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INTRODUCTION

Background

- 6.1 This section of the Environmental Impact Assessment Report (EIAR) provides a description of the existing land, soils and geological setting at the regional and local scale, an assessment of the impact of the proposed development on the land, soils and geological features of the area and also other geological aspects of the development.
- 6.2 Planning is being sought for the continuance of use of the existing quarry at Rossmore, County Cork to the permitted level of -40m OD. A detailed project description is included in Chapter 2 of this EIAR.
- 6.3 The proposed development will consist of continuance of use of the existing quarry development within an overall application area of c.24.7 hectares; extraction to the level of 40m below Ordnance Datum, previously permitted under Plan. Ref. 03/4570; final restoration of the quarry void area and an area of 3.8 hectares to the north adjacent to the public road. Permission is also being sought for an extension to the existing operating hours for the readymixed concrete plant, for out of hours operation of the plant up to a maximum of 40 occasions per year, to supply critical and strategic building / infrastructure / maintenance projects whose construction requires supply of concrete outside normal plant operating hours.
- 6.4 The site consists of an existing quarry and associated ancillary activities; therefore, the soils and subsoils at the site have already been removed to facilitate the existing operations as part of the existing planning permission for the site.

Scope of Work / EIA Scoping

- 6.5 This EIAR is based on a desk study of the site / surrounding lands using published geological data, a site investigation undertaken in 2003 comprising boreholes for the EIS, and annual geological inspections of the quarry (undertaken as part of the aggregate quality compliance programme).

Author

- 6.6 This EIAR chapter relating to Land, Soils and Geology was prepared by Peter Glanville (EurGeol PGeo) of SLR Consulting. Peter is a Quaternary Geologist and Hydrologist and has over seventeen year's professional experience.

Limitations / Difficulties Encountered

- 6.7 No difficulties were encountered in the preparation of this chapter of the EIAR.

REGULATORY BACKGROUND

EU Directives

- 6.8 The following European Union (EU) Directive relate to Land, Soils and Geology at the site in this EIAR:
- Environmental Impact Assessment Directive (2011/92/EU);
 - Environmental Impact Assessment Directive (2014/52/EU);
 - The management of waste from extractive industries (2006/21/EC); and
 - Environmental Liability Directive (2004/35/EC).
- 6.9 The EU EIA Directive regulates the information impact assessment process and information in this EIAR. The management of waste Directive and the Environmental Liability Directive regulates the activities at the site.

Irish Legislation

- 6.10 The following legislation relating to Land, Soils and Geology at the site in this EIAR:
- No. 349 of 1989, European Communities (Environmental Impact Assessment) Regulations, and subsequent amendments (S.I. No. 84 of 1994, S.I. No. 352 of 1998, S.I. No.; 93 of 1999, S.I. No. 450 of 2000 and S.I. No. 538 of 2001);
 - S.I. No. 473 of 2011, European Union (Environmental Impact Assessment and Habitats) Regulations 2011;
 - S.I. No. 584 of 2011, European Union (Environmental Impact Assessment and Habitats) (No.2) Regulations 2011;
 - The Planning and Development Acts, 2000 to 2009; and
 - The Planning and Development (Amendment) Act 2010, S.I. 600 of 2001 Planning and Development Regulations and subsequent amendments including, S.I. No. 364 of 2005 and S.I. 685 of 2006.
- 6.11 The above legislation regulates the information contained in an EIAR and planning at the site.

Planning Policy and Development Control

- 6.12 The following Planning Policy and Development Control relating to Land, Soils and Geology at the site in this EIAR is set out in the:
- Cork County Development Plan 2015-2021.
- 6.13 The county development plan sets out conservation objectives in relation to soils, geology, geomorphology and geological heritage in the County.

Guidelines

- 6.14 This Land, Soils and Geology section of the EIAR has been prepared with regard to the following guidelines:

- Environmental Protection Agency (2017) *Guidelines on the Information to be Contained in Environmental Impact Assessment Reports. Draft dated May 2017*. Environmental Protection Agency, Johnstown Castle Estate, Co. Wexford
- DoEHLG (2010) *Appropriate Assessment of Plans and Projects in Ireland - Guidance for Planning Authorities*;
- Environmental Protection Agency (2002) *Guidelines on the information to be contained in Environmental Impact Statements*;
- Environmental Protection Agency (2003) *Advice Notes on current practice (in the preparation of Environmental Impact Statements)*;
- Geological Survey of Ireland, Irish Concrete Federation (2008) *Geological Heritage Guidelines for the Extractive Industry*;
- Institute of Geologists of Ireland (2002) *Geology in Environmental Impact Statements, A Guide*;
- Institute of Geologists of Ireland (2013) *Guidelines for the preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements*;
- National Roads Authority (2008) *Environmental Impact Assessment of National Road Schemes - A Practical Guide*;
- National Roads Authority (2008) *Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes*.
- National Roads Authority (2006) *A Guide to Landscape Treatments for National Road Schemes in Ireland*; and
- Transport Infrastructure Ireland (March, 2013). *Specification for Road Works Series 600 – Earthworks*.

Technical Standards

6.15 The following Technical Standard is used to describe subsoils and rock in this EIAR where required:

- British Standards (2015). *Code of Practice for Site Investigations BS5930:2015*.

RECEIVING ENVIRONMENT

Study Area

- 6.16 The study area for this Land, Soils and Geology section of the EIAR comprises two principal geographic areas:
- the existing quarry at the site and ancillary working areas; and
 - the immediate surrounding area within approximately 5km of the site.

Baseline Study Methodology

- 6.17 The baseline study undertaken for Land, Soils and Geology, here involves a review of published literature and information, the previous 2003 EIS, 16 boreholes conducted at the site in 2003, and annual geological inspections of the quarry (carried out as part of the aggregate quality compliance programme .
- 6.18 This section describes the receiving environment at and in the immediate vicinity of the site using the available baseline information gathered, specifically the:
- **Context** of the receiving environment - location/ magnitude/ spatial extent and trends of the environmental factors;
 - **Character** of the receiving environment - distinguishing aspects of the environment being considered here;
 - **Significance** of the receiving environment - the quality, value or designation is assigned to the existing environment; and
 - **Sensitivity** of the receiving environment - how sensitive is the aspect of the environment to change.
- 6.19 The baseline study is a qualitative assessment of the available information, based on professional experience.

Sources of Information

- 6.20 The following sources of information were consulted in the preparation of the receiving environment baseline study for Land, Soils and Geology:
- Geological Survey of Ireland (www.gsi.ie);
 - Teagasc soil and subsoil mapping for Irish Forestry Soils Project (www.epa.ie);
 - Irish Soils Information System (www.teagasc.ie/soils);
 - Irish Geological Heritage Programme (www.gsi.ie); and
 - Ordnance Survey of Ireland (www.osi.ie).
- 6.21 A geophysical survey and a total of sixteen boreholes were conducted at the site in 2003 for the EIS, and although they were designed to provide information on groundwater levels for the EIS they also provide information on the site geology.
- 6.22 Annual geological inspections of the quarry are carried out as part of the aggregate quality compliance programme.

Land Baseline

- 6.23 Within the EIA EU Directive (2014/52/EU) Land is recognised as a ‘natural resource’ and the Directive also refers to the importance of the sustainable use of soil and the need to address the unsustainable increase in settlement areas over time (‘land take’). Therefore, the issues of land as both a natural resource and land take must be considered in an assessment.
- 6.24 The introduction section to the EU Directive (2014/52/EU) notes that the:
‘final document of the United Nations Conference on Sustainable Development held in Rio de Janeiro on 20-22 June 2012, which recognises the economic and social significance of good land management, including soil, and the need for urgent action to reverse land degradation. Public and private projects should therefore consider and limit their impact on land, particularly as regards land take, and on soil, including as regards organic matter, erosion, compaction and sealing; appropriate land use plans and policies at national, regional and local level are also relevant in this regard’.
- 6.25 Land can be considered to be a resource with a beneficial use to society, for example agricultural land use, extractive industry land use or urban residential land use; unnecessary land take may result in the loss of this resource which has the potential to have adverse social and economic consequences for society.
- 6.26 The site is an existing quarry with associated ancillary facilities for readymix production and block making; therefore, the lands are already in use for extraction and production purposes.
- 6.27 The extraction of Limestone rock at the site is a tied resource land use activity, as it is dependent on the location and suitability of suitable materials for block making and readymix production, and therefore the Limestone material may be considered to be a natural resource.
- 6.28 The Cork Co. Development Plan (2015-2021) recognises that extractive industry is generally located in a rural area and can only be developed where the resources occurs.
- 6.29 The County Development Plan addresses mineral extraction in the county and sets out a number of objectives for the mineral industry related to the land use and resource nature of extractive industries in the County. The plan recognises that mineral extraction and the aggregate industry are important to the economy of the county in terms of employment generation and providing raw materials to the construction industry.
- 6.30 Development Plan Objective EE 12-1 is to safeguard mineral reserves states that it is an objective to:
- *Protect and safeguard the county’s natural mineral resources from inappropriate development, by seeking to prevent incompatible land uses that could be located elsewhere, from being located in the vicinity of the resource, since the extraction of minerals and aggregates is resource based.*
- 6.31 Development Plan Objective EE 12-2 relates to a mineral strategy for the county Mineral Strategy and states that:
- *Consideration will be given to the desirability of preparing a Minerals Strategy to support a sustainable extractive industry during the life time of the plan.*
- 6.32 It is understood that no specific minerals strategy has been prepared for Cork County to date.
- 6.33 The development plan recognises that mineral extraction is an important part of the economy and that suitable mineral reserves are a natural resource-based material, are finite and are a tied

landuse, depending on where they occur and that the material is a tied or resource-based land use.

- 6.34 The plan therefore seeks to protect and safeguard natural mineral resources from inappropriate development, by seeking to prevent incompatible land uses that could be located elsewhere.
- 6.35 In terms of land take, the proposed development does not require any additional land take as the continuance of use of the existing quarry will be within the existing footprint of the quarry; however, the quarrying will result in a loss of the natural mineral resource at this location through its extraction.

Soils Baseline

- 6.36 Soil is defined as the top layer of the earth's crust and is formed by mineral particles, organic matter, water, air and living organisms. Soil is an extremely complex, variable and living medium and its characteristics are a function of parent subsoil or bedrock materials, climate, relief and the actions of living organisms over time.
- 6.37 Soil formation is an extremely slow process and can take thousands of years to evolve; soil can be considered essentially as a non-renewable resource.
- 6.38 As the interface between the earth, the air and the water, soil performs many vital functions; it supports food and other biomass production (forestry, biofuels etc.) by providing anchorage for vegetation and storing water and nutrients long enough for plants to absorb them. Soil also stores, filters and transforms other substances including carbon and nitrogen, and has a role supporting habitats serving as a platform for human activity.
- 6.39 The current County Development Plan *'recognises the key role that soil plays in many areas including food production, surface water/flooding management and providing the key ingredient for supporting a wide range of ecosystem habitats and enhancing biodiversity. Therefore the need to conserve and manage the soils in the County is a key consideration.'*
- 6.40 The development plan also states that *'The Council will encourage the reuse of brownfield land where possible in preference to developing green field sites in order to reduce the loss of the county's more agriculturally productive soils. The protection of our natural assets as part of the County's Green Infrastructure resources will also assist in maintaining soil permeability levels which are important for drainage functions and ecosystem habitats.'*
- 6.41 Objective GI 9-1 of the County Development Plan relates to the Protection of Soils and states that it is an objective to
- *'Ensure the protection and conservation of the soils in County Cork by encouraging sustainable management practices and the reuse of brownfield lands'.*

National Soils

- 6.42 The Irish Soil Information System (ISIS) project was undertaken by the EPA and Teagasc, and has gathered together existing information and data from soil survey work in Ireland, which has been augmented with a new field data, leading to the production of a new national soil map at a scale of 1:250,000 (www.teagasc.ie/soils).
- 6.43 The ISIS project has identified a number of Soil Associations across Ireland, which are each comprised of a range of soil types (or 'Series'), each of them different in properties, with different

environmental and agronomic responses. For each soil type, the properties have been recorded in a database maintained by Teagasc.

- 6.44 The soil association in the vicinity of the site is classified as the Clashmore Soil Association (1000n), see Figure 6.1, which is characterised by '*Coarse loamy drift with siliceous stones*'. The Elton Soil Association is described as comprising '*Brown Earths, Luvisols and Surface Water Gleys on drift with siliceous stones*'¹.
- 6.45 The Clashmore Soil Association is predominantly found in lowland areas and almost half of all soils found in this series are in Co. Cork (Creamer *et. al.*, 2018). The Brown Earths in this association are generally well drained.
- 6.46 The Clashmore Soil Association is comprised of a total of eight separate Soil Series which include soil series which have developed on glacial drift comprise predominantly of siliceous stones.

Site Soils

- 6.47 The Teagasc soil mapping for the Irish Forestry Soils (IFS) mapping project, indicates that the soils in the vicinity of the site are characterised by deep and well drained Acid Brown Earths and Brown Podzols, see Figure 6.2. There are smaller areas of peaty Lithosols along the foreshore and also areas of Rendzinas and Lithosols to the east of the site.
- 6.48 The soils mapping also indicates an extensive area of alluvial soils (fines) to the northwest of the site between Carrigtohill and Fota Island, see Figure 6.2.
- 6.49 The soils at the site have been removed in the past to facilitate quarrying activities and are currently stored in the western part of the site awaiting restoration. It is not proposed to remove any soils as part of this proposal to continue the use of the existing quarry.

Subsoils Baseline

Regional Subsoils

- 6.50 The Quaternary (Subsoil) deposits were deposited during the last 2 million years, and essentially comprise the unconsolidated materials overlying bedrock. The two main types of quaternary subsoils in Ireland are glacial till, deposited at the base of ice sheets, and Sand & Gravel deposits associated with the melting of the ice sheets which are generally termed glaciofluvial outwash sands and gravels. Other extensive quaternary subsoils in Ireland include peat, river alluvium and coastal process deposits. Most Quaternary subsoils in Ireland were deposited since the maximum of the last glaciation, the Midlandian, which occurred approximately 17,000 years ago.
- 6.51 The subsoils across Ireland have been mapped on a national basis by Teagasc as part of the EPA Soil and Subsoil Mapping Project for the Irish Forestry Soils (IFS) project. The subsoil mapping was undertaken at a national basis using existing Quaternary Geology maps, Publications, remote sensing, field mapping and sampling.
- 6.52 The subsoils in the vicinity of the site have been mapped under the IFS project as glacial till deposits which are comprised predominantly of Devonian Sandstone material, see Figure 6.3. Along the foreshore at the site the subsoils are thin or absent and rock if close to or at the

¹ EPA Report No. 130 (2014), Irish Soil Information System: Synthesis Report Appendix 3 - Soil Association List

surface. Other subsoils in the vicinity of the site have been mapped as alluvium material between Carrigtohill and Fota Island, see Figure 6.3.

- 6.53 The subsoils at the site have been removed in the past to facilitate quarrying activities and are currently stored in the western part of the site awaiting restoration. It is not proposed to remove any subsoils as part of this proposal to extend/deepen the existing quarry.

Site Investigation 2003 Baseline

- 6.54 A site investigation was undertaken in 2003 which comprised a geophysical survey and a total of sixteen boreholes. The ground investigation was designed to identify and monitor groundwater levels for the 2003 EIA, the investigation also provided information on the geology at the site. The information from the 2003 site investigation covers the extent of the existing quarry area.
- 6.55 Two geophysical surveys were carried out in 2002 at the site which comprises a series of resistivity profiles which were undertaken mainly across the eastern part of the site where the existing quarry void is located. The geophysical survey identified three potential weather zones in the bedrock at the site which included:
- A north-south trending vertical zone of weathering in the western part of the quarry void;
 - A weathered zone between -6m and -8m OD which did not have any water; and
 - A weathered zone at approximately -34m OD.
- 6.56 The boreholes comprise two pumping wells, six groundwater level monitoring wells and eight temporary monitoring wells, a copy of the borehole logs and borehole locations are included in Appendix 6-A.
- 6.57 The deepest borehole at the site (MWA3) extended to -46.9m OD which is c. 7m below the final depth of -40m OD which is being sought in this application. Borehole PWA1 was drilled to -21.4mOD and encountered '*solid limestone with no significant amounts of water in it*' (Readymix EIS, 2003).
- 6.58 The borehole logs show weathering at approximately -6m and -8m OD at a number of the boreholes, however the weathering was not present at PWA1 (central area), MW2A (south) and MW4A (northeast corner).
- 6.59 The logs further show weathering as -34m OD at a number of boreholes, and the weathering was not reported at MWA2, in the south central area, and MWA3, in the north central area. This suggests that the weathered zone is not continuous across the site.

Bedrock Geology Baseline

- 6.60 The GSI geology map Sheet 22 (East Cork - Waterford) shows major geological faults running north south in the vicinity of the site, see Figure 6.4.
- 6.61 The northern part of the site is underlain by the Carboniferous Clashavodig Formation Limestone, while the section where the quarry void is located in the Carboniferous Little Island Formation which is comprised of massive and crinoidal fine Limestone, see Figure 6.4. Both formations are fine grained limestones. The Little Island Formation is described in the GSI Geological memoirs (1995) as being comprised of a uniform 500m thick succession of mudbank Limestone.
- 6.62 The proposed development at the site involves the continuance of use of the existing quarry in the Little Island Formation Limestone, from its existing floor level to the existing permitted floor

level of -40 mOD. The Little Island Formation Limestone is the main geological unit which has been quarried at the site.

- 6.63 The geological structure in the area around the site is dominated by the Cork Syncline which runs in an east northeast to west southwest direction from Youghal Bay in the east to Cork City in the west (GSI, 1995).

Karst Baseline

- 6.64 According to the GSI, the bedrock in the vicinity of the site is classified as a Regionally Important Aquifer which is karstified. The quarry is located within the Midleton groundwater body (GWB) which includes the Regionally Important karstified Aquifer.
- 6.65 No significant karst features have been encountered at the quarry.
- 6.66 Karstification most often occurs in the upper bedrock layers and along certain fractures, fissures and joints, at the expense of others; there are numerous surface karst features in the limestones in the east Cork Region (www.gsi.ie). However, Karst features such as cave systems, sinking streams, springs, swallow holes and other collapse features are common in the Midleton GWB are known to extend below present sea levels and is estimated to extend to depths of up to 50m to 60m below O.D. Malin Head. Groundwater flows in these features will be through faults and joints formed by deformation that were subsequently enlarged by karstification.
- 6.67 There are no know geological faults at the site and this has been confirmed during the site inspection.
- 6.68 The GSI database (www.gsi.ie) shows the closest karst features to the site are two landforms east to northeast of the quarry. Goat Hole cave is located approximately 1.3 km to the north to northeast, and a spring is located approximately 1.6 km east of the quarry; both karst features are in in Ballintubbrid West townland.

Geological Heritage Baseline

- 6.69 The current Cork County Development plan lists sites of County geological importance. The plan recognises the importance of Geological Heritage and lists the important geological features within the County with the intention of maintaining their possible conservation value; the list of County Geological was produced by Cork Co. Council in consultation with the Geological Survey of Ireland and the Geology Department of the National University of Ireland, Cork.
- 6.70 Objective HE 2-6 of the County Development Plan states that the objective for Geological Sites is to *'Maintain the conservation value of those features or areas of geological interest that are listed in Volume 2, Chapter 3 Nature Conservation Areas, of the plan, and to protect them from inappropriate development.'*
- 6.71 There are no designated Irish Geological Heritage sites at Rossmore and there are no sites of County Geological Interest within or immediately adjacent to the development, as indicated in the current Cork County Development Plan.

Sensitive Receptors

- 6.72 In terms of land, soils and geology baseline considered here, the current landuse at the site is quarrying and both the soils and subsoils have been removed from the site previously to facilitate quarrying; therefore, no land use, land take, soil or subsoil sensitive receptors at the site have been identified from this baseline study.
- 6.73 The Limestone bedrock geology at the site is extensive in the east Cork area and is therefore not considered to be a sensitive receptor.
- 6.74 There are no geological heritage sites or sites of County Geological Interest present at the site.

IMPACT ASSESSMENT

Evaluation Methodology

- 6.75 The evaluation of impacts of the proposed development 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 the *Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements published by the IGI (2013)*.

Evaluation of Impacts

- 6.76 This assessment focuses on the potential impact of the continuance of use of the existing quarry on the land, soils and geology at the site. There are no site construction impacts associated with the continuance of use of the existing quarry and does not require any stripping of soils and subsoils across the lands.
- 6.77 The importance of existing land, soil and geology attributes identified at the application site is assessed in **Table 6-1** below.

Table 6-1
Importance of Attributes in Vicinity of Application Site

| Attribute | Status / Occurrence | Importance of attribute |
|-----------|--|---|
| Land | The land at the site comprises a working quarry and therefore has an existing industrial landuse. The land at present has no particular status in terms of its use or suitability for agriculture. | Very High - established landuse at the site based on a proven economic reserve of limestone resource. The industrial landuse at the site has a value in terms of its ability to provide employment, support the construction sector in the region and general economic growth, as well as maintaining competition in the marketplace. |
| Soils | There are no existing soils at the site. The soils at the site have been removed to facilitate extraction, and are stored for use in future restoration. | None - soils have been removed to facilitate extraction |
| Subsoils | The glacial till subsoils at the site have been removed to facilitate the existing quarrying operations (apart from a small area in the northwest of the existing | None – most of the subsoils have been removed to facilitate extraction |

| | | |
|---------|--|---|
| | extraction area), and are stored for use in future restoration. | |
| Geology | The limestone bedrock is currently quarried at the site. The Limestone is a finite resource within the east Cork and Waterford region which is resource tied. | Very High - the site has a proven economic reserve of limestone resource. The Limestone bedrock at the site provides employment, supports the construction sector in the region and general economic growth, as well as maintaining competition in the marketplace. |

6.78 The magnitude of these impacts on the land, soils and geology attributes is assessed in **Table 6-2** below.

Table 6-2
Significance of Impacts on Land, Soil and Geology with no Mitigation

| Attribute | Impact of Proposal on Land, Soil and Geology | Magnitude of potential impact |
|-----------|--|---|
| Land | No loss of existing industrial landuse | Negligible - no noticeable consequences with the continuance of an industrial landuse at the site. |
| Topsoil | No topsoil will be removed as part of the continued use of the existing quarry – existing extraction area to permitted floor level of – 40mOD. | Negligible - no noticeable consequences as the topsoil has already been removed to facilitate extraction within the permitted extraction area. |
| Subsoils | Subsoils will be used in the restoration of the overall site. | Moderate beneficial - long term and positive with use of subsoils for restoration. |
| Geology | Limestone bedrock will be removed from the site | Small Adverse - Loss of a small part of the overall natural resource through its extraction and use in the construction sector. |

Indirect Impacts

6.79 There will be no indirect impacts on land, soils or geology as a result of the continuance of use of the existing quarry at the site.

Unplanned Events (i.e. Accidents)

6.80 Unplanned events within the application site, such as accidents, have the potential to impact on the land, soils and geology adjoining the site.

6.81 Ground instability, particularly the long-term stability of quarry faces, has the potential to impact on adjoining lands. Operations at the quarry will adhere to the Health and Safety Authority Safe Quarry Guidelines in relation to the Safety Health and Welfare at Work (Quarries) Regulations 2008-2019 and this will limit the potential for unplanned events such as instability of quarry faces or instability in adjacent lands.

6.82 With the implementation of the Quarry Regulations 2008-2019, it is considered unlikely that instability of quarry faces would result in an impact on the land, soils and geology at the site.

Human Health

- 6.83 From a land, soils and geology perspective, any potential impacts on human health from the excavation and processing of the Limestone rock at the site would not be via the landuse, soils and geology pathways but via other pathways such as air and water, which are addressed in the relevant chapters of this EIAR.

Cumulative Impacts

- 6.84 No cumulative impacts have been identified on land, soil or geology associated with the proposed Greenfield development at the site.

Interaction with Other Impacts

- 6.85 No interactions with other impacts have been identified for the land, soils or geology attributes associated with the proposed development.

‘Do-nothing Scenario’

- 6.86 Under the ‘do nothing scenario’ there will be no additional impact on the land, soils and geology, over and above that from the existing quarry. The existing Limestone material in the proposed development area will remain.

MITIGATION MEASURES

- 6.87 Soil management measures are already in place at the site for the existing quarrying operation, and will remain in place during the lifetime of the proposed continuance of use of the existing quarry. There is a restoration scheme in place for the quarry for the post-operational afteruse of the land, refer to EIAR chapter 2.
- 6.88 The construction stage has been completed for the existing quarrying operations at the site. The operational stage of the quarry is the further extraction of the Limestone material within the permitted quarry footprint, over the proposed lifetime of the continuance of use of the existing quarry.

Construction Stage

- 6.89 The site preparation stage has been completed for the existing quarrying operations at the site and therefore no mitigation measures are required for this stage. This application relates to the continuance of use of the existing quarry.

Operational Stage

- 6.90 During the operational stage the Limestone rock will be quarried and processed at the site under the continuance of use.
- 6.91 Operations at the quarry will adhere to the Health and Safety Authority Safe Quarry Guidelines in relation to the Safety Health and Welfare at Work (Quarries) Regulations 2008-2019 and this will limit the potential for unplanned events such as instability of quarry faces or instability in adjacent lands.
- 6.92 No other specific mitigation measures are required at the site in terms of land, soil and geology at this stage.

RESIDUAL IMPACT ASSESSMENT

- 6.93 The residual impacts on land, soil and geology are those impacts which remain following the implementation of the mitigation measures outlined above.

Construction Stage

- 6.94 As the proposed development is within the existing quarry, a continuance of use, there are no residual impacts associated with this stage.

Operational Stage

- 6.95 The operation of the quarry in line with the Health and Safety Authority Safe Quarry Guidelines in relation to the Safety Health and Welfare at Work (Quarries) Regulations 2008-2019, will limit the potential for unplanned events such as instability of quarry face or instability in adjacent lands. Therefore, it is considered that the residual impact of the proposed continued extraction within the permitted extraction area will be low to imperceptible.

Restoration Stage

- 6.96 The planning application area will be restored to natural habitat afteruse, which is one of the beneficial after uses listed in the EPA Guidelines: 'Environmental Management in the Extractive Industry' (2006). This restoration scheme will assist in enhancing the biodiversity of the site and local area. The restoration will be achieved by implementation of the following measures:
- Creating a water body within the final quarry void as the groundwater level rebounds to its natural level, on permanent cessation of extraction operations.
 - Retaining existing vegetation and provision of woodland and barrier mix planting around the perimeter of the quarry void;
 - Leaving some areas for natural re-colonisation;
 - Landscaping of the overburden storage area located in the northern part of the site, including hedgerow and woodland mix plating.
- 6.97 The restoration of the application area to natural habitat afteruse will have a positive impact on the biodiversity of the site and local area.
- 6.98 There will be a residual impact associated with the loss of agricultural land and this will be both a permanent and minor negative impact at site level.
- 6.99 Following completion of the restoration work monitoring will be undertaken over a period of three years to ensure that the restoration scheme has been successfully implemented.
- 6.100 Following the restoration of the site monitoring will be undertaken over a period of three years to ensure that where the subsoils and soils have been restored at the site, that the overall restoration scheme has been successfully implemented.

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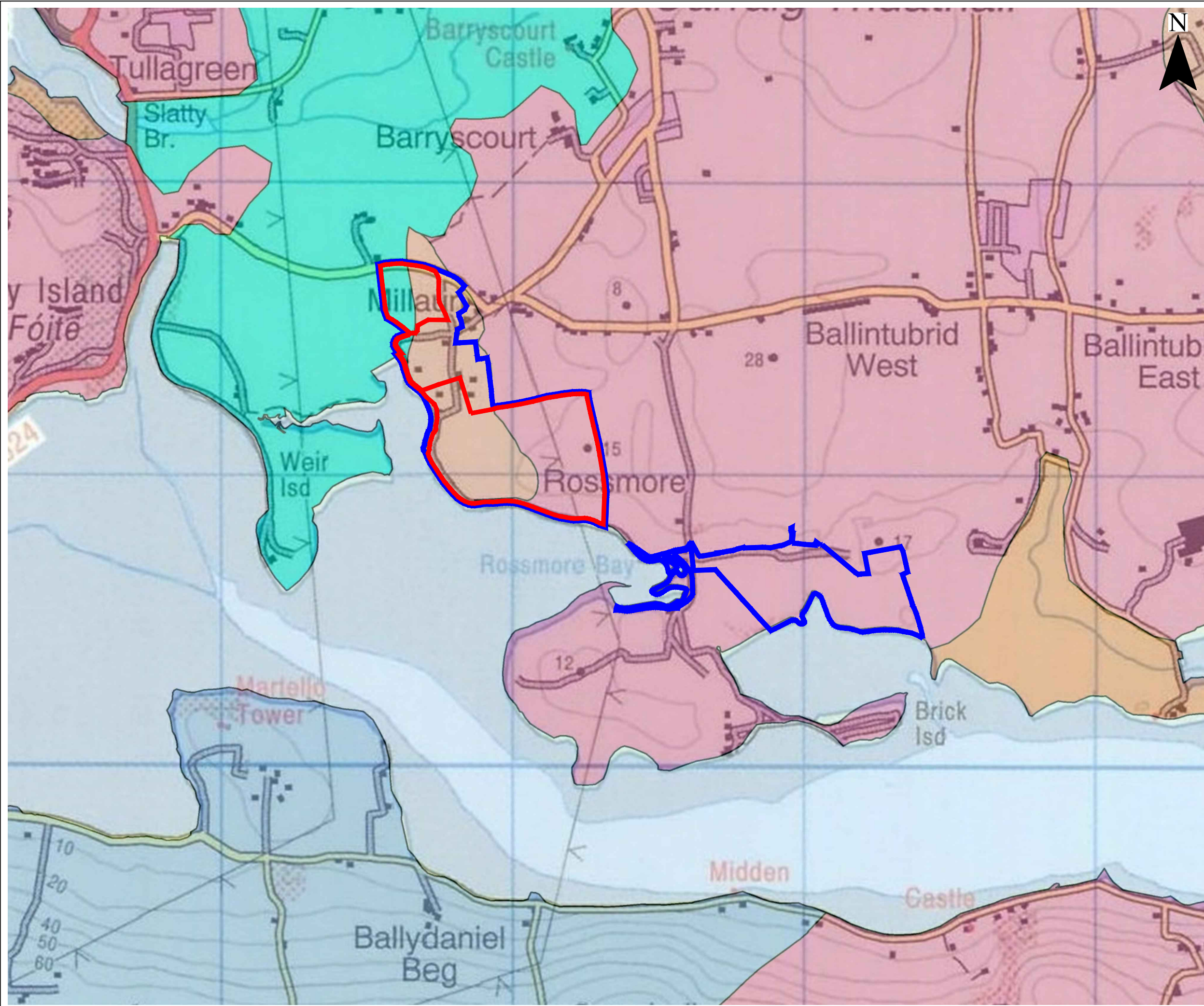
FIGURES

Figure 6.1 - Soil Association Map

Figure 6.2 - National Soils Map

Figure 6.3 - National Subsoils Map

Figure 6.4 - Geology Map



NOTES

1. EXTRACT FROM 1:50,000 O.S DISCOVERY MAP NO. 80, 81 & 87.
2. ORDNANCE SURVEY IRELAND LICENCE NO. CYAL50167032 (C) ORDNANCE SURVEY & GOVERNMENT OF IRELAND.

LEGEND

- APPLICANTS LAND INTEREST
- PLANNING APPLICATION AREA (c.24.7 ha)

Soil Association
Irish Soil Information System

- Boyne - RIVER
- Ross Carbery - 0900e
- Clashmore - 1100n
- ROCK
- TIAL MARSH
- URBAN

Kilsaran
Piercetown, Dunboyne, Co. Meath
www.kilsaran.ie T:01 802 6300

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DUBLIN 14
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F: +353-1-2964676
www.slrconsulting.com

KILSARAN CONCRETE
ENVIRONMENTAL IMPACT ASSESSMENT REPORT

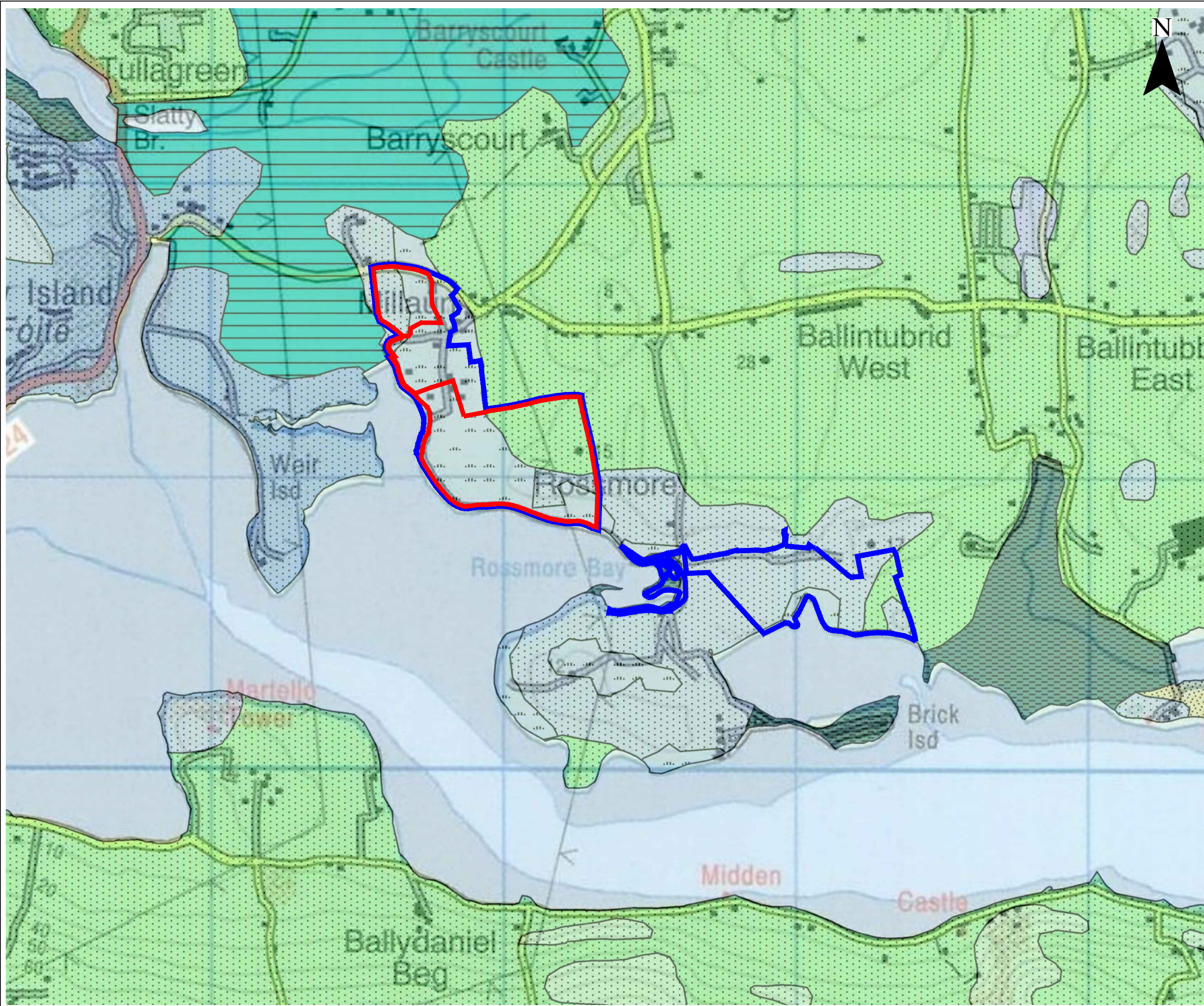
ROSSMORE QUARRY,
CARRIGTOHILL, CO. CORK

SOIL ASSOCIATION MAP

FIGURE 6-1

Scale 1:12,500 @ A3 Date JUNE 2021

00036.00070.00001.FIG_6-1_Soil Association Map.dwg



NOTES

1. EXTRACT FROM 1:50,000 O.S DISCOVERY MAP NO. 80, 81 & 87.
2. ORDNANCE SURVEY IRELAND LICENCE NO. CYAL50167032 (C) ORDNANCE SURVEY & GOVERNMENT OF IRELAND.

LEGEND

- APPLICANTS LAND INTEREST
- PLANNING APPLICATION AREA (c.24.7 ha)

TEAGASC/EPA SOIL MAPPING IFS SOIL TYPE

- Alluvium - Mineral
- Acid Brown Earths and Brown Podzolics
- Peaty Podzols, Lithosols and Peats derived from non-calcareous parent
- Renzinas and Lithosols
- Made Ground

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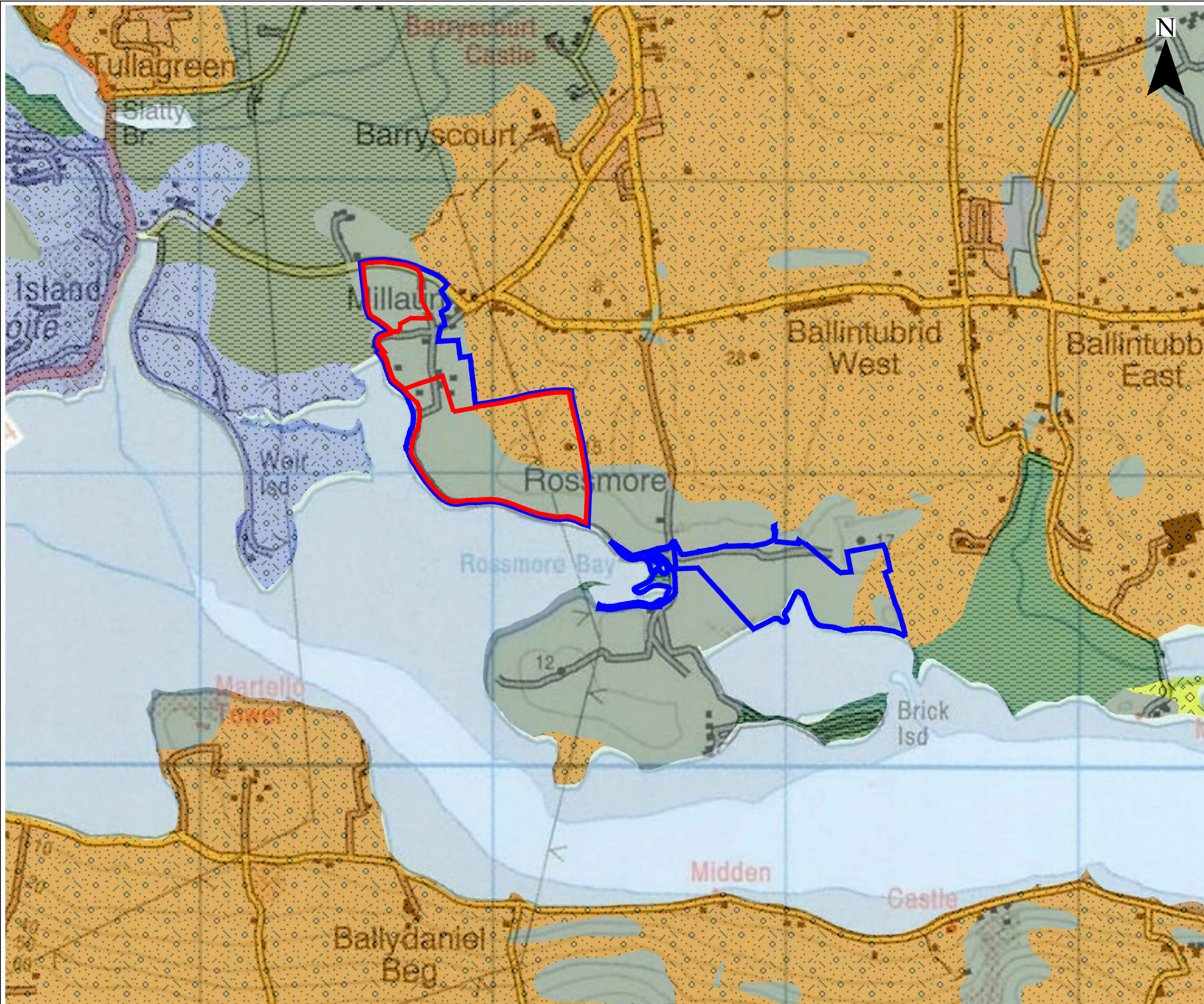
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 DUBLIN 14
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 ROSSMORE QUARRY,
 CARRIGTOHILL, CO. CORK
 NATIONAL SOILS MAP

FIGURE 6-2

Scale 1:12,500 @ A3 Date JUNE 2021

00036.00070.00001.FIG_6-2.National Soils Map.dwg



NOTES

1. EXTRACT FROM 1:50,000 O.S DISCOVERY MAP NO. 80, 81 & 87.
2. ORDNANCE SURVEY IRELAND LICENCE NO. CYAL50167032 (C) ORDNANCE SURVEY & GOVERNMENT OF IRELAND.

LEGEND

- APPLICANTS LAND INTEREST
- PLANNING APPLICATION AREA (c.24.7 ha)

IRELAND SUBSOILS PARENT MATERIAL TYPE

- Alluvium
- Made Ground
- Estuarine Silts and Clays
- Outcrop & Subcrop
- Till - Devonian Sandstone Clasts
- Till - Carboniferous Limestone Clasts

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KILSARAN CONCRETE
 ENVIRONMENTAL IMPACT ASSESSMENT REPORT

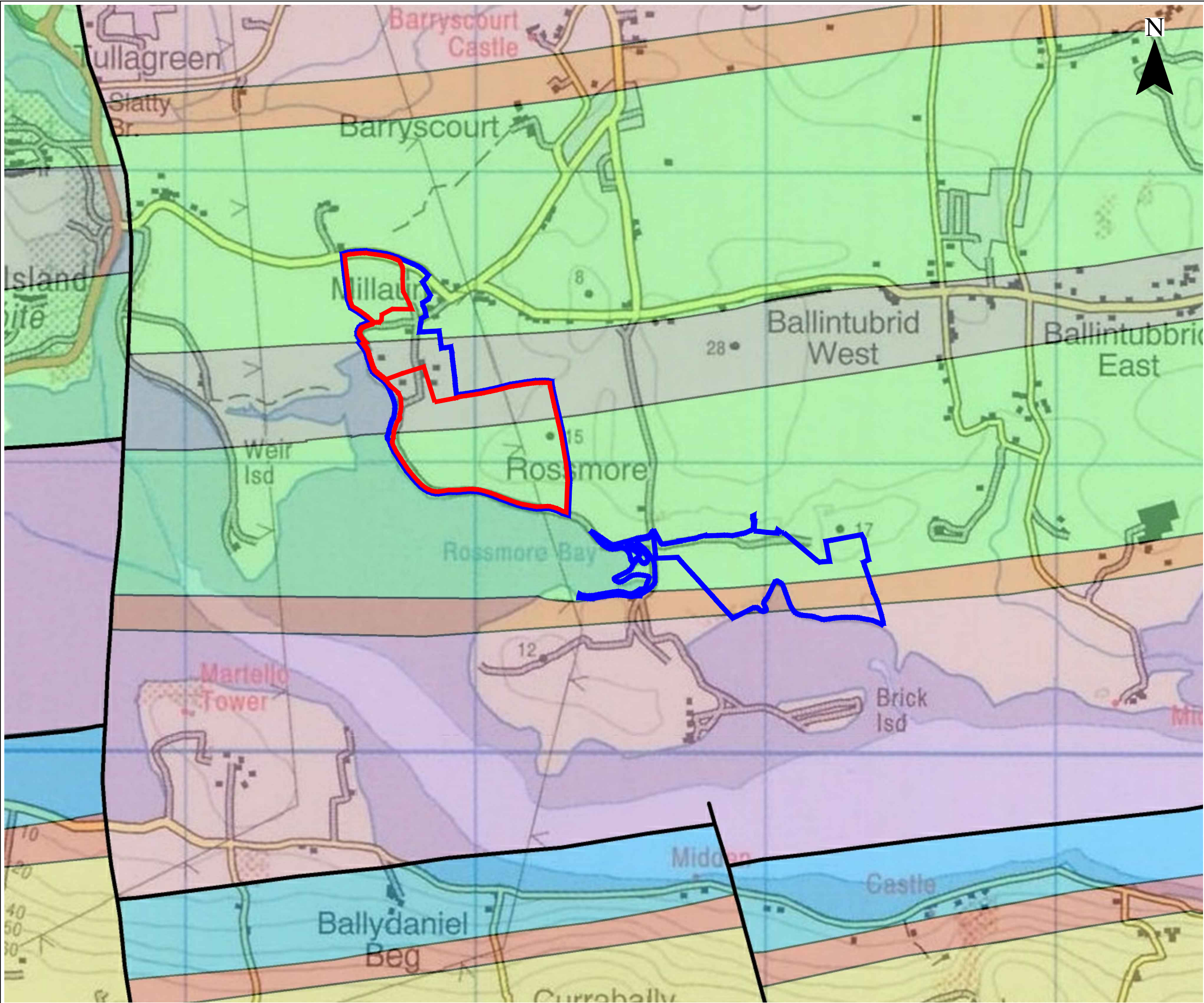
ROSSMORE QUARRY,
 CARRIGTOHILL, CO. CORK

NATIONAL SUBSOILS MAP

FIGURE 6-3

Scale 1:25,000 @ A3 Date JUNE 2021

00036.00070.00001.FIG_6-3.National Subsoil Map.dwg



NOTES

- EXTRACT FROM 1:50,000 O.S DISCOVERY MAP NO. 80, 81 & 87.
- ORDNANCE SURVEY IRELAND LICENCE NO. CYAL50167032 (C) ORDNANCE SURVEY & GOVERNMENT OF IRELAND.

LEGEND

- APPLICANTS LAND INTEREST
- PLANNING APPLICATION AREA (c.24.7 ha)

Solid Geology
GSI Digital Map (1:100,000)

- Clashavodig Formation
- Cork Red Marble Formation
- Cuskinny Member (Kinsale Formation)
- Little Island Formation
- Old Head Sandstone Formation (OH)
- Waulsortian Limestones

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ROSSMORE QUARRY,
CARRIGTOHILL, CO. CORK
BEDROCK GEOLOGY MAP

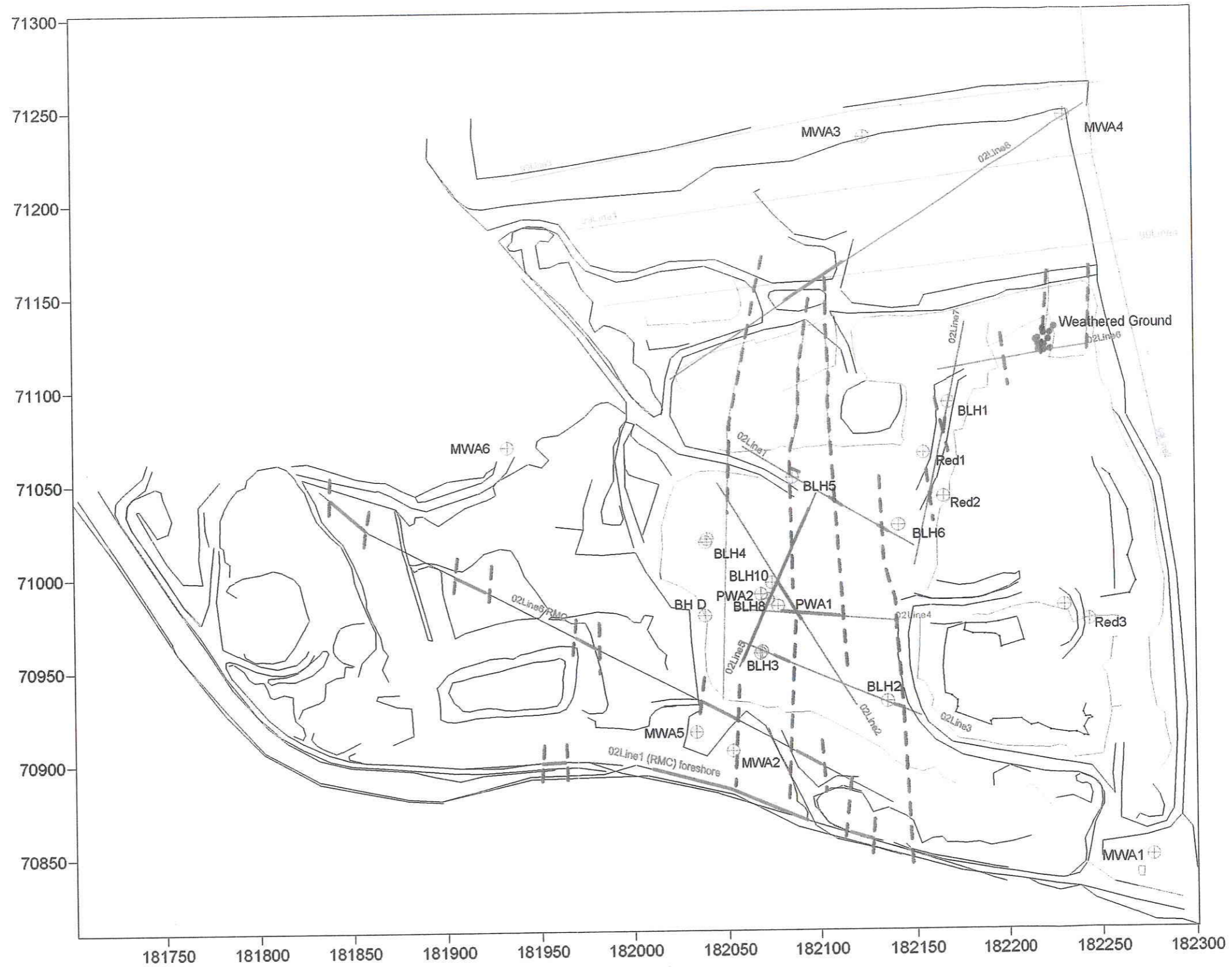
FIGURE 6-4

Scale 1:12,500 @ A3 Date JUNE 2021

00036.00070.00001.FIG_6-4_Bedrock Geology Map.dwg

APPENDICES

Appendix 6-A - Borehole Logs and Location Plan



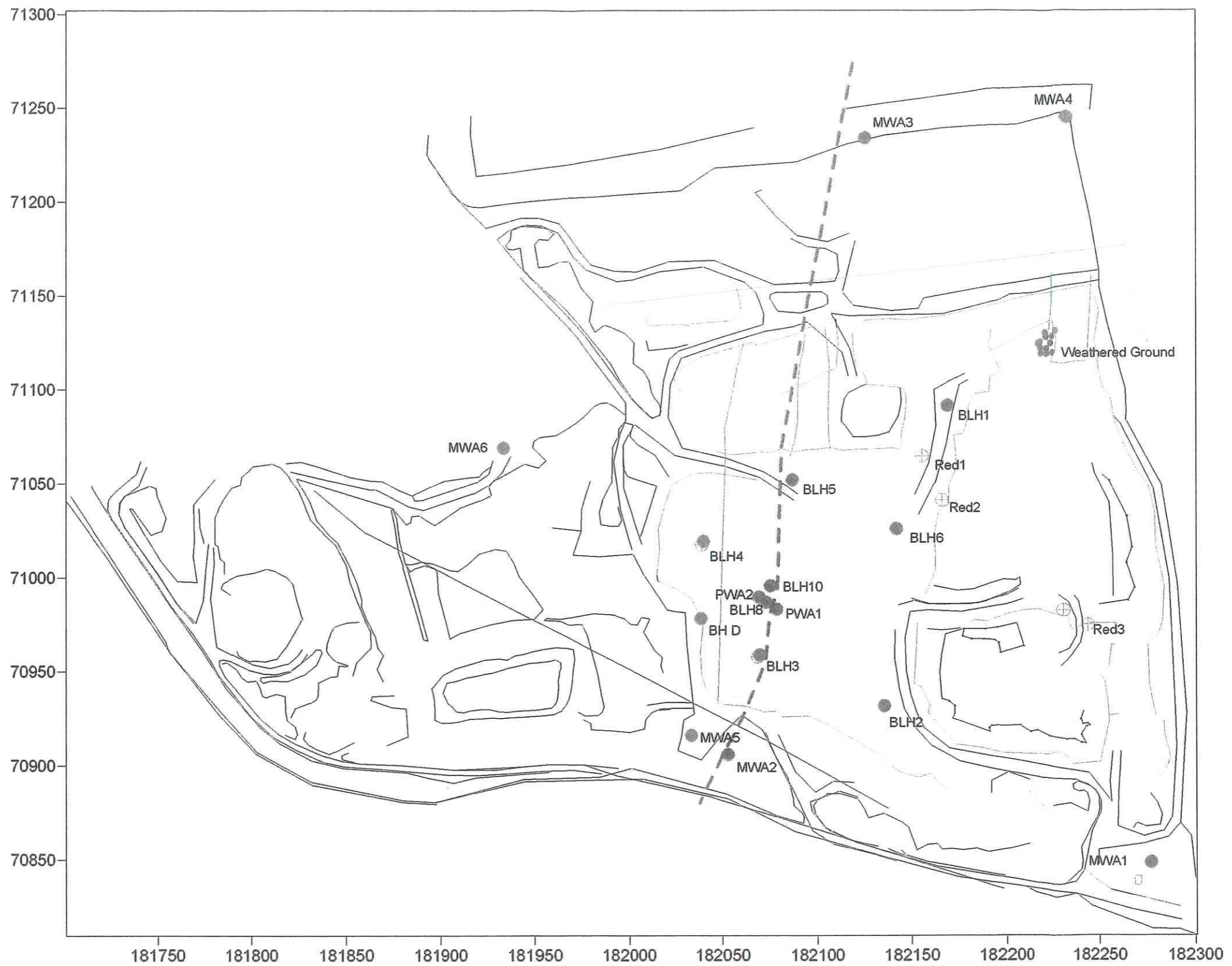
Key

| | |
|--|---|
| | Tomography Line(s) with year surveyed |
| | Tomography Line with position of weathered zone (in bold) |
| | Interpreted line of weathered rock |

7, South Main Street,
 Naas, Co. Kildare, Ireland.
 P+353-45-895668; F+353-45-881705; M+353-87-2300933
 info@groundwatereng.ie

| |
|---|
| Client : Readymix (ROI) Ltd |
| Project : Hydrogeological Investigation |
| Title : Summary of Geophysics |

| | | | |
|-------------------|------------|--------------------|--------------|
| Scale : | 1:2500 | Datum : | |
| Date : | Jan 03 | Checked : | S. O'Neill |
| Author : | S. O'Neill | Dwg. No. : | Figure No. 1 |
| Drawn By : | S. O'Neill | Reference : | 630201/2 |



Key

- Borehole, weathered zone encountered
- Borehole, no significant weathered zones
- - - - Eastern extent of principal fissure zone

Client :

Readymix (ROI) Ltd

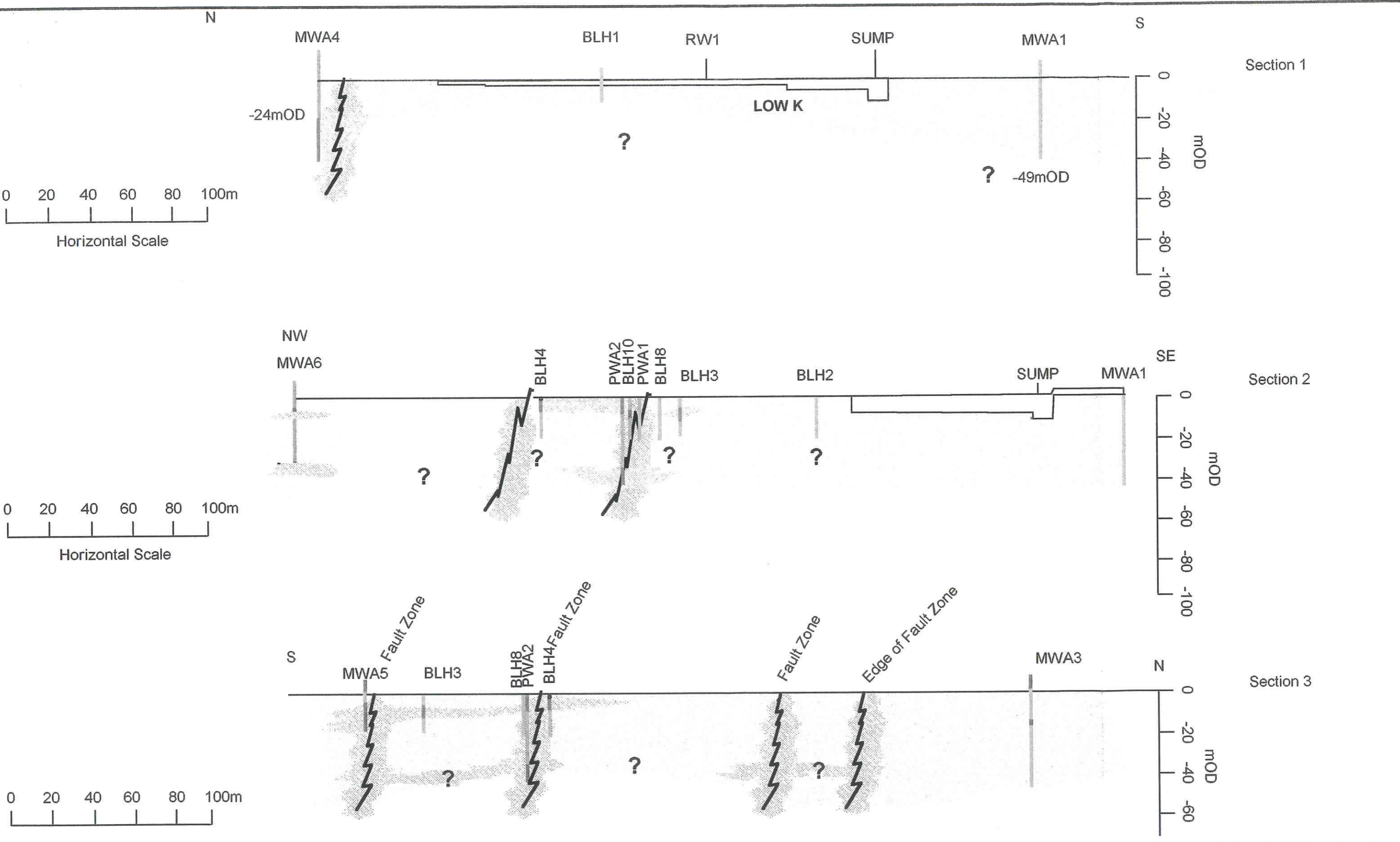
Project :

Hydrogeological Investigation

Title :

Summary of Drilling

| | | | |
|-------------------|------------|--------------------|--------------|
| Scale : | 1:2500 | Datum : | |
| Date : | Jan 2003 | Checked : | S. O'Neill |
| Author : | S. O'Neill | Dwg. No. : | Figure No. 2 |
| Drawn By : | S. O'Neill | Reference : | 630201/2 |



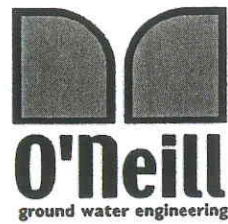
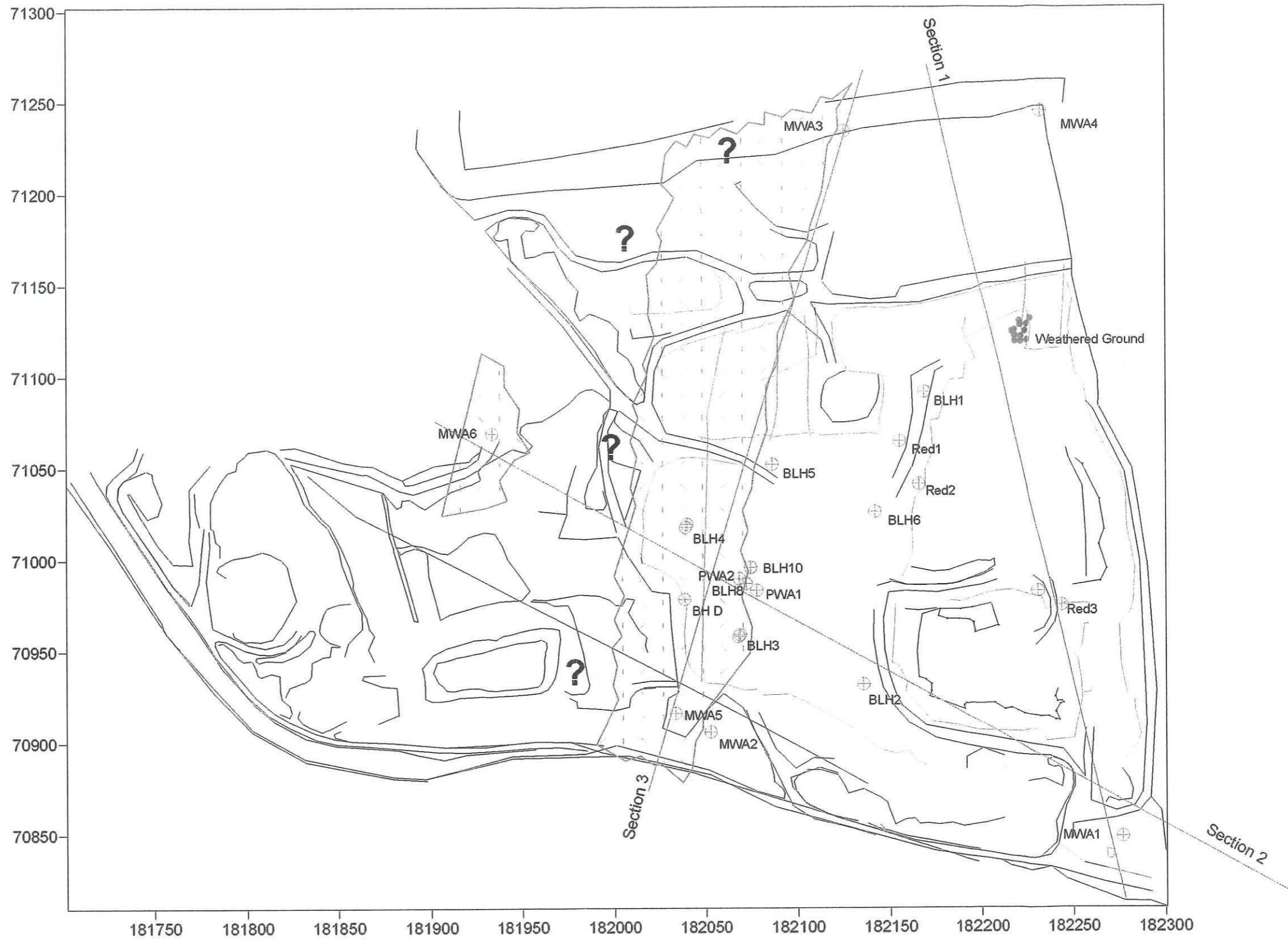
| | | | |
|--|-----------|--------------|-----------|
| Scale : | 1:800 | Datum : | Malin |
| Date : | Jan 2003 | Checked By : | S'ONeill |
| Author : | S.O'Neill | Dwg. No. : | Figure 3 |
| Drawn By : | S.O'Neill | Reference : | Fig3XSect |
| Title Rossmore A - Geological Cross Sections | | | |

| | |
|-----------|-------------------------------|
| Client : | Readymix (ROI) Ltd |
| Project : | Hydrogeological Investigation |

Key

- Unweathered or slightly weathered limestone
- Weathered zone
- Fault zone

7 South Main Street, Naas, Co. Kildare.
P+353-45895668; F+353-45-881705; Mb+353-87-2300933
email : sonell@groundwatereng.ie



Key



Interpreted Weathered Zone

Client :

Readymix (ROI) Ltd

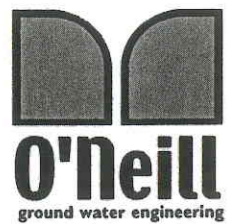
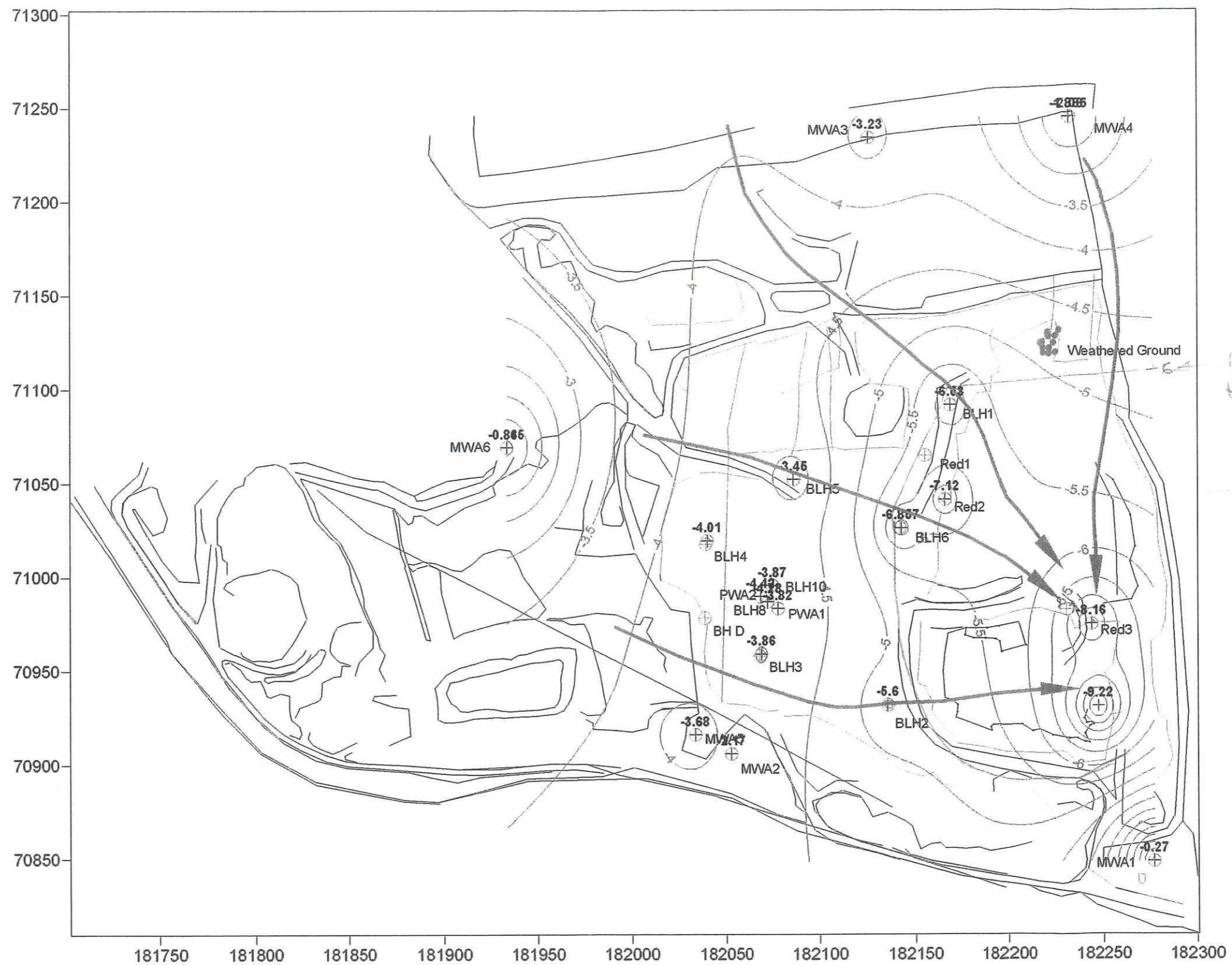
Project :

Hydrogeological Investigation

Title :

Extent Of Central Weathered Zone

| | | | |
|-------------------|------------|--------------------|--------------|
| Scale : | 1:2500 | Datum : | |
| Date : | Jan 2003 | Checked : | S. O'Neill |
| Author : | S. O'Neill | Dwg. No. : | Figure No. 4 |
| Drawn By : | S. O'Neill | Reference : | 630201/2 |



Key

- Direction of flow of ground water
- 5- Ground Water Contour (mOD)

Client :

Readymix (ROI) Ltd

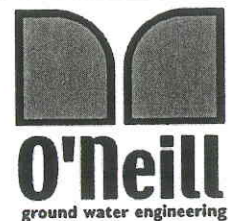
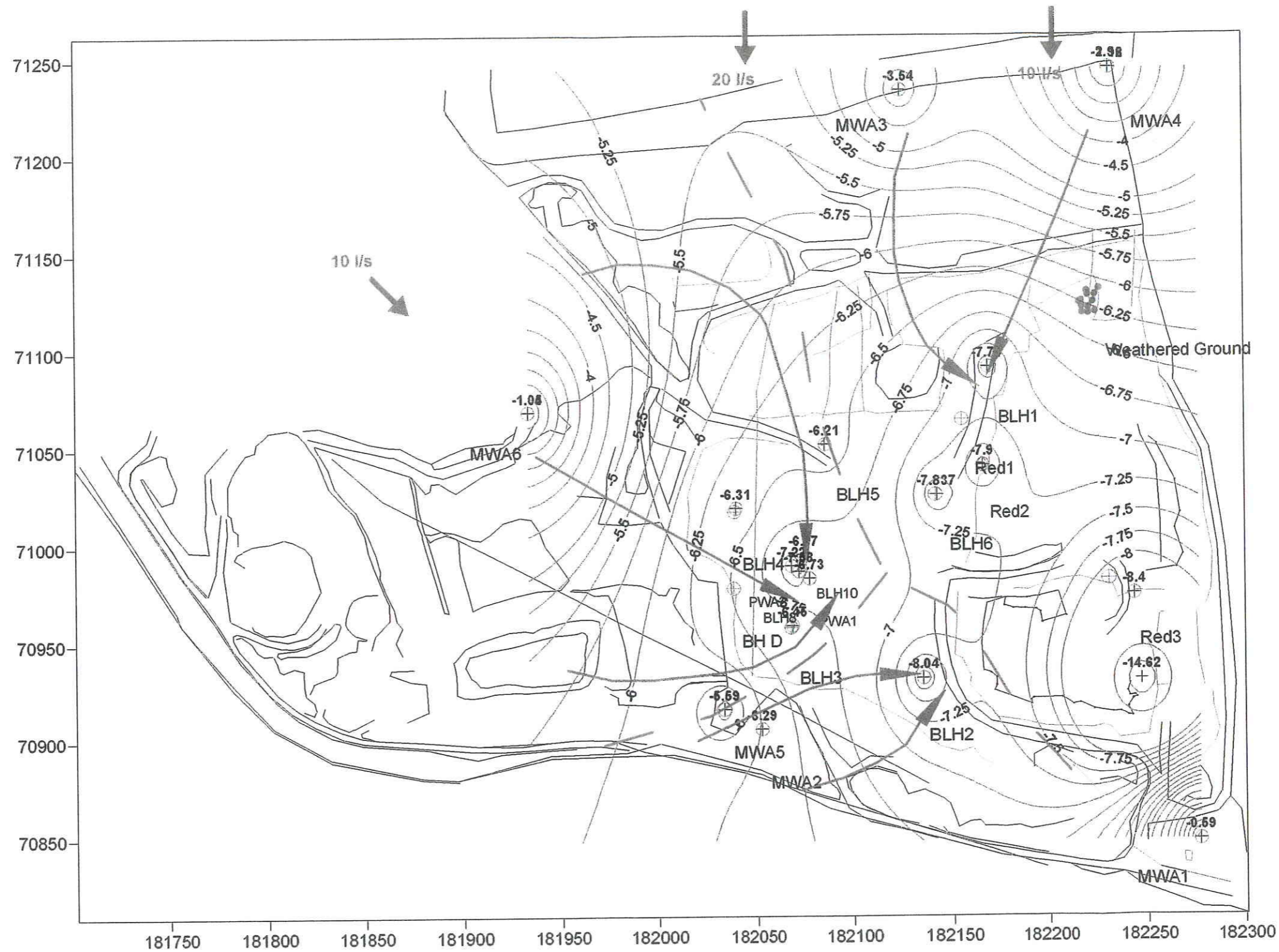
Project :

Hydrogeological Investigation

Title :

**Start of PWA2 Pumping Test
(28/11/02)**

| | | | |
|-------------------|------------|--------------------|--------------|
| Scale : | 1:2500 | Datum : | |
| Date : | Jan 2003 | Checked : | S. O'Neill |
| Author : | S. O'Neill | Dwg. No. : | Figure No. 8 |
| Drawn By : | S. O'Neill | Reference : | 630201/2 |



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Key

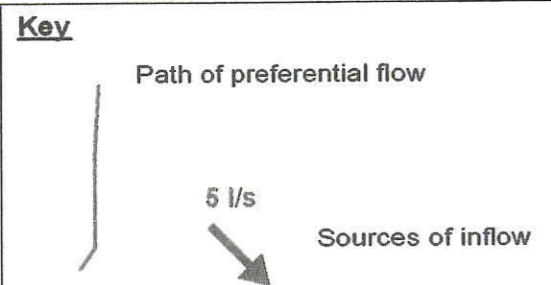
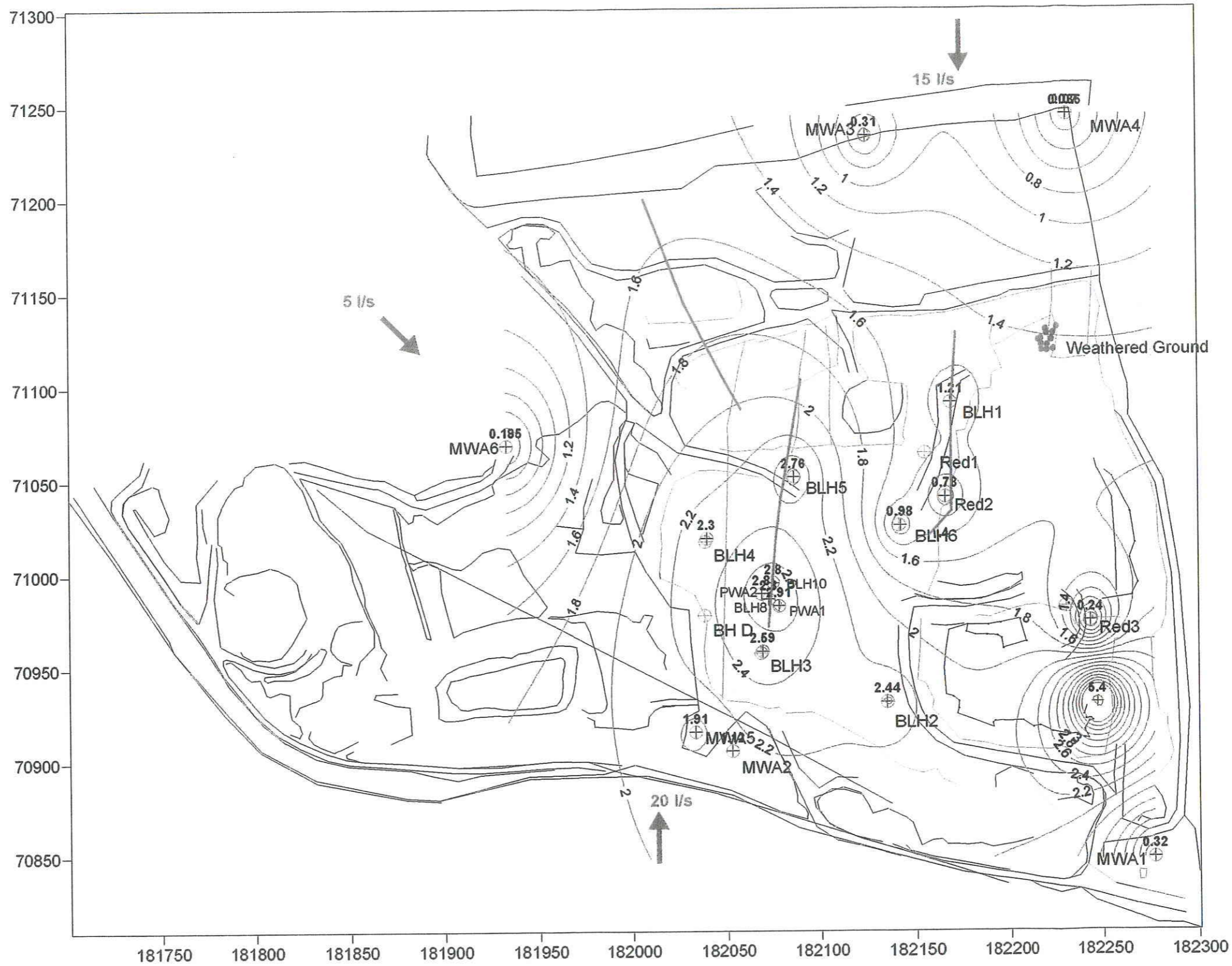
- Direction of flow of ground water
- 5 Ground Water Contour (mOD)
- Ground Water Divide
- 10 l/s Amount of flow of ground water

Client :
Readymix (ROI) Ltd

Project :
Hydrogeological Investigation

Title :
End of PWA2 Pumping Test
6/12/02))

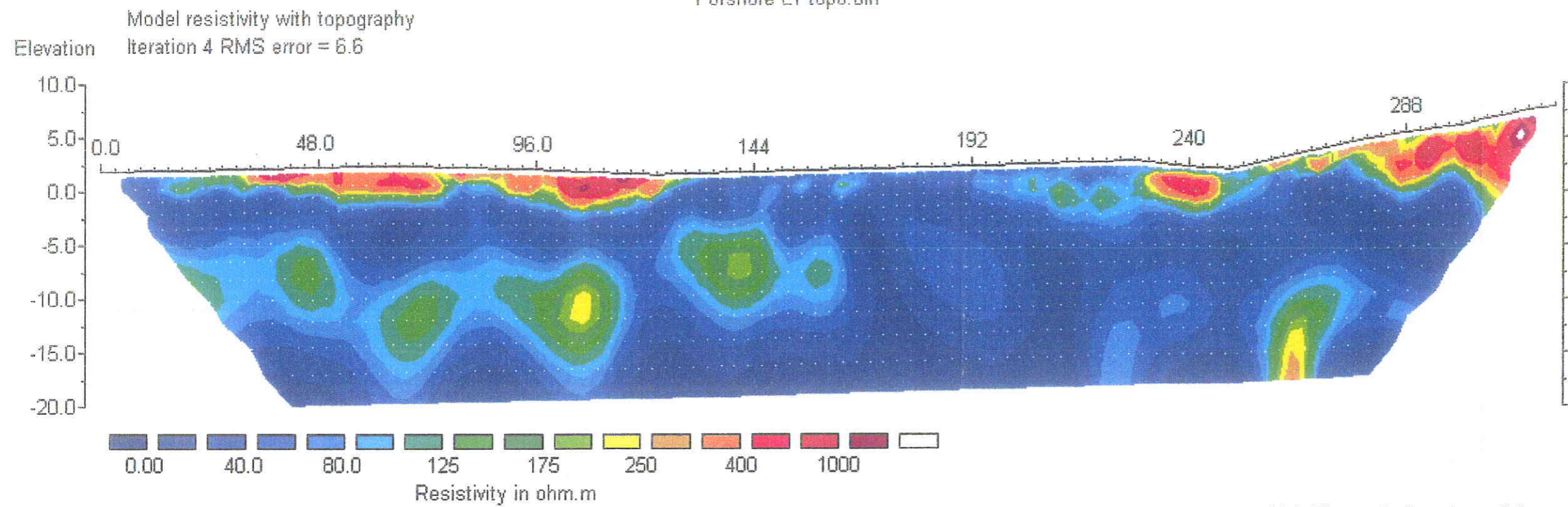
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| Author : | S. O'Neill | Dwg. No. : | Figure No. 10 |
| Drawn By : | S. O'Neill | Reference : | 630201/2 |



Client :
 Readymix (ROI) Ltd
Project :
 Hydrogeological Investigation
Title :
 Drawdown Over PWA2 Pumping Test
 (28/11/ to 6/12/02)

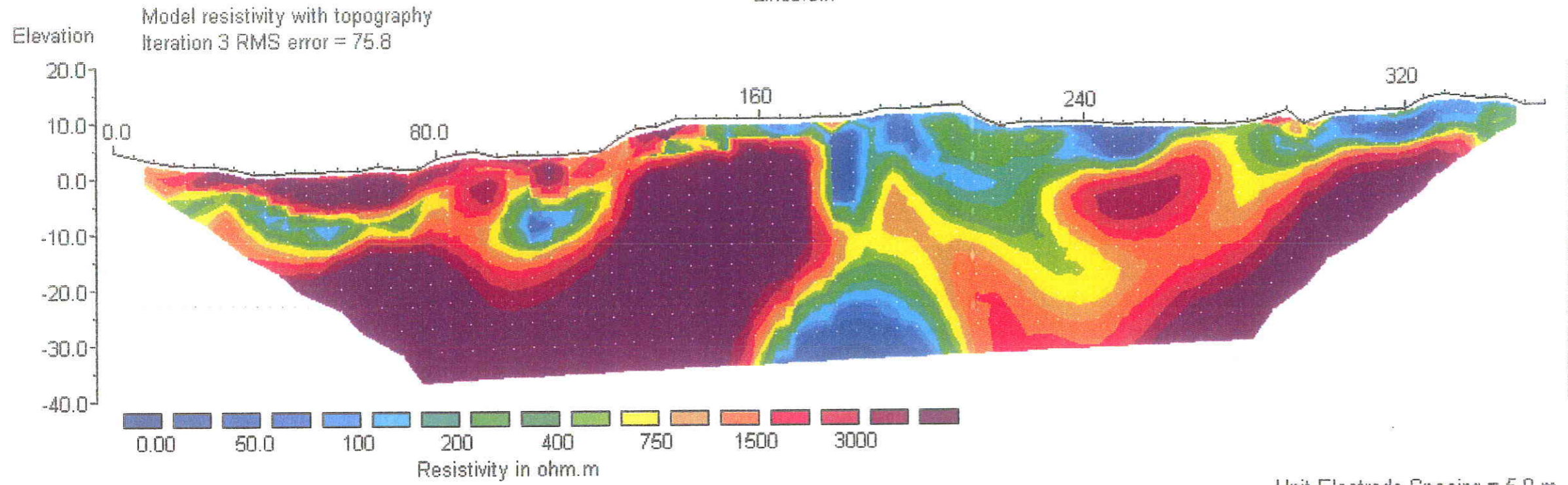
| | | | |
|-------------------|------------|--------------------|---------------|
| Scale : | 1:2500 | Datum : | |
| Date : | Jan 2003 | Checked : | S. O'Neill |
| Author : | S. O'Neill | Dwg. No. : | Figure No. 11 |
| Drawn By : | S. O'Neill | Reference : | 630201/2 |

Forshore L1 topo.bin



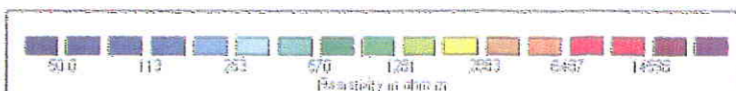
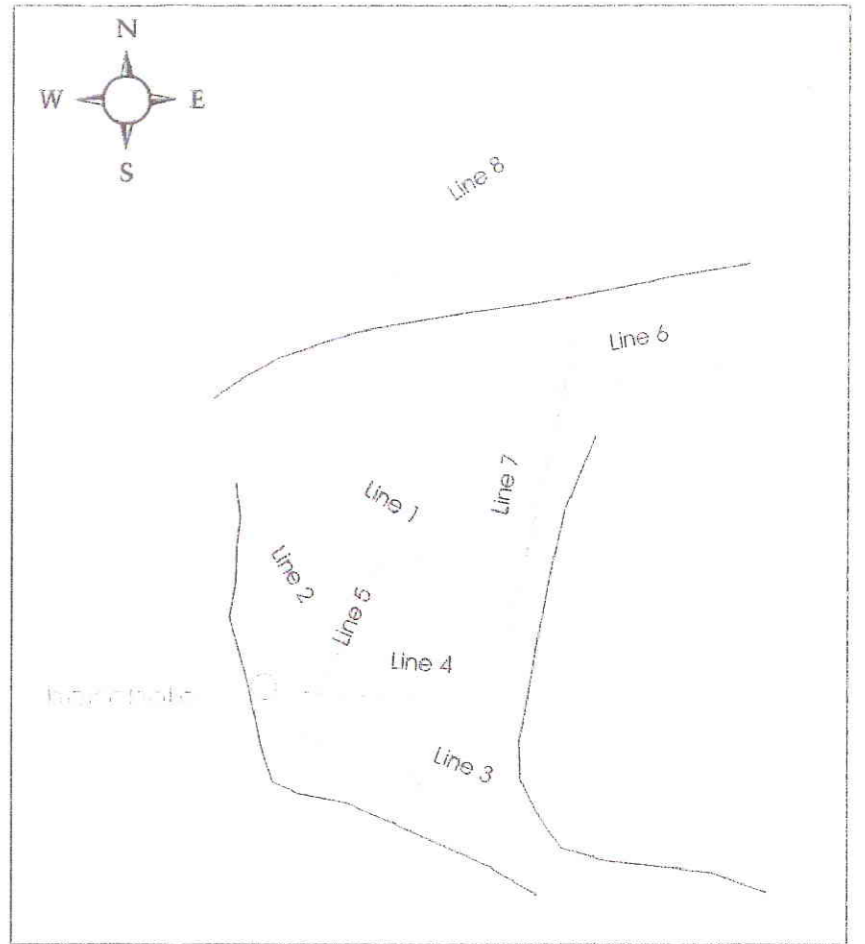
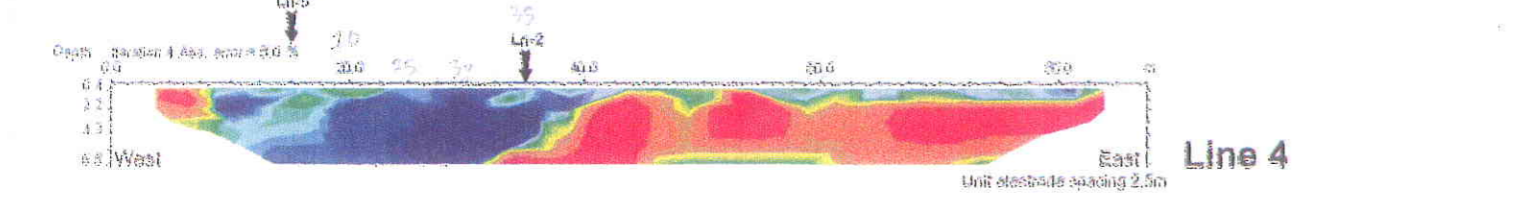
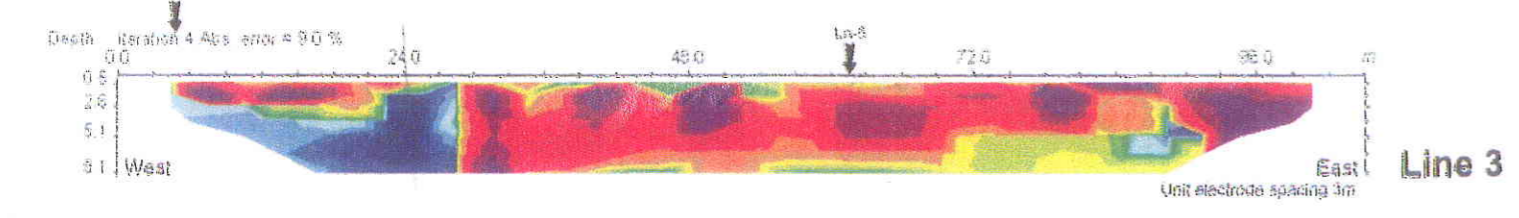
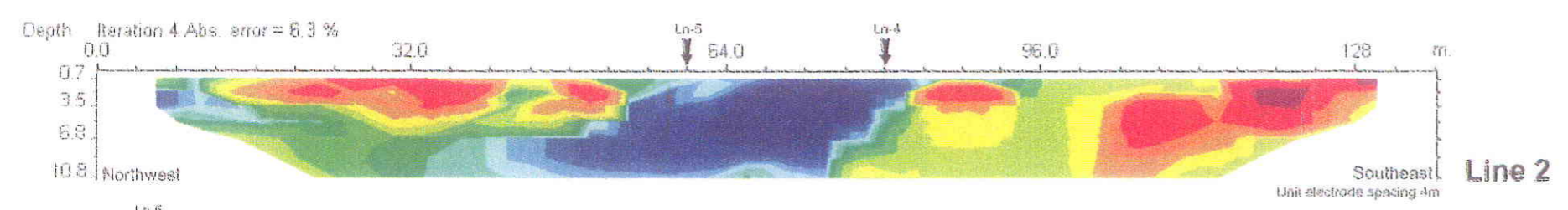
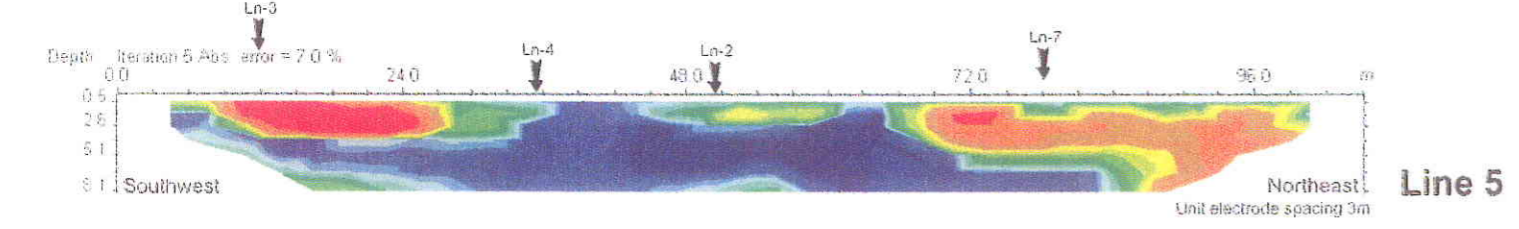
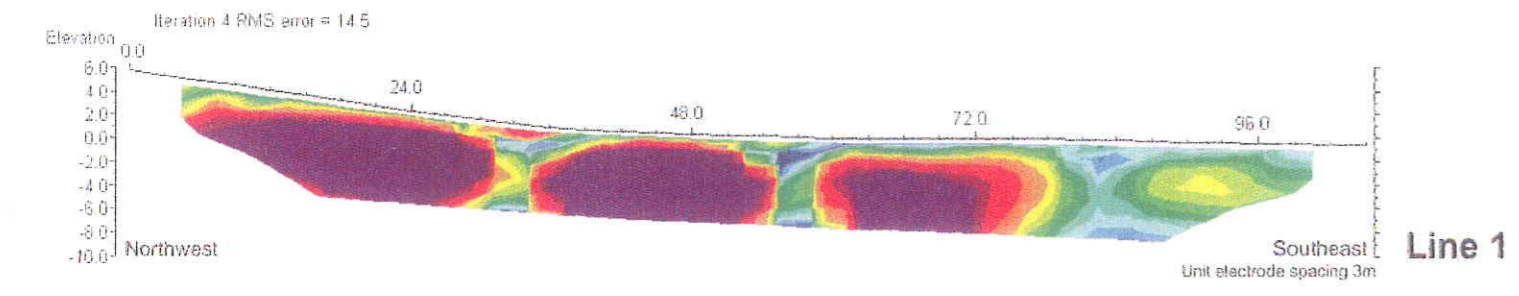
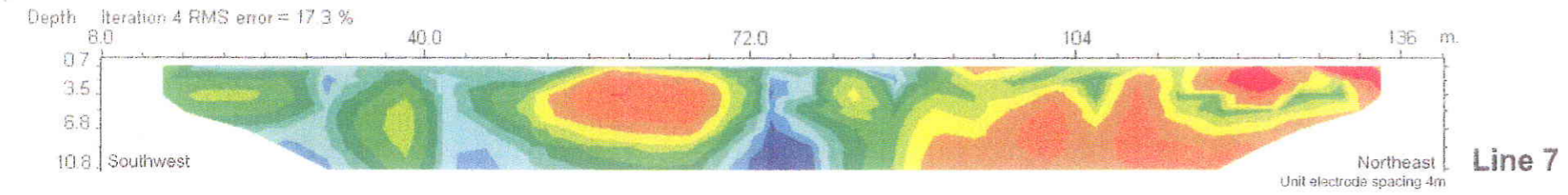
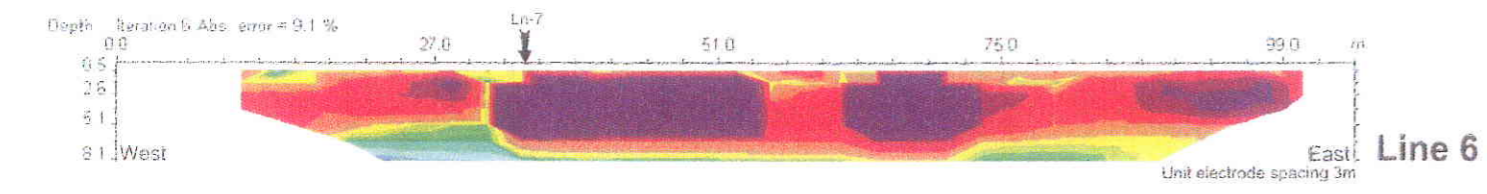
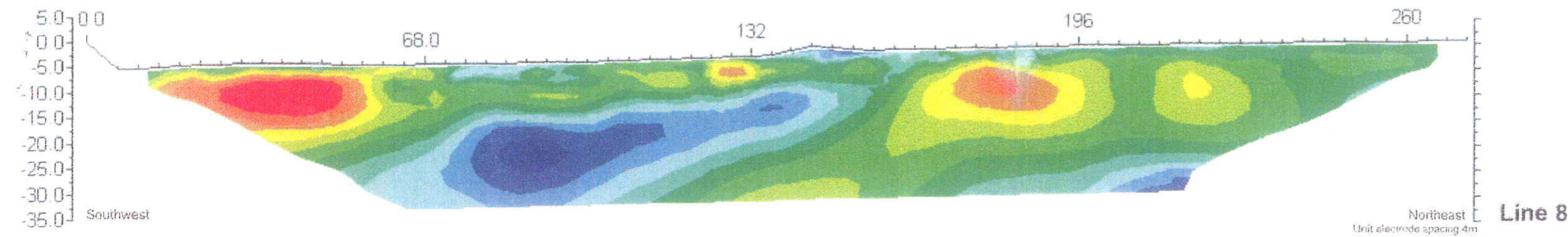
Horizontal scale is 8.81 pixels per unit spacing
Vertical exaggeration in model section display = 2.38
First electrode is located at 0.0 m.
Last electrode is located at 321.0 m.

Line6.bin



Horizontal scale is 13.13 pixels per unit spacing
Vertical exaggeration in model section display = 1.37
First electrode is located at 0.0 m.
Last electrode is located at 355.0 m.

Elevation Iteration 5 RMS error = 5.1



Intersection of resistivity lines
 Lines 1 & 8 - Elevations are set to individual datum
 Lines 2 to 7 - Depths given below ground level

DRAFT

Resistivity Tomography
 Cobh Site
 RMC Ireland
TERRADAT (UK) LTD

Figure 2

Start Thurs 7/11/02

Finish Thurs 7/11/02

Form for Single Bill of Quantities (Headed).

PUMPING WELL PWA2

mbgl

MOD Water

| Item No. | Description | Quantity | Unit | Rate |
|----------|--|----------|------|-----------------------|
| 0 | 0-8.4m Slightly weathered, dark and pale grey LIMESTONE, broken / fractured, brown silt partings or infill in joints | | | |
| 2 | | | | |
| 4 | | | | |
| 6 | 6.3m... pale grey, with calcite fragments, fractured. | | | |
| 8 | 8.4-9.0m Cavity, infilled with brown silt and sand | | | |
| 10 | 9.0-16.8 Pale and medium grey LIMESTONE mainly fresh / unweathered, with occasional brown weathered surfaces | | | |
| 12 | | | | EC 18.2ms/cm |
| 14 | | | | |
| 16 | | | | |
| 18 | 16.8-17.0m Cavity | | | |
| 20 | 20m... becoming mainly dark grey, slightly weathered, homogeneous. | | | |
| 22 | | | | EC 18.3ms/cm T 12.3°C |
| 24 | | | | |
| 26 | | | | |
| 28 | | | | |
| 30 | | | | EC 18.0ms/cm T 11.8°C |
| 32 | | | | |
| 34 | 34m... broken, weathered, with infill of brown sand, silt and clay. | | | |
| 36 | 36.0-36.9m Cavity | | | |
| 38 | | | | |
| 40 | | | | EC 17.8ms/cm T 12.4°C |
| 42 | | | | |
| 44 | END BH 43.0 mbgl 44.4 MOD | | | |

Plain steel casing 260mm (10 1/4") ID installed to 3.2m
 Drilled at 254mm (10") diameter

TOTAL

Form for Single Bill of Quantities (Headed).

MONITORING WELL MWA1

| Item No | Description | Quantity | Unit | Rate |
|---------|---|-----------|------|---|
| 0 | 0-2.2 MADE GROUND comprising gravel of limestone | | MOD | Water |
| 2 | | | | +3.0 0.5m Small amount of surface water |
| 4 | 2.2-9.0 Slightly weathered, medium and pale grey LIMESTONE weathered brown on surfaces. Fragments of calcite. | | | +1 3.50m b Top |
| 6 | | | | -1 11/11/02 |
| 8 | | | | -3 |
| 10 | 9.0-9.2m Cavity, infilled with medium brown silt and sand | | | -5 7.0m 0.5 l/s Brown silty water |
| 12 | 9.2-28.5 LIMESTONE, as above | | | -7 9.0m 0.75 l/s |
| 14 | | | | -9 Gradual increase to 1.0 l/s at 18m |
| 16 | | | | -11 Brown silty water |
| 18 | | | | -13 |
| 20 | | | | -15 |
| 22 | | | | -17 |
| 24 | | | | -19 |
| 26 | | | | -21 |
| 28 | | | | -23 |
| 30 | 28.5-29.0m CAVITY, infilled with medium brown silt and sand | | | -25 No increase |
| 32 | 29.0-36.8 LIMESTONE, as above | | | -27 |
| 34 | | | | -29 |
| 36 | | | | -31 |
| 38 | Below 36.8m...LIMESTONE as above | | | -33 |
| 40 | Increase in amount of brown weathered surfaces - moderately weathered. | | | -35 |
| 42 | | | | -37 |
| 44 | | | | -39 No increase |
| 46 | | | | -41 |
| 48 | | | | -43 |
| 50 | | | | -45 |
| | | | | -46 |
| | | END BH | | |
| | | 49.0 mbgl | | |
| | | -46.0 MOD | | |

Plain steel casing installed to 2.2 m bgl. 160mm ID.
 No piezometer installation. Left as 150mm (6") open hole.

TOTAL

MONITORING WELL MWA2

| Item No | Description | Quantity | Unit | Rate |
|---------|--|----------|------|--------------------------------------|
| 0 | 0-5.0m MADE GROUND. Assorted silty sand and gravel. | | mOD | 7.4 |
| 2 | | | | +6 |
| 4 | | | | +4 |
| 6 | 5.0-49.0 Moderately weathered pale grey LIMESTONE broken/fractured | 6.2m | | +2 |
| 8 | 8.0m... becoming medium grey | | | 0 |
| 10 | 9.0-9.5m... weathered brown | | | -2 |
| 12 | 9.5-16.5m... slightly weathered, pale and medium grey. | | | -4 |
| 14 | | | | -6 |
| 16 | | | | -8 |
| 18 | 16.5-29.7m... Mainly medium grey unweathered / slightly weathered | | | -10 |
| 20 | | | | -12 |
| 22 | | | | -14 |
| 24 | | | | -16 |
| 26 | | | | -18 |
| 28 | | | | -20 |
| 30 | Below 30.7m... becoming mainly dark grey, fresh/unweathered | | | -22 |
| 32 | | | | -24 |
| 34 | | | | -26 |
| 36 | | | | -28 |
| 38 | | | | -30 |
| 40 | | | | -32 |
| 42 | | | | -34 |
| 44 | | | | -36 |
| 46 | | | | -38 |
| 48 | | | | -40 |
| 50 | | | | -41 |
| | END BH 49.0mbgl -41.6MOD | | | |
| | Plain steel casing installed to 2.2m bgl 160mm ID | | | |
| | | | | No water encountered during drilling |
| TOTAL | | | | |

MONITORING WELL MWA4

| Item No | Description | Quantity | Unit | Rate |
|---------|--|----------|------|--------------------------------------|
| | | | | Water |
| 0 | 0-5.7m Medium grey and brown, silty very sandy GRAVEL, with cobbles of medium and dark grey limestone | | | MOD 9.25 |
| 2 | | | | 8- |
| 4 | 5.7-9.3m Moderately weathered grey and grey/brown LIMESTONE | | | 5- |
| 6 | | | | 4- |
| 8 | | | | 2- |
| 10 | 9.3-9.6m CAVITY/FRACTURE, with infill of brown silt and sand | | | 0- |
| 12 | | | | -2 |
| 14 | 14.5m ... becoming less weathered - slightly weathered, occasional brown weathered surfaces | | | -4 |
| 16 | | | | -6 |
| 18 | 18.5m ... becoming moderately weathered, increase in brown weathered surfaces, occasional larger fragments. Softer limestone | | | -8 |
| 20 | | | | -10 |
| 22 | | | | -12 |
| 24 | 23.6-24.0m CAVITY, with infill of medium brown silty sand (dry) | | | -14 |
| 26 | 24.0-34.0m Moderately weathered | | | -16 |
| 28 | | | | -18 |
| 30 | | | | -20 |
| 32 | | | | -22 |
| 34 | 34.0 ... Broken/fractured, fragments of calcite, infill of brown silt and clay | | | -24 |
| 36 | Very soft pale grey limestone | | | -26 |
| 38 | Abundant small cavities | | | -28 |
| 40 | | | | -30 |
| 42 | Pale and medium grey, fragments of calcite, very soft | | | -32 |
| 44 | | | | -34 |
| 46 | | | | -36 |
| 48 | | | | -38 |
| 50 | | | | -40 |
| 52 | 52.0-53.5m CAVITY, infilled with brown silt and sand. | | | -42 |
| 54 | | | | -44 |
| 55 | | | | -44 |
| | | | | 12.44 |
| | | | | 0.2 l/s EC 1,392 μ S/cm T 15.3°C |
| | | | | 0.3 l/s |
| | | | | 0.5 l/s EC 1,880 μ S/cm T 14.9°C |
| | | | | 0.75 l/s |
| | | | | 1.0 l/s EC 2,780 μ S/cm T 14.6°C |
| | | | | Gradual increase |
| | | | | 55.0 m bgl |
| | | | | TOTAL |

MONITORING WELL MWAS

| Item No. | Description | Quantity | Unit | Rate |
|----------|---|----------|------|-------|
| m bgl | | | MOD | Water |
| 0 | 0-2.0m Medium brown SAND AND GRAVEL. Gravel and cobbles of rounded grey limestone and other assorted rock types | | | +5.5 |
| 2 | | | | +4 - |
| 4 | | | | +2 - |
| 6 | 6.0 - 11.0 Medium grey LIMESTONE, slightly weathered. | | | 0 - |
| 8 | | | | -2 |
| 10 | | | | -4 |
| 12 | 11.0 - 12.4 Very weathered medium grey and brown LIMESTONE, cavities with infill of medium brown silt & fine sand | | | -6 |
| 14 | 12.4 - 14.5m Slightly weathered medium grey LIMESTONE | | | -8 |
| 16 | 14.5 - 24.6m Pale to medium grey LIMESTONE, very weathered, broken, cavities with infill of brown silt and sand & assorted gravel | | | -10 |
| 18 | | | | -12 |
| 20 | | | | -14 |
| 22 | | | | -16 |
| 24 | | | | -18 |
| | | | | -19 |

END BH
24.6m bgl
- 19.1 MOD

▽ 10.90m
12/11/02

-15.0m 0.5 l/s EC 13.6mS/cm T 13.2°C

-12 Very brown, silty water. Unable to airlift water above cavities / fissures at 11-12m

EC 11.8 mS/cm T 14.2°C

Borehole casing below 11.1m bgl
 Installed 27mm ID piezometer tube to 22.5m bgl 17.0 MOD, 2.5m slotted at base.
 Plain steel casing 160mm ID 6m length removed.
 Gravel pack installation not rising above 23.5m due to large cavity. BH later collapsed
 caved at 11.1m. Completed with backfill and grout to surface.

TOTAL

Form for Single Bill of Quantities (Headed).

MONITORING WELL MW6

| Item No | Description | Quantity | Unit | Rate |
|---------|---|----------|----------|--------------------------------------|
| | | | | mGD Water |
| 0 | 0-9.0m MADE GROUND, comprising soft, medium brown, very silty very sandy CLAY, with fine to medium assorted rounded gravel. | | gl + 7.3 | |
| 2 | | | + 6 - | |
| 4 | | | + 4 - | |
| 6 | | | + 2 - | |
| 8 | | | 0 - | 8.04m 21/11/02 open hole. |
| 10 | 9.0-14.0m Slightly to moderately weathered, pale to medium grey LIMESTONE with calcite veins. Weathered brown on surfaces | | - 2 | |
| 12 | | | - 4 | 12.0m 1st water, very small |
| 14 | 14.0-14.3m CAVITY, with infill of brown silt and fine to coarse sand | | - 6 | |
| 16 | 14.3-18.0m Moderately weathered broken / fractured medium to pale grey LIMESTONE, and brown silt | | - 8 | 14.0m < 0.1 l/s increasing to |
| 18 | | | - 10 | 16.3m 0.2 l/s EC 3.58 mS/cm T 11.8°C |
| 20 | 18.0-39.2m Slightly weathered pale to medium grey LIMESTONE Mainly intact, competent | | - 12 | 0.3 l/s |
| 22 | | | - 14 | |
| 24 | | | - 16 | |
| 26 | | | - 18 | 0.3 l/s EC 3.21 mS/cm T 10.1°C |
| 28 | | | - 20 | developing zone 14m - 18m |
| 30 | | | - 22 | No increase |
| 32 | | | - 24 | |
| 34 | | | - 26 | 0.3 l/s EC 3.49 mS/cm T 12.7° |
| 36 | | | - 28 | |
| 38 | | | - 30 | |
| 40 | | | - 32 | |
| 42 | 41.0-43.0m Fractured / broken pale to medium grey LIMESTONE, brown silt | | - 34 | 2.0 l/s EC 5.79 mS/cm T 12.3° |
| 44 | END BOREHOLE | | - 36 | After 15 mins EC 5.90 mS/cm T 12.0° |

Borehole caving at 14.8m and 40.7m. Unable to drill deeper than 43m, uncased.

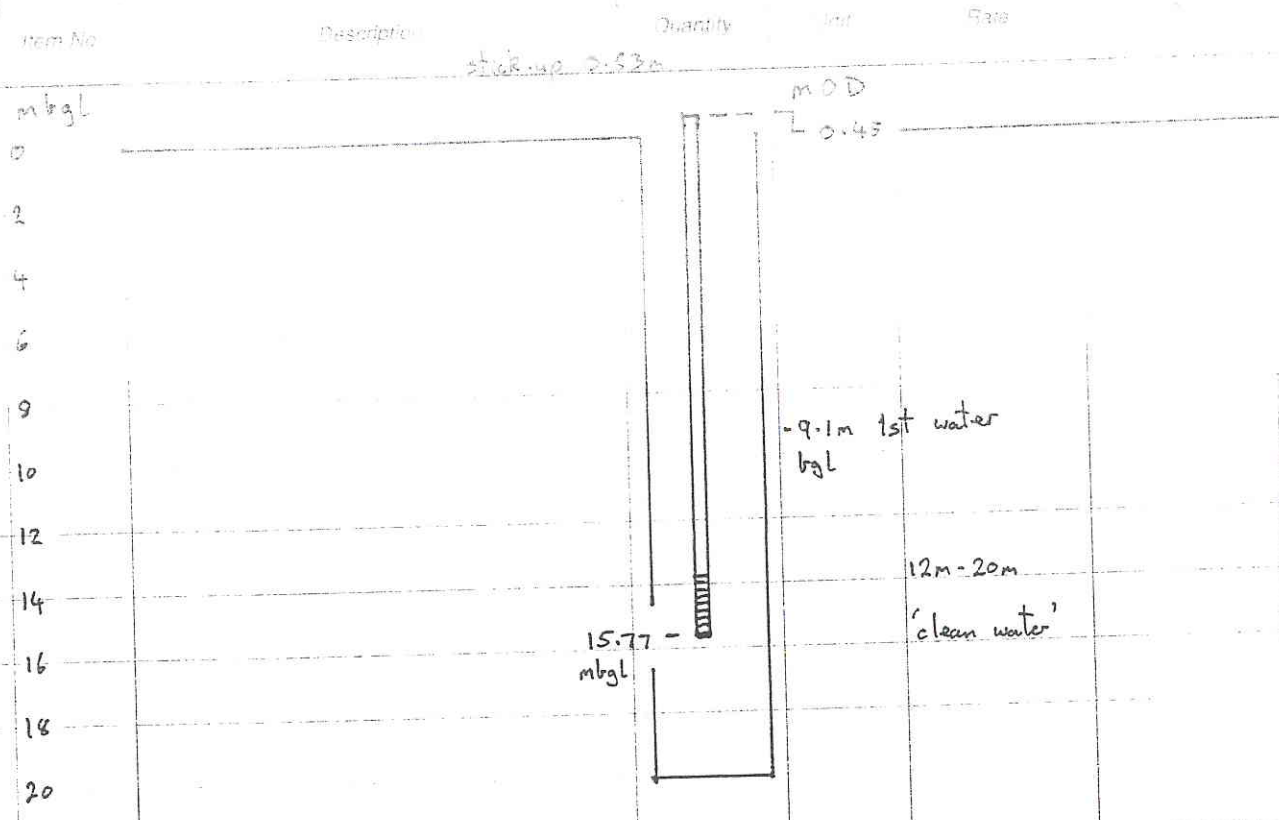
0-9.0m Reamed and installed 200mm (8") plain steel casing

0-13m Reamed 160mm to 200mm (6" to 8") diameter, and installed temporary 160mm (6") plain steel casing.

TOTAL

Form for Single Bill of Quantities (Headed).

BOREHOLE BLH 1



Datum: μ PVC TOC + 0.45 m OD

TOTAL

Form for Single Bill of Quantities (Headed).

BOREHOLE BKH 9

| Item No | Description | Quantity | Unit | Rate |
|---------|----------------|----------|-------|------|
| | stick-up 0.94m | | | |
| | | | Water | |
| 0 | | | | |
| 2 | | | | |
| 4 | | | | |
| 6 | | | | |
| 8 | | | | |
| 10 | | | | |
| 12 | | | | |
| 14 | | | | |
| 16 | | | | |
| 18 | | | | |
| 20 | | | | |

m bgl
0
2
4
6
8
10
12
14
16
18
20

17.53 mbgl
18.47 mb TOC

-15.3m bgl 1st water, very little.

Datum: upvc TOC +1.07m OD

TOTAL

BOREHOLE BLH3A

m bgl

| | |
|----|---|
| 0 | 0-2.0m Slightly weathered pale-dark grey LIMESTONE |
| 2 | 2.0-7.2m CAVITY, with infill of brown medium to coarse sand (collapsing) |
| 4 | |
| 6 | |
| 8 | |
| 8 | 7.2-12.4m Pale - medium grey very weathered limestone, broken / fractured, with cavities (collapsing) |
| 10 | 12.4-18.4m Slightly - moderately weathered pale to medium grey LIMESTONE, fragments of calcite |
| 12 | |
| 14 | |
| 16 | |
| 18 | |
| 20 | |



m OD

| | | |
|------|-----------------------------------|-------------------------|
| -1.1 | | |
| -2.4 | | |
| -4 | | |
| -6 | | |
| -8 | 6.2m Small amount water < 0.1 l/s | |
| -10 | | |
| -12 | 2.0 l/s | EC 14.91 mS/cm T 13.9°C |
| -14 | | |
| -16 | | |
| -18 | 2.0 l/s | EC 13.81 mS/cm T 13.1°C |
| -20 | | |

Steel casing 160mm (6") ID driven to 12.4m, pulled back to 10.0m
 uPVC piezometer tube 27mm ID installed to 18.0m, 2.5m slotted

TOTAL

Form for Single Bill of Quantities (Headed).



BOREHOLE BLH 4A

| Item No | Description | Quantity | Unit | Rate |
|---------|---|------------|------|-----------------------------------|
| | | | MOD | Water |
| 0 | 0-6.3m Slightly moderately weathered fractured/broken, pale and dark grey LIMESTONE. Brown silt and sand infills in fractures. | 1.6m | -2.3 | |
| 2 | | | -4 | |
| 4 | | | -6 | 2.8m 0.5 l/s EC 5.46 mS/cm T 14.8 |
| 6 | | | -8 | Silty brown water |
| 8 | | | -10 | Gradual increase |
| 10 | | | -12 | |
| 12 | 6.3-18.5m Slightly weathered pale and dark grey LIMESTONE, fragments of calcite. Occasional brown weathering on surfaces. | | -14 | EC 7.88 mS/cm T 14.1 |
| 14 | | | -16 | Grey / brown |
| 16 | Below 14.5m... with occasional partings of soft brown silty clay | | -18 | |
| 18 | | | -20 | 0.75 l/s EC 8.53 mS/cm T 16.1 |
| | | | | Grey / brown |
| | | END BH | | |
| | | 18.5 m bgl | | |
| | | - 20.8 MOD | | |

Install 27mm ID uPVC piezometer tube to 18.2 mbgl, 2.5m slotted.

Form for Single Bill of Quantities (Headed).

BOREHOLE BLH 6

| DEPTH | Description | Quantity | UNIT | Rate |
|-------|---|---|---|---|
| m bgl | stick-up 3.83m | | MOD | |
| 0 | Clean LIMESTONE No silt or soft areas/ cavities |  |  | No water encountered during drilling |
| 2 | | | | |
| 4 | | | | |
| 6 | | | | |
| 8 | | | | |
| 10 | | | | |
| 12 | | | | |
| 14 | | | | |
| 16 | | | | |
| 18 | | | | |
| 19 | 18.57m bgl --- | | | |
| 20 | 19.40m b TOC | | | |
| 22 | | | | |
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Datum: u PVC TOC - 0.02 MOD

TOTAL

Form for Single Bill of Quantities (Headed).

BOREHOLE BLH 8

| Item No. | Description | Quantity | Unit | Flow | |
|-----------------|---|-------------|------|-------------------|-------|
| | stick-r- up 0.87m | | | | |
| 0 | Alternating hard/competent LIMESTONE and silt-filled cavities | 3.27 m bgl | | | |
| 2 | | 4.1 m b TOC | | | |
| 4 | | | | | |
| 6 | | | | | |
| 8 | | 8.5 m bgl | | 1st water, clean. | |
| 10 | | | | | |
| 12 | | | | | |
| 14 | | | | | |
| 16 | | | | | |
| 18 | | | | | |
| 20 | | | | | |
| Datum: uPVC TOC | | -1.99 | m OD | | |
| | | | | | TOTAL |

Form for Single Bill of Quantities (Headed)

BOREHOLE BLH 10

| Item No. | Description | Quantity | Unit | Rate |
|-----------------------------|-------------------------|---------------|------|----------------------|
| | stick-up 2.90m | | | |
| 0 | 4.56m bgl 5.46m bTOC | 3.3m | lit | water |
| 2 | | | | |
| 4 | | 4.5m | | Increase in water |
| 6 | | | | |
| 8 | | | | |
| 10 | | | | |
| 12 | | 12.1m - 18.2m | | No water encountered |
| 14 | | | | |
| 16 | | | | |
| 18 | | 18.2m | | Water |
| 20 | | | | |
| Datum : wPVC TOC - 0.75m OD | | | | |
| TOTAL | | | | |