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1.0 INTRODUCTION

1.1 PROPOSED DEVELOPMENT

This Environmental Impact Assessment (EIS) has been prepared on behalf of Microsoft Ireland Operations Ltd (MI) to accompany an application to South Dublin County Council (SDCC) for a Data Server Centre facility at a greenfield site in Grange Castle International Business Park, Clondalkin, Co Dublin. The location of the development is shown on Figure 1.1.

In July 2013, an application for planning permission for a 35.2MW data server centre facility was submitted to SDCC. The application (which included an EIS) was granted permission by SDCC (Ref SD13A/0143) on 9th September 2013 subject to a number of conditions.

At the request of MI, this EIS has been prepared to accompany a planning application for an amended Data Server Facility at the same greenfield site in Grange Castle International Business Park. The proposed development is essentially the same as the development applied for in July 2013 other than a change to the final floor level of the development. The modifications to the approved SD13A/0143 proposed here are done for reasons of efficiency in construction and reduction in the quantity of excavated material from the site. The entire Data Centre development will now be constructed on a base level of 71m OD (rather than 69m OD as was applied for in July 2013). This EIS and the various chapters contained within it have been revised to account for this change. Other minor amendments (mostly arising from the conditions of the permission granted in September 2013) have also been assessed and included as appropriate.

1.2 CONTEXT

1.2.1 Legislative Requirements

The requirement for Environmental Impact Assessment (EIA) for certain types and scales of development is set out in the EIA directives (85/226/EEC, 97/11EC and 2003/35/EC) and for current purposes is given effect in Ireland by the Planning and Development Act, 2000 as amended and the Planning and Development Regulations 2001-2012.

Schedule 5 of the Planning and Development Regulations stipulates the type and classes of development for which an EIS is required. Part 2 of Schedule 5 states that an EIS is required for certain Infrastructure Projects including 10(a) Industrial Estate development projects where the area of the proposed development exceeds 15 hectares. The proposed development has a site area of in excess of 29.84 hectares and an EIS is therefore required on that basis.

There is a provision in the Part 2 of Schedule 5 where EIS is required for changes or extensions to developments, however given the nature of the proposed amendments to the facility, this is not considered applicable in this case.

This EIS has been prepared in the Direct Format Structure as set down in the “Guidelines on Information to be Contained in an EIS” produced by the Environmental Protection Agency (March 2002). In general the EIS follows the framework presented in the EPA “Advice Notes on Current Practice in the Preparation of Environmental Impact Statements” (September 2003).

1.2.2 Need for the Development

Between 2007 and September 2013 MI were granted planning permission for the construction of four data centres at Grange Castle International Business Park. Construction of the first data centre referred to as DUB03 was completed in 2008. The existing data centres are commonly referenced as Data Centre DUB03, DUB04 and DUB05 respectively. DUB05 is currently under construction. No construction works have yet been completed at DUB06 (i.e. the proposed development).

These facilities were designed to meet MI's data centre server requirements based on projections completed in 2007. Since that time the demand for online services has expanded exponentially and the proposed Data Centre (referenced as DUB06 henceforth) is now required to allow MI meet an ever growing worldwide demand for the services it offers over the internet.

1.3 MICROSOFT IRELAND LTD – COMPANY BACKGROUND

Microsoft was founded in Seattle Washington in 1975. Microsoft is a worldwide leader in software, services and solutions that help people and business realise their potential. Microsoft commenced its operations in Ireland in 1985 with a manufacturing facility employing 100 people. The business has now grown to employ over 1,200 full time staff and 700 on site vendor staff across a number of division including;

EMEA Operations Centre: Established in 1985 this division is responsible for operations, finance, billing and logistics for Microsoft's business throughout Europe, the Middle East and Africa.

European Product Development Centre: This centre is responsible for the localisation of Microsoft Products into different languages for use across Europe, the Middle East and Africa. EPDC works on a wide array of different Microsoft products from the 2007 Microsoft Office System to Xbox 360 games, business applications and online services such as MSN Windows Live. It is focussed on engineering excellence from design to completion.

Sales, Marketing and Services: Microsoft's sales, marketing and services group is responsible for sales, marketing and services for customers throughout Ireland.

European Development Centre: Established in 2005, the EDC is a full research and development facility undertaking projects across a range of areas. The centre provided core technology for Windows Vista and is undertaking research across a range of areas from security, online services and digital television.

Existing Data Centres: Microsoft's existing data centres DUB03, DUB04 and DUB05 at Grange Castle Business Park provide data storage services to a wide variety of clients. Due to ever increasing demand and the change in data handling and software applications the demand for more online services has increased exponentially. The increasing move of social and business life to the online or cloud world means the current facilities are approaching their capacity ahead of the most conservative predictions of five years ago. Demand capacity in the regions supported by MI requires additional facilities in the region to support customers needs. Long range capacity planning is utilised as the construction duration of such projects can take several years.

1.3.1 Microsoft Ireland – Environmental Principles

MI considers itself a global corporate citizen and as such seeks to develop principled pragmatic business approaches to challenging issues including the environmental challenges faced by society today. By working with its partners, customers, governments and leading environmental organisations MI brings the power of information technology and cloud computing to bear in addressing the worlds environmental challenges.

MI is committed to software and technology innovation that helps people and organisations around the world address their environmental impact Microsoft intends to;

- Minimize the environmental impact of its business operations and its products
- Create technology solutions that help individuals and business around the world address their environmental impact.

1.4 CONSULTATION

A pre application consultation meeting was conducted with representatives of SDCC on 12th December 2013 as part of the preparation of this application. As the proposed development is broadly similar to that applied for in July 2013, limited consultation with other statutory bodies (consulted in early 2013 regarding SD13A/0143) was completed as part of this latest application. The Department of Defence were consulted again, in relation to Casement Aerodrome flight paths and Inner Zone limits in December 2013. A copy of the correspondence is included in Appendix 1.1.

1.5 CONTRIBUTORS TO THE EIS

Table 1 below presents the EIS project team. The majority of the team is comprised of specialists at AWN supported with input from the project team including RKD Architects and Ethos Engineering as well as a number of external specialists for landscape, traffic, archaeology and ecological consultancy services.

• Chapter 1 Introduction	-	AWN Consulting
• Chapter 2 Description of Proposed Development	-	AWN/RKD/Ethos
• Chapter 3 Planning and Development Context	-	AWN Consulting
• Chapter 4 Alternatives	-	AWN Consulting
• Chapter 5 Human Beings	-	AWN Consulting
• Chapter 6 Soils and Geology	-	AWN Consulting
• Chapter 7 Water	-	AWN Consulting
• Chapter 8 Flora and Fauna	-	Moore Group
• Chapter 9 Air Quality and Climate	-	AWN Consulting
• Chapter 10 Noise and Vibration	-	AWN Consulting
• Chapter 11 Landscape and Visual	-	Brady Shipman Martin
• Chapter 12 Cultural Heritage	-	CRDS Ltd
• Chapter 13 Traffic	-	Roughan & O'Donovan
• Chapter 14 Material Assets	-	AWN Consulting
• Chapter 15 Interactions	-	AWN Consulting

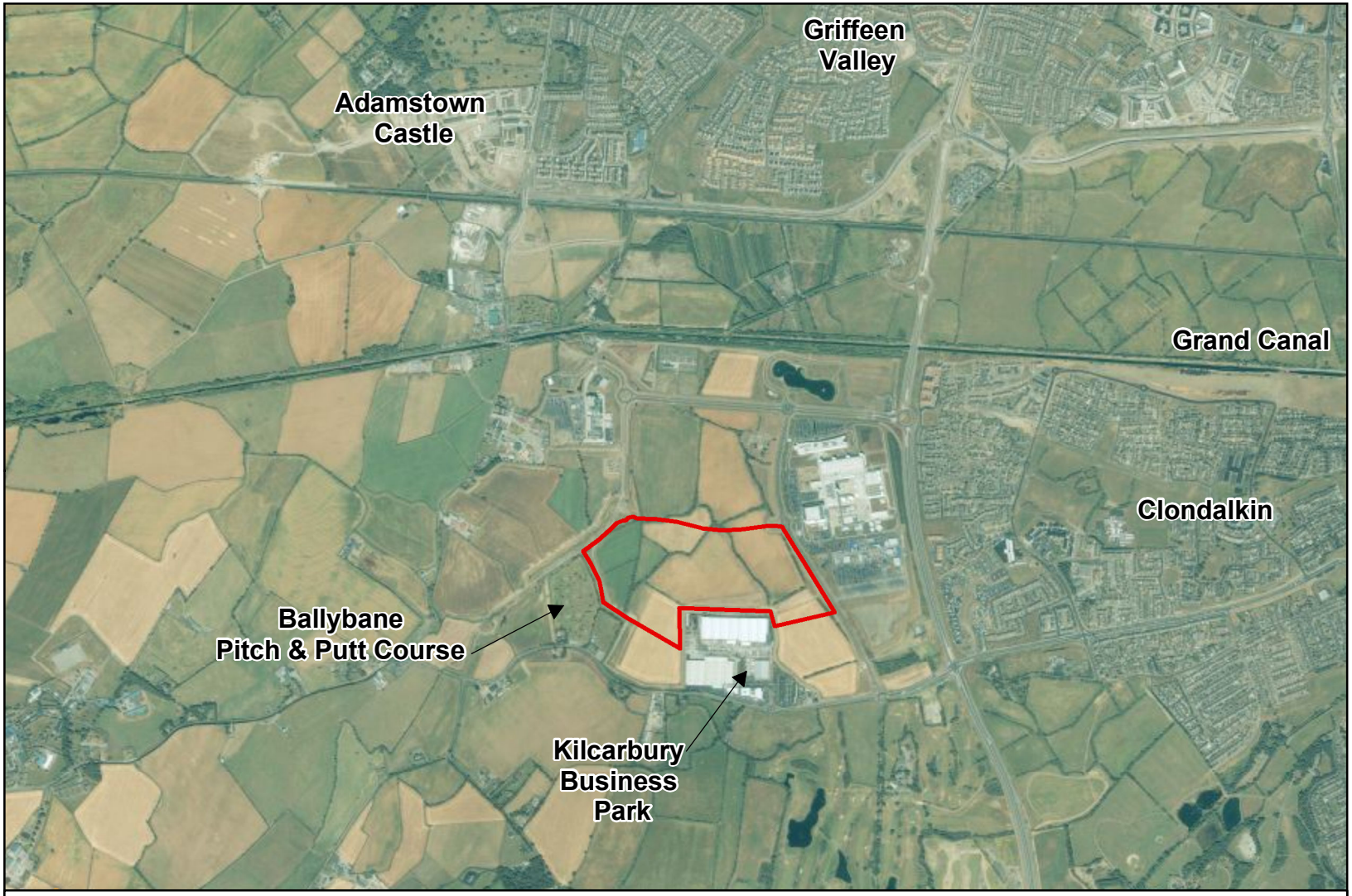
1.6 DIFFICULTIES IN COMPILING THE SPECIFIED INFORMATION

There were no significant difficulties in completing the Environmental Impact Statement. (Any minor difficulties are presented in each of the respective chapters).

It should be noted that a cumulative assessment of the impact of the proposed Grifols Worldwide Ltd development to the north of the site, particularly in terms of air emissions, could not be conducted as part of this EIS. Insufficient air modelling information was available to the project team. It is understood that the proposed development is primarily a warehouse for the storage and packaging of bio-pharmaceuticals and as such is expected to generate minor air and other emissions**.**

1.7 REFERENCES

- 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.
- The European Communities Environmental Impact Assessment (Amendment) Regulations 1999,SI No 93 of 1999
- Planning and Development Regulations 2001, S.I. No. 600 of 2001.



N
W E
S

Legend

Site outline (approximate)



0 0.25 0.5 1 Km

AWN licence no. EN 0007513; Source: Aerial photo: Bing Maps

Note: Drawing is for illustrative purposes only; Do not scale

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CLIENT: Microsoft Ireland	**PROJECT:** Environmental Impact Assessment for Proposed 35.2MW Data Centre for Microsoft Ireland at Grangecastle, Co. Dublin	**DRAWN:** P.G	**CHECKED:** T.H.	**APPROVED:** T.H.	**APP'D DATE:** 18/07/2013	
DRAWING TITLE: Site Location Map	**PROJECT Ref: 13/6668**	**Figure 1.1**		No. of Sheets: 1	**SIZE:** A4	**SCALE:** 1:40,000
		REVISION DESCRIPTION			SHEET	REV

APPENDIX 1.1

David Mcdermott

From: David Mcdermott
Sent: 17 December 2013 10:39
To: Info
Subject: FW: Casement Aerodrome Helicopter Training Paths
Attachments: A-B-08P - Site Plan.pdf; A-B-09P - DOD Sections.pdf

-----Original Message-----
From: Patrick Carney [mailto:pcarney@rkd.ie]
Sent: 17 December 2013 08:52
To: aircorpops@defenceforce.ie
Cc: David Mcdermott; Elaine Gillespie; Sean Hogan
Subject: Re: Casement Aerodrome Helicopter Training Paths

FAO Capt. Farrell and Comdt. Martin

Gentlemen
Further to the mail below SDCC granted permission for the development under Application Number SD13A/0143, however further to our recent phone calls to your office we have been instructed to make a modification to the Approved scheme, this modification being the raising of the entire scheme by 2M in height. As explained none of the relationships of the Approved have been altered merely the entire has been raised by 2M to reduce the quantity of digging on site that was intended to give one level floor finish for the entire site.

This modification does raise the proposed flue OD from 93.850 to 95.850.

This represents a raise of 2M from the Approved flue height to the New Proposed Ordenance Datum of 95.850, all still being below the cones and flight path but still on the perimeter of the helicopter training zone.

The attached drawings A-B-08P (site plan showing Casement Inner Zone Limit) and A-B-09P (Showing Casement Inner Zone limit in sections) are attached to this mail and will be enclosed with the Planning Application being lodged with South Dublin County Council this Thursday the 19th of December.

As noted this modification is to avoid the excess dig on the site and by consequence allow for the project to have less of an environmental impact.

As stated in our phone call to your office we are available at anytime to review and discuss this modification either prior to the 19th or anytime thereafter during the five week appraisal by SDCC.

Regards and Thanks

Patrick P Carney MRIAI
RKD Architects
Mob +353 87 4169200
Sent from Windows Mail

2.0 DESCRIPTION OF THE PROPOSED DEVELOPMENT

2.1 INTRODUCTION

This section of the EIS has been prepared by AWN Consulting with input from the project team. The section describes the nature of the proposed development in accordance with the requirements of the relevant EIA legislation and guidance on preparation and content of EIS.

2.2 CHARACTERISTICS OF THE SITE

2.2.1 The Existing Site

The proposed Data Centre development is to be located on a greenfield site at Grange Castle International Business Park, Clondalkin, Co Dublin. Infrastructure for the industrial estate was constructed a number of years ago, with the roads and services constructed in the late 1990's.

The site is located between the N4 and N7 national primary roads and is served by a good road network including the regional roads R120, R134 and R136 (The Grange Castle Road) and the road network through the business park.

The site (29.84 ha.) is currently under grass and arable crop and comprises a number of fields bound by hedgerows, treelines and ditches, albeit having been zoned for Technology Park since the early 2000's. A tributary of the River Griffeen passes along the western edge of the site. The site is relatively flat though there is a slight fall of approximately 7m from east to west.

The site is currently accessed from the north east or north west via the roundabouts on the Grange Castle Business Park Road to the east or west. A new link road is currently under construction along the northern boundary of the proposed development site. This will link up the two roundabouts to the north east and north west of the site. (See Figure 1.1). It is anticipated that this will be completed in March 2014

Most of the surrounding lands within the business park are occupied by industrial campuses including pharmaceutical, data centre and food manufacturing uses. Pfizer Irelands campus is located to the east, Kilcarbury Business Park is located to the south, Microsoft's existing DUB03-DUB05 campuses are located to the west as well as Takeda Ireland and Aryzta (IAWS, Cuisine De France) facilities to the south west and west respectively. Ballybane "Footgolf" course borders the site to the west. Two further undeveloped greenfield sites under SDCC control are located to the south around Kilcarbury Business Park. A portion of the site directly north of the proposed development has recently been granted permission for another industrial development (Grifols Worldwide Operations Ltd – please refer to Chapter 3 for further details). The Grange Castle protected archaeological site is located slightly further north.

Dwellings in the area immediately around the site are sparse and largely limited to one off houses along the regional roads to the south. Grange Castle golf club and other industrial business parks are located further south.

2.3 PROPOSED DEVELOPMENT

Microsoft intends to develop a 35.2MW Data Centre, in two phases, to help the company meet the growing global demand for services it offers over the internet. The facility will store, manage and distribute information to individuals, businesses and organisations.

The facility (c.35,000m^2 in total) will consist of the following primary aspects;

- c.13,136m^2 of Data Server Rooms (8 "Colos" approximately 1,642 m^2 each),
- c.8,552m^2 of associated Electrical Plant Rooms (one for each Colo approximately 1069m^2 each) for equipment to maintain the temperature, humidity and power supply required to run the facility,
- c.2,464m^2 of Plant, Electrics and MDF (Main Distribution Frame) Rooms (for telecommunication of data)
- c.1,272.46m^2 of Maintenance and Storage space (storage of spares and components)
- c.1,150m^2 Administration Building including Offices and Canteen including;
    - c.50.7m^2 Security and Facility Operations Centres
    - c.214.5m^2 Remote Monitoring Centre (monitoring of other EMEA data centre functions)
- Associated circulation space, WC rooms, stair wells etc

Ancillary infrastructure will include;

- ESB Substation Transformer (temporary and permanent)
- Road Network and Parking (156 spaces in total)
- Drainage Infrastructure
- Sprinkler Tank for fire suppression etc (670m^3) and pump room
- Back Up Generators (c.3 per Colo) and 1 No. Diesel Belly Tanks per generator (12m^3 each) to the underside of the Generator sets.
- Perimeter Berms and Landscaping
- Security Entrance and security fencing

The location of the facility is shown on Figure 2.1. The layout of the facility (and the area of application) is shown on the planning drawings accompanying the EIS. Various views of the proposed facility are shown on Figures 2.2, 2.3 and 2.4. The total site area is 29.84 ha.

The proposed development will be constructed in two phases. (Phases 1 and 2 will comprise 4 Colos and related infrastructure each). Subject to the outcome of the planning application, it is intended that construction of Phase 1 of the development will start in mid April 2014. A commencement date for Phase 2 has not yet been scheduled. Nevertheless all potential impacts associated with Phase 2 have been assessed and discussed in this Environmental Impact Statement to ensure the cumulative impacts of the future development are fully assessed from the outset.

2.3.1 Facility Process

Colos

A data centre is a centralised computer server system designed to provide information storage, management and distribution functions to individuals businesses and organisations. With ever increasing levels of online activity and ever larger volumes of data, the global demand for data storage is increasing rapidly. The proposed facility will enable Microsoft to meet this demand

The facility will be connected to its customers via the available fibre telecommunications network. The facility will enable Microsoft to provide a wide variety of services to its customers not just in Ireland but across the globe.

The Data Centre when completed will house 8 "Colos" (Colocation facility to give them their proper name) which will allow individuals, business' or organisations store their information at a secure and reliable facility off their premises for minimal cost and complexity compared to the traditional forms of in house data storage systems. Data Centres are typically constructed on a relatively large scale compared to other forms of industry which results in significant benefits in terms of economies of scale.

Colo systems have;

- much higher reliability with built in redundancy systems,
- 24/7 monitoring of the facility and its systems by staff,
- lower network latency and higher bandwidth at lower cost,
- specialist network and facilities engineers typically not viably employed by individuals, businesses or organisations.

The COLO's are conditioned utilising outside air, via roof mounted air handling units. Conditions in Ireland are conducive to this free cooling strategy, which essentially moves outside air across the servers to cool and then exhaust the higher temperature air to atmosphere.

There are small areas in the building which require cooling, i.e. the MDF Rooms, but the majority of the building is serviced by outside air cooling.

The COLO's equipment, including servers and the air handling plant to condition the space requires power to maintain the server availability and correct environment.

Electrical Plant Rooms

Each Colo is supported by a dedicated electrical plant room, which provides the necessary power to ensure the Colos operate optimally at all times.

Administration Building

The staff at the proposed facility will largely be housed at the 1,150m^2 administration system to be located along the eastern edge of the plant. The admin building comprises the following main components;

- Reception Areas
- General Office Areas for staff and management
- Canteen & Sanitary Facilities
- Conference Rooms
- Security Operations
- Facility Operations
- Remote Monitoring Centre

Please note; The Remote Monitoring Centre has been included at the proposed development to centralise the monitoring of MI's Data Centres throughout Europe, Middle East and Africa (EMEA). This is a very important component part of the proposed development, servicing an international need for MI. The RMC requires a permanent staff of c.50, altogether separate from the main Data server function of the proposed development.

Drainage Systems

All site drainage will be served by the existing foul and storm water drainage systems within the Business Park. The site storm water drainage system will pass through an interceptor before passing to the main storm drainage system located along the road network which connects to the main attenuation pond for the business park. A shut off valve and related monitoring system is in place on the surface water discharge so that site discharges can be shut off in the event of a fire. (Further detail of the proposed storm drainage system is included in Chapter 7 of the EIS).

Foul drainage will be collected from site (admin and canteen building etc) and discharged to the local foul drainage network which ultimately discharges to Ringsend WWTP.

Power Supply

The proposed facility has a critical electrical load of 35.2MW and this will be provided from the local supply network by ESB Ireland. A new ESB 110kV substation and associated 110kV/20kV transformer compound is to be constructed on site.

The primary power requirements of the development are to run the banks of servers in the Colo units and air-handling units to control temperature and humidity within the building. A back up power supply to the facility will be provided in the form of generators which will start automatically in the event that the primary power source to the facility fails. The generators will run on diesel supplied from storage tanks to be located directly beneath each generator. It is considered that these generators will be rarely used.

Utilities

In addition to the infrastructure above in terms of power and drainage systems, the following additional infrastructure will also be completed;

- 1 x 670m^3 Sprinkler Water Tanks and associated pump house
- 28 x 12m^3 double bunded belly diesel tanks

2.4 STAFFING & PARKING

It is proposed that c.148 staff will be employed at the facility. The facility will operate on a three 8 hour shift basis. Working hours are expected to be 24 hours a day 7 days a week. Approximately 120 staff will be employed and located at the Administration building (general admin, management, sales etc (54), remote monitoring centre (51), facility operations (8) and security(5)) with a further c.30 staff employed in the maintenance and operation of the facility. It is anticipated that a high volume of "transient" workers (including maintenance and other process specialists) will also attend site on a daily basis. Parking of c.147 spaces and 9 accessible spaces has been provided to ensure plenty of parking for all staff and visitors.

2.5 DESCRIPTION OF PROCESS INPUTS AND OUTPUTS

The primary inputs to the proposed development are power, water and diesel fuel (for emergency generators as and when required). The main outputs are waste air, water and emissions from the stacks (when the generators are in operation).

2.5.1 Inputs

Power

As outlined above the facility has been designed to be completed over 2 phases – these phases directly relate to the power consumption of each individual phase. Phases 1 and 2 will each require 17.6 MW of critical power each. This power will be sourced via the new substation and transformer compound to be located in the north west of the site from the National Grid.

Water

The facility when complete (i.e. Phases 1 and 2) will have an estimated water demand of c.10m^3/day. This water is required for cleaning, general potable supply for drinking and sanitary facilities. South Dublin County Council have confirmed that sufficient water is readily available from SDCC supplies for the facility.

Fuel

In the event of a loss of power supply i.e. power blackout, emergency generators are designed to automatically activate and provide power to the plant. The generators will be supplied by diesel. Each generator will be supplied by a 12m^3 diesel tank, located directly beneath the generators.

2.5.2 Outputs

Air

One of the primary outputs from the facility will be excess air which is removed continually by motorised fans in the AHU system. It is estimated that approximately 2,520m^3/s (8 No. COLO's) of warm air will be emitted by the facility. The utilisation of outside air is the most efficient means of cooling and conditioning the server space. It is considered that this is more efficient as a collective treatment as opposed to the maintenance of existing non-efficient individual data centres operated by standalone companies – hence the push for colocation data centres or Colo's.

As part of the development of the project, MI considered the offload/reuse/exchange of waste heat with neighbouring industrial facilities or other potential users within the environs of the business park. However at the time of preparation of the EIS no feasible outlet could be found. Nevertheless MI will continue to assess options for this in future.

Water

The facility will generate waste water in terms of both storm water and foul water. Storm water i.e. rain water run off will be collected in site storm water drainage from roofs and yards and discharged to the existing SDCC storm water mains and grange Castle Business Park attenuation system. The facility design includes interceptor system to ensure the quality of storm water discharge is controlled prior to attenuation. Shut off valves are in place on the discharge from the attenuation system to ensure any non conforming discharges are stopped.

Foul water will be generated from sanitary facilities. For c.150 people, based on a typical 8 hour working day this is estimated at a conservative 50 PE (population equivalent). This water will be discharged to public foul sewer. Further detail in relation to water emissions is presented in Chapter 7 Water.

There are no proposed process water emissions.

Emissions from the Generator Stacks

As outlined above it is anticipated that the back up generators will rarely be used however, they will be maintained for emergency readiness by being tested once a month i.ie each generator will be turned on for a period of one hour per month to maintain operational readiness, when required waste exhaust gases will be vented to air via 25m stacks along the northern and southern edge of the building. An assessment of the impact of these emissions in presented in Chapter 9 Air Quality and Climate.

2.6 DESCRIPTION OF NATURAL RESOURCES USED

Requirements for natural resources are discussed under Section 14 Material Assets.

2.7 DESCRIPTION OF SECONDARY PROCESS/ACTIVITIES

Off Site Traffic Movements

As outlined above there will be a small increase in traffic within the industrial estate owing to staff movements to and from the proposed development once operational. This traffic will use the existing road network which has more than adequate capacity. The new link road which will run directly along the northern boundary of the proposed development will be completed in March 2015.

Security

All traffic intending on accessing the facility will approach and access the site through the main access barriers and by-parting gate via the link road from the Grange Castle Road. A maximum speed limit of 10km/hour will be in place on the access road. These barrier and by-parting gates will be maintained by security personnel 24/7. Security will ensure that the procedure for accessing the facility is followed at all times.

A record will be maintained of all personnel visiting the site including deliveries and waste disposal. All visitors to site will be monitored and supervised at all times.

A 2.4m high palisade fence will be constructed around the perimeter of the facility. This palisade fence will be screened from the estate roads by the placement of 1-4M high clay berms, placed outside the SDCC service way leaves running parallel to the estate roads. CCTV cameras will be installed at strategic locations around the facility to ensure all approaches to the facility are adequately monitored.

Waste Management

Chapter 15 contains a description of waste management relating to the proposed development. A detailed Operational Waste management plan will be prepared in advance of the commencement of the activity at the site to ensure best practice is followed in the management of waste from the proposed development.

2.8 REGULATORY CONTROL

The proposed activity is not an EPA regulated activity and therefore there will be no requirement for an EPA licence. A greenhouse gas emission permit (for the temporary use of the generators) if required will be sought from the EPA as appropriate.

2.9 DECOMMISSIONING

It is envisaged that the proposed development will have a long lifespan of 10-20 years or more. Regular maintenance and upgrading of the facility over time will enable it to continue to meet future demands.

Upon closure it is anticipated that the facility will be suitable for re-use as would any other industrial site. All plant and equipment would simply be decommissioned, removed and recycled/disposed as appropriate. The costs associated with the closure of the facility will be met by Microsoft Ireland

2.10 HEALTH AND SAFETY & SEVESO

2.10.1 Design and Construction Health and Safety

The facility has been designed in accordance with the Safety Health and Welfare at Act 2005 and the Health and Safety and Welfare at Work (General Application) Regulations SI 299 of 2007 and associated regulations.

The plant has been designed by skilled personnel in accordance with internationally recognised standards, design codes, legislation, good practice and experience based on a number of similar existing facilities operated by Microsoft in Ireland and throughout the Globe.

2.10.2 General Operational Health and Safety

Microsoft operates Quality, Environmental Safety and Health management system approved to all internationally recognised quality, environmental, health and safety systems.

Prior to start up a comprehensive set of operational procedures will be established (based on those used at other similar facilities). This will ensure a smooth roll out of operations at the facility.

The facility will not be a Seveso facility. The only Seveso substance stored on site will be diesel for generators and the amounts propose do not exceed the relevant thresholds of the Seveso directive.

2.11 CONSTRUCTION

The construction of the facility will comprise three main stages, namely;

- Initial site preparation works
- Building construction
- Commissioning

In terms of the overall development (i.e. both phases of the project to a total of 35.2MW plant), it is proposed that the majority of site preparation works will be completed prior to Phase 1 with lesser site preparation required for the latter phase. A brief description of the construction works proposed for Phase 1 is set out below.

2.11.1 Working Hours

It is anticipated that the construction of the facility will be completed during normal construction hours i.e. 8am to 6pm Monday to Friday. However it is possible that the contractor may wish to carry out certain operations outside these hours i.e. half days on Saturday or evening hours during long summer days etc. Such occurrences will be kept to a minimum and take place over a short timeframe and as such are unlikely to cause excessive disturbance.

2.11.2 Site Preparation

The primary activities required during site preparation will be establishment of an access road, the contractors' compound, site clearance (of vegetation etc.) and cutting and filling of various parts of the site to provide the necessary base level for construction. Fill material required to raise the site to its final foundation level will be imported as required.

It is proposed to locate the construction compound in the south western portion of the site as shown on the planning drawings accompanying the EIS. The compound will provide office, portable sanitary facilities, equipment storage, parking etc for contractors for the duration of the works. The construction compound will be fenced off for health and safety reasons so that access is restricted to authorised personnel only.

Other works required will include surveying and setting out for structures, protection of agreed hedgerows, rerouting of services and setting up of the construction site with fencing, site compounds etc.

In advance of site preparation, a strategy will be developed in order to efficiently move material arising from excavations to locations where landscaped berms are required around the facility. The sequence will start with clearance of the critical areas including the site access routes, contractor's compound etc. A combination of bulldozer, excavators, trucks and other soil shifting plant will then commence the main site vegetation clearance and cutting and filling aspect.

2.11.3 Noise, Vibration and Dust Nuisance Prevention

With regard to construction activities, reference will be made to BS5228: Noise control on construction and open sites, which offers detailed guidance on the control of noise and vibration from demolition and construction activities. Various mitigation measures can be considered and applied during the construction of the proposed development, such as:

- limiting the hours during which site activities are likely to create high levels of noise are permitted, e.g. soil excavations;
- establishing channels of communication between the contractor/developer, Local Authority and residents;
- appointing a site representative responsible for matters relating to noise, and;
- monitoring typical levels of noise during critical periods and at sensitive locations.

Furthermore, it is envisaged that a variety of practicable noise control measures will be employed. These may include:

- selection of plant with low inherent potential for generation of noise;
- erection of barriers as necessary around items such as generators or high duty compressors, and;

- siting of noisy plant as far away from sensitive properties as permitted by site constraints.

The potential for dust to be emitted depends on the type of construction activity being carried out in conjunction with environmental factors including levels of rainfall, wind speeds and wind direction. The potential for impact from dust depends on the distance to potentially sensitive locations and whether the wind can carry the dust to these locations. The majority of dust produced will be deposited close to the generated source.

In order to ensure that no dust nuisance occurs, a series of measures will be implemented.

- Hard surface roads will be swept to remove mud and aggregate materials from their surface while any unsurfaced roads will be restricted to essential site traffic only.

- If required, any area/road that has the potential to give rise to fugitive dust will be regularly watered, as appropriate, during dry and/or windy conditions.

- Vehicles using site roads will have their speed restricted, and this speed restriction must be enforced rigidly. Indeed, on any un-surfaced site road, this will be 15-20 kph, and on hard surfaced roads as site management dictates.

- In dry conditions vehicles delivering material with dust potential (soil, aggregates) will be enclosed or covered with tarpaulin at all times to restrict the escape of dust.

- Wheel washing facilities will be provided for vehicles exiting the site in order to ensure that mud and other wastes are not tracked onto public roads.

- Public roads outside the site will be regularly inspected for cleanliness, and cleaned as necessary.

- At all times, these procedures will be strictly monitored and assessed. In the event of dust emissions occurring outside the site boundary, movements of materials likely to raise dust would be curtailed and satisfactory procedures implemented to rectify the problem before the resumption of construction operations.

2.11.4 Water Discharges

Welfare facilities will be provided for the contractors on site during the construction works. These facilities may be connected to the existing foul drainage system on site or portable sanitary facilities will be provided.

Any surface water run-off collecting in excavations will be pumped from the excavation and treated by use of suitably sized grit chambers and a 3 chamber Class I hydrocarbon interceptor prior to discharge to the Local Authority surface water drainage network in compliance with the requirements outlined in the Water Chapter of this EIS. See Chapter 7.0 for a full description of mitigation measures proposed.

2.11.5 Material Sourcing, Transportation and Storage

Materials
Key materials will include steel, concrete, glass, composite cladding, piping, electrical cabling, process equipment and architectural finishes. A 'Just In Time' delivery system will operate to minimise storage of materials on site.

Sourcing
Where possible it is proposed to source general construction materials from the Dublin area to minimize transportation distances.

Storage
Aggregate materials such as sands and gravels will be stored in clearly marked receptacles within a secure compound area to prevent contamination. Liquid materials will be stored within temporary bunded areas, doubled skinned tanks or bunded containers (all bunds will conform to standard bunding specifications - BS8007-1987) to prevent spillage.

Transportation
Construction materials will be brought to site by road. Construction materials will be transported in clean vehicles. Lorries/trucks will be properly enclosed or covered during transportation of friable construction materials and spoil to prevent the escape material along the public roadway.

2.11.6 Building Construction Works

Once site preparation is completed, building construction will take approximately 18-24 months. The total peak construction population on site will be c.400 staff with an average of 250 persons for the duration. Site staff will include management, engineers, construction crews, supervisors and indirect staff.

Foundations and Structure
Following the completion of site levelling, all structures will require deep concrete pad foundations. Geotechnical investigations completed in May 2013 indicate that the eastern portion of the proposed site has a very shallow rock profile. Building structures will comprise structural steel frames with concrete floors on metal decks.

Cut and Fill
It is envisaged that all spoil generated during site preparation will be re-used in the landscaping and levelling of the site where possible. As a worst case scenario i.e. construction during a period of extended poor weather, a maximum of 30-40,000m^3 may require removal.

Contractors will be required to submit and adhere to a method statement indicating the extent of the areas likely to be affected and demonstrating that this is the minimum disturbance necessary to achieve the required works.

Where stripping occurs, the resulting excavated fractions will be separated into subsoil and topsoil stockpiles. Temporary storage of spoil will be managed to prevent accidental release of dust and uncontrolled surface water run-off which may contain sediment etc.

Waste Management
Chapter 15 contains a detailed description of waste management relating to construction of the proposed development. A detailed Construction and Demolition

Waste management plan will be prepared in advance of the works to ensure best practice is followed in the management of waste from the proposed development.

Power Supply

Though a permanent ancillary 100kV/20kV transformer compound is to be located within the proposed development site, it is likely that this will not be in place at the outset of construction works. A temporary ESB MV substation and temporary switch room will be required and this will be established in the north western portion of the site. It will be maintained for the duration of construction, and beyond as required, to enable commissioning works (set out below) until the permanent substation becomes operational.

Building Envelopes and Finishes

The construction of the walls and roof of buildings will closely follow the completion of structures. Early completion of building envelopes allows the next stage of construction to be completed without delay i.e. building finishes, equipment installation including mechanical and electrical instrumentation, controls etc The outer finishing of the building envelope will be comprise a combination of glass and painted metal cladding, similar in quality and sympathetic in colour to the other buildings in the business park.

Roads, Services and Landscaping

The internal road system will initially be comprised of hard cored material, rolled and compacted sufficiently to support initial construction including civil/structural sub grade works.

An extensive programme of soft and hard landscaping will be undertaken in stages throughout construction works. An early phase of landscape planting will be undertaken following the initial cut and filling works to include planting of trees in selected sensitive areas. Early growth and development in these areas will promote a good screening of construction works into operational phase.

2.11.7 Commissioning Phase

Once the physical structures are in place, specialist contractors will be mobilised by Microsoft to complete the commissioning of the Colos and related plant. Commissioning is expected to take several months with Phase 1 being completed in mid-late 2015 at the earliest. As the construction phase will be complete prior to commissioning, site construction staff will be demobilised subject to the scheduling of Phase 2 construction works. Any hard landscaping and final soft landscaping will be completed.

2.11.8 Construction Schedule

As outlined above this application is for Phase 1 only. Phase 2 has not yet been scheduled. A summary of the proposed target dates (earliest possible dates) for Phase 1 are set out below.

- Application for Planning Permission - **December 2013**
- Commence Site Construction works (subject to planning permission) – **Mid April 2014**
- Complete Construction Works **– September 2015**
- Commence Commissioning Works **– June 2015**
- Complete Commissioning of Colo 1 **- End Q3 2015**
- Complete Commissioning of Colos 2-4 **- End 2015**

2.11.9 Construction Impacts

Each of the following EIS chapters (Chapters 3- 15) include an assessment of the potential impact of construction works on their individual environmental aspect and set out the relevant mitigation measures relating to that aspects. It is proposed that a Construction Environmental Management Plan be put in place by contractors to minimise the impact of all aspects of the construction works on the local environment. The CEMP will include emergency response procedures in the event of a spill, leak, fire or other environmental incident related to construction.

The primary impacts from construction are anticipated to include;

- Temporary impacts on the soils and geology of the site during construction i.e. some loss of protection of the underlying aquifer to contaminants during construction.
- Effects on the road network of the industrial estate and its environs due to construction workers and other staff attending site during preparation, construction and commissioning phases
- Impacts on the flora and fauna of the site i.e. removal of hedgerows and treelines for construction resulting in loss of habitat (minimised where possible)
- Impacts on the surface water network on site due to realignment of drainage systems
- Impacts on Human Beings in terms of nuisances relating to the air quality of the environs due to dust and other particulate matter generated from excavation works and impacts on the noise environment due to plant and equipment involved in construction. There is the potential for vibration impacts associated with rock breaking etc

Mitigation measures to address each of these potential impacts are presented in each individual EIS chapter.

At the time of production of this EIS, it is noted that a number of other construction projects are likely to occur on neighbouring sites at Grange Castle during 2014/2015. While these may occur during a similar timeframe as the proposed development, it is anticipated that the mitigation measures proposed above and for each of these projects will ensure no significant cumulative impact from the projects occurring within the estate at similar times.



AWN licence no. EN 0007513; Source: Aerial photo: Bing Maps

Note: Drawing is for illustrative purposes only; Do not scale

Project

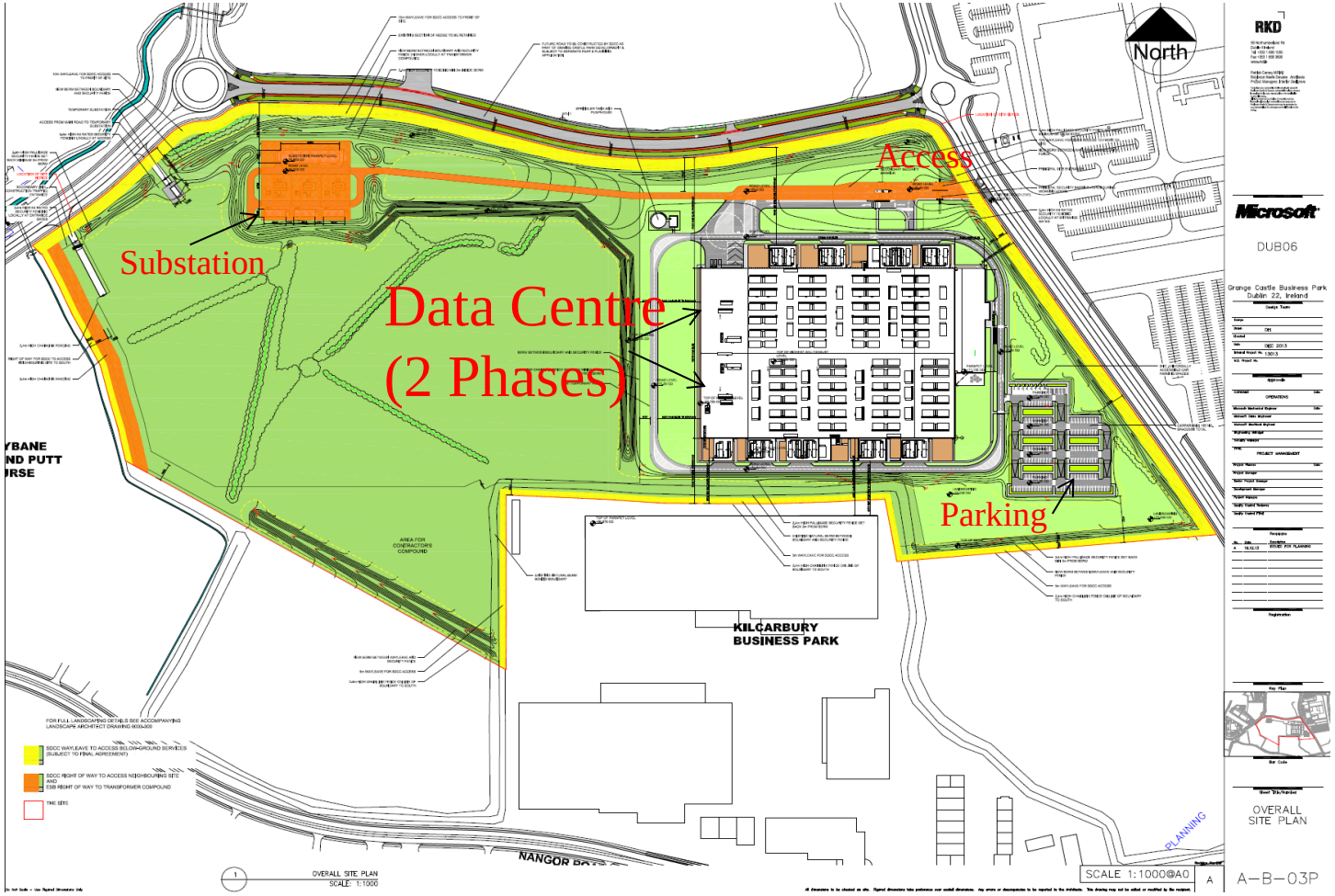
Environmental Impact Assessment for Proposed 35.2MW Data Centre for Microsoft Ireland at Grange Castle, Co Dublin

Figure 2.1

Site Location

awnconsulting

The Tecpro Building, Clonshaugh Business and Technology Park, Dublin 17
T: +353 1 847 4220 F: +353 1 847 4257



Project

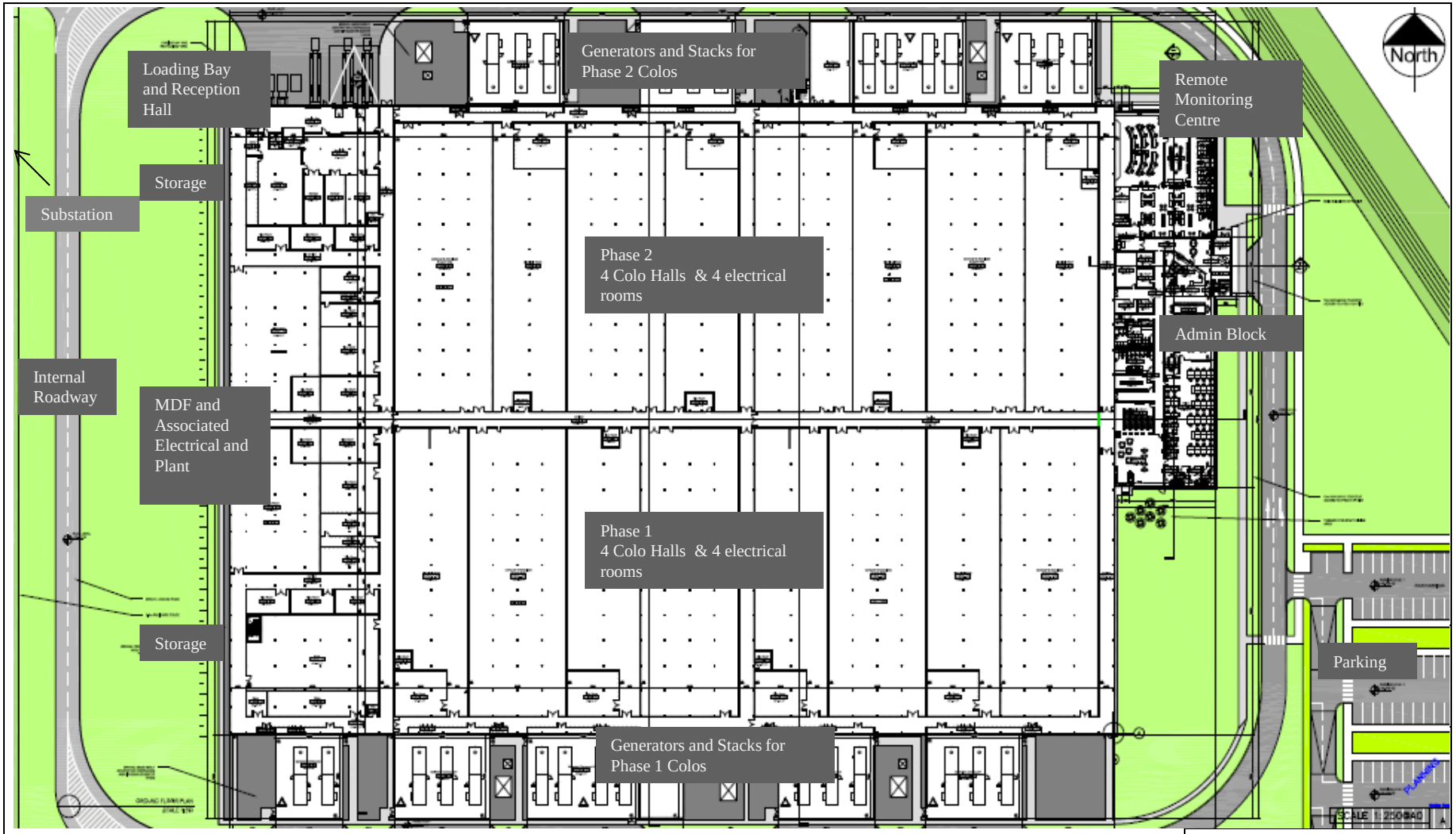
Environmental Impact Assessment for Proposed 35.2MW Data Centre for Microsoft Ireland at Grange Castle, Co Dublin

Figure 2.2a

Site Layout - Overview

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The Tecpro Building, Clonshaugh Business and Technology Park, Dublin 17
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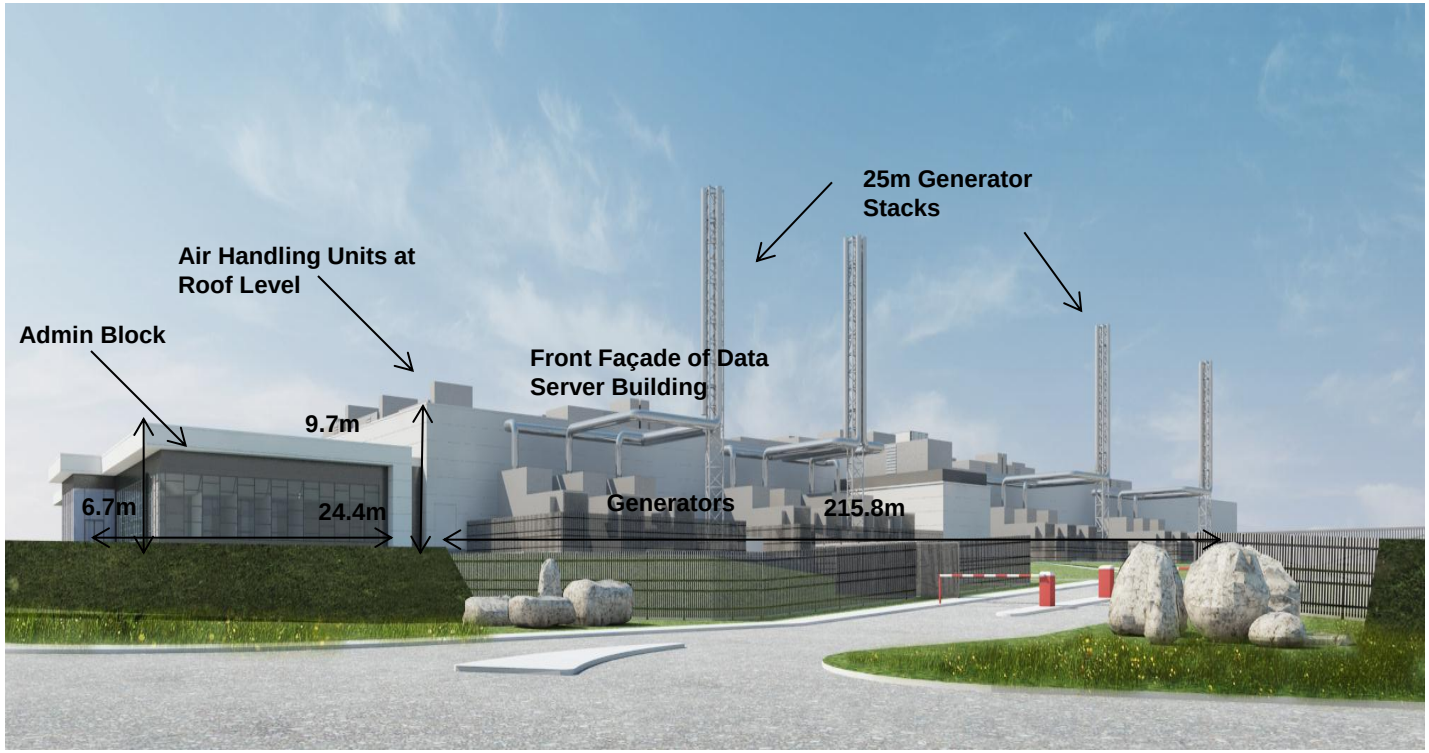
Environmental Impact Assessment for Proposed 35.2MW Data Centre for Microsoft Ireland at Grange Castle, Co Dublin

Figure 2.2b

Site Layout – Data Centre Phasing

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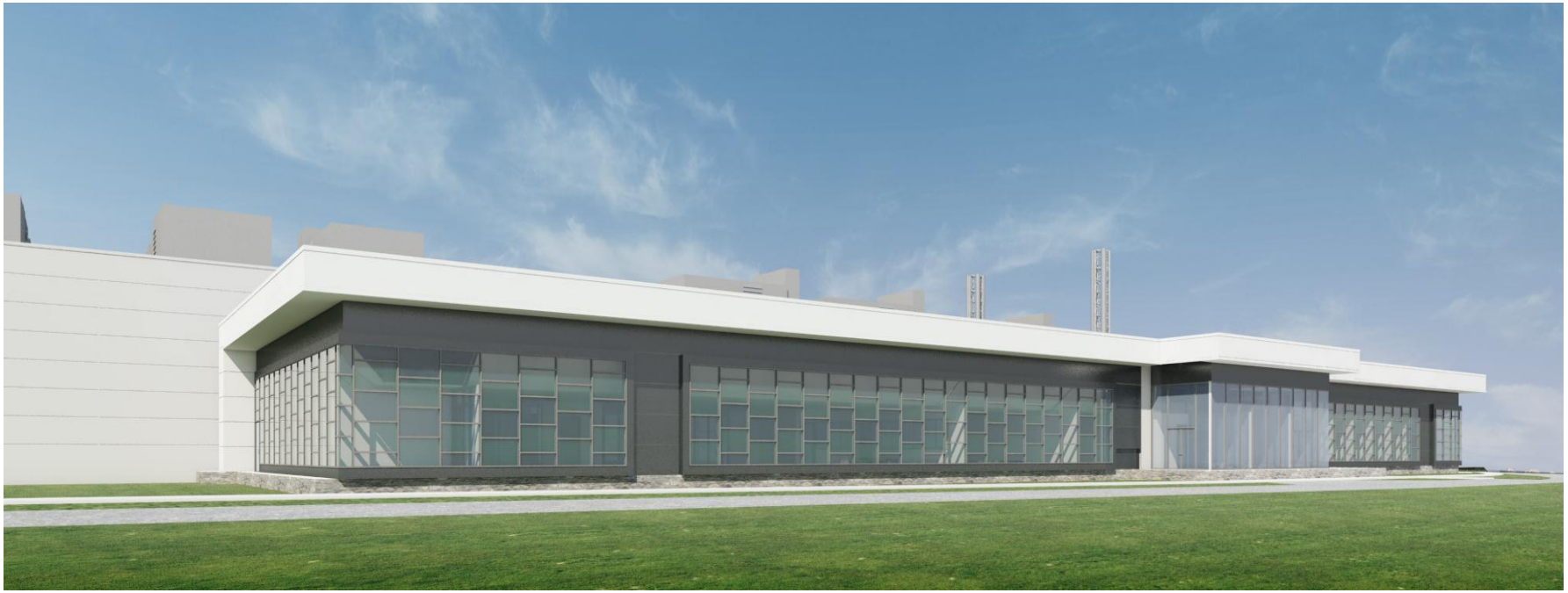
Environmental Impact Assessment for Proposed 35.2MW Data Centre for Microsoft Ireland at Grange Castle, Co Dublin

Figure 2.3

View of Proposed Plant from Access Road – Dimensions of Buildings and Structures (approx)

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Project

Environmental Impact Assessment for Proposed 35.2MW Data Centre for Microsoft Ireland at Grange Castle, Co Dublin

Figure 2.4

View of Proposed Administration Building

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The Tecpro Building, Clonshaugh Business and Technology Park, Dublin 17
T: +353 1 847 4220 F: +353 1 847 4257

3.0 PLANNING AND DEVELOPMENT CONTEXT

3.1 INTRODUCTION

This chapter describes the proposed development within the context of the relevant South Dublin County Council planning policy.

The Planning and Development Framework with which the development complies is defined by the:

- South Dublin County Council Development Plan 2010-2016
- Grange Castle Master Plan
- Grange Castle Local Area Plan

The following sections describe how the proposed development is in compliance with the stated and statutory requirements of South Dublin County Council with respect to planning and sustainable development.

3.2 SOUTH COUNTY DUBLIN DEVELOPMENT PLAN 2010-2016

The plan covers the administrative area of South County Dublin, which is 223 sq. Km in extent and is located approximately 16 Km south-west of the city-centre. The county extends from the Dublin Mountains to the River Liffey and includes Brittas, Clondalkin, Edmonstown, Lucan, Newcastle, Palmerstown, Rathcoole, Rathfarnham, Rockpool, Saggart, Tallaght and Templeogue.

Zoning

The proposed development is to be located within an area zoned EP2 (Enterprise Priority 2 Lands) with the stated aim of;

"To facilitate opportunities for high end manufacturing R&D facilities and light industry employment and related uses in industrial areas and business parks."

EP2 zoned areas are established economic industrial areas running essentially in an arc northwards from Citywest to Grange Castle.

Employment

It is the policy of the Council to facilitate economic development and the growth of employment in the county through support for objectives which promote economic, social, and cultural development and in assisting the provision of employment opportunities for all.

Specifically the development plan sets out South Dublin County Council's policies and objectives to;

"Provide for the future well being of the residents of the County by facilitating economic development and the growth of employment opportunities in all sectors in accordance with the principles of sustainable development."

Specifically in relation to Grange Castle SDCC state;

"The Council supports commercial and business development both indirectly by providing essential infrastructure and services, and directly by the provision of serviced and zoned lands. ***Grange Castle Business Park is considered one of the four parks nationally that is suitable for large scale Foreign Direct Investment (FDI).*** *To counteract global competition, particularly from Eastern Europe and Asia where there are lower labour and service costs, Grange Castle Business Park markets itself based on its strategic location and the quality of service that the Council and the Facilities Management Company can offer a client company. Grange Castle Business Park and the surrounding area were identified as an ideal location for the development of a "free trading zone" to cluster* ***mega data centres which would support international innovation and R&D centres****. These were a core component of the successful submission to 'Your Country Your Call' as part of the* ***Data Island Strategy****. The Council also played an active role in facilitating the establishment of two other data centres in Profile Park which is adjacent to Grange Castle Business Park. "*

Industry and Commerce

In particular with respect to industries and commerce, the plan contains specific policies and objectives which aim to '*ensure the orderly and sustainable development of the county through the setting out of zoning objectives for a variety of uses'*.

The area in which the proposed site is located lies within the functional area of South Dublin County Council. Under the Councils Development Plan, a variety of land use objectives are established for the area including specific location objectives for Grange Castle International Business Park. These objectives include providing for high quality developments, which are entirely appropriate to and fully compatible with the development of the Grange Castle Business Park.

Economic Clusters and Corridors are geographic concentrations of competing, complementary or interdependent firms and industries that may do business with each other and or have common needs for talent, technology and infrastructure and rely on the services of other cluster firms in the operation of their business.

Grange Castle and Citywest (Existing Established Industrial Areas) are cited as two particularly important areas for the creation of a cluster of high end economic development based around Foreign Direct Investment manufacturing and support industries. The positive characteristics of these areas is the availability of large plot sizes, infrastructures and heavily landscape corporate park models.

Environment and Conservation

In relation to the environment, the plan aims to '*provide a leadership role in relation to the control of air quality, noise and light pollution; and the sustainable management of waste through the council's own policy having regard to the European, National and Regional policies and implementation of solutions on waste minimisation, re-use and recycling so as to limit the financial and climatic impacts of waste disposal'.*

The main points included in the strategy of the council for the development of Environmental Services in the County during the period of this plan are summarised below;

- Conform to EU and National Waste Strategy in all matters relating to waste in the county.
- Purse solutions to achieve waste minimisation and re-use and recycle in line with the waste management hierarchy.
- Apply the 'polluter pays' policy.
- Cooperate with other agencies both private and public to coordinate waste management efforts.
- Encourage recycling of construction and demolition waste and recognise it's resource potential.
- Promote public education and awareness of environmental issues.
- Reduce the effects of air, noise and light pollution on environmental amenity.

3.3 SUSTAINABLE DEVELOPMENT

'Sustainable Development – A Strategy for Ireland' was published by the Department of the Environment in 1997. It provides analysis and a framework to ensure that development is undertaken in a sustainable manner. The strategy recognises that a considerable proportion of the industrial base in Ireland is made up of multi-nationals and these companies operate to high environmental standards.

The strategy aims to ensure that development is carried out sustainably and in an environmentally sound manner which includes; optimisation of natural resources, minimisation of waste, safe and sparing use of chemicals and the application of clean technology.

3.4 PLANNING PERMISSIONS

A number of Planning Applications have been made in Grange Castle Business Park in the last five years within the vicinity of the proposed development. These include applications by Microsoft, the neighbouring Takeda, IAWS (Aryzsta) facilties and the ESB. As part of the proposed development, account has been taken of planned developments in the area, as well as existing local land uses.

As referred to in Chapter 1, MI made an application for permission for a similar single storey data centre development at the site of the proposed development in July 2013. The facility was granted permission in September 2013.

Table 3.1 Recent Planning Applications to SDCC (search conducted 4/12/13)

South Dublin County Council Planning Application Reference No. & Applicant	Development Description	Location of Development	Decision Date
SD13A/0186 Grifols Worldwide Operations Ltd	Construction of a warehouse, distribution, packaging and logistics over two floors with a 3 storey administration and laboratory building	Grange Castle Business Park, Dublin 22 (North of Business Park)	Granted 1st November 2013
SD13A/0143 Microsoft Ireland Operations Ltd	Construction of a single storey data centre with plant at roof level which comprises the following uses; office, computer and associated support areas, electrical component rooms, plant and associated equipment and new three string 110Kv transformer of 974 sq.m	Grange Castle Business Park, Dublin 22 (Centre of Business Park)	Granted 9th September 2013

SD13A/0107 Takeda Ireland Ltd.	257sq.m Extension to existing warehouse and car parks	Takeda Ireland Limited, Grange Castle Business Park, Dublin 22 (North West of Business Park)	Granted 24/7/13
SD12A/0073 Takeda Ireland Ltd.	Construction of a waste water treatment plant to include a control room, 5 no. storage tanks, pipe rack, & a paved access road.	Takeda Ireland Limited, Grange Castle Business Park, Dublin 22 (North West of Business Park)	Granted 25/9/12
SD12A/0024 ESB	Alterations to existing Station consisting of extension to control building, 1 no. mobile MV module, 1 no. power transformer, neutral earth resistor, surge arresters, current transformer, circuit breakers, busbar disconnect and associated site works. All at ESB Grange Castle 110kV electrical transformer station	Grange Castle Business Park, Nangor Road, Clondalkin, Dublin 22. (North of Business Park)	Granted 8//512
SD11A/0211 Microsoft Operations Ireland Ltd	Construction of a single storey data centre with associated infrastructure including office, loading, storage, customer support and ancillary roads parking, drainage and landscaping	Grange Castle Business Park, Nangor Road, Clondalkin, Dublin 22. (West of Business Park)	Granted 17/11/11
SD11A/0121 Elume Ltd	Change of use of existing warehouse facility to an electronic technology facility including modifications to the existing structure	Units 502 and 503, Southgate, Profile Park, Grange Castle Dublin 22. • South of Grange Business Park	Granted 2/8/11
SD09A/0467 Takeda Ireland Ltd	2 storey extension to existing admin building internal rearrangement and additional parking and landscaping	Takeda Ireland Limited, Grange Castle Business Park, Dublin 22 (North West of Business Park)	Granted 18/3/10
SD09A/0466 Takeda Ireland Ltd	2 storey modular office building and all associated site works above and below ground	Takeda Ireland Limited, Grange Castle Business Park, Dublin 22 (North West of Business Park)	Granted 24/6/10
SD09A/0376 Microsoft Operations Ireland Ltd	Modifications to previously approved planning reference numbers SD07A/0632 and SD08A/0496	Grange Castle Business Park, Nangor Road, Clondalkin, Dublin 22. (West of Business Park)	Granted 12/1/10
SD08A/0630 IAWS Group	Alterations to previously approved reg ref SD)6A/0527 and SD07A/0702	Grange Castle Business Park, Nangor Road, Clondalkin, Dublin 22. (West of Business Park)	Granted 11/12/2008
SD08A/0496 Microsoft Operations	Modifications to previously approved ref ref SD07A/0632	Grange Castle Business Park, Nangor Road, Clondalkin, Dublin 22.	Granted 21/10/2008

Ireland Ltd		(West of Business Park)	
SD07A/0632 Microsoft Operations Ireland Ltd	Construction in 2 phases of 2 storey data centre with plant at roof level comprising offices, computer and associated support and workshop areas loading docks, storage and ancillary infrastructure, parking and landscaping	Grange Castle Business Park, Nangor Road, Clondalkin, Dublin 22. (West of Business Park)	Granted 26/10/2007

3.5 CONSULTATION WITH SOUTH DUBLIN COUNTY COUNCIL PLANNING DEPT

During the course of the preparation of this application, South Dublin County Council were kind enough to facilitate a series of pre-planning meetings where a range of issues were discussed. This included a discussion of the scale, nature and extent of the development to ensure the requirements of the Local Authority were incorporated into the design of the facility.

3.6 CONCLUSIONS

The proposed development will be in keeping with all of the aspects of the relevant policy documents described above, in that it is situated on suitably zoned lands in an industrial area in Southwest Dublin. Furthermore the development will minimise the potential environmental impacts as described in various chapters of this EIS.

South Dublin County Councils stated policies and objectives to conserve, protect and enhance the environmental resources and assets of the region will not be contravened by the proposed development. Specific details of potential impacts in relation to these resources are dealt with in the relevant chapters within this EIS.

In conclusion it can be stated that the proposed development complies fully with the stated requirements of SDCC and will be a strategic asset in the continued economic recovery of the Dublin area.

4.0 ALTERNATIVES

4.1 INTRODUCTION

EIA legislation and prevailing guidelines and best practice require that Environmental Impact Statements consider for EIA projects with regard to their environmental effects including;

- Alternative project locations;
- Alternative designs/layouts;
- Alternative processes;

This chapter describes the alternatives that were considered for the proposed development under each of these headings and the reasons for the selection of the preferred options.

4.2 ALTERNATIVE PROJECT LOCATIONS

At the outset of the project, MI undertook a detailed assessment of a number of sites towards determining the most appropriate location to establish the proposed Data Server facility. This evaluation was conducted on two levels;

- Selection of Preferred Country Location
- Selection of Preferred Site Location

The selection of Ireland as the preferred country location for this development was based largely on climatic conditions and strategic business considerations. As has been well documented, due to the relatively cool climate in Ireland, data centre equipment requires significantly less cooling in Ireland. As a result data centres here require far less air conditioning and temperature control systems which have a high power demand (and cost).

Having selected Ireland as the preferred country location for the data server facility, a detailed process of site selection was undertaken on a number of sites throughout Ireland. In total 6 candidate sites (including the selected site at Grange Castle) were considered and assessed based on the following primary criteria;

Environmental Considerations

- Site capacity to minimise visual impact of the development
- Site capacity to manage impact on local traffic
- Site capacity to minimise impact on Heritage, Flora and Fauna
- High standard of existing local air quality
- High standard of local water quality and availability of supply
- Clean soil and groundwater profile
- Elevation above sea level, natural disaster risk etc

Development Considerations

- Availability of necessary land type and quantity of lands (including cost)
- Appropriate site zoning and development objectives
- Site free from restrictive development constraints such as wayleaves, archaeological features etc
- Proximity to unsuitable neighbouring activities (heavy industry, airports etc)
- Good site access and road network capacity
- Suitable ground conditions to accommodate buildings
- Access to local emergency services including fire services

Infrastructural Developments

- Availability of suitable Electrical Power Supply
- High quality Telecommunications Services
- Potable Water Supply
- Foul Sewer network capacity
- Storm Sewer network capacity

Having undertaken this assessment it was concluded that the chosen site at Grange Castle International Business park met the highest proportion of the necessary criteria of the 6 candidate sites.

Particular advantages of the preferred site at Grange Castle included;

- Availability of suitable Power Supply and infrastructure
- Suitable zoning
- Site specifically designed for large scale industrial activities with good water, wastewater and road access

4.3 ALTERNATIVE DESIGN/LAYOUTS

The team under the direction of RKD Architects have carried out a number of studies for the overall utilization of the sites being purchased by MI for the proposed development. Albeit that no one can predict the development and deployment of data centres as they become ever more efficient and effective in the delivery of remote data services, a number of alternatives for the site have been considered.

In these appraisals it became apparent that the most effective location for the first of any developments on the site would be to the east end of the site and not the west. This was based on the following non-exhaustive list of considerations:-

a) Location of the development to the west of the site could lead to congestions of traffic with multiple Microsoft data centres having entrances opposite one another. As well as the associated security risk to the facilities in having a single point of failure for access if a traffic incident should occur at the common junction.

b) The topography of the site lent itself to development from the east to the west i.e. down the hill will allow for the maximum excavation spoil to be maintained on the site – rather than up a hill (a total rise of 7M occurs across the site rising from the northwest toward the southeast) and removal of vast quantities of spoil off the site. The final floor level of the proposed development at 71mOD will minimize the amount of excavation/rock breaking etc and cutting into the hill required during the construction of the proposed development.

c) The architectural aspect of being able to place the office area and the most featured element on the prow of the hill rather than in a valley with its back turned on all the surrounding elevations.

d) By starting on the eastern end of the site, the use of the existing Grange Castle Business Park Attenuation ponds could be utilised – thus avoiding the construction and associated environmental impacts of creating attenuation ponds on the site.

e) The development will be furthest away from any residential neighbours if located to the east of the site.

f) While developing the design for the facility and its layout, MI and the design team are cogniscent of the fact that there may be a requirement for further data centre facilities at Grange Castle in the future. The proposed site and the proposed

location and orientation of the plant allows sufficient space to accommodate at least some of that future demand should it be required.

The evaluation of the options available concluded that the preferred buildings arrangement for the Grange Castle site is as proposed (shown on the drawings accompanying the EIS).

4.4 ALTERNATIVES PROCESSES

In terms of the proposed technology while the proposed data servers are state of the art data storage technology, this technology is essentially the same data server technology used by Microsoft Corp. and replicated at its many data centres around the world. MI continues to assess and implement methods to improve this technology but at present there are limited alternative processes/technologies available to the proposed facility.

4.5 CONCLUSIONS

The preferred site is an excellent location for a proposed data centre from both an environmental perspective and a planning perspective. The site has all of the required infrastructure readily available resulting in minimal disruption to adjacent site users and nearby sensitive receptors.

The siting of the proposed facility at Grange Castle and its design and orientation have been selected based on a suitably comprehensive assessment of alternative site locations and designs.

If the proposed facility were not to proceed on the selected site, then it is likely that another alternative industry will be established on the site in accordance with the zoning policy of the lands. It is considered that the proposed site is highly suitable for a data centre site.

5.0 HUMAN BEINGS

5.1 INTRODUCTION

This chapter evaluates the impacts if any, of the proposed development on Human Beings as defined in the EPA Advice Notes on Current Practice (in the preparation of Environmental Impact Statements), 2003. In accordance with the above guidance, this chapter has considered the 'existence, activities and well- being of people' with respect to 'topics which are manifested in the environment such as new land-uses, more buildings or greater emissions'. Issues examined in this section include:

- Demography
- Population
- Employment
- Natural Resources
- Landscape Amenity and Tourism
- Social Infrastructure

Further discussion of these issues follows below.

The impacts of other environmental aspects associated with the project which may be human related such as noise and vibration, traffic, visual impact and air quality are discussed in the relevant chapters of this EIS.

5.2 METHODOLOGY

The effects of the proposed development on the human environment in its surrounding areas are analysed in compliance with the requirement of "Guidelines on the Information to be contained in Environmental Impact Statements" EPA, 2002 and "Advice Notes on Current Practice (in preparation of Environmental Impact Statements)" EPA, 2003.

Public bodies including the Central Statistics Office (CSO) and South Dublin County Council (SDCC) have been consulted to gather relevant information in relation to, employment statistics, demographic statistics and community aspects.

5.3 EXISTING ENVIRONMENT

The proposed development will be located at a green field site in Grange Castle International Business Park in Clondalkin, West Dublin. The Business Park is situated 1km west of Clondalkin village on the outskirts of Dublin City (10km south west of the city centre), approximately 16 km south of Dublin International Airport. Nearby towns and villages include Lucan 2.5 km to the north, Tallaght 3 km to the south east, Saggart 4 km to the south west, Newcastle 3 km to the west, all within South County Dublin and Leixlip, Co. Kildare 6 km to the North West.

5.3.1 Land Uses in the Environs of the Site

Grange Castle International Business Park is already home to several industrial facilities and comprises a number of different land uses (See Figure 5.1) These include two large biotechnology facility campuses – Pfizer Ireland and Takeda Pharma Ireland Ltd. Microsoft's existing data centres (DUB03 - DUB05) are located within the Business park to the west and in close proximity to the site of the proposed development. In 2008 Aryzta AG (Cuisine de France) began production at their purpose built food facility located west of the proposed development site in the

business park. Grange Castle Golf Course and its facility management building are located adjacent to the Park Milltown Business and Technology Park is located south of the Grange Castle Business park just across the Nangor road.

Planning permission has recently been granted to Grifols Worldwide Operations Ltd for a biopharmaceutical facility to the north of the proposed development. At the time of writing it is unclear as to when the facility will be constructed. A link road between the site of the proposed development and the proposed Grifols development is currently under construction. It will be completed in March 2014.

Other land uses adjacent to the business park and in the immediate surrounding area include; Kilcarberry Business Park to the south east; Ballybane "Footgolf" course to the south; agricultural lands including, Clutterland and Miltown to the south west in the vicinity of Polly Hops Pub; an area of land north of the Grand canal, currently used for amenity and agricultural purposes; and agricultural land to the south of the aforementioned Golf Course.

The area has excellent transport infrastructure due to its strategic location on the outskirts of the Greater Dublin Area. The Business Park lies between the N4 and N7 National Primary Routes and approximately 7 km to the west of the M50 motorway. The Nangor Road and the R136 Outer Ring Road provide access to the Grange Castle Business Park. The N7 can then be accessed by way of the R136. The site is also close to the mainline rail connections to the West and South of Ireland and enjoys easy access to Dublin Airport and Dublin Port.

5.3.2 The Wider Community

The demography of the population in the Grange Castle and surrounding areas is described in this report in order to ascertain the potential effects of the project on the wider community. Population attributes which are studied include population numbers, age profile including dependency, employment profile and social class.

This data is gathered from the following documents which are available from the Central Statistics Office (CSO); 2011 and 2006 censuses, Quarterly National Household Surveys.

5.3.3 Census

The most recent census of population was carried out by the CSO on the 10th of April 2011. The previous census was completed on the 23rd April 2006. The census compiles data for the whole state as well as smaller individual areas including counties, cities, towns and electoral divisions. Taking into consideration the location of the proposed development the census information on population, age profile, employment and social class, has been analysed in relation to the Dublin Region and County South Dublin.

POPULATION

Table 1 below shows that Dublin is a moderate growth population region. Significant population growth has occurred between the census years of 2011 and 2006, with a similar level of this growth occurring in the South Dublin County area. Nationwide and Dublin population projections indicate this trend of high population growth is to continue into the short term future, regardless of population patterns elsewhere in the state.

Table 1 Population Change at State, Primary and Secondary Hinterland Level

Area	2006	2011	% Change 2006-2011
State	4,239,848	4,588,252	+8.2
South Dublin	246,935	265,205	+6.9
Dublin Region	1,187,176	1,273,069	+6.7

Over the five year period from 2006 to 2011 the population of the state grew by approximately 8.2%, while the population of the Dublin and South Dublin Region increased by approximately 6.7% and 6.9% respectively. The South County Dublin suburbs have been among the fastest growing areas in Dublin in recent years and these figures reflect the economic role of this area in Dublin.

AGE PROFILE

The age profile of the population in the affected area is an important parameter as it provides a good insight into the potential labour force, the demand for schools, amenities and other facilities and the future housing demand.

Tables 2 and 3 below show the age profiles for the state, Primary (South Dublin County) and Secondary (County Dublin) hinterlands of the proposed development for 2006 and 2011 respectively. This allows comparison of the changes in the population profile between the years.

Table 2 Age Profile at State, Primary and Secondary Hinterland Level, 2011

	0-14	15-24	25-44	45-64	65+	Total Persons
State	21%	13%	31%	23%	12%	4,588,252
South Dublin	20%	13%	33%	22%	9%	265,205
Dublin Region	19%	14%	35%	21%	11%	1,273,069

Table3 Age Profile at State, Primary and Secondary Hinterland Level, 2006

	0-14	15-24	25-44	45-64	65+	Total Persons
State	21%	16%	33%	18%	11%	4,239,484
South Dublin	22%	16%	33%	22%	7%	246,935
Dublin Region	18%	16%	35%	21%	10%	1,187,176

Table 3 shows that the age profile of the population of the Dublin Region in 2011 revealed a slightly lower percentage within the 0-14 age group, at 18% compared with the state average which of 21%. South Dublin recorded a higher again figure compared to County Dublin and the state figures, at 22%. The older generation of the 65+ population makes up just 11% of the population in 2011, with the County Dublin and South Dublin being lower again at 10% and 7% respectively. These population statistics indicate a very youthful population in the area which can be seen as a direct effect of the recent arrival of a sizeable percentage of the resident population

Similar figures and Trends can be seen for the population in 2006 in Table 3. From Table 2 it can be seen that the percentage of people in the County Dublin area within working age groups (14-64) amounted to 72% in 2006 compared to the national average of 67% at that time. This cohort measured 66% of the population in the South Dublin region, again showing the youthful population living there, which increases the pool of labour force available in the area. Comparing these numbers to 2011, we can see there was a slight decrease in the working age population, making up 70% of the total population in the Dublin Region. However in the South Dublin Region, this percentage rose from 66% in 2006 to and 76% in 2011. Again these figures reflect the largely youthful population of working age residing in this area.

While the volatility of migration makes it difficult to make accurate estimations on future population changes, indications are that population in the primary and secondary hinterlands of this proposed site will continue to rise.

Due to the recent expansion of the Dublin Metropolitan Region, the area in question has experienced sustained population growth over the past number of years. Strong rates of population growth in the hinterland of the proposed development site mean there will be increasing job opportunities and the continuing expansion of the Dublin Region.

EMPLOYMENT

Table four describes the employment statistics for the South Dublin Region. It can be seen that there has been a significant rise in unemployment in both the South Dublin area and in the State as a whole between 2006 and 2011.

Table 2 Employment Statistics for Vicinity of Proposed Development

2011 – Labour Force					
	At Work	**Looking for first regular job**	**Unemployed having lost of given up previous job**	**Total in Labour Force**	**% Unemployment**
State	1807360	34166	390677	3608662	11.8%
South Dublin	106,534	2361	23678	203924	12.8%
2006 - Labour Force					
	At Work	**Looking for first regular job**	**Unemployed having lost of given up previous job**	**Total in Labour Force**	**% Unemployment**
State	1930042	29372	150084	3375399	5%
South Dublin	119280	1771	9988	193355	6%

Table 5 below shows the division of the population of South County Dublin into different socio-economic classes in 2006 and 2011. This categorisation indicates the type of employment that the work force in that area is employed in or is capable of being employed in. The data suggests that in terms of labour force, the South Dublin area has a significant requirement for and is capable of supporting industries with a need for professional, managerial and skilled employees.

Table 3 Population of South Dublin by Socio-Economic Group

Socio-economic group of reference person	**2011**	**2006**
Employers and managers	45469	43002
Higher professional	15887	14235
Lower professional	28431	22978
Non-manual	54014	48507
Manual skilled	28132	28446
Semi-skilled	22437	21315
Unskilled	8,865	8009
Own account workers	17009	14966
Farmers	378	411
Agricultural workers	246	137
All others gainfully occupied and unknown	42855	40954
Total	263723	242960

5.3.4 Quarterly National Household Survey

The Quarterly National household's survey is a large-scale, nationwide survey of households in Ireland in which 39,000 households are surveyed each quarter.

It generates quarterly labour force estimates that include the official measure of employment and unemployment for the state. The results of the most recent Quarterly survey which was published on May 30 2013 for the first quarter of 2013 are quoted below.

MAIN RESULTS

In the state as a whole there were 1,845,600 people in employment and 292,000 people unemployed in Q1, 2013 totalling to a labour force of 2,137,500. This represents increases in employment of 1.1% over the year to Q1 2013. However there was a decrease of -0.4% seen in the total workforce.

These figures are compared to the latest available figures for all EU-27 countries which date to Q4 2012. Over the year to Q4 2012, the employment rate in Ireland grew by 0.3% to 59.3%. The comparable figure for this in the EU-27 declined by 0.1% to 64.2% over the same period.

5.3.5 Summary

By comparing the figures for the 2006 and 2011 it can be seen that unemployment in Ireland has grown significantly during this period. However this rate of unemployment is lower in the South County Dublin area which has a more skilled workforce due to it being more densely populated than the rest of the country. The preceding data indicates that employment in Ireland is beginning to grow again at a slow but steady rate with employment figures for the State increasing from 1807360 in the 2011 National census to 1,845,600 in the first Quarterly household survey of 2013. The most recent statistical data from the QNHS 2013 indicates that the national labour force of Ireland is increasing at a slow rate compared to that of the EU-27 which is decreasing.

5.4 NATURAL RESOURCES

Natural resources and land uses in the hinterland of the proposed site have also been considered as they may have implications for the development of the lands.

Overall lands to the west of the area are mostly in agricultural use while land in the eastern direction has been developed for suburban housing towards Dublin.

In terms of extractive industries, there are a number of rock and gravel quarries in the west Dublin area. These quarries will play a role in supplying materials for the construction of the development but there is unlikely to be any negative impact in terms of natural resources as a result of the proposed development.

5.5 LANDSCAPE AMENITY &TOURISM

As mentioned above the proposed development will be located in a largely built up urban area where industrial activities are the main activity. Tourism is not a major industry in the immediate environs of the site. The wider area does contain a small number of hotels and other tourist accommodation (B&B's etc.) which generally increases towards the East in the direction of Dublin city and its many tourist sites.

In terms of Landscape amenity, SDCC recognise that the landscape, natural heritage and amenities of South County Dublin have an important role to play in contributing to a high quality of life for residents and a positive experience for visitors.

The primary areas of landscape amenity in the South Dublin region are the Dublin Mountains and Liffey Valley areas. As the proposed development is located between these two areas in an area designed for industrial land use, it is considered that the impact on landscape amenity has been minimised as much as possible. Further discussion of impact on Landscape amenity is presented in Chapter 11 Landscape and Visual.

5.6 SOCIAL INFRASTRUCTURE

Residential Dwellings
Residential development in the immediate Grange Castle Area is sparse. There are a number of residential properties along the regional roads R120 and R134 between the Business Park and other parts of west Dublin and Kildare. Clondalkin village is the most densely populated settlement in the environs of the site, located c.2km to the east.

Education
There are no schools in the immediate environs of the site. The population of the surrounding areas is serviced by schools in the surrounding villages and towns of Clondalkin, Lucan, Tallaght and Rathcoole.

Health
The nearest hospital to the facility is located at the Adelaide and Meath Hospital incorporating the National Childrens Hospital, Tallaght, Dublin 24.

Security
There is a garda station in Clondalkin and fire station at Belgard Road, Tallaght Dublin 24. Grange Castle International Business Park has 24 hour on site security.

Local Water Supply and Services
All dwellings in the area are connected to the SDCC public water supply and foul and storm drain network.

5.7 IMPACT ASSESSMENT

5.7.1 Impacts on Local Businesses and Residences

The two main potential impacts on local residences and businesses associated with the proposed development will be in relation to noise and visual impact. The two impacts are dealt with in the corresponding chapters of this EIS as follows:

- Chapter 10 – Noise & Vibration
- Chapter 11 – Landscape & Visual Impact

It's likely that the proposed facility will create some demand for additional housing for its employees. The workforce will be drawn from a wide geographical area and therefore it is not likely to have any direct impact on the population of the hinterlands. However, it is expected that the proposed development will have effects on employment in relation to both direct employment from the facility itself and indirect

employment created by the multiplier effect. The high degree of accessibility of the site will mean the beneficial impacts of the development will be spread over a wider geographical area.

5.7.2 Impacts on the Wider Community

Construction Phase

It is expected the construction of the proposed development will take approximately 18-24 months for phase 1 (up to and including commissioning), although this will be subject to planning permission process.

The proposed project will have a positive socio-economic impact by providing both direct and in-direct employment in the area. It is expected 250 jobs will be created in direct employment for the construction of the development, with a peak of 400 construction jobs.

Indirect employment and extra custom will be provided to the service industries in the local area that will benefit hugely from this surge of construction workers. It is expected that supplies and services will be locally sourced, where feasible, which will in turn maximise the positive socio-economic impact in the locality. Also it is expected that wages paid to construction workers in this area will be spent in this area and recirculate the wealth supporting local business and development.

The construction phase may also cause an increase in demand for temporary accommodation in the surrounding areas, again benefiting the hospitality sector in the local economy.

Operational Phase

In general the proposed development will have a significant positive impact on the human environment in this area and its surrounding region by providing both temporary and permanent employment and contributing to the local economy.

The operation of the new facility will be expected to provide c.150 new jobs. Again these people may come from the immediate hinterland or may immigrate to the area in search of employment.

A prediction of the location of residence of new employees to the facility isn't possible but it is likely that they will stay within a 30 km radius of the facility in an area roughly stretching from West Kildare to throughout the Dublin Region.

Additional housing demand may arise from the proposed development, the effects of which will be dispersed over a wide area. Due to this housing demand being dispersed it is expect that it will not create any adverse housing impact.

5.7.3 Impacts on Health and Safety

Any potential health and safety risks to people living and working in the vicinity of the proposed construction works and operational plant have been given due consideration within a number of Chapters of this EIS as follows:

- Chapter 6 – Traffic & Transportation
- Chapter 9 – Noise & Vibration
- Chapter 10 – Air Quality
- Chapter 12- Waste Management

This section considers any additional health and safety risks to the human environment which may arise from the proposed development.

Construction Phase

There are many potential health and safety risks arising from the construction phase due to the use of large, mobile machinery and heavy equipment and materials Mitigation measures which will be taken to reduce these risks are described in section 5.8.

Operational Phase

The equipment and materials present during operation at the site will determine the risks to health and safety that may occur during this phase. As the proposed facility is a data server center, the main equipment at the site during the operational phase will be I.T service related which, other than its power connections, do not typically introduce significant risk hazards. There will be no operator exposure concerns as there will be no production materials generated on site. The proposed facility has been designed to the highest standard with safety as a key priority so there will be little risk of fires or other related events. Mitigation measures are included in section 5.8.

5.7.4 Impacts on Local Amenities and Tourism

There are a range of local amenities in the area of the proposed development including; Grange Castle Golf Course, Ballybane Pitch & Putt course and the Grand Canal Way – used for boating, fishing and walking.

One way in which local amenities may be impacted is through a higher level of usage but these are thought to be neutral impacts. There will be no impact on the amenity value of the Grand Canal as it is over 200m away.

5.8 MITIGATION MEASURES

The previous sections have outlined the potential impacts of the proposed development on humans and related aspects such as noise, air quality and landscape/visual impact. The potential impact of these aspects and their associated mitigation measures are dealt with in the corresponding chapters of this EIS. Of the remaining potential impacts relating to the human environment only concerning Health and Safety require mitigation measures. These are outlined in the following sections.

5.8.1 Construction Phase Health and Safety

In accordance with the Safety, Health, and Welfare at Work (Construction) Regulations, 2006 (SI No. 504 of 2006), a safety management system will be put in place on-site to minimise any risks to both construction personnel and site visitors. The site will not be accessible to the public and will have strict procedures in place for allowing entrance to visitors and contractors.

5.8.2 Operational Phase Health and Safety

The operation of the proposed facility will be carried out in strict accordance with all Irish and European regulations governing safety in the work place with specific regard to the regulations implemented under the Safety, Health & Welfare at Work Act, 2005;

The building construction will comply with the building regulations and insurer' requirements;

Full relevant training in the operating procedures for equipment and processes will be provided to each employee;

In the case of a fire the extensive building sprinkler systems will come into operation and necessary personnel will be fully trained to deal with such emergencies. Also, the buildings have been designed so that any fire will be contained within its zone by a fire wall in order to prevent it spreading and therefore any damage and impact will be localised.

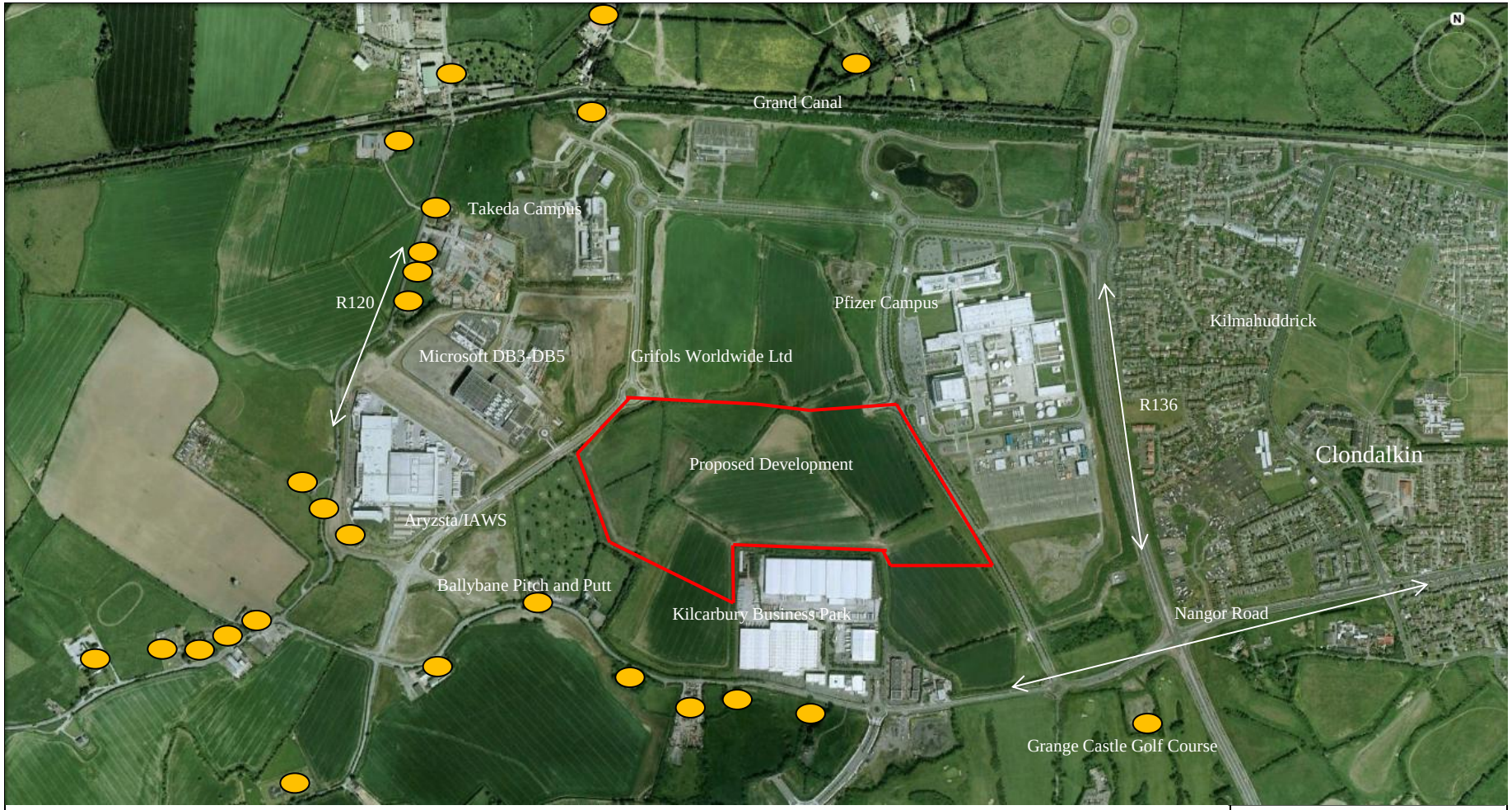
5.9 RESIDUAL IMPACTS

It is expected the proposed development will have a positive long term impact on the immediate hinterland and the Dublin Region through continued expanding employment and the associated economic and social benefits.

5.10 CONCLUSIONS

There will be no significant adverse impact on the human environment from the proposed development. It will have a significant positive impact in terms of creating direct and indirect employment opportunities for both people already living in the area and people living in a wider geographical area.

There will be no significant adverse impacts with respect to socio-economic factors, land-use, or the amenity value and tourism potential of the area. Health and Safety issues which may cause risks and hazards during the construction and operational phase of the development will be given due consideration. All necessary mitigation measures will be put in place to ensure the health and safety of all site personnel. All other environmental aspects relating to the human environment which could have an adverse impact on the local population such as noise, air & water and visual impacts have been addressed in the relevant chapters of this EIS.



Approx Site Boundary

Dwellings/Commercial Properties

Scale 1:15000 approx

awnconsulting

The Tecpro Building, Clonshaugh Business and Technology Park, Dublin 17
T: +353 1 847 4220 F: +353 1 847 4257

Project

Environmental Impact Assessment for Proposed 35.2MW Data Centre for Microsoft Ireland at Grange Castle, Co Dublin

Figure 5.1

Land Use in the Environs of the Site

6.0 SOILS, GEOLOGY & HYDROGEOLOGY

6.1 INTRODUCTION

The proposed Microsoft Ireland Data Server Centre is to be located on a Greenfield site within the Grange Castle International Business Park in Clondalkin (Figure 1.1), AWN Consulting has prepared this chapter of the EIS which assesses and evaluates the potential impacts on the soil, geological and hydrogeological aspects of the site and surrounding area.

In assessing likely potential and predicted impacts, account is taken of both the importance of the attributes and the predicted scale and duration of the likely impacts.

6.2 METHODOLOGY

6.2.1 Appraisal Methodology

The appraisal methodology for the EIS is completed in accordance with the EPA '*Guidelines on the Information to be contained in Environmental Impact Statements'* (EPA, 2002). The EPA document entitled '*Advice Notes on Current Practice in the Preparation of Environmental Impact Statements'* (EPA, 2003) is also followed in this geological assessment and classification of environmental impacts. Due consideration is also given to the guidelines provided by the Institute of Geologists of Ireland (IGI) in the document entitled '*Geology in Environmental Impact Statements, a Guide'*, (IGI, 2002) and *Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements* (IGI 2013 (in preparation)).

In addition, the document entitled '*Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes'* by the National Roads Authority (NRA, 2009) is referenced where the methodology for assessment of impact is appropriate

The rating of potential environmental impacts on the soils and geology environment is based on the matrix presented in Table 6.1 below which takes account of the quality, significance, duration and type of impact characteristic identified.

In the EIS assessment, consideration is given to both the importance of an attribute and the magnitude of the potential environmental impacts of the proposed activities on that cited attribute. These impact ratings presented in Table 6.1 below are in accordance with impact assessment criteria provided in the EPA (2002) publication.

Impact Characteristic	Term	Description
Quality	Positive	A change which improves the quality of the environment
	Neutral	A change which does not affect the quality of the environment
	Negative	A change which reduces the quality of the environment
Significance	Imperceptible	An impact capable of measurement but without noticeable consequences
	Slight	An impact which causes noticeable changes in the character

		of the environment without affecting its sensitivities
	Moderate	An impact that alters the character of the environment in a manner consistent with existing and emerging trends
	Significant	An impact, which by its character, magnitude, duration or intensity alters a sensitive aspect of the environment
	Profound	An impact which obliterates sensitive characteristics
Duration	Short-term	Impact lasting one to seven years
	Medium-term	Impact lasting seven to fifteen years
	Long-term	Impact lasting fifteen to sixty years
	Permanent	Impact lasting over sixty years
	Temporary	Impact lasting for one year or less
Type	Cumulative	The addition of many small impacts to create one larger, more significant impact
	'Do Nothing'	The environment as it would be in the future should no development of any kind be carried out
	Indeterminable	When the full consequences of a change in the environment cannot be described
	Irreversible	When the character, distinctiveness, diversity, or reproductive capacity of an environment is not permanently lost
	Residual	Degree of environmental change that will occur after the proposed mitigation measures have taken effect
	Synergistic	Where the resultant impact is of greater significance than the sum of its constituents
	'Worst Case'	The impacts arising from a development in the case where the mitigation measures may substantially fail

Table 6.1 Glossary of Impacts following EPA Guidance Documents

The duration of each impact is considered to be either temporary, short-term, medium term, long-term, or a permanent impact. Temporary impacts are considered to be those which are construction related and last less than one year. Short term impacts were seen as impacts lasting one to seven years; medium-term impacts lasting seven to fifteen years; long-term impacts lasting fifteen to sixty years; and permanent impacts lasting over sixty years.

The NRA criteria for rating the magnitude and significance of impacts at EIA stage on the geological related attributes are also relevant in determining impact assessment and area presented in Table 6.2 below.

Magnitude of Impact	**Criteria**	**Typical Examples**
Large Adverse	Results in loss of attribute	Loss of high proportion of future quarry or pit reserves
Moderate Adverse	Results in impact on integrity of attribute or loss of part of attribute	Loss of moderate proportion of future quarry or pit reserves
Small Adverse	Results in minor impact on integrity of attribute or loss of	Loss of small proportion of future quarry or pit reserves

	small part of attribute	
Negligible	Results in an impact on attribute but of insufficient magnitude to affect either use or integrity	No measurable changes in attributes
Minor Beneficial	Results in minor improvement of attribute quality	Minor enhancement of geological heritage feature
Moderate Beneficial	Results in moderate improvement of attribute quality	Moderate enhancement of geological heritage feature
Major Beneficial	Results in major improvement of attribute quality	Major enhancement of geological heritage feature

Table 6.2 Criteria for rating impact magnitude at EIS stage – Estimation of magnitude of impact on soil/ geology attribute (NRA, 2009)

The principal attributes (and impacts) to be assessed include the following:

- geological heritage sites in the vicinity of the perimeter of the subject site;
- landfills, industrial sites in the vicinity of the site and the potential risk of encountering contaminated ground;
- the quality, drainage characteristics and range of agricultural uses of soil around the subject site;
- quarries or mines in the vicinity, the potential implications (if any) for existing activities and extractable reserves;
- the extent of topsoil and subsoil cover and the potential use of this material on site as well or requirement to remove it off-site as waste for disposal or recovery;
- High yielding water supply springs/ wells in the vicinity of the site to within a 2Km radius and the potential for increased risk presented by the proposed development;
- Classification (regionally important, locally important) and extent of aquifers underlying the site perimeter area and increased risks presented to them by the proposed development associated with aspects such as for example removal of subsoil cover, removal of aquifer (in whole or part), drawdown in water levels, alteration in established flow regimes, change in groundwater quality;
- Natural hydrogeological/ karst features in the area and potential for increased risk presented by the activities at the site; and
- Groundwater-fed ecosystems and the increased risk presented by operations both spatially and temporally.

6.2.2 Sources of Information

Desk-based geological information on the substrata (both Quaternary deposits and bedrock geology) underlying the extent of the site was obtained through accessing databases and other archives where available. Data was sourced from the following:

- Geological Survey of Ireland (GSI) - on-line mapping, Geo-hazard Database, Geological Heritage Sites & Sites of Special Scientific Interest, Bedrock Memoirs and 1:100,000 mapping.
- Teagasc soil and subsoil database;
- Ordnance Survey Ireland - aerial photographs and historical mapping;
- Environmental Protection Agency (EPA) – website mapping and database information

- National Parks and Wildlife Services (NPWS) – Protected Site Register
- South Dublin County Council- Landfill information.

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Relevant documentation consulted as part of this assessment included the following:

- Report on the Geophysical Survey at Grange Castle, June 2013 prepared by Apex Geoservices
- Grange Castle Business Park Factual Site Investigation Report – Interim Report July2013 prepared by BLP.
- Grange Data Centre Facility Environmental impact Statement, 2007 prepared by PM

6.3 RECEIVING ENVIRONMENT

6.3.1 Site Area Description

The proposed development is to be located on currently undeveloped industrial lands in Grange Castle Business Park located between the town lands of Grange and Kilmahuddrick between the N4 and N7 in west Dublin.

The site is surrounded by a mixture of industrial and leisure uses. To the east is Pfizer Biotech and Grange Castle International Business Park. To the north is the proposed Grifols Worldwide site and the Grange Castle archaeological site, to the west is Ballybane Footgolf course and to the south is Kilcarbury Business Park (Figure 1.1).

6.3.2 Topography

The site is situated on gently undulating agricultural grassland which slopes gently from 65.5 m OD in the north-west of the site to approximately to c. 72.5 m OD in the south-east of the site.

6.3.3 Drainage

Drainage within the area is discussed in more detail in Chapter 7.0 (Water Quality and Hydrology). The proposed development is located within the Eastern River Basin District (ERBD). The most significant drainage system in the vicinity of the subject site is the River Grifeen, which drains to the River Liffey. For land improvement in the past, there is a system of field drainage which is mostly overgrown at the time of the site walkover (20th June 2013). The Griffeen River previously flowed through the west of the site and has been diverted outside the site boundary.

6.3.4 Land Use

The land surrounding the subject site is agricultural and currently used as pasture land predominantly for livestock grazing.

According to the EPA (www.epa.ie) there are a number of licensed IPPC facilities in the locality (Takeda Pharma Ltd and Pfizer Biotech) and there are no licensed waste sites in the vicinity of the subject site. Consultation with South Dublin County Council confirmed that there are no known illegal/historic landfills within 500 metres of the site.

6.3.5 Bedrock Geology

Inspection of the available GSI records (Data Sheet 16) show that the bedrock geology underlying the site and surrounding area is dominated by rocks of Carboniferous Age. The regional geology is presented in Figure 6.1. The site and local area is underlain by Dinantian (Upper Impure) Limestones.

Drilling on site confirmed that the bedrock comprises limestone and mudstones typical of the Lucan (Calp) formation. Depth to bedrock is shallow and varies across the site. East –west and north-south cross sections are presented in Figure 6.7(a) which shows the profile across the site based on the geological logs from the geotechnical investigation undertaken on site (geological logs are presented in Appendix 6.1). Depth to bedrock can be seen to vary across the site with over 3 metres of soil cover in the west and south of the site and less than 1.5 metres in places on the east of the site.

No bedrock was found outcropping on the site. However, bedrock outcrops at a number of locations within this region as shown in Figure 6.1.

Figure 6.1 does not show any faults on the site or within the immediate vicinity of the site. The closest recorded bedrock fault line is located to the north west of the site is at a distance of approximately 2.5km (orientated in a NE-SW direction.

The GSI database presently lists no karst features in the immediate vicinity of the subject site and significant karstification would not be expected in this type of limestone.

On-site drilling

A total of 67 boreholes were drilled between 20th and 30th May 2013. Borehole logs are presented in Appendix 6.1. Interpreted sections are presented in Figure 6.7a.

6.3.6 Soil & Subsoil

Figure 6.2 and 6.3 present the site and overburden geology which comprises Quaternary Glacial Till (source: GSI and Teagasc soil mapping) The Glacial Till is derived from Limestone and is a common soil cover in this region.

Site specific information has been derived from a geophysical survey of ground conditions and site investigation drilling and trial pitting undertaken in May 2013, copies of the geophysics report, site investigation boreholes and trial pit logs are included in Appendix 6.1. The topsoil/ subsoil cover at the site was approximately 1.5 m in the east of the site to over 3 metres thickness towards the south and west of the site. The overburden comprises sandy gravelly Clay with cobbles and boulders. Lenses of sand and silt were also noted. This interpretation is consistent with the GSI defined glacial till subsoil classification for the area. The geophysics survey interpreted an area of shallow fill material/ made ground in the far west of the site. Surface observations also indicate that this area may have been infilled. Trial pit 3 was located in this area and did not indicate any significant fill material. Bedrock was encountered in this trial pit at a depth of 1.6 metres below land surface.

On-site trial pit logs

A total of 30. trial pits were excavated on site on May 22nd and 23rd 2013. Logs are presented in Appendix 6.1. Interpreted sections are presented in Figure 6.7a.

6.3.7 Groundwater – Aquifer Classification & Vulnerability

Groundwater can be defined as water that is stored in, or moves through, pores and cracks in sub-soils. The potential of rock to store and transport water is governed by permeability of which there are two types, inter-granular and fissure permeability. Inter-granular permeability is found in sediments, sands, gravels and clays as are also present at the subject site, and fissure permeability which is found in bedrock, where water moves through (and is stored in) cracks, fissures, fracture planes and solution openings for example.

Aquifers are generally classified as rocks or other matrices that contain sufficient void spaces and which are permeable enough to allow water to flow through them in significant quantities.

Aquifer Classification

An inspection of the available GSI records on-line shows that the bedrock geology of the site and the surrounding area is dominated by Dinantian Limestones (Calp). The GSI has classified this aquifer as Locally Important (Ll) (Figure 6.4), i.e *an aquifer which is moderately productive only in local zones*.

Aquifer Vulnerability

Aquifer vulnerability is a term used to represent the intrinsic geological and hydrological characteristics that determine the ease with which groundwater may be contaminated generally by human activities. Due to the nature of the flow of groundwater through bedrock in Ireland, which is almost completely through fissures, the main feature that protects groundwater from contamination, and therefore the most important feature in protection of groundwater, is the subsoil (which can consist solely/ or of mixtures of peat, sand, gravel, glacial till, clays or silts).

The GSI (2013) presently classifies the aquifer in the region of the subject site as Extreme (E) where rock is near surface or outcrops to High (H) where greater than 3 metres of clayey till is present. Based on the site investigation data the site is considered to have High to Extreme Vulnerability.

Groundwater Table and Flow

Data on historical groundwater levels at the site is unavailable. Water strikes noted in drilling logs indicate a shallow water table in the overburden deposits but as no static water measurements were taken these do not reflect a water table. Groundwater flow has not been measured on site but is expected to discharge to the Griffeen and Liffey River i.e. in a northwest direction.

6.3.8 Soil and Water Quality

The site is located in the Dublin Urban Groundwater Body and its current status is 1(a) i.e. a*t risk of not achieving good status.* No water quality data was collected for this assessment.

10 representative soil samples (collected from 0.9 m to 3 m below land surface) were collected and analysed in June 2013. Samples were analysed for Mineral Oils BTEX, PCBs, PAHs Metals and Phenol. Results show that for all samples, the Mineral Oils BTEX, PCBs, PAHs and Phenol were all below laboratory detection level. Metal

leachate results were compared with landfill suitability criteria (Murphy Landfill Suite), i.e. Inert, non hazardous and hazardous. All metal concentrations were within the range of inert and stable non-reactive. These results are indicative of the use of the site for agriculture and do not indicate any evidence of historic contamination at the site. laboratory results are presented in Appendix 6.1 (internal Appendix 6).

6.3.9 Hydrogeological Features

According to the GSI Karst database (2013) there is no evidence of karstification in this area.

6.3.10 Areas of Conservation

The lands in which the proposed development is located have no formal designations. The nearest designated lands to the site at Grange Castle Business Park is the Grand Canal pNHA (Site Code: 002104) at 600m, see Chapter 8, Figure 8.1. The drainage ditches on the site lead to the Griffeen River which in turn discharges to the River Liffey at Lucan where it is designated as part of the Liffey Valley pNHA.

6.3.11 Water Supplies

The GSI Well Card Index is a record of wells drilled in Ireland. It is noted that this record is not comprehensive as licensing of wells is not currently a requirement in ROI. This current index, however, shows a number of wells drilled and springs in the wider region (see Figure 6.6) with the nearest recorded wells located over 2km to the north of the site. The area is serviced by public mains therefore it is unlikely that any wells are used for potable supply. The site is not located near any public groundwater supplies or group schemes.

There are no groundwater source protection zones in the immediate vicinity of the quarry.

6.3.12 Geological Heritage

The Geological Survey of Ireland (GSI) Irish Geological Heritage (IGH) Programme was contacted to determine if any geological heritage issues were present in relation to the subject quarry site. They referred us to their online assessment via their Public Viewer www.gsi.ie/mapping. There are no recorded sites on the site. A full audit has not yet been completed for Dublin however, there is no evidence of any site which could be considered suitable for protection under this programme or recorded the South Dublin County Development Plan The nearest recorded site is located 1.4 km south of the site at Kilcarberry Golf Course.

6.3.13 Economic Geology

The Extractive Industry Register (www.epa.ie) and the GSI mineral database was consulted to determine whether there were any mineral sites close to the subject quarry area. There are no active localities located within 5km from the site. The EPA ENVision website also confirmed that there are no mines on or near the site.

6.3.14 Geo-Hazards

According to the GSI web database, there are presently no records of geo-hazards such as landslides, within a radius of 10Km of the site.

6.4 CHARACTERISTICS OF THE DEVELOPMENT

The characteristics of the proposed Microsoft development with regard to the soil, geological and hydrogeological environment are outlined below. The characteristics relate to both construction and operation activities.

Construction Activities

- Removal of localised overburden material and weathered rock (where necessary) will be required during preparation of the platform for the building.
- Infilling and landscaping will be undertaken. All soils, subsoils and bedrock stripped will be reused for infilling, levelling or landscaping where possible. As a worst case scenario i.e. construction during a period of extended poor weather, a maximum of 40,000m3 may require off site removal and disposal at suitably licensed facilities.
- Temporary storage of fuel may be required on site for construction traffic.
- Small localised accidental releases of hydrocarbons have the potential to occur from construction traffic operating on site.
- No significant dewatering is anticipated to be required for construction as no basement structures are required.

Operational Activities

- There will be no direct discharges to ground required for operation of the facility. Water supply will be supplied from public mains and effluent discharge will be to public sewer.
- Increased hard stand will reduce local recharge to ground.
- Fuel will be stored on site for operation of generators

6.4.1 Conceptual Site Model

Interpretative cross sections have been undertaken for the site with views appropriate to the characterisation of the site in terms of the geological (and hydrogeological environment).

Figures 6.7a and 6.7b present cross sections for the site and regional area and indicate the following:

- The profile on site comprises thin sub soil overlying sandy gravelly CLAY with cobbles and boulders underlain by muddy Limestones (Calp). Depth to bedrock is shallow across the site and although no outcrops were noted on the site, outcropping bedrock is evident in the surrounding area. The section shows bedrock at c. 3 metres in the west rising to c. 1.5 metre in the east. Bedrock was noted in the realigned Griffeen river bed on the west of the site indicating that rock rises again in that direction
- The site is situated on gently undulating agricultural grassland which slopes gently from 65.5 m OD in the north-west of the site to approximately to c. 72.5 m (OD) in the south-east of the site.
- Although water levels have not been measured on site, geological logs indicate the presence of a shallow perched water table within the clay overburden. Depth to the

water table in the limestone bedrock is unknown. Development of the site will not require any significant dewatering of the bedrock aquifer.

- Review of the hydrogeology and geology in the surrounding region indicates that there are no sensitive receptors e.g groundwater fed wetlands, Council Water Supplies/Group water schemes, geological heritage sites which could be impacted.by this development.
- Previous agricultural use of the site does not indicate that any contaminated soil/water should arise during redevelopment on site. A small area of fill was interpreted in the west of the site by the geophysical survey. No evidence of disposal of waste material was identified in the two trial pits excavated in this area.

6.5 POTENTIAL IMPACTS OF THE DEVELOPMENT

An analysis of the potential impacts of the proposed development on the soils, geology And hydrogeological environment during the construction and operation is outlined below. Due to the inter-relationship between soils, geology and hydrogeology and surface water (hydrology) the following impacts discussed will be considered applicable to both chapter 6 and 7 of the EIS. Waste Management is also considered an interaction.

Mitigation measures to minimise risk of impact are provided in section 6.6.

6.5.1 Construction Phase

Excavation and Infilling

Excavation and infilling of soil and near-surface rock head will be required for levelling of the site to render it suitable for building the building platform. Excavated material will be reused on site for infilling and landscaping works where possible. As a worst case scenario i.e. construction during a period of extended poor weather, a maximum of 30-40,000m^3 may require removal. Site investigation and laboratory analysis has not identified any existing contamination and the previous use of the site for agriculture does not indicate that any contaminated soil or water should be encountered. However, if contaminated soil/water is encountered, it will be required to be removed by a licensed waste contractor.

Accidental Spills and Leaks

During construction of the development, there is a risk of accidental pollution incidences from the following sources:

- Spillage or leakage of oils and fuels stored on site.
- Spillage or leakage of oils and fuels from construction machinery or site vehicles.
- Spillage of oil or fuel from refuelling machinery on site.
- The use of concrete and cement during pad foundation construction.

Accidental spillages may result in contamination of soils and groundwater underlying the site, should contaminants migrate through the subsoil's and impact underlying groundwater. Soil stripping and pad foundation construction will also reduce the thickness of subsoil's.

Concrete (specifically, the cement component) is highly alkaline and any spillage which migrates though subsoil's would be detrimental to groundwater quality.

Surface Water Runoff
Surface water runoff during the construction phase may contain increased silt levels or become polluted from construction activities. Runoff containing large amounts of silt can cause damage to groundwater underlying the site particularly if it is contaminated. Silt water can arise from exposed ground and soil stockpiles (prior to reinstatement).

In relation to the construction phase the potential impact on the soils, geology and hydrogeology is considered to be moderate. This is because though significant excavations are required, most of this material will be levelled, reused and re-emplaced on site. Groundwater vulnerability at the site is currently classified as extreme.

6.5.2 Operation Phase

There will be no direct discharges to the water or soil environment during the operational phase.

There is a potential for leaks and spillages during operation and maintenance of the development. Any accidental emissions of chemicals or oil, petrol or diesel leaks could cause contamination if the emissions enter the soil and groundwater environment.

Incorporation of hard stand areas will reduce local recharge to ground.

6.6 REMEDIAL & MITIGATION MEASURES

The design has taken account of the potential impacts of the development on the soils, geology and hydrogeology environment local to the area where construction is taking place. Measures have been incorporated in the design to mitigate the potential effects on the surrounding soils, geology and hydrogeology. These measures seek to avoid or minimise potential effects in the main through the implementation of best practice construction methods and adherence to all relevant legislation.

In order to minimise the potential impacts from the development, the following mitigation measures will be implemented to ensure that contamination of soils and groundwater does not occur. Due to the inter-relationship between soils, geology and hydrogeology and water (hydrology) the following mitigation measures discussed will be considered applicable to both. Waste Management is also considered an interaction in some sections.

6.6.1 Construction Phase

Soil Removal and Compaction
Construction works will require removal of soil cover where levelling of the site is required. Although bedrock vulnerability is already extreme in places due to the thin cover of overburden on the site. Removal of soil cover will increase the vulnerability of the underlying bedrock.

It is envisaged that where feasible the majority of the soil excavated will be retained on site and reused as fill material or landscaping.

Temporary storage of soil will be carefully managed in such a way as to prevent any potential negative impact on the receiving environment and the material will be stored away from any surface water drains. Movement of material will be minimised in order to reduce degradation of soil structure and generation of dust.

Although there is no evidence of historical contamination in the area, all excavated materials will be visually assessed for signs of possible contamination such as staining or strong odours. Should any unusual staining or odour be noticed, samples of this soil will be analysed for the presence of possible contaminants in order to ensure that historical pollution of the soil has not occurred. Should it be determined that any of the soil excavated is contaminated, this will be disposed of by a licensed waste disposal contractor.

Fuel and Chemical Handling

To minimise any impact on the underlying subsurface strata from material spillages, all oils, solvents and paints used during construction will be stored within temporary bunded areas. Oil and fuel storage tanks shall be stored in designated areas, and these areas shall be bunded to a volume of 110% of the capacity of the largest tank/container within the bunded area(s) (plus an allowance of 30 mm for rainwater ingress). Drainage from the bunded area(s) shall be diverted for collection and safe disposal.

Refuelling of construction vehicles and the addition of hydraulic oils or lubricants to vehicles, will take place in a designated area (or where possible off the site) which will be away from surface water gulleys or drains. In the event of a machine requiring refuelling outside of this area, fuel will be transported in a mobile double skinned tank. An adequate supply of spill kits and hydrocarbon adsorbent packs will be stored in this area. All relevant personnel will be fully trained in the use of this equipment. Guidelines such as *"Control of Water Pollution from Construction Sites, Guidance for Consultants and Contractors"* (CIRIA 532, 2001) will be complied with.

All ready-mixed concrete will be brought to site by truck. A suitable risk assessment for wet concreting will be completed prior to works being carried out which will include measures to prevent discharge of alkaline wastewaters or contaminated storm water to the underlying subsoil. The pouring of concrete will take place within a designated area using a geosynthetic material to prevent concrete runoff into the soil/groundwater media. Wash down and washout of concrete transporting vehicles will take place at an appropriate facility offsite.

In the case of drummed fuel or other chemical which may be used during construction containers should be stored in a dedicated internally bunded chemical storage cabinet and labelled clearly to allow appropriate remedial action in the event of a spilage.

Surface Water Runoff

Water containing silt will be treated to ensure silt removal and then disposed of to the foul sewer See Chapter 7.0 (Water Quality & Hydrology) for more detailed information.

Construction Environmental Management Plan
A project-specific Construction and Environmental Management Plan (CEMP) will be established and maintained by the contractors during the construction and operational phases. The Plan CEMP will cover all potentially polluting activities and include an emergency response procedure. All personnel working on the site will be trained in the implementation of the procedures.

6.6.2 Operational Phase

Fuel and Chemical handling
Emissions from fuel spills or leaks or runoff from rainwater that has passed over impermeable surfaces will be prevented from entering the soil and/or underlying groundwater as all surface water runoff from the development will be directed to oil interceptors prior to discharge to the drainage system.

In order to minimise any impact on the underlying subsurface strata from material spillages, oil and fuel storage tanks will be stored above ground in designated areas with an impervious base. These areas will be bunded to a volume of 110% of the capacity of the largest tank/container within the bunded area(s) (plus an allowance of 30 mm for rainwater ingress). Drainage from the bunded area(s) will be diverted for collection and safe disposal.

Environmental Management Plan
An environmental management plan will apply to the development during the operational phase incorporating mitigation measures and emergency response measures. A summary of the environmental measures is presented in the previous section.

6.7 PREDICTED IMPACTS OF THE DEVELOPMENT

In terms of predicted specific impacts the following points are of note:

- There is no likely impact on the geological heritage, sensitive groundwater receptors or groundwater supplies in the vicinity of the proposed development site.
- The removal of the ‘protective’ topsoil and subsoil cover across the development area at the site will leave the underlying bedrock more vulnerable to potential on-site contamination if not mitigated. This vulnerability category for the site (classed as “High to Extreme’ by the GSI) will remain due to thin cover on site. Capping of significant areas of the site by hardstand/building following construction and installation of drainage will minimise the potential for contamination of the underlying locally important aquifer.
- There will be a loss of agricultural soil due to redevelopment. However, the area of redevelopment is small in the context of the overall region.
- The incorporation of a large hardstand area will reduce local recharge to ground. However, as this is localised it is not likely to have any impact in terms of the regional groundwater regime.

In summary, there are no likely significant impacts on the geological or hydrogeological environment associated with the proposed development of the site. It is not anticipated that any impacts will arise following the implementation of the mitigation measures discussed in Section 6.6 above.

6.8 RESIDUAL IMPACTS

The residual impacts are those that would occur after the mitigation measures have taken effect. In the case of the proposed development the residual impact is considered to be **neutral** in terms of quality and of an **imperceptible** significance (short term and long term) as a result of this proposed development on the surrounding soils, geology and hydrogeological environment. Following the NRA criteria for rating the magnitude and significance of impacts on the geological and hydrogeological related attributes, the magnitude of impact is considered **Negligible.**

6.9 REFERENCES

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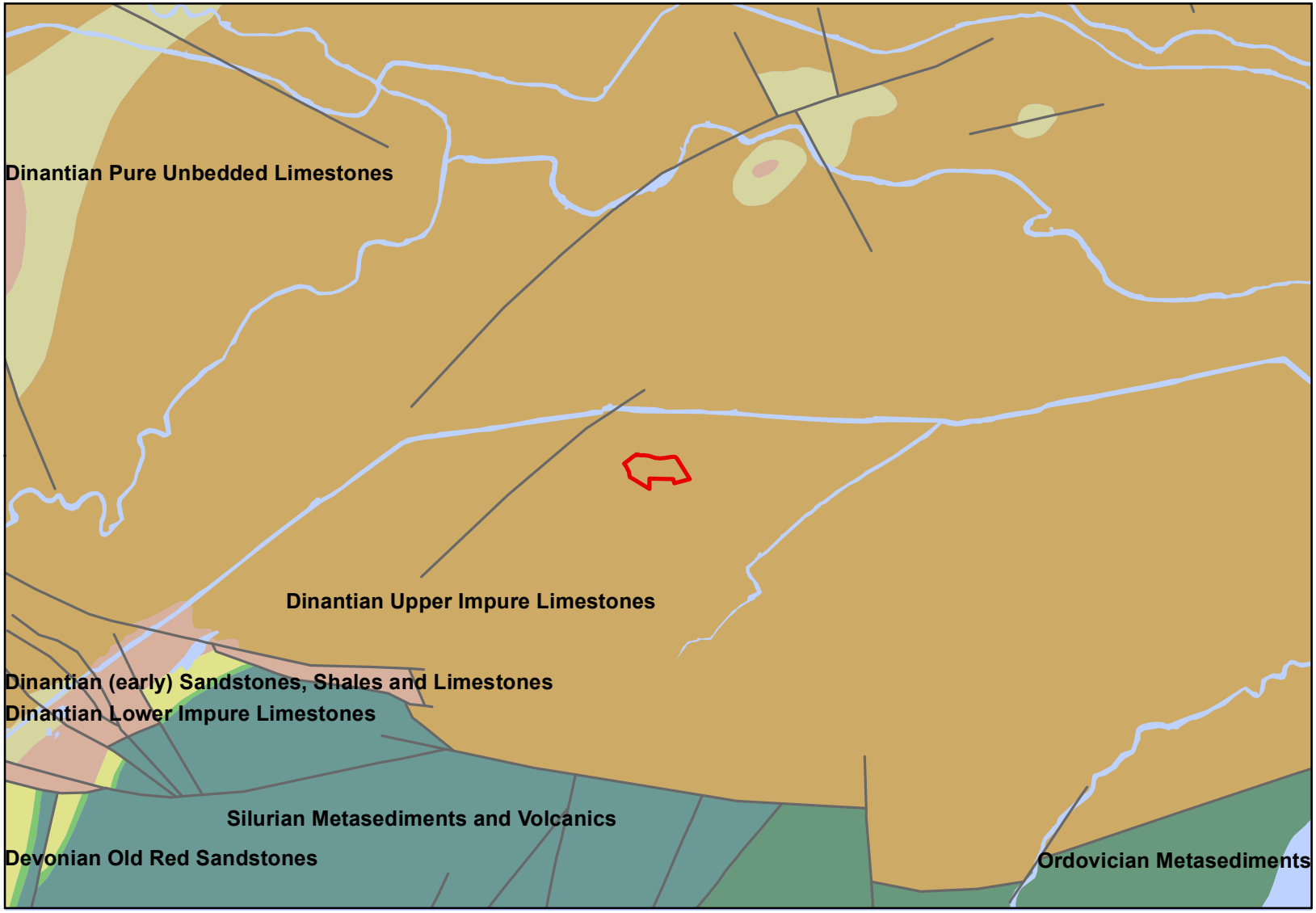
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N
W E
S

Legend

Site outline (approximate)

Structural faults (GSI 100k)

Bedrock Description

GSI Description

- Devonian Old Red Sandstones
- Dinantian (early) Sandstones, Shales and Limestones
- Dinantian Lower Impure Limestones
- Dinantian Pure Unbedded Limestones
- Dinantian Upper Impure Limestones
- Ordovician Metasediments
- Silurian Metasediments and Volcanics

Note: Drawing is for illustrative purposes only; Do not scale

0 1.25 2.5 5 Km

Source: Aerial photo -Bing Maps

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CLIENT: Microsoft Ireland

DRAWING TITLE: Bedrock Geology

PROJECT: Environmental Impact Assessment for Proposed 35.2MW Data Centre for Microsoft Ireland at Grangecastle, Co. Dublin

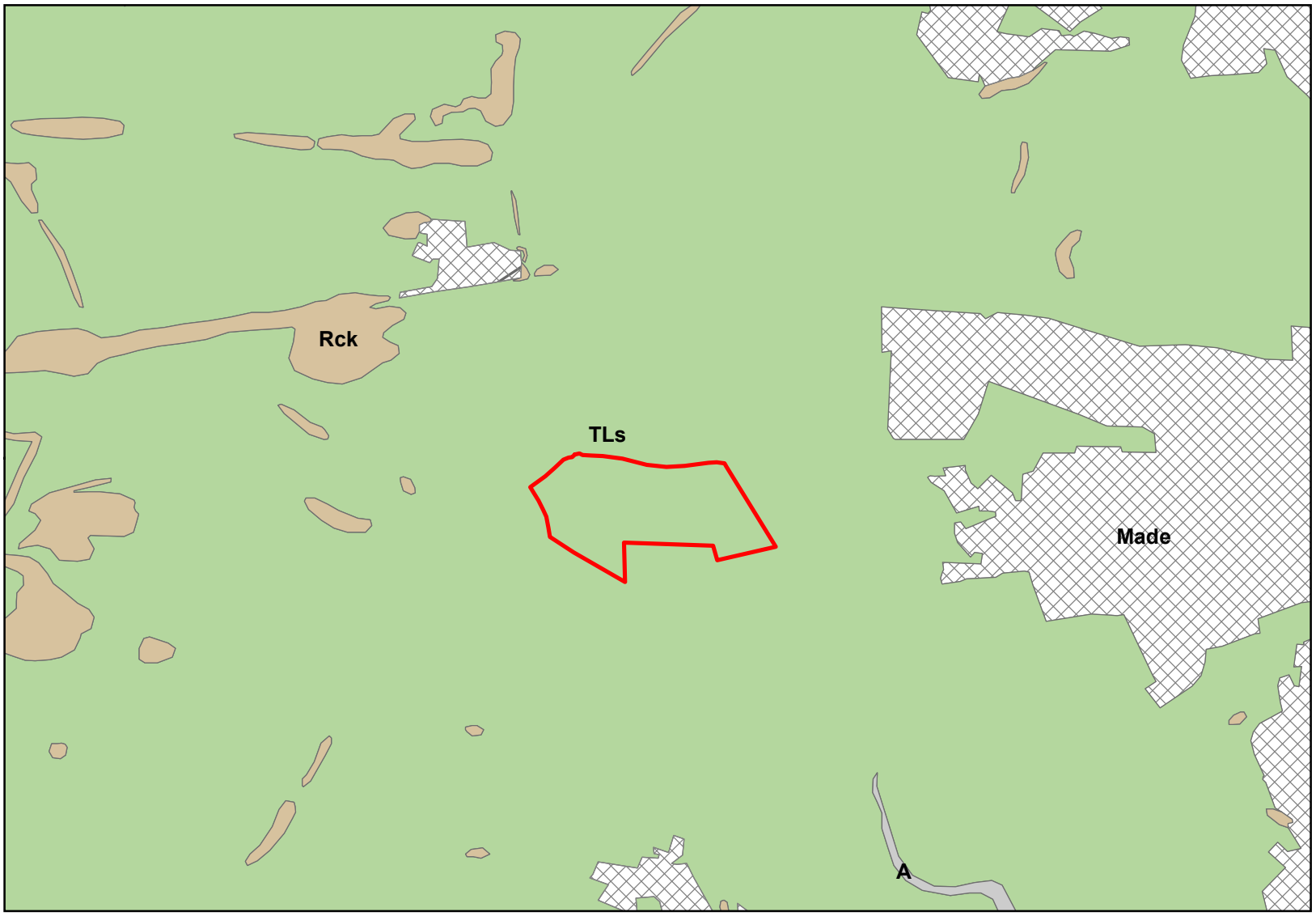
PROJECT Ref: 13/6668

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P.G	T.H.	T.H.	18/07/2013

Figure 6.1

No. of Sheets	SIZE:	SCALE:
1	A4	1:150,000

REVISION DESCRIPTION SHEET REV



N
W E
S

Legend

Site outline (approximate)

Superficial Deposits (Subsoils)

(A - all other values)

(Parent Material)

Made - Made Ground

Rck - Bedrock at surface

TLs - Limestone till Carboniferous

Note: Drawing is for illustrative purposes only; Do not scale

0 0.25 0.5 1 Km

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CLIENT: Microsoft Ireland

DRAWING TITLE: Drift Geology (Subsoils)

PROJECT: Environmental Impact Assessment for Proposed 35.2MW Data Centre for Microsoft Ireland at Grangecastle, Co. Dublin

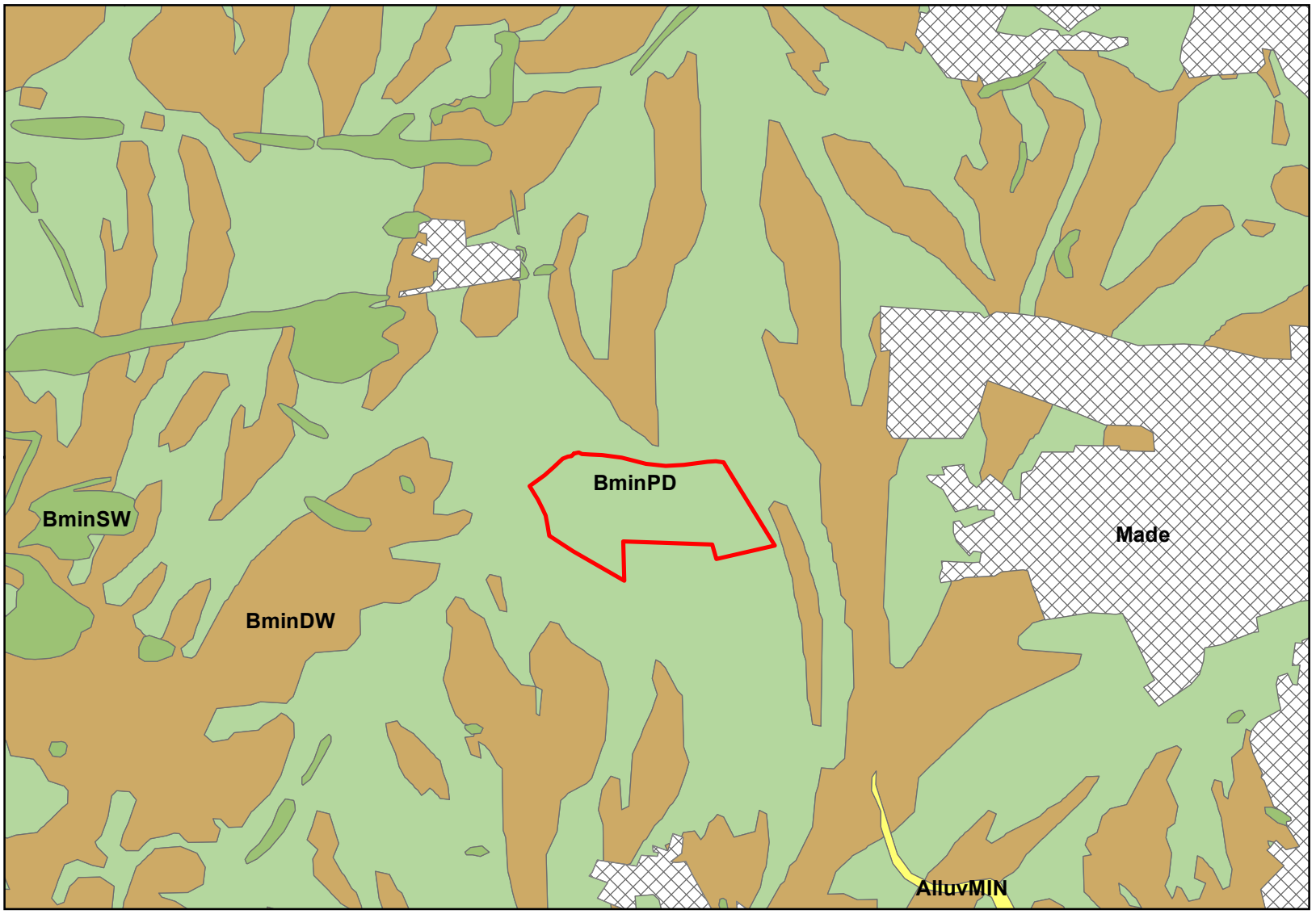
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Figure 6.2

No. of Sheets	SIZE:	SCALE:
1	A4	1:40,000

REVISION DESCRIPTION SHEET REV



N
W E
S

Legend

- Site outline (approximate)
- AlluvMIN - Mineral alluvium
- BminDW - Grey Brown Podzolics / Brown Earths Basic
- BminPD - Surface water Gleys / Ground water Gleys Basic
- BminSW - Renzinas / Lithosols
- Made Ground

Note: Drawing is for illustrative purposes only; Do not scale

0 0.25 0.5 1 Km

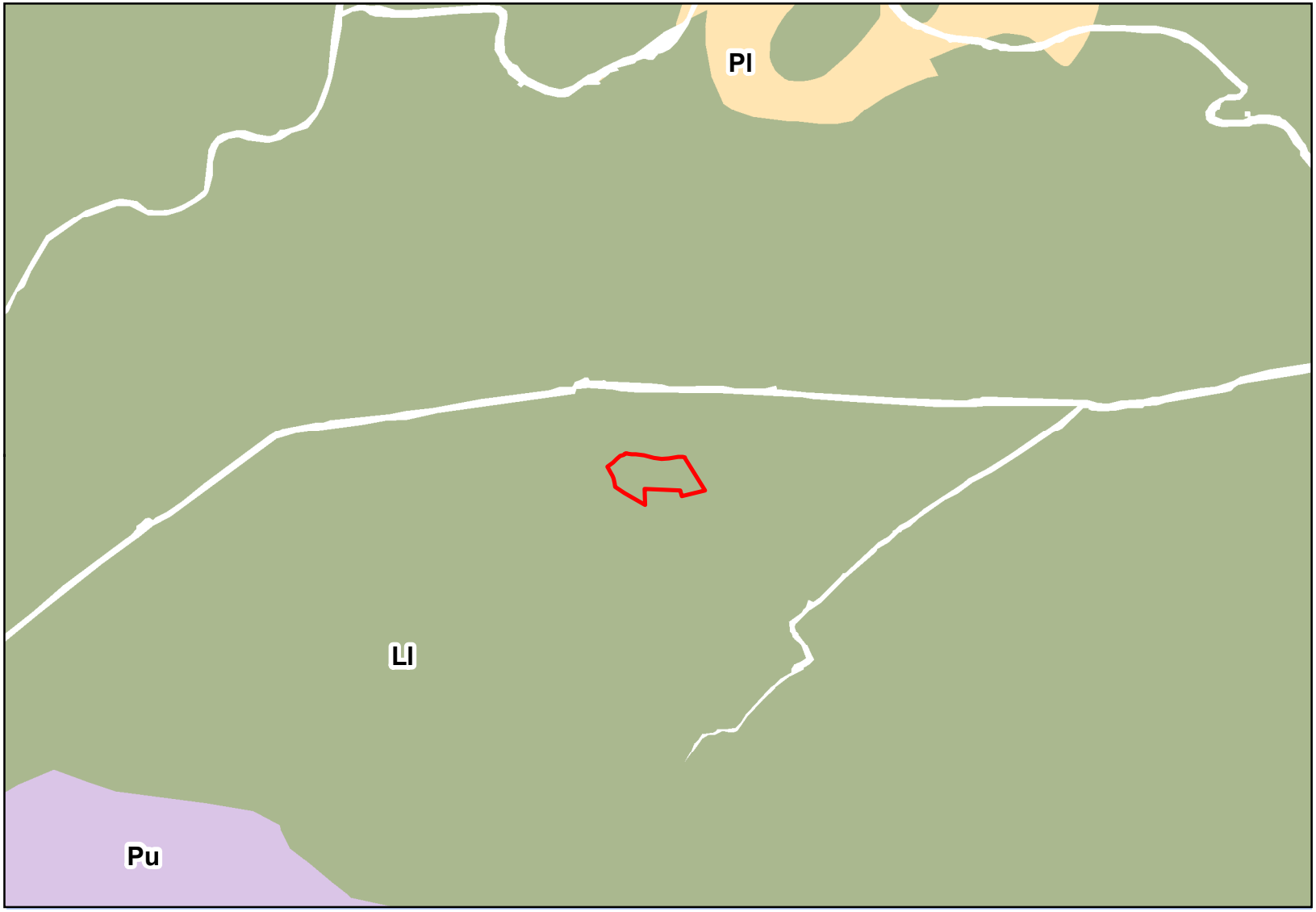
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Microsoft Ireland	Environmental Impact Assessment for Proposed 35.2MW Data Centre for Microsoft Ireland at Grangecastle, Co. Dublin	P.G	T.H.	T.H.	18/07/2013
DRAWING TITLE: Drift Geology (Soils)	PROJECT Ref: 13/6668	**Figure 6.3**	No. of Sheets: 1	SIZE: A4	SCALE: 1:40,000
		REVISION DESCRIPTION		SHEET	REV



N
W E
S

Legend

Site outline (approximate)

Aquifer Classification (Bedrock)

GSI Aquifer Type

LI

Pl

Pu

Key:

(LI) Locally Important Aquifer -
Bedrock which is Moderately Productive only in Local Zones

(Pl) Poor Aquifer -
Bedrock which is Generally Unproductive except for Local Zones

(Pu) Poor Aquifer - Bedrock which is Generally Unproductive

Note: Drawing is for illustrative purposes only; Do not scale

0 0.5 1 2 Km

Source: Aerial photo -Bing Maps

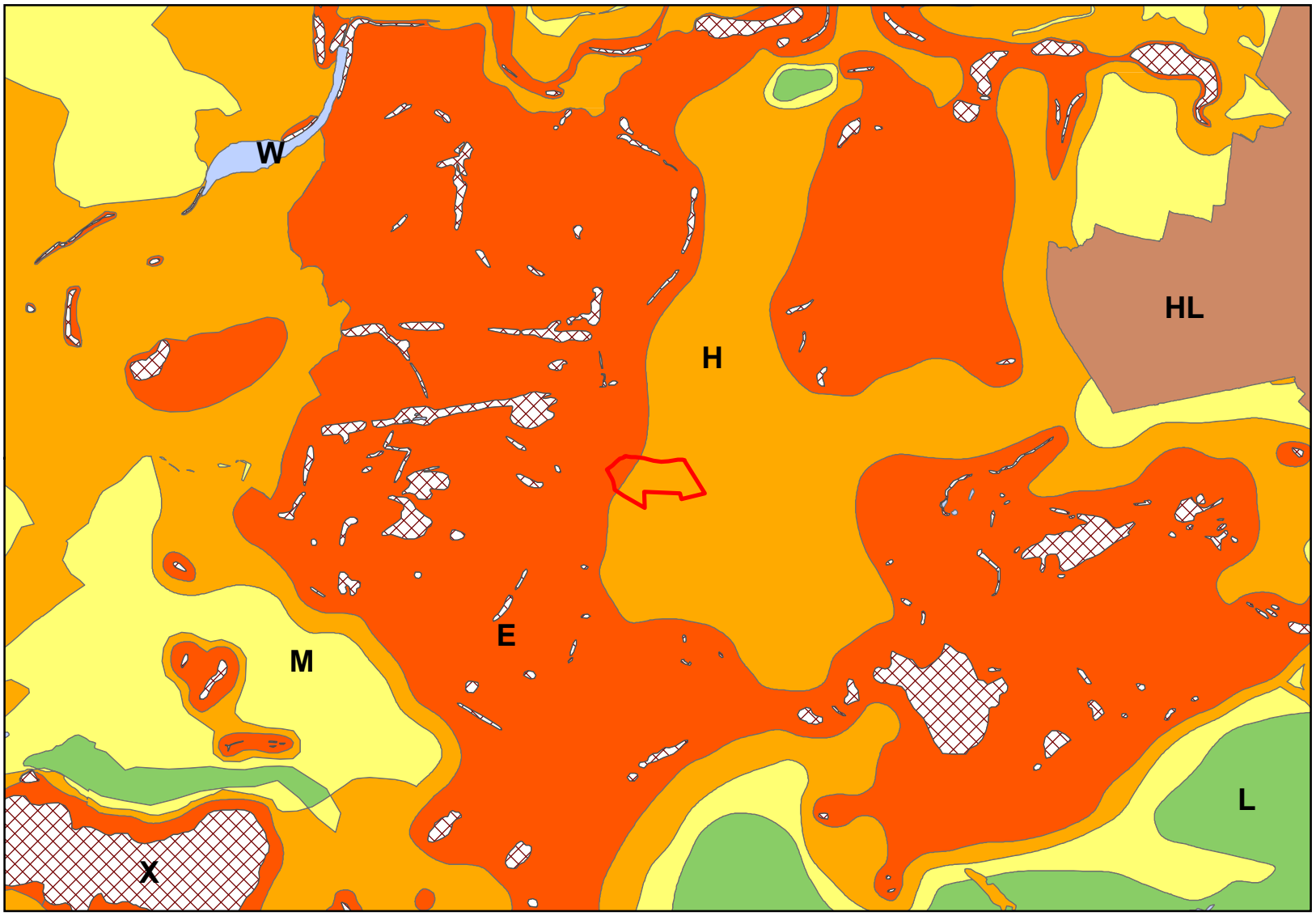
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DRAWING TITLE: Aquifer Classification (Bedrock)	**PROJECT Ref: 13/6668**	**Figure 6.4**		No. of Sheets: 1	**SIZE:** A4	**SCALE:** 1:100,000
		REVISION DESCRIPTION			SHEET	REV



N
W E
S

Legend

Site outline (approximate)

National Vulnerability (GSI 2011)

Vulnerability Class

- X (Rock at/near surface or karst)
- E (Rock at/near surface or karst)
- H High
- HL High-Low
- M Moderate
- L Low
- (Waterbody)

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0 0.5 1 2 Km

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CLIENT: Microsoft Ireland

DRAWING TITLE: Groundwater Vulnerability

PROJECT: Environmental Impact Assessment for Proposed 35.2MW Data Centre for Microsoft Ireland at Grangecastle, Co. Dublin

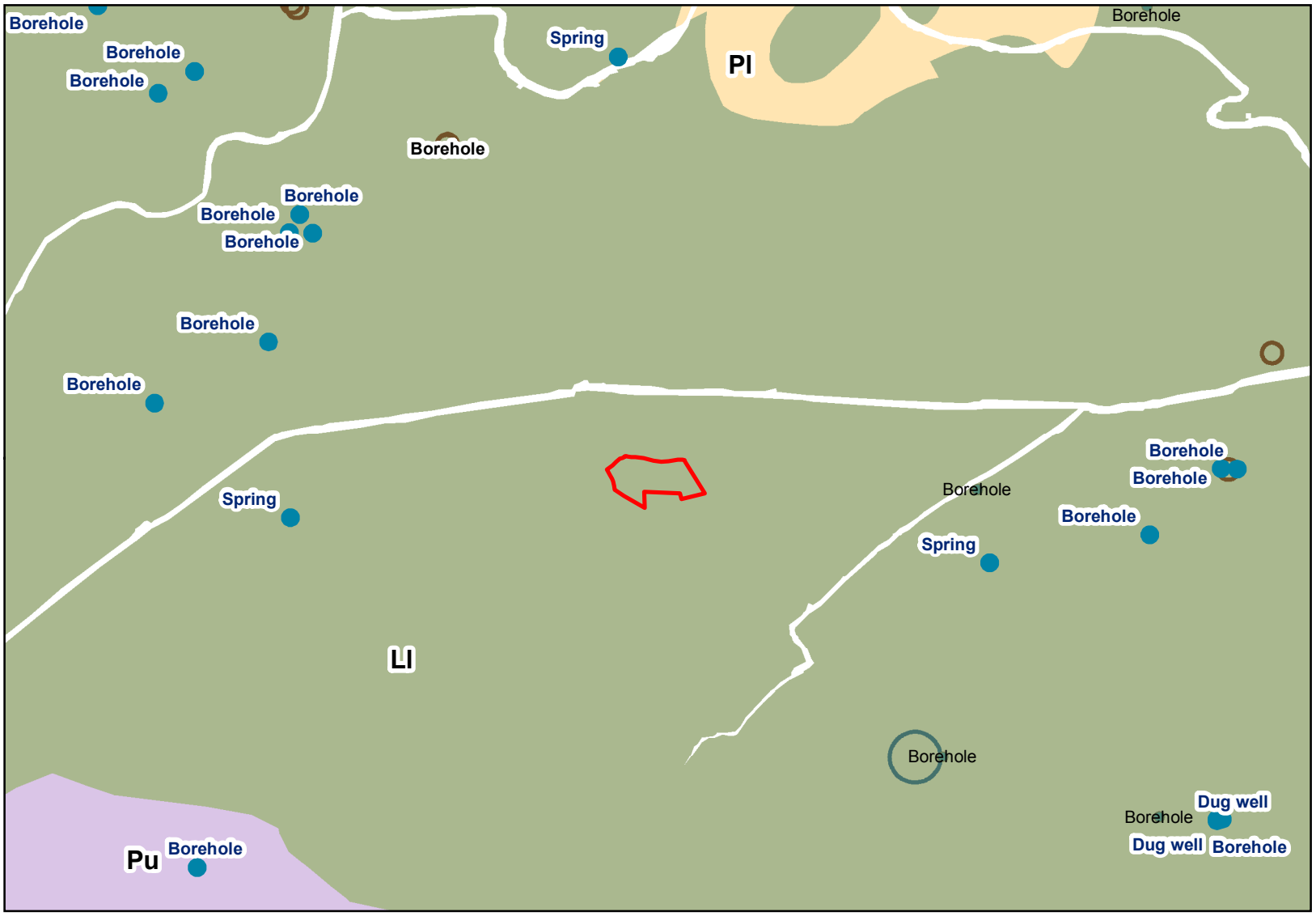
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Figure 6.5

No. of Sheets	SIZE:	SCALE:
1	A4	1:100,000

REVISION DESCRIPTION SHEET REV



N
W E
S

Legend

- Site outline (approximate)

Aquifer Classification (Bedrock)

GSI Aquifer Type

- LI
- Pl
- Pu
- Karst Features (N/A)
- Source Protection Areas (N/A)
- GSI well search (500m)
- GSI well search (200m)
- GSI well search (100m)

Note: Drawing is for illustrative purposes only; Do not scale

0 0.5 1 2 Km

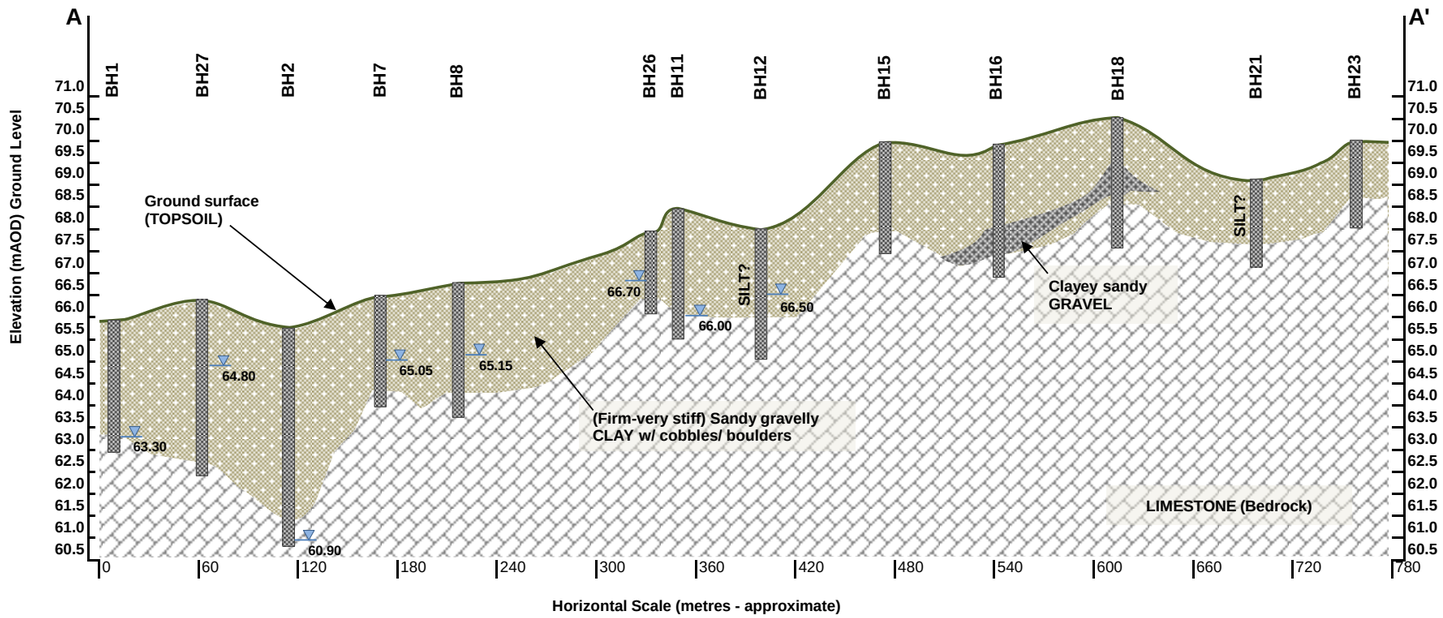
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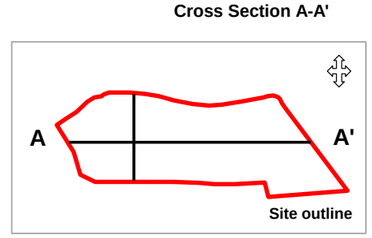
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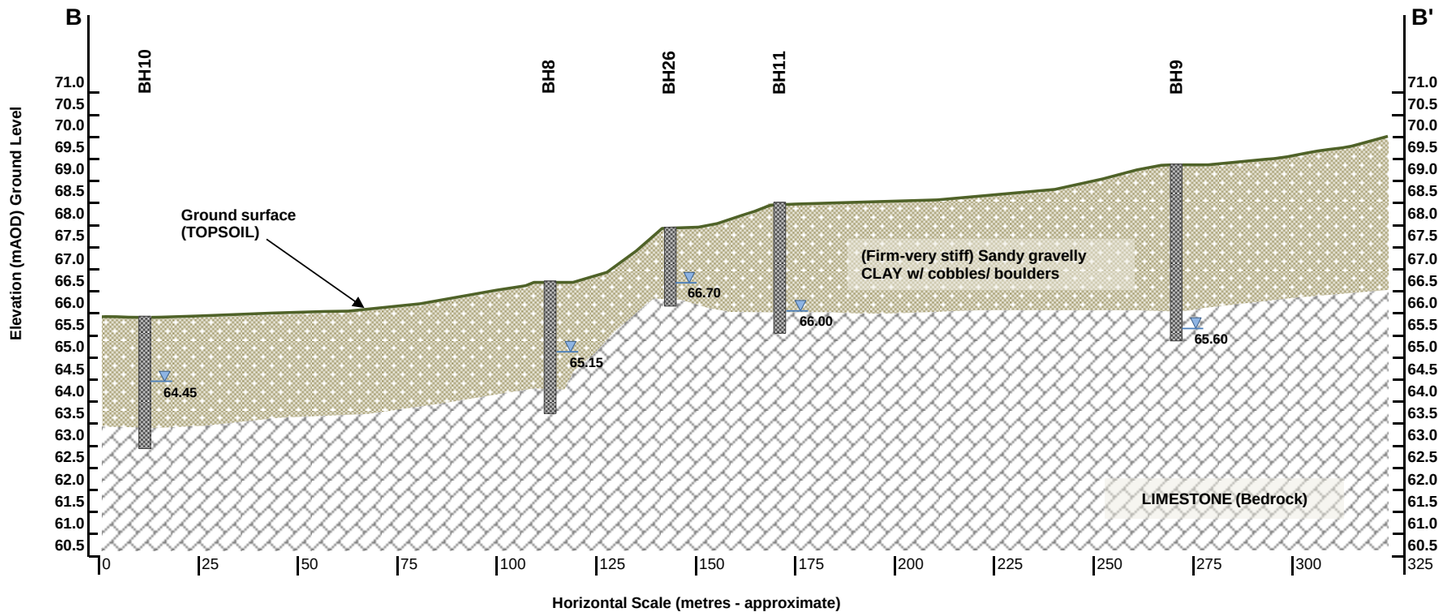
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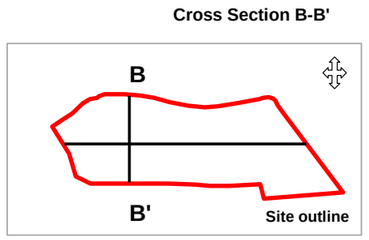
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DRAWING TITLE: Hydrogeological Characteristics	**PROJECT Ref: 13/6668**	**Figure 6.6**		No. of Sheets: 1	**SIZE:** A4	**SCALE:** 1:100,000
		REVISION DESCRIPTION			SHEET	REV









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Note: For the purpose of the sections, the site elevation has been taken as metres above ground level. Superficial deposits are generalised for presentation; Refer to Ground Investigation report for more detail on geological logs at each borehole location.

LEGEND

63.30 = Approximate depth (mAOD) of groundwater strike observed during drilling

Note: Geology below termination depth of CP boreholes has been explored at the site; CP borehole termination depths correspond well with depths to rockhead/ bedrock recorded in rotary follow-on at CP boreholes and at separate RC locations (CP-Cable percussive drilling; RC = Rotary core drilling)

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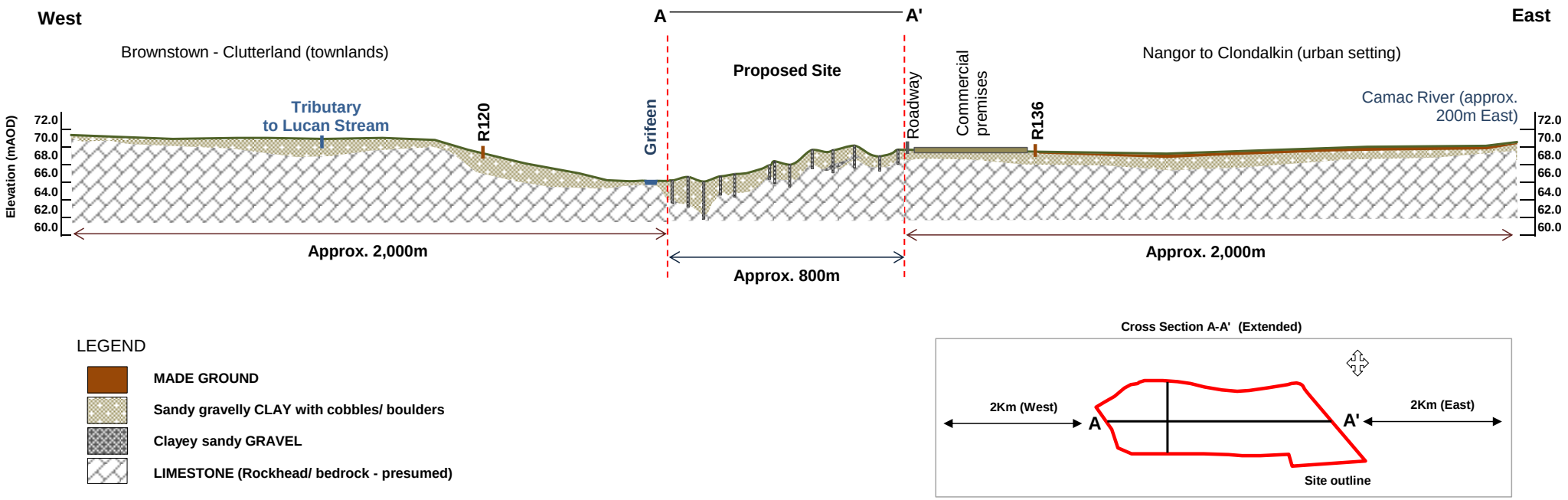
Project:

Environmental Impact Assessment for Proposed 35.2MW Data Centre for Microsoft Ireland at Grangecastle, Co. Dublin

Drawing:
Geological Cross Sections - Local Setting

Reference:
TH/DMD/13/6668/S/R/01

Figure 6.7a



LEGEND

- MADE GROUND
- Sandy gravelly CLAY with cobbles/ boulders
- Clayey sandy GRAVEL
- LIMESTONE (Rockhead/ bedrock - presumed)

Note: Drawing is for illustrative purposes only; Do not scale

Note: For the purpose of the regional section, elevation has been taken from Ordnance Survey 1:50,000 Discovery. Superficial deposits are generalised for presentation -bedrock inferred from Geological Survey of Ireland Vulnerability Mapping, and is indicative only. Refer Figure 6.7a for local geological setting of site.

Project:

Environmental Impact Assessment for Proposed 35.2MW Data Centre for Microsoft Ireland at Grangecastle, Co. Dublin

Drawing:
Geological Cross Sections - Regional Setting

Reference:
TH/DMD/13/6668/S/R/01

Figure 6.7b

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APPENDIX 6.1






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HANLEY PEPPER CONSULTING ENGINEERS

GRANGE CASTLE BUSINESS PARK
FACTUAL SITE INVESTIGATION REPORT – INTERIM REPORT

B1209

JULY 2013

REPORT No. R02

ISSUE No. 00

Document Control

Report Title: Factual Site Investigation Report – Interim Report

Project: Grange Castle Business Park

Client: Hanley Pepper Consulting Engineers

Job Number: B1209

Revision	Revision / Review Date	Details of Issue	Authorised		
			Prepared By	Reviewed By	Authorised By
00	03.07.13	Issued for Information	Maurice Ryan	John Byrne	John Byrne

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2.0 SITE INVESTIGATION DATA 2

APPENDIX A – GROUND INVESTIGATIONS IRELAND INTERIM REPORT

APPENDIX B – APEX GEOSERVICES REPORT ON GEOPHYSICAL SURVEY AT GRANGE CASTLE BUSINESS PARK

1.0 INTRODUCTION

Following the instructions of Hanley Pepper Consulting Engineers Byrne Looby Partners (BLP) have completed a site investigation at Grange Castle Business Park in Dublin.

This report details the interim factual information currently available following the completion of the site based works and the commencement of the laboratory testing.

The available information is summarised below and included in the attached appendices.

2.0 SITE INVESTIGATION DATA

The following information has been made available in the attached appendices, with the remaining information to be issued on completion of the remainder of the laboratory testing.

- Borehole Logs – BH1 to BH27
- Trial Pit Logs – TP1 to TP30
- Soak-away Tests – SW1 to SW6
- Drillers Logs for 40 No. Rotary Cores – RC1 to RC13 and BH1 to BH24
- Interim Laboratory Test Data
- Report on Geophysical Survey at Grange Castle Business Park

APPENDIX A – GROUND INVESTIGATIONS IRELAND INTERIM REPORT

The Grange, 12th Lock Road Lucan Co. Dublin
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GROUND INVESTIGATIONS IRELAND

GROUND INVESTIGATIONS IRELAND LTD

GRANGECASTLE BUSINESS PARK

DRAFT INTERIM SITE

INVESTIGATIONREPORT

DOCUMENT CONTROL SHEET

Engineer	Byrne Looby Partners
Project Title	Grangecastle Business Park
Project No	3717-05-13
Document Title	Draft Interim Site Investigation Report

Rev.	Status	Author(s)	Reviewed By	Approved By	Office of Origin	Issue Date
01	INTERIM	C Finnerty	J. Lombard	J .Lombard	Dublin	02 July 2013

Grangecastle

Site Investigation

Draft Interim Report

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4.1 General
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4.3 Environmental Laboratory Testing
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5.0 Gas and Groundwater Monitoring
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Appendix 2 Trial Pit Records
Appendix 3 Cable Percussive Borehole Records
Appendix 4 Rotary Core Drillers Records
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Appendix 6 Geotechnical Laboratory Test Results
Appendix 7 Contamination Laboratory Test Results

1.0 Preamble

On the instructions of Byrne Looby Consulting Engineers, a site investigation was carried out by Ground Investigations Ireland Ltd., between the 16th of May 2013 and the 26th June 2013 at the site of the Grange Castle Business Park in Co. Dublin.

This report is a draft interim report following the completion of the site works and prior to the completion of laboratory testing. The cable percussion, trial pitting and soakaway testing is included in this report. The rotary core engineers logs and laboratory testing is in progress and will be included in the final version of this report. Selected geotechnical testing and contamination testing which has been completed to date has been included in this interim report. Rotary core drillers logs are also included, which will be superseded by the rotary core engineers logs once the logging process is competed.

2.0 Overview

2.1 Background

A confidential development is planned on the site of the Grange Castle Business Park. The site is currently Greenfield and is a mixture of grass and barley crop at the time of the investigation fieldworks.

2.2 Purpose and Scope

The purpose of the site investigation was to investigate subsurface soil conditions at the site. This was carried out by means of Cable Percussive Boring, Rotary Coring and Trial Pitting. The scope of the work undertaken included the following:

- 27 No. Cable Percussive Boreholes to a maximum depth of 5.00mBGL
- 40 No. Rotary Cored (RC) boreholes consisting of 24 no RC follow on & 13 no RC
- 30 No. Trial Pits to a maximum depth of 3.80mBGL.
- 6 No. Soakaway tests to BRE Digest 365
- Laboratory testing and reporting

3.0 Subsurface Exploration

3.1 General

The exploratory holes were carried out at locations specified by the consulting engineer, set out using GPS surveying equipment on a square grid. Occasionally positions were set out in alternative locations due to the presence of hedgerows or the embankment running along a portion of the south of the site. The final as built locations of the exploratory holes locations are included in the site location plan in Appendix 1

Thiry trial pits and six soakaway pits were carried out using a 8T tracked excavator and were excavated to a maximum depth of 3.6m BGL. Regular sampling was undertaken in selected trial pits to facilitate laboratory testing. The trial pit logs can be found in Appendix 2 of this report.

Twenty seven cable percussion boreholes were completed on the site, twenty four of which have rotary follow on to prove rock. Regular sampling and insitu SPT testing was undertaken in the cable percussion boreholes to facilitate laboratory testing.

The standard method of boring in soil for site investigation is known as the Cable Percussion method. It consists of using a Shell in non-cohesive soils and a clay cutter in cohesive soils, both operated on a wire cable. Very hard soils, boulders and other hard

obstructions are broken up by chiselling and the fragments removed with the Shell. Where ground conditions made it necessary, the borehole was lined with 200mm diameter steel casing. While the use of the Cable Percussion method of boring gives the maximum data on soil conditions, some mixing of laminated soil is inevitable. For this reason thin lenses of granular material may not be noticed.

Disturbed samples were taken from the boring tools at suitable depths, so that there is a representative sample at the top of each change in stratum and thereafter at regular intervals down the borehole until the next stratum was encountered. The disturbed samples were then sealed and sent to the laboratory where they were visually examined to confirm the description of the relevant strata.

Standard Penetration Tests were carried out in the boreholes. The results of these tests, together with the depths at which the tests were taken are shown on the accompanying borehole records. The test consists of a thick wall sampler tube, 50mm external diameter, being driven into the soil by a drop weight weighing 65kg and with a free drop of 760mm. For gravels and glacial till the driving shoe was replaced by a solid 60º cone.

The Standard Penetration Test number referred to as the 'N' value is the number of blows required to drive the tube 300mm, after an initial penetration of 150mm. The number gives a guide to the consistency of the soil and can also be used to estimate the relative strength/density at the depth of the test and also to estimate the bearing capacity and compressibility of the soil.

Borehole water levels were recorded, together with the depths at which seepage of water or inflows can be detected and the observations are noted in the borehole logs. In general

these observations do not give an accurate indication of the actual ground water conditions as the borehole is rarely left standing at the relevant depth for a sufficient time for the water level to reach equilibrium, a permeable stratum may have been sealed off by the borehole casing or water may have been added to the borehole to facilitate progress.

The cable percussion borehole records are included in Appendix 3 of this report.
Thirteen rotary core boreholes were carried out from ground level adjacent to trial pit locations and the remainder, twenty four. were completed as RC follow-on from the base of the cable percussion boreholes.

The rotary coring was carried out by a track mounted T44 Beretta rig which allowed for short travel on pavement surfaces avoiding any damage to the surface. The T44 Beretta is triple tube core barrel system. The outer barrel is rotated by the drill rods and at its lower end, carries the coring bit. The inner barrel is mounted on a swivel so that it does not rotate during the process. The third barrel or liner is placed within the second one. The core is cut by the coring bit and passes to the inner liner. The core is brought up to the surface within the inner barrel on a small diameter wire rope or line attached to the “overshoot” recovery tool which is then placed into a core box in order of recovery. A drilling fluid, which is passed from the surface through hollow drill rods to the drill bit, is used to cool the drill bit. Temporary casing is used in some situations to support unstable ground or to seal off fissures or voids.

The location of the rotary cored borehole can be seen in the Exploratory Hole Location Plan in Appendix 1 of this report. The rotary core engineer’s logs are in progress and will be provided in the final report. The RC drillers logs can be found in Appendix 4 of this Report.

The above notes outline the procedures used in this site investigation and are in accordance with Eurocode 7 Part 2: Ground Investigation and testing (ISEN 1997 – 2:2007) and B.S. 5930:1999 + A2:2010.

3.2 Ground Conditions

Topsoil was present at the surface for the majority of the exploratory hole locations and extended mostly to depths of up to 0.3m below ground level (bgl).

Made Ground: Made Ground material was encountered in TP6 to a depth of up to 0.7m bgl, consisting of *Soft to firm brown mottled black slightly sandy gravelly CLAY with occasional cobbles , boulders and fragments of plastict*.

Cohesive Deposits: The majority of subsoil's encountered during the investigation were cohesive deposits. The strength and consistency of the deposits varied both with depth and location across the site. For the purposed of this interim draft report, a number of the most typical soil descriptions are listed below. The geotechnical laboratory testing, when complete, will further facilitate the classification of the cohesive deposits.

- *Firm to stiff brown slightly sandy slightly gravelly CLAY with occasional sub rounded to sub angular cobbles and boulders*
- *Soft to firm brown mottled orange and purple slightly sandy slightly gravelly SILT/CLAY with occasional sub angular to sub rounded cobbles and organic content*
- *Stiff grey sandy SILT with cobbles and boulders*
- *Soft to firm laminated sandy SILT and silty SAND*

- *Very soft to soft greenish grey mottled orange slightly sandy clayey SILT*
- *Soft to firm laminated purple and orange slightly gravelly sandy silty CLAY and clayey SILT with few sub rounded to sub angular cobbles and boulders*

Granular Deposits: Occasional granular deposits were encountered during the investigation and smaller lenses were occasionally present within the cohesive deposits. Occasionally the weathered rock was excavatable, and was described as a granular deposit where appropriate. For the purpose of this interim draft report, a number of the most typical soil descriptions are listed below. The geotechnical laboratory testing, when complete, will further facilitate the classification of the granular deposits.

- *Brown mottled orange and purple silty SAND with occasional sub rounded to sub angular cobbles and boulders and organic content*
- *Soft to firm laminated sandy SILT and silty SAND*
- *Loose grey gravelly SAND with a lens of grey brown silty SAND at 1.5m bgl*
- *Blue and black angular coarse GRAVEL and COBBLES of Limestone*
- *Light grey brown clayey sandy GRAVEL of mudstone with frequent angular platey pieces of cobble, pieces of slab (weathered rock)*

Preliminary records indicate that rotary coring revealed underlying strong grey LIMESTONE and calcareous MUDSTONE of the Lucan "Calp" Formation. The rotary core boreholes and photographs will permit the confirmation of the rock type, discontinuities and recovery indices for the rock beneath the proposed site.

3.3 Soakaway Testing

Six soakaway tests were completed at locations distributed throughout the proposed site, to give a representative coverage of the ground conditions. At these locations a pit was excavated and filled with water using a portable water tanker to a nominal invert level. The pit was filled to this level three times where practicable and allowed to drain. The rate of fall in water level was monitored to determine the time to drop from 75% to 25% pit volume.

Two of the soakaway tests permitted the calculation of an infiltration value; however, four of the pits failed to empty with sufficient speed to produce a useable infiltration value and are classified as failures. The soakaway tests were carried out in accordance with BRE Digest 365, Soakaway design. Soakaway test results can be found in Appendix 5 of this report.

4.0 Laboratory Testing

4.1 General

This draft interim report includes a portion of the geotechnical and rock testing which has been scheduled for analysis. The final and complete testing will be provided in the final version of this report. The contamination testing has been completed and is included in the Appendices of this report.

4.2 Geotechnical Laboratory Testing

Samples were selected from the boreholes and trial pits for a range of geotechnical and chemical testing to assist in the classification of soils and to provide information for the design of the proposed development. Testing consisting of Particle Size Distribution

(PSD), moisture content, atterberg limits, organic matter, sulphate and pH testing have been submitted to the laboratory for analysis.

MCV, CBR and Compaction testing have been scheduled to permit an evaluation of the subsoil's for reuse within the proposed development. Lime has been added to selected samples, with testing to be performed at specified durations, to permit an assessment of lime stabilisation of the subsoil's prior to reuse, if required.

The currently available results of this geotechnical testing are included in Appendix 6 of this report. The complete set of test results will be made available, once complete, in the final version of this report.

4.3 Environmental Laboratory Testing

Samples were selected for a range of contamination testing, consisting of the Murphy Suite, ICRLL Maxi Suite and individual analyses of DRO, PRO & Mineral Oil. The samples were sent to Jones Environmental Laboratory in the UK.

The results will permit an assessment of sub soils for disposal, in accordance with European Council Directive 1999 131/EC Article 16 Annex II 'Criteria and procedures for the acceptance of waste at landfills which lays down guidelines for the classification of waste as inert' 'Non Hazardous' and 'Hazardous'.

The final results of this testing is available and can be found in Appendix 7 of this Report.

4.4 Rock Laboratory Testing

Rock samples are being selected during the core logging and sent to the Geotechnical Laboratory for Point Load and Unconfined Compression Strength testing.

The complete set of test results will be made available, once complete, in the final version of this report.

5.0 Gas & Groundwater Monitoring

Borehole water levels were recorded, together with the depths at which seepage of water or inflows can be detected and the observations are noted in the borehole and trial pit logs. In general these observations do not give an accurate indication of the actual ground water conditions as the borehole is rarely left standing at the relevant depth for a sufficient time for the water level to reach equilibrium, a permeable stratum may have been sealed off by the borehole casing or water may have been added to the borehole to facilitate progress.

For this reason gas and groundwater monitoring standpipes were installed in BH01, BH10, RC03, RC12 & RC15. Details of the standpipe and groundwater information can be found on the borehole logs.

Gas and groundwater monitoring will be undertaken at regular intervals throughout the reporting phase and will be included in the final version of this report.

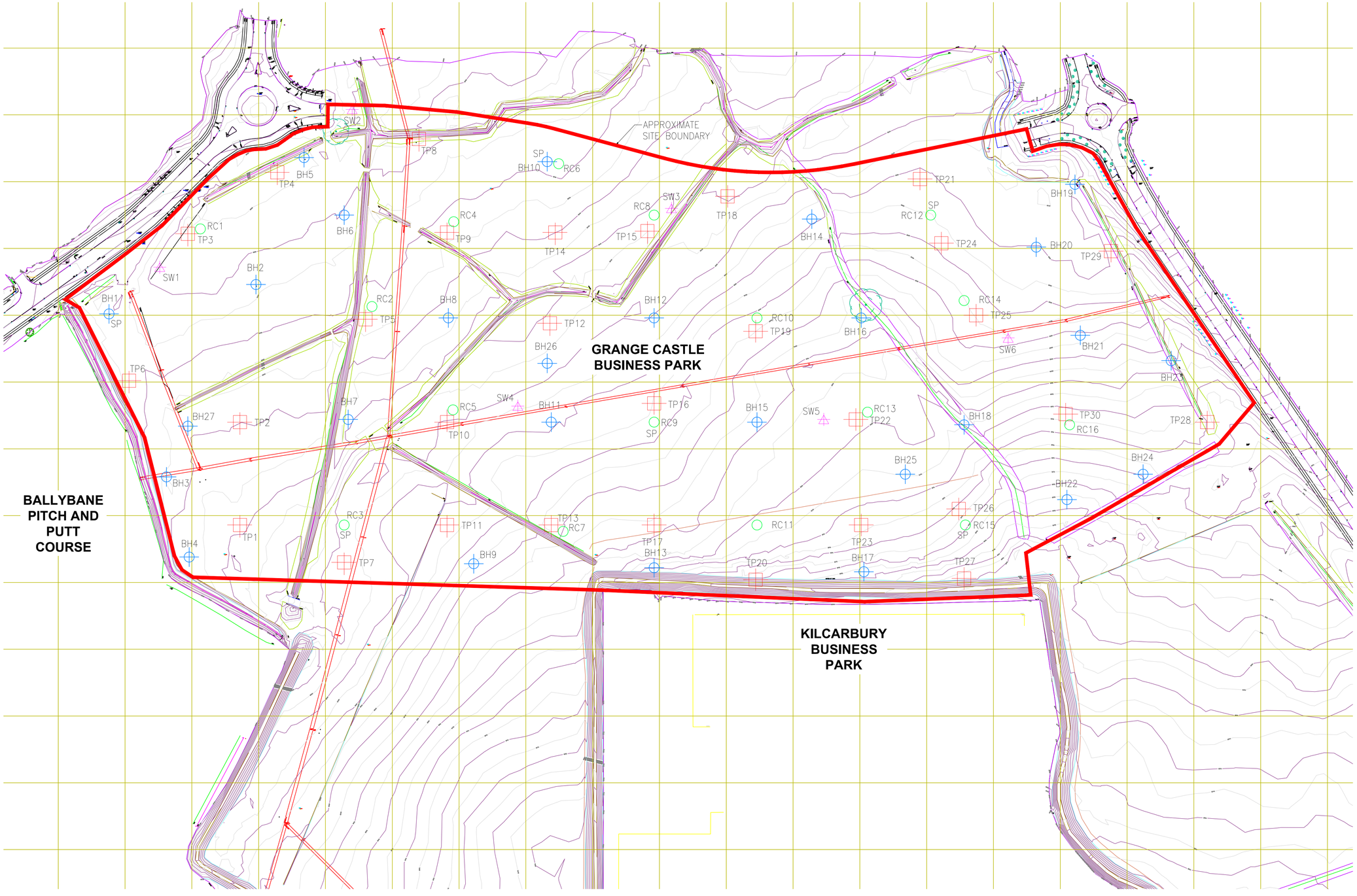
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Appendix 1 Site Location Plan

A1

LEGEND

- TRIAL PIT LOCATIONS (30 NO.)
- SHELL & AUGER WITH ROTARY FOLLOW ON (27 NO.)
- ROTARY COREHOLE ONLY (16 NO.)
- SOAK AWAY LOCATIONS (6 NO.)
- SP STANDPIPE LOCATIONS (6 NO.)



GENERAL NOTES:

TP/BH/RC CO-ORDINATES

TRIAL PITS		
Location	Easting	Northing
TP1	703336	731293
TP2	703336	731370
TP3	703297	731511
TP4	703364	731557
TP5	703430	731447
TP6	703253	731401
TP7	703414	731265
TP8	703470	731582
TP9	703491	731512
TP10	703491	731370
TP11	703491	731293
TP12	703568	731444
TP13	703569	731293
TP14	703572	731512
TP15	703641	731513
TP16	703646	731384
TP17	703646	731293
TP18	703701	731539
TP19	703722	731438
TP20	703722	731252
TP21	703845	731552
TP22	703797	731372
TP23	703801	731293
TP24	703861	731504
TP25	703887	731450
TP26	703874	731305
TP27	703878	731253
TP28	704060	731370
TP29	703988	731498
TP30	703954	731376

SHELL & AUGER WITH ROTARY FOLLOW ON		
Location	Easting	Northing
BH1	703238	731451
BH2	703348	731473
BH3	703281	731329
BH4	703298	731269
BH5	703384	731568
BH6	703414	731525
BH7	703417	731372
BH8	703492	731448
BH9	703511	731264
BH10	703566	731565
BH11	703569	731370
BH12	703646	731448
BH13	703646	731261
BH14	703764	731522
BH15	703723	731370
BH16	703801	731448
BH17	703803	731258
BH18	703878	731368
BH19	703961	731548
BH20	703932	731501
BH21	703965	731435
BH22	703955	731312
BH23	704033	731416
BH24	704012	731331
BH25	703834	731331
BH26	703566	731414
BH27	703297	731367

ROTARY COREHOLE ONLY		
Location	Easting	Northing
RC1	703304	731513
RC2	703433	731449
RC3	703414	731293
RC4	703496	731520
RC5	703491	731370
RC6	703568	731565
RC7	703569	731293
RC8	703646	731525
RC9	703646	731370
RC10	703723	731448
RC11	703723	731293
RC12	703853	731525
RC13	703802	731371
RC14	703878	731461
RC15	703879	731293
RC16	703957	731368

SOAK-AWAY		
Location	Easting	Northing
SW01	703276	731486
SW02	703420	731604
SW03	703659	731530
SW04	703544	731382
SW05	703773	731372
SW06	703911	731433

Rev	Date	Revision	by	chkd
01	01/07/13	CO-ORDINATED REVISED	DM	MR
00	14/05/13	ISSUED FOR INFORMATION	AC	MR

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CLIENT
HANLEY PEPPER CONSULTING ENGINEERS

PROJECT
GRANGE CASTLE BUSINESS PARK

DRAWING TITLE
SITE INVESTIGATION PLAN
LAYOUT

STATUS
FOR INFORMATION

drawn by: AC	date 14/05/13	scale: 1:1500	chk: MR

project no	drg.no.	rev.
B1209	02	01

Appendix 2 Trial Pit Records

TRIAL PIT RECORD

Project Name: Grangecastle Business Park **Hole ID:** TP1

Client: Hanley Pepper
Consultant: BLP
Location: Grangecastle
Date: 22/05/2013
Excavator used: 8T Tracked

Co-ordinates: 703336.00 731293.00
Elevation: 66.950
Project no. 3718-05-13
Logged by: C Finnerty

Strata Description	Legend	Depth	Level (mOD)	Samples / tests Type	Depth	Result	Water Depth	Date
TOPSOIL								
		0.30	66.65					
Soft to firm light brown sandy slightly gravelly CLAY								
		0.50	66.45					
Firm brown mottled orange and purple slightly sandy slightly gravelly CLAY with occasional sub rounded to sub angular cobbles								
		1						
		1.10	65.85					
Firm black slightly sandy slighlty gravelly SILT/CLAY with occasional sub rounded to sub angular cobbles and organic content				B	1.50			
		2						
		2.20	64.75					
Angular coarse GRAVEL and COBBLES of Limestone		2.30	64.65					
End of Trial pit at 2.30 m								
		3						
		4						

Remarks:

Stability: Pit sides stable
Water: Moderate seepage at 2.2m bgl
Remarks:

KEY

B Bulk disturbed sample.
D Small disturbed sample
U Undisturbed sample

Dimensions: 3.00
Depth: 0.70
2.30

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TRIAL PIT RECORD

Project Name: Grangecastle Business Park — Hole ID: TP2

Client: Hanley Pepper
Consultant: BLP
Location: Grangecastle
Date: 22/05/2013
Excavator used: 8T Tracked

Co-ordinates: 703336.00 731370.00
Elevation: 66.500
Project no. 3718-05-13
Logged by: C Finnerty

Strata Description	Legend	Depth	Level (mOD)	Samples / tests: Type	Samples / tests: Depth	Samples / tests: Result	Water Depth	Date
TOPSOIL								
Soft to firm orangish brown mottled grey slightly sandy slightly gravelly CLAY		0.30	66.20					
Firm brown slightly sandy slightly gravelly CLAY with occasional sub rounded to sub angular cobbles and boulders		0.50 0.60	66.00 65.90					
Soft to firm dark grey mottled orange and brown slightly sandy slighlty gravelly SILT/CLAY with occasional sub rounded to sub angular cobbles and organic content		1		B T	0.90 0.90			
Blue and black angular coarse GRAVEL and COBBLES of Limestone		1.20	65.30	B	1.20			
End of Trial pit at 1.40 m		1.40	65.10	B	1.40			
		2						
		3						
		4						

Remarks:

Stability: Pit sides stable
Water: Slow to moderate seepage at 1.2m bgl
Remarks:

KEY

B Bulk disturbed sample.
D Small disturbed sample
U Undisturbed sample

Dimensions: 3.00
Depth: 0.70
1.40

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TRIAL PIT RECORD

Project Name: Grangecastle Business Park — Hole ID: TP3

Client: Hanley Pepper
Consultant: BLP
Location: Grangecastle
Date: 22/05/2013
Excavator used: 8T Tracked

Co-ordinates: 703297.00 731511.00
Elevation: 65.300
Project no. 3718-05-13
Logged by: C Finnerty

Strata Description	Legend	Depth	Level (mOD)	Samples / tests: Type	Samples / tests: Depth	Samples / tests: Result	Water Depth	Date
TOPSOIL								
		0.30	65.00					
Soft to firm orangey brown mottled purple sandy slightly gravelly CLAY								
		0.60	64.70					
Firm to stiff brown slightly sandy slightly gravelly CLAY with occasional sub rounded to sub angular cobbles and boulders								
		1		B T	1.00 1.00			
		1.20	64.10					
Soft to firm black mottled orange and grey slightly sandy slighlty gravelly SILT/CLAY with occasional sub rounded to sub angular cobbles and organic content				B T	1.50 1.50			
		1.60	63.70	T	1.60			
Angular coarse GRAVEL and COBBLES of Limestone		1.70	63.60					
End of Trial pit at 1.70 m								
		2						
		3						
		4						

Remarks:

Stability: Pit sides stable
Water: Slow seepage at 1.65m bgl
Remarks:

KEY

B Bulk disturbed sample.
D Small disturbed sample
U Undisturbed sample

Dimensions: 3.00
Depth: 0.70
1.70

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TRIAL PIT RECORD

Project Name: Grangecastle Business Park **Hole ID:** TP4

Client: Hanley Pepper
Consultant: BLP
Location: Grangecastle
Date: 22/05/2013
Excavator used: 8T Tracked

Co-ordinates: 703364.00 731557.00
Elevation: 65.100
Project no. 3718-05-13
Logged by: C Finnerty

Strata Description	Legend	Depth	Level (mOD)	Samples / tests: Type	Samples / tests: Depth	Samples / tests: Result	Water Depth	Date
TOPSOIL								
Soft to firm orangish brown mottled purple sandy slightly gravelly CLAY		0.30	64.80					
Firm brown slightly sandy slightly gravelly CLAY with occasional sub rounded to sub angular cobbles and boulders		0.60	64.50					
		1		B	1.00			
				B	1.50			
Stiff black slightly sandy slighlty gravelly CLAY with occasional sub rounded to sub angular cobbles		1.70	63.40	B	1.70			
		1.80	63.30	B	1.80			
Blue and black angular coarse GRAVEL and COBBLES of Limestone		1.90	63.20					
End of Trial pit at 1.90 m		2						
		3						
		4						

Remarks:

Stability: Pit sides stable
Water: Slow seepage at 1.8m bgl
Remarks:

KEY

B Bulk disturbed sample.
D Small disturbed sample
U Undisturbed sample

Dimensions: 3.00
Depth: 0.70
1.90

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TRIAL PIT RECORD

Project Name: Grangecastle Business Park — Hole ID: TP5

Client: Hanley Pepper
Consultant: BLP
Location: Grangecastle
Date: 23/05/2013
Excavator used: 8T Tracked

Co-ordinates: 703430.00 731447.00
Elevation: 66.100
Project no. 3718-05-13
Logged by: C Finnerty

Strata Description	Legend	Depth	Level (mOD)	Samples / tests: Type	Depth	Result	Water Depth	Date
TOPSOIL								
Soft to firm brown mottled orange and purple slightly sandy slightly gravelly SILT/CLAY with occasional sub angular to sub rounded cobbles and organic content		0.30	65.80					
		0.50	65.60					
Firm bluish grey mottled orange slightly sandy slightlly gravelly SILT/CLAY with occasional sub angular to sub rounded cobbles and organic content		1.00	65.10					
Firm to stiff bluish black slighlty sandy slightly gravelly CLAY with occasional sub angular to sub rounded cobbles and organic content								
		1.80	64.30					
Black angular coarse GRAVEL and COBBLES of Shale / Mudstone		1.90	64.20					
End of Trial pit at 1.90 m		2						
		3						
		4						

Remarks:

Stability: Pit sides stable
Water: Slow to moderate seepage at 1.8m bgl
Remarks:

KEY

B Bulk disturbed sample.
D Small disturbed sample
U Undisturbed sample

Dimensions: 3.30
Depth: 1.90
0.70

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TRIAL PIT RECORD

Project Name: Grangecastle Business Park **Hole ID:** TP6

Client: Hanley Pepper
Consultant: BLP
Location: Grangecastle
Date: 22/05/2013
Excavator used: 8T Tracked

Co-ordinates: 703253.00 731401.00
Elevation: 66.850
Project no. 3718-05-13
Logged by: C Finnerty

Strata Description	Depth	Level (mOD)	Samples / tests: Type	Samples / tests: Depth	Samples / tests: Result	Water Depth	Date
TOPSOIL							
MADE GROUND: Soft to firm brown mottled black slightly sandy gravelly CLAY with occasional cobbles and boulders with fragments of plastic fencing	0.30	66.55	B	0.50			
Firm to stiff brown slightly sandy slightly gravelly CLAY	0.70	66.15					
Soft to firm black mottled orange and grey slightly sandy slighlty gravelly SILT/CLAY with occasional sub rounded to sub angular cobbles and organic content	0.90	65.95					
	1		B T	1.00 1.00			
Black clayey sandy angular coarse GRAVEL with frequent angular cobbles of shale/mudstone (Possible weathered rock)	1.40	65.45					
	2		T	2.00			
			W	2.20			
Black angular coarse GRAVEL and COBBLES of Shale/Mudstone (Weathered Rock)	2.30	64.55					
			B	2.50			
End of Trial pit at 2.60 m	2.60	64.25					
	3						
	4						

Remarks:

Stability: Pit sides spalling below 1.6m
Water: Slow seepage at 2.0m bgl
Remarks:

KEY

B Bulk disturbed sample.
D Small disturbed sample
U Undisturbed sample

Dimensions: 3.00
Depth: 0.70
2.60

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TRIAL PIT RECORD

Project Name: Grangecastle Business Park — Hole ID: TP7

Client: Hanley Pepper
Consultant: BLP
Location: Grangecastle
Date: 22/05/2013
Excavator used: 8T Tracked

Co-ordinates: 703414.00 731265.00
Elevation: 68.100
Project no. 3718-05-13
Logged by:

Strata Description	Legend	Depth	Level (mOD)	Samples / tests: Type	Samples / tests: Depth	Samples / tests: Result	Water Depth	Date
TOPSOIL								
Firm brown mottled orange and grey slightly sandy slightly gravelly CLAY with organic content		0.30	67.80					
becoming firm to stiff below 0.7m				B T	0.70 0.70			
		1		B	1.00			
Blue and black angular coarse GRAVEL and COBBLES of Limestone		1.10	67.00					
		1.20	66.90					
End of Trial pit at 1.20 m								

Remarks:

Stability: Pit sides stable
Water: No groundwater encountered
Remarks:

KEY

B Bulk disturbed sample.
D Small disturbed sample
U Undisturbed sample

Dimensions: 3.00
Depth: 0.70
1.20

GROUND INVESTIGATIONS IRELAND
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TRIAL PIT RECORD

Project Name: Grangecastle Business Park **Hole ID:** TP8

Client: Hanley Pepper
Consultant: BLP
Location: Grangecastle
Date: 23/05/2013
Excavator used: 8T Tracked

Co-ordinates: 703470.00 731582.00
Elevation: 65.200
Project no. 3718-05-13
Logged by: C Finnerty

Strata Description	Legend	Depth	Level (mOD)	Samples / tests: Type	Samples / tests: Depth	Samples / tests: Result	Water Depth	Date
TOPSOIL								
		0.30	64.90					
Firm brown mottled orange and purple silty SAND with occasional sub rounded to sub angular cobbles and boulders and organic content				B T	0.70 0.70			
		1.00	64.20					
Brownish grey gravelly SAND (wet)				B T	1.30 1.30			
		1.40	63.80					
Firm black slightly sandy slightlly gravelly SILT/CLAY with occasional sub angular to sub rounded cobbles and boulders				B	1.50			
		1.80	63.40					
Blue and black angular coarse GRAVEL and COBBLES of Limestone		1.90	63.30					
End of Trial pit at 1.90 m		2						
		3						
		4						

Remarks:

Stability: Pit sides stable
Water: Slow seepage at 1.4m bgl
Remarks: Land drain encountered at 0.7m with fast seepage into pit. Pit extended to progress trial pit.

KEY

B Bulk disturbed sample.
D Small disturbed sample
U Undisturbed sample

Dimensions: 4.30
Depth: 0.70
1.90

GROUND INVESTIGATIONS IRELAND
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TRIAL PIT RECORD

Project Name: Grangecastle Business Park — Hole ID: TP9

Client: Hanley Pepper
Consultant: BLP
Location: Grangecastle
Date: 23/05/2013
Excavator used: 8T Tracked

Co-ordinates: 703491.00 731512.00
Elevation: 66.100
Project no. 3718-05-13
Logged by: C Finnerty

Strata Description	Depth	Level (mOD)	Samples / tests: Type	Samples / tests: Depth	Samples / tests: Result	Water Depth	Date
TOPSOIL							
	0.30	65.80	B	0.35			
Very soft to soft greenish grey mottled orange slightly sandy clayey SILT	0.40	65.70					
			B	0.50			
			T	0.50			
Soft to firm brown mottled orange and purple slightly sandy slightly gravelly SILT/CLAY with occasional sub angular to sub rounded cobbles and organic content	0.70	65.40					
	1		B	1.00			
			T	1.00			
Soft to firm bluish grey mottled orange slightly sandy slightlly gravelly SILT/CLAY with occasional sub angular to sub rounded cobbles and organic content							
	1.90	64.20					
Blue and black angular coarse GRAVEL and COBBLES of Limestone	2.00	64.10					
End of Trial pit at 2.00 m							
	3						
	4						

Remarks:

Stability: Pit sides stable
Water: Slow seepage at 1.2m bgl
Remarks:

KEY

B Bulk disturbed sample.
D Small disturbed sample
U Undisturbed sample

Dimensions: 3.30
Depth: 0.70
2.00

GROUND INVESTIGATIONS IRELAND
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TRIAL PIT RECORD

Project Name: Grangecastle Business Park **Hole ID:** TP10

Client: Hanley Pepper
Consultant: BLP
Location: Grangecastle
Date: 23/05/2013
Excavator used: 8T Tracked

Co-ordinates: 703491.00 731370.00
Elevation: 68.000
Project no. 3718-05-13
Logged by: C Finnerty

Strata Description	Legend	Depth	Level (mOD)	Samples / tests: Type	Samples / tests: Depth	Samples / tests: Result	Water Depth	Date
TOPSOIL								
Soft orange brown sandy slightly gravelly CLAY		0.30	67.70					
Firm to stiff grey brown and orange and purple slightly sandy slightly gravelly clayey SILT and silty CLAY with occasional sub rounded to sub angular cobbles and boulders frequent cobbles and boulders below 2.0m		1.00	67.00	B T	1.50 1.50			
		2						
Firm to stiff brown mottled orange and purple slightly sandy slightly gravelly CLAY/SILT becoming very gravelly below 2.0m		2.20	65.80					
Blue and black angular COBBLES of Limestone and Shale/Mudstone		2.30	65.70					
End of Trial pit at 2.30 m								
		3						
		4						

Remarks:

Stability: Pit sides collapsing below 1.0m
Water: Slow to moderate seepage at 1.2m bgl
Remarks:

KEY

B Bulk disturbed sample.
D Small disturbed sample
U Undisturbed sample

Dimensions: 3.00
Depth: 0.70
2.30

GROUND INVESTIGATIONS IRELAND
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TRIAL PIT RECORD

Project Name: Grangecastle Business Park — Hole ID: TP11

Client: Hanley Pepper
Consultant: BLP
Location: Grangecastle
Date: 22/05/2013
Excavator used: 8T Tracked

Co-ordinates: 703491.00 731293.00
Elevation: 68.600
Project no. 3718-05-13
Logged by: C Finnerty

Strata Description	Legend	Depth	Level (mOD)	Samples / tests: Type	Samples / tests: Depth	Samples / tests: Result	Water Depth	Date
TOPSOIL								
Firm redish brown sandy slightly gravelly CLAY		0.30	68.30	B	0.50			
Brown mottled orange and grey slightly sandy slightly gravelly CLAY with occasional sub rounded to sub angular cobbles and boulders		0.90 1	67.70	B	1.60			
Soft to firm laminated orange brown sandy silty CLAY and purple clayey SILT		1.70	66.90	B	1.80			
Blue and black angular coarse GRAVEL and COBBLES of Limestone		2.00 2.10	66.60 66.50					
End of Trial pit at 2.10 m		3 4						

Remarks:

Stability: Pit sides stable
Water: Moderate to fast seepage at 1.8m bgl
Remarks:

KEY

B Bulk disturbed sample.
D Small disturbed sample
U Undisturbed sample

Dimensions: 3.00
Depth: 0.70
2.10

GROUND INVESTIGATIONS IRELAND
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TRIAL PIT RECORD

Project Name: Grangecastle Business Park — Hole ID: TP12

Client: Hanley Pepper
Consultant: BLP
Location: Grangecastle
Date: 23/05/2013
Excavator used: 8T Tracked

Co-ordinates: 703568.00 731444.00
Elevation: 67.600
Project no. 3718-05-13
Logged by: C Finnerty

Strata Description	Legend	Depth	Level (mOD)	Samples / tests: Type	Samples / tests: Depth	Samples / tests: Result	Water Depth	Date
TOPSOIL								
Soft brown slightly sandy slightly gravelly CLAY with occasional sub angular to sub rounded cobbles and boulders		0.30	67.30					
Firm to stiff purple mottled orange slightly sandy slightly gravelly SILT/CLAY with occasional sub rounded to sub angular cobbles and boulders		0.70	66.90					
		1		B	1.00			
Firm to stiff brown mottled orange and purple slightly sandy slightly gravelly CLAY/SILT becoming very gravelly below 2.0m		1.50	66.10					
				B	1.70			
		2						
Blue and black angular COBBLES of Limestone and Shale/Mudstone		2.20	65.40	B	2.20			
		2.30	65.30					
End of Trial pit at 2.30 m								
		3						
		4						

Remarks:

Stability: Pit sides stable
Water: Fast seepage at 1.2m bgl
Remarks:

KEY

B Bulk disturbed sample.
D Small disturbed sample
U Undisturbed sample

Dimensions: 3.00
Depth: 0.70
2.30

GROUND INVESTIGATIONS IRELAND
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TRIAL PIT RECORD

Project Name: Grangecastle Business Park **Hole ID:** TP13

Client: Hanley Pepper
Consultant: BLP
Location: Grangecastle
Date: 23/05/2013
Excavator used: 8T Tracked

Co-ordinates: 703569.00 731293.00
Elevation: 69.300
Project no. 3718-05-13
Logged by: C Finnerty

Strata Description	Legend	Depth	Level (mOD)	Samples / tests: Type	Samples / tests: Depth	Samples / tests: Result	Water Depth	Date
TOPSOIL								
Soft to firm orange brown sandy slighty gravelly CLAY		0.30	69.00					
Soft to firm grey brown mottled purple and orange slightly gravelly slightly sandy CLAY with occasional sub rounded to sub angular cobbles and boulders		0.60	68.70					
		1						
		2						
Firm to stiff black occasionally mottled green slightly sandy slightly gravelly CLAY with occasional sub rounded to sub angular cobbles and boulders		2.60	66.70					
		3		B T	3.00 3.00			
End of Trial pit at 3.20 m		3.20	66.10					
		4						

Remarks:

Stability: Pit sides stable
Water: Slow seepage at 2.2m bgl
Remarks:

KEY

B Bulk disturbed sample.
D Small disturbed sample
U Undisturbed sample

Dimensions: 3.00
Depth: 0.70
3.20

GROUND INVESTIGATIONS IRELAND
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TRIAL PIT RECORD

Project Name: Grangecastle Business Park **Hole ID:** TP14

Client: Hanley Pepper
Consultant: BLP
Location: Grangecastle
Date: 23/05/2013
Excavator used: 8T Tracked

Co-ordinates: 703572.00 731512.00
Elevation: 66.500
Project no. 3718-05-13
Logged by: C Finnerty

Strata Description	Legend	Depth	Level (mOD)	Samples / tests: Type	Samples / tests: Depth	Samples / tests: Result	Water Depth	Date
TOPSOIL								
		0.30	66.20					
Soft orange brown mottled slightly gravelly snady CLAY with rootlets								
		0.50	66.00	B	0.50			
Soft to firm grey mottled orange and green slightly sandy slightly gravelly CLAY/SILT								
		0.90	65.60					
Loose grey gravelly SAND		1		B	1.00			
lense of grey brown silty SAND at 1.5m								
		1.70	64.80					
Soft to firm laminated sandy SILT and sitly SAND				T B	1.80 1.80			
		2						
		2.20	64.30					
Black slightly sandy gravelly CLAY with occasional sub angular to sub rounded cobbles				B	2.30			
		2.40	64.10					
Black slightly sandy gravelly CLAY with frequent angular cobbles		2.50	64.00					
End of Trial pit at 2.50 m								
		3						
		4						

Remarks:

Stability: Pit sides collapsing below 0.9m
Water: Fast seepage at 1.5m bgl
Remarks:

KEY

B	Bulk disturbed sample.
D	Small disturbed sample
U	Undisturbed sample

Dimensions: 4.30
Depth: 0.70
2.50

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TRIAL PIT RECORD

Project Name: Grangecastle Business Park — Hole ID: TP15

Client: Hanley Pepper
Consultant: BLP
Location: Grangecastle
Date: 23/05/2013
Excavator used: 8T Tracked

Co-ordinates: 703641.00 731513.00
Elevation: 67.250
Project no. 3718-05-13
Logged by: C Finnerty

Strata Description	Legend	Depth	Level (mOD)	Samples / tests: Type	Depth	Result	Water Depth	Date
TOPSOIL								
Soft to firm brown mottled orange and purple slightly sandy slightly gravelly CLAY/SILT with occasional sub angular to sub rounded cobbles and boulders		0.30	66.95					
Firm to stiff brown slightly sandy slightly gravelly CLAY with frequent sub rounded to sub angular cobbles and boulders		1.20	66.05					
Blue and black angular COBBLES of Limestone and Shale/Mudstone		1.80	65.45					
End of Trial pit at 2.00 m		2.00	65.25					

Remarks:

Stability: Pit sides stable
Water: Moderate to fast seepage at 1.5m bgl
Remarks:

KEY

B Bulk disturbed sample.
D Small disturbed sample
U Undisturbed sample

Dimensions: 4.30
Depth: 0.70
2.00

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TRIAL PIT RECORD

Project Name: Grangecastle Business Park — Hole ID: TP16

Client: Hanley Pepper
Consultant: BLP
Location: Grangecastle
Date: 24/05/2013
Excavator used: 8T Tracked

Co-ordinates: 703646.00 731384.00
Elevation: 68.750
Project no. 3718-05-13
Logged by: C Finnerty

Strata Description	Legend	Depth	Level (mOD)	Samples / tests: Type	Samples / tests: Depth	Samples / tests: Result	Water Depth	Date
TOPSOIL								
		0.30	68.45					
Soft orange brown sandy slightly gravelly CLAY								
		0.50	68.25					
Firm laminated brown purple and orange sandy slightly gravelly CLAY								
		1						
		1.20	67.55					
Firm to stiff purple orange laminations of slightly sandy slightly gravelly CLAY / SILT with sub angular and sub rounded cobbles								
		2		B	2.00			
		2.30	66.45					
Platey blue LIMESTONE		2.40	66.35					
End of Trial pit at 2.40 m								
		3						
		4						

Remarks:

Stability: Collapse below 1.5m
Water: Slow seepage at 1.2m bgl
Remarks:

KEY

B Bulk disturbed sample.
D Small disturbed sample
U Undisturbed sample

Dimensions: 3.00
Depth: 0.65
2.40

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TRIAL PIT RECORD

Project Name: Grangecastle Business Park **Hole ID:** TP17

Client: Hanley Pepper
Consultant: BLP
Location: Grangecastle
Date: 23/05/2013
Excavator used: 8T Tracked

Co-ordinates: 703646.00 731293.00
Elevation: 69.800
Project no. 3718-05-13
Logged by: C Finnerty

Strata Description	Legend	Depth	Level (mOD)	Samples / tests: Type	Samples / tests: Depth	Samples / tests: Result	Water Depth	Date
TOPSOIL								
		0.30	69.50					
Soft to firm orange brown sandy slighty gravelly CLAY		0.40	69.40					
Soft to firm grey brown mottled purple and orange slightly gravelly slightly sandy CLAY with occasional sub rounded to sub angular cobbles and boulders		1		B T	1.00 1.00			
		2		B T	2.00 2.00			
		2.40	67.40					
Soft to firm laminated purple and orange slightly gravelly snady silty CLAY and clayey SILT with few sub rounded to sub angular cobbles and boulders				B T	2.60 2.60			
		3						
		3.10	66.70	B W	3.10 3.10			
Blue and black angular GRAVEL and COBBLES of Shale/Mudstone		3.20	66.60	B	3.20			
End of Trial pit at 3.20 m								
		4						

Remarks:

Stability: Pit sides stable
Water: Slow seepage at 2.5m bgl
Remarks:

KEY

B Bulk disturbed sample.
D Small disturbed sample
U Undisturbed sample

Dimensions: 3.00
Depth: 0.70
3.20

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TRIAL PIT RECORD

Project Name: Grangecastle Business Park — Hole ID: TP18

Client: Hanley Pepper
Consultant: BLP
Location: Grangecastle
Date: 24/05/2013
Excavator used: 8T Tracked

Co-ordinates: 703701.00 731539.00
Elevation: 67.500
Project no. 3718-05-13
Logged by: C Finnerty

Strata Description	Legend	Depth	Level (mOD)	Samples / tests: Type	Samples / tests: Depth	Samples / tests: Result	Water Depth	Date
TOPSOIL				T	0.20			
		0.30	67.20					
Soft brown sandy slighty gravelly CLAY								
		0.60	66.90	B	0.60			
Soft to firm grey mottled green and orange slightly sandy gravelly CLAY with weathered rock								
		1.00	66.50	B T	1.00 1.00			
Grey very clayey sandy GRAVEL				B	1.20			
		1.40	66.10					
Blue LIMESTONE with cobbles		1.50	66.00					
End of Trial pit at 1.50 m								
		2						
		3						
		4						

Remarks:

Stability: Pit sides stable
Water: Slow seepage at 1.4m bgl
Remarks:

KEY

B Bulk disturbed sample.
D Small disturbed sample
U Undisturbed sample

Dimensions: 3.00
Depth: 0.70
1.50

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TRIAL PIT RECORD

Project Name: Grangecastle Business Park — Hole ID: TP19

Client: Hanley Pepper
Consultant: BLP
Location: Grangecastle
Date: 24/05/2013
Excavator used: 8T Tracked

Co-ordinates: 703722.00 731438.00
Elevation: 69.250
Project no. 3718-05-13
Logged by: C Finnerty

Strata Description	Legend	Depth	Level (mOD)	Samples / tests: Type	Samples / tests: Depth	Samples / tests: Result	Water Depth	Date
TOPSOIL								
Soft orange brown sandy slightly gravelly CLAY		0.30	68.95	B	0.50			
Firm brown slightly sandy slightly gravelly CLAY with occasional sub angular and sub rounded cobbles		0.60	68.65					
		1		B	1.00			
Firm to stiff grey and orange laminated clayey sandy GRAVEL with occasional fine to coarse angular blocky mudstone		1.30	67.95					
		2		B	2.00			
End of Trial pit at 2.40 m		2.40	66.85					
		3						
		4						

Remarks:

Stability: Sides pit stable
Water: No groundwater encountered
Remarks:

KEY

B Bulk disturbed sample.
D Small disturbed sample
U Undisturbed sample

Dimensions: 3.00
Depth: 0.65
2.40

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TRIAL PIT RECORD

Project Name: Grangecastle Business Park **Hole ID:** TP20

Client: Hanley Pepper
Consultant: BLP
Location: Grangecastle
Date: 24/05/2013
Excavator used: 8T Tracked

Co-ordinates: 703722.00
731252.00
Elevation: 72.000
Project no. 3718-05-13
Logged by: C Finnerty

Strata Description	Legend	Depth	Level (mOD)	Samples / tests: Type	Depth	Result	Water Depth	Date
TOPSOIL								
Soft to firm grey brown stiff slightly sandy slighty gravelly CLAY with occasional cobbles and boulders		0.30	71.70					
Stiff brown slightly sandy slightly gravelly CLAY		1.60	70.40					
Light grey brown very sandy slightly gravelly CLAY with some cobbles and sub angular limestone		1.80	70.20					
Angular platey COBBLES shed pieces of shale		2.60	69.40					
End of Trial pit at 2.70 m		2.70	69.30					

Remarks:

Stability: Pit sides stable
Water: No groundwater encountered
Remarks:

KEY

B Bulk disturbed sample.
D Small disturbed sample
U Undisturbed sample

Dimensions: 3.80
Depth: 0.65
2.70

GROUND INVESTIGATIONS IRELAND
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TRIAL PIT RECORD

Project Name: Grangecastle Business Park — Hole ID: TP21

Client: Hanley Pepper
Consultant: BLP
Location: Grangecastle
Date: 24/05/2013
Excavator used: 8T Tracked

Co-ordinates: 703845.00 731552.00
Elevation: 68.100
Project no. 3718-05-13
Logged by: C Finnerty

Strata Description	Legend	Depth	Level (mOD)	Samples / tests Type	Depth	Result	Water Depth	Date
TOPSOIL								
		0.30	67.80					
Brown mottled orange and purple slightly sandy slightly gravelly CLAY		0.50	67.60					
Brown mottled orange and purple slightly sandy slightly gravelly CLAY				B T	0.70 0.70			
		1						
		1.20	66.90	B T	1.20 1.20			
Firm to stiff brown mottled grey blue orange slightly sandy slightly gravelly clayey SILT and silty CLAY with cobbles		1.40	66.70					
Stiff grey mudstone / shale sandy GRAVEL with cobbles and boulders		1.50	66.60	B	1.50			
Blue LIMESTONE								
		2						
End of Trial pit at 2.10 m		2.10	66.00					
		3						
		4						

Remarks:

Stability: Pit sides stable
Water: No groundwater encountered
Remarks:

KEY

B Bulk disturbed sample.
D Small disturbed sample
U Undisturbed sample

Dimensions: 3.80
Depth: 0.65
2.10

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TRIAL PIT RECORD

Project Name: Grangecastle Business Park **Hole ID:** TP22

Client: Hanley Pepper
Consultant: BLP
Location: Grangecastle
Date: 24/05/2013
Excavator used: 8T Tracked

Co-ordinates: 703797.00 731372.00
Elevation: 70.400
Project no. 3718-05-13
Logged by: C Finnerty

Strata Description	Legend	Depth	Level (mOD)	Samples / tests: Type	Samples / tests: Depth	Samples / tests: Result	Water Depth	Date
TOPSOIL								
Soft orange brown sandy slightly gravelly CLAY		0.30	70.10					
Firm brown mottled orange slightly sandy slightly gravelly CLAY with limestone cobbles becoming more granular below 1.3		0.80	69.60					
		1						
Stiff to hard grey clayey sandy fine to coarse GRAVEL of mudstone		1.70	68.70					
		2						
Weathered ROCK		2.90	67.50					
End of Trial pit at 3.00 m		3.00	67.40					
		4						

Remarks:

Stability: Pit sides stable
Water: No groundwater encountered
Remarks:

KEY

B Bulk disturbed sample.
D Small disturbed sample
U Undisturbed sample

Dimensions: 3.00
Depth: 0.65
3.00

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TRIAL PIT RECORD

Project Name: Grangecastle Business Park **Hole ID:** TP23

Client: Hanley Pepper
Consultant: BLP
Location: Grangecastle
Date: 24/05/2013
Excavator used: 8T Tracked

Co-ordinates: 703801.00 731293.00
Elevation: 71.150
Project no. 3718-05-13
Logged by: C Finnerty

Strata Description	Legend	Depth	Level (mOD)	Samples / tests Type	Samples / tests Depth	Samples / tests Result	Water Depth	Date
TOPSOIL								
Firm brown sandy gravelly CLAY matrix with cobbles and boulders		0.40	70.75					
Stiff brown slightly sandy slightly gravelly CLAY		0.60	70.55	B	0.70			
		1						
				B	1.50			
Light grey brown clayey sandy GRAVEL of mudstone with frequent angular platey pieces of cobble, pieces of slab (weathered rock)		1.80	69.35					
		2		B	2.00			
End of Trial pit at 2.40 m		2.40	68.75	B	2.40			
		3						
		4						

Remarks:

Stability: Pit sides stable
Water: No groundwater encountered
Remarks:

KEY

B Bulk disturbed sample.
D Small disturbed sample
U Undisturbed sample

Dimensions: 3.80
Depth: 0.65
2.40

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TRIAL PIT RECORD

Project Name: Grangecastle Business Park — Hole ID: TP24

Client: Hanley Pepper
Consultant: BLP
Location: Grangecastle
Date: 24/05/2013
Excavator used: 8T Tracked

Co-ordinates: 703861.00 731504.00
Elevation: 68.400
Project no. 3718-05-13
Logged by: C Finnerty

Strata Description	Legend	Depth	Level (mOD)	Samples / tests: Type	Samples / tests: Depth	Samples / tests: Result	Water Depth	Date
TOPSOIL								
Soft to firm redish brown slightly sandy slightly gravelly CLAY		0.30	68.10					
Soft grey brown slightly sandy slightly gravelly CLAY with occasional cobbles		0.50	67.90					
Soft to firm orange sandstone gravel COBBLES of limestone		0.90	67.50					
		1		B	1.20			
Stiff brown mottled purple and orange slightly sandy slightly gravelly CLAY / SILT		1.30	67.10					
		2		B	2.00			
Angular blue LIMESTONE block		2.50	65.90					
End of Trial pit at 2.60 m		2.60	65.80					
		3						
		4						

Remarks:

Stability: Pit sides stable
Water: No groundwater encountered
Remarks:

KEY

B Bulk disturbed sample.
D Small disturbed sample
U Undisturbed sample

Dimensions: 0.00
Depth: 0.00
2.60

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TRIAL PIT RECORD

Project Name: Grangecastle Business Park — Hole ID: TP25

Client: Hanley Pepper
Consultant: BLP
Location: Grangecastle
Date: 24/05/2013
Excavator used: 8T Tracked

Co-ordinates: 703887.00 731450.00
Elevation: 68.750
Project no. 3718-05-13
Logged by: C Finnerty

Strata Description	Legend	Depth	Level (mOD)	Samples / tests: Type	Depth	Result	Water Depth	Date
TOPSOIL								
Soft to firm brown slightly sandy slightly gravelly CLAY with occasional abd boulders		0.30	68.45					
Stiff grey brown sandy GRAVEL of shale/ mudstone with cobbles		0.50	68.25					
		1						
Stiff grey brown sandy gravelly CLAY / SILT		1.50	67.25					
		2						
End of Trial pit at 2.50 m		2.20	66.55					
		3						
		4						

Remarks:

Stability: Pit sides stable
Water: No groundwater encountered
Remarks:

KEY

B Bulk disturbed sample.
D Small disturbed sample
U Undisturbed sample

Dimensions: 0.00
Depth: 0.00
2.50

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TRIAL PIT RECORD

Project Name: Grangecastle Business Park — Hole ID: TP26

Client: Hanley Pepper
Consultant: BLP
Location: Grangecastle
Date: 24/05/2013
Excavator used: 8T Tracked

Co-ordinates: 703874.00 731305.00
Elevation: 71.600
Project no. 3718-05-13
Logged by: C Finnerty

Strata Description	Legend	Depth	Level (mOD)	Samples / tests: Type	Samples / tests: Depth	Samples / tests: Result	Water Depth	Date
TOPSOIL								
Soft orange brown sandy slightly gravelly CLAY		0.30	71.30					
Firm to stiff brown mottled orange blue slightly sandy slightly gravelly CLAY with occasional cobbles		0.60	71.00					
		1		B	1.00			
Stiff to hard grey clayey sandy GRAVEL with mudstone / siltstone and weathered rock		1.30	70.30					
		2		B	2.00			
Angular LIMESTONE		2.40	69.20					
End of Trial pit at 2.50 m		2.50	69.10					
		3						
		4						

Remarks:

Stability: Pit sides stable
Water: No groundwater encountered
Remarks:

KEY

B Bulk disturbed sample.
D Small disturbed sample
U Undisturbed sample

Dimensions: 0.00
Depth: 0.00
2.50

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TRIAL PIT RECORD

Project Name: Grangecastle Business Park — Hole ID: TP27

Client: Hanley Pepper
Consultant: BLP
Location: Grangecastle
Date: 24/05/2013
Excavator used: 8T Tracked

Co-ordinates: 703878.00 731253.00
Elevation: 73.400
Project no. 3718-05-13
Logged by: C Finnerty

Strata Description	Legend	Depth	Level (mOD)	Samples / tests: Type	Samples / tests: Depth	Samples / tests: Result	Water Depth	Date
TOPSOIL								
Soft to firm grey brown slightly sandy slightly gravelly CLAY matrix with cobbles and boulders of angular limestone		0.30	73.10					
Stiff brown mottled orange grey blue slightly sandy slightly gravelly CLAY		0.70	72.70					
		1		B B	1.50 1.50			
Angular blue blocky LIMESTONE		1.80	71.60					
End of Trial pit at 1.90 m		1.90	71.50					
		2						
		3						
		4						

Remarks:

Stability: Pit sides stable
Water: No groundwater encountered
Remarks:

KEY

B Bulk disturbed sample.
D Small disturbed sample
U Undisturbed sample

Dimensions: 0.00
Depth: 0.00
1.90

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TRIAL PIT RECORD

Project Name: Grangecastle Business Park — Hole ID: TP28

Client: Hanley Pepper
Consultant: BLP
Location: Grangecastle
Date: 24/05/2013
Excavator used: 8T Tracked

Co-ordinates: 704060.00 731370.00
Elevation: 71.000
Project no. 3718-05-13
Logged by: C Finnerty

Strata Description	Legend	Depth	Level (mOD)	Samples / tests: Type	Samples / tests: Depth	Samples / tests: Result	Water Depth	Date
TOPSOIL								
		0.30	70.70					
Firm orangey brown sandy slightly gravelly CLAY								
		0.60	70.40					
Stiff grey sandy gravelly SILT/ CLAY (weathered rock)								
		1		B T	1.00 1.00			
		1.20	69.80					
Angular blockey blue grey LIMESTONE		1.30	69.70					
End of Trial pit at 1.30 m								
		2						
		3						
		4						

Remarks:

Stability: Pit sides stable
Water: No groundwater encountered
Remarks:

KEY

B Bulk disturbed sample.
D Small disturbed sample
U Undisturbed sample

Dimensions: 0.00
Depth: 0.00
1.30

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TRIAL PIT RECORD

Project Name: Grangecastle Business Park — Hole ID: TP29

Client: Hanley Pepper
Consultant: BLP
Location: Grangecastle
Date: 24/05/2013
Excavator used: 8T Tracked

Co-ordinates: 703988.00 731498.00
Elevation: 68.100
Project no. 3718-05-13
Logged by: C Finnerty

Strata Description	Legend	Depth	Level (mOD)	Samples / tests: Type	Samples / tests: Depth	Samples / tests: Result	Water Depth	Date
TOPSOIL with rootlets								
		0.30	67.80					
Firm brown slightly sandy slightly gravelly CLAY								
		1		B T	1.00 1.00			
		1.40	66.70					
Stiff greyish green and orange brown laminated mix sandy SILT				B T	1.50 1.50			
		1.90	66.20					
Stiff to hard grey blue with orange brown laminated sandy SILT/ CLAY with pea gravel sized portions of siltstone / mudstone.		2		B T	2.00 2.00			
		2.10	66.00					
LIMESTONE below 2.1m								
End of Trial pit at 2.10 m								
		3						
		4						

Remarks:

Stability: Pit sides stable
Water: No groundwater encountered
Remarks:

KEY

B Bulk disturbed sample.
D Small disturbed sample
U Undisturbed sample

Dimensions: 0.00
Depth: 0.00
2.10

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TRIAL PIT RECORD

Project Name: Grangecastle Business Park — Hole ID: TP30

Client: Hanley Pepper
Consultant: BLP
Location: Grangecastle
Date: 24/05/2013
Excavator used: 8T Tracked

Co-ordinates: 703954.00 731376.00
Elevation: 70.650
Project no. 3718-05-13
Logged by: C Finnerty

Strata Description	Legend	Depth	Level (mOD)	Samples / tests: Type	Samples / tests: Depth	Samples / tests: Result	Water Depth	Date
TOPSOIL with rootlets								
		0.30	70.35					
Soft to firm brown slightly sandy slightly gravelly CLAY								
		0.70	69.95					
Stiff dense clayey sandy GRAVEL with occasional cobbles of mudstone and weathered rock		1						
		1.40	69.25					
Blocky blue LIMESTONE		1.50	69.15					
End of Trial pit at 1.50 m		2						
		3						
		4						

Remarks:

Stability: Pit sides stable
Water: No groundwater encountered
Remarks:

KEY

B Bulk disturbed sample.
D Small disturbed sample
U Undisturbed sample

Dimensions: 3.00
Depth: 0.65
1.50

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Appendix 3 Cable Percussion Records

Project Name: Grangecastle Business Park

Hole ID: BH1

Client: Hanley Pepper
Consultant: BLP
Location: Grangecastle
Start date: 20/05/2013 End date: 20/05/2013
Type of drilling: CP Hole diameter: 200 mm

Co-ordinates: 703238.00 731451.00
Elevation: 65.900
Project no. 3718-05-13
Drilled by: J. O'Toole
Logged by: N. Sheehan

Strata Description	Legend	Depth	Level (mOD)	Samples / tests: Type	Samples / tests: Depth	Samples / tests: Result	Water Depth	Date
TOPSOIL		0.20	65.70					
Firm brown sandy slightly gravelly CLAY with cobbles								
Stiff brown sandy slightly gravelly CLAY with cobbles		1		SPT-C D	1.00 1.00	N=18		
		1.60	64.30					
Stiff black sandy gravelly CLAY with cobbles and boulders		2		SPT-C D	2.00 2.00	N=26		
		2.50	63.40					
Obstruction - presumed LIMESTONE bedrock		3.00	62.90	SPT-C D	3.00 3.00	50/10mm		
End of Borehole at 3.00 m		4						
		5						
		6						
		7						
		8						
		9						

Remarks:
Groundwater encountered at 2.60mBGL on 20/05/13, end of day at 1.00mBGL.
Chiselling from 2.50 to 3.00mBGL for 1 hour.

KEY

B	Bulk disturbed sample.
D	Small disturbed sample
U	Undisturbed sample
SPT-S	Standard Penetration Test, split spoon.
SPT-C	Standard Penetration Test, solid cone.
▽	Groundwater strike
▼	Water level 20mins after strike.

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Project Name: Grangecastle Business Park

Hole ID: BH2

Client: Hanley Pepper
Consultant: BLP
Location: Grangecastle
Start date: 17/05/2013 End date: 17/05/2013
Type of drilling: CP Hole diameter: 200 mm

Co-ordinates: 703348.00 731473.00
Elevation: 65.700
Project no. 3718-05-13
Drilled by: J. O'Toole
Logged by: N. Sheehan

Strata Description	Legend	Depth	Level (mOD)	Samples / tests: Type	Depth	Result	Water Depth	Date
TOPSOIL		0.10	65.60					
Firm brown sandy slightly gravelly CLAY with cobbles				D	1.00			
Stiff black sandy gravelly CLAY with cobbles and boulders		1.40	64.30	SPT-C	1.50	N=15		
				D	2.00			
				SPT-C	3.00	N=23		
				D	3.00			
				D	4.00			
Obstruction - presumed LIMESTONE bedrock		4.40	61.30	SPT-C	4.50	N=39		
End of Borehole at 5.00 m		5.00	60.70	SPT-C	5.00	50/10mm		
				D	5.00			

Remarks:
Groundwater encountered at 4.80mBGL on 17/05/13, end of day at 1.00mBGL.
Chiselling from 4.80 to 5.00mBGL for 1 hour.

KEY

B	Bulk disturbed sample.
D	Small disturbed sample
U	Undisturbed sample
SPT-S	Standard Penetration Test, split spoon.
SPT-C	Standard Penetration Test, solid cone.
▽	Groundwater strike
▼	Water level 20mins after strike.

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Project Name: Grangecastle Business Park

Hole ID: BH3

Client: Hanley Pepper
Consultant: BLP
Location: Grangecastle
Start date: 21/05/2013 End date: 21/05/2013
Type of drilling: CP Hole diameter: 200 mm

Co-ordinates: 703281.00, 731329.00
Elevation: 66.250
Project no. 3718-05-13
Drilled by: J. O'Toole
Logged by: N. Sheehan

Strata Description	Legend	Depth	Level (mOD)	Samples / tests: Type	Samples / tests: Depth	Samples / tests: Result	Water Depth	Date
TOPSOIL		0.20	66.05					
Firm brown sandy slightly gravelly CLAY with cobbles		0.60	65.65					
Stiff black sandy gravelly CLAY with cobbles and boulders		1		D	1.00			
				SPT-C	1.50	N=20		
		2		D	2.00			
Obstruction - presumed LIMESTONE bedrock		2.40	63.85					
End of Borehole at 3.00 m		3.00	63.25	SPT-C D	3.00 3.00	50/10mm		

Remarks:

Groundwater encountered at 2.60mBGL on 21/05/13, end of day at 2.60mBGL.
Chiselling from 2.50 to 3.00mBGL for 1 hour.

KEY

B	Bulk disturbed sample.
D	Small disturbed sample
U	Undisturbed sample
SPT-S	Standard Penetration Test, split spoon.
SPT-C	Standard Penetration Test, solid cone.
▽	Groundwater strike
▼	Water level 20mins after strike.

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Project Name: Grangecastle Business Park

Hole ID: BH4

Client: Hanley Pepper
Consultant: BLP
Location: Grangecastle
Start date: 21/05/2013 End date: 21/05/2013
Type of drilling: CP Hole diameter: 200 mm

Co-ordinates: 703298.00 731269.00
Elevation: 66.650
Project no. 3718-05-13
Drilled by: J. O'Toole
Logged by: N. Sheehan

Strata Description	Legend	Depth	Level (mOD)	Samples / tests: Type	Depth	Result	Water Depth	Date
TOPSOIL		0.20	66.45					
Firm brown sandy slightly gravelly CLAY with cobbles		0.65	66.00					
Stiff black sandy gravelly CLAY with cobbles and boulders				D	1.00			
				SPT-C	1.50	N=22		
				D	2.00			
Obstruction - presumed LIMESTONE bedrock		2.30	64.35					
End of Borehole at 3.00 m		3.00	63.65	SPT-C D	3.00 3.00	50/10mm		

Remarks:
Groundwater encountered at 2.40mBGL on 21/05/13, end of day at 2.00mBGL.
Chiselling from 2.30 to 3.00mBGL for 1 hour.

KEY

B	Bulk disturbed sample.
D	Small disturbed sample
U	Undisturbed sample
SPT-S	Standard Penetration Test, split spoon.
SPT-C	Standard Penetration Test, solid cone.
▽	Groundwater strike
▼	Water level 20mins after strike.

GROUND INVESTIGATIONS IRELAND
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Project Name: Grangecastle Business Park

Hole ID: BH5

Client: Hanley Pepper
Consultant: BLP
Location: Grangecastle
Start date: 16/05/2013 End date: 16/05/2013
Type of drilling: CP Hole diameter: 200 mm

Co-ordinates: 703384.00, 731568.00
Elevation: 66.200
Project no. 3718-05-13
Drilled by: J. O'Toole
Logged by: N. Sheehan

Strata Description	Depth	Level (mOD)	Samples / tests: Type	Depth	Result	Water Depth	Date
TOPSOIL	0.20	66.00					
Firm brown sandy slightly gravelly CLAY with cobbles							
Medium dense brownish grey gravelly SAND	0.80	65.40					
			D	1.00			
Stiff black sandy gravelly CLAY with cobbles and boulders	1.30	64.90					
			SPT-C	1.50	N=18		
Very stiff black sandy gravelly CLAY with cobbles and boulders							
			D	2.00			
	2.50	63.70	SPT-C	2.50	N=38		
			D	3.00			
			SPT-C	3.50	50/275mm		
			D	4.00			
			SPT-C	4.50	50/245mm		
			D	5.00			
Obstruction - presumed LIMESTONE bedrock	5.20	61.00					
	5.50	60.70	SPT-C	5.50	50/10mm		
End of Borehole at 5.50 m							

Remarks:
Groundwater encountered at 1.40mBGL on 16/05/13, end of day at 5.40mBGL.
Chiselling from 5.20 to 5.50mBGL for 1 hour.

KEY

B	Bulk disturbed sample.
D	Small disturbed sample
U	Undisturbed sample
SPT-S	Standard Penetration Test, split spoon.
SPT-C	Standard Penetration Test, solid cone.
▽	Groundwater strike
▼	Water level 20mins after strike.

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Project Name: Grangecastle Business Park

Hole ID: BH6

Client: Hanley Pepper
Consultant: BLP
Location: Grangecastle
Start date: 22/05/2013 End date: 22/05/2013
Type of drilling: CP Hole diameter: 200 mm

Co-ordinates: 703414.00 731525.00
Elevation: 65.500
Project no. 3718-05-13
Drilled by: J. O'Toole
Logged by: N. Sheehan

Strata Description	Legend	Depth	Level (mOD)	Samples / tests: Type	Samples / tests: Depth	Samples / tests: Result	Water Depth	Date
TOPSOIL		0.20	65.30					
Firm to stiff brown sandy slightly gravelly CLAY with cobbles				D	1.00			
Stiff black sandy gravelly CLAY with cobbles and boulders		1.40	64.10	SPT-C	1.50	N=26		
				D	2.00			
Very dense brownish grey gravelly SAND		2.90	62.60	SPT-C	3.00	50/210mm		
				D	3.00			
				D	4.00			
Obstruction - presumed LIMESTONE bedrock		4.30	61.20					
End of Borehole at 4.50 m		4.50	61.00	SPT-C	4.50	50/10mm		

Remarks:
Groundwater encountered at 1.50mBGL on 22/05/13, end of day at 1.00mBGL.
Chiselling from 4.30 to 4.50mBGL for 1 hour.

KEY

B	Bulk disturbed sample.
D	Small disturbed sample
U	Undisturbed sample
SPT-S	Standard Penetration Test, split spoon.
SPT-C	Standard Penetration Test, solid cone.
▽	Groundwater strike
▼	Water level 20mins after strike.

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Project Name: Grangecastle Business Park

Hole ID: BH7

Client: Hanley Pepper
Consultant: BLP
Location: Grangecastle
Start date: 23/05/2013 End date: 23/05/2013
Type of drilling: CP Hole diameter: 200 mm

Co-ordinates: 703417.00, 731372.00
Elevation: 66.950
Project no. 3718-05-13
Drilled by: J. O'Toole
Logged by: N. Sheehan

Strata Description	Legend	Depth	Level (mOD)	Samples / tests: Type	Depth	Result	Water Depth	Date
TOPSOIL		0.20	66.75					
Firm brown sandy slightly gravelly CLAY with cobbles				D	1.00			
Firm to stiff grey brown sandy slighlt gravelly CLAY with cobbles		1.20	65.75	SPT-C	1.50	N=14		
Stiff black sandy gravelly CLAY with cobbles and boulders		1.90	65.05	D	2.00			
Obstruction - presumed LIMESTONE bedrock		2.60	64.35					
End of Borehole at 3.00 m		3.00	63.95	SPT-C D	3.00 3.00	50/10mm		

Remarks:
Groundwater encountered at 1.90mBGL on 23/05/13, end of day at 1.20mBGL.
Chiselling from 2.60 to 3.00mBGL for 1 hour.

KEY

B	Bulk disturbed sample.
D	Small disturbed sample
U	Undisturbed sample
SPT-S	Standard Penetration Test, split spoon.
SPT-C	Standard Penetration Test, solid cone.
▽	Groundwater strike
▼	Water level 20mins after strike.

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Project Name: Grangecastle Business Park

Hole ID: BH8

Client: Hanley Pepper
Consultant: BLP
Location: Grangecastle
Start date: 23/05/2013 End date: 23/05/2013
Type of drilling: CP Hole diameter: 200 mm

Co-ordinates: 703492.00, 731448.00
Elevation: 66.650
Project no. 3718-05-13
Drilled by: J. O'Toole
Logged by: N. Sheehan

Strata Description	Legend	Depth	Level (mOD)	Samples / tests: Type	Depth	Result	Water Depth	Date
TOPSOIL		0.20	66.45					
Firm brown sandy slightly gravelly CLAY with cobbles				D	1.00			
		1.50	65.15	SPT-C	1.50	N=8		
Firm to stiff black sandy gravelly CLAY with cobbles and boulders				D	2.00			
		2.40	64.25					
Obstruction - presumed LIMESTONE bedrock								
		3.00	63.65	SPT-C D	3.00 3.00	50/10mm		
End of Borehole at 3.00 m								

Remarks:
Groundwater encountered at 1.50mBGL on 23/05/13, end of day at 1.00mBGL.
Chiselling from 2.40 to 3.00mBGL for 1 hour.

KEY

B	Bulk disturbed sample.
D	Small disturbed sample
U	Undisturbed sample
SPT-S	Standard Penetration Test, split spoon.
SPT-C	Standard Penetration Test, solid cone.
▽	Groundwater strike
▼	Water level 20mins after strike.

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Project Name: Grangecastle Business Park

Hole ID: BH9

Client: Hanley Pepper
Consultant: BLP
Location: Grangecastle
Start date: 24/05/2013 End date: 24/05/2013
Type of drilling: CP Hole diameter: 200 mm

Co-ordinates: 703511.00, 731264.00
Elevation: 69.300
Project no. 3718-05-13
Drilled by: J. O'Toole
Logged by: N. Sheehan

Strata Description	Legend	Depth	Level (mOD)	Samples / tests: Type	Depth	Result	Water Depth	Date
TOPSOIL		0.20	69.10					
Firm to stiff brown sandy slightly gravelly CLAY with cobbles				D	1.00			
		1.20	68.10					
Firm to stiff grey brown sandy slightly gravelly CLAY with cobbles				SPT-C	1.50	N=11		
				D	2.00			
		2.70	66.60					
Stiff black sandy gravelly CLAY with cobbles and boulders				SPT-C D	3.00 3.00	N=34		
		3.40	65.90					
Obstruction - presumed LIMESTONE bedrock								
		4.00	65.30	SPT-C	4.00	50/10mm		
End of Borehole at 4.00 m								

Remarks:
Groundwater encountered at 3.70mBGL on 24/05/13, end of day at 1.60mBGL.
Chiselling from 3.40 to 4.00mBGL for 1 hour.

KEY

B	Bulk disturbed sample.
D	Small disturbed sample
U	Undisturbed sample
SPT-S	Standard Penetration Test, split spoon.
SPT-C	Standard Penetration Test, solid cone.
▽	Groundwater strike
▼	Water level 20mins after strike.

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Project Name: Grangecastle Business Park

Hole ID: BH10

Client: Hanley Pepper
Consultant: BLP
Location: Grangecastle
Start date: 23/05/2013 End date: 23/05/2013
Type of drilling: CP Hole diameter: 200 mm

Co-ordinates: 703566.00 731565.00
Elevation: 65.950
Project no. 3718-05-13
Drilled by: J. O'Toole
Logged by: N. Sheehan

Strata Description	Legend	Depth	Level (mOD)	Samples / tests: Type	Samples / tests: Depth	Samples / tests: Result	Water Depth	Date
TOPSOIL		0.20	65.75					
Firm brown sandy slightly gravelly CLAY with cobbles		0.60	65.35					
Firm to stiff grey brown sandy slightly gravelly CLAY with cobbles				D	1.00			
		1.50	64.45	SPT-C	1.50	N=15		
Stiff black sandy gravelly CLAY with cobbles and boulders				D	2.00			
Obstruction - presumed LIMESTONE bedrock		2.50	63.45					
End of Borehole at 3.00 m		3.00	62.95	SPT-C D	3.00 3.00	50/10mm		

Remarks:
Groundwater encountered at 1.50mBGL on 24/05/13, end of day at 0.80mBGL.
Chiselling from 2.50 to 3.00mBGL for 1 hour.

KEY

B	Bulk disturbed sample.
D	Small disturbed sample
U	Undisturbed sample
SPT-S	Standard Penetration Test, split spoon.
SPT-C	Standard Penetration Test, solid cone.
▽	Groundwater strike
▼	Water level 20mins after strike.

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Project Name: Grangecastle Business Park

Hole ID: BH11

Client: Hanley Pepper
Consultant: BLP
Location: Grangecastle
Start date: 23/05/2013 End date: 23/05/2013
Type of drilling: CP Hole diameter: 200 mm

Co-ordinates: 703569.00 731370.00
Elevation: 68.500
Project no. 3718-05-13
Drilled by: J. O'Toole
Logged by: N. Sheehan

Strata Description	Legend	Depth	Level (mOD)	Samples / tests: Type	Samples / tests: Depth	Samples / tests: Result	Water Depth	Date
TOPSOIL		0.20	68.30					
Firm brown sandy slightly gravelly CLAY with cobbles				D	1.00			
Stiff brown sandy slightly gravelly CLAY with cobbles		1.30	67.20	SPT-C	1.50	N=14		
Stiff black sandy gravelly CLAY with cobbles and boulders		2.00	66.50	D	2.00			
Obstruction - presumed LIMESTONE bedrock		2.45	66.05					
End of Borehole at 3.00 m		3.00	65.50	SPT-C D	3.00 3.00	50/10mm		

Remarks:

Groundwater encountered at 2.50mBGL on 22/05/13, end of day at 1.60mBGL.
Chiselling from 2.50 to 3.00mBGL for 1 hour.

KEY

B	Bulk disturbed sample.
D	Small disturbed sample
U	Undisturbed sample
SPT-S	Standard Penetration Test, split spoon.
SPT-C	Standard Penetration Test, solid cone.
▽	Groundwater strike
▼	Water level 20mins after strike.

GROUND INVESTIGATIONS IRELAND
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Project Name: Grangecastle Business Park — Hole ID: BH12

Client: Hanley Pepper
Consultant: BLP
Location: Grangecastle
Start date: 22/05/2013 End date: 22/05/2013
Type of drilling: CP Hole diameter: 200 mm

Co-ordinates: 703646.00 731448.00
Elevation: 68.000
Project no. 3718-05-13
Drilled by: J. O'Toole
Logged by: N. Sheehan

Strata Description	Legend	Depth	Level (mOD)	Samples / tests: Type	Depth	Result	Water Depth	Date
TOPSOIL		0.20	67.80					
Firm brown sandy slightly gravelly CLAY with cobbles				D	1.00			
Firm grey brown sandy SILT / CLAY		1.40	66.60	SPT-C	1.50	N=6		
Firm grey black sandy SILT / CLAY		1.80	66.20					
Obstruction - presumed LIMESTONE bedrock		2.10	65.90	D	2.00			
End of Borehole at 3.00 m		3.00	65.00	SPT-C D	3.00 3.00	50/10mm		

Remarks:
Groundwater encountered at 1.50mBGL on 22/05/13, end of day at 1.60mBGL.
Chiselling from 2.10 to 3.00mBGL for 1 hour.

KEY

B	Bulk disturbed sample.
D	Small disturbed sample
U	Undisturbed sample
SPT-S	Standard Penetration Test, split spoon.
SPT-C	Standard Penetration Test, solid cone.
▽	Groundwater strike
▼	Water level 20mins after strike.

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Project Name: Grangecastle Business Park

Hole ID: BH13

Client: Hanley Pepper
Consultant: BLP
Location: Grangecastle
Start date: 24/05/2013 End date: 24/05/2013
Type of drilling: CP Hole diameter: 200 mm

Co-ordinates: 703646.00 731261.00
Elevation: 71.000
Project no. 3718-05-13
Drilled by: J. O'Toole
Logged by: N. Sheehan

Strata Description	Legend	Depth	Level (mOD)	Samples / tests: Type	Depth	Result	Water Depth	Date
TOPSOIL		0.20	70.80					
FILL of brown black clay with fragments of timber and cobbles				D	1.00			
Stiff brown sandy slightly gravelly CLAY with cobbles		1.40	69.60	SPT-C	1.50	N=35		
Stiff grey black sandy SILT / CLAY		1.70	69.30					
				D	2.00			
Very stiff black sandy gravelly CLAY with cobbles and boulders		3.00	68.00	SPT-C D	3.00 3.00	50/85mm		
Obstruction - presumed LIMESTONE bedrock		3.50	67.50					
End of Borehole at 4.00 m		4.00	67.00	SPT-C	4.00	50/10mm		

Remarks:
No groundwater encountered.
Chiselling from 3.50 to 4.00mBGL for 1 hour.

KEY

B	Bulk disturbed sample.
D	Small disturbed sample
U	Undisturbed sample
SPT-S	Standard Penetration Test, split spoon.
SPT-C	Standard Penetration Test, solid cone.
▽	Groundwater strike
▼	Water level 20mins after strike.

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Project Name: Grangecastle Business Park

Hole ID: BH14

Client: Hanley Pepper
Consultant: BLP
Location: Grangecastle
Start date: 28/05/2013 End date: 28/05/2013
Type of drilling: CP Hole diameter: 200 mm

Co-ordinates: 703764.00 731522.00
Elevation: 68.400
Project no. 3718-05-13
Drilled by: J. O'Toole
Logged by: N. Sheehan

Strata Description	Legend	Depth	Level (mOD)	Samples / tests: Type	Samples / tests: Depth	Samples / tests: Result	Water Depth	Date
TOPSOIL		0.20	68.20					
Firm to stiff brown sandy slightly gravelly CLAY with cobbles				D	1.00			
		1.20	67.20					
Firm to stiff grey brown sandy slightly gravelly CLAY with cobbles		1.40	67.00	SPT-C	1.50	50/75mm		
Very stiff black sandy gravelly CLAY with cobbles and boulders		2.00	66.40	D	2.00			
Obstruction - presumed LIMESTONE bedrock		2.50	65.90	SPT-C	2.50	50/10mm		
End of Borehole at 2.50 m								

Remarks:
No groundwater encountered.
Chiselling from 2.00 to 2.50mBGL for 1 hour.

KEY

B	Bulk disturbed sample.
D	Small disturbed sample
U	Undisturbed sample
SPT-S	Standard Penetration Test, split spoon.
SPT-C	Standard Penetration Test, solid cone.
▽	Groundwater strike
▼	Water level 20mins after strike.

GROUND INVESTIGATIONS IRELAND
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Project Name: Grangecastle Business Park

Hole ID: BH15

Client: Hanley Pepper
Consultant: BLP
Location: Grangecastle
Start date: 28/05/2013 End date: 28/05/2013
Type of drilling: CP Hole diameter: 200 mm

Co-ordinates: 703723.00, 731370.00
Elevation: 69.900
Project no. 3718-05-13
Drilled by: J. O'Toole
Logged by: N. Sheehan

Strata Description	Legend	Depth	Level (mOD)	Samples / tests: Type	Samples / tests: Depth	Samples / tests: Result	Water Depth	Date
TOPSOIL		0.20	69.70					
Firm to stiff brown sandy slightly gravelly CLAY with cobbles				D	1.00			
Stiff grey brown sandy slightly gravelly CLAY with cobbles		1.40	68.50	SPT-C	1.50	50/20mm		
Very stiff black sandy gravelly CLAY with cobbles and boulders		1.60	68.30					
Obstruction - presumed LIMESTONE bedrock		2.00	67.90	SPT-C D	2.00 2.00	50/10mm		
End of Borehole at 2.50 m		2.50	67.40					

Remarks:
No groundwater encountered.
Chiselling from 2.00 to 2.50mBGL for 1 hour.

KEY

B	Bulk disturbed sample.
D	Small disturbed sample
U	Undisturbed sample
SPT-S	Standard Penetration Test, split spoon.
SPT-C	Standard Penetration Test, solid cone.
▽	Groundwater strike
▼	Water level 20mins after strike.

GROUND INVESTIGATIONS IRELAND
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Project Name: Grangecastle Business Park — Hole ID: BH16

Client: Hanley Pepper
Consultant: BLP
Location: Grangecastle
Start date: 27/05/2013 End date: 27/05/2013
Type of drilling: CP Hole diameter: 200 mm

Co-ordinates: 703801.00 731448.00
Elevation: 69.870
Project no. 3718-05-13
Drilled by: J. O'Toole
Logged by: N. Sheehan

Strata Description	Legend	Depth	Level (mOD)	Samples / tests: Type	Depth	Result	Water Depth	Date
TOPSOIL		0.20	69.67					
Firm to stiff brown sandy slightly gravelly CLAY with cobbles				D	1.00			
Stiff dark brown sandy slightly gravelly CLAY with cobbles		1.20	68.67	SPT-C	1.50	N=50		
Dense grey fine to coarse clayey sandy GRAVEL with cobbles and boulders		1.80	68.07	SPT-C D	2.00 2.00	50/10mm		
Obstruction - presumed LIMESTONE bedrock		2.50	67.37					
End of Borehole at 3.00 m		3.00	66.87	D	3.00			

Remarks:
No groundwater encountered.
Chiselling from 2.50 to 3.00mBGL for 1 hour.

KEY

B	Bulk disturbed sample.
D	Small disturbed sample
U	Undisturbed sample
SPT-S	Standard Penetration Test, split spoon.
SPT-C	Standard Penetration Test, solid cone.
▽	Groundwater strike
▼	Water level 20mins after strike.

GROUND INVESTIGATIONS IRELAND
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Project Name: Grangecastle Business Park — Hole ID: BH17

Client: Hanley Pepper
Consultant: BLP
Location: Grangecastle
Start date: 24/05/2013 End date: 24/05/2013
Type of drilling: CP Hole diameter: 200 mm

Co-ordinates: 703803.00, 731258.00
Elevation: 72.300
Project no. 3718-05-13
Drilled by: J. O'Toole
Logged by: N. Sheehan

Strata Description	Legend	Depth	Level (mOD)	Samples / tests: Type	Samples / tests: Depth	Samples / tests: Result	Water Depth	Date
TOPSOIL		0.20	72.10					
Firm to stiff brown sandy slightly gravelly CLAY with cobbles				D	1.00			
		1.50	70.80	SPT-C	1.50	N=25		
Stiff brown sandy slightly gravelly CLAY with cobbles and boulders				D	2.00			
		2.50	69.80					
Obstruction - presumed LIMESTONE bedrock		3.00	69.30	SPT-C D	3.00 3.00	50/10mm		
End of Borehole at 3.00 m								

Remarks:
No groundwater encountered.
Chiselling from 2.50 to 3.00mBGL for 1 hour.

KEY

B	Bulk disturbed sample.
D	Small disturbed sample
U	Undisturbed sample
SPT-S	Standard Penetration Test, split spoon.
SPT-C	Standard Penetration Test, solid cone.
▽	Groundwater strike
▼	Water level 20mins after strike.

GROUND INVESTIGATIONS IRELAND
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Project Name: Grangecastle Business Park — Hole ID: BH18

Client: Hanley Pepper
Consultant: BLP
Location: Grangecastle
Start date: 27/05/2013 End date: 27/05/2013
Type of drilling: CP Hole diameter: 200 mm

Co-ordinates: 703878.00, 731368.00
Elevation: 70.500
Project no. 3718-05-13
Drilled by: J. O'Toole
Logged by: N. Sheehan

Strata Description	Legend	Depth	Level (mOD)	Samples / tests: Type	Depth	Result	Water Depth	Date
TOPSOIL		0.20	70.30					
Firm to stiff brown sandy slightly gravelly CLAY with cobbles				D	1.00			
		1.20	69.30					
Medium dense grey brown clayey sandy GRAVEL with cobbles				SPT-C	1.50	N=16		
		2.00	68.50					
Obstruction - presumed LIMESTONE bedrock				D	2.00			
		3.00	67.50	SPT-C	3.00	50/10mm		
End of Borehole at 3.00 m				D	3.00			

Remarks:
No groundwater encountered.
Chiselling from 2.00 to 3.00mBGL for 1 hour.

KEY

B	Bulk disturbed sample.
D	Small disturbed sample
U	Undisturbed sample
SPT-S	Standard Penetration Test, split spoon.
SPT-C	Standard Penetration Test, solid cone.
▽	Groundwater strike
▼	Water level 20mins after strike.

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Project Name: Grangecastle Business Park

Hole ID: BH19

Client: Hanley Pepper
Consultant: BLP
Location: Grangecastle
Start date: 29/05/2013 End date: 29/05/2013
Type of drilling: CP Hole diameter: 200 mm

Co-ordinates: 703961.00 731548.00
Elevation: 67.900
Project no. 3718-05-13
Drilled by: J. O'Toole
Logged by: N. Sheehan

Strata Description	Legend	Depth	Level (mOD)	Samples / tests: Type	Samples / tests: Depth	Samples / tests: Result	Water Depth	Date
TOPSOIL		0.20	67.70					
Firm to stiff brown sandy slightly gravelly CLAY with cobbles		1		SPT-C	1.00	N=13		
				D	1.00			
Stiff grey sandy SILT with cobbles and boulders		1.20	66.70					
		2		D	2.00			
Obstruction - presumed LIMESTONE bedrock		2.50	65.40					
End of Borehole at 3.00 m		3.00	64.90	SPT-C	3.00	50/10mm		

Remarks:
No groundwater encountered.
Chiselling from 2.50 to 3.00mBGL for 30 minutes.

KEY

B	Bulk disturbed sample.
D	Small disturbed sample
U	Undisturbed sample
SPT-S	Standard Penetration Test, split spoon.
SPT-C	Standard Penetration Test, solid cone.
▽	Groundwater strike
▼	Water level 20mins after strike.

GROUND INVESTIGATIONS IRELAND
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Project Name: Grangecastle Business Park

Hole ID: BH20

Client: Hanley Pepper
Consultant: BLP
Location: Grangecastle
Start date: 29/05/2013 End date: 29/05/2013
Type of drilling: CP Hole diameter: 200 mm

Co-ordinates: 703932.00 731501.00
Elevation: 68.000
Project no. 3718-05-13
Drilled by: J. O'Toole
Logged by: N. Sheehan

Strata Description	Legend	Depth	Level (mOD)	Samples / tests: Type	Samples / tests: Depth	Samples / tests: Result	Water Depth	Date
TOPSOIL		0.20	67.80					
Firm to stiff brown sandy slightly gravelly CLAY with cobbles				SPT-C	1.00	N=23		
		1		D	1.00			
Stiff grey sandy SILT with cobbles and boulders		1.20	66.80					
		2		SPT-C	2.00	50/10mm		
Obstruction - presumed LIMESTONE bedrock		2.10	65.90	D	2.00			
End of Borehole at 2.50 m		2.50	65.50					
		3						
		4						
		5						
		6						
		7						
		8						
		9						

Remarks:
No groundwater encountered.
Chiselling from 2.10 to 2.50mBGL for 30 minutes.

KEY

B	Bulk disturbed sample.
D	Small disturbed sample
U	Undisturbed sample
SPT-S	Standard Penetration Test, split spoon.
SPT-C	Standard Penetration Test, solid cone.
▽	Groundwater strike
▼	Water level 20mins after strike.

GROUND INVESTIGATIONS IRELAND
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Project Name: Grangecastle Business Park

Hole ID: BH21

Client: Hanley Pepper
Consultant: BLP
Location: Grangecastle
Start date: 29/05/2013 End date: 29/05/2013
Type of drilling: CP Hole diameter: 200 mm

Co-ordinates: 703965.00 731435.00
Elevation: 69.100
Project no. 3718-05-13
Drilled by: J. O'Toole
Logged by: N. Sheehan

Strata Description	Legend	Depth	Level (mOD)	Samples / tests: Type	Samples / tests: Depth	Samples / tests: Result	Water Depth	Date
TOPSOIL		0.20	68.90					
Firm to stiff brown sandy slightly gravelly CLAY with cobbles								
Stiff grey sandy SILT with cobbles and boulders		1.10	68.00	D	1.00			
Obstruction - presumed LIMESTONE bedrock		1.50	67.60	SPT-C	1.50	50/75mm		
End of Borehole at 2.00 m		2.00	67.10	SPT-C D	2.00 2.00	50/10mm		

Remarks:
No groundwater encountered.
Chiselling from 1.50 to 2.00mBGL for 30 minutes.

KEY

B	Bulk disturbed sample.
D	Small disturbed sample
U	Undisturbed sample
SPT-S	Standard Penetration Test, split spoon.
SPT-C	Standard Penetration Test, solid cone.
▽	Groundwater strike
▼	Water level 20mins after strike.

GROUND INVESTIGATIONS IRELAND
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Project Name: Grangecastle Business Park — Hole ID: BH22

Client: Hanley Pepper
Consultant: BLP
Location: Grangecastle
Start date: 28/05/2013 End date: 28/05/2013
Type of drilling: CP Hole diameter: 200 mm

Co-ordinates: 703955.00 731312.00
Elevation: 72.300
Project no. 3718-05-13
Drilled by: J. O'Toole
Logged by: N. Sheehan

Strata Description	Legend	Depth	Level (mOD)	Samples / tests: Type	Depth	Result	Water Depth	Date
TOPSOIL		0.20	72.10					
Firm to stiff brown sandy slightly gravelly CLAY with cobbles		0.80	71.50					
Stiff grey sandy SILT with cobbles and boulders				D	1.00			
				SPT-C	1.50	N=13		
Obstruction - presumed LIMESTONE bedrock		1.90	70.40	SPT-C	2.00	50/10mm		
				D	2.00			
End of Borehole at 2.50 m		2.50	69.80					

Remarks:
No groundwater encountered.
Chiselling from 2.00 to 2.50mBGL for 1 hour.

KEY

B	Bulk disturbed sample.
D	Small disturbed sample
U	Undisturbed sample
SPT-S	Standard Penetration Test, split spoon.
SPT-C	Standard Penetration Test, solid cone.
▽	Groundwater strike
▼	Water level 20mins after strike.

GROUND INVESTIGATIONS IRELAND
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Project Name: Grangecastle Business Park

Hole ID: BH23

Client: Hanley Pepper
Consultant: BLP
Location: Grangecastle
Start date: 29/05/2013 End date: 29/05/2013
Type of drilling: CP Hole diameter: 200 mm

Co-ordinates: 704033.00 731416.00
Elevation: 70.000
Project no. 3718-05-13
Drilled by: J. O'Toole
Logged by: N. Sheehan

Strata Description	Legend	Depth	Level (mOD)	Samples / tests: Type	Samples / tests: Depth	Samples / tests: Result	Water Depth	Date
TOPSOIL		0.20	69.80					
Firm to stiff brown sandy slightly gravelly CLAY with cobbles		1.00	69.00	D	1.00			
Stiff black sandy gravelly CLAY with coblles and boulders		1.30	68.70					
Obstruction - presumed LIMESTONE bedrock				SPT-C	1.50	50/20mm		
End of Borehole at 2.00 m		2.00	68.00	SPT-C D	2.00 2.00	50/10mm		

Remarks:
No groundwater encountered.
Chiselling from 1.30 to 2.00mBGL for 30 minutes.

KEY

B	Bulk disturbed sample.
D	Small disturbed sample
U	Undisturbed sample
SPT-S	Standard Penetration Test, split spoon.
SPT-C	Standard Penetration Test, solid cone.
▽	Groundwater strike
▼	Water level 20mins after strike.

GROUND INVESTIGATIONS IRELAND
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Project Name: Grangecastle Business Park

Hole ID: BH24

Client: Hanley Pepper
Consultant: BLP
Location: Grangecastle
Start date: 29/05/2013 End date: 29/05/2013
Type of drilling: CP Hole diameter: 200 mm

Co-ordinates: 704012.00 731331.00
Elevation: 71.500
Project no. 3718-05-13
Drilled by: J. O'Toole
Logged by: N. Sheehan

Strata Description	Legend	Depth	Level (mOD)	Samples / tests: Type	Samples / tests: Depth	Samples / tests: Result	Water Depth	Date
TOPSOIL		0.20	71.30					
Firm to stiff brown sandy slightly gravelly CLAY with cobbles		1.00	70.50	SPT-C	1.00	N=15		
				D	1.00			
Stiff brown sandy slightly gravelly CLAY with coblles and boulders		1.20	70.30					
Stiff grey sandy SILT with cobbles		2		SPT-C	2.00	50/10mm		
				D	2.00			
Obstruction - presumed LIMESTONE bedrock		2.40	69.10					
End of Borehole at 3.00 m		3.00	68.50	D	3.00			

Remarks:
No groundwater encountered.
Chiselling from 2.40 to 3.00mBGL for 1 hour.

KEY

B	Bulk disturbed sample.
D	Small disturbed sample
U	Undisturbed sample
SPT-S	Standard Penetration Test, split spoon.
SPT-C	Standard Penetration Test, solid cone.
▽	Groundwater strike
▼	Water level 20mins after strike.

GROUND INVESTIGATIONS IRELAND
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Project Name: Grangecastle Business Park

Hole ID: BH25

Client: Hanley Pepper
Consultant: BLP
Location: Grangecastle
Start date: 30/05/2013 End date: 30/05/2013
Type of drilling: CP Hole diameter: 200 mm

Co-ordinates: 703834.00 731331.00
Elevation: 70.750
Project no. 3718-05-13
Drilled by: J. O'Toole
Logged by: N. Sheehan

Strata Description	Legend	Depth	Level (mOD)	Samples / tests: Type	Samples / tests: Depth	Samples / tests: Result	Water Depth	Date
TOPSOIL		0.20	70.55					
Firm to stiff brown sandy slightly gravelly CLAY with cobbles								
Stiff black sandy gravelly CLAY with coblles and boulders		1.10	69.65	D	1.00			
		1.30	69.45					
Obstruction - presumed LIMESTONE bedrock		1.50	69.25	SPT-C	1.50	50/10mm		
End of Borehole at 1.50 m								

Remarks:
No groundwater encountered.
Chiselling from 1.30 to 1.50mBGL for 30 minutes.

KEY

B	Bulk disturbed sample.
D	Small disturbed sample
U	Undisturbed sample
SPT-S	Standard Penetration Test, split spoon.
SPT-C	Standard Penetration Test, solid cone.
▽	Groundwater strike
▼	Water level 20mins after strike.

GROUND INVESTIGATIONS IRELAND
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Project Name: Grangecastle Business Park

Hole ID: BH25A

Client: Hanley Pepper
Consultant: BLP
Location: Grangecastle
Start date: 31/05/2013 End date: 31/05/2013
Type of drilling: CP Hole diameter: 200 mm

Co-ordinates: 703836.00 731335.00
Elevation: 70.750
Project no. 3718-05-13
Drilled by: J. O'Toole
Logged by: N. Sheehan

Strata Description	Legend	Depth	Level (mOD)	Samples / tests: Type	Depth	Result	Water Depth	Date
TOPSOIL		0.20	70.55					
Firm to stiff brown sandy slightly gravelly CLAY with cobbles		0.90	69.85	D	1.00			
Stiff grey brown sandy slightly gravelly CLAY with coblles and boulders				SPT-C	1.50	N=14		
Obstruction - presumed LIMESTONE bedrock		2.00	68.75	D	2.00			
End of Borehole at 2.50 m		2.50	68.25	SPT-C	2.50	50/10mm		

Remarks:
No groundwater encountered.
Chiselling from 2.00 to 2.50mBGL for 30 minutes.

KEY

B	Bulk disturbed sample.
D	Small disturbed sample
U	Undisturbed sample
SPT-S	Standard Penetration Test, split spoon.
SPT-C	Standard Penetration Test, solid cone.
▽	Groundwater strike
▼	Water level 20mins after strike.

GROUND INVESTIGATIONS IRELAND
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Project Name: Grangecastle Business Park

Hole ID: BH26

Client: Hanley Pepper
Consultant: BLP
Location: Grangecastle
Start date: 30/05/2013 End date: 30/05/2013
Type of drilling: CP Hole diameter: 200 mm

Co-ordinates: 703566.00 731414.00
Elevation: 67.900
Project no. 3718-05-13
Drilled by: J. O'Toole
Logged by: N. Sheehan

Strata Description	Legend	Depth	Level (mOD)	Samples / tests Type	Depth	Result	Water Depth	Date
TOPSOIL		0.20	67.70					
Firm to stiff brown sandy slightly gravelly CLAY with cobbles		1		D	1.00			
Stiff grey brown sandy slightly gravelly CLAY with coblles and boulders		1.20	66.70					
		1.50	66.40	SPT-C	1.50	50/10mm		
Obstruction - presumed LIMESTONE bedrock		1.80	66.10					
End of Borehole at 1.80 m		2						
		3						
		4						
		5						
		6						
		7						
		8						
		9						

Remarks:
Groundwater encountered at 1.20mBGL on 30/02/13, end of day at 1.00mBGL.
Chiselling from 1.50 to 1.80mBGL for 30 minutes.

KEY

B	Bulk disturbed sample.
D	Small disturbed sample
U	Undisturbed sample
SPT-S	Standard Penetration Test, split spoon.
SPT-C	Standard Penetration Test, solid cone.
▽	Groundwater strike
▼	Water level 20mins after strike.

GROUND INVESTIGATIONS IRELAND
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Project Name: Grangecastle Business Park — Hole ID: BH27

Client: Hanley Pepper
Consultant: BLP
Location: Grangecastle
Start date: 30/05/2013 End date: 30/05/2013
Type of drilling: CP Hole diameter: 200 mm

Co-ordinates: 703297.00, 731367.00
Elevation: 66.400
Project no. 3718-05-13
Drilled by: J. O'Toole
Logged by: N. Sheehan

Strata Description	Legend	Depth	Level (mOD)	Samples / tests: Type	Depth	Result	Water Depth	Date
TOPSOIL		0.20	66.20					
Firm to stiff brown sandy slightly gravelly CLAY with cobbles				SPT-C D	1.00 1.00	N=29		
Very stiff black sandy gravelly CLAY with cobbles and boulders		1.40	65.00					
				SPT-C D	2.00 2.00	50/275mm		
Stiff grey brown sandy slightly gravelly CLAY with coblles and boulders		3.00	63.40	D	3.00			
Obstruction - presumed LIMESTONE bedrock		3.80	62.60	SPT-C	3.80	50/10mm		
End of Borehole at 4.00 m		4.00	62.40	D	4.00			

Remarks:

Groundwater encountered at 1.60mBGL on 30/02/13, end of day at 1.00mBGL.
Chiselling from 3.80 to 4.00mBGL for 30 minutes.

KEY

B	Bulk disturbed sample.
D	Small disturbed sample
U	Undisturbed sample
SPT-S	Standard Penetration Test, split spoon.
SPT-C	Standard Penetration Test, solid cone.
▽	Groundwater strike
▼	Water level 20mins after strike.

GROUND INVESTIGATIONS IRELAND
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Appendix 4 Rotary Core Records

GROUND INVESTIGATIONS IRELAND Ltd.
DAILY REPORT

Location: Grange castle Business Pk	BOREHOLE NO. BH-1
Drilling Crew: Tom + Shane Collins	Casing diameter: mm
	Drilled Today From: To:
Date: 18/6/13 Tuesday.	Cored Today From: 0m To: 7.05
Type of rig:	Cased Today From: 0m To: 7.05

DEPTH from	DEPTH to	STRATA DRILLED TODAY Description	SAMPLES Type	Depth	Ref no.
0m	2.5m	Clay.			
2.5	3.6m	Small pieces of Rock 95%REC			
3.6	5.1m	Large to Small Rock 100%REC			
5.1	6.50m	" " 100%REC			
6.50	7.05m	Large to Small Rock 100%REC			
		Standpipe Installed to 7.0m. 4m-Slotted 3m-Plain			
		pulled Casing, Moved to Nxt BH Location			

Groundwater:		
Water strikes	1	2
Depth		
After 20 min		
Sealed off?		
Depth		
Water depth start day:		
Water depth end day:		

Remarks, delays etc

Standard penetration tests

Test type:								
Start depth:								
Blows/75mm S =split spoon C =solid cone U = U100 R =refusal.								

Chiselling: Boring in hard strata	from	to	time

Installations	
Pipe size	
Slotted: From	To
Sealed: From	To
From	To
Cover type	Flush Raised

Signed for client: Tom Collins

GROUND INVESTIGATIONS IRELAND Ltd.
DAILY REPORT

Location: Grange castle Business Pk	BOREHOLE NO. BH-2
Drilling Crew: Tom + Shane Colling	Casing diameter: mm
	Drilled Today From: To:
Date: 20/6/13 Thursday.	Cored Today From: 0m To: 7.3m
Type of rig:	Cased Today From: 0m To: 7.3m

DEPTH from	DEPTH to	STRATA DRILLED TODAY Description	SAMPLES Type	Depth	Ref no.
0m	2.6m	Clay			
2.6	3.6m	Small to Exact Rock 90% Rec			
3.6	5.1m	" " 100% Rec			
5.1	6.1m	" " 100% Rec			
6.1	7.3m	Small to Exact Rock 100% Rec			
		Pulled Casing, Loaded Rig and Moved of Site.			

Groundwater:

	1	2
Water strikes		
Depth		
After 20 min		
Sealed off?		
Depth		
Water depth start day:		
Water depth end day:		

Remarks, delays etc

7am - 7.30pm.

Standard penetration tests

Test type:									
Start depth:									
Blows/75mm									
S =split spoon									
C =solid cone U = U100 R =refusal.									

Chiselling: Boring in hard strata	from	to	time

Installations

Pipe size	
Slotted: From	To
Sealed: From	To
From	To
Cover type	Flush Raised

Signed for client: Tom Colling

GROUND INVESTIGATIONS IRELAND Ltd.
DAILY REPORT

Location: grange Castle Business Pk	BOREHOLE NO. BH-3
Drilling Crew: Tom + Shane Collins	Casing diameter: mm
	Drilled Today From: To:
Date: 19/6/13 Wednesday.	Cored Today From: 0m To: 6.7m
Type of rig:	Cased Today From: 0m To: 6.7m

DEPTH from	DEPTH to	STRATA DRILLED TODAY Description	SAMPLES Type	Depth	Ref no.
0m	2.1m	Clay			
2.1	3.6m	Small to Fract Rock 85% Rec			
3.6	5.0m	" " 100% Rec			
5.0	6.7m	Large to Fract Rock 100% Rec			
		pulled Casing, Moved to Nxt BH Location			

Groundwater:

Water strikes	1	2
Depth		
After 20 min		
Sealed off?		
Depth		
Water depth start day:		
Water depth end day:		

Remarks, delays etc

Standard penetration tests

Test type:									
Start depth:									
Blows/75mm S =split spoon C =solid cone U = U100 R =refusal.									

Chiselling: Boring in hard strata	from	to	time

Installations

Pipe size	
Slotted: From	To
Sealed: From	To
From	To
Cover type	Flush Raised

Signed for client Tom Collins

GROUND INVESTIGATIONS IRELAND Ltd.
DAILY REPORT

Location: Grangecastle Business Pk	BOREHOLE NO. BH-4
Drilling Crew: Tom + Shane Collins	Casing diameter: mm
	Drilled Today From: To:
Date: 20/6/13 Thursday	Cored Today From: 0m To: 6·35m
Type of rig:	Cased Today From: 0m To: 6·35m

DEPTH from	DEPTH to	STRATA DRILLED TODAY Description	SAMPLES Type	Depth	Ref no.
0m	1·4m	Clay.			
1·4	2·1m	Small Rock / Clay. 70% Rec			
2·1	3·6m	" " 70% Rec			
3·6	5·1m	Large to Small Rock 100% Rec			
5·1	6·35m	" " 100% Rec			
		pulled Casing, Moved to Nxt BH Location.			

Groundwater:

	1	2
Water strikes		
Depth		
After 20 min		
Sealed off?		
Depth		
Water depth start day:		
Water depth end day:		

Remarks, delays etc

Standard penetration tests

Test type:									
Start depth:									
Blows/75mm									
S =split spoon									
C =solid cone U = U100 R =refusal.									

Chiselling: Boring in hard strata	from	to	time

Installations

Pipe size	
Slotted: From	To
Sealed: From	To
From	To
Cover type	Flush Raised

Signed for client: Tom Collins

GROUND INVESTIGATIONS IRELAND Ltd.
DAILY REPORT

Location: Grangecastle Business Pk	BOREHOLE NO. BH-5
Drilling Crew: Tom + Shane Collins	Casing diameter: mm
	Drilled Today From: To:
Date: 18/6/13 Tuesday	Cored Today From: 0m To: 8.05m
Type of rig:	Cased Today From: 0m To: 8.05m

DEPTH from	DEPTH to	STRATA DRILLED TODAY Description	SAMPLES Type	SAMPLES Depth	SAMPLES Ref no.
0m	2.6m	Clay			
2.6	3.6m	Rock with Clay bands 75%Rec			
3.6	5.1m	Small to Exact Rock 100%Rec			
5.1	6.55m	Large to Small Rock 100%Rec			
6.55	8.05m	" " with Clay bands 85%Rec			
		pulled Casing, Moved to Nxt BH location			

Groundwater:		
Water strikes	1	2
Depth		
After 20 min		
Sealed off?		
Depth		
Water depth start day:		
Water depth end day:		

Remarks, delays etc

Standard penetration tests

Test type:								
Start depth:								
Blows/75mm S =split spoon C =solid cone U = U100 R =refusal.								

Chiselling: Boring in hard strata	from	to	time

Installations		
Pipe size		
Slotted: From	To	
Sealed: From	To	
From	To	
Cover type	Flush	Raised

Signed for client Tom Collins

GROUND INVESTIGATIONS IRELAND Ltd.
DAILY REPORT

Location: Grange castle Business Pk	BOREHOLE NO. BH-6
Drilling Crew: Tom + Shane Colling	Casing diameter: mm
	Drilled Today From: To:
Date: 20/6/13 Thursday	Cored Today From: 0m To: 6.7m
Type of rig:	Cased Today From: 0m To: 6.7m

DEPTH from	DEPTH to	STRATA DRILLED TODAY Description	SAMPLES Type	Depth	Ref no.
0m	2.2m	Clay			
2.2	3.6m	Fract Rock/Clay 85%Rec			
3.6	5.1m	Small to Med Rock 100%Rec			
5.1	6.7m	Large to Small Rock 100%Rec			
		Pulled Casing, Moved to Nxt BH Location			

Groundwater:			Standard penetration tests								
Water strikes	1	2	Test type:								
Depth			Start depth:								
After 20 min											
Sealed off?			Blows/75mm								
Depth			S =split spoon C =solid cone U = U100 R =refusal.								
Water depth start day:											
Water depth end day:											
Remarks, delays etc											

Chiselling: Boring in hard strata	from	to	time

Installations		
Pipe size		
Slotted: From	To	
Sealed: From	To	
From	To	
Cover type	Flush	Raised

Signed for client Tom Collins

GROUND INVESTIGATIONS IRELAND Ltd.
DAILY REPORT

Location: Garage castle Business Pk	BOREHOLE NO. BH-7
Drilling Crew: Tom + Shane Collins	Casing diameter: mm
	Drilled Today From: To:
Date:	Cored Today From: 0m To: 6.3m
Type of rig:	Cased Today From: 0m To: 6.3m

DEPTH from	DEPTH to	STRATA DRILLED TODAY Description	SAMPLES Type	SAMPLES Depth	SAMPLES Ref no.
0m	1.5m	Clay			
1.5	2.1m	Fract Rock / Clay bands 50% Rec			
2.1	3.6m	Small to Med Rock 100% Rec			
3.6	5.1m	" " 100% Rec			
5.1	6.3m	Small to Med Rock 100% Rec			
		pulled Casing, loaded Rig and Moved off Site.			

Groundwater:

Water strikes	1	2
Depth		
After 20 min		
Sealed off?		
Depth		
Water depth start day:		
Water depth end day:		

Standard penetration tests

Test type:									
Start depth:									
Blows/75mm S =split spoon C =solid cone U = U100 R =refusal.									

Remarks, delays etc

7am - 6.30pm.

Chiselling: Boring in hard strata	from	to	time

Installations		
Pipe size		
Slotted: From	To	
Sealed: From	To	
From	To	
Cover type	Flush	Raised

Signed for client Tom Collins

GROUND INVESTIGATIONS IRELAND Ltd.
DAILY REPORT

Location: Grange castle Business Pk	BOREHOLE NO. BH-8
Drilling Crew: Tom + Shane Collins	Casing diameter: mm
	Drilled Today From: To:
Date: 20/6/13 Thursday	Cored Today From: 0m To: 7.20m
Type of rig:	Cased Today From: 0m To: 7.20m

DEPTH from	DEPTH to	STRATA DRILLED TODAY Description	SAMPLES Type	SAMPLES Depth	SAMPLES Ref no.
0m	2.3m	Clay.			
2.3	3.6m	Small to Med Rock/Clay bands 80%Rec			
3.6	5.1m	Small to Med Rock 100%Rec			
5.1	6.6m	Large to Small Rock 100%Rec			
6.6	7.2m	" " 100%Rec			
		Pulled Casing, Moved to Nxt BH Location			

Groundwater:	1	2
Water strikes		
Depth		
After 20 min		
Sealed off?		
Depth		
Water depth start day:		
Water depth end day:		

Remarks, delays etc

Standard penetration tests

Test type:									
Start depth:									

Blows/75mm
S =split spoon
C =solid cone U = U100 R =refusal.

Chiselling: Boring in hard strata	from	to	time

Installations		
Pipe size		
Slotted: From		To
Sealed: From		To
From		To
Cover type	Flush	Raised

Signed for client Tom Collins

GROUND INVESTIGATIONS IRELAND Ltd.
DAILY REPORT

Location: grangecastle Business P/c	BOREHOLE NO. BH-9
Drilling Crew: Tom + Shane Collins	Casing diameter: mm
	Drilled Today From: To:
Date: 21/6/13 Friday	Cored Today From: 0m To: 7.0m
Type of rig:	Cased Today From: 0m To: 7.0m

DEPTH from	DEPTH to	STRATA DRILLED TODAY Description		SAMPLES Type	SAMPLES Depth	SAMPLES Ref no.
0m	2.1m	Clay -				
2.1	3.05m	Fract Rock Clay Seams	90% rec			
3.05	5.0m	Small to Med Rock	100% rec			
5.0	7.0m	" "	100% rec			
		pulled casing				
		Rig broke down. Had to go into town for parts				
		Mick came out at 3.30pm.				
		Took cover off Rig changed Starter. got Rig Started loaded up and took back to yard.				

Groundwater:

	1	2
Water strikes		
Depth		
After 20 min		
Sealed off?		
Depth		
Water depth start day:		
Water depth end day:		

Remarks, delays etc

7am - 8.30pm.

Standard penetration tests

Test type:								
Start depth:								
Blows/75mm								
S =split spoon								
C =solid cone U = U100 R =refusal.								

Chiselling: Boring in hard strata	from	to	time

Installations

Pipe size	
Slotted: From	To
Sealed: From	To
From	To
Cover type	Flush Raised

Signed for client Tom Collins

GROUND INVESTIGATIONS IRELAND Ltd.
DAILY REPORT

Location: Greenyecastle Business Plc	BOREHOLE NO. BH-10
Drilling Crew: Tom + Shane Colling	Casing diameter: mm
	Drilled Today From: To:
Date: 17/6/13 Monday.	Cored Today From: 0m To: 6·60
Type of rig:	Cased Today From: 0m To: 6·6m

DEPTH from	DEPTH to	STRATA DRILLED TODAY Description	SAMPLES Type	Depth	Ref no.
0m	2·3m	Clay			
2·3	3·6m	Clay / Small to fract Rock 85% Rec			
3·6	5·1m	Med to Small Rock 100% Rec			
5·1	6·6m	Med to fract Rock 100% Rec			
		Standpipe Installed to 6·6m.			
		5m - Slotted 1·6m - plain			
		pulled Casing			
		7·30am - 5·30pm.			

Groundwater:

	1	2
Water strikes		
Depth		
After 20 min		
Sealed off?		
Depth		
Water depth start day:		
Water depth end day:		

Standard penetration tests

Test type:								
Start depth:								
Blows/75mm S =split spoon C =solid cone U = U100 R =refusal.								

Remarks, delays etc

went to Site and Switch was Pulled off Rig, Casing was damaged had to get diggee to get leading Length out of ground €50 Had to get pipe Fixed on Rig

Chiselling: Boring in hard strata	from	to	time

Installations

Pipe size	
Slotted: From	To
Sealed: From	To
From	To
Cover type	Flush Raised

Signed for client my Tom Colling

GROUND INVESTIGATIONS IRELAND Ltd.
DAILY REPORT

Location: Grange castle Business Pk	BOREHOLE NO. BH12
Drilling Crew: Tom + Shane Collins	Casing diameter: mm
	Drilled Today From: To:
Date: 15/6/13 Saturday.	Cored Today From: 0m To: 6.8m
Type of rig:	Cased Today From: 0m To: 6.8m

DEPTH from	DEPTH to	STRATA DRILLED TODAY Description	SAMPLES Type	Depth	Ref no.
0m	2.3m	Clay.			
2.3	3.6m	Small to fract Rock 95% REC			
3.6	5.1m	Med to Small Rock 100% REC			
5.1	6.0m	" " 100% REC			
6.0	6.8m	Large to Med Rock 100% REC			
		pulled Casing.			
		pulled Casing, Moved to Nxt BH Location			

Groundwater:

	1	2
Water strikes		
Depth		
After 20 min		
Sealed off?		
Depth		
Water depth start day:		
Water depth end day:		

Remarks, delays etc

Standard penetration tests

Test type:								
Start depth:								
Blows/75mm S =split spoon C =solid cone U = U100 R =refusal.								

Chiselling: Boring in hard strata	from	to	time

Installations

Pipe size	
Slotted: From	To
Sealed: From	To
From	To
Cover type	Flush Raised

Signed for client Tom Collins

GROUND INVESTIGATIONS IRELAND Ltd.
DAILY REPORT

Location: Grange castle Business Plc	BOREHOLE NO BH14 Cont
Drilling Crew: Tom + Shane Collins	Casing diameter: mm
	Drilled Today From: To:
Date: 15/6/13 Saturday.	Cored Today From: 3.65 To: 6.00
Type of rig:	Cased Today From: 3.65 To: 6.00

DEPTH from	DEPTH to	STRATA DRILLED TODAY Description	SAMPLES Type	Depth	Ref no.
3.65	5.25m	Small to Med Rock 100%Rec			
5.25	6.00m	Small to Med Rock 100%Rec			
		Pulled Casing and Moved to Next BH location.			

Groundwater:			Standard penetration tests									
Water strikes	1	2	Test type:									
Depth			Start depth:									
After 20 min			Blows/75mm S =split spoon C =solid cone U = U100 R =refusal.									
Sealed off?												
Depth												
Water depth start day:												
Water depth end day:												
Remarks, delays etc												

Chiselling: Boring in hard strata	from	to	time

Installations	
Pipe size	
Slotted: From	To
Sealed: From	To
From	To
Cover type	Flush Raised

Signed for client Tom Collins

GROUND INVESTIGATIONS IRELAND Ltd.
DAILY REPORT

Location: Grange Castle Business Pk	BOREHOLE NO. BH-19
Drilling Crew: Tom + Shane Collins	Casing diameter: mm
	Drilled Today From: To:
Date: 6/6/13 Thursday.	Cored Today From: 0m To: 7.55m
Type of rig:	Cased Today From: 0m To: 7.55m

DEPTH from	DEPTH to	STRATA DRILLED TODAY Description	SAMPLES Type	Depth	Ref no.
0m	2.5m	Clay			
2.5	3.4m	Clay, Fract Rock 75% Rec			
3.4	4.5m	Small to Fract Rock 100% Rec			
4.5	6.25m	Large to small Rock 100% Rec			
6.25	7.55m	Large to Small Rock 100% Rec			
		Pulled Casing, Moved Rig to Nxt BH Location, Set up Rig.			
		Moved tractor + trailer back to yard.			

Groundwater:	1	2
Water strikes		
Depth		
After 20 min		
Sealed off?		
Depth		
Water depth start day:		
Water depth end day:		

Standard penetration tests

Test type:								
Start depth:								
Blows/75mm S =split spoon C =solid cone U = U100 R =refusal.								

Remarks, delays etc

8am - 5.30pm.

Chiselling: Boring in hard strata	from	to	time

Installations	
Pipe size	
Slotted: From	To
Sealed: From	To
From	To
Cover type	Flush Raised

Signed for client: Tom Collins

GROUND INVESTIGATIONS IRELAND Ltd.
DAILY REPORT

Yard / ~~Office~~

Location:	Grangecastle B.P.	BOREHOLE NO.	BH-20
Drilling Crew:	TOM + Shane Collins	Casing diameter:	mm
		Drilled Today From:	To:
Date:	6/6/13 Thursday.	Cored Today From:	0m To: 7.00m
Type of rig:		Cased Today From:	0m To: 7.00m

DEPTH from	DEPTH to	STRATA DRILLED TODAY Description	SAMPLES Type	Depth	Ref no.
		Took Compressor back to Swan, Moved to Yard off Loaded gear and Moved out to Grangecastle, set up on BH.			
0.0	1.9m	Clay			
1.9	3.30m	Small to Fract Rock 100%Rec			
3.30	5.00m	Small to Fract Rock/Clay Seams 75%Rec			
5.00	6.15m	- Large Rock 100%Rec			
6.15	7.0m	Small to Medium Rock 100%Rec			
		Pulled Casing, Moved to Nxt BH Location, Set up Rig.			

Groundwater:	1	2
Water strikes		
Depth		
After 20 min		
Sealed off?		
Depth		
Water depth start day:		
Water depth end day:		

Remarks, delays etc

Standard penetration tests								
Test type:								
Start depth:								
Blows/75mm S =split spoon C =solid cone U = U100 R =refusal.								

Chiselling: Boring in hard strata	from	to	time

Installations	
Pipe size	
Slotted: From	To
Sealed: From	To
From	To
Cover type	Flush Raised

Signed for client: My Tom Collins

GROUND INVESTIGATIONS IRELAND Ltd.
DAILY REPORT

Location: Grangecastle Business Pk	BOREHOLE NO. BH-23
Drilling Crew: Tom + Shane Collins	Casing diameter: mm
	Drilled Today From: To:
Date: 7/6/13 Friday	Cored Today From: 0m To: 6.25m
Type of rig:	Cased Today From: 0m To: 6.25m

DEPTH from	DEPTH to	STRATA DRILLED TODAY Description	SAMPLES Type	SAMPLES Depth	SAMPLES Ref no.
0.0	0.9m	Clay.			
0.9	1.6m	Clay, Fract Rock 90% Rec			
1.6	3.15m	Fract Rock with Clay bands 50% Rec			
3.15	4.55m	Fract Rock 100% Rec			
4.55	6.25m	Large to Fract Rock 100% Rec			
		Pulled Casing, Moved Rig to Nxt BH Location, Set up Rig.			

Groundwater:		
Water strikes	1	2
Depth		
After 20 min		
Sealed off?		
Depth		
Water depth start day:		
Water depth end day:		

Remarks, delays etc

Standard penetration tests

Test type:								
Start depth:								
Blows/75mm S =split spoon C =solid cone U = U100 R =refusal.								

Chiselling: Boring in hard strata	from	to	time

Installations

Pipe size	
Slotted: From	To
Sealed: From	To
From	To
Cover type	Flush Raised

Signed for client Tom Collins

GROUND INVESTIGATIONS IRELAND Ltd.
DAILY REPORT

Location: Grangecastle business PK	BOREHOLE NO. BH-24
Drilling Crew: Tom + Shane Collins	Casing diameter: mm
	Drilled Today From: To:
Date: 7/6/13 Friday	Cored Today From: 0m To: 6.85m
Type of rig:	Cased Today From: 0m To: 6.85m

DEPTH from	DEPTH to	STRATA DRILLED TODAY Description	SAMPLES Type	Depth	Ref no.
0.0	2.5m	Clay.			
2.5	3.5m	Clay / Rock Med to Small 90% Rec			
3.5	5.5m	Large to fract Rock 100% Rec			
5.5	6.85m	Large to fract Rock 100% Rec			
		Pulled Casing, Moved Rig to Nxt BH location, Set up Rig.			

Groundwater:			Standard penetration tests								
Water strikes	1	2	Test type:								
Depth			Start depth:								
After 20 min			Blows/75mm S =split spoon C =solid cone U = U100 R =refusal.								
Sealed off?											
Depth											
Water depth start day:											
Water depth end day:											
Remarks, delays etc											

Chiselling: Boring in hard strata	from	to	time

Installations	
Pipe size	
Slotted: From	To
Sealed: From	To
From	To
Cover type	Flush Raised

Signed for client Tom Collins

GROUND INVESTIGATIONS IRELAND Ltd.
DAILY REPORT

Location: Grange castle Business Pk	BOREHOLE NO. RC-1
Drilling Crew: Tom + Shane Collins	Casing diameter: mm
	Drilled Today From: To:
Date: 18/6/13 Tuesday	Cored Today From: 0m To: 6.30
Type of rig:	Cased Today From: 0m To: 6.30

DEPTH from	DEPTH to	STRATA DRILLED TODAY Description		SAMPLES Type	Depth	Ref no.
0m	1.6m	Clay				
1.6	2.1m	Clay / Fract Rock	90% Rec			
2.1	3.6m	Med to Small Rock	100% Rec			
3.6	4.5m	"	100% Rec			
4.5	5.5m	"	90% Rec			
5.5	6.3m	Med to Small Rock	100% Rec			
		pulled Casing Loaded Rig and Moved off Site				

Groundwater:

	1	2
Water strikes		
Depth		
After 20 min		
Sealed off?		
Depth		
Water depth start day:		
Water depth end day:		

Remarks, delays etc

7am - 7pm

Standard penetration tests

Test type:									
Start depth:									
Blows/75mm									
S =split spoon									
C =solid cone U = U100 R =refusal.									

Chiselling: Boring in hard strata	from	to	time

Installations

Pipe size	
Slotted: From	To
Sealed: From	To
From	To
Cover type	Flush Raised

Signed for client: Tom Collins

GROUND INVESTIGATIONS IRELAND Ltd.
DAILY REPORT

Location: Grange castle Business Pk	BOREHOLE NO. RC-2
Drilling Crew: Tom + Shane Collins	Casing diameter: mm
	Drilled Today From: To:
Date: 19/6/13 Wednesday	Cored Today From: 0m To: 6.65m
Type of rig:	Cased Today From: 0m To: 6.65m

DEPTH from	DEPTH to	STRATA DRILLED TODAY Description	SAMPLES Type	Depth	Ref no.
0m	2.1m	Clay.			
2.1	3.6m	Small Rock / Clay Seams 85% Rec			
3.6	5.0m	Small to Med Rock 100% Rec			
5.0	6.65m	Small to Med Rock 100% Rec			
		pulled Casing Moved to Nxt BH Location.			

Groundwater:			Standard penetration tests								
Water strikes	1	2	Test type:								
Depth			Start depth:								
After 20 min			Blows/75mm S =split spoon C =solid cone U = U100 R =refusal.								
Sealed off?											
Depth											
Water depth start day:											
Water depth end day:											
Remarks, delays etc											

Chiselling: Boring in hard strata	from	to	time

Installations	
Pipe size	
Slotted: From	To
Sealed: From	To
From	To
Cover type	Flush Raised

Signed for client Tom Collins

GROUND INVESTIGATIONS IRELAND Ltd.
DAILY REPORT

Location: Graigecastle Business Pk	BOREHOLE NO. RC-3
Drilling Crew: Tom + Shane Collins	Casing diameter: mm
	Drilled Today From: To:
Date: 21/6/13 Friday -	Cored Today From: 0m To: 5.9m
Type of rig:	Cased Today From: 0m To: 5.9m

DEPTH from	DEPTH to	STRATA DRILLED TODAY Description	SAMPLES Type	Depth	Ref no.
0m	1.0m	Clay			
1.0	2.1m	Small pieces of Rock. 85% Rec			
2.1	3.1m	" " 100% Rec			
3.1	3.9m	Med to Small Rock 100% Rec			
3.9	5.9m	" " 100% Rec			
		Standpipe Installed to 5.9m.			
		3m - Slotted 2.9m - plain			
		pulled Casing			

Groundwater:		
Water strikes	1	2
Depth		
After 20 min		
Sealed off?		
Depth		
Water depth start day:		
Water depth end day:		

Remarks, delays etc

Standard penetration tests

Test type:								
Start depth:								
Blows/75mm								
S =split spoon								
C =solid cone U = U100 R =refusal.								

Chiselling: Boring in hard strata	from	to	time

Installations		
Pipe size		
Slotted: From	To	
Sealed: From	To	
From	To	
Cover type	Flush	Raised

Signed for client Tom Collins

GROUND INVESTIGATIONS IRELAND Ltd.
DAILY REPORT

Location: Grangecastle Business Pk	BOREHOLE NO. RC-4
Drilling Crew: Tom + Shane Collins	Casing diameter: mm
	Drilled Today From: ~~0m To 7.05~~
Date: 18/6/13 Tuesday	Cored Today From: 0m To: 7.05
Type of rig:	Cased Today From: 0m To: 7.05

DEPTH from	DEPTH to	STRATA DRILLED TODAY Description	SAMPLES Type	Depth	Ref no.
0m	2.0m	Clay			
2.0	3.6m	Rock with large bands of Clay 50%Rec			
3.6	5.1m	Small to Med Rock 100%Rec			
5.1	6.7m	" 100%Rec			
6.7	7.05m	Small to Med Rock 100%Rec			
		pulled Casing, Moved to Nxt BH Location			

Groundwater:		
Water strikes	1	2
Depth		
After 20 min		
Sealed off?		
Depth		
Water depth start day:		
Water depth end day:		

Remarks, delays etc

Standard penetration tests									
Test type:									
Start depth:									
Blows/75mm S =split spoon C =solid cone U = U100 R =refusal.									

Chiselling: Boring in hard strata	from	to	time

Installations	
Pipe size	
Slotted: From	To
Sealed: From	To
From	To
Cover type	Flush Raised

Signed for client: my Tom Collins

GROUND INVESTIGATIONS IRELAND Ltd.
DAILY REPORT

Location: Grange Castle Business Plc	BOREHOLE NO. RC-8
Drilling Crew: Tom + Shane Collins	Casing diameter: mm
	Drilled Today From: To:
Date: 15/6/13 Saturday -	Cored Today From: 0m To: 7.0m
Type of rig:	Cased Today From: 0m To: 7.0m

DEPTH from	DEPTH to	STRATA DRILLED TODAY Description	SAMPLES Type	Depth	Ref no.
0m	2.1m	Clay			
2.1	3.6m	Small to Med Rock/Clay Seam 90%Rec			
3.6.	5.1m	Small to Med Rock 100%Rec			
5.1	6.05m	" " 100%Rec			
6.05	7.0m	Large to Medium Rock 100%Rec			
		pulled Casing.			

Groundwater:			Standard penetration tests								
Water strikes	1	2	Test type:								
Depth			Start depth:								
After 20 min											
Sealed off?			Blows/75mm								
Depth			S =split spoon								
Water depth start day:			C =solid cone U = U100 R =refusal.								
Water depth end day:											
Remarks, delays etc											

Chiselling: Boring in hard strata	from	to	time

8am - 5.00pm.

Installations	
Pipe size	
Slotted: From	To
Sealed: From	To
From	To
Cover type	Flush Raised

Signed for client Tom Collins

Collins

Date: 7/6/13 Friday

Type of rig:

Drilled Today From: To:

Cored Today From: 0m To: 6.3m

Cased Today From: 0m To: 6.3m

DEPTH from	DEPTH to	STRATA DRILLED TODAY Description	SAMPLES Type	Depth	Ref no.
0m	0.8m	Clay			
0.8	1.4m	Small to fract Rock 90% Rec			
1.4	2.1m	Fract Rock / Clay Seams 85% Rec			
2.1	3.5m	Clay, fract Rock 100% Rec			
3.5	4.7m	fract Rock 100% Rec			
4.7	6.3m	Small to fract Rock 100% Rec			

Groundwater:

Water strikes	1	2
Depth		
After 20 min		
Sealed off?		
Depth		
Water depth start day:		
Water depth end day:		

Standard penetration tests

Test type:									
Start depth:									
Blows/75mm S =split spoon C =solid cone U = U100 R =refusal.									

Remarks, delays etc

8am - 5:00pm.

Chiselling: Boring in hard strata	from	to	time

Installations

Pipe size	
Slotted: From	To
Sealed: From	To
From	To
Cover type	Flush Raised

Signed for client Gary Collins

GROUND INVESTIGATIONS IRELAND Ltd.
DAILY REPORT

Location: Grange Castle Business Pk	BOREHOLE NO. BH-1
Drilling Crew: Tom + Shane Collins	Casing diameter: mm
	Drilled Today From: To:
Date: 18/6/13 Tuesday.	Cored Today From: 0m To: 7.05
Type of rig:	Cased Today From: 0m To: 7.05

DEPTH from	DEPTH to	STRATA DRILLED TODAY Description	SAMPLES Type	Depth	Ref no.
0m	2.5m	Clay.			
2.5	3.6m	Small pieces of Rock 95%rec			
3.6	5.1m	Large to Small Rock 100%rec			
5.1	6.50m	" " 100%rec			
6.50	7.05m	Large to Small Rock 100%Rec			
		Standpipe Installed to 7.0m.			
		4m-Slotted 3m-Plain			
		pulled Casing, Moved to Nxt BH Location			

Groundwater:			Standard penetration tests								
Water strikes	1	2	Test type:								
Depth			Start depth:								
After 20 min											
Sealed off?			Blows/75mm								
Depth			S =split spoon								
Water depth start day:			C =solid cone U = U100 R =refusal.								
Water depth end day:											
Remarks, delays etc											

Chiselling: Boring in hard strata	from	to	time

Installations	
Pipe size	
Slotted: From	To
Sealed: From	To
From	To
Cover type	Flush Raised

Signed for client Tom Collins

GROUND INVESTIGATIONS IRELAND Ltd.
DAILY REPORT

Location: Grange Castle Business Pk	BOREHOLE NO. BH-2
Drilling Crew: Tom + Shane Collins	Casing diameter: mm
	Drilled Today From: To:
Date: 20/6/13 Thursday.	Cored Today From: 0m To: 7.3m
Type of rig:	Cased Today From: 0m To: 7.3m

GROUND INVESTIGATIONS IRELAND

DEPTH from	DEPTH to	STRATA DRILLED TODAY Description	SAMPLES Type	Depth	Ref no.
0m	2.6m	Clay			
2.6	3.6m	Small to Fract Rock 90% Rec			
3.6	5.1m	" " 100% Rec			
5.1	6.1m	" " 100% Rec			
6.1	7.3m	Small to Fract Rock 100% Rec			
		Pulled Casing, Loaded RIG and Moved of Site.			

Groundwater:

Water strikes	1	2
Depth		
After 20 min		
Sealed off?		
Depth		
Water depth start day:		
Water depth end day:		

Standard penetration tests

Test type:									
Start depth:									

Blows/75mm
S =split spoon
C =solid cone U = U100 R =refusal.

Remarks, delays etc

7am - 7.30pm.

Chiselling: Boring in hard strata	from	to	time

Installations

Pipe size	
Slotted: From	To
Sealed: From	To
From	To
Cover type	Flush Raised

Signed for client: Tom Collins

GROUND INVESTIGATIONS IRELAND Ltd.
DAILY REPORT

Location: Grange Castle Business Pk	BOREHOLE NO. BH-3
Drilling Crew: Tom + Shane Collins	Casing diameter: mm
	Drilled Today From: To:
Date: 19/6/13 Wednesday	Cored Today From: 0m To: 6.7m
Type of rig:	Cased Today From: 0m To: 6.7m

GROUND INVESTIGATIONS IRELAND

DEPTH from	DEPTH to	STRATA DRILLED TODAY Description	SAMPLES Type	Depth	Ref no.
0m	2.1m	Clay			
2.1	3.6m	Small to Fract Rock 85% Rec			
3.6	5.0m	" " 100% Rec			
5.0	6.7m	Large to Fract Rock 100% Rec			
		pulled Casing, Moved to Nxt BH Location			

Groundwater:			Standard penetration tests								
Water strikes	1	2	Test type:								
Depth			Start depth:								
After 20 min											
Sealed off?			Blows/75mm								
Depth			S =split spoon C =solid cone U = U100 R =refusal.								
Water depth start day:											
Water depth end day:											
Remarks, delays etc											

Chiselling: Boring in hard strata	from	to	time

Installations	
Pipe size	
Slotted: From	To
Sealed: From	To
From	To
Cover type	Flush Raised

Signed for client Tom Collins

GROUND INVESTIGATIONS IRELAND Ltd.
DAILY REPORT

Location: Orangecastle Business Pk	BOREHOLE NO. BH-4
Drilling Crew: Tom + Shane Collins	Casing diameter: mm
	Drilled Today From: To:
Date: 20/6/13 Thursday	Cored Today From: 0m To: 6.35m
Type of rig:	Cased Today From: 0m To: 6.35m

DEPTH from	DEPTH to	STRATA DRILLED TODAY Description	SAMPLES Type	Depth	Ref no.
0m	1.4m	Clay.			
1.4	2.1m	Small Rock / Clay. 70%Rec			
2.1	3.6m	" " 70%Rec			
3.6	5.1m	Large to Small Rock 100%Rec			
5.1	6.35m	" " 100%Rec			
		pulled Casing, Moved to Nxt BH location.			

Groundwater:

Water strikes	1	2
Depth		
After 20 min		
Sealed off?		
Depth		
Water depth start day:		
Water depth end day:		

Remarks, delays etc

Standard penetration tests

Test type:								
Start depth:								
Blows/75mm S =split spoon C =solid cone U = U100 R =refusal.								

Chiselling: Boring in hard strata	from	to	time

Installations

Pipe size	
Slotted: From	To
Sealed: From	To
From	To
Cover type	Flush Raised

Signed for client Tom Collins

GROUND INVESTIGATIONS IRELAND Ltd.
DAILY REPORT

Location: Grangecastle Business Pk	BOREHOLE NO. BH-5
Drilling Crew: Tom + Shane Collins	Casing diameter: mm
	Drilled Today From: To:
Date: 18/6/13 Tuesday	Cored Today From: 0m To: 8.05m
Type of rig:	Cased Today From: 0m To: 8.05m

DEPTH from	DEPTH to	STRATA DRILLED TODAY Description	SAMPLES Type	Depth	Ref no.
0m	2.6m	Clay			
2.6	3.6m	Rock with Clay bands 75%Rec			
3.6	5.1m	Small to Exact Rock 100%Rec			
5.1	6.55m	Large to Small Rock 100%Rec			
6.55	8.05m	" " with Clay bands 85%Rec			
		pulled Casing, Moved to Nxt BH location			

Groundwater:

Water strikes	1	2
Depth		
After 20 min		
Sealed off?		
Depth		
Water depth start day:		
Water depth end day:		

Standard penetration tests

Test type:								
Start depth:								
Blows/75mm S =split spoon C =solid cone U = U100 R =refusal.								

Remarks, delays etc

Chiselling: Boring in hard strata	from	to	time

Installations	
Pipe size	
Slotted: From	To
Sealed: From	To
From	To
Cover type	Flush Raised

Signed for client Tom Collins

GROUND INVESTIGATIONS IRELAND Ltd.
DAILY REPORT

Location: Grange castle Business Pk	BOREHOLE NO. BH-6
Drilling Crew: Tom + Shane Collins	Casing diameter: mm
	Drilled Today From: To:
Date: 20/6/13 Thursday.	Cored Today From: 0m To: 6.7m
Type of rig:	Cased Today From: 0m To: 6.7m

GROUND INVESTIGATIONS IRELAND

DEPTH from	DEPTH to	STRATA DRILLED TODAY Description	SAMPLES Type	Depth	Ref no.
0m	2.2m	Clay			
2.2	3.6m	Fract Rock/Clay 85%Rec			
3.6	5.1m	Small to Med Rock 100%Rec			
5.1	6.7m	Large to Small Rock 100%Rec			
		Pulled Casing, Moved to Nxt BH Location			

Groundwater:			Standard penetration tests								
Water strikes	1	2	Test type:								
Depth			Start depth:								
After 20 min											
Sealed off?			Blows/75mm								
Depth			S =split spoon								
Water depth start day:			C =solid cone U = U100 R								
Water depth end day:			=refusal.								
Remarks, delays etc											

Chiselling: Boring in hard strata	from	to	time

Installations	
Pipe size	
Slotted: From	To
Sealed: From	To
From	To
Cover type	Flush Raised

Signed for client Tom Collins

GROUND INVESTIGATIONS IRELAND Ltd.
DAILY REPORT

Location: Garage castle Business Pk	BOREHOLE NO. BH-7
Drilling Crew: Tom + Shane Collins	Casing diameter: mm
	Drilled Today From: To:
Date:	Cored Today From: 0m To: 6.3m
Type of rig:	Cased Today From: 0m To: 6.3m

DEPTH from	DEPTH to	STRATA DRILLED TODAY Description	SAMPLES Type	SAMPLES Depth	SAMPLES Ref no.
0m	1.5m	Clay			
1.5	2.1m	Fract Rock / Clay bands 50% Rec			
2.1	3.6m	Small to Med Rock 100% Rec			
3.6	5.1m	" " 100% Rec			
5.1	6.3m	Small to Med Rock 100% Rec			
		pulled casing, loaded Rig and Moved off Site.			

Groundwater:			Standard penetration tests								
Water strikes	1	2	Test type:								
Depth			Start depth:								
After 20 min											
Sealed off?			Blows/75mm								
Depth			S =split spoon								
Water depth start day:			C =solid cone U = U100 R =refusal.								
Water depth end day:											
Remarks, delays etc											

7am - 6.30pm.

Chiselling: Boring in hard strata	from	to	time

Installations	
Pipe size	
Slotted: From	To
Sealed: From	To
From	To
Cover type	Flush Raised

Signed for client: Tom Collins

GROUND INVESTIGATIONS IRELAND Ltd.
DAILY REPORT

Location: Grange castle Business Pk	BOREHOLE NO. BH-8
Drilling Crew: Tom + Shane Collins	Casing diameter: mm
	Drilled Today From: To:
Date: 20/6/13 Thursday	Cored Today From: 0m To: 7.20m
Type of rig:	Cased Today From: 0m To: 7.20m

DEPTH from	DEPTH to	STRATA DRILLED TODAY Description	SAMPLES Type	Depth	Ref no.
0m	2.3m	Clay.			
2.3	3.6m	Small to Med Rock / Clay bands 80% Rec			
3.6	5.1m	Small to Med Rock 100% Rec			
5.1	6.6m	Large to Small Rock 100% Rec			
6.6	7.2m	" " 60% Rec			
		pulled easy, Moved to Nxt BH location			

Groundwater:		
Water strikes	1	2
Depth		
After 20 min		
Sealed off?		
Depth		
Water depth start day:		
Water depth end day:		

Remarks, delays etc

Standard penetration tests

Test type:								
Start depth:								
Blows/75mm S =split spoon C =solid cone U = U100 R =refusal.								

Chiselling: Boring in hard strata	from	to	time

Installations	
Pipe size	
Slotted: From	To
Sealed: From	To
From	To
Cover type	Flush Raised

Signed for client Tom Collins

GROUND INVESTIGATIONS IRELAND Ltd.
DAILY REPORT

Location: grange castle Business P/c	BOREHOLE NO. BH-9
Drilling Crew: Tom + Shane Collins	Casing diameter: mm
Date: 21/6/13 Friday.	Drilled Today From: To:
Type of rig:	Cored Today From: 0m To: 7.0m
	Cased Today From: 0m To: 7.0m

GROUND INVESTIGATIONS IRELAND

DEPTH from	DEPTH to	STRATA DRILLED TODAY Description	SAMPLES Type	Depth	Ref no.
0m	2.1m	Clay -			
2.1	3.05m	Fract Rock Clay Seams 90% rec			
3.05	5.0m	Small to Med Rock 100% rec			
5.0	7.0m	" " 100% roc			
		pulled casing			
		Rig broke down. Had to go into town for parts			
		Mick came out at 3.30pm.			
		Took cover off Rig changed Starter. got Rig Started loaded up and took back to Yard.			

Groundwater:		
Water strikes	1	2
Depth		
After 20 min		
Sealed off?		
Depth		
Water depth start day:		
Water depth end day:		

Standard penetration tests

Test type:						
Start depth:						
Blows/75mm S =split spoon C =solid cone U = U100 R =refusal.						

Remarks, delays etc

7am - 8.30pm.

Chiselling: Boring in hard strata	from	to	time

Installations	
Pipe size	
Slotted: From	To
Sealed: From	To
From	To
Cover type	Flush Raised

Signed for client Tom Collins

GROUND INVESTIGATIONS IRELAND Ltd.
DAILY REPORT

Location: Greenycastle Business Plc	BOREHOLE NO. BH-10
Drilling Crew: Tom + Shane Colling	Casing diameter: mm
	Drilled Today From: To:
Date: 17/6/13 Monday.	Cored Today From: 0m To: 6·60
Type of rig:	Cased Today From: 0m To: 6·6m

GROUND INVESTIGATIONS IRELAND

DEPTH from	DEPTH to	STRATA DRILLED TODAY Description	SAMPLES Type	Depth	Ref no.
0m	2·3m	Clay			
2·3	3·6m	Clay / Small to fract Rock 95% Rec			
3·6	5·1m	Med to Small Rock. 100% Rec			
5·1	6·6m	Med to fract Rock 100% Rec			
		Standpipe Installed to 6·6m.			
		5m - Slotted 1·6m - plain			
		pulled Casing			
		7·30am - 5·30pm.			

Groundwater:

	1	2
Water strikes		
Depth		
After 20 min		
Sealed off?		
Depth		
Water depth start day:		
Water depth end day:		

Standard penetration tests

Test type:								
Start depth:								
Blows/75mm S =split spoon C =solid cone U = U100 R =refusal.								

Remarks, delays etc

went to Site and Switch was Pulled off Rig, Casing was damaged had to get diggee to get leading Length out of ground €50 Had to get pipe Fixed on Rig

Chiselling: Boring in hard strata	from	to	time

Installations

Pipe size	
Slotted: From	To
Sealed: From	To
From	To
Cover type	Flush Raised

Signed for client My Tom Ball

1 NIGHT

GROUND INVESTIGATIONS IRELAND Ltd.
DAILY REPORT

Location: Grange castle business Pk	BOREHOLE NO. BH-11
Drilling Crew: Tom + Shane Collins	Casing diameter: mm
	Drilled Today From: To:
Date: 24/6/13 Monday.	Cored Today From: 0m To: 7.05m
Type of rig:	Cased Today From: 0m To: 7.05m

DEPTH from	DEPTH to	STRATA DRILLED TODAY Description	SAMPLES Type	Depth	Ref no.
0m	2.6m	Clay.			
2.6	3.6m	Small to Exact Rock 100%Rec			
3.6	4.7m	" " 100%Rec			
4.7	6.35m	Small to Large Rock 100%Rec			
6.35	7.05m	Small to Large Rock 100%Rec			
		pulled Casing Loaded Rig and Moved off Site.			

Groundwater:			Standard penetration tests								
Water strikes	1	2	Test type:								
Depth			Start depth:								
After 20 min			Blows/75mm S =split spoon C =solid cone U = U100 R =refusal.								
Sealed off?											
Depth											
Water depth start day:											
Water depth end day:											
Remarks, delays etc											

Chiselling: Boring in hard strata	from	to	time

Installations	
Pipe size	
Slotted: From	To
Sealed: From	To
From	To
Cover type	Flush Raised

Signed for client Tom Collins

GROUND INVESTIGATIONS IRELAND Ltd.
DAILY REPORT

Location: Grange castle Business Pk	BOREHOLE NO. BH12
Drilling Crew: Tom + Shane Collins	Casing diameter: mm
	Drilled Today From: To:
Date: 15/6/13 Saturday.	Cored Today From: 0m To: 6·8m
Type of rig:	Cased Today From: 0m To: 6·8m

DEPTH from	DEPTH to	STRATA DRILLED TODAY Description	SAMPLES Type	Depth	Ref no.
0m	2·3m	Clay.			
2·3	3·6m	Small to fract Rock 95% REC			
3·6	5·1m	Med to Small Rock 100% REC			
5·1	6·0m	" " 100% REC			
6·0	6·8m	Large to Med Rock 100% REC			
		pulled Casing.			
		pulled Casing, Moved to Nxt BH location			

Groundwater:		
Water strikes	1	2
Depth		
After 20 min		
Sealed off?		
Depth		
Water depth start day:		
Water depth end day:		

Standard penetration tests

Test type:									
Start depth:									
Blows/75mm S =split spoon C =solid cone U = U100 R =refusal.									

Remarks, delays etc

Chiselling: Boring in hard strata	from	to	time

Installations	
Pipe size	
Slotted: From	To
Sealed: From	To
From	To
Cover type	Flush Raised

Signed for client Tom Collins

GROUND INVESTIGATIONS IRELAND Ltd.
DAILY REPORT

Location: Grangecastle Business Pk	BOREHOLE NO. BH-13
Drilling Crew: Tom + Shane Collins	Casing diameter: mm
	Drilled Today From: To:
Date: 26/6/13 Wednesday	Cored Today From: 0m To: 7.6m
Type of rig:	Cased Today From: 0m To: 7.6m

DEPTH from	DEPTH to	STRATA DRILLED TODAY Description		SAMPLES Type	Depth	Ref no.
0.0	3.0m	Clay.				
3.0	3.6m	Rock with Clay Seams	90% Rec			
3.6	5.1m	Med to Fract Rock	100% Rec			
5.1	6.65m	Small to Large Rock	100% Rec			
6.65	7.60m	Small to Large Rock	100% Rec			
		pulled casing and Moved Rig back to Yard.				

Groundwater:			Standard penetration tests								
Water strikes	1	2	Test type:								
Depth			Start depth:								
After 20 min			Blows/75mm S =split spoon C =solid cone U = U100 R =refusal.								
Sealed off?											
Depth											
Water depth start day:											
Water depth end day:											
Remarks, delays etc											

Chiselling: Boring in hard strata	from	to	time

Installations	
Pipe size	
Slotted: From	To
Sealed: From	To
From	To
Cover type	Flush Raised

Signed for client Tom Collins

GROUND INVESTIGATIONS IRELAND Ltd.
DAILY REPORT

Location: Grange castle Business Plc	BOREHOLE NO BH14 Cont
Drilling Crew: Tom + Shane Collins	Casing diameter: mm
	Drilled Today From: To:
Date: 15/6/13 Saturday.	Cored Today From: 3.65 To: 6.00
Type of rig:	Cased Today From: 3.65 To: 6.00

DEPTH from	DEPTH to	STRATA DRILLED TODAY Description	SAMPLES Type	Depth	Ref no.
3.65	5.25m	Small to Med Rock 100%Rec			
5.25	6.00m	Small to Med Rock 100%Rec			
		Pulled Casing and Moved to Next BH location.			

Groundwater:		
Water strikes	1	2
Depth		
After 20 min		
Sealed off?		
Depth		
Water depth start day:		
Water depth end day:		

Remarks, delays etc

Standard penetration tests								
Test type:								
Start depth:								
Blows/75mm S =split spoon C =solid cone U = U100 R =refusal.								

Chiselling: Boring in hard strata	from	to	time

Installations	
Pipe size	
Slotted: From	To
Sealed: From	To
From	To
Cover type	Flush Raised

Signed for client Tom Collins

GROUND INVESTIGATIONS IRELAND Ltd.
DAILY REPORT

Location: Grange Castle Business Pk	BOREHOLE NO. BH-19
Drilling Crew: Tom + Shane Collins	Casing diameter: mm
	Drilled Today From: To:
Date: 6/6/13 Thursday.	Cored Today From: 0m To: 7.55m
Type of rig:	Cased Today From: 0m To: 7.55m

DEPTH from	DEPTH to	STRATA DRILLED TODAY Description	SAMPLES Type	SAMPLES Depth	SAMPLES Ref no.
0m	2.5m	Clay			
2.5	3.4m	Clay, Fract Rock 75% Rec			
3.4	4.5m	Small to Fract Rock 100% Rec			
4.5	6.25m	Large to Small Rock 100% Rec			
6.25	7.55m	Large to Small Rock 100% Rec			
		Pulled Casing, Moved Rig to Nxt BH Location, Set Up Rig.			
		Moved tractor + trailer back to yard.			

Groundwater:		
Water strikes	1	2
Depth		
After 20 min		
Sealed off?		
Depth		
Water depth start day:		
Water depth end day:		

Standard penetration tests

Test type:								
Start depth:								
Blows/75mm S =split spoon C =solid cone U = U100 R =refusal.								

Remarks, delays etc

8am - 5.30pm.

Chiselling: Boring in hard strata	from	to	time

Installations

Pipe size	
Slotted: From	To
Sealed: From	To
From	To
Cover type	Flush Raised

Signed for client: Tom Collins

GROUND INVESTIGATIONS IRELAND Ltd.
DAILY REPORT

Yard / ~~Office~~

Location: Grangecastle B.P.	BOREHOLE NO. BH-20
Drilling Crew: TOM + Shane Collins	Casing diameter: mm
	Drilled Today From: To:
Date: 6/6/13 Thursday	Cored Today From: 0m To: 7.00m
Type of rig:	Cased Today From: 0m To: 7.00m

DEPTH from	DEPTH to	STRATA DRILLED TODAY Description	SAMPLES Type	Depth	Ref no.
		Took Compressor back to Swan, Moved to Yard off Loaded gear and Moved out to Grangecastle, Set up on BH.			
0.0	1.9m	Clay			
1.9	3.30m	Small to React Rock 100%Rec			
3.30	5.00m	Small to React Rock/Clay Seams 75%Rec			
5.00	6.15m	- Large Rock 100%Rec			
6.15	7.0m	Small to Medium Rock 100%Rec			
		Pulled Casing, Moved to Nxt BH Location, Set up Rig.			

Groundwater:

Water strikes	1	2
Depth		
After 20 min		
Sealed off?		
Depth		
Water depth start day:		
Water depth end day:		

Remarks, delays etc

Standard penetration tests

Test type:						
Start depth:						
Blows/75mm S =split spoon C =solid cone U = U100 R =refusal.						

Chiselling: Boring in hard strata	from	to	time

Installations

Pipe size	
Slotted: From	To
Sealed: From	To
From	To
Cover type	Flush Raised

Signed for client My Tom Collins

GROUND INVESTIGATIONS IRELAND Ltd.
DAILY REPORT

Location: Grangecastle Business Pk	BOREHOLE NO. BH-23
Drilling Crew: Tom + Shane Collins	Casing diameter: mm
	Drilled Today From: To:
Date: 7/6/13 Friday	Cored Today From: 0m To: 6.25m
Type of rig:	Cased Today From 0m To: 6.25m

DEPTH from	DEPTH to	STRATA DRILLED TODAY Description	SAMPLES Type	Depth	Ref no.
0.0	0.9m	Clay.			
0.9	1.6m	Clay, Fract Rock 90% Rec			
1.6	3.15m	Fract Rock with Clay bands 50% Rec			
3.15	4.55m	Fract Rock 100% Rec			
4.55	6.25m	Large to fract Rock 100% Rec			
		Pulled Casing, Moved Rig to Nxt BH Location, Set up Rig.			

Groundwater:

Water strikes	1	2
Depth		
After 20 min		
Sealed off?		
Depth		
Water depth start day:		
Water depth end day:		

Remarks, delays etc

Standard penetration tests

Test type:									
Start depth:									
Blows/75mm S =split spoon C =solid cone U = U100 R =refusal.									

Chiselling: Boring in hard strata	from	to	time

Installations

Pipe size	
Slotted: From	To
Sealed: From	To
From	To
Cover type	Flush Raised

Signed for client Tom Collins

GROUND INVESTIGATIONS IRELAND Ltd.
DAILY REPORT

Location: Grange castle business PK	**BOREHOLE NO.** BH-24
Drilling Crew: Tom + Shane Collins	Casing diameter: mm
	Drilled Today From: To:
Date: 7/6/13 Friday	Cored Today From: 0m To: 6.85m
Type of rig:	Cased Today From: 0m To: 6.85m

GROUND INVESTIGATIONS IRELAND

DEPTH from	DEPTH to	STRATA DRILLED TODAY Description	SAMPLES Type	Depth	Ref no.
0.0	2.5m	Clay.			
2.5	3.5m	Clay / Rock Med to Small 90% Rec			
3.5	5.5m	Large to React Rock 100% Rec			
5.5	6.85m	Large to React Rock 100% Rec			
		Pulled Casing, Moved Rig to Nxt BH location, Set up Rig.			

Groundwater:

Water strikes	1	2
Depth		
After 20 min		
Sealed off?		
Depth		
Water depth start day:		
Water depth end day:		

Remarks, delays etc

Standard penetration tests

Test type:						
Start depth:						
Blows/75mm S =split spoon C =solid cone U = U100 R =refusal.						

Chiselling: Boring in hard strata	from	to	time

Installations

Pipe size	
Slotted: From	To
Sealed: From	To
From	To
Cover type	Flush Raised

Signed for client: Tom Collins

Appendix 5 Soakaway Tests

SW01

Soakaway Test to BRE Digest 365
Trial Pit Dimensions: 2.2 x 0.6 x 1.8 (L x W x D)
Seepage @1.5m during excavation
Rock encountered at 1.8m bgl

Date	Time	Water level (m bgl)	Remarks
29/05/2013	12.54	0.485	
29/05/2013	13.15	0.495	
29/05/2013	13.33	0.51	
29/05/2013	13.49	0.515	
29/05/2013	14.07	0.525	
29/05/2013	13.32	0.54	
29/05/2013	15.17	0.54	
29/05/2013	16.05	0.57	Failed: Backfilled

SW02

Soakaway Test to BRE Digest 365
Trial Pit Dimensions: 2.2 x 0.7 x 1.5 (L x W x D)
Seepage @1.5m during excavation
Rock encountered at 1.5m bgl

Date	Time	Water level (m bgl)	Remarks
29/05/2013	12.43	0.485	
29/05/2013	12.47	0.475	
29/05/2013	13.07	0.495	
29/05/2013	13.13	0.5	
29/05/2013	13.30	0.51	
29/05/2013	13.46	0.51	
29/05/2013	14.04	0.52	
29/05/2013	14.25	0.53	
29/05/2013	15.22	0.55	
29/05/2013	15.54	0.565	Failed: Backfilled

SW03

Soakaway Test to BRE Digest 365
Trial Pit Dimensions: 2.2 x 0.6 x 1.2 (L x W x D)
Rock encountered at 1.2m bgl

Date	Time	Water level (m bgl)	Remarks
29/05/2013	12.14	0.39	
29/05/2013	12.10	0.3975	
29/05/2013	12.18	0.405	
29/05/2013	12.20	0.41	
29/05/2013	13.17	0.55	
29/05/2013	13.50	0.615	
29/05/2013	14.17	0.67	
29/05/2013	15.30	0.8	
29/05/2013	15.38	0.81	
29/05/2013	16.55	0.93	
30/05/2013	8.25	1.2	Empty
30/05/2013	8.26	0.58	
30/05/2013	9.49	0.69	
30/05/2013	9.59	0.69	
30/05/2013	11.47	0.81	
30/05/2013	14.25	0.935	
30/05/2013	15.30	0.101	
30/05/2013	16.44	0.104	Backfilled

SW04

Soakaway Test to BRE Digest 365
Trial Pit Dimensions: 2.2 x 0.6 x 1.9 (L x W x D)
Damp @ 1m during excavation
Rock encountered at 1.5m bgl

Date	Time	Water level (m bgl)	Remarks
29/05/2013	12.26	0.47	
29/05/2013	12.28	0.475	
29/05/2013	12.32	0.48	
29/05/2013	12.35	0.485	
29/05/2013	13.22	0.53	
29/05/2013	13.55	0.555	
29/05/2013	14.22	0.57	
29/05/2013	14.41	0.625	
29/05/2013	16.27	0.655	
30/05/2013	8.30	0.115	
30/05/2013	11.54	0.105	Failed: Backfilled

SW05

Soakaway Test to BRE Digest 365
Trial Pit Dimensions: 2.2 x 0.6 x 1.8 (L x W x D)
Rock encountered at 1.8m bgl

Date	Time	Water level (m bgl)	Remarks
29/05/2013	11.53	0.52	
29/05/2013	11.55	0.53	
29/05/2013	12.00	0.54	
29/05/2013	12.05	0.56	
29/05/2013	13.13	0.72	
29/05/2013	13.28	0.75	
29/05/2013	13.44	0.79	
29/05/2013	13.58	0.81	
29/05/2013	14.10	0.84	
29/05/2013	14.46	0.9	
29/05/2013	15.23	0.965	
29/05/2013	16.34	1.09	
29/05/2013	16.50	1.12	
30/05/2013	8.10	1.8	Empty
30/05/2013	8.20	0.59	
30/05/2013	9.35	0.68	
30/05/2013	9.45	0.7	
30/05/2013	9.54	0.71	
30/05/2013	11.45	0.855	
30/05/2013	14.20	1.04	
30/05/2013	15.30	1.14	
30/05/2013	16.35	1.67	Backfilled

SW06

Soakaway Test to BRE Digest 365
Trial Pit Dimensions: 2.4 x 0.6 x 1.2 (L x W x D)
Rock encountered at 1.2m bgl

Date	Time	Water level (m bgl)	Remarks
29/05/2013	11.30	0.615	
29/05/2013	11.32	0.615	
29/05/2013	11.35	0.615	
29/05/2013	11.40	0.62	
29/05/2013	11.44	0.635	
29/05/2013	12.00	0.645	
29/05/2013	12.15	0.655	
29/05/2013	12.30	0.665	
29/05/2013	12.45	0.68	
29/05/2013	13.00	0.695	
29/05/2013	13.15	0.705	
29/05/2013	13.30	0.715	
29/05/2013	13.45	0.725	
29/05/2013	14.00	0.745	

SW06
contd

Date	Time	Water level (m bgl)	Remarks
29/05/2013	14.15	0.755	
29/05/2013	14.30	0.765	
29/05/2013	14.45	0.775	
29/05/2013	15.00	0.785	
29/05/2013	15.15	0.795	Failed: Backfilled

Appendix 6 Geotechnical Laboratory Test Results

Test Report: **Particle Size Distribution Test**

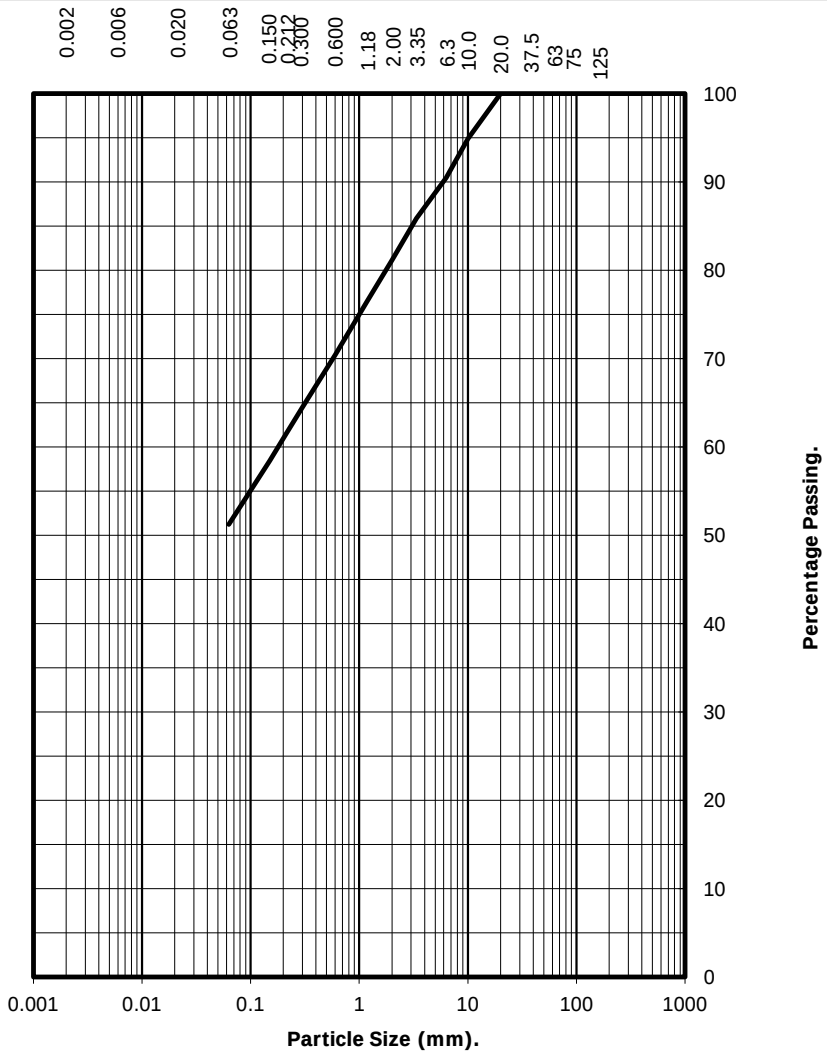
BS 1377 Part 2:1990.

Wet Sieve, Clause 9.2

Client ref:	**3718-05-13**
Location:	**Grangecastle**
Contract Number:	**19871-180613**
Hole Number	**TP1**
Sample Number:	**N/A**
Depth (m) :	**1.50**
Sample Type	**B**

BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	100
20	100
10	95
6.3	90
3.35	86
2.00	81
1.18	76
0.60	70
0.300	64
0.212	61
0.150	58
0.063	51

Particle Diameter	Percentage Passing
0.02	#
0.006	#
0.002	#



	Silt and Clay	Sand	Gravel	Cobbles	Soil Fraction
	51	**30**	**19**	**0**	Total Percentage

Remarks:

#- not determined

GSTL GEO Site & Testing Services Limited

Checked By

D P Evans

Approved By:

Date Approved: 27.7.13

UKAS TESTING 2788

Test Report: **Particle Size Distribution Test**

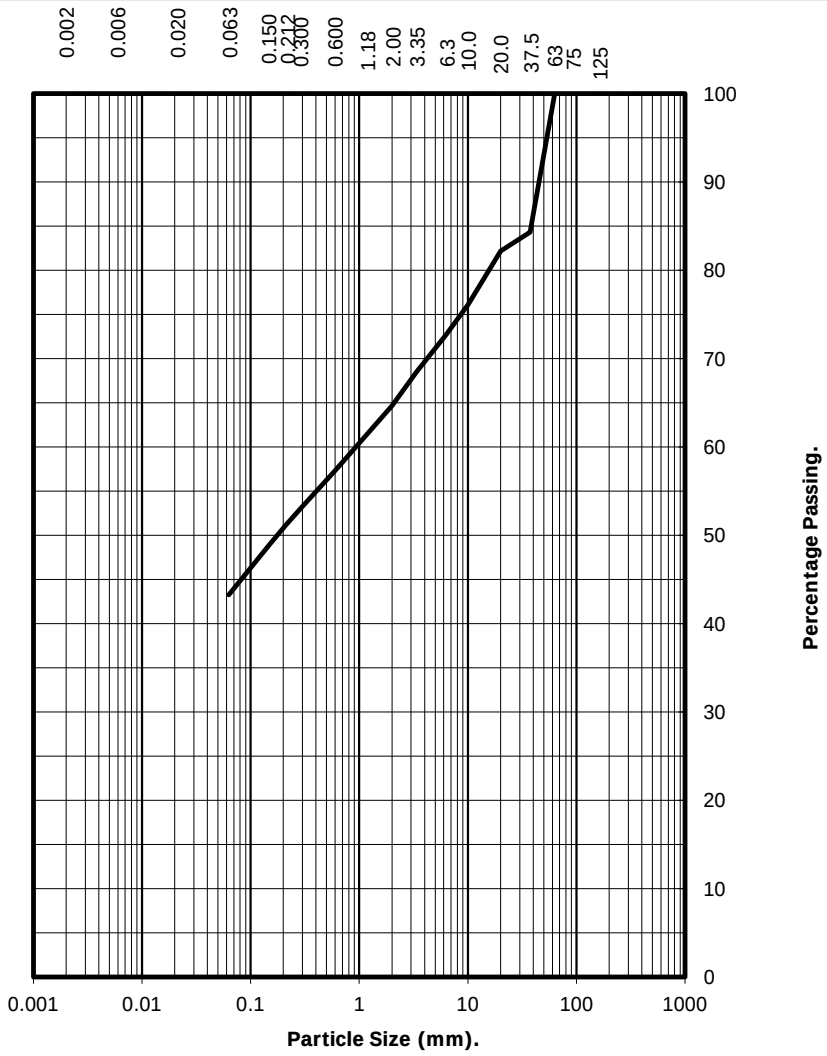
BS 1377 Part 2:1990.

Wet Sieve, Clause 9.2

Client ref:	**3718-05-13**
Location:	**Grangecastle**
Contract Number:	**19871-180613**
Hole Number	**TP3**
Sample Number:	**N/A**
Depth (m) :	**1.00**
Sample Type	**B**

BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	84
20	82
10	76
6.3	73
3.35	68
2.00	65
1.18	61
0.60	57
0.300	53
0.212	51
0.150	49
0.063	43

Particle Diameter	Percentage Passing
0.02	#
0.006	#
0.002	#



	Silt and Clay	Sand	Gravel	Cobbles	Soil Fraction
	43	**22**	**35**	**0**	Total Percentage

Remarks:

#- not determined

GSTL GEO Site & Testing Services Limited

Checked By

D P Evans

Approved By:

Date Approved: 27.7.13

UKAS TESTING 2788

Test Report: **Particle Size Distribution Test**

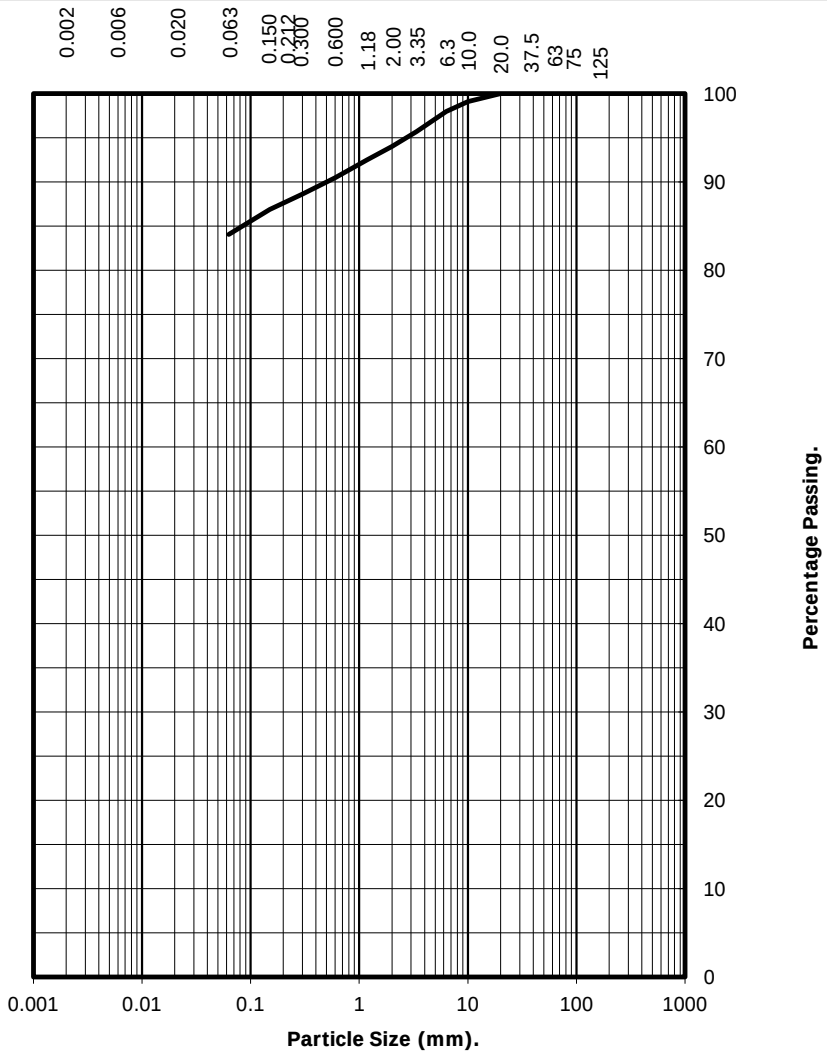
BS 1377 Part 2:1990.

Wet Sieve, Clause 9.2

Client ref:	**3718-05-13**
Location:	**Grangecastle**
Contract Number:	**19871-180613**
Hole Number	**TP3**
Sample Number:	**N/A**
Depth (m) :	**1.50**
Sample Type	**B**

BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	100
20	100
10	99
6.3	98
3.35	96
2.00	94
1.18	93
0.60	90
0.300	89
0.212	88
0.150	87
0.063	84

Particle Diameter	Percentage Passing
0.02	#
0.006	#
0.002	#



	Silt and Clay	Sand	Gravel	Cobbles	Soil Fraction
	84	**10**	**6**	**0**	Total Percentage

Remarks:

#- not determined

GSTL GEO Site & Testing Services Limited

Checked By

D P Evans

Approved By:

Date Approved: 2.7.13

UKAS TESTING 2788

Test Report: **Particle Size Distribution Test**

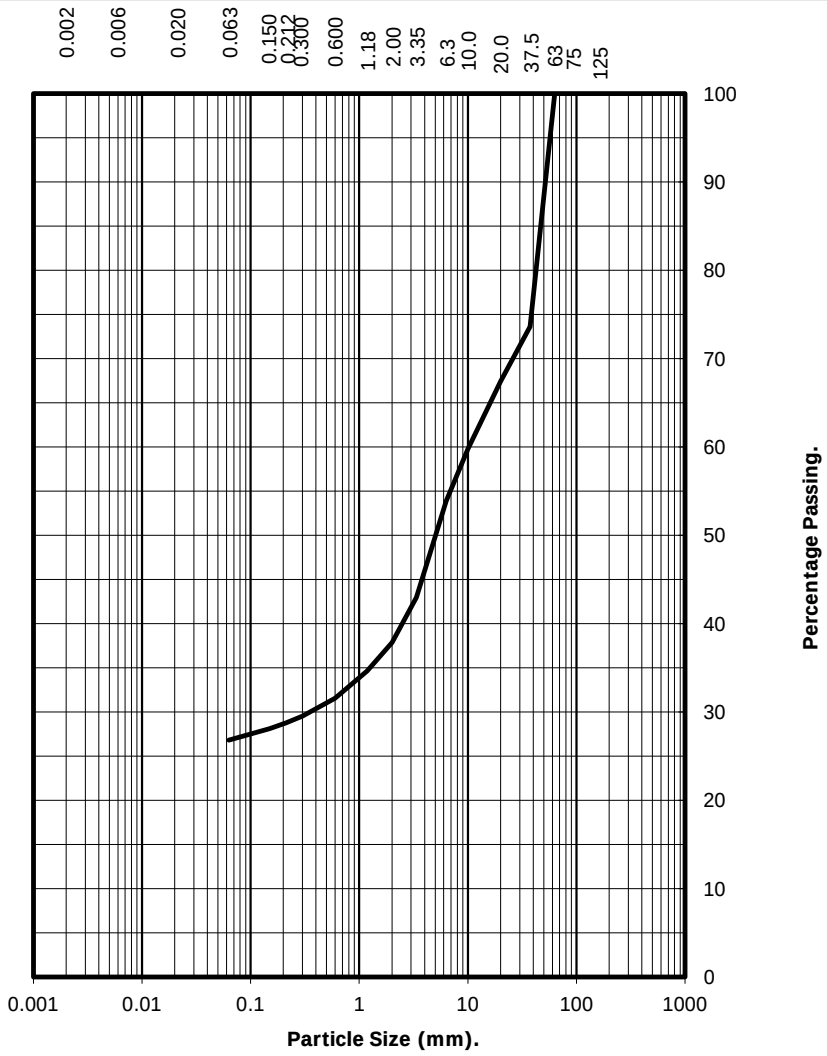
BS 1377 Part 2:1990.

Wet Sieve, Clause 9.2

Client ref:	**3718-05-13**
Location:	**Grangecastle**
Contract Number:	**19871-180613**
Hole Number	**TP6**
Sample Number:	**N/A**
Depth (m) :	**2.00**
Sample Type	**B**

BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	74
20	67
10	60
6.3	54
3.35	43
2.00	38
1.18	35
0.60	32
0.300	30
0.212	29
0.150	28
0.063	27

Particle Diameter	Percentage Passing
0.02	#
0.006	#
0.002	#



	Silt and Clay	Sand	Gravel	Cobbles	Soil Fraction
	27	**11**	**62**	**0**	Total Percentage

Remarks:

#- not determined

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Approved By:

Date Approved: 27.7.13

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Test Report: **Particle Size Distribution Test**

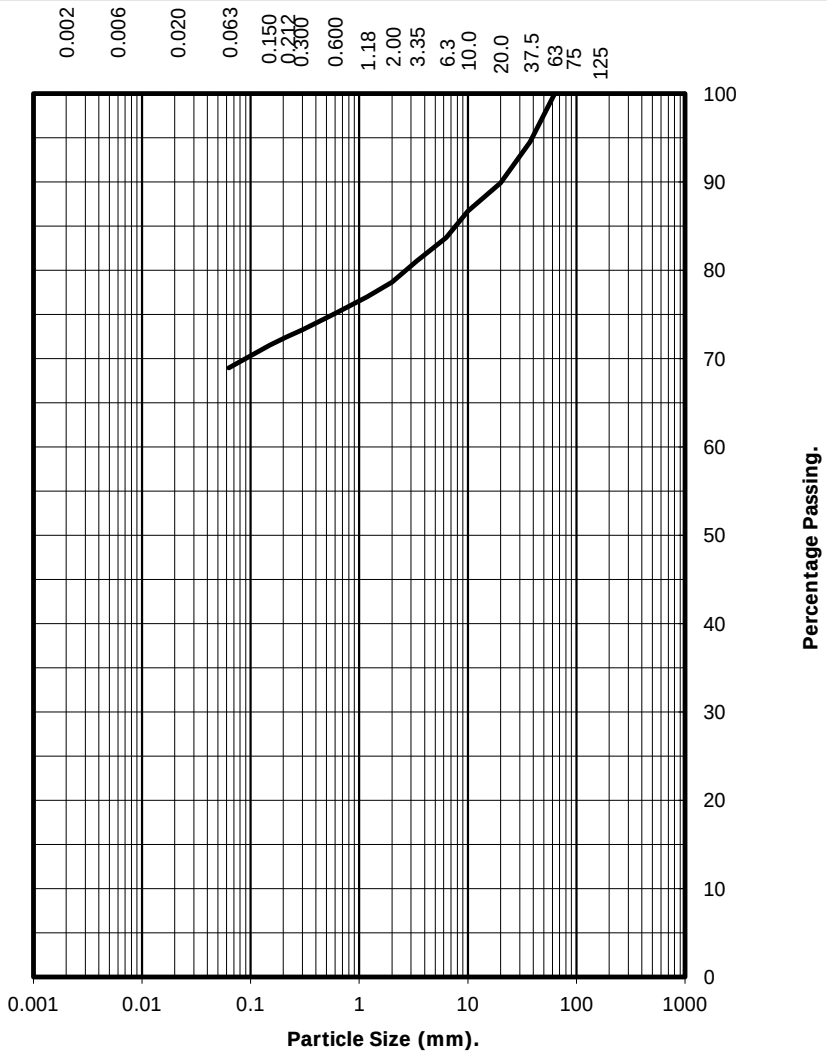
BS 1377 Part 2:1990.

Wet Sieve, Clause 9.2

Client ref:	**3718-05-13**
Location:	**Grangecastle**
Contract Number:	**19871-180613**
Hole Number	**TP7**
Sample Number:	**N/A**
Depth (m) :	**0.70-1.00**
Sample Type	**B**

BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	95
20	90
10	87
6.3	84
3.35	81
2.00	79
1.18	77
0.60	75
0.300	73
0.212	72
0.150	72
0.063	69

Particle Diameter	Percentage Passing
0.02	#
0.006	#
0.002	#



	Silt and Clay	Sand	Gravel	Cobbles	Soil Fraction
	69	**10**	**21**	**0**	Total Percentage

Remarks:

#- not determined

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Approved By:

Date Approved: 27.7.13

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Test Report: **Particle Size Distribution Test**

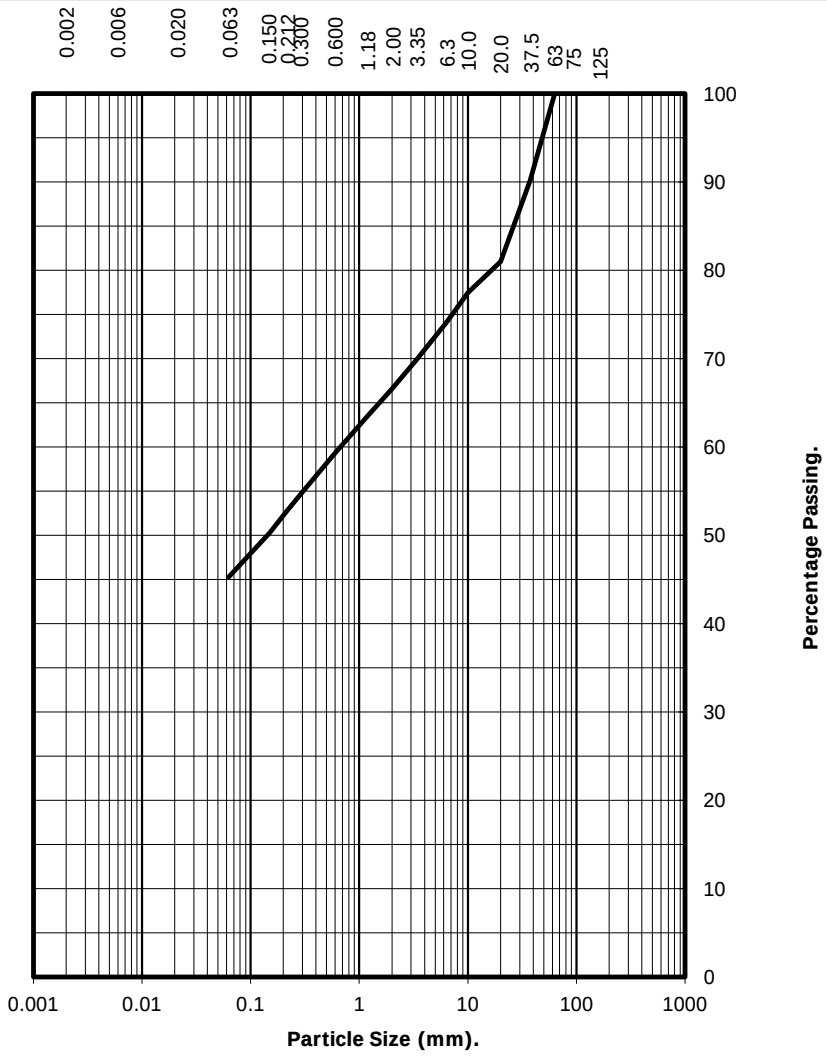
BS 1377 Part 2:1990.

Wet Sieve, Clause 9.2

Client ref:	**3718-05-13**
Location:	**Grangecastle**
Contract Number:	**19871-180613**
Hole Number	**TP9**
Sample Number:	**N/A**
Depth (m) :	**1.00**
Sample Type	**B**

BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	90
20	81
10	77
6.3	74
3.35	70
2.00	67
1.18	63
0.60	59
0.300	55
0.212	53
0.150	50
0.063	45

Particle Diameter	Percentage Passing
0.02	#
0.006	#
0.002	#



	Silt and Clay	Sand	Gravel	Cobbles	Soil Fraction
	45	**22**	**33**	**0**	Total Percentage

Remarks:

#- not determined

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D P Evans

Approved By:

Date Approved: 27.7.13

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Test Report: **Particle Size Distribution Test**

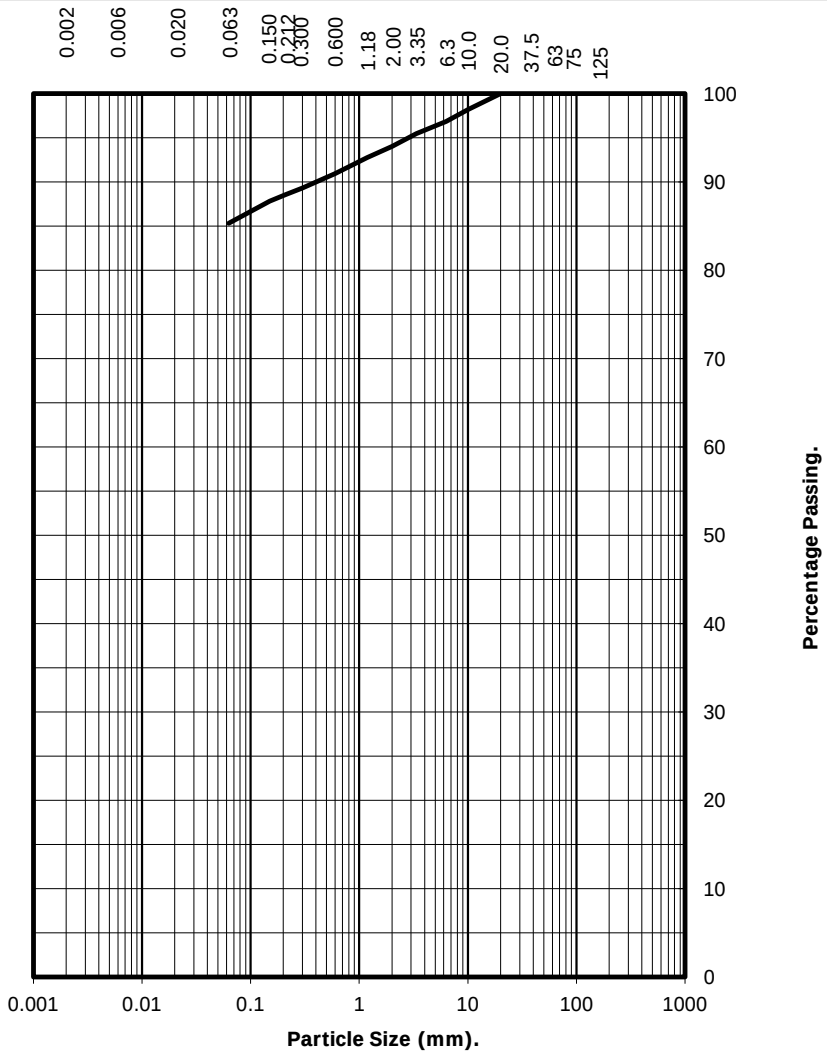
BS 1377 Part 2:1990.

Wet Sieve, Clause 9.2

Client ref:	**3718-05-13**
Location:	**Grangecastle**
Contract Number:	**19871-180613**
Hole Number	**TP10**
Sample Number:	**N/A**
Depth (m) :	**1.50**
Sample Type	**B**

BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	100
20	100
10	98
6.3	97
3.35	95
2.00	94
1.18	93
0.60	91
0.300	89
0.212	89
0.150	88
0.063	85

Particle Diameter	Percentage Passing
0.02	#
0.006	#
0.002	#



	Silt and Clay	Sand	Gravel	Cobbles	Soil Fraction
	85	**9**	**6**	**0**	Total Percentage

Remarks:

#- not determined

GSTL GEO Site & Testing Services Limited

Checked By

D P Evans

Approved By:

Date Approved: 27.7.13

UKAS TESTING 2788

Test Report: **Particle Size Distribution Test**

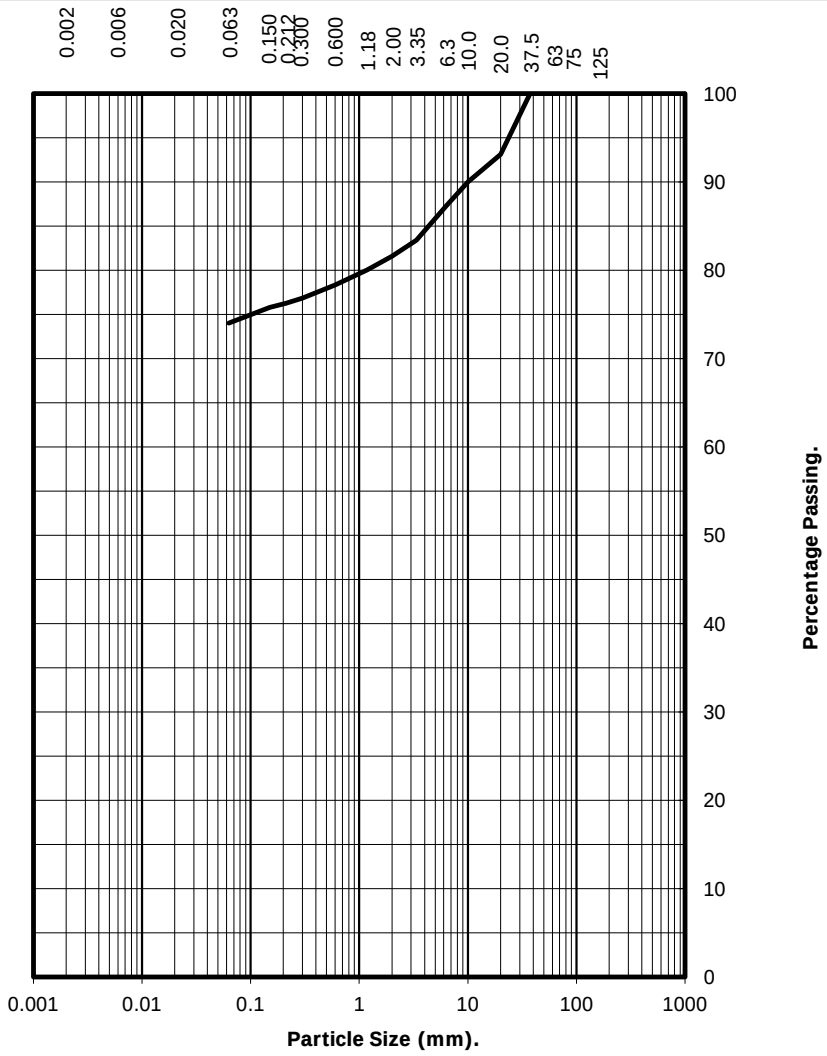
BS 1377 Part 2:1990.

Wet Sieve, Clause 9.2

Client ref:	**3718-05-13**
Location:	**Grangecastle**
Contract Number:	**19871-180613**
Hole Number	**TP12**
Sample Number:	**N/A**
Depth (m) :	**1.00**
Sample Type	**B**

BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	100
20	93
10	90
6.3	87
3.35	83
2.00	82
1.18	80
0.60	78
0.300	77
0.212	76
0.150	76
0.063	74

Particle Diameter	Percentage Passing
0.02	#
0.006	#
0.002	#



	Silt and Clay	Sand	Gravel	Cobbles	Soil Fraction
	74	**8**	**18**	**0**	Total Percentage

Remarks:

#- not determined

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Checked By

D P Evans

Approved By:

Date Approved: 2.7.13

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Test Report: **Particle Size Distribution Test**

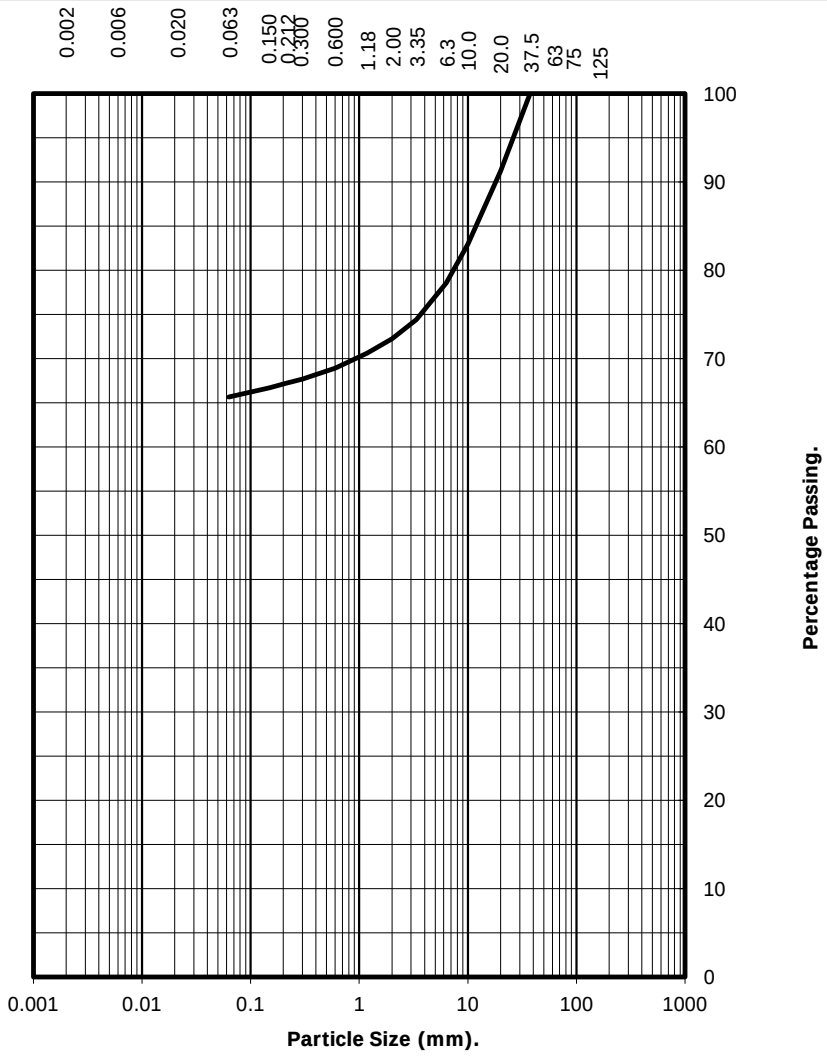
BS 1377 Part 2:1990.

Wet Sieve, Clause 9.2

Client ref:	**3718-05-13**
Location:	**Grangecastle**
Contract Number:	**19871-180613**
Hole Number	**TP12**
Sample Number:	**N/A**
Depth (m) :	**1.70**
Sample Type	**B**

BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	100
20	91
10	83
6.3	79
3.35	74
2.00	72
1.18	71
0.60	69
0.300	68
0.212	67
0.150	67
0.063	66

Particle Diameter	Percentage Passing
0.02	#
0.006	#
0.002	#



	Silt and Clay	Sand	Gravel	Cobbles	Soil Fraction
	66	**6**	**28**	**0**	Total Percentage

Remarks:

#- not determined

GSTL GEO Site & Testing Services Limited

Checked By

D P Evans

Approved By:

Date Approved: 2.7.13

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Test Report: **Particle Size Distribution Test**

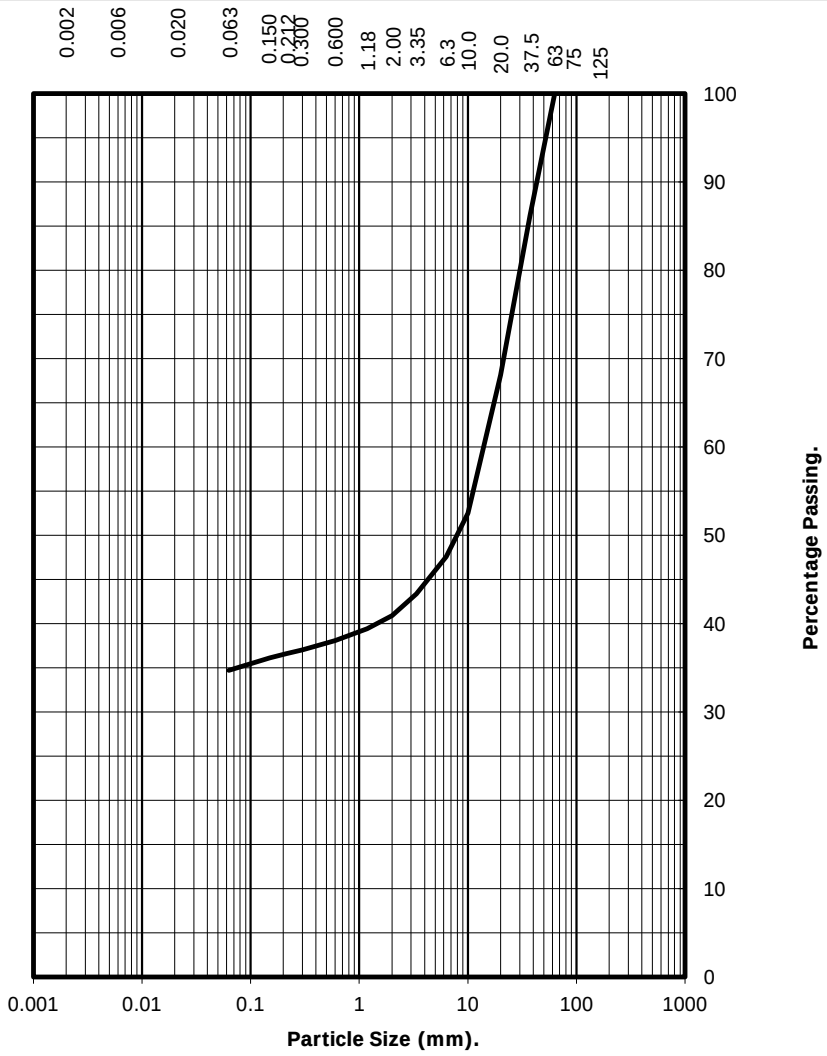
BS 1377 Part 2:1990.

Wet Sieve, Clause 9.2

Client ref:	**3718-05-13**
Location:	**Grangecastle**
Contract Number:	**19871-180613**
Hole Number	**TP12**
Sample Number:	**N/A**
Depth (m) :	**2.20**
Sample Type	**B**

BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	86
20	68
10	53
6.3	48
3.35	43
2.00	41
1.18	39
0.60	38
0.300	37
0.212	37
0.150	36
0.063	35

Particle Diameter	Percentage Passing
0.02	#
0.006	#
0.002	#



	Silt and Clay	Sand	Gravel	Cobbles	Soil Fraction
	35	**6**	**59**	**0**	Total Percentage

Remarks:

#- not determined

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Checked By

D P Evans

Approved By:

Date Approved: 2.7.13

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Test Report: **Particle Size Distribution Test**

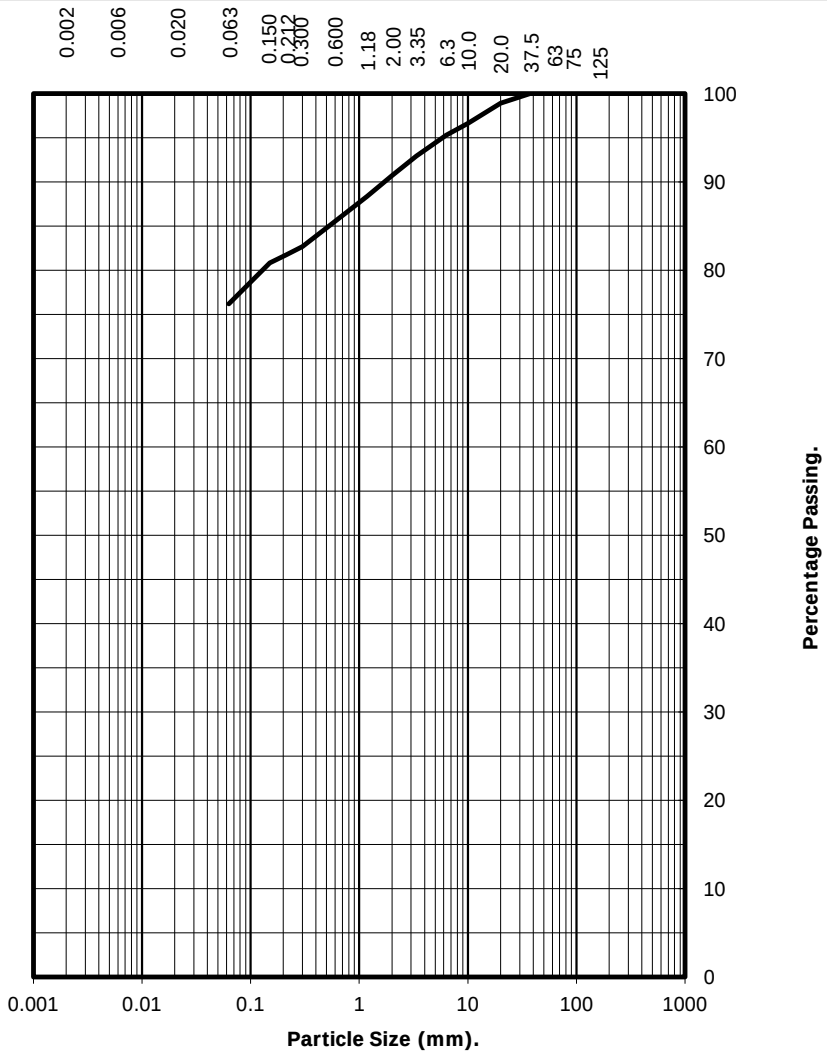
BS 1377 Part 2:1990.

Wet Sieve, Clause 9.2

Client ref:	**3718-05-13**
Location:	**Grangecastle**
Contract Number:	**19871-180613**
Hole Number	**TP14**
Sample Number:	**N/A**
Depth (m) :	**1.80**
Sample Type	**B**

BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	100
20	99
10	97
6.3	95
3.35	93
2.00	91
1.18	88
0.60	86
0.300	83
0.212	82
0.150	81
0.063	76

Particle Diameter	Percentage Passing
0.02	#
0.006	#
0.002	#



	Silt and Clay	Sand	Gravel	Cobbles	Soil Fraction
	76	**15**	**9**	**0**	Total Percentage

Remarks:

#- not determined

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Checked By

D P Evans

Approved By:

Date Approved: 27.7.13

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Test Report: **Particle Size Distribution Test**

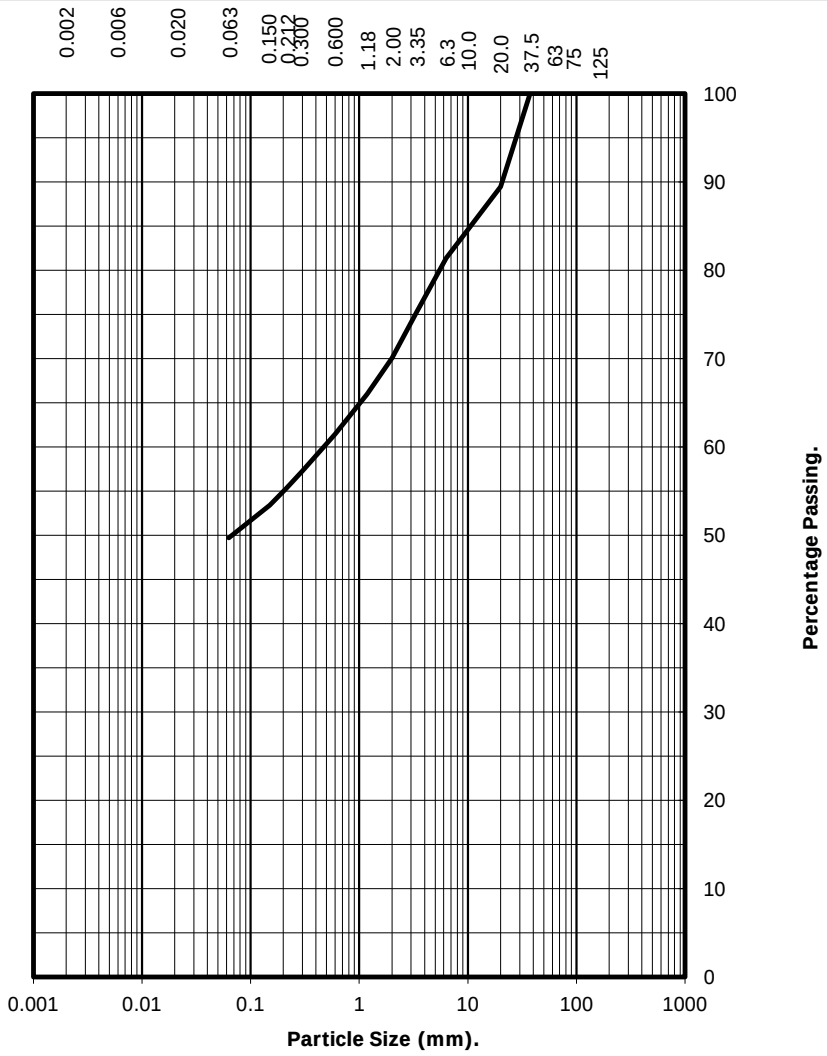
BS 1377 Part 2:1990.

Wet Sieve, Clause 9.2

Client ref:	**3718-05-13**
Location:	**Grangecastle**
Contract Number:	**19871-180613**
Hole Number	**TP14**
Sample Number:	**N/A**
Depth (m) :	**2.30**
Sample Type	**B**

BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	100
20	89
10	85
6.3	81
3.35	75
2.00	70
1.18	66
0.60	61
0.300	57
0.212	55
0.150	53
0.063	50

Particle Diameter	Percentage Passing
0.02	#
0.006	#
0.002	#



	Silt and Clay	Sand	Gravel	Cobbles	Soil Fraction
	50	**20**	**30**	**0**	Total Percentage

Remarks:

#- not determined

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Checked By

D P Evans

Approved By:

Date Approved: 27.7.13

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Test Report: **Particle Size Distribution Test**

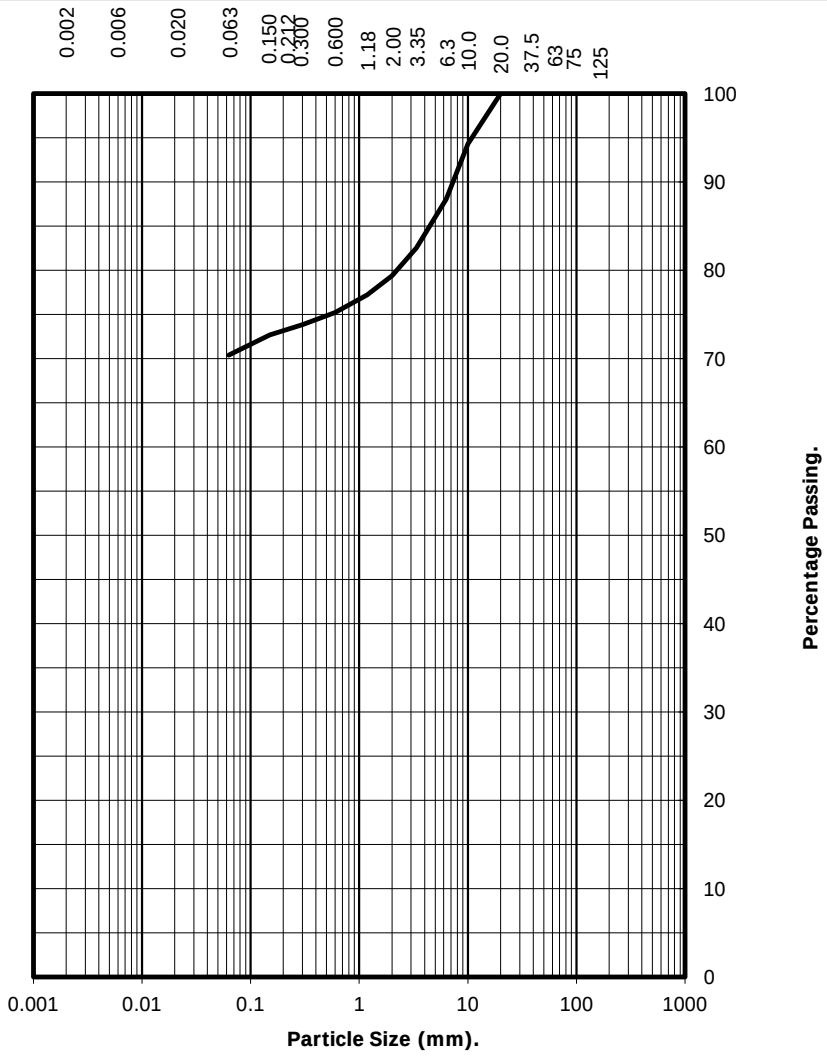
BS 1377 Part 2:1990.

Wet Sieve, Clause 9.2

Client ref:	**3718-05-13**
Location:	**Grangecastle**
Contract Number:	**19871-180613**
Hole Number	**TP17**
Sample Number:	**N/A**
Depth (m) :	**3.10-3.20**
Sample Type	**B**

BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	100
20	100
10	94
6.3	88
3.35	83
2.00	79
1.18	77
0.60	75
0.300	74
0.212	73
0.150	73
0.063	70

Particle Diameter	Percentage Passing
0.02	#
0.006	#
0.002	#



	Silt and Clay	Sand	Gravel	Cobbles	Soil Fraction
	70	**9**	**21**	**0**	Total Percentage

Remarks:

#- not determined

GSTL GEO Site & Testing Services Limited

Checked By

D P Evans

Approved By:

UKAS TESTING 2788

Date Approved: 2.7.13

Test Report: **Particle Size Distribution Test**

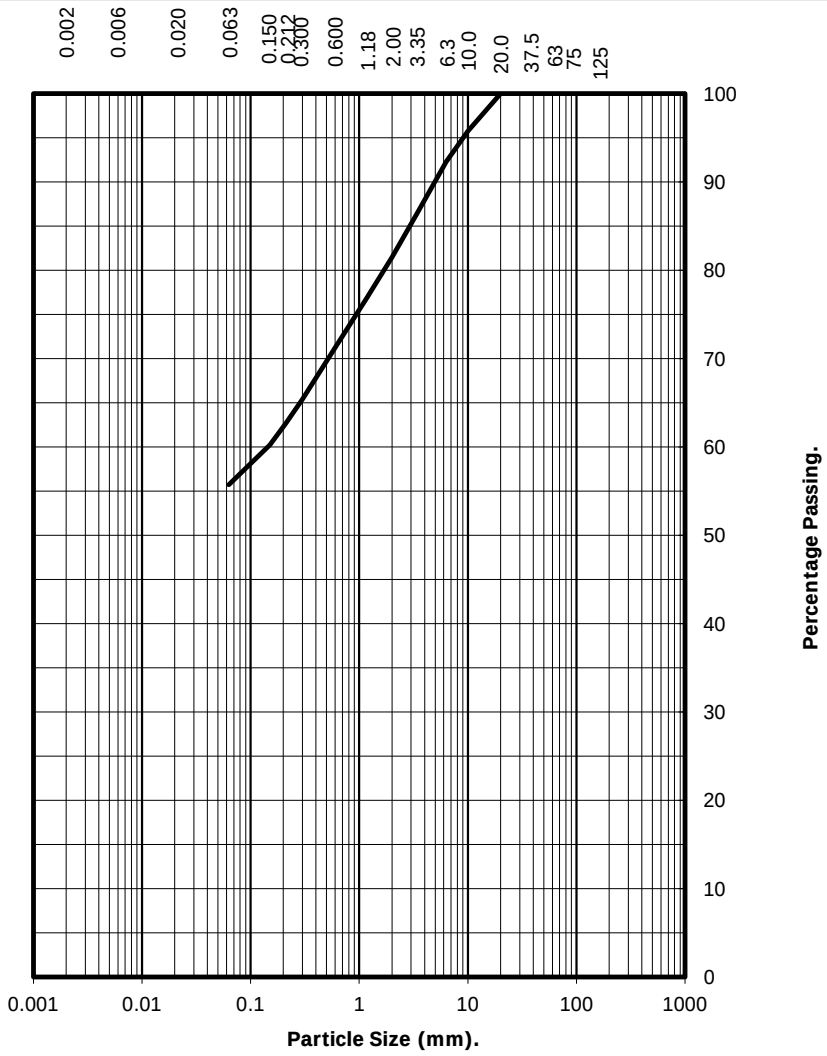
BS 1377 Part 2:1990.

Wet Sieve, Clause 9.2

Client ref:	**3718-05-13**
Location:	**Grangecastle**
Contract Number:	**19871-180613**
Hole Number	**TP21**
Sample Number:	**N/A**
Depth (m) :	**0.70**
Sample Type	**B**

BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	100
20	100
10	96
6.3	92
3.35	86
2.00	81
1.18	77
0.60	71
0.300	65
0.212	63
0.150	60
0.063	56

Particle Diameter	Percentage Passing
0.02	#
0.006	#
0.002	#



	Silt and Clay	Sand	Gravel	Cobbles	Soil Fraction
	56	**25**	**19**	**0**	Total Percentage

Remarks:

#- not determined

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Checked By

D P Evans

Approved By:

UKAS TESTING 2788

Date Approved: 27.7.13

Test Report: **Particle Size Distribution Test**

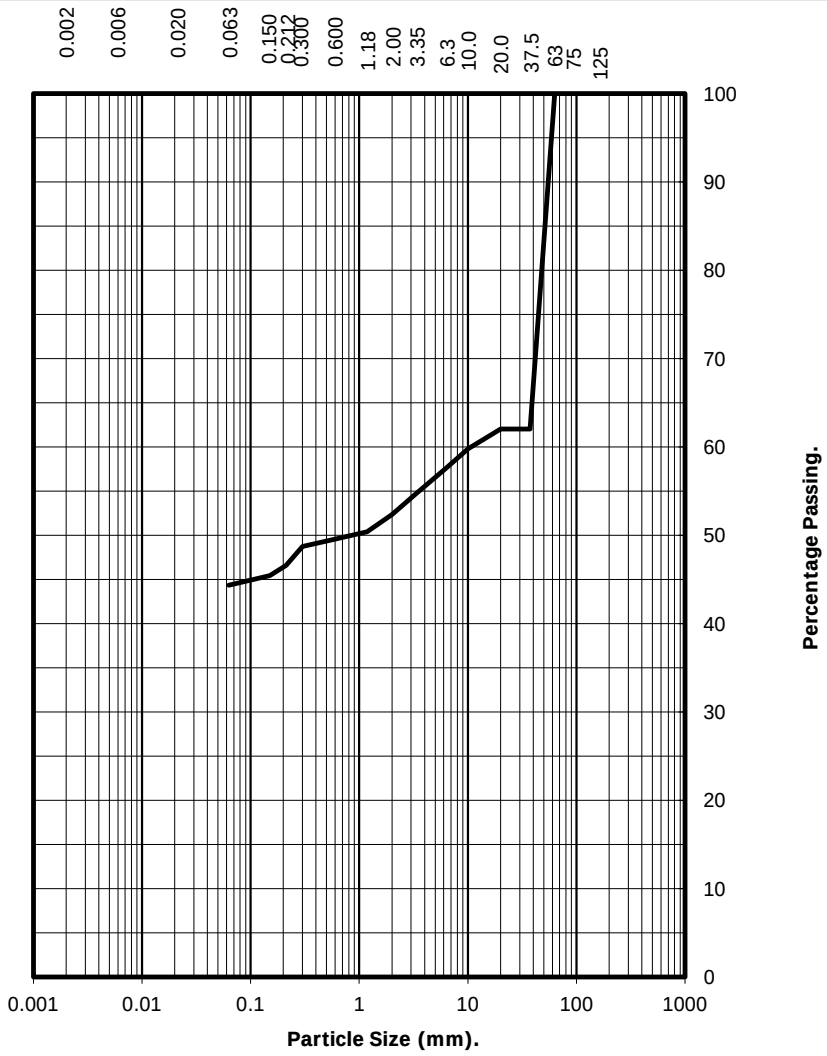
BS 1377 Part 2:1990.

Wet Sieve, Clause 9.2

Client ref:	**3718-05-13**
Location:	**Grangecastle**
Contract Number:	**19871-180613**
Hole Number	**TP21**
Sample Number:	**N/A**
Depth (m) :	**1.20**
Sample Type	**B**

BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	62
20	62
10	60
6.3	58
3.35	55
2.00	52
1.18	50
0.60	50
0.300	49
0.212	47
0.150	45
0.063	44

Particle Diameter	Percentage Passing
0.02	#
0.006	#
0.002	#



	Silt and Clay	Sand	Gravel	Cobbles	Soil Fraction
	44	**8**	**48**	**0**	Total Percentage

Remarks:

#- not determined

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D P Evans

Approved By:

Date Approved: 2.7.13

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Test Report: **Particle Size Distribution Test**

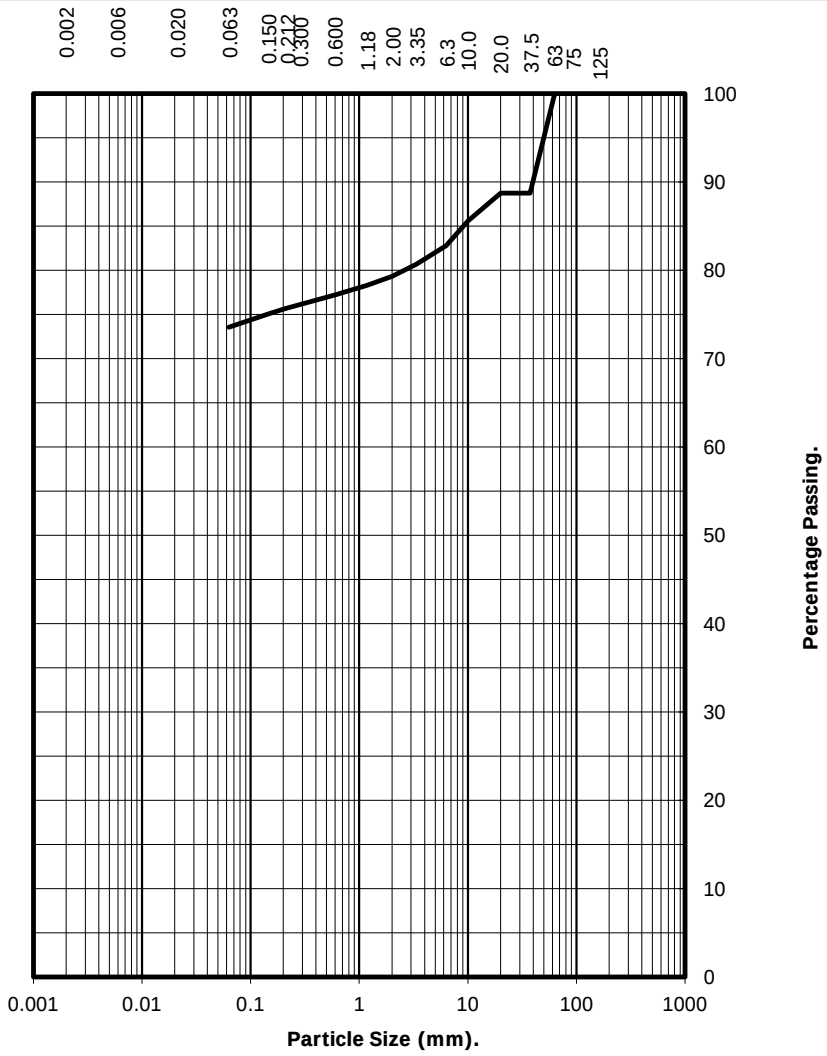
BS 1377 Part 2:1990.

Wet Sieve, Clause 9.2

Client ref:	**3718-05-13**
Location:	**Grangecastle**
Contract Number:	**19871-180613**
Hole Number	**TP26**
Sample Number:	**N/A**
Depth (m) :	**1.00**
Sample Type	**B**

BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	89
20	89
10	86
6.3	83
3.35	81
2.00	79
1.18	78
0.60	77
0.300	76
0.212	76
0.150	75
0.063	74

Particle Diameter	Percentage Passing
0.02	#
0.006	#
0.002	#



	Silt and Clay	Sand	Gravel	Cobbles	Soil Fraction
	74	**5**	**21**	**0**	Total Percentage

Remarks:

#- not determined

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Checked By

D P Evans

Approved By:

Date Approved: 2.7.13

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Test Report: **Particle Size Distribution Test**

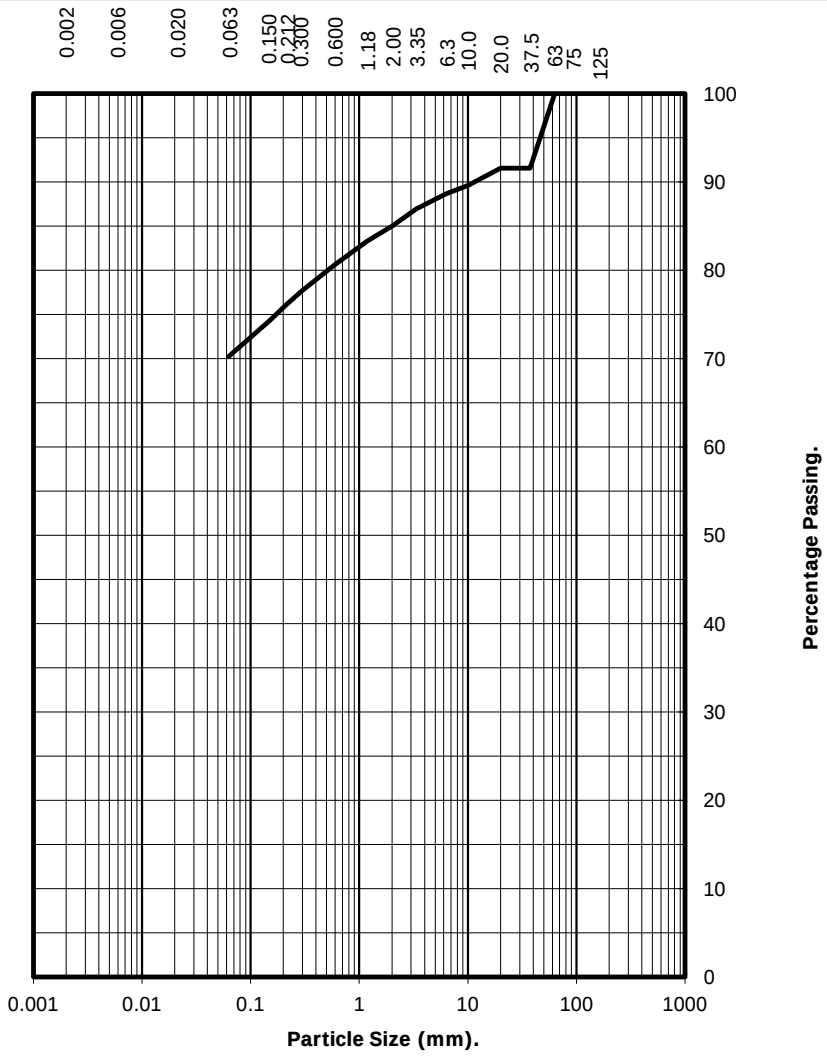
BS 1377 Part 2:1990.

Wet Sieve, Clause 9.2

Client ref:	**3718-05-13**
Location:	**Grangecastle**
Contract Number:	**19871-180613**
Hole Number	**TP29**
Sample Number:	**N/A**
Depth (m) :	**1.00**
Sample Type	**B**

BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	92
20	92
10	90
6.3	89
3.35	87
2.00	85
1.18	83
0.60	81
0.300	78
0.212	76
0.150	74
0.063	70

Particle Diameter	Percentage Passing
0.02	#
0.006	#
0.002	#



	Silt and Clay	Sand	Gravel	Cobbles	Soil Fraction
	70	**15**	**15**	**0**	Total Percentage

Remarks:

#- not determined

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Checked By

D P Evans

Approved By:

Date Approved: 2.7.13

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Test Report: **Particle Size Distribution Test**

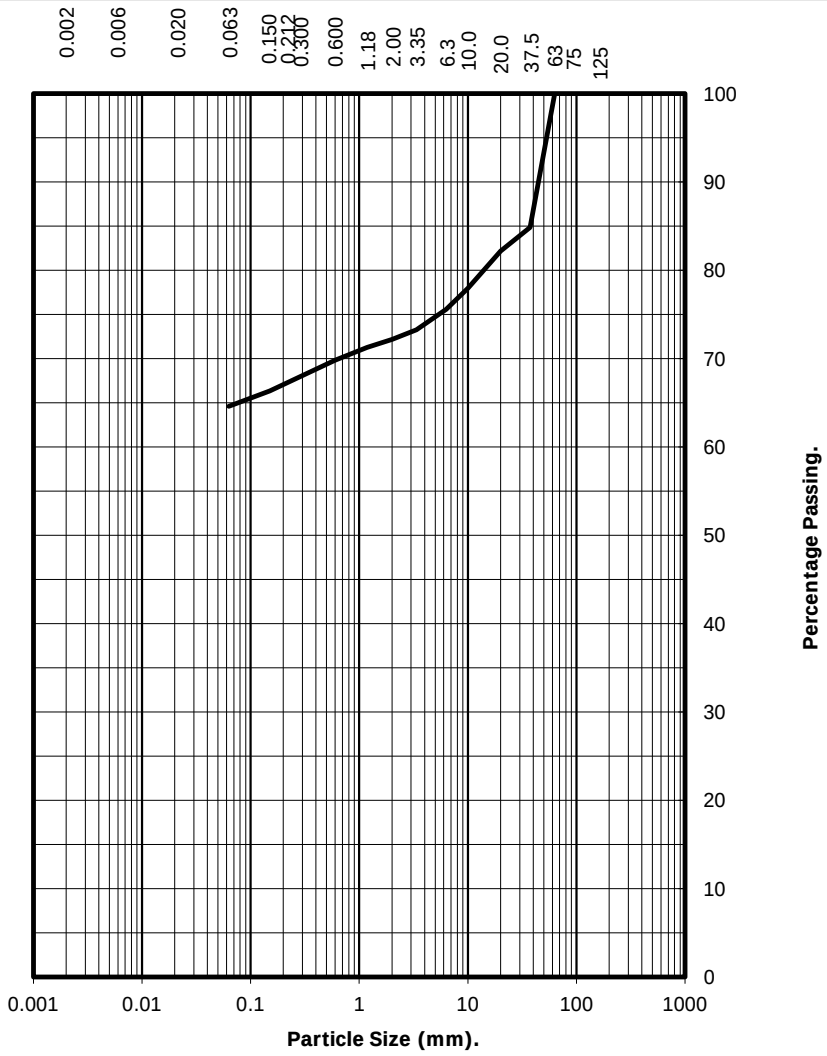
BS 1377 Part 2:1990.

Wet Sieve, Clause 9.2

Client ref:	**3718-05-13**
Location:	**Grangecastle**
Contract Number:	**19871-180613**
Hole Number	**TP29**
Sample Number:	**N/A**
Depth (m) :	**1.50**
Sample Type	**B**

BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	85
20	82
10	78
6.3	76
3.35	73
2.00	72
1.18	71
0.60	70
0.300	68
0.212	67
0.150	66
0.063	65

Particle Diameter	Percentage Passing
0.02	#
0.006	#
0.002	#



	Silt and Clay	Sand	Gravel	Cobbles	Soil Fraction
	65	**7**	**28**	**0**	Total Percentage

Remarks:

#- not determined

GSTL GEO Site & Testing Services Limited

Checked By

D P Evans

Approved By:

Date Approved: 2.7.13

UKAS TESTING 2788

Unit 4
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Dafen Ind Estate
Dafen
Carmarthenshire
SA14 8QN
Tel: 01554 784040
01554 750752
Fax: 01554 770529
01554 784041
Web: www.geo.uk.com

Certificate of Analysis

Date:	09/10/2012
Client:	BLP
Our Reference:	19871-180613
Client Reference:	3718-05-13
Contract Title:	Grangecastle
Description: (Total Samples)	10
Date Received:	18/06/2013
Date Started:	27/06/2013
Date Completed:	01/07/2013
Test Procedures:	(B.S. 1377 : PART 3 : 1990)

Notes:

Solid samples will be disposed 1 month and liquids 2 weeks

Approved By:

Authorised Signatories:	Emma Williams Laboratory Office Manager	Wayne Honey Laboratory Technician	Paul Evans Quality Manager

Contract No: 19871-180613
Client Ref: 3718-05-13
Location: Grangecastle
Date: 01/07/2013

GSTL
GEO Site & Testing Services Limited

SUMMARY OF CHEMICAL ANALYSIS

(B.S. 1377 : PART 3 : 1990)

Hole Number	Sample Number	Depth m	Sulphate Content SO3 (as SO_4)			Chloride Content		pH Value @ 25°C	Organic Matter Content %	Loss on Ignition %	Remarks
			Acid Soluble Sulphate as % SO_4	Aqueous Extract Sulphate as g/l SO_4	Ground-water g/l	Soluble Chloride as % equiv. NaCl	Ground-water g/l				
			Clause 5.5.	Clause 5.5.	Clause 5.4.	Clause 7.3	Clause 7.2	Clause 9.	Clause 3.	Clause 4.	
TP21		0.70		0.04 (0.05)				7.45			
TP24		2.00		0.03 (0.04)				8.01			
TP29		1.00		0.02 (0.02)				7.96			
TP1		1.50		0.06 (0.07)				8.11			
TP3		1.50		0.05 (0.06)				8.26			
TP6		0.50		0.06 (0.07)				8.10			
TP9		1.00		0.02 (0.02)				7.87			
TP10		1.50		0.02 (0.02)				8.32			
TP14		1.80		0.03 (0.03)				8.28			
TP17		1.00		0.02 (0.02)				8.11			

NCP - No Chloride present

Unit 4
Heol Aur
Dafen Ind Estate
Dafen
Carmarthenshire
SA14 8QN
Tel: 01554 784040
01554 750752
Fax: 01554 770529
01554 784041
Web: www.geo.uk.com

Certificate of Analysis

Date:	09/10/2012
Client:	BLP
Our Reference:	19871-180613
Client Reference:	3718-05-13
Contract Title:	Grangecastle
Description: (Total Samples)	8
Date Received:	18/06/2013
Date Started:	27/06/2013
Date Completed:	28/06/2013
Test Procedures:	(B.S. 1377 : PART 3 : 1990)

Notes:

Solid samples will be disposed 1 month and liquids 2 weeks

Approved By:

Authorised Signatories:	Emma Williams Laboratory Office Manager	Wayne Honey Laboratory Technician	Paul Evans Quality Manager

Contract No: 19871-180613
Client Ref: 3718-05-13
Location: Grangecastle
Date: 28/06/2013

GSTL
GEO Site & Testing Services Limited

SUMMARY OF CHEMICAL ANALYSIS

(B.S. 1377 : PART 3 : 1990)

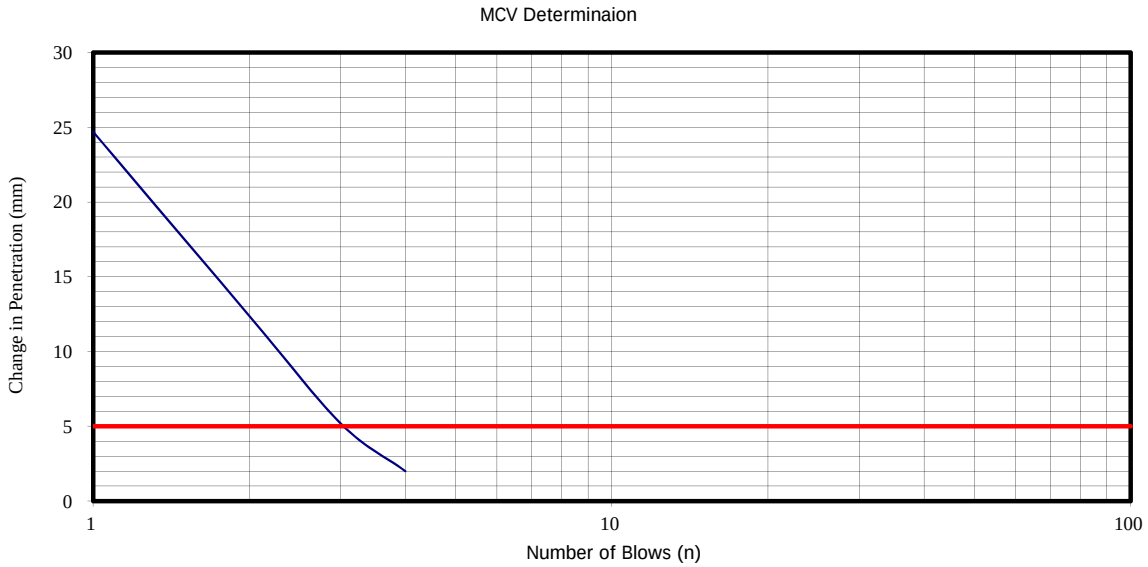
Hole Number	Sample Number	Depth m	Sulphate Content SO3 (as SO_4)			Chloride Content		pH Value @ 25°C	Organic Matter Content %	Loss on Ignition %	Remarks
			Acid Soluble Sulphate as % SO_4	Aqueous Extract Sulphate as g/l SO_4	Ground-water g/l	Soluble Chloride as % equiv. NaCl	Ground-water g/l				
			Clause 5.5.	Clause 5.5.	Clause 5.4.	Clause 7.3	Clause 7.2	Clause 9.	Clause 3.	Clause 4.	
TP21		1.20							1.7		
TP29		1.50							2.3		
TP3		1.30							2.1		
TP6		2.50							1.6		
TP9		1.00							2.5		
TP14		1.80							2.7		
TP17		1.00							2.1		
TP17		3.10							1.8		

NCP - No Chloride present

Moisture Condition Value

BS 1377:Part 4:1990

Client ref:	**19871-180613**
Location:	**Grangecastle**
Contract Number:	**3718-05-13**
Hole Number:	**TP1**
Sample Number:	
Depth (m) :	**1.50**
Sample Type	**B**



Remarks: Normal method used to determine MCV

Material Retained on the 20mm BS Test Sieve (%).:	0

Blows (N)	Penetration (mm)	n to 4 n (mm)
1	81.4	24.7
2	67.3	12.4
3	60	5.2
4	56.7	2.0
6	55.2	
8	54.9	
12	54.8	
16	54.7	

Blows (N)	Penetration (mm)	n to 4 n (mm)
24		
32		
48		
64		
96		
128		
192		
256		

Test Results.

Moisture Content (%). **13**

MCV **6.0**

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Checked By

Approved By:

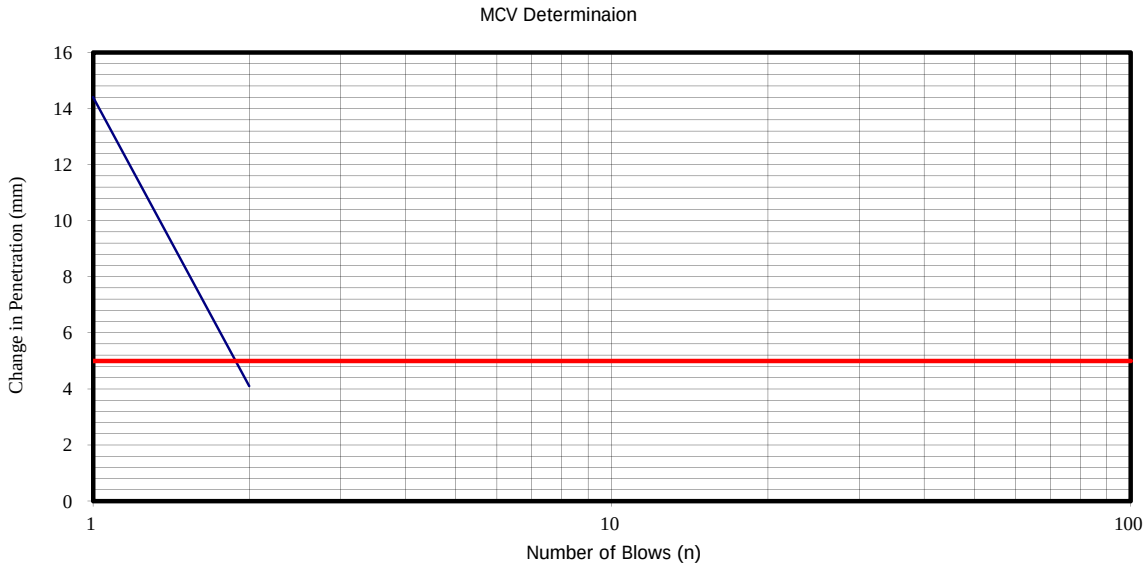
Date Approved: 27.6.13

UKAS TESTING 2788

Moisture Condition Value

BS 1377:Part 4:1990

Client ref:	**19871-180613**
Location:	**Grangecastle**
Contract Number:	**3718-05-13**
Hole Number:	**TP3**
Sample Number:	
Depth (m) :	**1.50**
Sample Type	**B**



Remarks: Normal method used to determine MCV

Material Retained on the 20mm BS Test Sieve (%).:	0

Blows (N)	Penetration (mm)	n to 4 n (mm)
1	74.3	14.4
2	62.9	4.1
3	60.7	
4	59.9	
6	59.3	
8	58.8	
12	0	
16	0	

Blows (N)	Penetration (mm)	n to 4 n (mm)
24		
32		
48		
64		
96		
128		
192		
256		

Test Results.

Moisture Content (%). **19**

MCV **3.0**

GSTL
GEO Site & Testing Services Limited

Checked By

Approved By:

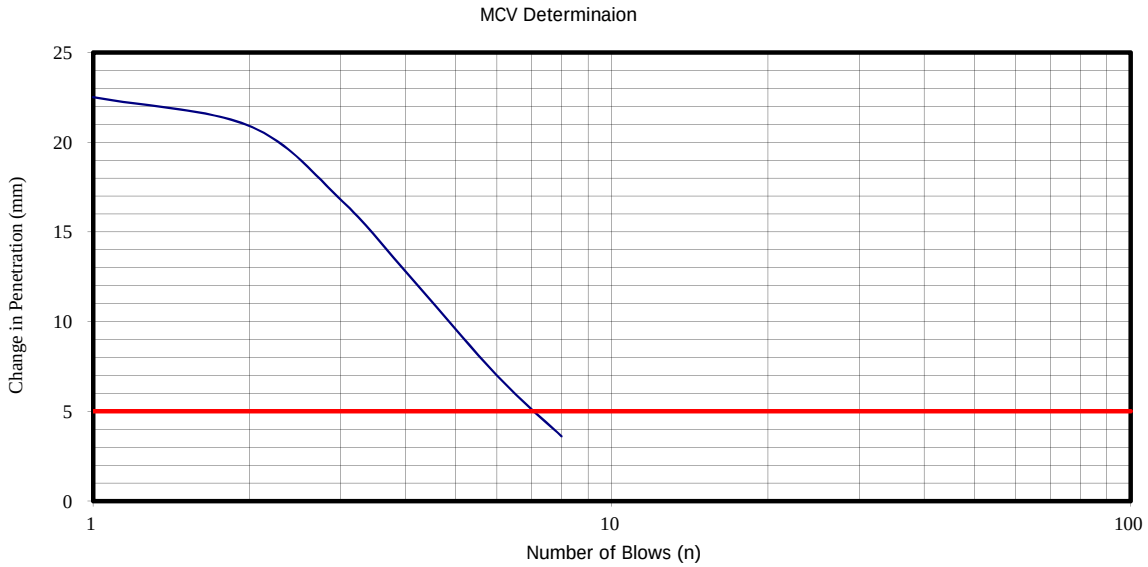
Date Approved: 27.6.13

UKAS TESTING 2788

Moisture Condition Value

BS 1377:Part 4:1990

Client ref:	**19871-180613**
Location:	**Grangecastle**
Contract Number:	**3718-05-13**
Hole Number:	**TP7**
Sample Number:	
Depth (m) :	**0.70-1.00**
Sample Type	**B**



Remarks: Normal method used to determine MCV

Material Retained on the 20mm BS Test Sieve (%).:	0

Blows (N)	Penetration (mm)	n to 4 n (mm)
1	96	22.5
2	84.7	20.9
3	78.2	16.8
4	73.5	12.8
6	67.3	7.0
8	63.8	3.6
12	61.4	
16	60.7	

Blows (N)	Penetration (mm)	n to 4 n (mm)
24		
32		
48		
64		
96		
128		
192		
256		

Test Results.

Moisture Content (%). **11**

MCV **9.0**

GSTL
GEO Site & Testing Services Limited

Checked By

Approved By:

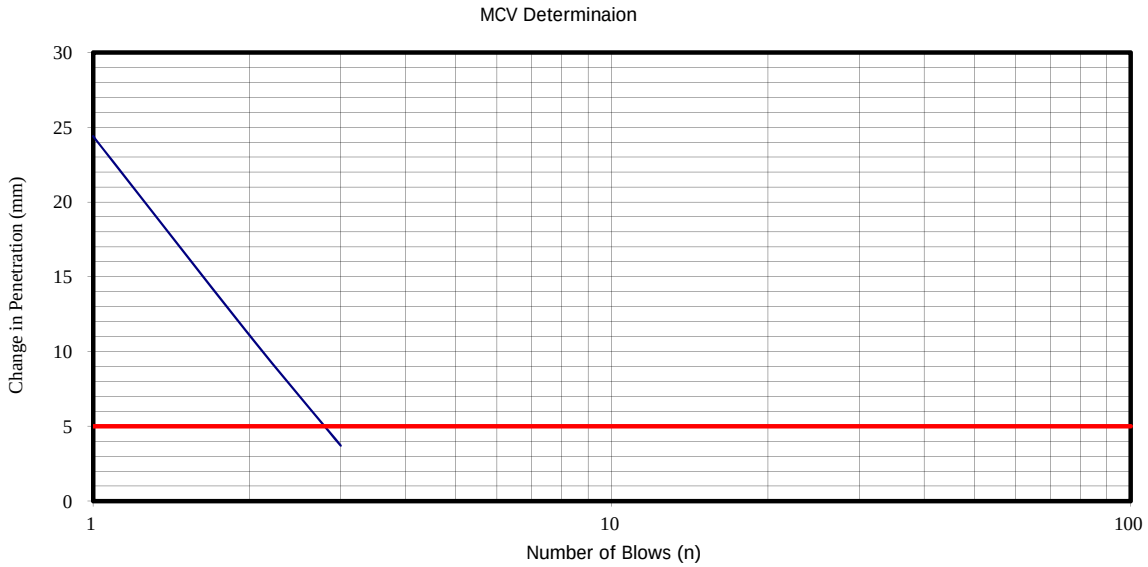
Date Approved: 27.6.13

UKAS TESTING 2788

Moisture Condition Value

BS 1377:Part 4:1990

Client ref:	**19871-180613**
Location:	**Grangecastle**
Contract Number:	**3718-05-13**
Hole Number:	**TP10**
Sample Number:	
Depth (m) :	**1.50**
Sample Type	**B**



Remarks: Normal method used to determine MCV

Material Retained on the 20mm BS Test Sieve (%).:	0

Blows (N)	Penetration (mm)	n to 4 n (mm)
1	89.8	24.4
2	75.6	11.1
3	67.9	3.7
4	65.4	
6	64.6	
8	64.5	
12	64.2	
16	0	

Blows (N)	Penetration (mm)	n to 4 n (mm)
24		
32		
48		
64		
96		
128		
192		
256		

Test Results.

Moisture Content (%). **42**

MCV **4.8**

GSTL
GEO Site & Testing Services Limited

Checked By

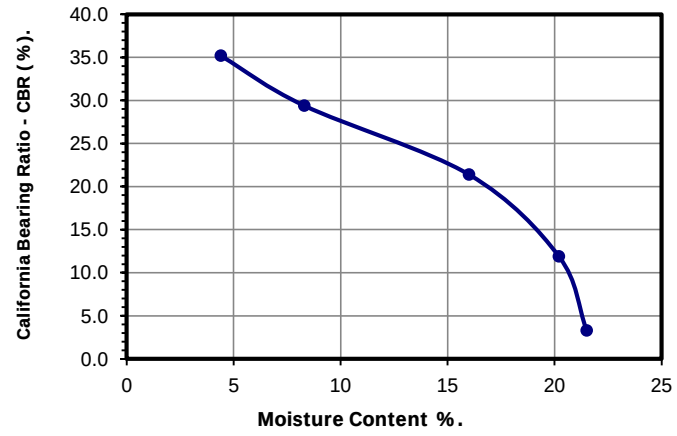
Approved By:

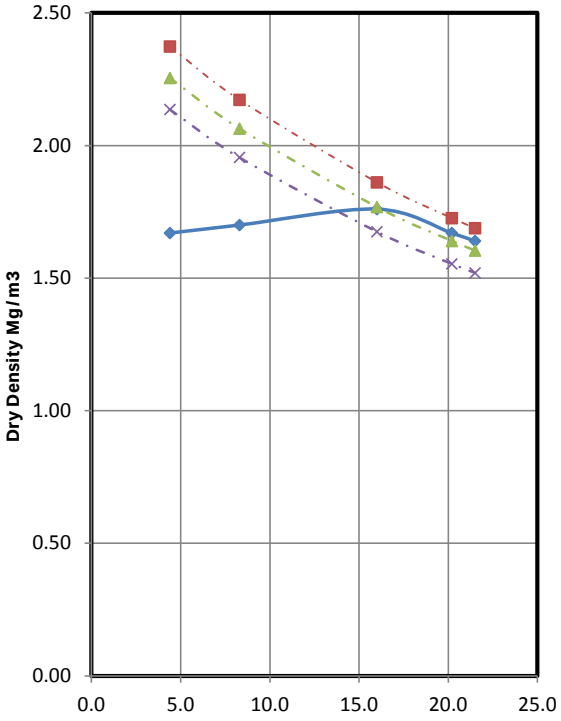
Date Approved: 27.6.13

UKAS TESTING 2788

Test Report: **Determination of the California Bearing Ratio / MCV Moisture Relation Moisture Content Dry Density Relationship**
BS 1377: Part 4: 1990 Clause 7 / 5.5 / 3.3-3.6

Client:	**Ground Investigation Ireland**
Client ref:	**3818-05-13**
Location:	**Grangecastle**
Contract Number:	**19781-180613**
Date tested:	**01/07/2013**
Hole Number:	**TP26**
Sample Number:	
Depth (m) :	**1.00**
Tested By:	**Sean Penn**





Moisture Content	4.4	8.3	16	20.2	21.5
Mean CBR Value	35.2	29.4	21.4	11.9	3.3
Dry Density	1.67	1.70	1.76	1.67	1.64
Moisture Condition Value	15.05	13.61	13.22	12.8	10.8

* reading unobtainable

Initial Sample Conditions:

		Method of Compaction	2.5 KG
Initial Moisture Content (%):	21.5	Particle Density (Mg/m^3) :	
Maximum Dry Density (Mg/m^3) :	1.76	Assumed	2.65
Material Retained on the 37.5mm BS Sieve (%):	0	Single sample Tested	
Material Retained on the 20.0mm BS Sieve (%):	0	OMC (%):	16

Remarks:

This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced in full, without the prior written approval of the laboratory.

For and behalf of GEO Site and Testing Services Ltd

GSTL
GEO Site & Testing Services Limited

Vaughan Edwards - Managing Director ○
Paul Evans - Technical/Quality Manager ●
Emma Sharp - Laboratory Co-Ordinator ○

DP Evans

Date Approved: 1.7.13

UKAS TESTING 2788

Appendix 7 Contamination Test Results

Jones Environmental Laboratory

Unit 3 Deeside Point
Zone 3
Deeside Industrial Park
Deeside
CH5 2UA

Tel: +44 (0) 1244 833780
Fax: +44 (0) 1244 833781

Ground Investigations Ireland
The Grange
12th Lock Road
Lucan
Ireland

No.4225

Attention :	Fergal McNamara
Date :	28th June, 2013
Your reference :	3718-05-13
Our reference :	Test Report 13/5609 Batch 1
Location :	GRANGECASTLE
Date samples received :	18th June, 2013
Status :	Final report
Issue :	1

Eleven samples were received for analysis on 18th June, 2013. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.
All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

Where Waste Acceptance Criteria Suite (EC Decision of 19 December 2002 (2003/33/EC)) has been requested, all analyses have been performed using the relevant EN methods where they exist.

Compiled By:

Phil Sommerton B.Sc
Project Manager

Bob Millward B.Sc FRSC
Principal Chemist

Jones Environmental Laboratory

Client Name: Ground Investigations Ireland

Reference: 3718-05-13

Location: GRANGECASTLE

Contact: Fergal McNamara

JE Job No.: 13/5609

Report : MURPHY

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

Please see attached notes for all abbreviations and acronyms

J E Sample No.	1	2	3	4	5	6	7	8	9	10	Inert	Stable Non-reactive	Hazardous	LOD	Units	Method No.
Sample ID	TP2	TP3	TP4	TP8	TP13	TP16	TP18	TP19	TP24	TP28						
Depth	0.90	1.60	1.00	0.7	3.0	2.0	1.20	1.0	1.2	1.0						
COC No / misc																
Containers	T	T	T	T	T	T	T	T	T	T						
Sample Date	<>	<>	<>	<>	<>	<>	<>	<>	<>	<>						
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil						
Batch Number	1	1	1	1	1	1	1	1	1	1						
Date of Receipt	18/06/2013	18/06/2013	18/06/2013	18/06/2013	18/06/2013	18/06/2013	18/06/2013	18/06/2013	18/06/2013	18/06/2013						
Solid Waste Analysis																
Total Organic Carbon #	0.47	0.82	0.39	0.38	1.01	0.30	0.29	0.43	0.32	0.55	3	5	6	<0.02	%	TM21/PM24
Sum of BTEX	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	6	-	-	<0.025	mg/kg	TM31/PM12
Sum of 7 PCBs #	<0.035	<0.035	<0.035	<0.035	<0.035	<0.035	<0.035	<0.035	<0.035	<0.035	1	-	-	<0.035	mg/kg	TM17/PM8
PAH Sum of 6 #	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	-	-	-	<0.22	mg/kg	TM4/PM8
PAH Sum of 17	<0.64	<0.64	<0.64	<0.64	<0.64	<0.64	<0.64	<0.64	<0.64	<0.64	100	-	-	<0.64	mg/kg	TM4/PM8
CEN 10:1 Leachate																
Arsenic #	0.048	0.051	0.055	<0.025	0.037	<0.025	<0.025	<0.025	<0.025	0.055	0.5	2	25	<0.025	mg/kg	TM30/PM17
Barium #	<0.03	0.06	<0.03	<0.03	0.12	<0.03	<0.03	<0.03	<0.03	<0.03	20	100	300	<0.03	mg/kg	TM30/PM17
Cadmium #	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.04	1	5	<0.005	mg/kg	TM30/PM17
Chromium #	<0.015	<0.015	0.025	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	0.024	0.5	10	70	<0.015	mg/kg	TM30/PM17
Copper #	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	2	50	100	<0.07	mg/kg	TM30/PM17
Mercury #	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.01	0.2	2	<0.0001	mg/kg	TM61/PM38
Molybdenum #	0.12	0.08	0.08	0.09	0.08	0.05	0.03	0.12	0.10	0.03	0.5	10	30	<0.02	mg/kg	TM30/PM17
Nickel #	<0.02	<0.02	<0.02	<0.02	0.04	<0.02	<0.02	<0.02	<0.02	0.03	0.4	10	40	<0.02	mg/kg	TM30/PM17
Lead #	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.5	10	50	<0.05	mg/kg	TM30/PM17
Antimony #	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.06	0.7	5	<0.02	mg/kg	TM30/PM17
Selenium #	<0.03	0.16	<0.03	<0.03	0.13	<0.03	<0.03	<0.03	<0.03	<0.03	0.1	0.5	7	<0.03	mg/kg	TM30/PM17
Zinc #	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	0.04	4	50	200	<0.03	mg/kg	TM30/PM17
Chloride	5	<3	5	5	5	5	4	4	5	4	800	15000	25000	<3	mg/kg	TM27/PM0
Fluoride	8	5	6	5	<3	<3	<3	5	6	5	10	150	500	<3	mg/kg	TM27/PM0
Sulphate as SO4	5.1	361.6	6.7	5.3	1104.8	12.2	9.1	8.6	8.8	5.6	1000	20000	50000	<0.5	mg/kg	TM27/PM0
Total Dissolved Solids #	450	960	350	210	2350	310	690	640	690	580	4000	60000	100000	<100	mg/kg	TM20/PM0
Dissolved Organic Carbon	30	<20	40	50	<20	30	40	30	30	50	500	800	1000	<20	mg/kg	TM60/PM0
Mass of raw test portion	0.1037	0.0962	0.1002	0.103	0.1086	0.1071	0.1021	0.1044	0.107	0.1114	-	-	-		kg	NONE/PM17
Dry Matter Content Ratio	86.4	93.1	89.5	87.5	82.6	83.9	87.7	85.8	84.3	80.7	-	-	-	<0.1	%	NONE/PM4
Leachant Volume	0.886	0.893	0.889	0.887	0.881	0.883	0.887	0.885	0.883	0.878	-	-	-		l	NONE/PM17
Eluate Volume	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	-	-	-		l	NONE/PM17
Mineral Oil	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	-	-	-	<30	mg/kg	TM5/PM16
Phenol	<0.1	<0.1	<0.1	<0.1	<1.0	<0.1	<0.1	<0.1	<0.1	<0.1	-	-	-	<0.1	mg/kg	TM26/PM0

Client Name: Ground Investigations Ireland

Reference: 3718-05-13

Location: GRANGECASTLE

Contact: Fergal McNamara

JE Job No.: 13/5609

Report : MURPHY

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

Please see attached notes for all abbreviations and acronyms

J E Sample No.	11															
Sample ID	TP17															
Depth	0.2															
COC No / misc																
Containers	T															
Sample Date	<>															
Sample Type	Soil															
Batch Number	1															
Date of Receipt	18/06/2013											Inert	Stable Non-reactive	Hazardous	**LOD**	**Units**	**Method No.**
Solid Waste Analysis																	
Total Organic Carbon #	0.74											3	5	6	<0.02	%	TM21/PM24
Sum of BTEX	<0.025											6	-	-	<0.025	mg/kg	TM31/PM12
Sum of 7 PCBs #	<0.035											1	-	-	<0.035	mg/kg	TM17/PM8
PAH Sum of 6 #	<0.22											-	-	-	<0.22	mg/kg	TM4/PM8
PAH Sum of 17	<0.64											100	-	-	<0.64	mg/kg	TM4/PM8
CEN 10:1 Leachate																	
Arsenic #	<0.025											0.5	2	25	<0.025	mg/kg	TM30/PM17
Barium #	0.14											20	100	300	<0.03	mg/kg	TM30/PM17
Cadmium #	<0.005											0.04	1	5	<0.005	mg/kg	TM30/PM17
Chromium #	0.017											0.5	10	70	<0.015	mg/kg	TM30/PM17
Copper #	<0.07											2	50	100	<0.07	mg/kg	TM30/PM17
Mercury #	<0.0001											0.01	0.2	2	<0.0001	mg/kg	TM61/PM38
Molybdenum #	<0.02											0.5	10	30	<0.02	mg/kg	TM30/PM17
Nickel #	<0.02											0.4	10	40	<0.02	mg/kg	TM30/PM17
Lead #	<0.05											0.5	10	50	<0.05	mg/kg	TM30/PM17
Antimony #	<0.02											0.06	0.7	5	<0.02	mg/kg	TM30/PM17
Selenium #	<0.03											0.1	0.5	7	<0.03	mg/kg	TM30/PM17
Zinc #	0.11											4	50	200	<0.03	mg/kg	TM30/PM17
Chloride	3											800	15000	25000	<3	mg/kg	TM27/PM0
Fluoride	<3											10	150	500	<3	mg/kg	TM27/PM0
Sulphate as SO4	14.4											1000	20000	50000	<0.5	mg/kg	TM27/PM0
Total Dissolved Solids #	1060											4000	60000	100000	<100	mg/kg	TM20/PM0
Dissolved Organic Carbon	80											500	800	1000	<20	mg/kg	TM60/PM0
Mass of raw test portion	0.1119											-	-	-		kg	NONE/PM17
Dry Matter Content Ratio	80.3											-	-	-	<0.1	%	NONE/PM4
Leachant Volume	0.878											-	-	-		l	NONE/PM17
Eluate Volume	0.05											-	-	-		l	NONE/PM17
Mineral Oil	<30											-	-	-	<30	mg/kg	TM5/PM16
Phenol	<0.1											-	-	-	<0.1	mg/kg	TM26/PM0

Notification of Deviating Samples

Matrix : Solid

Client Name: Ground Investigations Ireland

Reference: 3718-05-13

Location: GRANGECASTLE

Contact: Fergal McNamara

J E Job No.	Batch	Sample ID	Depth	J E Sample No.	Analysis	Reason
13/5609	1	TP2	0.90	1	EPH	Sample received in inappropriate container
13/5609	1	TP2	0.90	1	All analyses	No sampling date given
13/5609	1	TP3	1.60	2	EPH	Sample received in inappropriate container
13/5609	1	TP3	1.60	2	All analyses	No sampling date given
13/5609	1	TP4	1.00	3	EPH	Sample received in inappropriate container
13/5609	1	TP4	1.00	3	All analyses	No sampling date given
13/5609	1	TP8	0.7	4	EPH	Sample received in inappropriate container
13/5609	1	TP8	0.7	4	All analyses	No sampling date given
13/5609	1	TP13	3.0	5	EPH	Sample received in inappropriate container
13/5609	1	TP13	3.0	5	All analyses	No sampling date given
13/5609	1	TP16	2.0	6	EPH	Sample received in inappropriate container
13/5609	1	TP16	2.0	6	All analyses	No sampling date given
13/5609	1	TP18	1.20	7	EPH	Sample received in inappropriate container
13/5609	1	TP18	1.20	7	All analyses	No sampling date given
13/5609	1	TP19	1.0	8	EPH	Sample received in inappropriate container
13/5609	1	TP19	1.0	8	All analyses	No sampling date given
13/5609	1	TP24	1.2	9	EPH	Sample received in inappropriate container
13/5609	1	TP24	1.2	9	All analyses	No sampling date given
13/5609	1	TP28	1.0	10	EPH	Sample received in inappropriate container
13/5609	1	TP28	1.0	10	All analyses	No sampling date given
13/5609	1	TP17	0.2	11	EPH	Sample received in inappropriate container
13/5609	1	TP17	0.2	11	All analyses	No sampling date given

Please include all sections of this report if it is reproduced

NOTES TO ACCOMPANY ALL SCHEDULES AND REPORTS

JE Job No.: 13/5609

SOILS

Please note we are only MCERTS accredited for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary. If we are instructed to keep samples, a storage charge of £1 (1.5 Euros) per sample per month will be applied until we are asked to dispose of them.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

WATERS

Please note we are not a Drinking Water Inspectorate (DWI) Approved Laboratory . It is important that detection limits are carefully considered when requesting water analysis.

UKAS accreditation applies to surface water and groundwater and one other matrix which is analysis specific, any other liquids are outside our scope of accreditation

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

DEVIATING SAMPLES

Samples must be received in a condition appropriate to the requested analyses. All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. If this is not the case you will be informed and any test results that may be compromised highlighted on your deviating samples report.

SURROGATES

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

NOTE

Data is only accredited when all the requirements of our Quality System have been met. In certain circumstances where the requirements have not been met, the laboratory may issue the data in an interim report but will remove the accreditation, in this instance results should be considered indicative only. Where possible samples will be re-extracted and a final report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.

ABBREVIATIONS and ACRONYMS USED

#	UKAS accredited.
B	Indicates analyte found in associated method blank.
DR	Dilution required.
M	MCERTS accredited.
NA	Not applicable
NAD	No Asbestos Detected.
ND	None Detected (usually refers to VOC and/SVOC TICs).
NDP	No Determination Possible
SS	Calibrated against a single substance.
SV	Surrogate recovery outside performance criteria. This may be due to a matrix effect.
W	Results expressed on as received basis.
+	AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page.
++	Result outside calibration range, results should be considered as indicative only and are not accredited.
*	Analysis subcontracted to a Jones Environmental approved laboratory.
CO	Suspected carry over
OC	Outside Calibration Range
NFD	No Fibres Detected

JE Job No 13/5609

Test Method No.	Description	Prep Method No. (if appropriate)	Description	UKAS	MCERTS (soils only)	Analysis done on As Received (AR) or Air Dried (AD)	Solid Results expressed on Dry/Wet basis
TM4	16 PAH by GC-MS, modified USEPA 8270	PM8	End Over End extraction			AR	DRY
TM4	16 PAH by GC-MS, modified USEPA 8270	PM8	End Over End extraction	Yes		AR	DRY
TM5	EPH by GC-FID, modified USEPA 8015	PM16	Aliphatic/Aromatic fractionation			AR	DRY
TM5	EPH by GC-FID, modified USEPA 8015	PM8	End Over End extraction	Yes		AR	DRY
TM17	PCB 7 Congeners and WHO 12 PCBs by GC-MS	PM8	End Over End extraction	Yes		AR	DRY
TM20	TDS, TSS and TS - gravimetric	PM0	No Preparation	Yes		AR	DRY
TM21	TOC and TC by Combustion	PM24	Eltra preparation	Yes		AD	DRY
TM26	Phenols by HPLC	PM0	No Preparation			AR	DRY
TM27	SO4,Cl,NO3,NO2,F,PO4 by Dionex	PM0	No Preparation			AR	DRY
TM30	Metals by ICP-OES	PM17	CEN PR12457-2 10:1 1 batch leach	Yes		AR	DRY
TM31	BTEX/MTBE by GC-FID, modified USEPA 8015	PM12	GRO GC-FID			AR	DRY
TM31	BTEX/MTBE by GC-FID, modified USEPA 8015	PM12	GRO GC-FID	Yes		AR	DRY
TM36	GRO by Headspace GC-FID	PM12	GRO GC-FID	Yes		AR	DRY
TM60	TOC/DOC by NDIR	PM0	No Preparation			AR	DRY
TM61	Mercury - low level CVAF	PM38	Mercury CVAF	Yes		AR	DRY
NONE	No Method Code	PM17	CEN PR12457-2 10:1 1 batch leach				
NONE	No Method Code	PM17	CEN PR12457-2 10:1 1 batch leach			AR	
NONE	No Method Code	PM4	Moisture Content			AR	

Appendix - Methods used for WAC (2003/33/EC)

Leachate tests	
10l/kg; 4mm	I.S. EN 12457-2:2002 Specified particle size; water added to L/S ratio; capped; agitated for 24 ± 0.5 hours; eluate settled and filtered over 0.45 µm membrane filter.
Eluate analysis	
As	I.S. EN 12506 : EN ISO 11885 (ICP-OES)
Ba	I.S. EN 12506 : EN ISO 11885 (ICP-OES)
Cd	I.S. EN 12506 : EN ISO 11885 (ICP-OES)
Cr total	I.S. EN 12506 : EN ISO 11885 (ICP-OES)
Cu	I.S. EN 12506 : EN ISO 11885 (ICP-OES)
Hg	I.S. EN 13370 rec. EN 1483 (CVAAS)
Mo	I.S. EN 12506 : EN ISO 11885 (ICP-OES)
Ni	I.S. EN 12506 : EN ISO 11885 (ICP-OES)
Pb	I.S. EN 12506 : EN ISO 11885 (ICP-OES)
Sb	I.S. EN 12506 : EN ISO 11885 (ICP-OES)
Se	I.S. EN 12506 : EN ISO 11885 (ICP-OES)
Zn	I.S. EN 12506 : EN ISO 11885 (ICP-OES)
Chloride	I.S. EN 12506 rec. EN ISO 10304-part 1 (liquid chromatography of ions)
Fluoride	I.S. EN 12506 rec. EN ISO 10304-part 1 (liquid chromatography of ions)
Sulphate	I.S. EN 12506 rec. EN ISO 10304-part 1 (liquid chromatography of ions)
Phenol index	I.S. EN 13370 rec. ISO 6439 (4-Aminoantipyrine spectrometic methods after distillation)* (BY HPLC - Jones Env)
DOC	I.S. EN 1484
TDS	I.S. EN 15216
Compositional analysis	
TOC	I.S. EN 13137 Method B: carbonates removed with acid; TOC by combustion.
BTEX	GC-FID
PCB7**	I.S. EN 15308 analysis by GC-ECD.
Mineral oil	I.S. EN 14039 C10 to C40 analysis by GC-FID.
PAH17***	I.S. EN 15527 PAH17 analysis by GC-MS
Metals	I.S. EN 13657 - Aqua regia digestion: EN ISO 11885 (ICP-OES)
Other	
Dry matter	I.S. EN 14346 sample is dried to a constant mass in an oven at 105 ± 3 °C; Method B Water content by direct Karl-Fischer-titration and either volumetric or coulometric detection.
LOI	I.S. EN 15169 Difference in mass after heating in a furnace up to 550 ± 25 °C.
ANC	CEN/TS 15364 Determined by amouns of acid or base needed to cover the pH range

Notes:

*If not suitable due to LOD, precision, etc., any other suitable method can be used, e.g. AFS, ICP-MS

**PCB-28, PCB-52, PCB-101, PCB-118, PCB-138, PCB-153 and PCB-180

***Naphthalene, Acenaphthylene, Acenaphthene, Anthracene, Benzo(a)anthracene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(g,h,i)perylene, Benzo(a)pyrene, Chrysene, Coronene, Dibenzo(a,h)anthracene, Fluorene, Fluoranthene, Indeno(1,2,3-c,d)pyrene, Phenanthrene and Pyrene.

APPENDIX B – APEX GEOSERVICES REPORT ON GEOPHYSICAL SURVEY AT GRANGE CASTLE BUSINESS PARK

AGL13093_01

REPORT ON THE GEOPHYSICAL SURVEY AT GRANGE CASTLE FOR BYRNE LOOBY PARTNERS

12TH JUNE 2013

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PRIVATE AND CONFIDENTIAL

THE FINDINGS OF THIS REPORT ARE THE RESULT OF A GEOPHYSICAL SURVEY USING NON-INVASIVE SURVEY TECHNIQUES CARRIED OUT AT THE GROUND SURFACE. INTERPRETATIONS CONTAINED IN THIS REPORT ARE DERIVED FROM A KNOWLEDGE OF THE GROUND CONDITIONS, THE GEOPHYSICAL RESPONSES OF GROUND MATERIALS AND THE EXPERIENCE OF THE AUTHOR. APEX GEOSERVICES LTD. HAS PREPARED THIS REPORT IN LINE WITH BEST CURRENT PRACTICE AND WITH ALL REASONABLE SKILL, CARE AND DILIGENCE IN CONSIDERATION OF THE LIMITS IMPOSED BY THE SURVEY TECHNIQUES USED AND THE RESOURCES DEVOTED TO IT BY AGREEMENT WITH THE CLIENT. THE INTERPRETATIVE BASIS OF THE CONCLUSIONS CONTAINED IN THIS REPORT SHOULD BE TAKEN INTO ACCOUNT IN ANY FUTURE USE OF THIS REPORT.

PROJECT NUMBER	AGL13093		
AUTHOR	**CHECKED**	**REPORT STATUS**	**DATE**
EurGeol Shane O`Rourke P.Geo., M.Sc (geophysics)	EurGeol Peter O'Connor P.Geo., M.Sc (geophysics), Dip. EIA Mgt.	V.01	12TH June 2013

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1. EXECUTIVE SUMMARY

APEX Geoservices Limited was requested by Byrne Looby Partners to carry out a geophysical investigation as part of the ground investigation prior to a new development at Grange Castle Business Park.

The objectives of the survey were to produce a depth to bedrock contour map for the site, provide information on the type and quality of the bedrock, provide information on the thickness and stiffness of the superficial deposits, and to provide soil resistivity values for the site.

The investigation consisted of 2D Electrical Resistivity Tomography (ERT), Seismic Refraction Profiling and Conductivity Mapping.

The site is located within Grange Castle Business Park and comprises a series of open crop and grass fields and is approx. 26 Ha in area.

The interpreted Bedrock Depth has been contoured as ranging from 60.3 mOD in the west to 71.8 mOD in the south-east of the site. Bedrock has been interpreted as good quality muddy limestone and shale which will require breaking/blasting.

Overburden has been interpreted as mainly soft-very stiff sandy gravelly clay (boulder clay), with pockets of silt/clay. Average overburden thickness has been interpreted as 2.5m.

The Soil Resistivity results are provided for 2.5m and 5.6m bgl at every 20m interval along each of the ERT Profiles. Of the 624 values shown, only one is below 50 ohm-m (deemed to be the cut-off for corrosivity), located in the far south-eastern corner of the site.

2. INTRODUCTION

APEX Geoservices Limited was requested by Byrne Looby Partners to carry out a geophysical investigation as part of the ground investigation prior to a new development at Grange Castle Business Park.

2.1 Survey Objectives

The objectives of the survey were to:

1. Produce a depth to bedrock contour map for the site.
2. Provide information on the type and quality of the bedrock.
3. Provide information on the thickness and stiffness of the superficial deposits.
4. Provide soil resistivity values for the site.

2.2 Site Background

The site is located within Grange Castle Business Park in west County Dublin. The site comprises a series of open crop and grass fields and is approx. 26 Ha in area. The site is bounded by grass fields to the north and south with large factories to the east, west and south.

2.2.1 Topography

The topography of the site slopes gently from approx. 65.5 mOD in the north-west of the site to approx. 72.5 mOD in the south-east of the site.

2.2.2 Geology

The GSI Bedrock Geology map for the area (Fig.2.1) indicates that the site is underlain by argillaceous limestone and shale of the Lucan Formation (Calp).

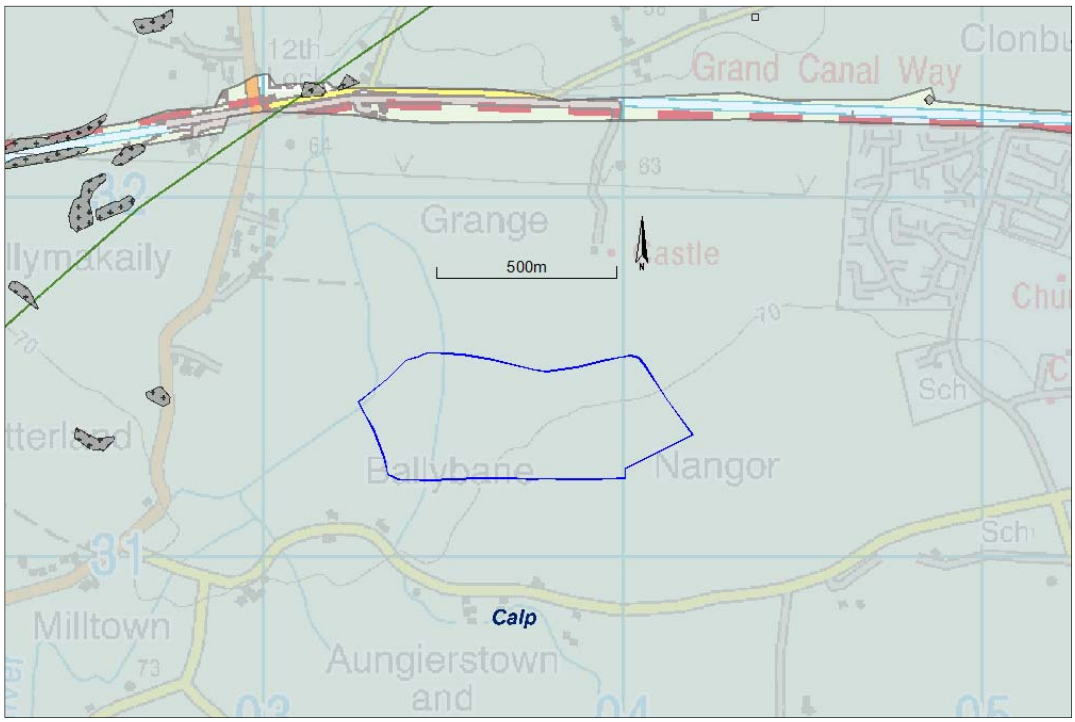


Fig.2.1. Geological map for the site.

2.2.3 Soils & Vulnerability

The Teagasc soils map for the site (Fig.2.2) shows that the site comprises limestone till. The vulnerability for the site (Fig.2.3) is rated as high in the centre and east, and extreme in the west of the site.

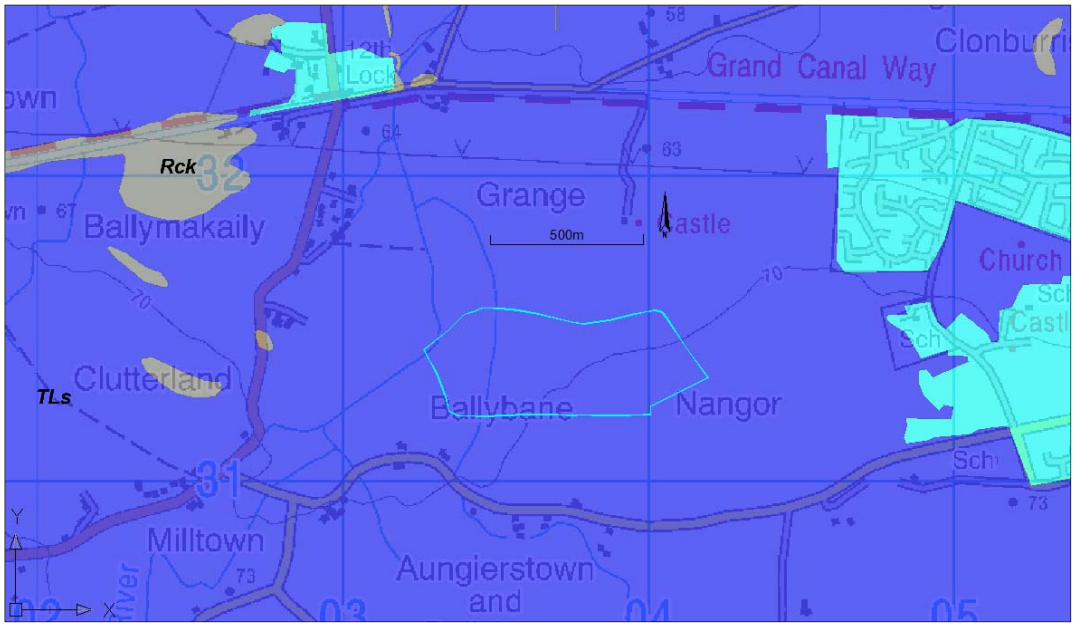


Fig.2.2. Soils map for the site.

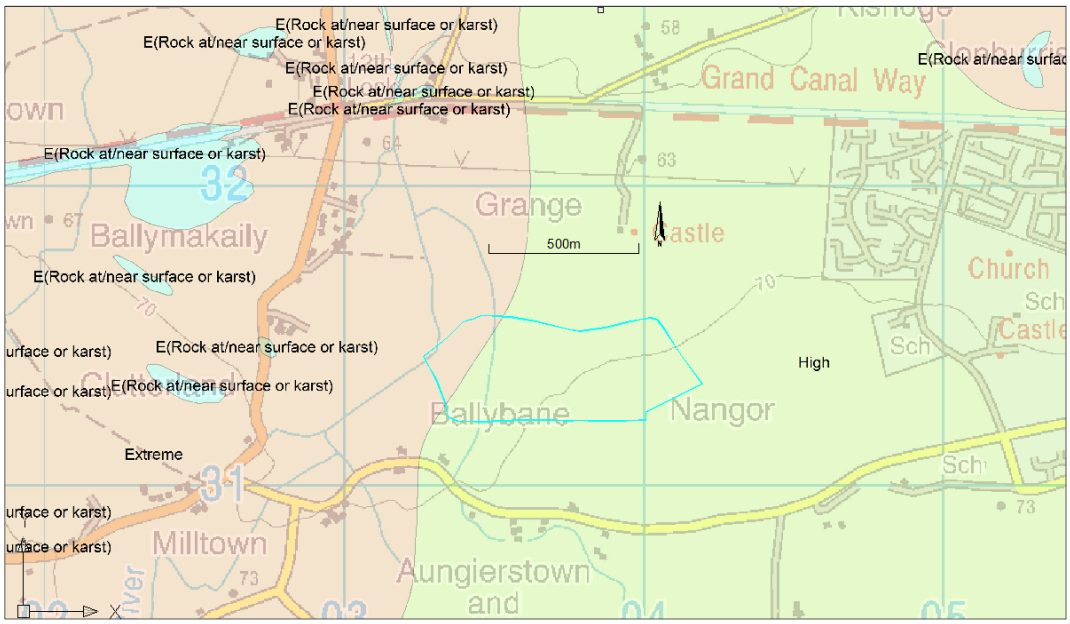


Fig.2.3. Vulnerability map for the site.

2.2.4 Site Investigation

The drillers' logs for no.27 shell & auger boreholes carried out by Ground Investigations Ireland Ltd. from 20-31st May 2013 were made available to assist with the geophysical interpretation. These logs generally recorded firm-stiff boulder clay to 1.2-4.8 m followed by shale/rock.

A summary sheet of no. 28 trial pits carried out on site was also provided and these were terminated on rock at 1.2-3.2 m bgl.

2.3 Survey Rationale

Electrical Resistivity Tomography (ERT) soundings will image the resistivity of the materials in the subsurface along a profile to produce a pseudo-section showing the variation in resistivity to 17-57m bgl (depending on the array length). Each pseudo-section will be interpreted to determine the material type along the profile at increasing depth, based on the typical resistivities returned for Irish ground materials.

Conductivity Mapping works on the same geophysical principle as ERT, and in this case materials with a low resistivity will have a high conductivity. Conductivity mapping is carried out using an EM31 Conductivity Meter, which is carried across the ground in set pattern, to provide conductivity values for the materials from 0 – 6.0m bgl.

Seismic Refraction Profiling measures the velocity of refracted seismic waves through the overburden and rock material and allows an assessment of the thickness and quality of the materials present to be made. Stiffer and stronger materials usually have higher seismic velocities while soft, loose or fractured materials have lower velocities. Readings are taken using geophones connected via multi-core cable to a seismograph. This method will allow us to profile the depth to the top of the bedrock, along profiles across the site, and will therefore allow us to calibrate the bedrock depth for the ERT data.

The soil resistivity tests were carried out at each turbine base using the Wenner Array as described in IEEE Std 81-1983 (Guide for measuring Earth Resistivity, Ground Impedance and Earth Surface Potentials of a Ground System). The results are presented in tabular format in Appendix B.

3. RESULTS & INTERPRETATION

3.1 2D Electrical Resistivity Tomography (ERT)

2-D ERT Profiles R1-R26 have been acquired across the site (Drawing 13093_01-10). The profiles have been interpreted on the following basis:

Resistivity (Ohm.m)	Interpretation
50 - 75	SILT/CLAY
75 - 186	Sandy Gravelly CLAY
30 - 186	SHALE
186 - 500	Muddy LIMESTONE

3.2 Conductivity Mapping

The conductivity results are indicative of the bulk conductivity of the ground materials from 0-6.0m bgl and have been generally interpreted as follows:

Conductivity (mS/m)	Interpretation
2 - 12	Mainly Sandy Gravelly CLAY followed by Muddy LIMESTONE & SHALE
12 - 15	Mainly SILT/CLAY followed by Muddy LIMESTONE & SHALE
15 - 18	MADE GROUND

These results are discussed in Section 3.4 below.

The conductivity results and interpretation are shown on Drawings 13093_13 and 13093_14 respectively.

3.3 Seismic Refraction Profiling

Fourteen seismic refraction spreads were recorded throughout the site. Each of the profiles was 46m in length and have a depth of investigation of approx. 16m.

The seismic data has outlined up to four velocity layers and has been generally interpreted on the following basis:

Layer	Seismic Velocity (m/s)	Average Seismic Velocity (m/s)	Thickness (m)	Interpretation	Stiffness/Rock Quality	Excavatibility
1	211 - 811	401	0.3 – 1.0	Overburden	Soft-Firm	Diggable
2	593 - 1333	964	0.25 - 5.0	Overburden	Firm-Stiff	Diggable
3	1000 - 2187	1748	1.7-5.2	Overburden	Stiff-Very Stiff	Diggable
4	2414 - 4388	3402		Slightly Weathered – Fresh Bedrock	Good	Breaking/Blasting

Layer 2 has been interpreted as absent from Profiles S8, S10 & S17 and Layer 3 has been interpreted as absent from Profiles S6, S15 & S22.

3.3 Soil Resistivity

The Soil Resistivity results are provided for 2.5m and 5.6m bgl at every 20m interval along each of the ERT Profiles. The results are tabulated in Appendix B. Of the 624 values shown, only one is below 50 ohm-m (deemed to be the cut-off for corrosivity), and this is at 232.5m (and 2.5m bgl) along Profile R15. This value is located in the far south-eastern corner of the site.

3.4 Discussion

The ERT, Seismic Refraction and direct investigation results have been combined to produce the Interpreted Sections on Drawings 13093_02 to 13093_10. The contoured Interpreted Bedrock Depth is presented on Drawing 13093_11 and is constructed from the Interpreted Sections and the direct investigation results.

3.4.1 Overburden

Material with resistivities of 50 – 75 and 75 - 186 ohm-m has been interpreted as silt/clay and gravelly clay (boulder clay respectively). Boulder clay is by far the most prevalent overburden type throughout as shown in the borehole and conductivity results, with silt/clay interpreted on the western and eastern sides of the site.

The conductivity results (and visual observation) indicate that an area of fill/made ground is present in the far west of the site. The high conductivity of this material may be indicative of some waste material here also. TP3 is located within this area and should be consulted.

The seismic refraction results indicate that the overburden ranges from soft-very stiff, with soft-firm in the upper 0.3-1.0m, followed by firm-stiff to approx. 1.8m followed by stiff-very stiff material.

The interpreted overburden thickness across the site is contoured on Drawing 13093_12 and ranges from 0.6-5.4m and is an average of 2.5m.

3.4.2 Bedrock

Bedrock with a resistivity of 30 - 186 and 186 - 500 ohm-m has been interpreted as shale and muddy limestone respectively. Muddy limestone is by far the most prevalent bedrock type with zones of interpreted shale throughout the site.

The seismic refraction results indicate that bedrock will require breaking/blasting upon excavation.

The interpreted Bedrock Depth map is shown on Drawing 13093_11 and indicates that bedrock depth ranges from 60.3-71.8 mOD across the site with the lowest bedrock on the western side, gradually rising towards the south and east.

It should be noted that the Bedrock Depth and Overburden Thickness maps presented in this report are mainly based on the top of the 107 ohm-m contour from the ERT results, with the majority of the boreholes/trial pits showing this to be most suitable contour to map bedrock depth. Some deviations are made above or below this contour based on suspected shallow shale, and due to variations across the site in the direct investigation / seismic results. The map includes a degree of interpolation, and the data points used to construct the map are shown on Drawing 13093_11.

Note that there may be a thin layer (c.0.2m) of highly-moderately bedrock at the base of the overburden which may or may not be continuous throughout the site. This will be evident from the final published site investigation logs.

Some possible fault zones have been shown in the Interpreted Sections, within area of generally low resistivity at depth.

4. RECOMMENDATIONS

Where bedrock excavation is proposed a detailed assessment of excavatability should be carried out combining the results of the geophysical survey, rotary core drilling, strength testing, and trial excavation pits using a high powered excavator.

The report should be revised upon the completion of any additional site investigation.

5. REFERENCES

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6. APPENDIX A: DETAILED METHODOLOGY

6.1 Electrical Resistivity Tomography (ERT)

6.1.1 Principles

This surveying technique makes use of the Gradient resistivity array. The 2D-resistivity profiling method records a large number of resistivity readings in order to map lateral and vertical changes in material types. The 2D-resistivity profiling method involves the use of 1-81 electrodes connected to a resistivity meter, using computer software to control the process of data collection and storage.

6.1.2 Data Collection

Profiles R1-R24 were recorded using a Abem resistivity meter and up to four 20 takeout multicore cable and up to 81 stainless steel electrodes. Saline solution was used at the electrode\ground interface in order to gain a good electrical contact required for the technique to work effectively. The recorded data were processed and viewed immediately after the survey. The data was recorded from 13-17th May 2013.

6.1.3 Data Processing

The field readings were stored in computer files and inverted using the RES2DINV package with up to 5 iterations of the measured data carried out for each profile to obtain a 2D-Depth model of the resistivities.

The inverted 2D-Resistivity models and corresponding interpreted geology are displayed on the accompanying drawings. Distance is indicated along the horizontal axis of the profiles. Profiles have been contoured using the same contour intervals and colour codes.

6.1.4 Relocation

All data were referenced using a Pro-XR Differential GPS system with c.20mm accuracy.

6.2 Ground Conductivity Mapping

6.2.1 Principles

This is an electromagnetic technique used to investigate lateral variations in overburden material and to assist with the indication of the depth to bedrock.

This method operates on the principle of inducing currents in conductive substrata and measuring the resultant secondary electro-magnetic field. The strength of this secondary EM field is calibrated to give apparent ground conductivity in milliSiemens/metre (mS/m). Readings over material such as organic waste and peat give high conductivity values while readings over dry materials with a low clay mineral content such as gravels, limestone or quartzite give low readings.

The EM31 survey technique determines the apparent conductivity of the ground material from 0-6m bgl depending on the dipole mode used. Depending on the dipole mode used, the measured conductivity is a function of the different overburden layers and/or rock from 0 to 6m below ground level.

6.2.2 Data Collection

The EM31 equipment used was a GF CMD-4 conductivity meter equipped with data logger. This instrument features a real time graphic display of the previous 20 measurement points to monitor data quality and results. Conductivity and in-phase values were recorded one each side of the roadway which surrounds the TMF. Local conditions and variations were recorded.

6.2.3 Data Processing

The conductivity and inphase field readings were downloaded, contoured and plotted using the SURFER 8 program (Golden Software, 2008). Data which was affected by metallic objects was removed. Assignation of material types and possible anomaly sources was carried out, with cross-reference to other data. The contoured conductivity data and interpretation are displayed on Drawings 13093_12 and 13093_13.

6.2.4 Relocation

All data were referenced using a Garmin handheld system with sub 3m accuracy. All positions are given in Irish National Grid coordinates.

6.3 Seismic Refraction Profiling

6.3.1 Principles

The seismic refraction profiling method measures the velocity of refracted seismic waves through the overburden and rock material and allows an assessment of the thickness and quality of the materials present to be made. Stiffer and stronger materials usually have higher seismic velocities while soft, loose or fractured materials have lower velocities. Readings are taken using geophones connected via multi-core cable to a seismograph.

6.3.2 Data Collection

Fourteen seismic spreads were recorded from 13-17th May 2013. 2013 using a Geode high-resolution 24 channel digital seismograph with geophone spacings of 2m. The source of the seismic waves was a sledgehammer.

6.3.3 Data Processing

The recorded data was interpreted using the ray-tracing and intercept time methods, to acquire depths to layer boundaries and the P-wave velocities of these layers, using the FIRSTPIX and GREMIX programs.

GREMIX interprets seismic refraction data as a laterally varying layered earth structure. It incorporates the slope-intercept method, parts of the Plus-Minus Method of Hagedoorn (1959), Time-Delay Method, and features the Generalized Reciprocal Method (GRM) of Palmer (1980). Up to four layers can be mapped, one deduced from direct arrivals and three deduced from refractions. Phantoming of all possible travel time pairs can be carried out by adjusting reciprocal times of off shots.

6.3.4 Relocation

All data were referenced using a Pro-XS Differential GPS system with c.20mm accuracy.

7. APPENDIX B: SOIL RESISTIVITY

Profile	Depth (m)	Distance Along Profile (m)	Resistivity (Ohm-m)	Profile	Depth (m)	Distance Along Profile (m)	Resistivity (Ohm-m)
R1	2.5	12.5	65.501	R1	5.6	12.5	133.3
	2.5	32.5	85.611		5.6	32.5	123.22
	2.5	52.5	70.702		5.6	52.5	143.47
	2.5	72.5	74.769		5.6	72.5	125.27
	2.5	92.5	85.972		5.6	92.5	130.35
	2.5	112.5	95.38		5.6	112.5	230.67
R2	2.5	12.5	109.97	R1	5.6	12.5	151.8
	2.5	32.5	97.358		5.6	32.5	144.11
	2.5	52.5	103.65		5.6	52.5	96.434
	2.5	72.5	106.93		5.6	72.5	111.53
	2.5	92.5	110.75		5.6	92.5	99.957
	2.5	112.5	88.832		5.6	112.5	100.67
	2.5	132.5	90.849		5.6	132.5	113.71
	2.5	152.5	89.454		5.6	152.5	123.36
	2.5	172.5	95.128		5.6	172.5	108.52
	2.5	192.5	118.77		5.6	192.5	126.55
	2.5	212.5	94.606		5.6	212.5	103.54
	2.5	232.5	94.183		5.6	232.5	132.31
R3	2.5	12.5	110.13	R3	5.6	12.5	96.58
	2.5	32.5	84.667		5.6	32.5	113.77
	2.5	52.5	99.442		5.6	52.5	99.39
	2.5	72.5	84.264		5.6	72.5	107.17
	2.5	92.5	71.624		5.6	92.5	105.14
	2.5	112.5	79.149		5.6	112.5	107.62
	2.5	132.5	75.677		5.6	132.5	110.54
	2.5	152.5	70.707		5.6	152.5	113.32
	2.5	172.5	72.961		5.6	172.5	114.84
	2.5	192.5	67.104		5.6	192.5	114.16
	2.5	212.5	74.786		5.6	212.5	114.77
	2.5	232.5	82.351		5.6	232.5	128.13
R4	2.5	32.5	105.36	R4	5.6	32.5	138.43
	2.5	52.5	78.391		5.6	52.5	145.32
	2.5	72.5	80.494		5.6	72.5	126.73
	2.5	92.5	67.026		5.6	92.5	127.11
	2.5	112.5	82.902		5.6	112.5	120.84
	2.5	132.5	87.98		5.6	132.5	165.99
R4A	2.5	32.5	86.964	R4A	5.6	32.5	191.25
	2.5	52.5	207.27		5.6	52.5	195.58
	2.5	72.5	108.56		5.6	72.5	177.38
	2.5	92.5	110.92		5.6	92.5	115.3
	2.5	112.5	128.22		5.6	112.5	192.26

Profile	Depth (m)	Distance Along Profile (m)	Resistivity (Ohm-m)	Profile	Depth (m)	Distance Along Profile (m)	Resistivity (Ohm-m)
R5	2.5	12.5	96.616	R5	5.6	12.5	154.68
	2.5	32.5	100.88		5.6	32.5	171.8
	2.5	52.5	241.92		5.6	52.5	354.56
	2.5	72.5	111.37		5.6	72.5	139.52
	2.5	92.5	89.076		5.6	92.5	112.92
	2.5	112.5	106.61		5.6	112.5	153.45
	2.5	132.5	95.624		5.6	132.5	124.62
	2.5	152.5	89.23		5.6	152.5	97.953
R6	2.5	12.5	99.098	R6	5.6	12.5	164.28
	2.5	32.5	161.34		5.6	32.5	212.27
	2.5	52.5	127.47		5.6	52.5	193.25
	2.5	72.5	97.835		5.6	72.5	162.6
	2.5	92.5	77.759		5.6	92.5	172.98
	2.5	112.5	119.47		5.6	112.5	169.19
	2.5	132.5	102.62		5.6	132.5	136.19
	2.5	152.5	99.228		5.6	152.5	137.97
	2.5	172.5	114.86		5.6	172.5	138.5
	2.5	192.5	123.06		5.6	192.5	157.67
	2.5	212.5	89.28		5.6	212.5	124.27
R7	2.5	12.5	135.03	R7	5.6	12.5	165.14
	2.5	32.5	88.747		5.6	32.5	283.68
	2.5	52.5	93.694		5.6	52.5	140.96
	2.5	72.5	90.563		5.6	72.5	160.14
	2.5	92.5	82.064		5.6	92.5	216.59
	2.5	112.5	89.34		5.6	112.5	111.27
	2.5	132.5	80.872		5.6	132.5	207.82
	2.5	152.5	56.71		5.6	152.5	209.55
	2.5	172.5	101.67		5.6	172.5	172.27
	2.5	192.5	93.393		5.6	192.5	223.35
	2.5	212.5	60.767		5.6	212.5	128.69
	2.5	232.5	55.925		5.6	232.5	164.37
R8A	2.5	12.5	90.89	R8A	5.6	12.5	121.72
	2.5	32.5	88.438		5.6	32.5	110.23
	2.5	52.5	95.902		5.6	52.5	117.19
	2.5	72.5	79.82		5.6	72.5	102.96
	2.5	92.5	85.069		5.6	92.5	98.096
	2.5	112.5	78.503		5.6	112.5	110.84

Profile	Depth (m)	Distance Along Profile (m)	Resistivity (Ohm-m)	Profile	Depth (m)	Distance Along Profile (m)	Resistivity (Ohm-m)
R8B	2.5	12.5	61.686	R8B	5.6	12.5	151.53
	2.5	32.5	77.713		5.6	32.5	130.14
	2.5	52.5	74.219		5.6	52.5	114.4
	2.5	72.5	52.609		5.6	72.5	162.27
	2.5	92.5	71.935		5.6	92.5	123.95
	2.5	112.5	62.937		5.6	112.5	128.1
	2.5	-7.5	66.734		5.6	132.5	135.62
R9	2.5	12.5	64.055	R9	5.6	12.5	127.37
	2.5	32.5	72.29		5.6	32.5	79.102
	2.5	52.5	72.167		5.6	52.5	104.52
	2.5	72.5	73.279		5.6	72.5	101.6
	2.5	92.5	71.206		5.6	92.5	86.964
	2.5	112.5	100.69		5.6	112.5	180.13
	2.5	132.5	109.21		5.6	132.5	243.01
	2.5	152.5	106.33		5.6	152.5	112.8
	2.5	172.5	88.309		5.6	172.5	194.74
	2.5	192.5	99.675		5.6	192.5	348.38
	2.5	212.5	84.117		5.6	212.5	135.16
	2.5	232.5	51.113		5.6	232.5	170.84
R10	2.5	12.5	80.542	R10	5.6	12.5	225.88
	2.5	32.5	102.1		5.6	32.5	105.38
	2.5	52.5	92.122		5.6	52.5	226.99
	2.5	72.5	71.911		5.6	72.5	66.208
	2.5	92.5	82.444		5.6	92.5	207.52
	2.5	112.5	93.985		5.6	112.5	121.37
	2.5	132.5	75.615		5.6	132.5	68.353
	2.5	152.5	79.638		5.6	152.5	317.52
	2.5	172.5	104.1		5.6	172.5	93.539
	2.5	192.5	90.594		5.6	192.5	528.32
	2.5	212.5	82.673		5.6	212.5	118.08

Profile	Depth (m)	Distance Along Profile (m)	Resistivity (Ohm-m)	Profile	Depth (m)	Distance Along Profile (m)	Resistivity (Ohm-m)
R11	2.5	12.5	115.01	R11	5.6	12.5	134.91
	2.5	32.5	72.239		5.6	32.5	179.2
	2.5	52.5	96.41		5.6	52.5	130.06
	2.5	72.5	64.466		5.6	72.5	135.75
	2.5	92.5	53.708		5.6	92.5	227.65
	2.5	112.5	86.526		5.6	112.5	86.696
	2.5	132.5	67.066		5.6	132.5	447.27
	2.5	152.5	86.284		5.6	152.5	133.07
	2.5	172.5	84.373		5.6	172.5	189.47
	2.5	192.5	97.519		5.6	192.5	126.01
	2.5	212.5	82.501		5.6	212.5	86.513
	2.5	232.5	61.436		5.6	232.5	314.08
	2.5	252.5	89.185		5.6	252.5	227.1
	2.5	272.5	82.783		5.6	272.5	296.6
R12	2.5	12.5	61.675	R12	5.6	12.5	220.97
	2.5	32.5	84.381		5.6	32.5	102.99
	2.5	52.5	79.578		5.6	52.5	494.69
	2.5	72.5	107.08		5.6	72.5	223.02
	2.5	92.5	78.426		5.6	92.5	192.01
	2.5	112.5	108.82		5.6	112.5	85.505
	2.5	132.5	59.907		5.6	132.5	238.3
	2.5	152.5	121.1		5.6	152.5	94.571
	2.5	172.5	69.394		5.6	172.5	374.95
R13	2.5	12.5	79.529	R13	5.6	12.5	104.07
	2.5	32.5	83.524		5.6	32.5	348.12
	2.5	52.5	113.63		5.6	52.5	172.9
	2.5	72.5	95.829		5.6	72.5	92.267
	2.5	92.5	56.865		5.6	92.5	279.51
	2.5	112.5	70.273		5.6	112.5	228.71
	2.5	132.5	179.28		5.6	132.5	807.27
	2.5	152.5	79.325		5.6	152.5	184.95
	2.5	172.5	84.908		5.6	172.5	174.74
	2.5	192.5	77.35		5.6	192.5	176.77
	2.5	212.5	78.682		5.6	212.5	182.38
	2.5	232.5	116.85		5.6	232.5	184.03
	2.5	252.5	65.299		5.6	252.5	132.51
	2.5	272.5	73.9		5.6	272.5	221.8

Profile	Depth (m)	Distance Along Profile (m)	Resistivity (Ohm-m)	Profile	Depth (m)	Distance Along Profile (m)	Resistivity (Ohm-m)
R14	2.5	12.5	102.57	R14	5.6	12.5	177.67
	2.5	32.5	132.29		5.6	32.5	325.33
	2.5	52.5	104.51		5.6	52.5	87.315
	2.5	72.5	142.98		5.6	72.5	762.47
	2.5	92.5	72.678		5.6	92.5	172.5
	2.5	112.5	81.101		5.6	112.5	321.36
	2.5	132.5	177.89		5.6	132.5	557.98
	2.5	152.5	81.463		5.6	152.5	189.23
	2.5	172.5	120.24		5.6	172.5	236.77
	2.5	192.5	68.26		5.6	192.5	156.13
	2.5	212.5	54.359		5.6	212.5	314.78
	2.5	232.5	97.798		5.6	232.5	136.39
	2.5	252.5	78.33		5.6	252.5	272.22
	2.5	272.5	92.928		5.6	272.5	145.06
	2.5	292.5	87.643		5.6	292.5	319.34
	2.5	312.5	80.572		5.6	312.5	94.658
	2.5	332.5	79.247		5.6	332.5	87.201
R15	2.5	12.5	74.384	R15	5.6	12.5	102.98
	2.5	32.5	76.861		5.6	32.5	111.41
	2.5	52.5	88.95		5.6	52.5	141.48
	2.5	72.5	96.154		5.6	72.5	89.072
	2.5	92.5	71.423		5.6	92.5	177.96
	2.5	112.5	98.775		5.6	112.5	140.03
	2.5	132.5	81.298		5.6	132.5	99.648
	2.5	152.5	111.55		5.6	152.5	153.61
	2.5	172.5	92.964		5.6	172.5	149.1
	2.5	192.5	91.047		5.6	192.5	131.92
	2.5	212.5	70.687		5.6	212.5	99.178
	2.5	232.5	43.123		5.6	232.5	68.347
R16	2.5	12.5	117.07	R16	5.6	12.5	225.29
	2.5	32.5	222.52		5.6	32.5	277.45
	2.5	52.5	103.83		5.6	52.5	350.46
	2.5	72.5	90.71		5.6	72.5	165.81
	2.5	92.5	59.685		5.6	92.5	151.9
	2.5	112.5	61.201		5.6	112.5	138.27
	2.5	132.5	63.76		5.6	132.5	160.03
	2.5	152.5	87.91		5.6	152.5	138.37
	2.5	172.5	71.171		5.6	172.5	241.2
	2.5	192.5	85.698		5.6	192.5	122.02
	2.5	212.5	78.667		5.6	212.5	72.421
	2.5	232.5	61.502		5.6	232.5	107.17
	2.5	252.5	72.863		5.6	252.5	146.08
	2.5	272.5	66.862		5.6	272.5	209.74

Profile	Depth (m)	Distance Along Profile (m)	Resistivity (Ohm-m)	Profile	Depth (m)	Distance Along Profile (m)	Resistivity (Ohm-m)
R17	2.5	12.5	116.73	R17	5.6	12.5	111.82
	2.5	32.5	75.679		5.6	32.5	134.7
	2.5	52.5	61.959		5.6	52.5	131.02
	2.5	72.5	92.419		5.6	72.5	81.673
	2.5	92.5	78.603		5.6	92.5	147.07
	2.5	112.5	61.525		5.6	112.5	94.69
	2.5	132.5	63.961		5.6	132.5	89.133
	2.5	152.5	76.003		5.6	152.5	111.83
	2.5	172.5	66.274		5.6	172.5	118.33
	2.5	192.5	77.433		5.6	192.5	66.382
	2.5	212.5	55.808		5.6	212.5	96.972
	2.5	232.5	65.092		5.6	232.5	75.715
	2.5	252.5	70.743		5.6	252.5	104.23
	2.5	272.5	90.381		5.6	272.5	125.27
R18	2.5	12.5	131.16	R18	5.6	12.5	142.3
	2.5	32.5	66.239		5.6	32.5	177.41
	2.5	52.5	105.48		5.6	52.5	139.72
	2.5	72.5	108.1		5.6	72.5	173.95
	2.5	92.5	183.28		5.6	92.5	308.1
	2.5	112.5	83.315		5.6	112.5	173.04
	2.5	132.5	109.98		5.6	132.5	189.34
	2.5	152.5	125.79		5.6	152.5	181.09
	2.5	172.5	101.42		5.6	172.5	153.12
	2.5	192.5	97.665		5.6	192.5	128.89
	2.5	212.5	141.28		5.6	212.5	179.41
	2.5	232.5	111.12		5.6	232.5	214.15
	2.5	252.5	160.84		5.6	252.5	224.09
R19	2.5	12.5	92.456	R19	5.6	12.5	303.01
	2.5	32.5	119.28		5.6	32.5	179.95
	2.5	52.5	95.172		5.6	52.5	135.86
	2.5	72.5	100.83		5.6	72.5	164.59
	2.5	92.5	87.261		5.6	92.5	82.345
	2.5	112.5	85.552		5.6	112.5	97.202
R20	2.5	12.5	71.954	R20	5.6	12.5	115.63
	2.5	32.5	94.559		5.6	32.5	114.59
	2.5	52.5	99.442		5.6	52.5	188.04
	2.5	72.5	124.47		5.6	72.5	126.28
	2.5	92.5	90.231		5.6	92.5	158.87
	2.5	112.5	83.002		5.6	112.5	135.95
	2.5	132.5	88.735		5.6	132.5	100.92
	2.5	152.5	117.01		5.6	152.5	118.52
	2.5	172.5	84.96		5.6	172.5	128.87
	2.5	192.5	89.359		5.6	192.5	112.68
	2.5	212.5	60.718		5.6	212.5	110.81
	2.5	232.5	86.779		5.6	232.5	107.33
	2.5	252.5	88.393		5.6	252.5	132.07
	2.5	272.5	104.46		5.6	272.5	168.82

Profile	Depth (m)	Distance Along Profile (m)	Resistivity (Ohm-m)	Profile	Depth (m)	Distance Along Profile (m)	Resistivity (Ohm-m)
R21	2.5	12.5	86.728	R21	5.6	12.5	140.95
	2.5	32.5	96.915		5.6	32.5	117.88
	2.5	52.5	80.403		5.6	52.5	143.1
	2.5	72.5	97.439		5.6	72.5	153.82
	2.5	92.5	104.3		5.6	92.5	149.71
	2.5	112.5	97.495		5.6	112.5	144.55
	2.5	132.5	131.7		5.6	132.5	123.39
	2.5	152.5	72.577		5.6	152.5	159.02
	2.5	172.5	92.443		5.6	172.5	104.13
	2.5	192.5	103.64		5.6	192.5	130.05
R22	2.5	12.5	65.975	R22	5.6	12.5	67.155
	2.5	32.5	93.383		5.6	32.5	239.84
	2.5	52.5	128.29		5.6	52.5	122.33
	2.5	72.5	88.987		5.6	72.5	258.12
	2.5	92.5	93.372		5.6	92.5	99.309
	2.5	112.5	118.08		5.6	112.5	111.77
	2.5	132.5	81.259		5.6	132.5	126.96
R23	2.5	12.5	84.658	R23	5.6	12.5	103.26
	2.5	32.5	92.314		5.6	32.5	127.6
	2.5	52.5	96.691		5.6	52.5	94.961
	2.5	72.5	76.036		5.6	72.5	146.74
	2.5	92.5	103.96		5.6	92.5	89.65
	2.5	112.5	124.51		5.6	112.5	195.7
	2.5	132.5	127.73		5.6	132.5	97.66
	2.5	152.5	78.824		5.6	152.5	160.03
	2.5	172.5	93.062		5.6	172.5	126.83
R24	2.5	17.75	113.37	R24	5.6	17.75	451.45
	2.5	37.75	118.63		5.6	37.75	145.92
	2.5	57.75	98.384		5.6	57.75	196.67
	2.5	77.75	91.361		5.6	77.75	114.01
	2.5	97.75	73.91		5.6	97.75	122.16
	2.5	117.75	100.2		5.6	117.75	112.44
	2.5	137.75	91.641		5.6	137.75	123.64
	2.5	157.75	145.13		5.6	157.75	156.35
	2.5	177.75	106.3		5.6	177.75	247.97
	2.5	197.75	90.796		5.6	197.75	103.75
	2.5	217.75	71.086		5.6	217.75	227.81
	2.5	237.75	149.71		5.6	237.75	82.858
	2.5	257.75	121.42		5.6	257.75	258.99
	2.5	277.75	77.863		5.6	277.75	121.29
	2.5	297.75	79.487		5.6	297.75	186.01
	2.5	317.75	85.01		5.6	317.75	171.38
	2.5	337.75	88.916		5.6	337.75	132.63
	2.5	357.75	73.891		5.6	357.75	89.965
	2.5	377.75	75.367		5.6	377.75	76.715

Profile	Depth (m)	Distance Along Profile (m)	Resistivity (Ohm-m)	Profile	Depth (m)	Distance Along Profile (m)	Resistivity (Ohm-m)
R25	2.5	12.5	120.91	R25	5.6	12.5	197.09
	2.5	32.5	99.13		5.6	32.5	116.67
	2.5	52.5	92.076		5.6	52.5	157.67
	2.5	72.5	86.936		5.6	72.5	171
	2.5	92.5	78.536		5.6	92.5	147.36
	2.5	112.5	96.834		5.6	112.5	132.92
	2.5	132.5	87.714		5.6	132.5	130.44
R26	2.5	12.5	79.989	R26	5.6	12.5	134.43
	2.5	32.5	68.203		5.6	32.5	111.86
	2.5	52.5	114.47		5.6	52.5	95.592
	2.5	72.5	87.267		5.6	72.5	345.59
	2.5	92.5	138.78		5.6	92.5	97.57
	2.5	112.5	74.415		5.6	112.5	130.13
	2.5	132.5	111.8		5.6	132.5	162.65
	2.5	152.5	61.511		5.6	152.5	150.96
	2.5	172.5	107.94		5.6	172.5	88.896
	2.5	192.5	55.691		5.6	192.5	87.129
	2.5	212.5	64.551		5.6	212.5	79.462

8. APPENDIX C: SEISMIC REFRACTION PLATES

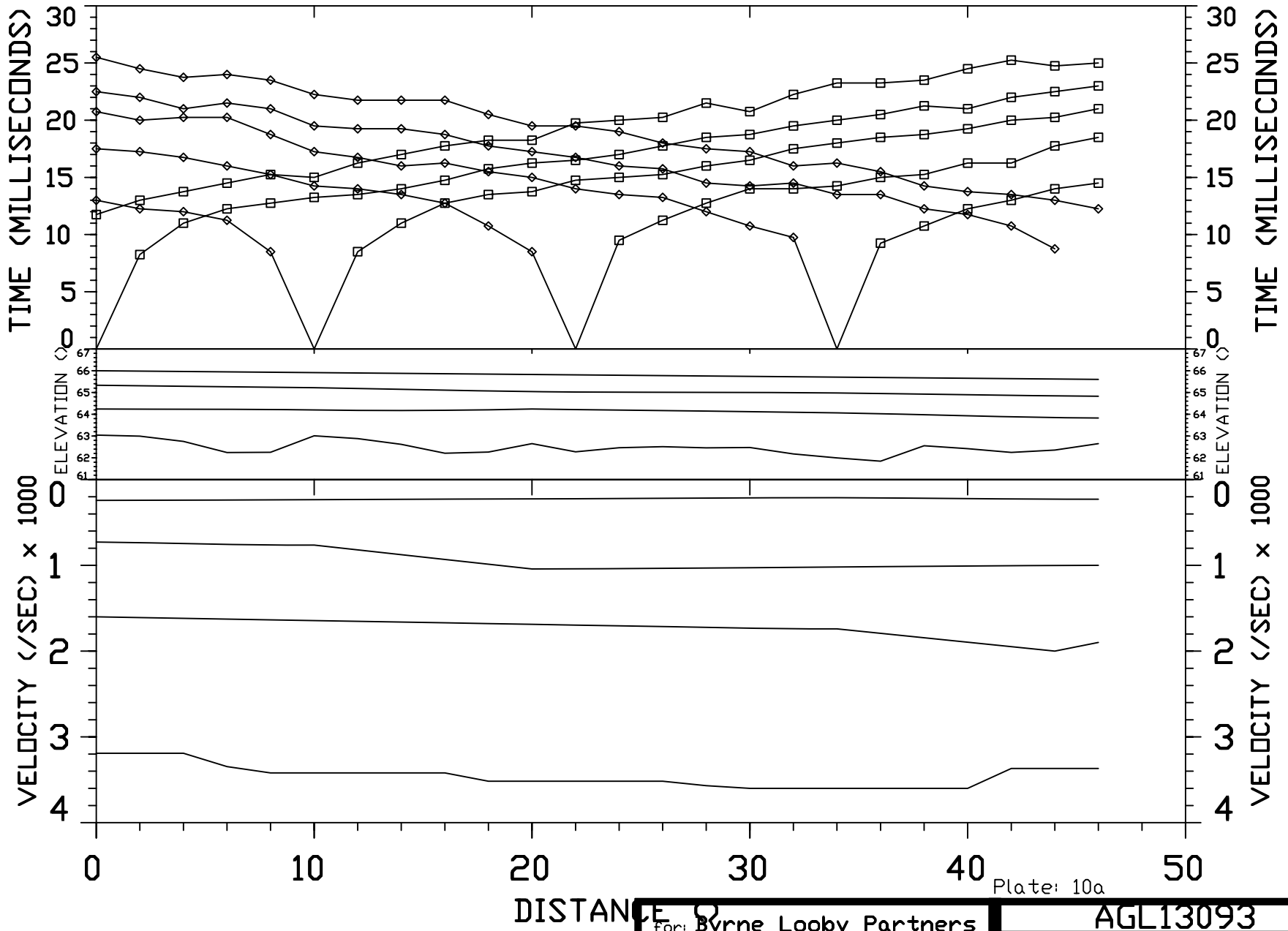


Plate: 10a

for: Byrne Looby Partners	AGL13093
by: Strata Geophysical, Inc.	Grange Castle Business Park
Data SetS2 / Date: May 2013	Dublin
Equipment: Geode / Spread: S2	Azimuth:

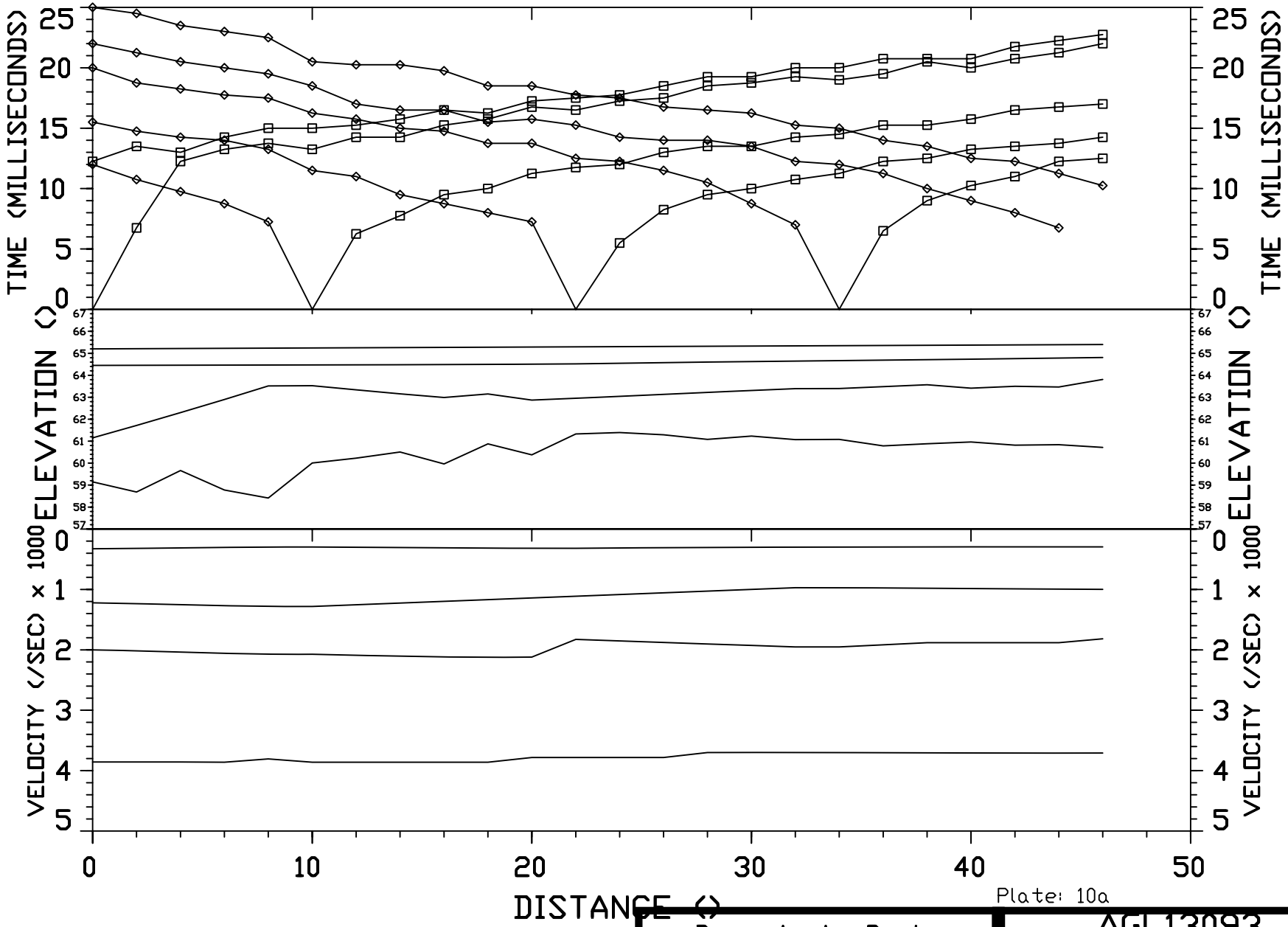


Plate: 10a

for: Byrne Looby Partners	AGL13093
by: Strata Geophysical, Inc.	Grange Castle Business Park
Data SetS3 / Date: May 2013	Dublin
Equipment: Geode / Spread: S3	Azimuth:

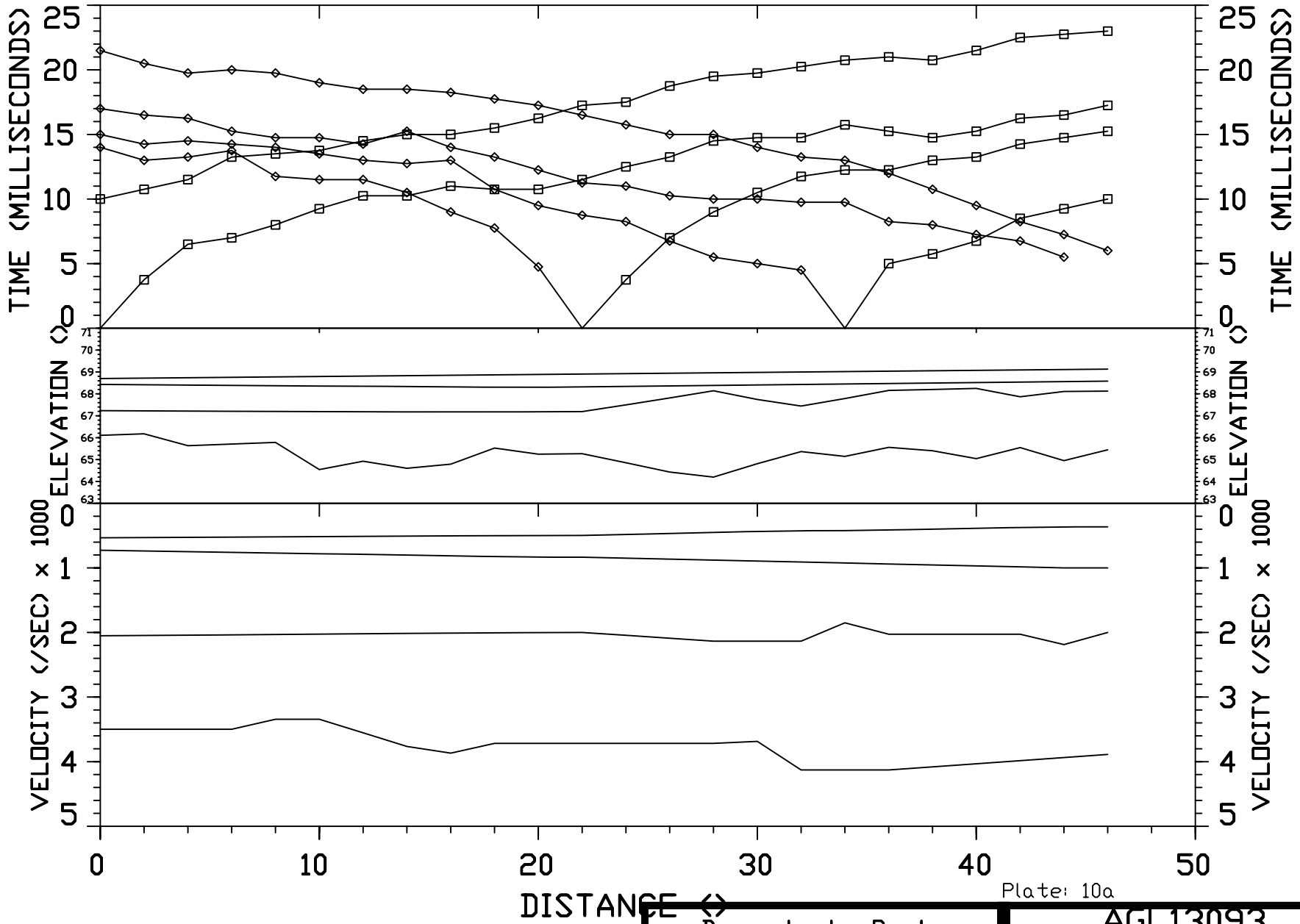


Plate: 10a

for: Byrne Looby Partners		AGL13093
by: Strata Geophysical, Inc.		Grange Castle Business Park
Data SetS5	Date: May 2013	Dublin
Equipment: Geode	Spread: S5	Azimuth:

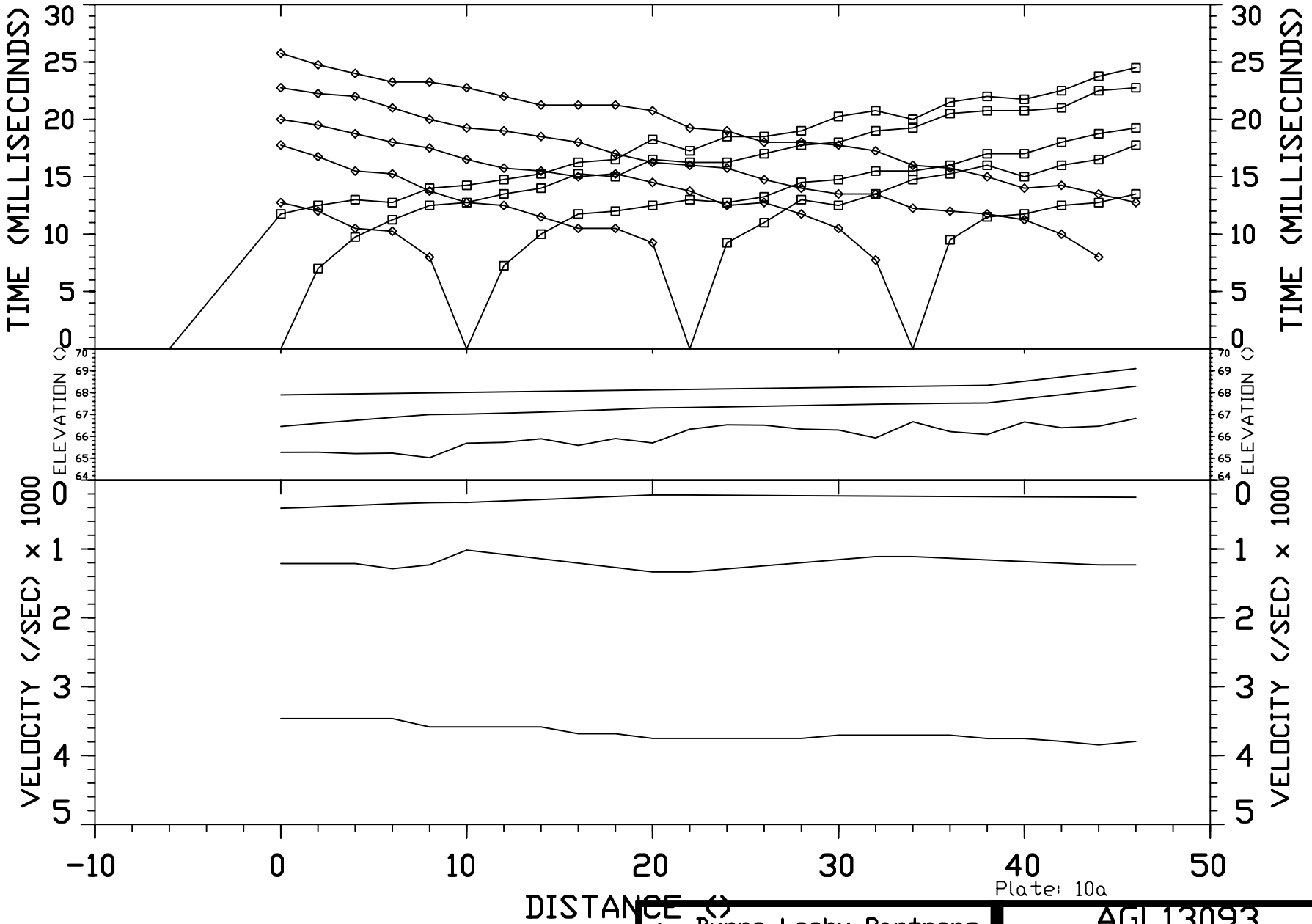


Plate: 10a

for: Byrne Looby Partners	AGL13093
by: Strata Geophysical, Inc.	Grange Castle Business Park
Data SetS6 / Date: May 2013	Dublin
Equipment: Geode / Spread: S6	Azimuth:

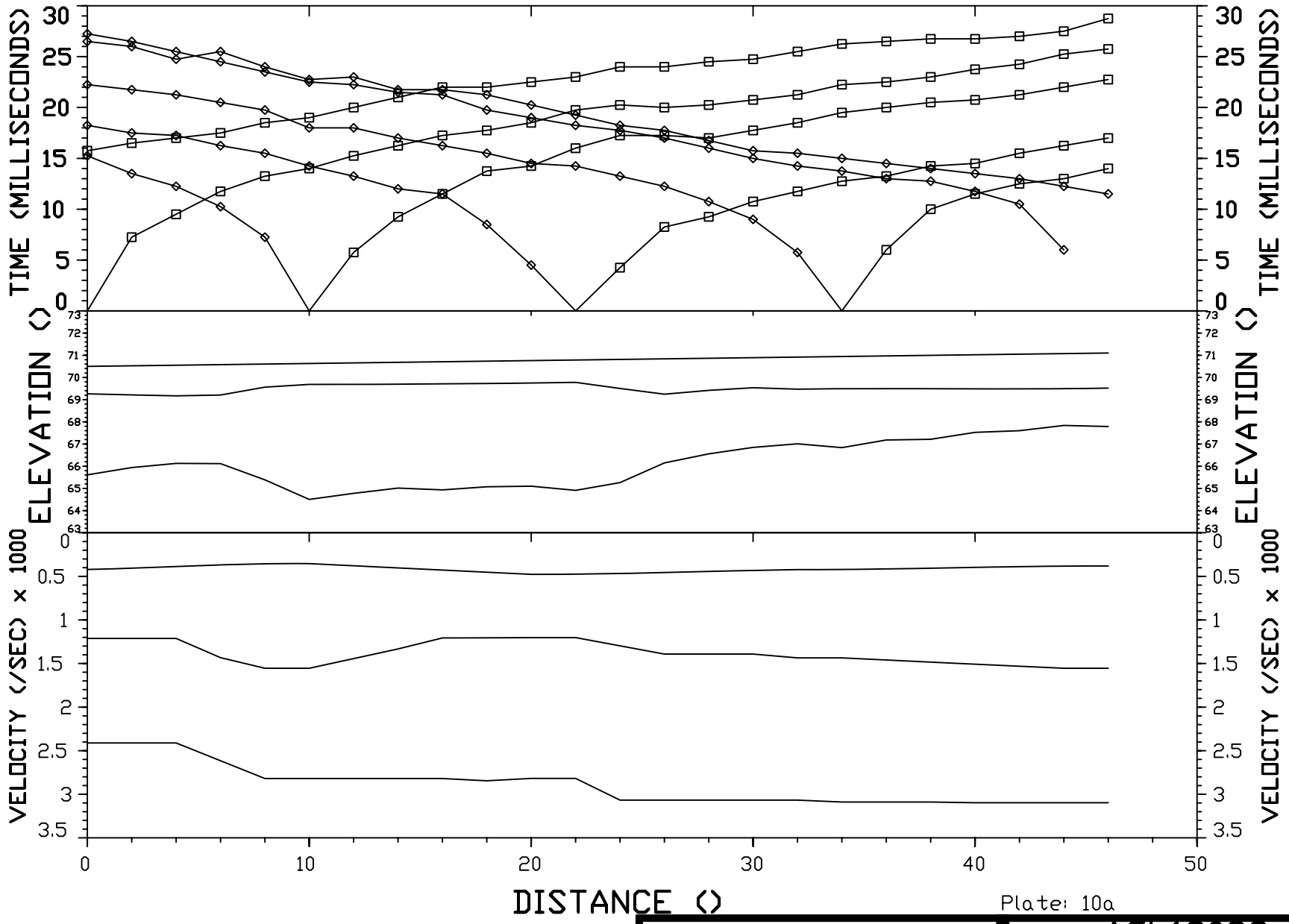


Plate: 10a

for: Byrne Looby Partners	AGL13093
by: Strata Geophysical, Inc.	Grange Castle Business Park Dublin
Data SetS8 / Date: May 2013	
Equipment: Geode / Spread: S8	Azimuth:

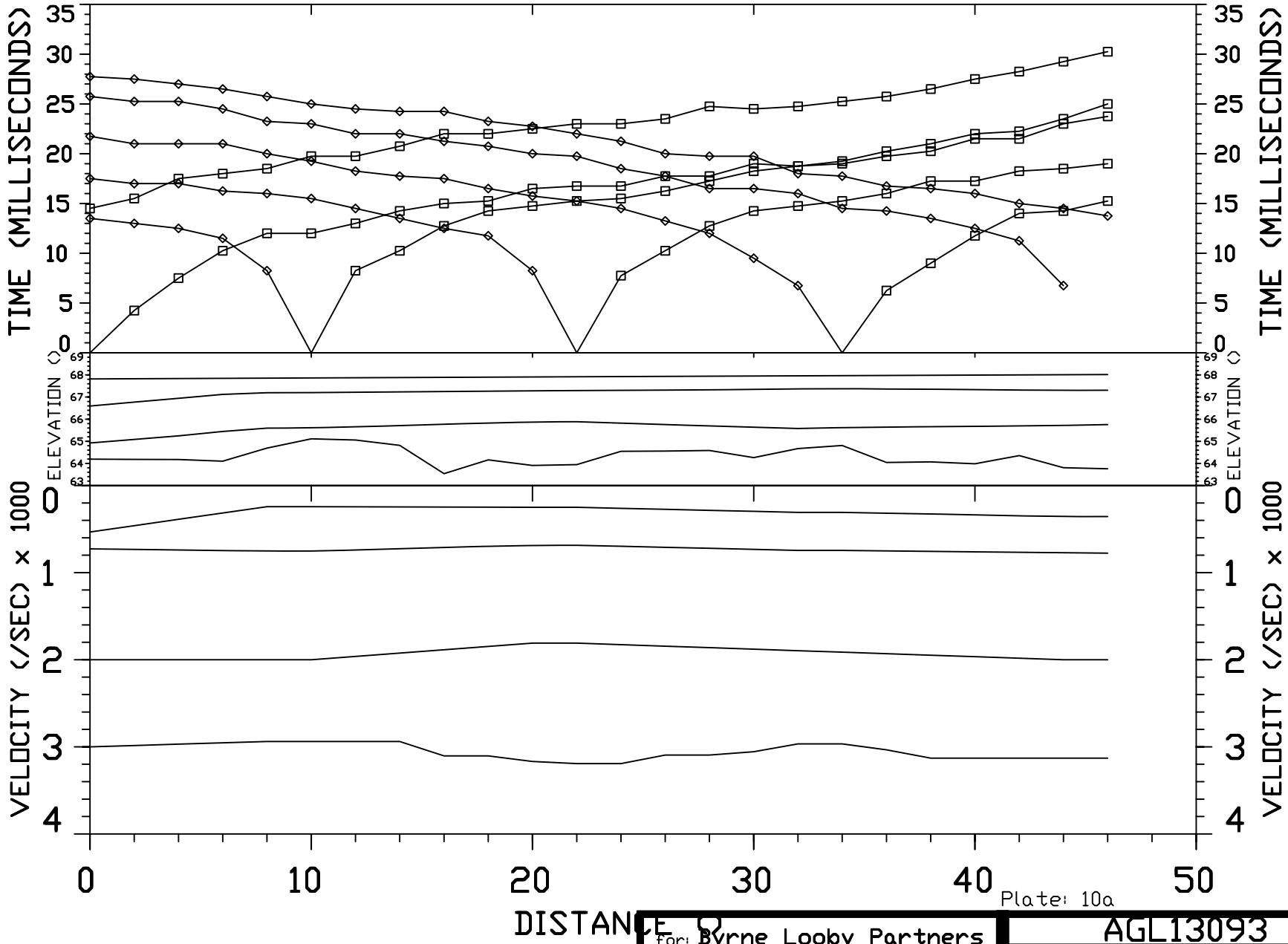


Plate: 10a

for: Byrne Looby Partners	AGL13093
by: Strata Geophysical, Inc.	Grange Castle Business Park Dublin
Data SetS9 / Date: May 2013	
Equipment: Geode / Spread: S9	Azimuth:

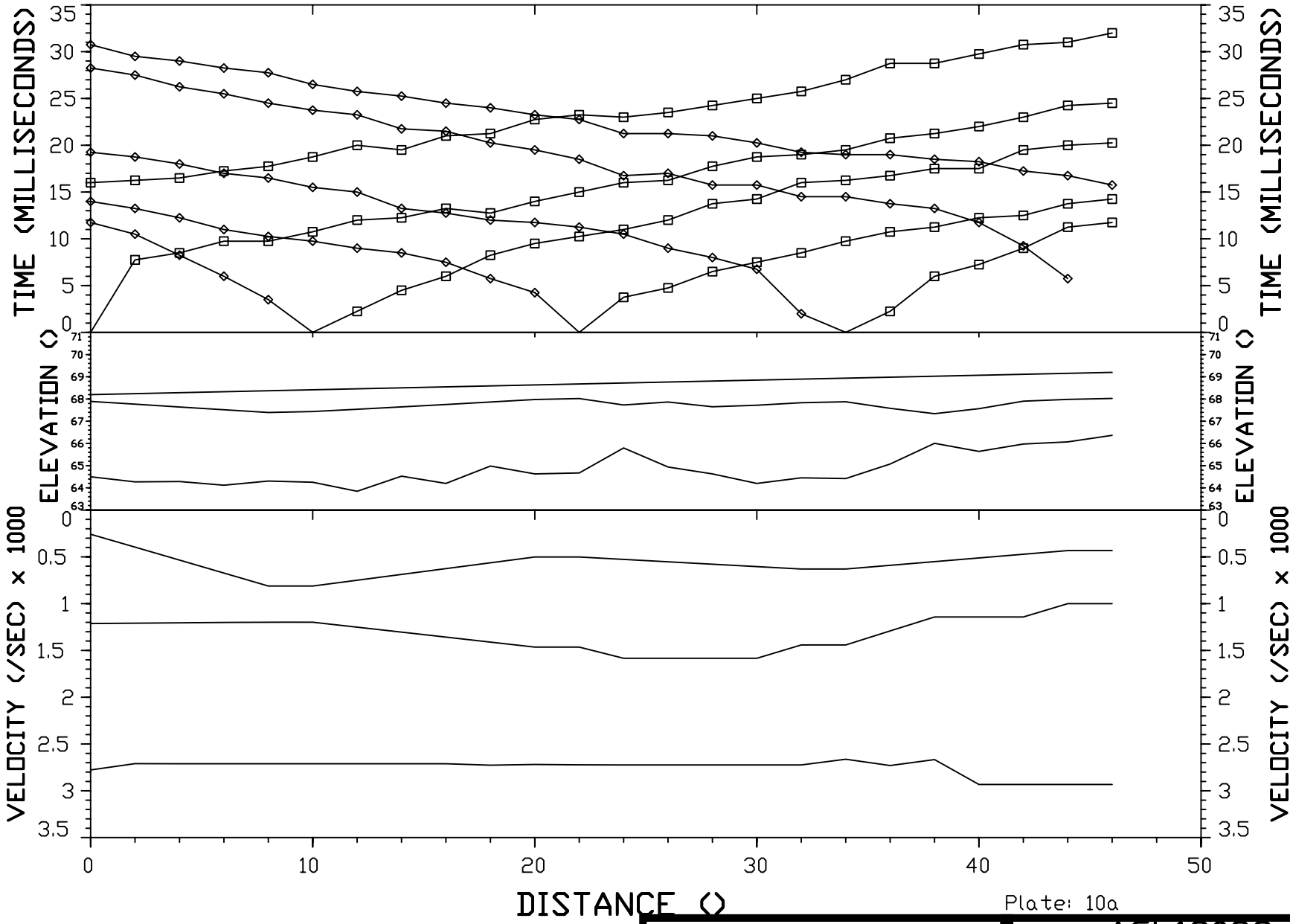


Plate: 10a

for: Byrne Looby Partners	AGL13093
by: Strata Geophysical, Inc.	Grange Castle Business Park
Data SetS10 / Date: May 2013	Dublin
Equipment: Geode / Spread: S10	Azimuth:

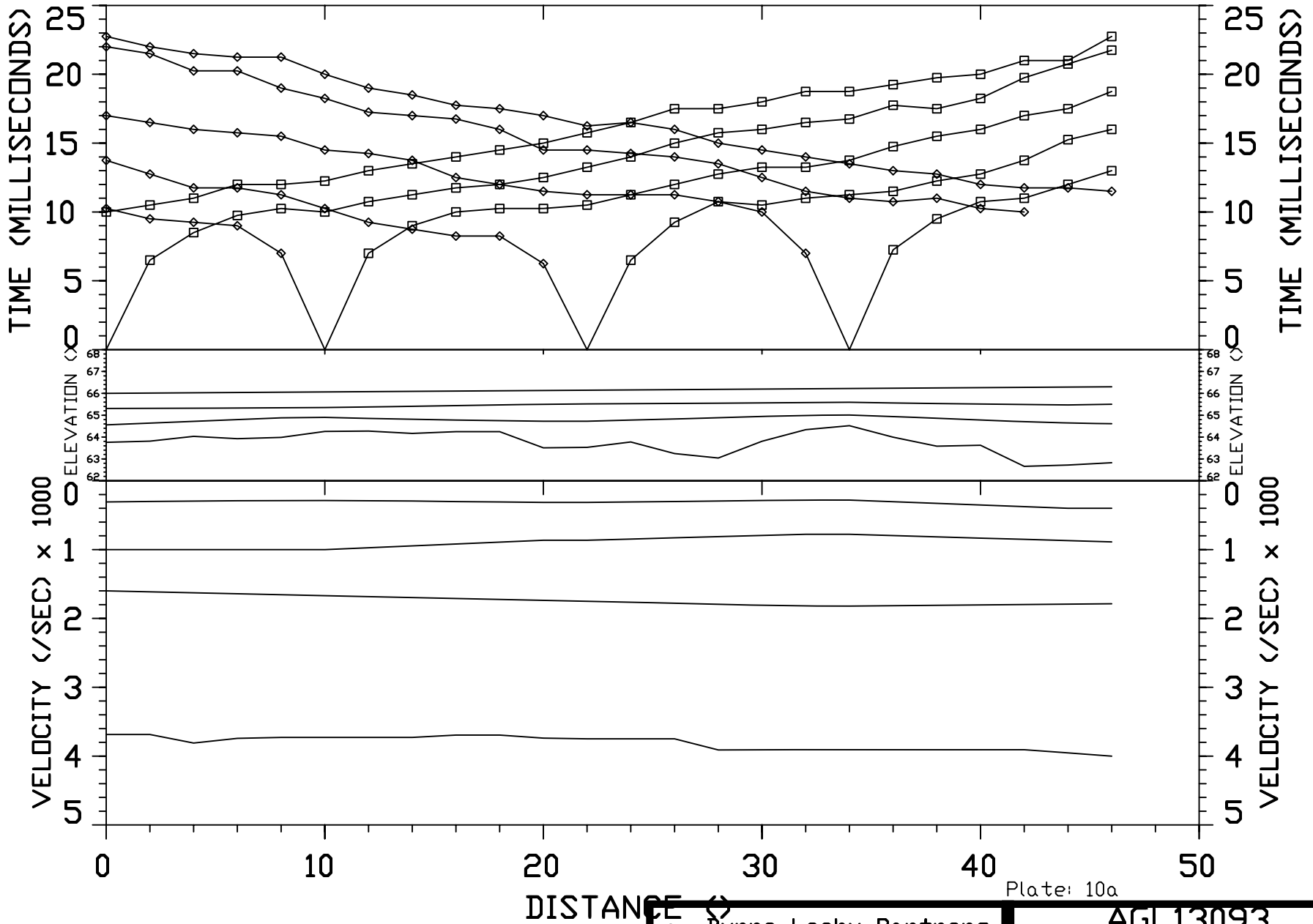


Plate: 10a

for: Byrne Looby Partners	AGL13093
by: Strata Geophysical, Inc.	Grange Castle Business Park
Data SetS11 / Date: May 2013	Dublin
Equipment: Geode / Spread: S11	Azimuth:

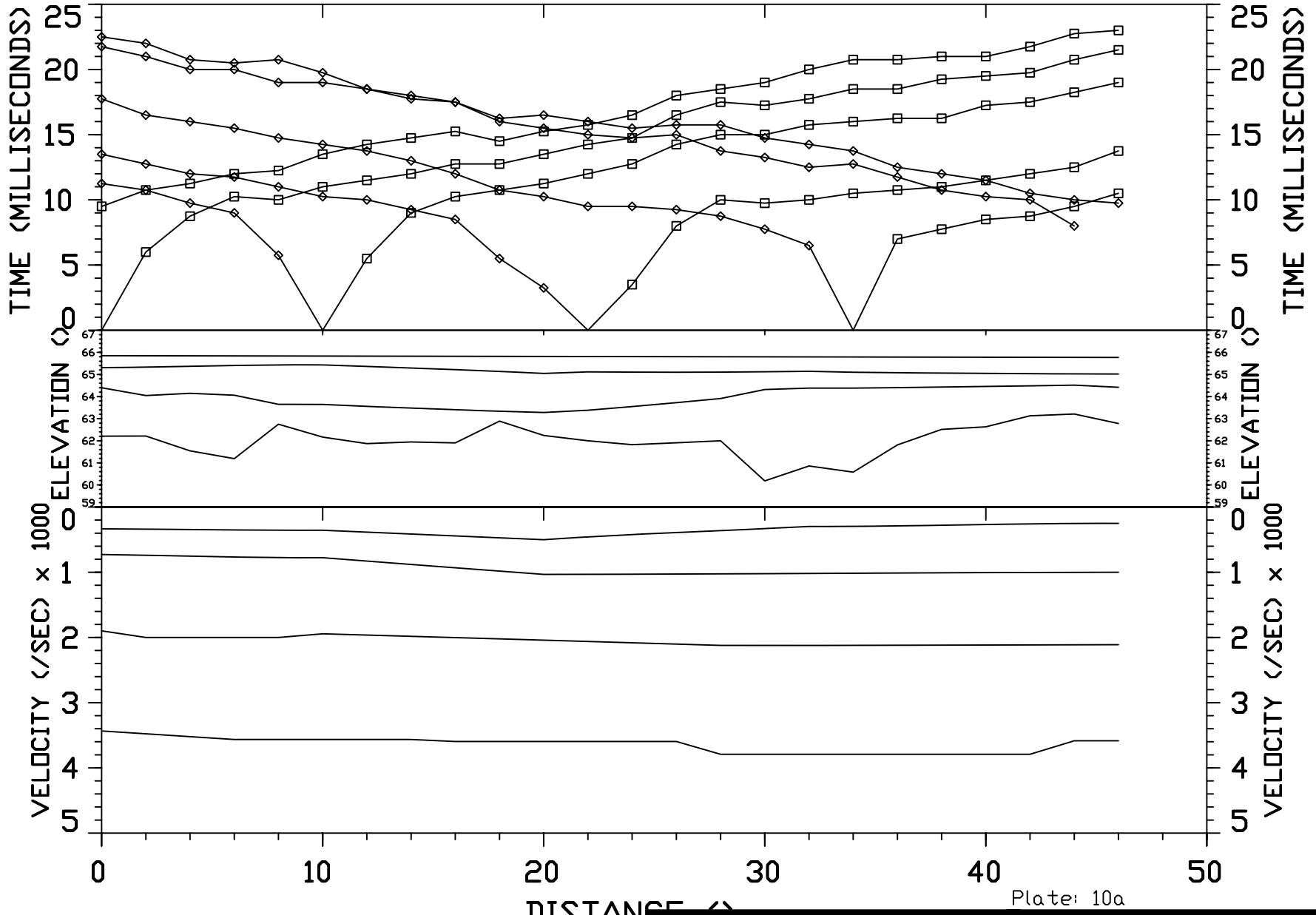


Plate: 10a

for: Byrne Looby Partners	AGL13093
by: Strata Geophysical, Inc.	Grange Castle Business Park Dublin
Data SetS12 / Date: May 2013	
Equipment: Geode / Spread: S12	Azimuth:

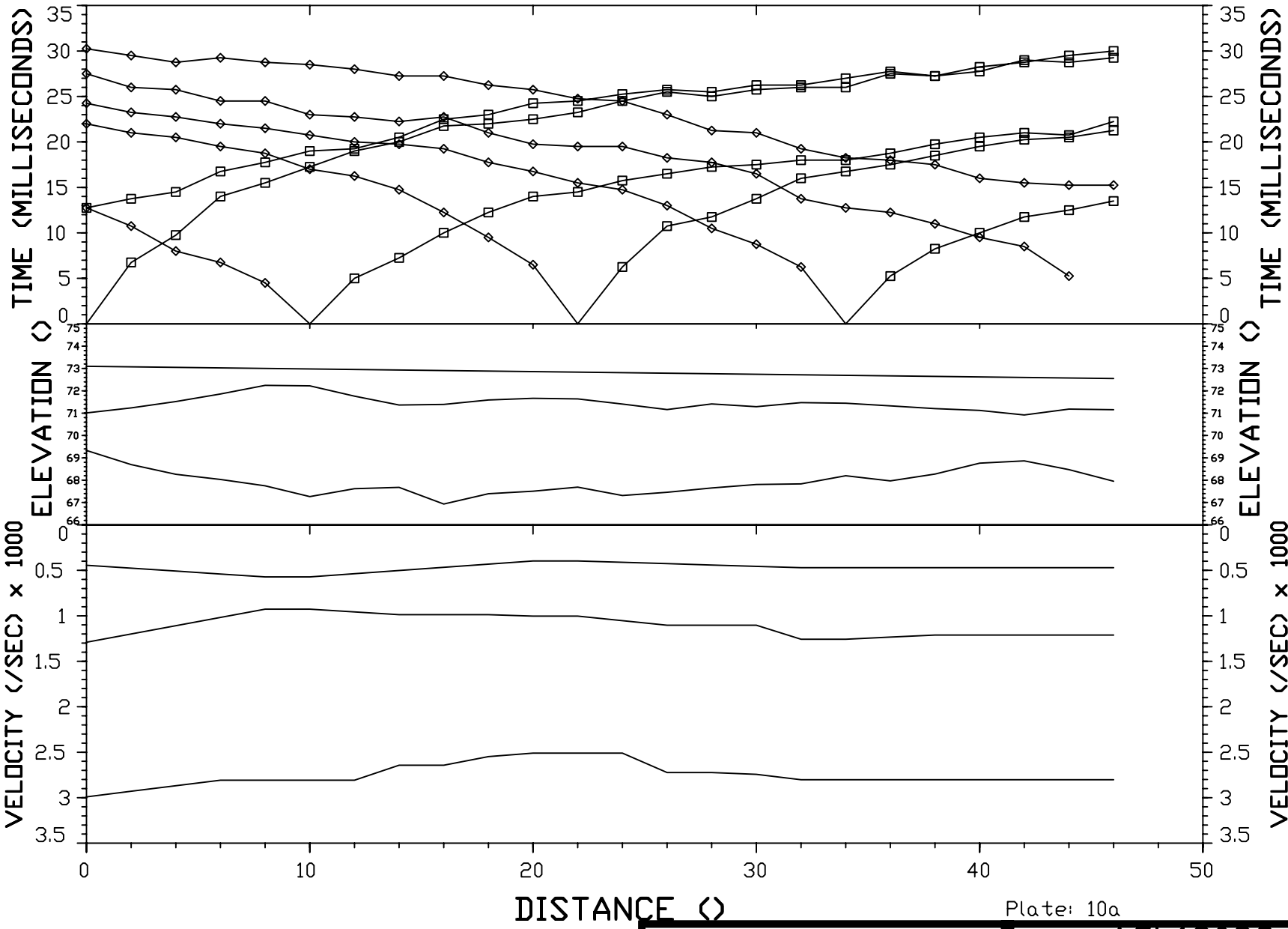


Plate: 10a

for: Byrne Looby Partners	AGL13093
by: Strata Geophysical, Inc.	Grange Castle Business Park
Data SetS15 / Date: May 2013	Dublin
Equipment: Geode / Spread: S15	Azimuth:

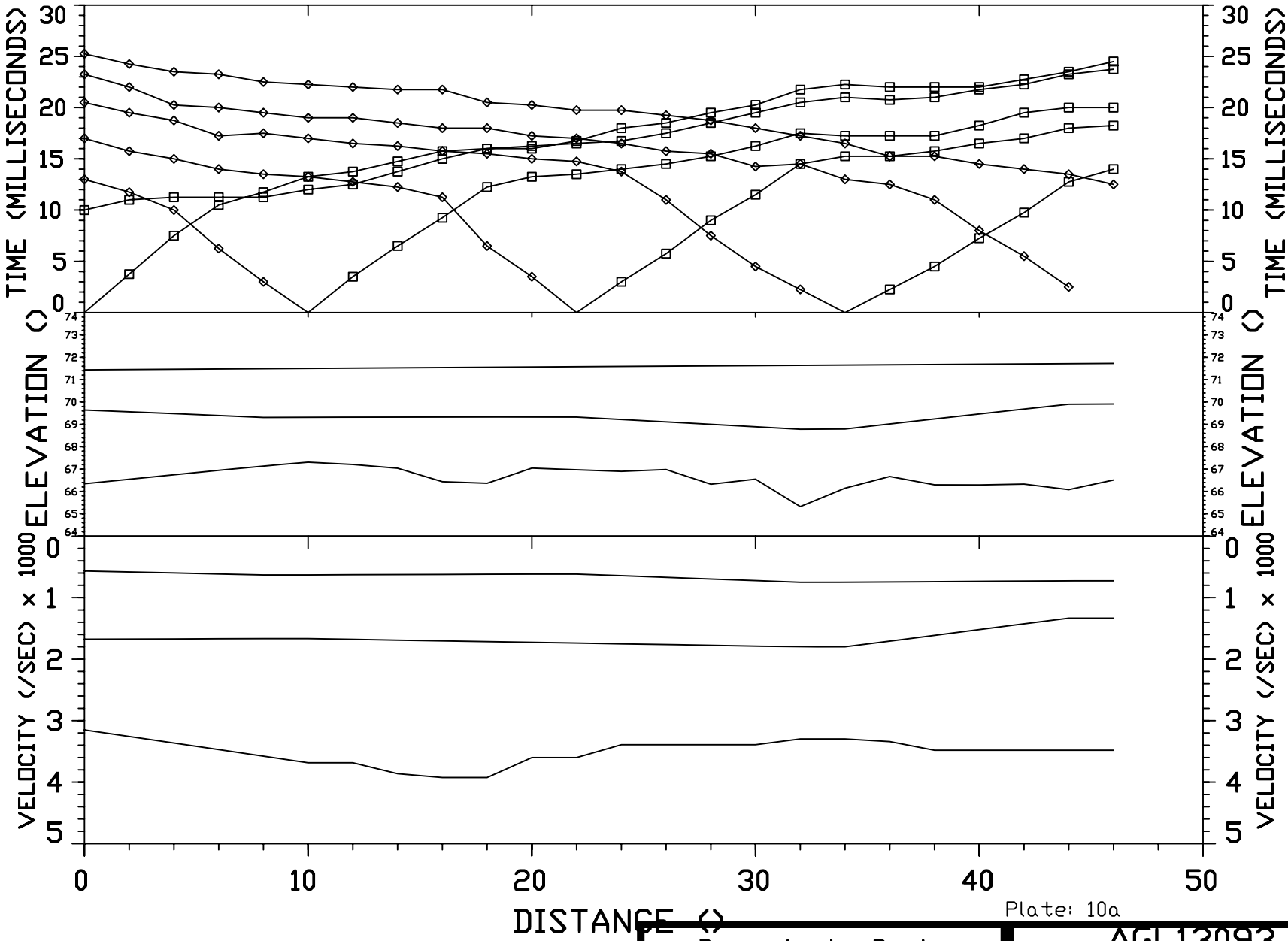


Plate: 10a

for: Byrne Looby Partners	AGL13093
by: Strata Geophysical, Inc.	Grange Castle Business Park
Data SetS17 / Date: May 2013	Dublin
Equipment: Geode / Spread: S17	Azimuth:

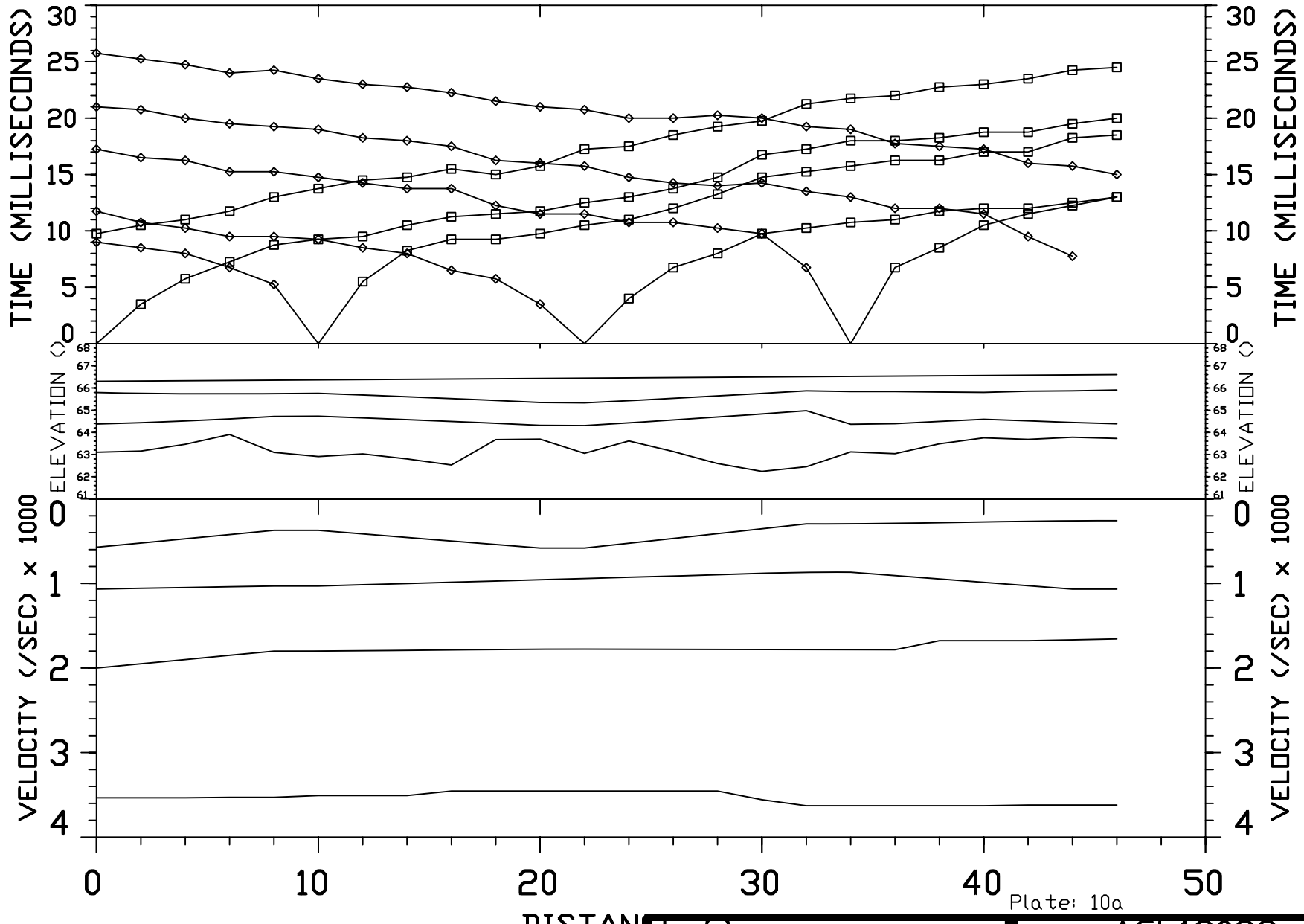


Plate: 10a

for: Byrne Looby Partners	AGL13093
by: Strata Geophysical, Inc.	Grange Castle Business Park
Data SetS19 / Date: May 2013	Dublin
Equipment: Geode / Spread: S19	Azimuth:

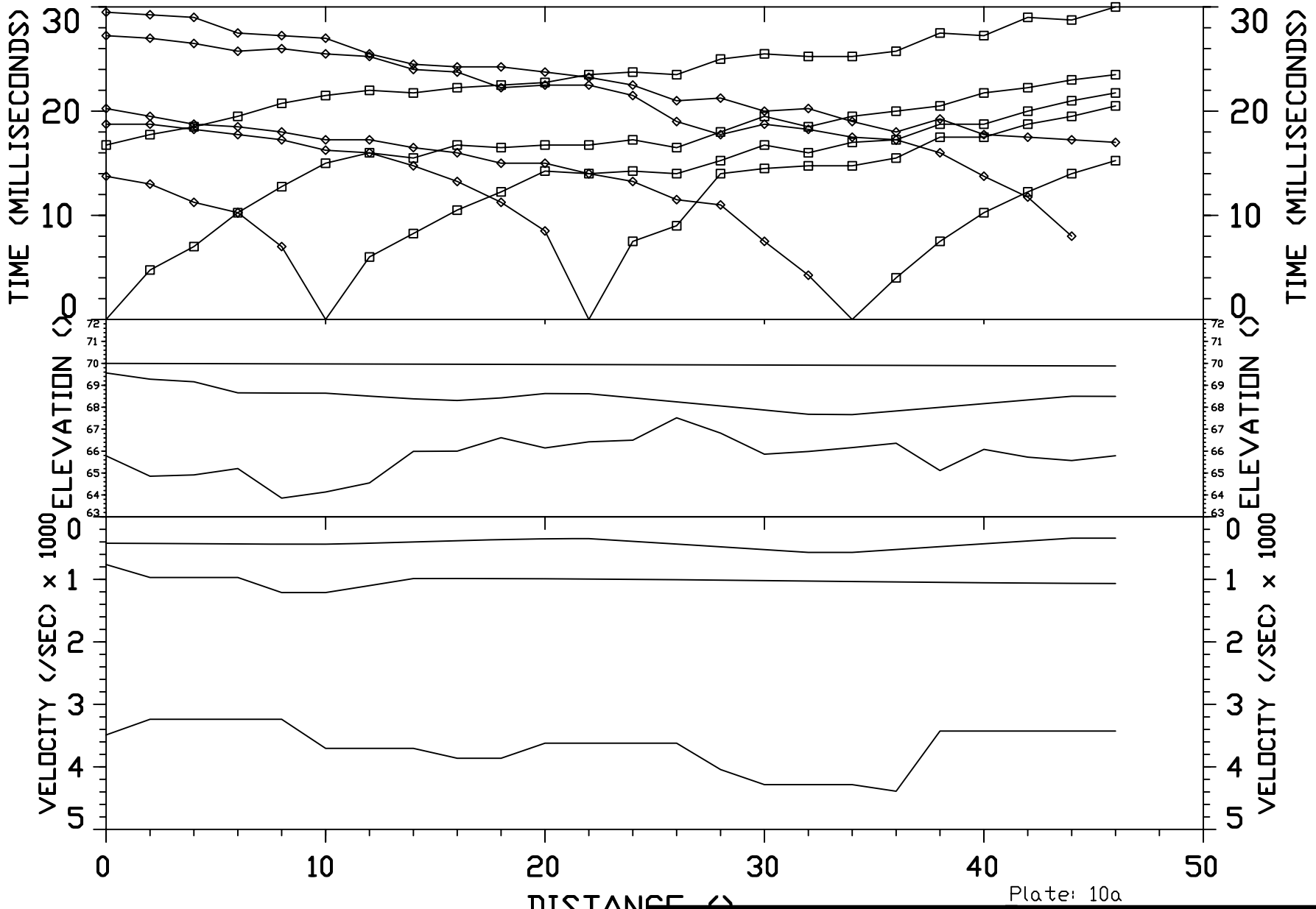


Plate: 10a

for: Byrne Looby Partners	AGL13093
by: Strata Geophysical, Inc.	Grange Castle Business Park
Data SetS22	Date: May 2013
Equipment: Geode	Spread: S22
	Dublin
	Azimuth: