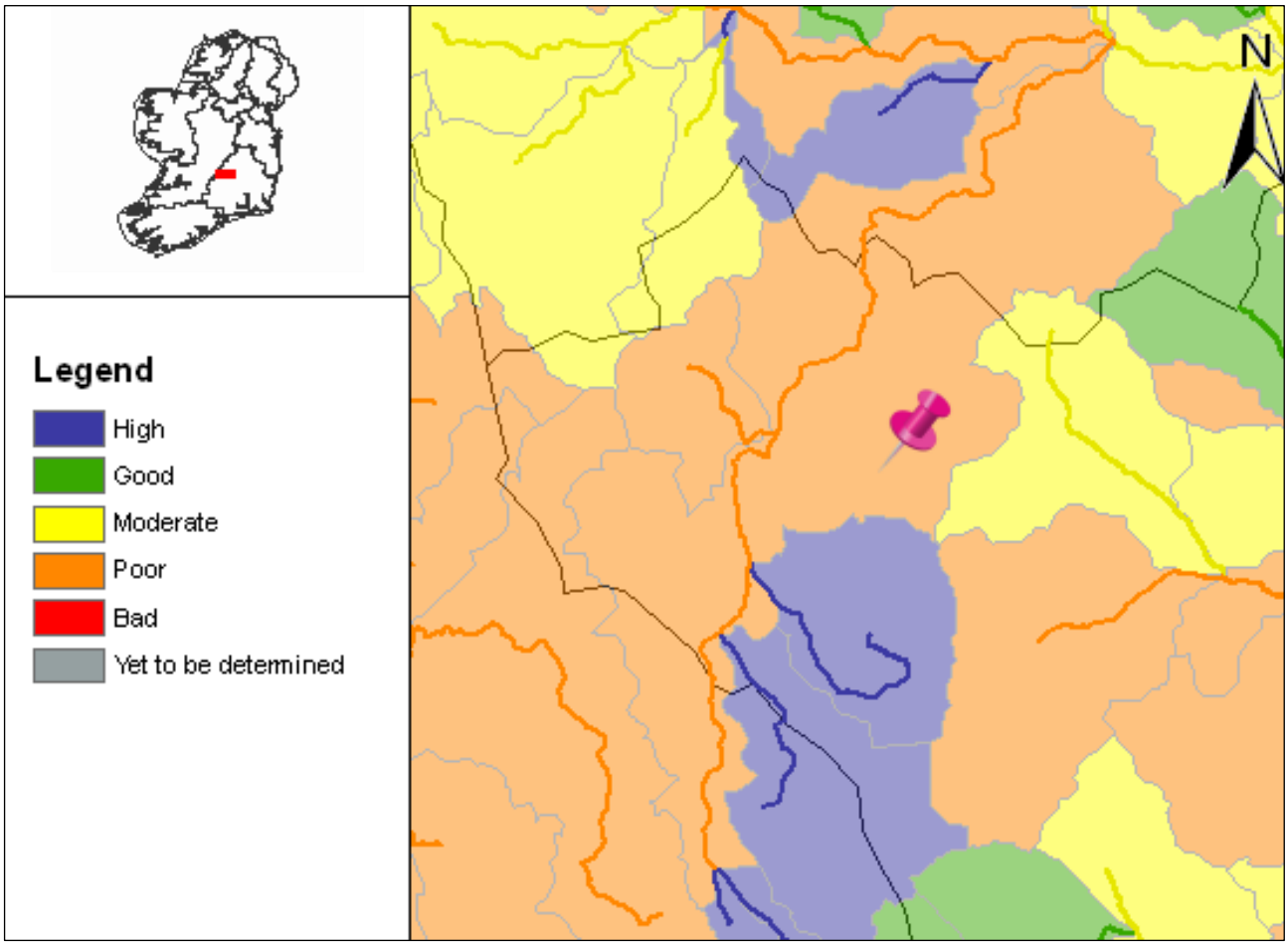

Figure 4.7: WFD Status[6] for the River Goul at point (IE_SE_15_196) which captures the Site

4.3.5.3 Surface Water Quality

As extensively described within Chapter 6.0, surface water quality upstream and downstream of the Site has been studied over an extensive period of time. Baseline monitoring data from the downstream surface water locations show that the chemistry of the key parameters remains stable and below Galmoy (Site) compliance values and Irish surface water regulations.

The monitoring point known as 'Glasha crossroads' is continuing to show a seasonal variation in pH, electrical conductivity and some metals (such as iron, manganese and zinc). The seasonal variations are typical of groundwater-fed baseflow streams in Ireland with increased dissolved solids during the summer when the greatest contribution to the streams is from groundwater. During winter the dissolved solids reduce as the contribution of rainfall-runoff to the stream increases. Therefore, the water quality in the middle of summer is a good proxy for the groundwater quality entering the streams. No compliance values of surface water regulations were exceeded at any time, demonstrating that the quality of groundwater entering the streams is good (Chapter 6.0).

[6] www.wfdireland.ie.

4.3.6 Fauna Assessment

The presence, or potential presence, of species on the Site was identified from the desk study and Phase 1 Habitat survey. Table 4.5 lists the species which were considered likely to occur within the Application Site, on the basis of the presence of suitable habitat and/or the occurrence of recent records in the vicinity. The species, together with its legislative designation is listed. The source(s) of information relating to each species could include:

- Existing records from desk study;
- Presence of suitable habitat identified during the Phase 1 survey; and / or
- Direct observation.

For each species with the potential to occur on the Application Site, the final column of Table 4.5 presents a brief summary of the status of the species in relation to the Site itself. If the survey fails to record the species and the habitats are unsuitable, then it is concluded that the species is unlikely to occur and it is not considered further within the assessment. If a species is confirmed as present, an indication of the likely population size/status within the Site is provided. This information is used in the evaluation presented in Table 4.5.

Table 4.5: Species Recorded

Species/ Group	Protection Status	Source	Summary of status on site
Badger	Wildlife Acts (1976 – 2010)	Survey (suitability)	The broader Site is suitable for foraging and hedgerows may be suitable for sett building. However, available resource is situated outside of the development Site footprint. Not considered further within this report.
Fox	-	Survey (suitability)	The broader Site is suitable for foraging and hedgerows may be suitable for earth building. However, available resource is situated outside of the development Site footprint. Not considered further within this report.
Rabbit	-	Survey (suitability)	The broader Site is suitable for foraging and hedgerows may be suitable for warren building. However, available resource is situated outside of the development Site footprint. Not considered further within this report.
Irish Hare	Wildlife Acts (1976 – 2010)	Survey (suitability)	Likely to occur within the Site. However, The broader Site is suitable for foraging and rank grassland may be suitable for form building. However, available resource is situated outside of the development Site footprint. Not considered further within this report.
Otter	Wildlife Acts (1976 – 2010) – EU Habitat Directive.	Survey (suitability)	Likely to occur within the Site. The river Goul contains habitat and resource for this species.
Stoat	Wildlife Acts (1976 – 2010)	Survey (suitability)	Potential to occur within the Site. The broader Site is suitable for foraging and hedgerows may be suitable for nest building. However, available resource is situated outside of the development Site footprint. Not considered further within this report.
Hedgehog	Wildlife Acts (1976 – 2010)	Survey (suitability)	Potential to occur within the Site. The broader Site is suitable for foraging and hedgerows may be suitable for nest building/hibernation. However, available resource is situated outside of the development Site footprint. Not considered further within this report.

Species/ Group	Protection Status	Source	Summary of status on site
Red Squirrel	Wildlife Acts (1976 – 2010)	Sub-optimal - Survey (suitability)	No available resource (mixed woodland). Not considered further within this assessment.
Pygmy Shrew	Wildlife Acts (1976 – 2010)	Survey (suitability)	Potential to occur within the Site. The broader Site is suitable for foraging and hedgerows may be suitable for nest building/hibernation. However, available resource is situated outside of the development Site footprint. Not considered further within this report.
Bats	Wildlife Acts (1976 – 2010) – EU Habitat Directive.	Survey (suitability – Foraging with some potential for roosting)	Some foraging habitat was observed within the Site e.g. open water and grassland. Trees within the Site may exhibit low (Collins, 2016) bat roosting potential.
Breeding Birds	Wildlife Acts (1976 – 2010), EU Birds Directive and Birds of Conservation Concern (BoCC[7], Ireland).	Survey (suitability) Phase 1 habitat survey (direct observation)	Breeding birds are likely to occur in areas of scrub vegetation (gorse and broom) which provides good cover. Additionally, there is the potential for ground nesting birds to breed in areas of tussocky grassland and recolonising bare ground.
Aquatic Fauna	White-clawed crayfish, Salmonids, Lamprey, Eel and pearl mussel. Wildlife Acts (1976 – 2010) – EU Habitat Directive.	Desk Study	The Goul catchment is a salmonid water and has populations of brown trout *Salmo trutta*.
Other Taxa	Lepidoptera / Odonata	Sub-optimal - Survey (suitability)	Available resource situated outside of the development Site boundary (species-rich grassland, mature woodland or standing water bodies). Not considered further within this assessment.

4.3.7 Natura 2000 and Protected Sites

The potential impact of the proposed development on Natura 2000 sites is dealt with in the accompanying AA.

4.3.8 Evaluation

The evaluation of ecological features (habitats and species) which could be affected by the proposed continuation of activities is presented in Table 4.6. The table includes:

- Any statutory designated areas[8], with the exception of Natura 2000 sites, which are situated within 10 km of the Application Site that have potential ecological connection (s) with the Site;
- Any surface or groundwater bodies that have hydrological connectivity with the Site; and
- Any species or habitats of conservation importance which has been confirmed as occurring within the Application Site.

[7] Colhoun, K. & Cummins, S. (2013) Birds of Conservation Concern in Ireland 2014–2019. Irish Birds 9: 523–544.

[8] pNHA sites are non-statutory

The value of the feature is based upon how important the feature is in relation to its geographical context. In other words, at what level of geographical resolution would the feature contained within the Site (Designated Area, habitat or species) be recognised as contributing to biodiversity to a significant degree. The evaluation takes into account any statutory or non-statutory conservation status, its extent (or population size) within the Site compared to the resource elsewhere and whether it has characteristics which either elevate or depress its importance in comparison with a 'typical' example (for example, whether a habitat is particularly species rich, or depleted in species).

Common and widespread species or habitats, therefore, only have a level of importance in respect to the biodiversity of their immediate area (taken in this case to be represented by the boundary of the Site). Such features are not considered further within the Impact Assessment. Some protected species may, under certain circumstances (such as a single example occurring within the Site, as part of a much larger local population) be considered to only be of importance within the Site itself. Such species, on the basis of legal and planning regulation compliance, are included within the Impact Assessment and, (if necessary) dedicated impact mitigation measures are provided. Table 4.6 presents each feature occurring, together with the rationale for its evaluation.

Table 4.6: Classifying the Geographical Importance of Key Ecological Features

Key Ecological Features	Importance	Rationale
Habitats		
Artificial Lakes and ponds	Site	This habitat is of value to birds, foraging bats and insects in particular. It is however outside of the Project influence. It will thus not be affected by Project proposals and it is not considered further in this assessment.
Reed Bed	Local	Does not represent a significant contribution to a local or regional resource. Not affected by Project proposals and not considered further in this assessment.
Hedgerows	Local	No hedgerows will be affected by Project proposals. They are therefore not considered further in this assessment.
Species		
Aquatic Fauna	Regional	Hydrological connectivity occurs between the Site and River Goul (Erkina) catchment. This feature (species group) is thus carried forward into the design mitigation and impact assessment sections.
Otter	Regional	Hydrological connectivity occurs between the Site and the River Goul. This species is carried forward into the design mitigation and impact assessment sections.
Bats	Site	The Site supports suitable foraging, commuting and potential roosting habitat. This feature (species group) is carried forward into the design mitigation and impact assessment sections.
Breeding Birds	Site	The Site hedgerows, grassland and scrub are likely to support a number of common and widespread bird species. There is the potential for ground nesting birds such as skylark breeding within the Site due the suitable mosaic of habitats available for this life stage for the species. This species group (breeding birds) is carried forward into the design mitigation and impact assessment sections.

4.4 Design Mitigation

This section describes the mitigation measures that were incorporated at the design stage. Additional mitigation measures not incorporated at the design stage are considered under Section 4.6. A number of measures which follow generic best practice are proposed to mitigate the impacts of the proposed Project on the ecological environment at the Site:

- All Site construction will be undertaken in accordance with the CIRIA (2010) Environmental Good Practice;
- Very little vegetation clearance is likely to be required. However, any vegetation clearance will be undertaken outside of the bird nesting season (March to August). If there is a necessity for vegetation clearance within this period, a suitably qualified ecologist must carry out a series of nesting bird checks in advance of any works to ascertain breeding activity in affected areas; and
- Lighting will be minimised during hours of darkness and will not illuminate peripheral mature trees and vegetation to ensure no adverse effects on bats and other nocturnal species.

4.4.1 Committed Water Treatment Requirements

As described in Chapter 6.0. The existing water treatment plant will be recommissioned to remove trace metals from the discharge water. The goal of the treatment system will be to reduce values of lead, zinc, arsenic, nickel and iron in the water, prior to discharge into the river system. The upgraded design of the water treatment system is currently being carried out. The expected capacity will be 20,000 m^3/d (or 20 MLD). During times of peak flow, some underground or surface storage of water may be required following extreme rainfall and recharge events. The future performance of the recommissioned water treatment system is expected to be similar to the previous operation.

4.4.2 Discharge of Pumped Water

To provide flexibility during mine operations, two potential discharge points (Figure 6.45) will be required for the proposed Garrylaun mining operation, as follows:

4.4.2.1 Primary Discharge Point

The primary means for mine water discharge will be through the existing (rehabilitated) pipeline into the River Goul.

4.4.2.2 Secondary Discharge Point

The planned secondary discharge point is on the Glasha Stream to the north of the Plant Site Settlement Ponds. This discharge point will be used for discharging clean groundwater (up to 5,000 m^3/d (5 MLD)) intercepted directly in the mine workings. As a result of discharging only clean groundwater, any future impacts are expected to be small and transitory.

4.5 Impact Assessment

Impacts associated with the proposed Project have been defined given the implementation of design mitigation alone and their significance assessed in relation to their implications on ecological features, defined in terms of their geographical extent (Table 4.6).

The key construction, operational and closure impacts assessed are:

- Disturbance to species through noise, traffic and blasting; and
- Impacts on water quality and quantity.

Potential direct and indirect impacts from water quality and quantity are as follows:

- Effects on important aquatic species such as salmon and otter;
- Otter prey species have specific water quality requirements and any decline in water quality in the River Goul could have indirect impacts on the otter populations using the area;

- Increased macrophyte and algal growth – oxygen depletion, alteration of invertebrate/fish populations which serve as food sources, vegetation changes causing alterations to fish habitats;
- Impacts of dust and site runoff (sediments, fuel, etc.) as a result of mining activities;
- Impacts on ground and surface water from Site de-watering (drawdown), pumping and usage; and
- Impacts on ground and surface water from Site closure.

4.5.1 Drawdown and Dewatering Impacts

It is understood that previous mining at the Site was carried out without any significant hydrogeological impacts. The area of drawdown was localised to the defined Galmoy block. The final area of drawdown from previous mining is shown in Figure 6.19 (Chapter 6.0).

Characterisation of Unmitigated Impact on the Feature

The characterisation of unmitigated impacts uses the 'worst case' impact magnitude scenario in all cases. Impacts would potentially be mitigated by seasonal fluctuations in water level.

Rationale for Prediction of Effect

Modelling undertaken previously indicates that effects attributed to de-watering will be minimal and localised to the defined Galmoy block. The effects are considered highly unlikely to adversely affect the valued ecological features or effect WFD ground or surface water status.

Effect without Mitigation

The unmitigated effect to this development would result in a **minor** short, medium and potentially long-term (operational, closure and post closure of the mine) impact to a feature of **low local** sensitivity and importance.

4.5.2 Impacts to Springs, Wetlands and Bogs (Inc. Galmoy Fen)

During previous mining operations at the Site two bedrock springs within the immediate area of the Plant Site (Figure 6.51, Chapter 6.0) were affected. Both springs occur at a topographic elevation of about 130 m OD, and both formed part of the natural groundwater discharge system for the Galmoy block. It is predicted that both of these springs will also dry up during the proposed recommencement of mining. As dewatering progresses, the water-table will drop below the invert level of the springs, so the groundwater discharge and spring flow will cease.

There were no other observed impacts to springs or bogs during the previous period of mining. There were no changes to the Galmoy Fen or to other wetland areas to the north and east of the mine. No impacts to other springs, wetlands or bogs are expected as a result of the proposed future Garrylaun (Site) mining operation (Chapter 6.0).

Characterisation of Unmitigated Impact on the Feature

The characterisation of unmitigated impacts uses the 'worst case' impact magnitude scenario in all cases. Impacts would potentially be mitigated by seasonal fluctuations in water level.

Rationale for Prediction of Effect

Modelling undertaken previously indicates that three bedrock springs would be adversely affected. The effects are considered highly unlikely to adversely affect the valued ecological features or effect WFD ground or surface water status. Furthermore, it is considered highly unlikely that Galmoy Fen would be afforded adverse impacts.

Effect without Mitigation

The unmitigated effect to this development would result in a **minor** short, medium and potentially long-term (operational, closure and post closure of the mine) impact to a feature of **low local** sensitivity and importance.

4.5.3 Impacts to Groundwater Chemistry

As described within Chapter 6.0, during the past period of mining operations at the Site, the mine itself becomes a hydrogeological sink. All local groundwater flow paths are towards the mine. There are no groundwater flow paths away from the mine. Therefore, there is no potential for the mine to significantly affect the surrounding water quality. This has been demonstrated by the previous monitoring program. The previous monitoring has shown that dewatering does not cause any adverse changes to water quality in the surrounding groundwater system.

Characterisation of Unmitigated Impact on the Feature

The characterisation of unmitigated impacts uses the 'worst case' impact magnitude scenario in all cases. Impacts would potentially be mitigated by seasonal fluctuations in water level.

Rationale for Prediction of Effect

Modelling undertaken previously indicates that all local groundwater flow paths are towards the mine and a 'sink' process would result in no adverse effect to neighbouring groundwater chemistry.

Effect without Mitigation

The unmitigated effect to this development would result in a **minor** short, medium and potentially long-term (operational, closure and post closure of the mine) impact to a feature of **low local** sensitivity and importance.

4.5.4 Impacts to the Erkina River

Baseline monitoring for the Site including data from the downstream surface water locations on the headwater tributaries of the Erkina River show that the water chemistry has remained stable and below Irish surface water regulations. There were no adverse impacts from the previous mining operations. The Glasha crossroads station (Chapter 6.0) shows a seasonal variation in pH, EC and some metals (iron, manganese and zinc). The seasonal variations are typical of groundwater-fed streams in Ireland with increased dissolved solids during the summer when the greatest contribution to the streams is from groundwater. During winter, the dissolved solids reduce as the contribution of rainfall-runoff to the stream increases.

Characterisation of Unmitigated Impact on the Feature

The characterisation of unmitigated impacts uses the 'worst case' impact magnitude scenario in all cases. Impacts would potentially be mitigated by seasonal fluctuations in water level which may promote dilution effects.

Rationale for Prediction of Effect

Design mitigation would mitigate any construction and operational impacts associated with water quality. Proactive and reactive monitoring of water quality parameters would also mitigate the potential for anthropogenic effects.

Effect without Mitigation

The unmitigated effect to this development would result in a **minor** short, medium and potentially long-term (operational, closure and post closure of the mine) impact to a feature of **County** sensitivity and importance.

4.5.5 Impacts to the River Goul

As described within Chapter 6.0. The chemistry of the mine water discharge to the River Goul during previous mine operations did influence the river. However, the reported changes between upstream and downstream river chemistry were relatively small, particularly for the later years of mine dewatering.

In common with many other streams locally in the Irish Midlands, the River Goul shows naturally elevated levels of nitrate and ammonia. Since discharge from the previous mine operation ceased in 2013, reported ammonia values in the river have ranged from about 0.02 to 1.0 mg/l.

During the period of previous mining operations, the ammonia trend was generally similar between the upstream and downstream monitoring stations, but the reported upstream data tended to show slightly greater peaks, which became buffered downstream by the addition of the mine water discharge to the natural river flow.

Nitrate values have ranged between about 5 and 13 mg/l since the previous mine discharge ceased. During the previous active mine water discharge, the observed changes in nitrate between the upstream and downstream monitoring points was also small.

Sulphate concentrations downstream of the discharge point are higher than upstream, peaking at approximately 360 mg/l, but generally declining since 2003, and values during the later stages of previous mining were generally less than 100 mg/l. Zinc concentrations both upstream and downstream increased in 2008 but are declining, with concentrations downstream remaining slightly elevated compared to upstream. Arsenic concentrations generally remain below 0.01 mg/l at both upstream and downstream monitoring points (Chapter 6.0).

Characterisation of Unmitigated Impact on the Feature

The characterisation of unmitigated impacts uses the 'worst case' impact magnitude scenario in all cases. Impacts would potentially be mitigated by seasonal fluctuations in water level which may promote dilution effects.

Rationale for Prediction of Effect

Design mitigation would mitigate any construction and operational impacts associated with water quality. Proactive and reactive monitoring of water quality parameters would also mitigate the potential for anthropogenic effects.

Effect without Mitigation

The unmitigated effect to this development would result in a **minor** short, medium and potentially long-term (operational, closure and post closure of the mine) impact to a feature of **County** sensitivity and importance.

4.5.6 Aquatic Fauna and Otter

The potential for ecological impact to aquatic fauna and otter in the absence of mitigation focuses on the following factors:

- Groundwater effects;
- Surface water effects;
- Direct effects on the River Goul and Erkina and due to water quality deterioration from sediment release or accidental spills – in particular, on aquatic species that are reliant on high water quality;
- Pollution spills – potential oil, fuel or other pollutant spillages may to impact aquatic animal species within receiving waters, causing mortality or other sub-lethal effects such as reduced birth rates and / or juvenile survival;
- Siltation - suspended solids have the potential to damage the gills of aquatic fauna including, salmon, lamprey and white-clawed crayfish;
- Sedimentation - deposition of silt can smother fish eggs, fry and benthic invertebrate communities (food sources for fish and crayfish);
- Interference with fish migration - anadromous species must be able to reach suitable spawning areas upstream and even a small stretch of poor water quality can block or interfere with migration; and
- Other indirect impacts may occur on species that forage in the stream downstream such as Otter and Kingfisher.

Groundwater effects can be summarised by understanding that there is likely to be some further expansion of localised drawdown. However, due to the fact that the de-watering will promote a sink effect the expansion is expected to be minimal (Chapter 6.0).

The results of the water quality assessment indicate that there will be no decrease in any of the quality parameters in the downstream River Goul as a result of the proposed discharge (Chapter 6.0). Therefore, no significant surface water impacts on the River Goul are anticipated as a result of the Project. Suspended solids are also consistently very low and therefore there is no potential for water quality impacts from this parameter.

As such, it is considered highly unlikely that a residual effect would be afforded to species such as the white-clawed crayfish (likely absent from the Goul), lamprey, Atlantic salmon and eel. The freshwater pearl mussel *Margaritifera margaritifera* and Nore freshwater pearl mussel *Margaritifera durrovensis* are also likely to be absent from this watercourse though these species and white-clawed crayfish will be assessed for presence or likely absence (refer to monitoring section 4.6). It should be noted that no works to the riparian bank of the River Goul will occur as part of this application. As such, no direct habitat loss or severance of otter terrestrial habitats will occur.

Characterisation of Unmitigated Impact on the Feature

The characterisation of unmitigated impacts uses the 'worst case' impact magnitude scenario in all cases. Impacts would potentially be mitigated by dilution e.g. hydrocarbon spills and effects could be considered to be reversible depending on the severity of a pollution incident.

Rationale for Prediction of Effect

Modelling undertaken for the Water chapter (Chapter 6.0) indicates that effects attributed to increased groundwater drawdown are likely to be minimal. Surface water quality modelling has also indicated that the baseline quality parameters will be maintained during the mine re-opening. As previously alluded to, the results of the water quality assessment indicate that there will be no decrease in any of the quality parameters in the downstream River Goul as a result of the proposed mine discharge. Therefore, no significant surface water impacts on the River Goul are anticipated as a result of the proposed discharges. As such, the rationale for defining the effects to aquatic species in the absence of mitigation are focussed on 'incident events' such as a breakdown of monitoring equipment.

Effect without Mitigation

The unmitigated effect to this development would result in a **moderate** short, medium and potentially long-term (operational, closure and post closure of the quarry) impact to species of **regional** sensitivity and importance.

4.5.7 Bats

The potential for ecological impact to bats, in the absence of mitigation focuses on the following factors:

- Operational noise disturbance; and
- Dust deposition and subsequent changes in habitat composition (changes to structural, foraging and commuting habitat).

No potential bat roosts would be directly affected by the proposed Project. It is understood that the mine entrance is sealed. The only other openings to the mine workings are the ventilation shafts which at present are capped by concrete plinths with the only opening being a narrow borehole. All of the ventilation shafts barring the K vent (no pump in place) have pumps at depth and piping within the borehole. The pumps are not in operation regularly however all vents are filled with water preventing any access or egress for bat species.

Low level effects attributed to minor operational noise may be afforded. Noise effects associated with the operation of the Site would be temporary during diurnal parts of the day and no nocturnal noise effects are anticipated. Effects associated with operational noise are temporary and reversible. Commitments defined within the design mitigation section to negate Site lighting will ensure dark skies are preserved.

Characterisation of Unmitigated Impact

Noise effects associated with the operation of the Site would be temporary during diurnal parts of the day and no nocturnal noise effects are anticipated.

Rationale for Prediction of Effect

The rationale for effect to bat species considers that no bat roosts will be affected by the proposed Project. On a precautionary basis, it is considered likely that this temporary noise impact (mine operation and traffic) could negatively affect the conservation status of the bat population.

Effect without Mitigation

The unmitigated effect to this development would result in a **minor** short to medium-term impact to species of **low local** sensitivity and importance. All bat species are protected under the Irish Wildlife Acts (1976 – 2012) and they are also listed on the EU Habitats Directive. As such, there is an identified, albeit low, potential for a breach of relevant legislation.

4.5.8 Breeding Birds

The potential for ecological impact to the breeding bird group, in the absence of mitigation focuses on the following factors:

- Operational noise disturbance including blasting; and
- Dust deposition and subsequent changes in habitat composition (changes to structural, foraging and commuting habitat);

There will be no foraging habitat loss. Noise effects associated with the operation of the Site would be temporary during diurnal phases and this has the potential to affect avian behaviour. Ground nesting bird species such as skylark *Alauda arvensis* could be disturbed. The effects of increased noise during operation would be temporary and reversible.

Characterisation of Unmitigated Impact

Noise effects associated with the operation of the Site would be temporary and reversible.

Rationale for Prediction of Effect

On a precautionary basis, it is considered likely that the noise temporary impact could negatively affect the conservation status of the bird population.

Effect without Mitigation

The unmitigated effect to this feature would result in a **minor** short to medium-term impact to species of **low local** sensitivity and importance. The majority of bird species are protected under the Wildlife Acts (1976 – 2012) where it is an offence to hunt, interfere with or destroy their breeding or resting places unless authority is obtained via statutory licence provision.

4.6 Mitigation, Compensation and Enhancement Measures

Committed mitigation, compensation and enhancement measures are provided as follows:

Aquatic Ecological Monitoring

It is proposed to undertake full presence absence surveys of white-clawed crayfish and freshwater pearl mussel during 2018. Furthermore, the aquatic invertebrate studies consolidated by Aquens (2015) will be recommenced in 2018 during the optimal survey windows of either April or September. The re-commencement of this data set will ensure a continuity of data that has recently ceased. This work will inform the ecological status and health of the River Goul which is of course hydrologically linked to the River Nore SAC.

Surface and Groundwater Monitoring

Surface and ground water monitoring will address:

- Groundwater flowing from each active mining zone; flow, chemistry, suspended solids (underground monitoring);
- The overall mine dewatering rate; flow, chemistry and suspended solids;
- Input and output to the water treatment plant; flow and chemistry;
- Mine water discharge; flow, chemistry and suspended solids;
- Upstream and downstream surface water locations in the River Goul and Erkina River (as necessary), for stage, chemistry and suspended solids; and
- Groundwater levels and water quality in existing wells.

Underground Monitoring

Inflows to active mining zones will be monitored as follows:

- Instantaneous pumping rate measured at least daily;
- Cumulative pumped volume totalled weekly;
- Weekly sampling for the indicator suite, plus suspended solids; and
- Daily sampling for any identified parameters of concern based on interactive analysis of the monitoring results.

Overall Dewatering Flow

The overall mine dewatering flow will be monitored as follows:

- Instantaneous pumping rate measured at least daily;
- Cumulative pumped volume totalled weekly;
- Daily sampling of any key parameters;
- Weekly sampling for the indicator suite, plus suspended solids; and
- Monthly sampling for the full suite.

Mine Water Discharge

The mine water discharge will be monitored at the outfall as follows:

- Instantaneous pumping rate measured daily; and
- Cumulative pumped volume totalled weekly.

Receiving Surface Waters

Upstream and downstream monitoring will be carried out for all receiving waters. There will be one upstream monitoring point, and one downstream monitoring point. The sampling locations on the River Goul will be consistent with the previous sampling locations. The monitoring frequency will be as follows:

- River stage continuously;
- Weekly sampling for the indicator suite, plus suspended solids; and
- Monthly sampling for the full suite.

Other Surface Waters

Monitoring will be continued for the existing surface water monitoring points (Chapter 6.0). River stage will be measured monthly. Sampling for the indicator suite will be monthly. There will be two full samples per year during summer baseflow period.

Hydrocarbons/Chemicals

Proposed mitigation measures are outlined as follows (much of these were previously implemented at the mine and will be defined within the Site's EMS):

- All plant and machinery will continue to be regularly serviced before being used on Site;
- Refuelling will be take place in the existing refuelling area;
- Procedures and contingency plans will be set up to deal with emergency accidents or spills; and
- An emergency spill kit with oil boom, absorbers etc. will be kept on-Site for use in the event of an accidental spill.

Dust Suppression

- Dust suppression will be implemented in accordance with best practice guidance (CIRIA, 2010).

4.7 Residual Impacts

Residual ecological impacts are those that remain once the development proposals have been implemented. The main aim of ecological mitigation, compensation, and enhancement is to minimise or eliminate residual impacts. The works (both surface and underground) at the Site are not expected to have a residual impact on the surrounding environment including statutory protected sites.

It is important to note that effects to groundwater and surface water systems are considered to be negligible.

As demonstrated in the Water chapter (6.0), there will be no decrease in any of the water quality parameters as a result of the proposed mine discharge. Therefore, no surface water impacts on the River Goul are anticipated as a result of the proposed recommencement of mine water discharge. As such, it is considered that no negative change to existing WFD status will be afforded to waterbodies pertinent to this assessment.

In the absence of mitigation, compensation and enhancement detailed, **Moderate** and **Minor** effects to features of **Regional, County** and **Low Local** value were realised. However, consideration of the measures outlined above has resulted in residual effects being considered to be **Not Significant**. In essence, this can be described as having no perceivable impacts on ecological features (habitat or species). Impacts may be beneath levels of perception, within normal bounds of variation.

Final restoration of the Site and the surrounding facilities will include the re-watering (flooding) of the mine void to natural groundwater levels (on cessation of underground mining).

4.8 Cumulative Impacts

There are no other known activities or proposed activities at or within close proximity to the Application Site that would be likely to result in any significant cumulative impacts on the ecology of local area at this current time. It is therefore considered that no significant cumulative impacts would occur.

4.9 Conclusions

When considering the mitigation and monitoring measures outlined within this Chapter it is considered that a 'no net loss' for biodiversity will be afforded over the medium to long term (operational to closure life of the mine). The monitoring prescribed and committed within this Chapter will serve to raise awareness of species such as the white-clawed crayfish and freshwater pearl mussel.

References

- CIEEM (2016) Guidelines for Ecological Impact Assessment in the United Kingdom. CIEEM, 26th June 2006.
- Colhoun, K. & Cummins, S. (2013) Birds of Conservation Concern in Ireland 2014–2019. Irish Birds 9: 523–544.
- EIS Appendix 2, Proposed EIS for a Bioenergy Facility, 7th June 2011.
- Environmental Monitoring of Rivers in the Galmoy Area. Report Number 21. AQUENS Ltd. December 2015.
- EPA IPPC licence dated 22nd January 2015.
- Galmoy Mine Project, Environmental Impact Statement. Prepared on behalf of Arcon Mines Ltd by EOLAS, The Irish Science and Technology Agency. 1992.
- Galmoy Mine Extension, Environmental Impact Statement. Arcon Mines Limited. 2000.
- Galmoy Mine Underground Extension: R Zone. Arcon Mines Limited. 2003.
- Fossitt, J.A. (2000). A Guide to Habitats in Ireland. The Heritage Council, Kilkenny.
- Hydrogeology (Chapter 6, Golder 2018) Garrylaun Project. Unpublished Report.
- Joint Nature Conservation Committee (2010) Handbook for Phase 1 Habitat Survey: A Technique for Environmental Audit. Revised reprint 2010.
- Underground Extension; K2 Orebody, Environmental Impact Statement. Galmoy Mines Limited. 2008.

5.0 SOILS & GEOLOGY

5.1 Introduction

This chapter of the EIAR considers and assesses any potential impact resulting from the proposed recommencement of underground mining activities at the Site on the surrounding soils and geology. Blasting will be used to extract the ore. Previous mining activities ceased in October 2012 resulting in the switching off of groundwater pumps in March 2013. The proposed mining activities will take place after dewatering and refurbishment of underground infrastructure.

5.2 Study Methodology

The geological information described in this chapter is based primarily on data taken from four EIS's previously undertaken at the Site as follows:

- Galmoy Mine Project, Environmental Impact Statement. Prepared on behalf of Arcon Mines Limited by EOLAS, The Irish Science and Technology Agency. 1992;
- Galmoy Mine Extension, Environmental Impact Statement. Arcon Mines Limited. 2000;
- Galmoy Mine Underground Extension: R Zone. Arcon Mines Limited. 2003; and
- Underground Extension; K2 Orebody, Environmental Impact Statement. Galmoy Mines Limited. 2008.

Additional data has been taken from the Geological Survey of Ireland (GSI) interactive special data resources map database (www.gsi.ie) and the Environmental Protection Agency (EPA) interactive environmental data map viewers (http://gis.epa.ie/SeeMaps).

In order to assess impacts on the soil and geology, 'Guidelines for the Assessment of Geology, Hydrology and Hydrogeology for National Road Schemes' published by the National Roads Authority (2009) , 'Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements' published by the Institute of Geologists of Ireland (2013) and 'Draft Guidelines on information to be contained in Environmental Impact Assessment Reports' published by the EPA (2017) have been referenced.

5.3 Existing Environment

The Site comprises lands previously held by Galmoy Mines for the underground extraction of zinc and lead. The lands surrounding the Plant Site are predominantly used for agricultural purposes, the dominant agricultural use is livestock grazing, either by cattle or sheep. There is some sparse residential housing in the area, however this is primarily concentrated to linear ribbon settlements along local roads.

5.3.1 Topography

Topography in the vicinity of the Site is predominantly undulating with pronounced ridges running in a southeast- northwest direction interspersed with flat valleys. Topography is ca. 130 to 150 m OD at the Site and rises to 196 m OD in the west at Knockdrinnia Hill. Flat valley basins are a significant feature of the area, being drained by ditches and a stream network (including the Glasha Stream) flowing northwards which joins the River Erkina at Rathdowney.

To either side of Knockdrinnia Hill the lands slope gently away to the flat valley basins which are a significant feature of both the Plant Site and the TMF. One basin forms part of a larger area of recently drained marshland pasture which extends to Whiteswall House and the county road to the east. The other valley basin is flanked to the west by the slopes of Knockdrinnia Hill. The low-lying area east of Knockdrinnia Hill is well drained by ditches constructed during the construction of the TMF.

5.3.2 Soils

Teagasc (EPA, 2018) has identified the following predominant soil types at and in the vicinity of the Site (Figure 5.1):

- A deep well drained mineral soil which is mainly basic (BminDW);
- A shallow well drained mineral soil which is mainly basic (BminSW);
- Made ground; and
- Cutover/cutaway peat (Cut).

Various ground investigations carried out pre-mining and throughout the life of Galmoy Mine before it was closed, indicate a sequence of unconsolidated outwash deposits of clays, silts, sands and gravels which were attributed to the last glacial ice sheet retreat. Once deglaciation was complete, ponds and lakes were left occupying depressions and kettle-holes in the drift surface. These features either silted up or became fen areas (such as Whiteswall Bog) depending on the development of the post glacial drainage network. In poorly drained areas these fen areas developed into raised bogs.

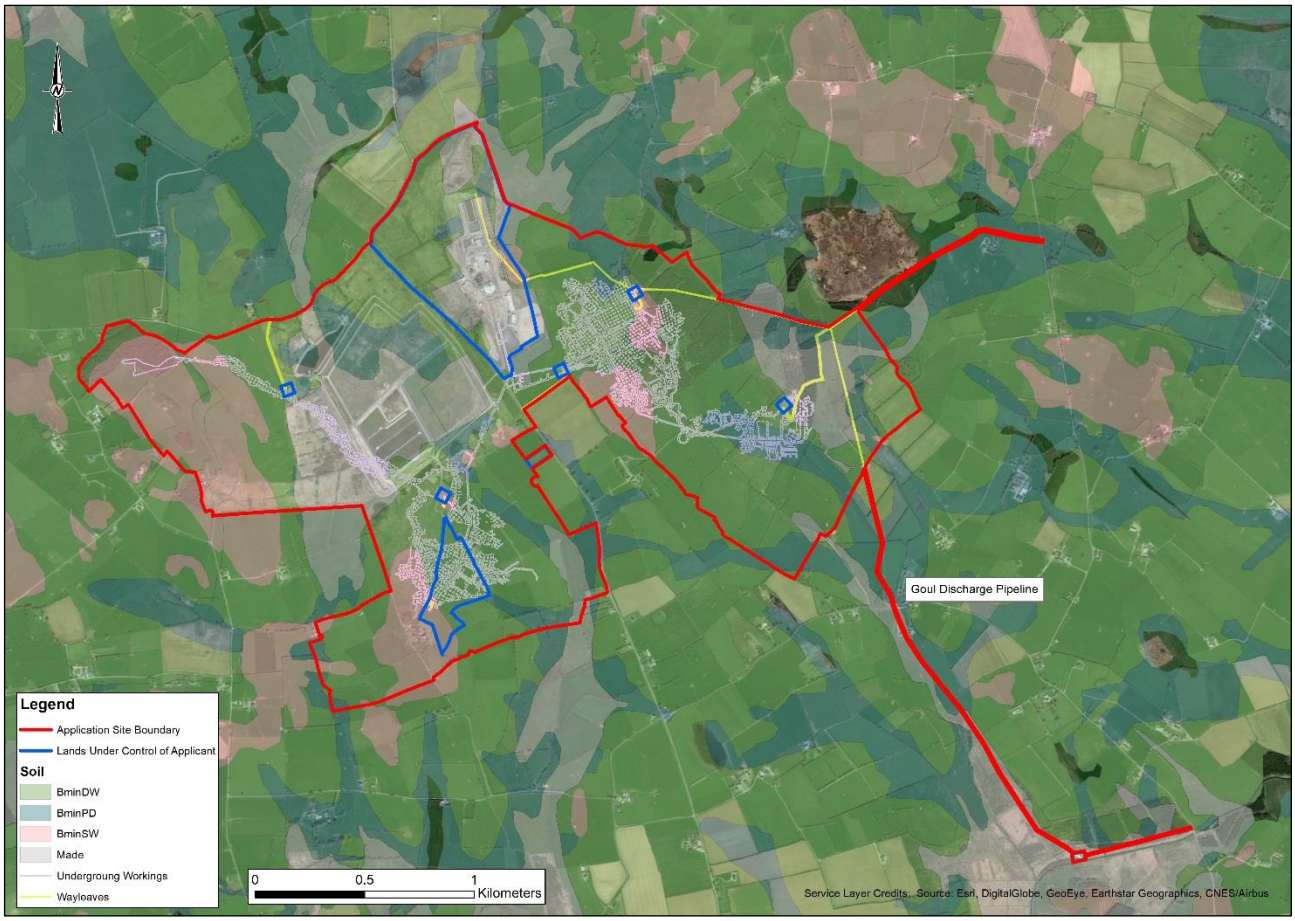

Figure 5.1: Soils Map

5.3.3 Sub-soils

The underlying soils at and in the vicinity of the Site consist of varying depths (ca. 0 to 15 m) of glacial till (EOLAS, 1992). According to sub-soil mapping compiled by Teagasc, the Site consists of made ground (Made) beneath the former plant site and Carboniferous limestone tills (TLs) chiefly derived from Lower Palaeozoic rocks with minor outcrops of karstic limestones (KaRck) to the south east and sand and gravels (GLs) to the south (Figure 5.2).

Exploration drillholes carried out by Conroy Petroleum and Natural Resources P.I.c., Arcon Mines and Galmoy Mines Ltd. in the 1990s and 2000s identified varying depths of overburden and confirmed the palaeokarstic nature of the underlying bedrock. Lands to the north of Kyle Wood had thickness of ca. 6 m (Borehole GY834, 2007). Borehole GY218, over the Garrylaun area identified up to ca. 16 m of overburden. Boreholes over the R Zone identified highly variable depths of overburden, ca. 3 m in borehole 3245-145 to ca. 40 m in borehole 3145/129.

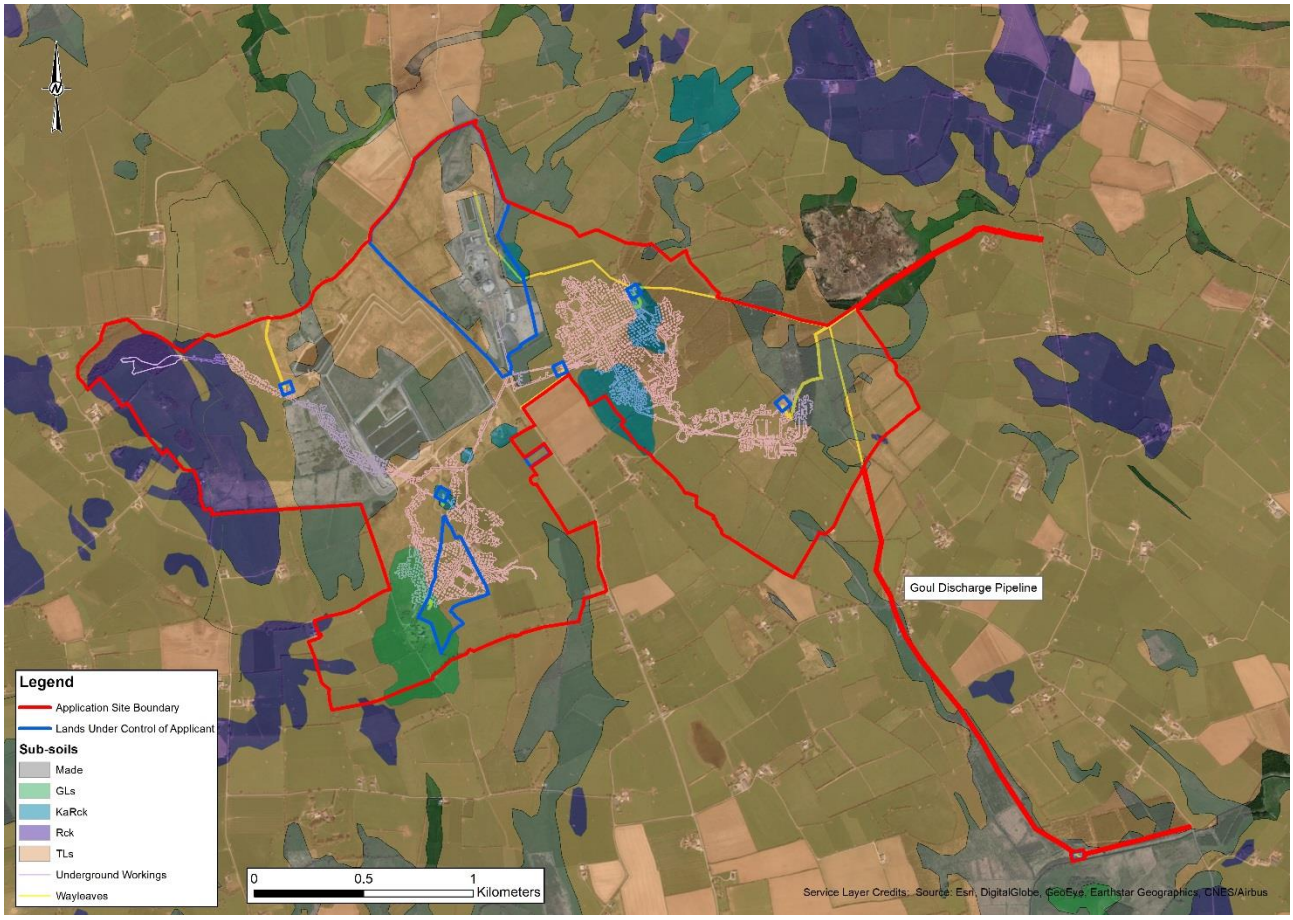

Figure 5.2: Sub-soils Map

5.3.4 Palaeokarst

Arcon Mines Ltd. had identified in 1992 that limited development of karst had occurred in the Galmoy area during the Cenozoic Era, primarily controlled by the presence of dominant NNW-SSE trending structural features in the bedrock. However, by the Holocene epoch (ca. 12,000 years ago) the karstic environment had become clogged with sediment and there was no longer any active groundwater circulation. The karst features became “buried, inert and fossilised karst” termed ‘palaeokarst’ (Drew & Jones, 2000).

Palaeokarst features were identified during exploratory drilling, surface geomorphological mapping, geophysical investigation, pumping tests and underground mapping but found that were was no evidence of unstable near surface conditions or extensive karst development at the time. No active subsidence, extensive cave systems or sinkhole (doline) development had been identified in the area attributed to these features. All evidence from the mine and drilling in the vicinity indicates that the karst features which were once active in the past are now ‘choked’ with debris from infilling of features during the last ice age, leading to the palaeokarst environment of today.

5.3.5 Bedrock

The Site lies within a broad southwest-northeast trending belt known as the 'Rathdowney Trend', some 20 km wide, and composed of Lower Carboniferous carbonate rocks. It is bounded to the northwest by the Silurian and Devonian rocks of the Devil's Bit and Slieve Bloom Mountains and to the southeast by Middle and Upper Carboniferous rocks of the Slieve Ardagh Hills and the northwest edge of the Castlecomer Plateau (Archer et al.,1996) (Figure 5.3).

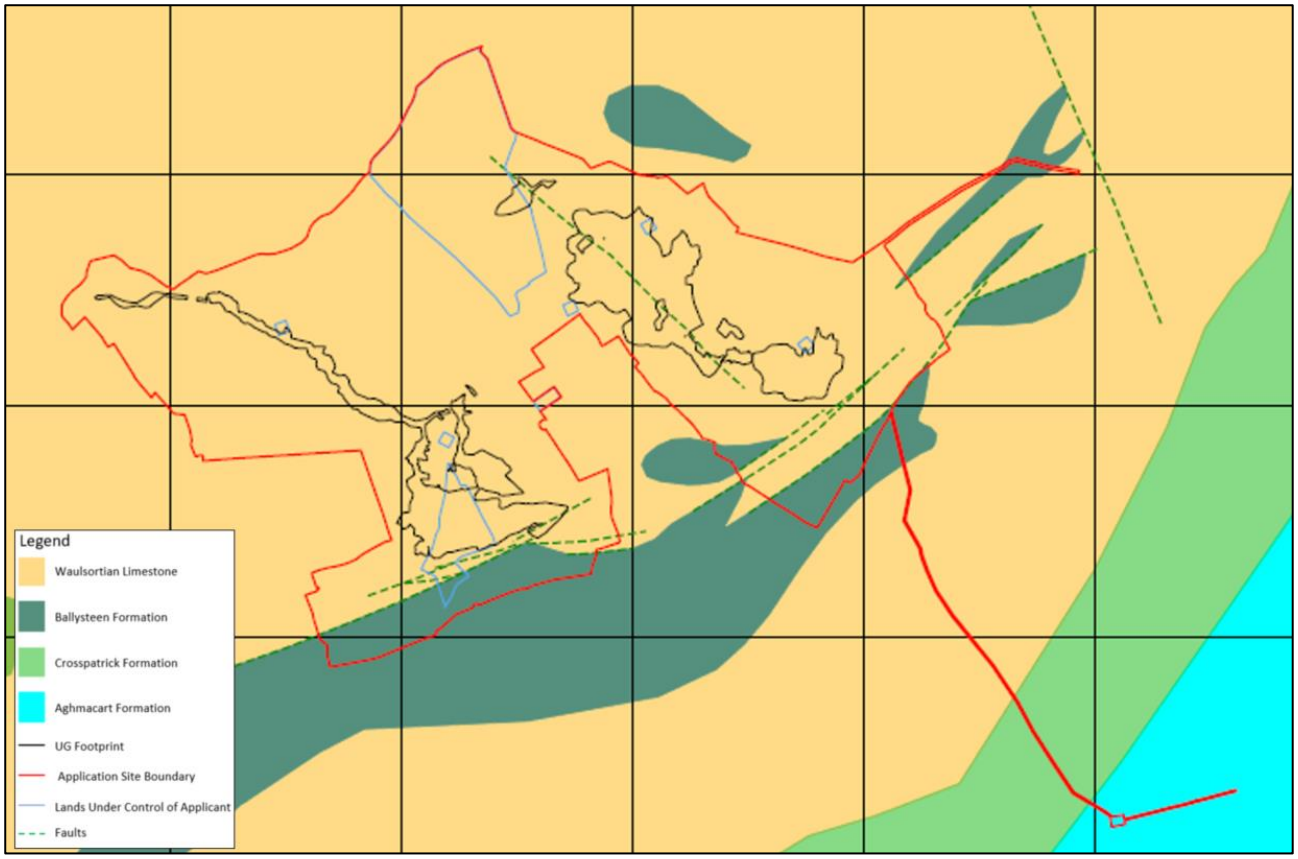

Figure 5.3: Bedrock Geology Map.

The stratigraphy of the area commences with the Devonian Old Red Sandstone which is overlain by the Mellon House Formation, Ringmoylan Shale Formation, Ballyvergin Shale Formation and Ballymartin Limestones. These Formations consist of a sequence interbedded sandstones, siltstones and shales (Figure 5.4)

Stratigraphical Column

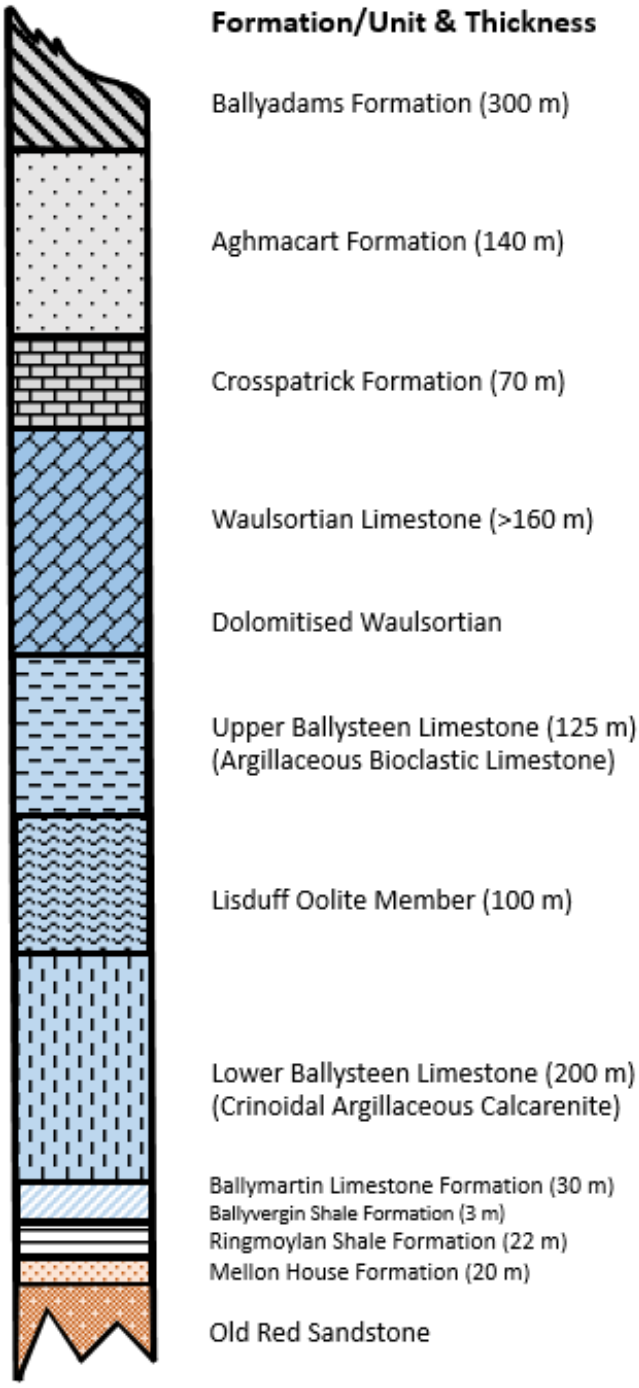

Figure 5.4: Stratigraphical Column for the Site, after Arcon Mines Ltd (1992).

Overlying these are the Argillaceous Bioclastic Limestone (ABL) of the Ballysteen Formation; which may be sub-divided into three main lithological units. The basal sub-division consists of bio-turbated bioclastic calcarenite with some thin irregular black mudstone beds. This sequence is approximately 200 m thick. Above this lies a 100 m thick Lisduff Oolite Member. At Garrylaun, these rocks are dolomitized close to the G fault. The top sub-division is an argillaceous bioclastic limestone. This limestone is approximately 125 m thick and commonly forms the footwall of the zinc – lead mineralisation at the Site.

Above the Ballysteen Formation lies the Waulsortian Mudbank Limestone. This is a fine to medium grained, massive, pale-medium grey and intensely dolomitised rock. Waulsortian rocks locally around the K2 Orebody have undolomitised upper drill hole sections indicating that the edge of the dolomite front is close (Galmoy Mines Ltd. 2008). The Waulsortian is commonly brecciated and is the host rock for the zinc-lead mineralisation at Galmoy. The Site consists of four main orebodies, the CW, G, K and R with associated satellite bodies, the CW South, G West and K2. The proposed extraction will take place in the unworked K2 and remnant orebodies of the R and Garrylaun (formerly G).

Above the Waulsortian lies the unmineralised Supra-Waulsortian formations. The basal formation, the Crosspatrick Formation, is a pale grey, crinoidal calcarenites with inter-bedded cherts or chert nodules in micritic beds. The Crosspatrick Formation is overlain by the Aghmacart Formation which consists of dark grey fine grained bioclastic micrites and calcarenites. In places, this Formation is massively bedded. Overlying the Aghmacart Formation is the Ballyadams Formation. This comprises a coarse grained grey bioclastic limestone with rare thin shale beds. Above the Ballyadams Formation lies the Clogrenan Formation which consists of thick-bedded pale-grey calcarenite limestones with some chert beds.

5.3.6 Structural Geology

The Carboniferous sequence dips gently to the south-east at approximately 10°, with some minor undulations causing local changes in the dip and dip direction. Faulting in the area is pervasive with two main fault directions, ENE and NNW (Figure 5.3). The ENE faults pre-date the NNW trending faults as the latter displace the former to varying degrees. The G fault is an ENE fault, the dominant structure in the area and occurs at the southern margin of the G orebody. It is a normal fault, dipping to the north at about 55° and has a displacement of at least 120 m. It is believed that the G-Fault was the original source of the fluids which formed the orebodies at Galmoy and that minor fault structures acted as conduits for these fluids to mineralise the R and CW orebodies (Arcon Mines, 2003). The NNW trending faults are commonly fracture zones, usually with limited vertical displacement of lithological units. The main joint direction as measured from the sparse outcrops is 350° and may be related to the NNW faults (Galmoy Mines Ltd, 2008).

It is believed that the entire area straddles a significant strike parallel shelf edge or 'hinge zone' that was active in the late Courceyan to Chadian (Galmoy Mines Ltd. 2008). Both regional aeromagnetics and gravity confirm the presence of this and both the Waulsortian and the Crosspatrick Formations are significantly less developed on the southeast side of this 'hinge zone'. Galmoy Mines Ltd suggest that the 'hinge zone' is related to the major southwest-northeast striking en-echelon normal fault system (the G Fault at Galmoy and the Killoran Fault at Lisheen) with downthrow to the north.

5.3.7 Mine Geology

The Galmoy zinc-lead deposits were discovered in February 1986 following drilling on a geophysical anomaly. Mineralisation occurs at the base of the Waulsortian at depths ranging from approximately 50 mbgl to 100 mbgl.

The ore mineralogy consists of sulphide phases, comprising sphalerite (ZnS), galena (PbS) and pyrite (FeS_2). The sphalerite is cream-buff in colour and is the main sulphide phase. The galena is a metallic grey mineral and occurs in relatively minor amounts. The main gangue minerals are pyrite- marcasite (FeSO) and dolomite ($CaMg(CO_3)_2$). Microscopic mineralogical studies have identified other very minor minerals including quartz. The mineralisation occurs within the basal part of the regionally dolomitised Waulsortian Limestone Formation, of upper Courceyan age. The ABL lies immediately below the Waulsortian.

Historically, the deposit at Galmoy consisted of four main orebodies, the CW, G, K and R, with associated satellite bodies, the CW South, G West and K2 (Figure 5.3). The proposed development will involve the extraction of remnant ore from the R Orebody/Zone and Garrylaun (formerly G) Orebody and extraction of ore from the unmined K2 Orebody and unmined pillars.

The Garrylaun Orebody occurs 900 m to the west of the CW Orebody and is still open to the south-east, along the strike of the G Fault. The mineralisation had an average thickness of 8 m with a range of 3 m (minimum mining thickness) to 22 m. Mineralisation occurs at an average depth of 70 m bgl and dips gently at approximately 10° to the north. The sulphide mineralisation in the G and R Orebodies is directly related to the G-Fault.

The R Orebody/Zone was identified as a tabular, shallow dipping orebody hosted by the basal dolomitised Waulsortian Limestones (Arcon Mines Ltd. 2003).

The K2 Orebody is a thin, typically less than 4 m thick, narrow orebody (ca. 50 m at its widest), and ca. 300 m in length (Galmoy Mines Ltd. 2008). The orebody is essentially a sphalerite dominated body with localised highs of galena, and pyrite.

5.4 Predicted Impacts

The evaluation of impacts on the soils and geology at and in the vicinity of the Site is based on a methodology similar to that outlined in the '*Guidelines for the Assessment of Geology, Hydrology and Hydrogeology for National Road Schemes*' published by the National Roads Authority (2009) and '*Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements'* published by the Institute of Geologists of Ireland (2013).

The proposed recommencement of mining activities at the Site is to extract zinc/lead ore from the Garrylaun, R and K2 Orebodies. Therefore, the main impact on the geology will be the removal of sulphide ore deposits and associated waste rock from underground and the re-opening of the respective underground access points (i.e. mine portal and ventilation shafts). Backfill will be pumped underground from the Plant Site to fill mining voids. This practice will also be augmented by the use of Waste-Rock Packing and Cemented Rockfill (CRF) in thinner ore zones so as to ensure ground stability.

5.4.1 Subsidence

Chapter 2.0, Section 2.6 Mining, presents the proposed mining methods for the Project and discusses in more detail Ground Stability and Support (Section 2.6.5), Backfilling (Section 2.6.6) and Mine Dewatering (Section 2.6.7). Mine Dewatering and Rewatering are further discussed in some detail in Chapter 6.0, Water.

5.4.1.1 Mining

Mining involves the extraction of ore creating a void where none existed before, leading to the removal of rock support. Detailed consideration of the mine design, based upon the orebody geometry and geotechnical parameters, has led to the previously successful implementation of room and pillar with backfill operations at the former Galmoy Mine. The preferred mining methods for the future recovery of ore is Longhole Open Stoping, Longhole Pillar Retreat, Drift and Fill and Room & Pillar. The mining methods have been chosen on the basis of no significant subsidence occurring at the surface from the mining operations. All mining operations will be carried out in a safe manner and in accordance with the directions of the Inspector of Mines of the Health and Safety Authority. An extensive underground drilling programme is planned as part of the recommencement of mining to provide date geotechnical information that will be used to refine the mine plan and schedule.

At the cessation of the previous mining cycle and following a period of extensive monitoring during the closure period, the overall stability of the former Galmoy Mine was good and a final audit verified this in October 2012. A new geotechnical assessment (which included field inspections and the review of cored boreholes drilled by Shanoon) was carried out by Avoca Geotech Ltd. in 2017, to determine the geotechnical design requirements for the reopening, accessing and safe mining the targeted ore zones. Conclusions from this report include the monitoring and management of the induced stresses and spans caused by mining to decide on the strategic placement of backfill/CRF and support (including yield pillars) to ensure the long-term stability of the underground workings. In addition, proactive management will be used to manage the overall mining environment.

After mining operations recommence, more detailed geotechnical data will be gathered which will be incorporated into the details of the mining scheduling. Geotechnical studies carried out by the mine engineering staff and, on occasion, by geotechnical consultants, will be an ongoing programme throughout the life of the mine. A data bank will thus be accumulated allowing the basic mining method to be modified and refined to accommodate variations in underground conditions as they are encountered.

Once the ore has been extracted, roof support will be provided by rock bolting, screening and shotcreting, where appropriate. Following this, the resulting rooms will be backfilled with a mixture of coarse tailings, sand and cement, thus eliminating the voids. The rock support removed during the mining process results in an increase in support load generated upon the unmined pillars. The unmined pillars are designed and sized to

support the increased load and remain stable for the life of the mine. The backfilling operations aid in maintaining pillar stability by filling the mined voids and confining the mined pillars, thereby enhancing their strength.

As well as additional geotechnical data, samples of backfill will undergo testing before actual backfilling operations commence. Test data from the backfill, combined with geotechnical data, will allow meaningful computer models to be built to determine mining parameters that will in turn ensure that no significant subsidence will occur. Primary pillar design will be an integral part of the ongoing geotechnical programme. In addition to the determination of dimensions, the proportion and type of cement and supplementary cementing materials will be adjusted when required to accommodate variations in ground conditions and mining heights.

A series of surface survey subsidence stations will be established for each of the extraction areas. These will be regularly surveyed and compared with stations remote from the extraction areas. If ground movements occur as a result of mining activities, the stoping parameters and support methods will be adjusted to remedy the situation.

5.4.1.2 Dewatering

The possibility of subsidence related to dewatering has been carefully considered by Avoca Geotech Ltd and all re-exposed ground will be inspected and assessed following the dewatering of the underground workings.

Although a number of doline-like geomorphological depressions occur in the area (similar to many areas of the Irish Midlands which is extensively underlain by similar rocks and palaeokarst), investigation of a number of these by resistivity and deep overburden sampling indicated that they were more likely to be caused by glacial deposit variation rather than by any underlying karstic features in the host rock (Arcon Mines Ltd. 1992).

The thickness of the ice sheet during the last glaciation (which ended ca. 10,000 years ago) has already subjected the area to considerable stress by loading it with several hundred metres of ice. Compared to active karst areas in Ireland e.g. the Burren, the intensity of karst development at Galmoy is low. Most of the poor ground conditions intersected in drilling and during mining are the result of alteration along fractures rather than solution. Most of the cavities intersected are filled with sediment, usually sand sized grains of dolomite, indicating in-situ alteration of the host rock rather than transported material associated with collapse, or extensive cave systems.

The previous Galmoy Mine Underground Failure Prevention Plan used at the mine will be revised and updated. This document includes protocols, pillar databases, subsidence monitoring, caution zones, extraction procedures and backfilling.

5.4.2 Impact Summary

The importance of existing soil and geology attributes identified at the Site are assessed in Table 5.1 below.

Table 5.1: Importance of Geological Attributes in the Vicinity of the Site

Attribute	Status	Importance
Geohazards	Mining and dewatering induced subsidence.	High
Geological Heritage	No heritage important locations on the Site area.	Negligible
Economic Geology	Economic extraction the underground - an existing mine.	High
Agricultural Soils	Soil on the Site is currently 'brownfield'. Other soil in the vicinity of Site is used for agricultural activities, primarily grazing.	Low
Made Ground	Made Ground makes up the plant site area to the north of the Site.	Negligible

The significance of the impacts on the soils and geology attributes is assessed in Table 5.2 below.

Table 5.2: Significance of Impacts on Soil and Geology

Attribute	Status	Magnitude of Impact
Geohazards	Proposed design on the Site incorporates extraction of Lead/ Zinc ore from the underground mine. Geotechnical assessments will be conducted during extraction life.	Small Adverse
Geological Heritage	Will not have an effect on heritage locality.	Negligible
Economic Geology	The proposed re-commencement will facilitate the extraction of Lead/ Zinc ore at the Site.	Major Beneficial
Agricultural Soils	Drainage measures will be put in place to avoid pollution to groundwater from activities. Topsoil and overburden/ glacial till removed will be reused in the ongoing and phased restoration of the Site.	Small Adverse
Made Ground	The pre-existing Made Ground at the Site will be restored to a mixture of agricultural/ forestry and industrial/ commercial use after mine closure. Some Made Ground may be kept if above ground structures are given an alternative use after mine closure.	Negligible

5.5 Mitigation

The following mitigation measures will be employed during the proposed extraction activities at the Site:

- Mobile plant will use the existing facilities at the plant-site garage for refuelling. Static plant or tracked excavators will refuel over a drip tray with an absorbent mat. These practices will have little or no effect on glacial till/overburden or bedrock material;
- All plant on the Site be regularly maintained, and where plant is damaged or leaking, it will be fixed or replaced immediately, as part of ongoing operational management of the site;
- Existing groundwater wells will be continuously monitored on site during mining operations and for a period following cessation of mining (to be agreed with the relevant authorities);
- Ground support will be installed (including rock-bolts, cable-bolts, mesh and shortcrete);
- Backfill will be used to incrementally fill mining voids in areas where ground conditions are in need of added support;
- Geotechnical assessments will be conducted on a regular basis by an experienced and suitably qualified geotechnical engineer;
- Underground conditions will be monitored continuously for any signs of abnormal ground stability and this will include an assessment of pillars, bed separation, the formation of large spans, wedges or bad brows;
- As voids are created sequentially and are filled shortly after being mined it is highly unlikely that stable conditions will not be maintained. This will ensure that surface subsidence is minimised;
- The previous Galmoy Mine Underground Failure Prevention Plan used at the mine will be revised and updated, and used throughout the life of the mine; and
- The mine manager will ensure compliance with relevant safety and statutory legislation and best practices recommended by national legislation (and guidelines).

5.6 Residual/Likely Significant Effects

The materials to be extracted will be transported offsite for processing, which is considered an acceptable use of the resource. The extraction of lead and zinc at the Site is an important metalliferous mineral resource internationally.

Blasting and bedrock removal may cause unstable rock faces, this would be a temporary impact at the Site and once the mine is closed, rewatering will occur and there will be no rock face exposures.

Experience (and review of data) from previous mining at Galmoy (and also the more recently closed Lisheen Mine) has indicated that no dewatering impact is likely in the long-term following cessation of mining (Chapter 6.0). Nonetheless monitoring will be carried out during dewatering, operation, rewatering and for a period post closure (to be agreed with the authorities) at Garrylaun.

In the long-term, there will be no deleterious effects on the remaining bedrock and groundwater at the end of the mining cycle.

5.7 Cumulative Impacts

The interactions of the known palaeokarst environment and the main features associated with it (from previous mining) within the area and the proposed mining activities including dewatering prior to recommencement of mining, extraction of material and rewatering of the mine after closure are not expected to lead to a significant increase in the likelihood of subsidence occurring in the area. The geological strike length of the main features is known from previous mining and these features will be closely monitored over the life of the proposed development.

The extraction of the ore will tend to induce a relaxation in the overlying rocks. This will occur during the operational phase of the mine's life and, once the load bearing backfill takes up its load, the ground surface will be supported. There is very little risk of any subsidence in the long-term due to the mining practices that will be followed during the proposed mine's life.

Following mining, the mine pumps will be turned off and the watertable will return to its pre-mining levels. Any cavities with porous sediments will again become saturated as evidenced by recent data. There is no expected residual impact due to rewatering operations once the mine has closed and the pre-mining situation reinstated.

Mitigation measures, as previously mentioned above in Section 5.5, will be utilised to minimise the risk from mining related subsidence through careful management and planning. Continuous monitoring will be undertaken of ground support, ground stability and any identified underground fissures/fractures/faults/fluid conduits throughout the life of the proposed mine including during closure.

The nearest extractive industries are Lisduff Quarry limestone quarry, located ca. 9 km northwest of the Site; Campion's Quarry, another limestone quarry located ca. 11 km southwest of the Site; and Aharney Quarry (siltstone) located ca. 12 km east of the Site. The former Lisheen Mine was located ca. 8 km southwest of the Site but closed in 2015 and no other active mines are nearby. As there are no extractive industries within the immediate vicinity of the Site, there will be no cumulative impacts on the soils and geology environment that could be attributed to the interaction of several extractive industries in close proximity to each other.

References

- Arcon Mines Limited. 2000. Galmoy Mine Extension, Environmental Impact Statement.
- Arcon Mines Limited. 2003. Galmoy Mine Underground Extension: R Zone.
- Department of the Environment, 2004. Quarries and Ancillary Activities, Guidelines for Planning Authorities 2004.
- Drew D. P. & Jones G. Ll. 2000. Post-Carboniferous, pre-Quaternary karstification in Ireland. Proc. Geol. Assn., 111, 345-353.
- Environmental Management in the Extractive Industry: Guidelines for Regulators 2006.
- Environmental Protection Agency website, http://gis.epa.ie/SeeMaps. Accessed 01/03/2018.
- Environmental Protection Agency, 2002. Guidelines on the Information to be contained in Environmental Impact Statement. Environmental Protection Agency, Johnstown Castle Estate, Co. Wexford, Ireland.
- Environmental Protection Agency, 2003. Advice Notes on Current Practice in the preparation of Environmental Impact Statements.
- Environmental Protection Agency, 2015. Draft - Revised Guidelines on the Information to be contained in Environmental Impact Statements.
- Environmental Protection Agency, 2017.Draft Guidelines on information to be contained in Environmental Impact Assessment Reports.
- EOLAS, The Irish Science and Technology Agency, 1992. Galmoy Mine Project, Environmental Impact Statement.
- Galmoy Mines Limited. 2008. Underground Extension; K2 Orebody, Environmental Impact Statement.
- Geological Survey of Ireland website, www.gsi.ie; online mapping services, Accessed 28/02/2018.
- Golder Associates, 2014. Galmoy Mine, Investigation of the Possible Causes of the Sinkhole in the vicinity of the Galmoy Mine Workings and Recommended Remediation.
- Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment Department of Environment, Community and Local Government, 2013.
- Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements. Institute of Geologist of Ireland (2013).