



Fingal County Council

Comhairle Contae Fhine Gall



Fingal Landfill Project



VOLUME 5

Environmental Impact Statement

Supporting Documents

Geophysical Investigation



WASTE MANAGEMENT PLAN
Working for the Dublin Region

April 2006

RPS

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Final Report

(PRIVATE AND CONFIDENTIAL)

Fingal Landfill, Geophysical Investigation
(An integration of previous investigations and siting studies).

for

RPS MCOS

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FOREWORD

Geophysical surveying is an indirect, non-invasive process and involves interpretation of readings made at the ground surface in terms of likely subsurface conditions. This interpretation is based on the existing knowledge of ground conditions, typical geophysical responses of known materials and the experience of the author. **Direct investigations are recommended to confirm the findings of this report.** This report has been prepared by BMA GeoServices in line with best current practice and with all reasonable skill, care and diligence within the limitations imposed by the survey technique applied and the resources devoted to it by agreement with the client. The client should take the interpretative basis for any conclusions or opinions contained therein into account in any future use of this report.

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1. Introduction

This report integrates the three geophysical investigation carried out as part of the Fingal Landfill Site Investigation. These three surveys consisted of;

- (1) An initial survey carried out to help identify a suitable landfill site and reported on in 'Geophysical Survey on designated Sites A - D for Fingal Landfill Siting Study, Co. Dublin' April 2004.
- (2) A follow up survey and further geophysical investigations on two selected sites were carried out and reported on in 'Extended geophysical Survey on Designated Sites B & C for Fingal Landfill Siting Study, Co. Dublin' July 2004.
- (3) Following the selection of Site B further geophysical investigations were carried out and report on in 'Fingal Landfill Site B EIS, Geophysical Investigation'.

This report supersedes all previous geophysical reports. Previous geophysical data has been re-interpreted on the basis of the information from the previous and recent direct investigations.

Objectives

- To outline and investigate by non-destructive geophysical methods the suitability of the site as a potential location for a landfill.
- To help determine variations in overburden thickness and type.
- To help determine depth to bedrock, variation in bedrock type and rock quality.
- To help determine the presence of any faulting / change in lithology.

Methodology

- 2D-Resistivity profiling to estimate the overburden thickness and variation in rock type with depth and the presence of any faults in the bedrock.
- VLF Conductivity mapping to help identify the large north-south trending fault that is marked on the GSI geology map running close to the eastern part of the site (Map 1b).

For notation purposes, the first investigation is referred to as the 'initial (short)' survey with 2D resistivity profiles labelled 1, 2, 3 etc. The second investigation is referred to as the 'extended survey' with 2D resistivity profiles labelled 1Long, 2Long etc. The third investigation is referred to as the 'EIS survey' with 2D resistivity profiles labelled 1(EIS), 2(EIS) etc.

Report Outline

Section 2 outlines the geological setting and discusses combined geophysical and borehole data as well as the VLF survey carried out to the east of the site. A detailed account of the geophysical methods and equipment used and data processing is contained in Appendix D.

The 'initial survey' was undertaken between 2nd February and 11th March 2004. Weather conditions were generally good throughout the period of the survey. The 'extended geophysical survey' was carried out between 22nd June and 10th August 2004. Weather conditions were mostly dry and warm although a number of heavy showers were encountered. Ground surface conditions predominantly consisted of dry grass fields although some crop fields were also encountered. The 'EIS survey' was carried out between 2nd and 30th March 2005. Weather conditions were generally fine with some rain and generally light winds.

2. Geophysical Results

Site Description & Geological Setting (Site B)

Site B centred on the townlands of Nevitt and Tooman, encompasses an area of approximately 2,490,000 m² (249 ha) and is located approximately 7 km southwest of Skerries and 6 km southwest of Balbriggan. Elevation across site rises gradually from east to west from about 30 mOD to a high of 70 mOD. A third class road runs west to east, through the centre of the site. The new M1 motorway bounds the site on its eastern margin. The ground is typically grass and agricultural fields. A number of small streams run northwest - southeast through the site and one stream run north south close to the eastern boundary.

The geological map for the area 'Geology of Meath, 2001' indicates that the area is underlain by rocks from a number of different formations. To the south of the site 'Calp' limestone of the Lucan Formation are mapped. Moving northwards through the site the geology changes from calcarenites and calcisiltites of the Naul Formation to dark micrite and calcarenite shales of the Loughshinney Formation towards shale, sandstone and limestone of the Walshetown Formation and the Balrickard Formation. The GSI bedrock map shows a number of southwest-northeast trending faults to the north of the site and a north-south trending fault to the east of the site (Map 3)

The GSI six-inch field sheets for the area indicate there are a number of rock outcrops on and close to the site. An outcrop is located in the northern corner of the site. This outcrop is described as black shales with grit bands and is folded, dipping 40-50^o to the north and also dipping to the south. An outcrop of limestone is also marked on the GSI six-inch field sheet, located just to the west of the southwest corner of the site. The outcrop is located in an old quarry and is described as hard dark grey limestone in flags. The bedding is folded, dipping 50^o to the northwest and 30^o to the south.

The following section integrates the geophysical results with the available geological data. The interpretation is based on the available factual information, typical geophysical responses of known materials and the experience of the author. The interpreted 2D-Resistivity and seismic sections are shown at the end of this report.

Locations for the geophysical readings are shown on maps 1 and 2. Maps were provided by RPS MCOS.

2D Resistivity Data.

The geophysical survey comprised of 22 2D resistivity profiles at 155 m length in the 'initial survey'. This was followed by 13 resistivity profiles of 315 m length in the 'extended survey'. The two surveys generally showed a thick sequence of low resistivity (< 150 ohm-m) boulder clay overlying intermediate resistivity (100 - 300 ohm-m) gravelly clay / weathered rock or more shaley / clay rich bedrock. Intermediate to high resistivities (> 200 ohm-m) have been interpreted as indicating shale / limestone bedrock. The geophysical survey for the EIS involved 10 2D-resistivity profiles at up to 635 m length and 110 m deep. All the geophysical locations are shown on Map 1.

Combined Geophysical and Borehole Data.

Using a combination of the borehole data and the 2D-Resistivity and seismic data from the three investigations a contour map of minimum clay thickness (Map 2a) and depth to bedrock (Map 2b) has been produced.

The contour map shows an area of thick (> 24 m) clay overburden through the centre of the site. On either side of this area the clay overburden thins and is typically 5 - 20 m thick. Clay overburden is thinnest in the extreme northwest where outcrop is seen within the stream and to the southwest and southeast where clay thickness is less than 5 m.

Depth to bedrock follows a similar pattern with rock deepest in the centre of the site and shallowest in the northwest, southwest and southeast corners. Possible faults are interpreted on Profiles 1A (EIS), 3B(EIS), 5B(EIS) and 6(EIS) and should be investigated.

VLF Data (Site B)

A number of VLF profiles were carried out in the eastern part of the site and the area to the east of the site. The purpose of the VLF profiling was to try and locate the presence of the large marked (GSI Bedrock Map) fault that runs north-south along the eastern boundary of the site. The VLF survey was restricted by the M1 Motorway, which runs through the centre of the VLF survey. A total of 12 VLF lines were carried out, four lines to the west of the M1 and eight lines to the east.

A number of strong anomalies were recorded on lines 5 to 12 (except Line 8). The anomalies on lines 5, 6, 7, 9 and 10 highlight some north south linear feature. This feature could represent the large north south trending fault marked on the GSI Bedrock Map. The large VLF anomalies on lines 11 and 12 may represent the continuation of this linear feature. However, the fault

marked on the GSI map swings towards the west, away from lines 11 and 12. The anomalies on lines 11 and 12 could be highlighting an offshoot of the fault. At the eastern end of lines 3 and 4 there seems to be the beginnings of a VLF anomaly which coincides with the GSI fault. Smaller VLF anomalies are also interpreted. These anomalies may be highlighting smaller linear features in the sub-soil. Another possible explanation for the large anomalies in the VLF data to the east of the site is the presence of a gas pipeline or another such pipeline that runs through the area.

3. References

Campus Geophysical Instruments, 1997: User Manual for computer program RES2DINV, Birmingham, England.

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Interpex, 1997: GREMIX users manual. Golden, Co, USA.

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McConnell B., *et al.*, Geology of Meath: 2007. Geological Survey of Ireland.

Redpath, B.B., 1973: Seismic refraction exploration for engineering site investigations, NTIS, U.S. Dept. of Commerce.

Scintrex Ltd, 1997. ENVI Geophysics System Operations Manual

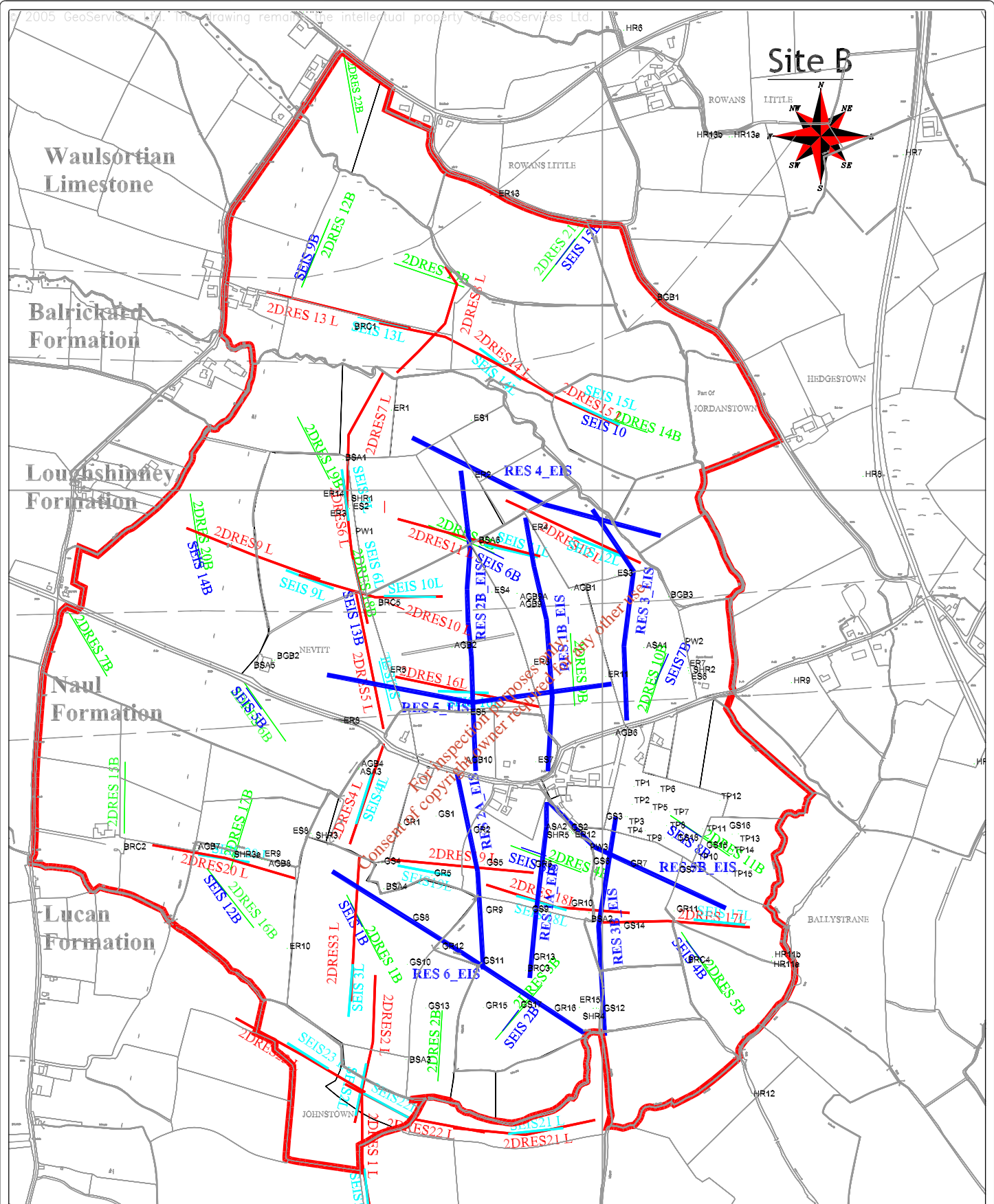
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Appendix A

Maps

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Legend

- Site Boundary
- 2D Resistivity Profile 2004
- EIS 2D Resistivity Profile
- 2D Resistivity Profile
- Seismic Spread
- Borehole
- Geological Formation

Drawn: Kevin Galvin
 Scale: 1 / 7,500 @ A3
 Date: Apr 2008
 Checked: Jim Hodgson
 Based On:

Title:
 MAP 1a
 LOCATION OF GEOPHYSICAL
 PROFILES

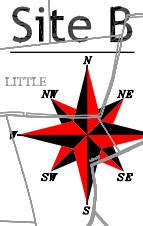
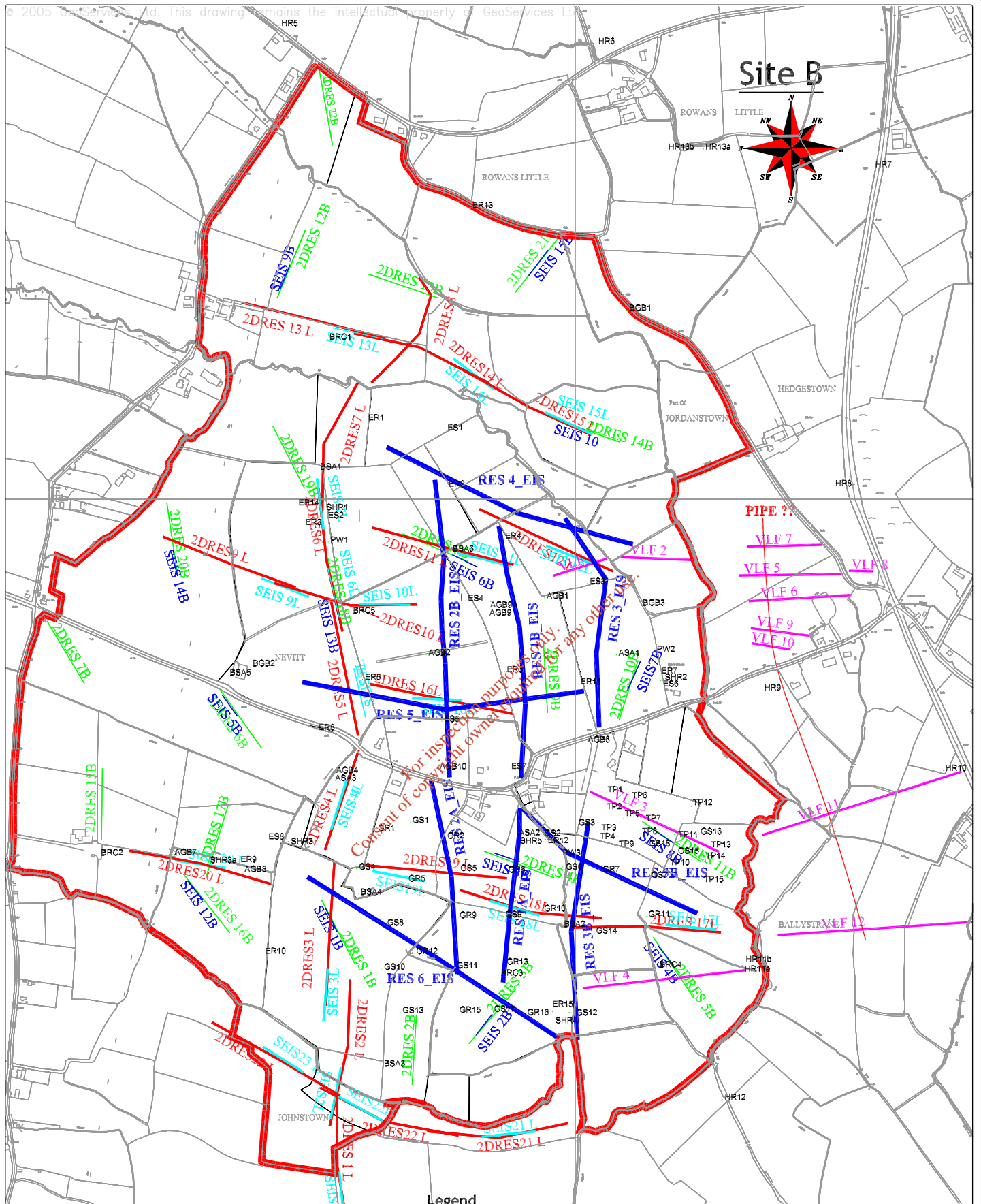
Job:
 DUBLIN LANDFILL SITING STUDY
 (SITE B)
 EIS SERIES GEOPHYSICS

Client:
 RPS MCOS

BMA GeoServices
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Legend

- Site Boundary
- 2D Resistivity Profile 2004
- EIS 2D Resistivity Profile
- 2D Resistivity Profile
- Seismic Spread
- VLF Profile
- Borehole

Drawn: Kevin Galvin
 Scale: 1 / 7,500 @ A3
 Date: Apr 2008
 Checked: Jim Hodgson
 Based On:

MAP 1b
 LOCATION OF GEOPHYSICAL &
 VLF PROFILES

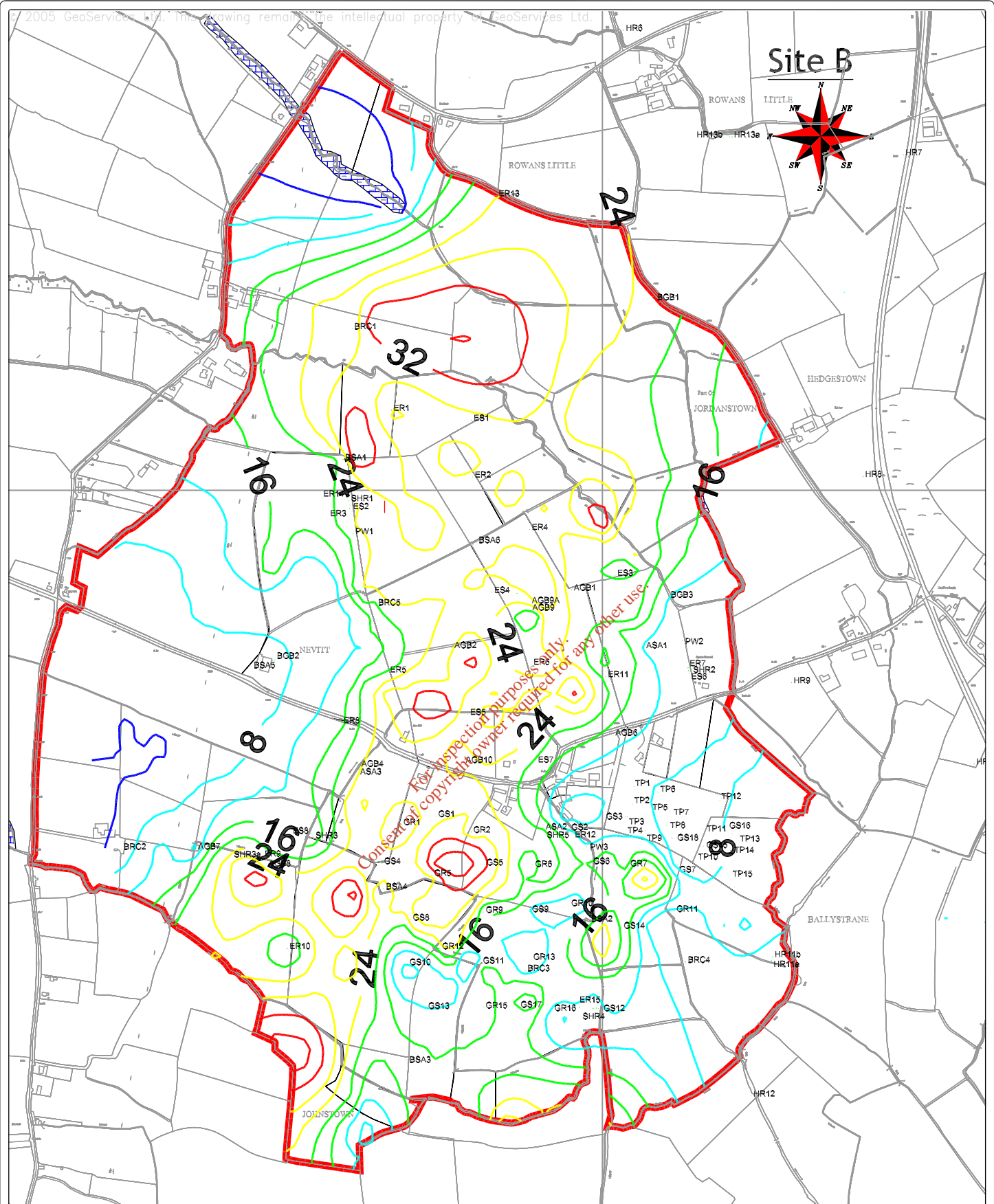
Job: DUBLIN LANDFILL SITING STUDY
 (SITE B)
 EIS SERIES GEOPHYSICS

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Legend

- Site Boundary
- <4 m Clay Thickness
- 8-12 m Clay Thickness
- 16-20 m Clay Thickness
- 24-28 m Clay Thickness
- >32 m Clay Thickness
- BOREHOLE
- Rock Outcrop (GSI 6")

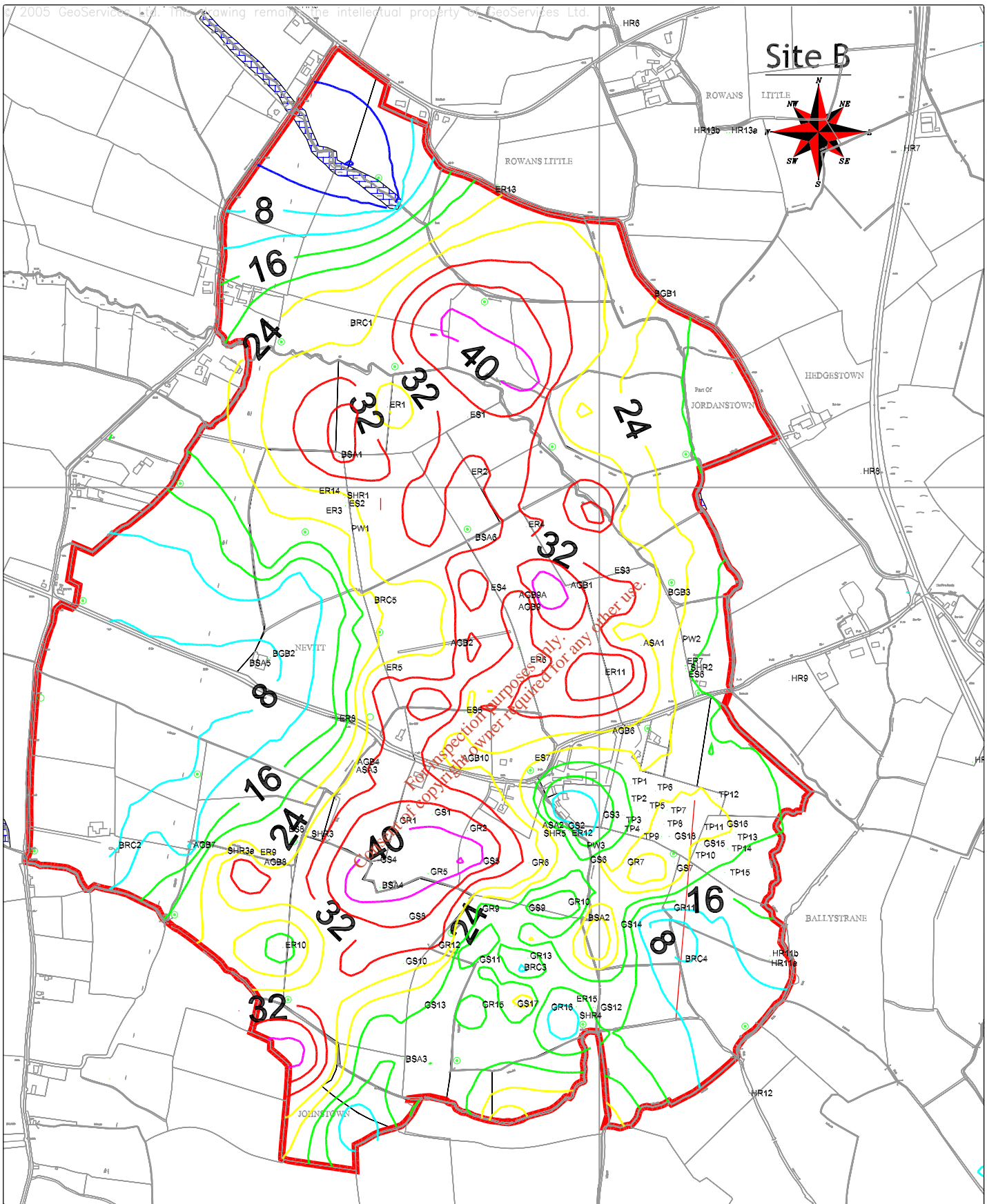
Drawn: Kevin Galvin
 Scale: 1 / 7,500 @ A3
 Date: Apr 2008
 Checked: Jim Hodgson
 Based On:

MAP 2a
 MINIMUM CLAY THICKNESS
 CONTOUR MAP

Job: DUBLIN LANDFILL SITING STUDY
 (SITE B)
 EIS SERIES GEOPHYSICS

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Legend

- Site Boundary
- <4 m Clay Thickness
- 8-12 m Clay Thickness
- 16-20 m Clay Thickness
- 24-28 m Clay Thickness
- 32 - 36 m Clay Thickness
- >36 m Clay Thickness
- BOREHOLE
- Rock Outcrop (GSI 6")

Drawn: Kevin Galvin Scale: 1 / 7,500 @ A3 Date: Apr 2008 Checked: Jim Hodgson Based On:	MAP 2b DEPTH TO BEDROCK CONTOUR MAP	Job: DUBLIN LANDFILL SITING STUDY (SITE B) EIS SERIES GEOPHYSICS	Client: RPS MCOS	<div style="text-align: center;"> </div> BMA GeoServices Ground Engineering Consultants <small>Comhairleoirí Cré-Ionaidéiríochta</small> BMA, Strawhall Business Park, Athy Road, Carlow, Ireland. Phone: 353-59-9134488 Mobile: 087-2477923 Fax: 353-59-9134490 E-mail: bmacarlow@bma.ie
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Appendix B Interpreted Resistivity Sections – SHORT 2004

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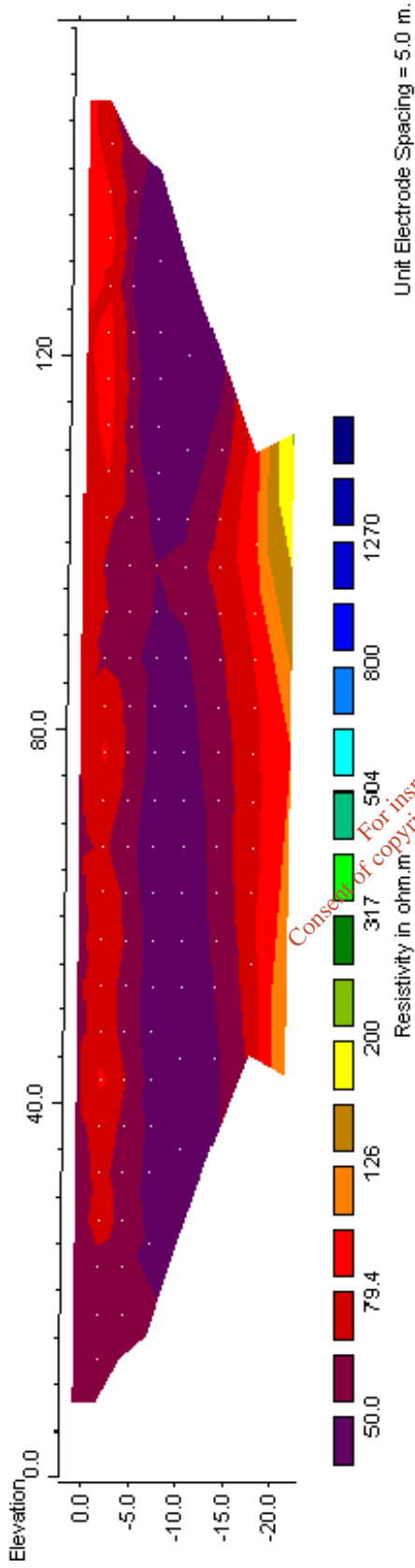
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2D-Resistivity Profile 1 (Site B)

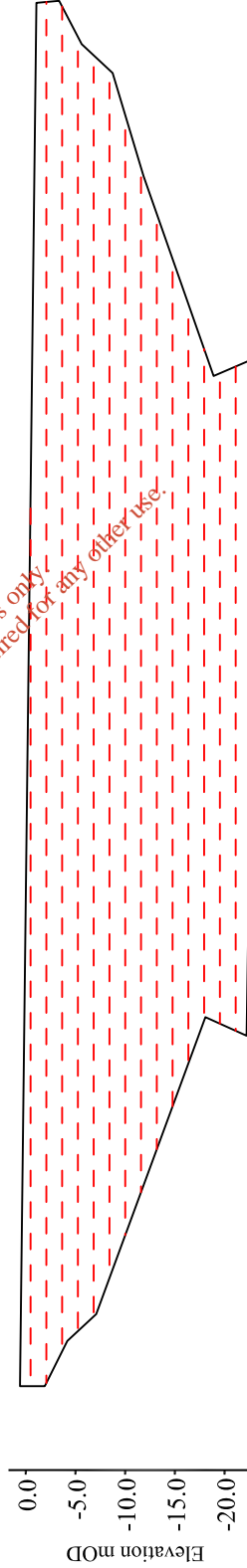
317465 E
256654 N

317536 E
256518 N

Modelled Data



Vertical exaggeration in model section display = 1.0



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Notes

Drawn	Kevin Galvin
Scale	1 / 750
Date	Mar 2004
Checked	Janes Hodgson
Based On	

Title
SECTION 1
INTERPRETATION
2D-RESISTIVITY PROFILE 1

Job
FINGAL LANDFILL SITING
STUDY
(SITE B)

Client
RPSMCS

Dwg No: 1492B/R1

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BMA,
Strawhall Business Park,
Athy Road,
Carlow,
Ireland.

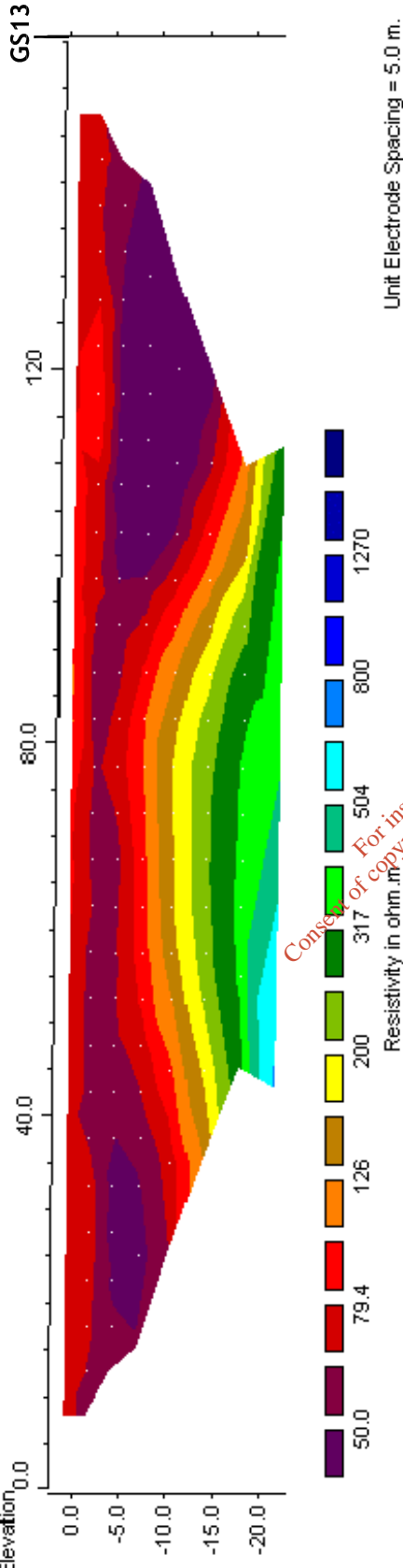
Phone: 353-59-9134488
Mobile: 087-8165810
Fax: 353-59-9134490
E-mail: kgalvin@bma.ie

2D-Resistivity Profile 2 (Site B)

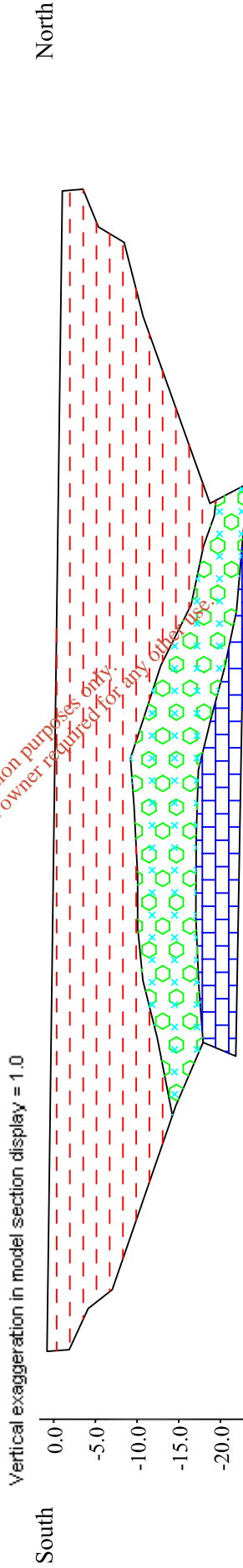
317656 E
256264 N

317665 E
256411 N
Elevation mOD
Elevation 0.0

Modelled Data



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- Boulder Clay
- Saturated Gravel / Weathered Rock
- Limestone / Shale

Notes:	Drawn: Kevin Galvin	Title:	Client:	Drg No: 1492B/R2
	Scale: 1 / 750	SECTION 2 INTERPRETATION 2D-RESISTIVITY PROFILE 2	FINGAL LANDFILL SITING STUDY (SITE B)	RPSMCOS
	Date: Mar 2004			
	Checked: James Hodgson			
	Based On:			

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Athy Road,
Carlow,
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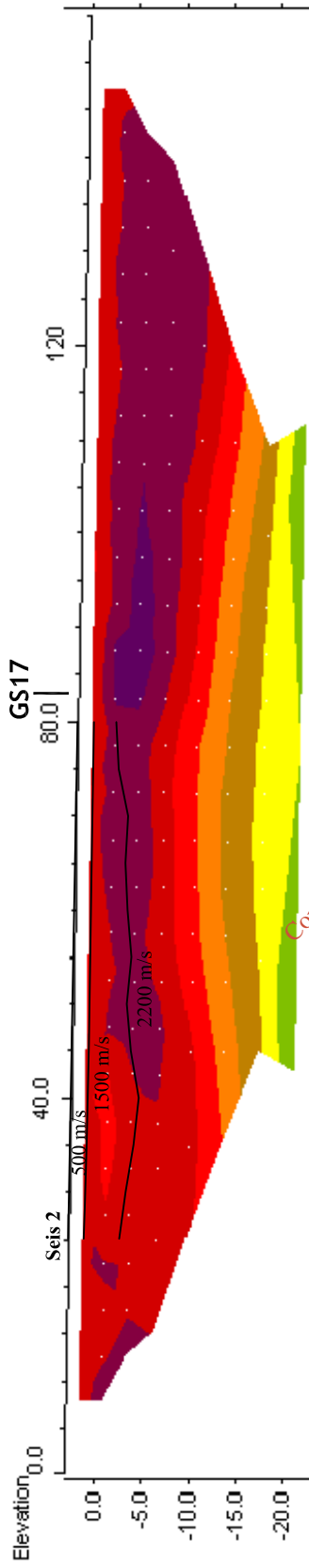
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Mobile: 087-8165810
Fax: 353-59-9134490
E-mail: kgalvin@bma.ie

2D-Resistivity Profile 3 (Site B)

317776 E
256351 N

317874 E
256465 N

Modelled Data

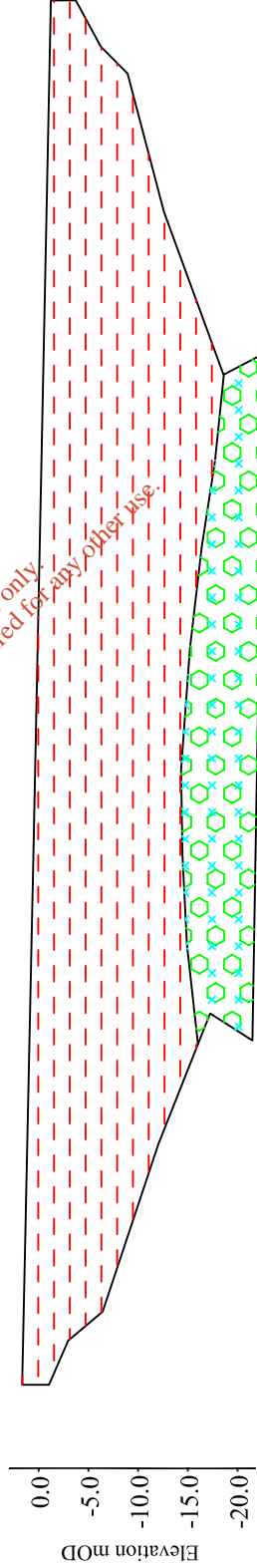


Unit Electrode Spacing = 5.0 m.

Southwest

Northeast

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Boulder Clay

Saturated Gravel / Weathered Bedrock

Notes:

Drawn	Kevin Galvin
Scaler	1 / 750
Date	Mar 2004
Checked	James Hodgson
Based On	

Title:
**SECTION 3
INTERPRETATION
2D-RESISTIVITY PROFILE 3**

Job:
**FINGAL LANDFILL SITING
STUDY
(SITE B)**

Client:
RPSMCS

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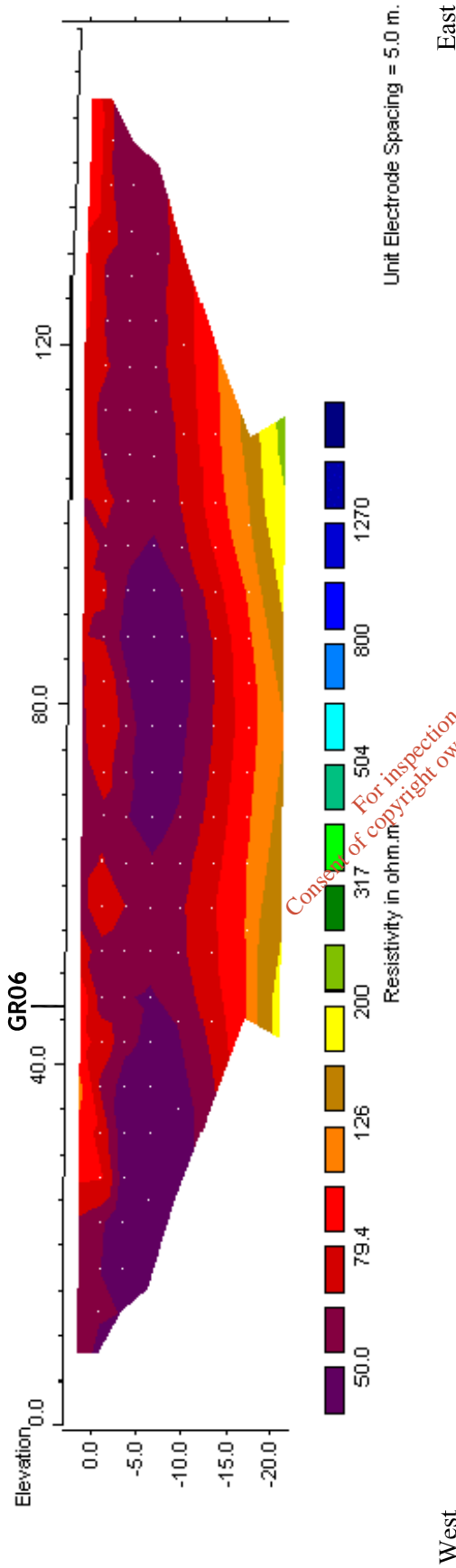
Dwg No: 1492/B/R3

2D-Resistivity Profile 4 (Site B)

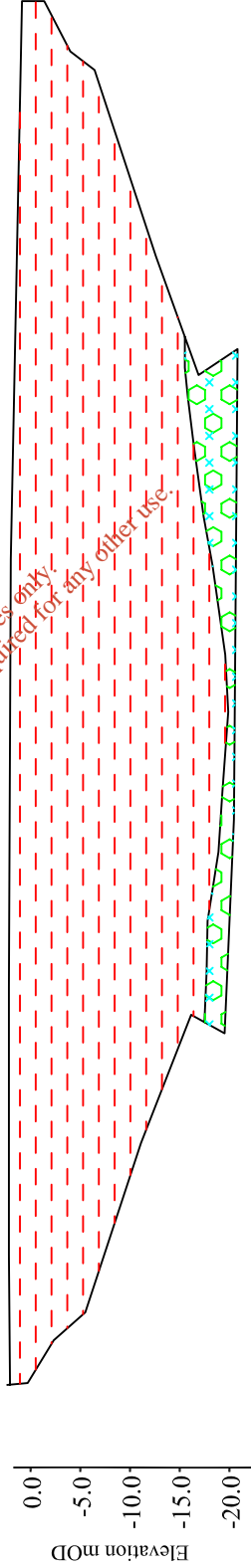
317808 E
256757 N

317956 E
256701 N

Modelled Data



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 Saturated Gravel / Weathered Rock
 Boulder Clay

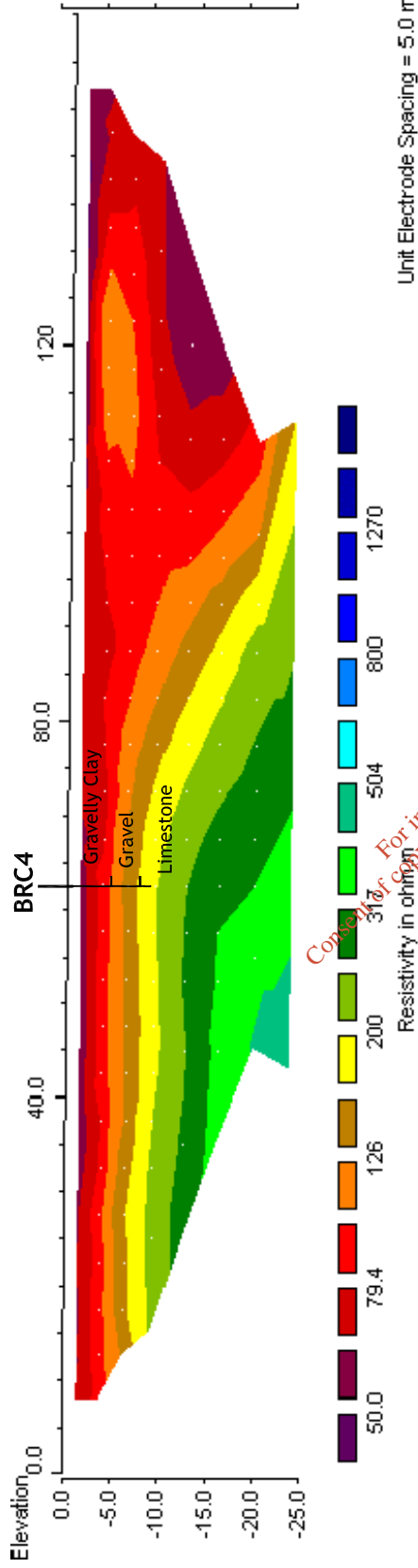
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	Date: Mar 2004	2D-RESISTIVITY PROFILE 4	STUDY		
	Checked: James Hodgson		(SITE B)		
	Based On:				
		Drg No: 1492B/R4		 BMA GeoServices Ground Engineering Consultants Comhairleoir Cré-Innealtóireachta BMA, Strawhall Business Park, Athy Road, Carlow, Ireland.	
				Phone: 353-59-9134488 Mobile: 087-8165810 Fax: 353-59-9134490 E-mail: kgalvin@bma.ie	

2D-Resistivity Profile 5 (Site B)

318251 E
256447 N

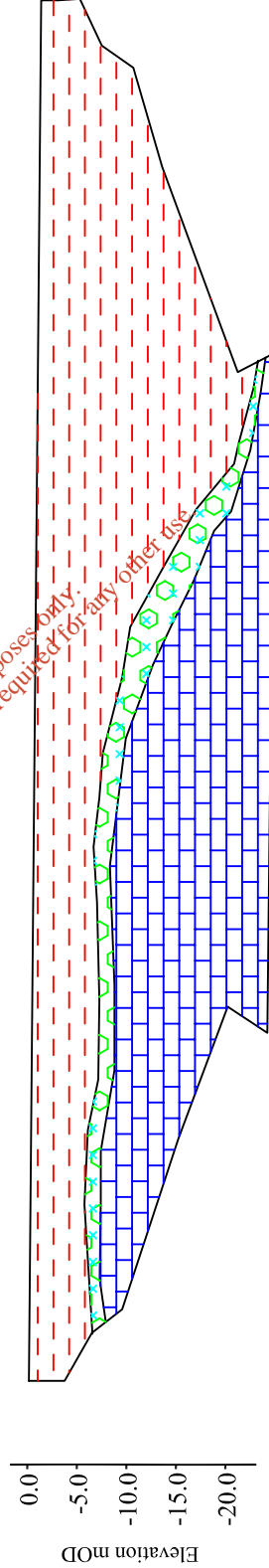
318165 E
256576 N

Modelled Data



Northwest

Southeast



-  Boulder Clay
-  Saturated Gravel / Weathered Rock
-  Limestone / Shale

Notes

Drawn	Kevin Galvin
Scale	1 / 750
Date	Mar 2004
Checked	Janes Hodgson
Based On	

Title
SECTION 5
INTERPRETATION
2D-RESISTIVITY PROFILE 5

Job
FINGAL LANDFILL SITING
STUDY
(SITE B)

Client
RPSMOS

Dwg No: 1492/B/R5

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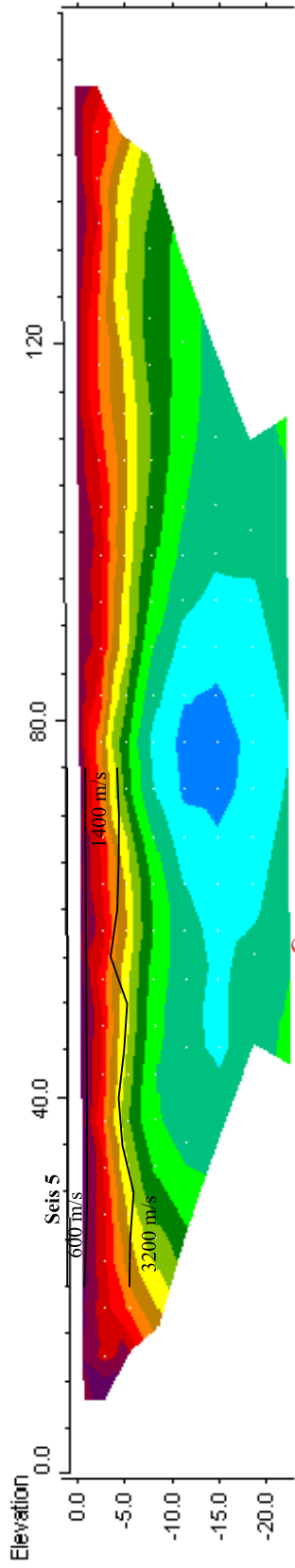
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2D-Resistivity Profile 6 (Site B)

317338 E
256975 N

317250 E
257099 N

Modelled Data

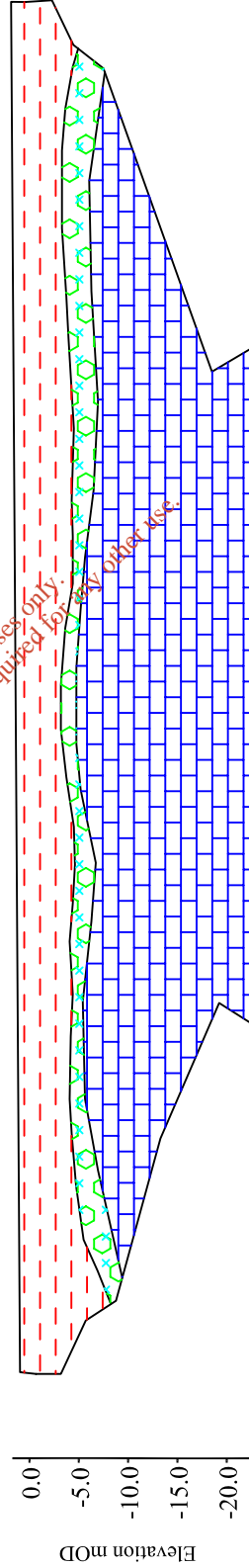


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Unit Electrode Spacing = 5.0 m.

Southeast

Northwest



- Boulder Clay
- Saturated Gravel / Weathered Rock
- Limestone / Shale

Notes

Drawn	Kevin Galvin
Scale	1 / 750
Date	Mar 2004
Checked	Jane Hodgson
Based On	

Title
**SECTION 6
INTERPRETATION
2D-RESISTIVITY PROFILE 6**

Job
**FINGAL LANDFILL SITING
STUDY
(SITE B)**

Client
RPSM/COS

Dwg No: 1492/B/R6

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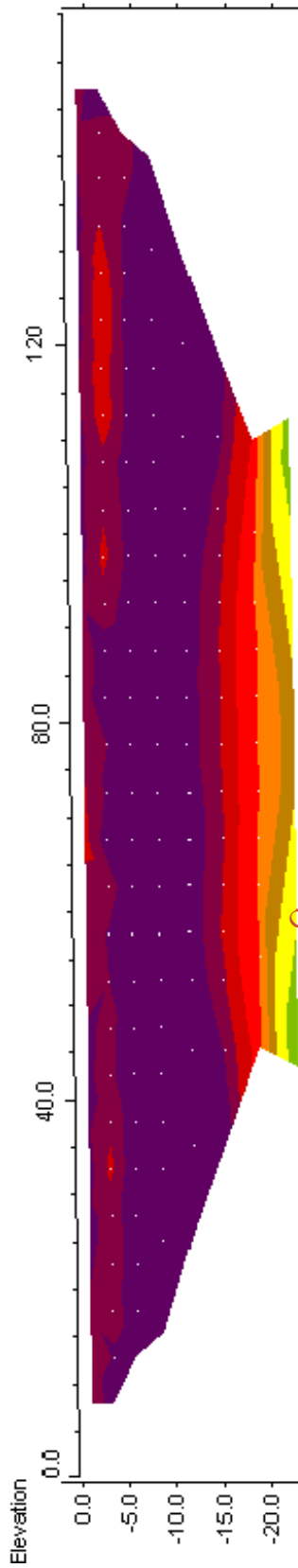
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E-mail: kgalvin@bma.ie

2D-Resistivity Profile 7 (Site B)

316964E
257111 N

316885 E
257243 N

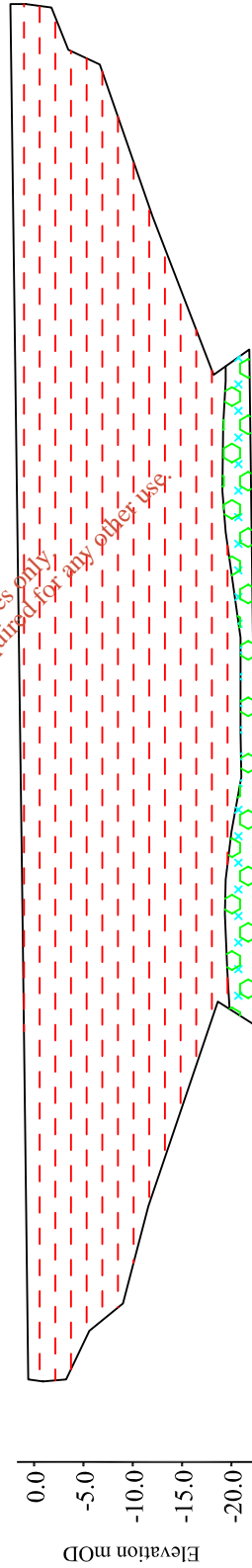
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Southeast

Northwest



Boulder Clay



Saturated Gravel / Weathered Rock

Notes

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Scale	1 / 750
Date	Mar 2004
Checked	Jones Hodgson
Based On	

Title
SECTION 7
INTERPRETATION
2D-RESISTIVITY PROFILE 7

Job
FINGAL LANDFILL SITING
STUDY
(SITE B)

Client
RPSMCO

Dwg No: 1492/B/R7

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Ground Engineering Consultants
Comhairleoir Cré-Innealtóireachta

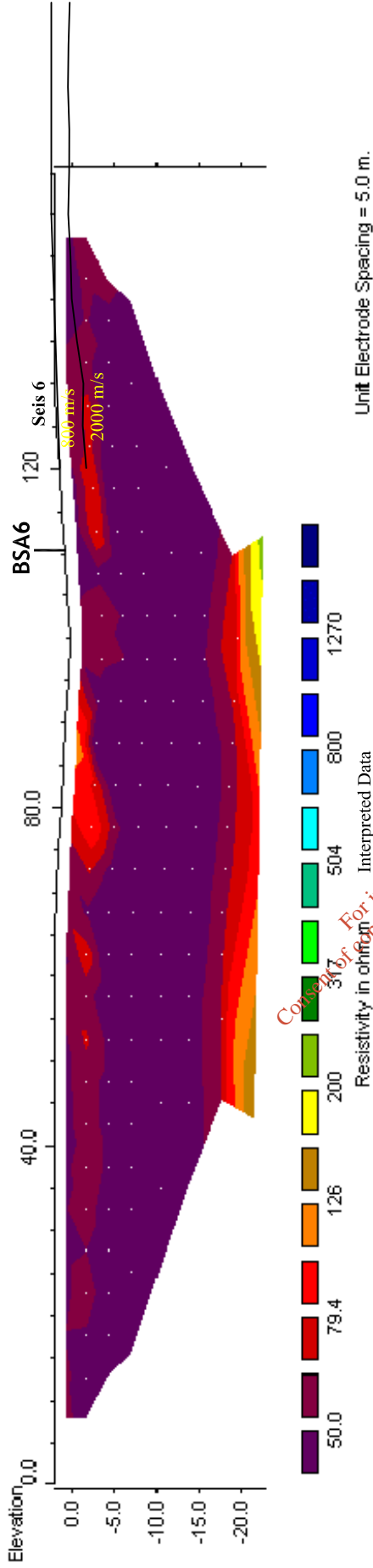
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2D-Resistivity Profile 8 (Site B)

317636 E
257427 N

317774 E
257369 N

Modelled Data



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-  Saturated Gravel / Weathered Rock
-  Boulder Clay
-  Seis 6

Drawn: Kevin Galvin
Scale: 1 / 750
Date: Mar 2004
Checked: James Hodgson
Based On:

Title:
SECTION 8
INTERPRETATION
2D-RESISTIVITY PROFILE 8

Job:
FINGAL LANDFILL SITING
STUDY
(SITE B)

Client:
RPSMCS

Drg No: 1492B/R8

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Athy Road,
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Ireland.

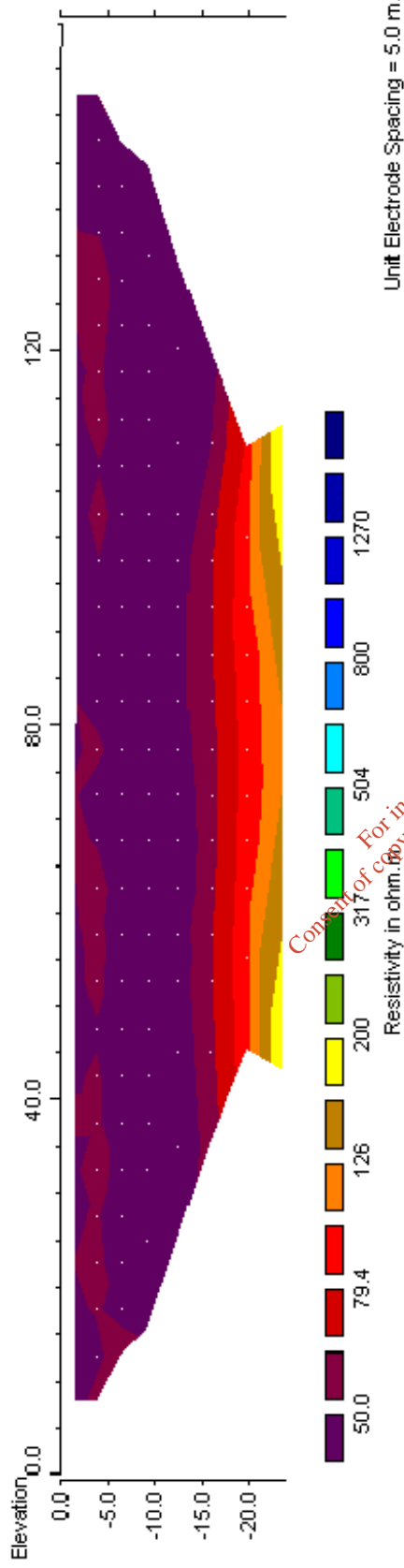
Phone: 353-59-913488
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E-mail: kgalvin@bma.ie

2D-Resistivity Profile 9 (Site B)

317942 E
257049 N

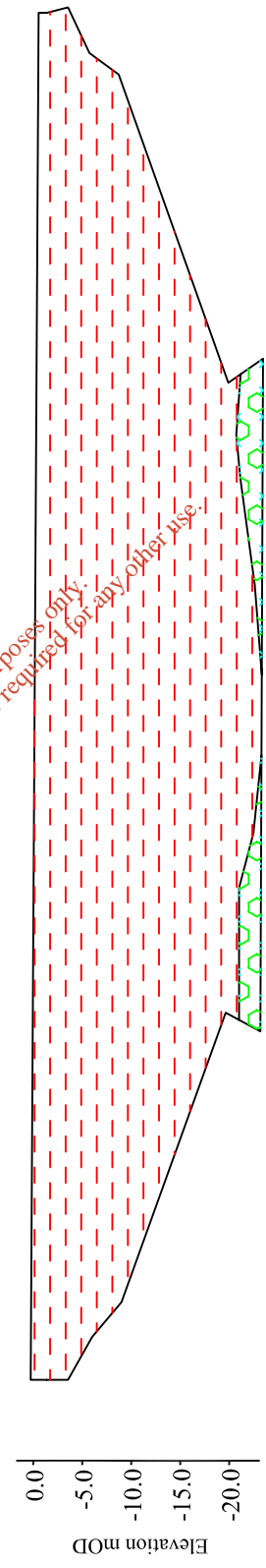
317933 E
257201 N

Modelled Data



South

North



-  Boulder Clay
-  Saturated Gravel / Weathered Rock

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For inspection purposes only.

Notes: None	Drawn: Kevin Galvin	Title:	SECTION 9	Job:	FINGAL LANDFILL SITING	Client:	RPSMOS
	Scale: 1 / 750	INTERPRETATION	STUDY		STUDY		
	Date: Mar 2004	2D-RESISTIVITY PROFILE 9					
	Checked: James Hodgson						
	Based On:						
							Drg No: 1492B/R9
						 BMA GeoServices Ground Engineering Consultants Comhairleoiri Cré-Innealtóireachta BMA, Strawhall Business Park, Athy Road, Carlow, Ireland. Phone: 353-59-9134488 Mobile: 087-8165810 Fax: 353-59-9134490 E-mail: kgalvin@bma.ie	

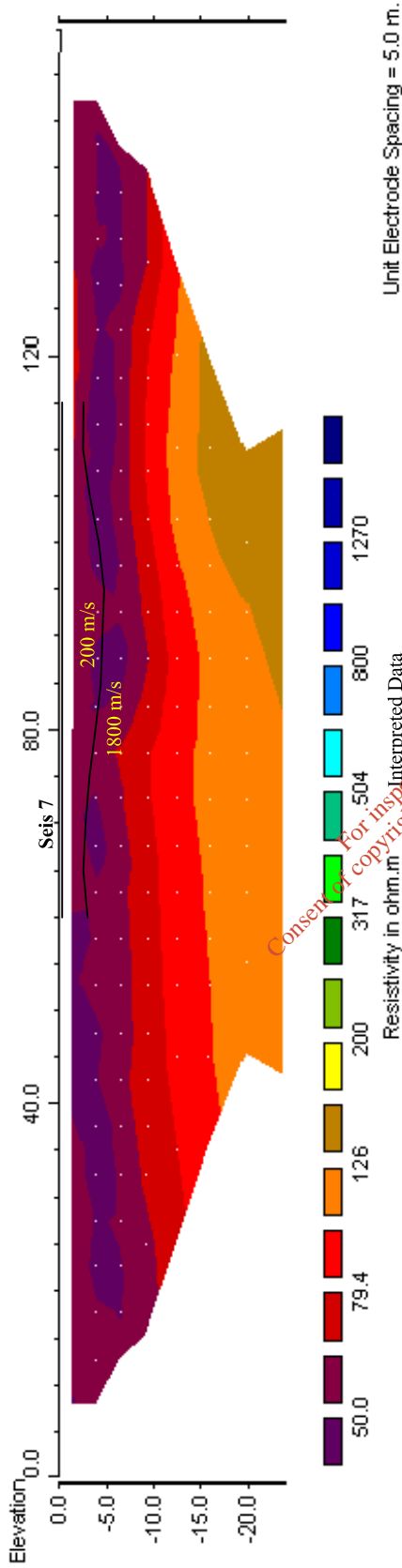
2D-Resistivity Profile 10 (Site B)

318093 E
257034 N

318133 E
257160 N

Modelled Data

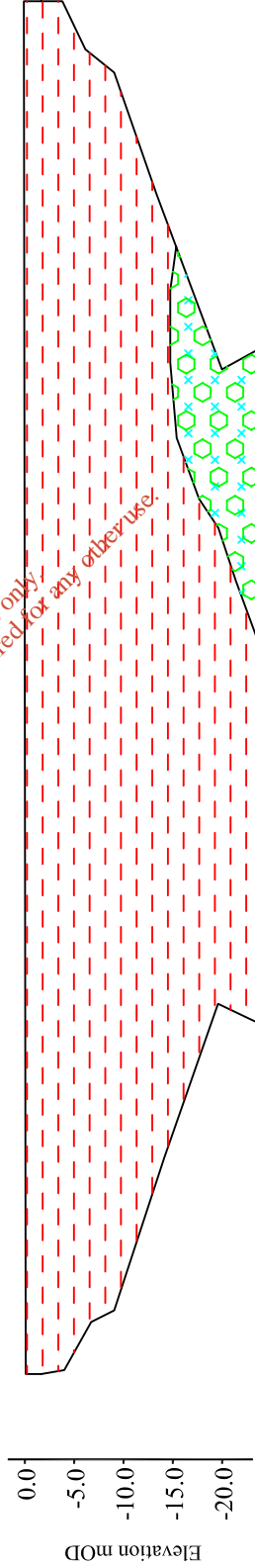
ASA1



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Southwest

Northeast



Notes:

Drawn: Kevin Galvin
Scale: 1 / 750
Date: Mar 2004
Checked: James Hodgson
Based On:

Title:
SECTION 10
INTERPRETATION
2D-RESISTIVITY PROFILE 10

Job:
FINGAL LANDFILL SITING
STUDY
(SITE B)

Client:
RPSMOS

Page No: 1492/R10

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