Chemtest
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Results - Water

Project: P19188 Howth

Client: Priority Geotechnical Ltd					Chemtest Job No.:	20-12149	20-12149	20-12149	20-12149
Quotation No.: Q20-19850					Chemtest Sample ID.:	1003879	1003880	1003881	1003882
					Client Sample ID.:	P5	P6	P7	P8
					Sample Location:	MGM14	MGM14	MGM14	MGM14
					Sample Type:	WATER	WATER	WATER	WATER
					Date Sampled:	13-Mar-2020	20-Mar-2020	09-Apr-2020	07-May-2020
Determinand	**Accred.**	**SOP**	**Units**	**LOD**					
Chloride	U	1220	mg/l	1.0		[B] 63	[B] 110	[B] 120	120
Sulphate	U	1220	mg/l	1.0		[B] 20	[B] 23	[B] 14	8.2
Calcium	U	1415	mg/l	5.0		[B] 63	[B] 43	[B] 81	82
Sodium	U	1415	mg/l	0.50		[B] 21	[B] 48	[B] 94	93
Arsenic (Dissolved)	U	1450	µg/l	1.0		[B] < 1.0	[B] < 1.0	[B] < 1.0	< 1.0
Cadmium (Dissolved)	U	1450	µg/l	0.080		[B] < 0.080	[B] < 0.080	[B] < 0.080	< 0.080
Chromium (Dissolved)	U	1450	µg/l	1.0		[B] 1.0	[B] 1.2	[B] 2.0	1.5
Copper (Dissolved)	U	1450	µg/l	1.0		[B] 8.3	[B] 6.9	[B] 2.1	1.6
Mercury (Dissolved)	U	1450	µg/l	0.50		[B] 5.5	[B] 2.3	[B] 0.93	< 0.50
Nickel (Dissolved)	U	1450	µg/l	1.0		[B] 5.2	[B] 6.4	[B] 3.5	2.2
Lead (Dissolved)	U	1450	µg/l	1.0		[B] < 1.0	[B] < 1.0	[B] < 1.0	< 1.0
Selenium (Dissolved)	U	1450	µg/l	1.0		[B] 4.4	[B] 4.5	[B] 4.8	4.8
Tin (Dissolved)	U	1450	µg/l	1.0		[B] < 1.0	[B] < 1.0	[B] < 1.0	< 1.0
Vanadium (Dissolved)	U	1450	µg/l	1.0		[B] 4.0	[B] 3.8	[B] 4.0	2.8
Zinc (Dissolved)	U	1450	µg/l	1.0		[B] 6.3	[B] 5.3	[B] 6.7	7.1
Dibutyl Tin	N	1730	µg/l	0.050		< 0.050	< 0.050	< 0.050	< 0.050
Tributyl Tin	N	1730	µg/l	0.0500		< 0.050	< 0.050	< 0.050	< 0.050

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Deviations

In accordance with UKAS Policy on Deviating Samples TPS 63, Chemtest have a procedure to ensure 'upon receipt of each sample a competent laboratory shall assess whether the sample is suitable with regard to the requested test(s)'. This policy and the respective holding times applied, can be supplied upon request. The reason a sample is declared as deviating is detailed below. Where applicable the analysis remains UKAS/MCERTs accredited but the results may be compromised.

Sample:	Sample Ref:	Sample ID:	Sample Location:	Sampled Date:	Deviation Code(s):	Containers Received:
1003879		P5	MGM14	13-Mar-2020	B	Plastic Tub 500g
1003880		P6	MGM14	20-Mar-2020	B	Plastic Tub 500g
1003881		P7	MGM14	09-Apr-2020	B	Plastic Bottle 1000ml

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Test Methods

SOP	Title	Parameters included	Method summary
1220	Anions, Alkalinity & Ammonium in Waters	Fluoride; Chloride; Nitrite; Nitrate; Total Oxidisable Nitrogen (TON); Sulfate; Phosphate; Alkalinity; Ammonium	Automated colorimetric analysis using 'Aquakem 600' Discrete Analyser.
1415	Cations in Waters by ICP-MS	Sodium; Potassium; Calcium; Magnesium	Direct determination by inductively coupled plasma - mass spectrometry (ICP-MS).
1450	Metals in Waters by ICP-MS	Metals, including: Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Tin; Vanadium; Zinc	Filtration of samples followed by direct determination by inductively coupled plasma mass spectrometry (ICP-MS).
1730	Organo-Leads	Organo-Leads	Solvent extraction / GCMS detection

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Report Information

Key

U	UKAS accredited
M	MCERTS and UKAS accredited
N	Unaccredited
S	This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
SN	This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
T	This analysis has been subcontracted to an unaccredited laboratory
I/S	Insufficient Sample
U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"

Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
Uncertainty of measurement for the determinands tested are available upon request
None of the results in this report have been recovery corrected
All results are expressed on a dry weight basis
The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols
For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at the indicated laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

A - Date of sampling not supplied
B - Sample age exceeds stability time (sampling to extraction)
C - Sample not received in appropriate containers
D - Broken Container
E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

All soil samples will be retained for a period of 45 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:
customerservices@chemtest.com

Chemtest
The right chemistry to deliver results
Chemtest Ltd.
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

UKAS TESTING
2183

Final Report

Report No.:	20-09327-1		
Initial Date of Issue:	30-Mar-2020		
Client	Priority Geotechnical Ltd		
Client Address:	Unit 12 Owenacurra Business Park Midleton County Cork Ireland		
Contact(s):	Colette Kelly		
Project	P19188 Howth		
Quotation No.:	Q20-19850	**Date Received:**	25-Mar-2020
Order No.:	12451	**Date Instructed:**	25-Mar-2020
No. of Samples:	4		
Turnaround (Wkdays):	7	**Results Due:**	02-Apr-2020
Date Approved:	30-Mar-2020		
Approved By:			
Details:	Glynn Harvey, Technical Manager		

Chemtest
The right chemistry to deliver results

Results - Water

Project: P19188 Howth

Client: Priority Geotechnical Ltd				Chemtest Job No.:	20-09327	20-09327	20-09327	20-09327
Quotation No.: Q20-19850				Chemtest Sample ID.:	991411	991412	991413	991414
				Client Sample ID:	P1	P2	P3	P4
				Sample Location:	MGM28	MGM28	MGM28	MGM28
				Sample Type:	WATER	WATER	WATER	WATER
				Date Sampled:	19-Mar-2020	20-Mar-2020	22-Mar-2020	23-Mar-2020
Determinand	**Accred.**	**SOP**	**Units**	**LOD**				
Chloride	U	1220	mg/l	1.0	140	120	220	23
Sulphate	U	1220	mg/l	1.0	1.4	< 1.0	3.8	< 1.0
Calcium	U	1415	mg/l	5.0	62	68	82	48
Sodium	U	1415	mg/l	0.50	110	92	190	18
Arsenic (Dissolved)	U	1450	µg/l	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Cadmium (Dissolved)	U	1450	µg/l	0.080	< 0.080	< 0.080	< 0.080	< 0.080
Chromium (Dissolved)	U	1450	µg/l	1.0	< 1.0	1.2	1.8	< 1.0
Copper (Dissolved)	U	1450	µg/l	1.0	< 1.0	1.3	3.1	1.1
Mercury (Dissolved)	U	1450	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50
Nickel (Dissolved)	U	1450	µg/l	1.0	1.2	2.1	2.2	< 1.0
Lead (Dissolved)	U	1450	µg/l	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Selenium (Dissolved)	U	1450	µg/l	1.0	2.9	3.1	6.4	1.3
Tin (Dissolved)	U	1450	µg/l	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Vanadium (Dissolved)	U	1450	µg/l	1.0	1.6	2.3	3.4	< 1.0
Zinc (Dissolved)	U	1450	µg/l	1.0	1.7	11	5.5	3.3
Dibutyl Tin	N	1730	µg/l	0.050	< 0.050	< 0.050	< 0.050	< 0.050
Tributyl Tin	N	1730	µg/l	0.0500	< 0.050	< 0.050	< 0.050	< 0.050

Chemtest
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Test Methods

SOP	Title	Parameters included	Method summary
1220	Anions, Alkalinity & Ammonium in Waters	Fluoride; Chloride; Nitrite; Nitrate; Total Oxidisable Nitrogen (TON); Sulfate; Phosphate; Alkalinity; Ammonium	Automated colorimetric analysis using 'Aquakem 600' Discrete Analyser.
1415	Cations in Waters by ICP-MS	Sodium; Potassium; Calcium; Magnesium	Direct determination by inductively coupled plasma - mass spectrometry (ICP-MS).
1450	Metals in Waters by ICP-MS	Metals, including: Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Tin; Vanadium; Zinc	Filtration of samples followed by direct determination by inductively coupled plasma mass spectrometry (ICP-MS).
1730	Organo-Leads	Organo-Leads	Solvent extraction / GCMS detection

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06-07-2021F 21A/0368
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Report Information

Key

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M	MCERTS and UKAS accredited
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I/S	Insufficient Sample
U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
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All results are expressed on a dry weight basis
The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols
For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at the indicated laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

A - Date of sampling not supplied
B - Sample age exceeds stability time (sampling to extraction)
C - Sample not received in appropriate containers
D - Broken Container
E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

All soil samples will be retained for a period of 45 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:
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Chemtest Ltd.
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CB8 0AL
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Email: info@chemtest.com

UKAS TESTING
2183

Final Report

Report No.:	20-07859-1		
Initial Date of Issue:	17-Mar-2020		
Client	Priority Geotechnical Ltd		
Client Address:	Unit 12 Owenacurra Business Park Midleton County Cork Ireland		
Contact(s):	Colette Kelly		
Project	P19188 Howth		
Quotation No.:	Q20-19850	**Date Received:**	11-Mar-2020
Order No.:	12451	**Date Instructed:**	12-Mar-2020
No. of Samples:	4		
Turnaround (Wkdays):	7	**Results Due:**	20-Mar-2020
Date Approved:	17-Mar-2020		
Approved By:			
Details:	Darrell Hall, Director		

Chemtest
The right chemistry to deliver results

Results - Water

Project: P19188 Howth

Client: Priority Geotechnical Ltd				Chemtest Job No.:	20-07859	20-07859	20-07859	20-07859
Quotation No.: Q20-19850				Chemtest Sample ID.:	984330	984331	984332	984333
				Client Sample ID.:	P1	P2	P3	P4
				Sample Location:	MGM14	MGM14	MGM14	MGM14
				Sample Type:	WATER	WATER	WATER	WATER
				Date Sampled:	05-Mar-2020	06-Mar-2020	07-Mar-2020	09-Mar-2020
Determinand	**Accred.**	**SOP**	**Units**	**LOD**				
Chloride	U	1220	mg/l	1.0	290	270	350	110
Sulphate	U	1220	mg/l	1.0	6.7	5.5	9.5	1.2
Calcium	U	1415	mg/l	5.0	< 5.0	< 5.0	< 5.0	77
Sodium	U	1415	mg/l	0.50	230	220	260	87
Arsenic (Dissolved)	U	1450	µg/l	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Cadmium (Dissolved)	U	1450	µg/l	0.080	< 0.080	< 0.080	< 0.080	< 0.080
Chromium (Dissolved)	U	1450	µg/l	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Copper (Dissolved)	U	1450	µg/l	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Mercury (Dissolved)	U	1450	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50
Nickel (Dissolved)	U	1450	µg/l	1.0	1.7	1.8	2.8	< 1.0
Lead (Dissolved)	U	1450	µg/l	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Selenium (Dissolved)	U	1450	µg/l	1.0	3.5	5.8	8.0	3.7
Tin (Dissolved)	U	1450	µg/l	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Vanadium (Dissolved)	U	1450	µg/l	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Zinc (Dissolved)	U	1450	µg/l	1.0	13	23	39	15
Dibutyl Tin	N	1730	µg/l	0.050	< 0.050	< 0.050	< 0.050	< 0.050
Tributyl Tin	N	1730	µg/l	0.0500	< 0.050	< 0.050	< 0.050	< 0.050

Chemtest
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Test Methods

SOP	Title	Parameters included	Method summary
1220	Anions, Alkalinity & Ammonium in Waters	Fluoride; Chloride; Nitrite; Nitrate; Total; Oxidisable Nitrogen (TON); Sulfate; Phosphate; Alkalinity; Ammonium	Automated colorimetric analysis using 'Aquakem 600' Discrete Analyser.
1415	Cations in Waters by ICP-MS	Sodium; Potassium; Calcium; Magnesium	Direct determination by inductively coupled plasma - mass spectrometry (ICP-MS).
1450	Metals in Waters by ICP-MS	Metals, including: Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Tin; Vanadium; Zinc	Filtration of samples followed by direct determination by inductively coupled plasma mass spectrometry (ICP-MS).
1730	Organo-Leads	Organo-Leads	Solvent extraction / GCMS detection

Chemtest
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U/S	Unsuitable Sample
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<	"less than"
>	"greater than"

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For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at the indicated laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

A - Date of sampling not supplied
B - Sample age exceeds stability time (sampling to extraction)
C - Sample not received in appropriate containers
D - Broken Container
E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

All soil samples will be retained for a period of 45 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:
customerservices@chemtest.com

eurofins
Chemtest
Eurofins Chemtest Ltd
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

UKAS TESTING 2183

Final Report

Report No.:	20-19232-1		
Initial Date of Issue:	31-Jul-2020		
Client	Priority Geotechnical Ltd		
Client Address:	Unit 12 Owenacurra Business Park Midleton County Cork Ireland		
Contact(s):	Colette Kelly		
Project	P19188 Howth		
Quotation No.:	Q20-19850	**Date Received:**	24-Jul-2020
Order No.:	12451	**Date Instructed:**	24-Jul-2020
No. of Samples:	2		
Turnaround (Wkdays):	7	**Results Due:**	03-Aug-2020
Date Approved:	31-Jul-2020		
Approved By:			
Details:	Glynn Harvey, Technical Manager		

Results - Water

Project: P19188 Howth

Client: Priority Geotechnical Ltd		Chemtest Job No.:		20-19232	20-19232
Quotation No.: Q20-19850		Chemtest Sample ID.:		1037332	1037333
		Client Sample ID.:		P7	P8
		Sample Location:		TRM90	TRM90
		Sample Type:		WATER	WATER
		Date Sampled		25-Jun-2020	23-Jul-2020
Determinand	Accred.	SOP	Units	LOD	
Chloride	U	1220	mg/l	1.0	[B] 180 190
Sulphate	U	1220	mg/l	1.0	[B] 99 120
Calcium	U	1415	mg/l	5.0	[B] 11 13
Sodium	U	1415	mg/l	0.50	[B] 170 170
Arsenic (Dissolved)	U	1450	µg/l	1.0	[B] 2.6 2.3
Cadmium (Dissolved)	U	1450	µg/l	0.080	[B] < 0.080 < 0.080
Chromium (Dissolved)	U	1450	µg/l	1.0	[B] < 1.0 < 1.0
Copper (Dissolved)	U	1450	µg/l	1.0	[B] 24 22
Mercury (Dissolved)	U	1450	µg/l	0.50	[B] < 0.50 < 0.50
Nickel (Dissolved)	U	1450	µg/l	1.0	[B] 3.6 3.0
Lead (Dissolved)	U	1450	µg/l	1.0	[B] < 1.0 < 1.0
Selenium (Dissolved)	U	1450	µg/l	1.0	[B] 2.9 3.2
Tin (Dissolved)	U	1450	µg/l	1.0	[B] < 1.0 < 1.0
Vanadium (Dissolved)	U	1450	µg/l	1.0	[B] 18 20
Zinc (Dissolved)	U	1450	µg/l	1.0	[B] 4.7 5.1
Dibutyl Tin	N	1730	µg/l	0.050	< 0.050 < 0.050
Tributyl Tin	N	1730	µg/l	0.0500	< 0.050 < 0.050

Deviations

In accordance with UKAS Policy on Deviating Samples TPS 63, Chemtest have a procedure to ensure 'upon receipt of each sample a competent laboratory shall assess whether the sample is suitable with regard to the requested test(s)'. This policy and the respective holding times applied, can be supplied upon request.The reason a sample is declared as deviating is detailed below. Where applicable the analysis remains UKAS/MCERTs accredited but the results may be compromised

Sample:	Sample Ref:	Sample ID:	Sample Location:	Sampled Date:	Deviation Code(s):	Containers Received:
1037332		P7	TRM90	25-Jun-2020	B	Plastic Bottle 1000ml

Test Methods

SOP	Title	Parameters included	Method summary
1220	Anions, Alkalinity & Ammonium in Waters	Fluoride; Chloride; Nitrite; Nitrate; Total; Oxidisable Nitrogen (TON); Sulfate; Phosphate; Alkalinity; Ammonium	Automated colorimetric analysis using 'Aquakem 600' Discrete Analyser.
1415	Cations in Waters by ICP-MS	Sodium; Potassium; Calcium; Magnesium	Direct determination by inductively coupled plasma - mass spectrometry (ICP-MS).
1450	Metals in Waters by ICP-MS	Metals, including; Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Tin; Vanadium; Zinc	Filtration of samples followed by direct determination by inductively coupled plasma mass spectrometry (ICP-MS).
1730	Organo-Leads	Organo-Leads	Solvent extraction / GCMS detection

Report Information

Key	
U	UKAS accredited
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N	Unaccredited
S	This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
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I/S	Insufficient Sample
U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"

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Sample Retention and Disposal

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UKAS TESTING 2183

eurofins
Chemtest
Eurofins Chemtest Ltd.
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

Final Report

Report No.:	20-17639-1		
Initial Date of Issue:	14-Jul-2020		
Client	Priority Geotechnical Ltd		
Client Address:	Unit 12 Owenacurra Business Park Midleton County Cork Ireland		
Contact(s):	Colette Kelly		
Project	P19188 Howth		
Quotation No.:	Q20-19850	**Date Received:**	10-Jul-2020
Order No.:	12451	**Date Instructed:**	10-Jul-2020
No. of Samples:	2		
Turnaround (Wkdays):	7	**Results Due:**	20-Jul-2020
Date Approved:	14-Jul-2020		
Approved By:			
Details:	Glynn Harvey, Technical Manager		

Results - Water

Project: P19188 Howth

Client: Priority Geotechnical Ltd					Chemtest Job No.:	20-17639	20-17639
Quotation No.: Q20-19850					Chemtest Sample ID.:	1029575	1029576
					Client Sample ID.:	P7	P8
					Sample Location:	TRM76	TRM76
					Sample Type:	WATER	WATER
					Date Sampled:	10-Jun-2020	08-Jul-2020
Determinand	**Accred.**	**SOP**	**Units**	**LOD**			
Chloride	U	1220	mg/l	1.0		[B] 220	180
Sulphate	U	1220	mg/l	1.0		[B] 100	120
Calcium	U	1415	mg/l	5.0		[B] < 5.0	12
Sodium	U	1415	mg/l	0.50		[B] 200	160
Arsenic (Dissolved)	U	1450	µg/l	1.0		[B] 3.2	2.3
Cadmium (Dissolved)	U	1450	µg/l	0.080		[B] < 0.080	< 0.080
Chromium (Dissolved)	U	1450	µg/l	1.0		[B] 9.5	6.1
Copper (Dissolved)	U	1450	µg/l	1.0		[B] 28	25
Mercury (Dissolved)	U	1450	µg/l	0.50		[B] < 0.50	< 0.50
Nickel (Dissolved)	U	1450	µg/l	1.0		[B] 4.4	3.6
Lead (Dissolved)	U	1450	µg/l	1.0		[B] < 1.0	< 1.0
Selenium (Dissolved)	U	1450	µg/l	1.0		[B] 8.8	4.6
Tin (Dissolved)	U	1450	µg/l	1.0		[B] < 1.0	< 1.0
Vanadium (Dissolved)	U	1450	µg/l	1.0		[B] 22	21
Zinc (Dissolved)	U	1450	µg/l	1.0		[B] 6.6	7.1
Dibutyl Tin	N	1730	µg/l	0.050		< 0.050	< 0.050
Tributyl Tin	N	1730	µg/l	0.0500		< 0.050	< 0.050

Deviations

In accordance with UKAS Policy on Deviating Samples TPS 63, Eurofins Chemtest have a procedure to ensure 'upon receipt of each sample a competent laboratory shall assess whether the sample is suitable with regard to the requested test(s)'. This policy and the respective holding times applied, can be supplied upon request. The reason a sample is declared as deviating is detailed below. Where applicable the analysis remains UKAS/MCERTs accredited but the results may be compromised.

Sample:	Sample Ref:	Sample ID:	Sample Location:	Sampled Date:	Deviation Code(s):	Containers Received:
1029575		P7	TRM76	10-Jun-2020	B	Plastic Bottle 1000ml

Test Methods

SOP	Title	Parameters included	Method summary
1220	Anions, Alkalinity & Ammonium in Waters	Fluoride; Chloride; Nitrite; Nitrate; Total Oxidisable Nitrogen (TON); Sulfate; Phosphate; Alkalinity; Ammonium	Automated colorimetric analysis using 'Aquakem 600' Discrete Analyser.
1415	Cations in Waters by ICP-MS	Sodium; Potassium; Calcium; Magnesium	Direct determination by inductively coupled plasma - mass spectrometry (ICP-MS).
1450	Metals in Waters by ICP-MS	Metals, including: Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Tin; Vanadium; Zinc	Filtration of samples followed by direct determination by inductively coupled plasma mass spectrometry (ICP-MS).
1730	Organo-Leads	Organo-Leads	Solvent extraction / GCMS detection

Report Information

Key

U	UKAS accredited
M	MCERTS and UKAS accredited
N	Unaccredited
S	This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
SN	This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
T	This analysis has been subcontracted to an unaccredited laboratory
I/S	Insufficient Sample
U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"

Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
Uncertainty of measurement for the determinands tested are available upon request
None of the results in this report have been recovery corrected
All results are expressed on a dry weight basis
The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols
For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at the indicated laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

A - Date of sampling not supplied
B - Sample age exceeds stability time (sampling to extraction)
C - Sample not received in appropriate containers
D - Broken Container
E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

All soil samples will be retained for a period of 45 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:
customerservices@chemtest.com

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Chemtest Ltd.
Depot Road
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CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

Final Report

Report No.:	20-14322-1		
Initial Date of Issue:	10-Jun-2020		
Client	Priority Geotechnical Ltd		
Client Address:	Unit 12 Owenacurra Business Park Midleton County Cork Ireland		
Contact(s):	Colette Kelly		
Project	P19188 Howth		
Quotation No.:	Q20-19850	**Date Received:**	08-Jun-2020
Order No.:	12451	**Date Instructed:**	08-Jun-2020
No. of Samples:	2		
Turnaround (Wkdays):	7	**Results Due:**	16-Jun-2020
Date Approved:	10-Jun-2020		
Approved By:			
Details:	Glynn Harvey, Technical Manager		

Results - Water

Chemtest
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Project: P19188 Howth

Client: Priority Geotechnical Ltd			Chemtest Job No.:	20-14322	20-14322
Quotation No.: Q20-19850			Chemtest Sample ID.:	1013909	1013910
			Client Sample ID.:	P5	P6
			Sample Location:	TRM90	TRM90
			Sample Type:	WATER	WATER
			Date Sampled:	28-May-2020	05-Jun-2020
Determinand	**Accred.**	**SOP**	**Units**	**LOD**	
Chloride	U	1220	mg/l	1.0	77	65
Sulphate	U	1220	mg/l	1.0	5.3	13
Calcium	U	1415	mg/l	5.0	< 5.0	< 5.0
Sodium	U	1415	mg/l	0.50	69	90
Arsenic (Dissolved)	U	1450	µg/l	1.0	< 1.0	1.2
Cadmium (Dissolved)	U	1450	µg/l	0.080	< 0.080	< 0.080
Chromium (Dissolved)	U	1450	µg/l	1.0	< 1.0	< 1.0
Copper (Dissolved)	U	1450	µg/l	1.0	8.4	9.6
Mercury (Dissolved)	U	1450	µg/l	0.50	2.5	0.64
Nickel (Dissolved)	U	1450	µg/l	1.0	< 1.0	< 1.0
Lead (Dissolved)	U	1450	µg/l	1.0	< 1.0	< 1.0
Selenium (Dissolved)	U	1450	µg/l	1.0	1.3	1.8
Tin (Dissolved)	U	1450	µg/l	1.0	< 1.0	< 1.0
Vanadium (Dissolved)	U	1450	µg/l	1.0	4.0	7.3
Zinc (Dissolved)	U	1450	µg/l	1.0	< 1.0	< 1.0
Dibutyl Tin	N	1730	µg/l	0.050	< 0.050	< 0.050
Tributyl Tin	N	1730	µg/l	0.0500	< 0.050	< 0.050

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Test Methods

SOP	Title	Parameters included	Method summary
1220	Anions, Alkalinity & Ammonium in Waters	Fluoride; Chloride; Nitrite; Nitrate; Total Oxidisable Nitrogen (TON); Sulfate; Phosphate; Alkalinity; Ammonium	Automated colorimetric analysis using 'Aquakem 600' Discrete Analyser.
1415	Cations in Waters by ICP-MS	Sodium; Potassium; Calcium; Magnesium	Direct determination by inductively coupled plasma - mass spectrometry (ICP-MS).
1450	Metals in Waters by ICP-MS	Metals, including; Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Tin; Vanadium; Zinc	Filtration of samples followed by direct determination by inductively coupled plasma mass spectrometry (ICP-MS).
1730	Organo-Leads	Organo-Leads	Solvent extraction / GCMS detection

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Report Information

Key

U	UKAS accredited
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I/S	Insufficient Sample
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N/E	not evaluated
<	"less than"
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Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
Uncertainty of measurement for the determinands tested are available upon request
None of the results in this report have been recovery corrected
All results are expressed on a dry weight basis
The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols
For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at the indicated laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

A - Date of sampling not supplied
B - Sample age exceeds stability time (sampling to extraction)
C - Sample not received in appropriate containers
D - Broken Container
E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

All soil samples will be retained for a period of 45 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:
customerservices@chemtest.com

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Chemtest Ltd.
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

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Final Report

Report No.:	20-13487-1		
Initial Date of Issue:	04-Jun-2020		
Client	Priority Geotechnical Ltd		
Client Address:	Unit 12 Owenacurra Business Park Midleton County Cork Ireland		
Contact(s):	Colette Kelly		
Project	P19188 Howth		
Quotation No.:	Q20-19850	**Date Received:**	28-May-2020
Order No.:	12451	**Date Instructed:**	29-May-2020
No. of Samples:	2		
Turnaround (Wkdays):	7	**Results Due:**	08-Jun-2020
Date Approved:	04-Jun-2020		
Approved By:			
Details:	Glynn Harvey, Technical Manager		

Results - Water

Chemtest
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Project: P19188 Howth

Client: Priority Geotechnical Ltd				Chemtest Job No.:	20-13487	20-13487
Quotation No.: Q20-19850				Chemtest Sample ID.:	1010091	1010092
				Client Sample ID.:	P5	P6
				Sample Location:	TRM76	TRM76
				Sample Type:	WATER	WATER
				Date Sampled:	14-May-2020	21-May-2020
Determinand	Accred.	SOP	Units	LOD		
Chloride	U	1220	mg/l	1.0	[B] 72	97
Sulphate	U	1220	mg/l	1.0	[B] 2.5	8.8
Calcium	U	1415	mg/l	5.0	[B] 32	11
Sodium	U	1415	mg/l	0.50	[B] 61	99
Arsenic (Dissolved)	U	1450	µg/l	1.0	[B] < 1.0	< 1.0
Cadmium (Dissolved)	U	1450	µg/l	0.080	[B] < 0.080	< 0.080
Chromium (Dissolved)	U	1450	µg/l	1.0	[B] < 1.0	< 1.0
Copper (Dissolved)	U	1450	µg/l	1.0	[B] 4.8	12
Mercury (Dissolved)	U	1450	µg/l	0.50	[B] 1.1	1.4
Nickel (Dissolved)	U	1450	µg/l	1.0	[B] < 1.0	1.7
Lead (Dissolved)	U	1450	µg/l	1.0	[B] < 1.0	< 1.0
Selenium (Dissolved)	U	1450	µg/l	1.0	[B] 1.5	3.4
Tin (Dissolved)	U	1450	µg/l	1.0	[B] < 1.0	< 1.0
Vanadium (Dissolved)	U	1450	µg/l	1.0	[B] 1.7	5.3
Zinc (Dissolved)	U	1450	µg/l	1.0	[B] 2.5	3.1
Dibutyl Tin	N	1730	µg/l	0.050	< 0.050	< 0.050
Tributyl Tin	N	1730	µg/l	0.0500	< 0.050	< 0.050

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Deviations

In accordance with UKAS Policy on Deviating Samples TPS 63, Chemtest have a procedure to ensure 'upon receipt of each sample a competent laboratory shall assess whether the sample is suitable with regard to the requested test(s)'. This policy and the respective holding times applied, can be supplied upon request. The reason a sample is declared as deviating is detailed below. Where applicable the analysis remains UKAS/MCERTs accredited but the results may be compromised.

Sample:	Sample Ref:	Sample ID:	Sample Location:	Sampled Date:	Deviation Code(s):	Containers Received:
1010091		P5	TRM76	14-May-2020	B	Plastic Bottle 1000ml

Chemtest
The right chemistry to deliver results

Test Methods

SOP	Title	Parameters included	Method summary
1220	Anions, Alkalinity & Ammonium in Waters	Fluoride; Chloride; Nitrite; Nitrate; Total; Oxidisable Nitrogen (TON); Sulfate; Phosphate; Alkalinity; Ammonium	Automated colorimetric analysis using 'Aquakem 600' Discrete Analyser.
1415	Cations in Waters by ICP-MS	Sodium; Potassium; Calcium; Magnesium	Direct determination by inductively coupled plasma - mass spectrometry (ICP-MS).
1450	Metals in Waters by ICP-MS	Metals, including: Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Tin; Vanadium; Zinc	Filtration of samples followed by direct determination by inductively coupled plasma mass spectrometry (ICP-MS).
1730	Organo-Leads	Organo-Leads	Solvent extraction / GCMS detection

Chemtest
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Report Information

Key

U	UKAS accredited
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U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"

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The results relate only to the items tested
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The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols
For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at the indicated laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

A - Date of sampling not supplied
B - Sample age exceeds stability time (sampling to extraction)
C - Sample not received in appropriate containers
D - Broken Container
E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

All soil samples will be retained for a period of 45 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:
customerservices@chemtest.com

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Chemtest Ltd.
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

Final Report

Report No.:	20-13342-1		
Initial Date of Issue:	01-Jun-2020		
Client	Priority Geotechnical Ltd		
Client Address:	Unit 12 Owenacurra Business Park Midleton County Cork Ireland		
Contact(s):	Colette Kelly		
Project	P19188 Howth		
Quotation No.:	Q20-19850	**Date Received:**	27-May-2020
Order No.:	12451	**Date Instructed:**	27-May-2020
No. of Samples:	4		
Turnaround (Wkdays):	7	**Results Due:**	04-Jun-2020
Date Approved:	01-Jun-2020		
Approved By:			
Details:	Glynn Harvey, Technical Manager		

Chemtest
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Results - Water

Project: P19188 Howth

Client: Priority Geotechnical Ltd					Chemtest Job No.:	20-13342	20-13342	20-13342	20-13342
Quotation No.: Q20-19850					Chemtest Sample ID.:	1009377	1009378	1009379	1009380
					Client Sample ID.:	P1	P2	P3	P4
					Sample Location:	TRM90	TRM90	TRM90	TRM90
					Sample Type:	WATER	WATER	WATER	WATER
					Date Sampled:	20-May-2020	21-May-2020	22-May-2020	25-May-2020
Determinand	**Accred.**	**SOP**	**Units**	**LOD**					
Chloride	U	1220	mg/l	1.0		90	79	46	75
Sulphate	U	1220	mg/l	1.0		2.4	2.5	1.4	2.4
Calcium	U	1415	mg/l	5.0		6.6	6.2	7.4	6.0
Sodium	U	1415	mg/l	0.50		70	66	39	64
Arsenic (Dissolved)	U	1450	µg/l	1.0		< 1.0	< 1.0	< 1.0	< 1.0
Cadmium (Dissolved)	U	1450	µg/l	0.080		< 0.080	< 0.080	< 0.080	< 0.080
Chromium (Dissolved)	U	1450	µg/l	1.0		< 1.0	< 1.0	< 1.0	< 1.0
Copper (Dissolved)	U	1450	µg/l	1.0		< 1.0	< 1.0	< 1.0	1.8
Mercury (Dissolved)	U	1450	µg/l	0.50		< 0.50	< 0.50	< 0.50	< 0.50
Nickel (Dissolved)	U	1450	µg/l	1.0		1.0	< 1.0	2.0	< 1.0
Lead (Dissolved)	U	1450	µg/l	1.0		< 1.0	< 1.0	< 1.0	< 1.0
Selenium (Dissolved)	U	1450	µg/l	1.0		< 1.0	< 1.0	< 1.0	< 1.0
Tin (Dissolved)	U	1450	µg/l	1.0		< 1.0	< 1.0	< 1.0	< 1.0
Vanadium (Dissolved)	U	1450	µg/l	1.0		< 1.0	< 1.0	< 1.0	1.6
Zinc (Dissolved)	U	1450	µg/l	1.0		2.2	< 1.0	< 1.0	< 1.0
Dibutyl Tin	N	1730	µg/l	0.050		< 0.050	< 0.050	< 0.050	< 0.050
Tributyl Tin	N	1730	µg/l	0.0500		< 0.050	< 0.050	< 0.050	< 0.050

Chemtest
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Test Methods

SOP	Title	Parameters Included	Method summary
1220	Anions, Alkalinity & Ammonium in Waters	Fluoride; Chloride; Nitrite; Nitrate; Total Oxidisable Nitrogen (TON); Sulfate; Phosphate; Alkalinity; Ammonium	Automated colorimetric analysis using 'Aquakem 600' Discrete Analyser.
1415	Cations in Waters by ICP-MS	Sodium; Potassium; Calcium; Magnesium	Direct determination by inductively coupled plasma - mass spectrometry (ICP-MS).
1450	Metals in Waters by ICP-MS	Metals, including: Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Tin; Vanadium; Zinc	Filtration of samples followed by direct determination by inductively coupled plasma mass spectrometry (ICP-MS).
1730	Organo-Leads	Organo-Leads	Solvent extraction / GCMS detection

Chemtest
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Report Information

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U/S	Unsuitable Sample
N/E	not evaluated
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>	"greater than"

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Sample Deviation Codes

A - Date of sampling not supplied
B - Sample age exceeds stability time (sampling to extraction)
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D - Broken Container
E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

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All water samples will be retained for 14 days from the date of receipt
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Final Report

Report No.:	20-13188-1		
Initial Date of Issue:	01-Jun-2020		
Client	Priority Geotechnical Ltd		
Client Address:	Unit 12 Owenacurra Business Park Midleton County Cork Ireland		
Contact(s):	Colette Kelly		
Project	P19188 Howth		
Quotation No.:	Q20-19850	**Date Received:**	26-May-2020
Order No.:	12451	**Date Instructed:**	26-May-2020
No. of Samples:	4		
Turnaround (Wkdays):	7	**Results Due:**	03-Jun-2020
Date Approved:	01-Jun-2020		
Approved By:			
Details:	Glynn Harvey, Technical Manager		

Chemtest
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Results - Water

Project: P19188 Howth

Client: Priority Geotechnical Ltd		Chemtest Job No.:			20-13188	20-13188	20-13188	20-13188
Quotation No.: Q20-19850		Chemtest Sample ID.:			1008641	1008642	1008643	1008644
		Client Sample ID.:			P5	P6	P7	P8
		Sample Location:			TRM28	TRM28	TRM28	TRM28
		Sample Type:			WATER	WATER	WATER	WATER
		Date Sampled:			27-Mar-2020	03-Apr-2020	23-Apr-2020	21-May-2020
Determinand	**Accred.**	**SOP**	**Units**	**LOD**				
Chloride	U	1220	mg/l	1.0	[B] 76	[B] 110	[B] 150	130
Sulphate	U	1220	mg/l	1.0	[B] 3.6	[B] 7.1	[B] 30	79
Calcium	U	1415	mg/l	5.0	[B] 15	[B] 6.0	[B] < 5.0	6.3
Sodium	U	1415	mg/l	0.50	[B] 85	[B] 110	[B] 130	130
Arsenic (Dissolved)	U	1450	µg/l	1.0	[B] < 1.0	[B] < 1.0	[B] 1.4	1.3
Cadmium (Dissolved)	U	1450	µg/l	0.080	[B] < 0.080	[B] < 0.080	[B] < 0.080	< 0.080
Chromium (Dissolved)	U	1450	µg/l	1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	< 1.0
Copper (Dissolved)	U	1450	µg/l	1.0	[B] 4.5	[B] 7.8	[B] 12	18
Mercury (Dissolved)	U	1450	µg/l	0.50	[B] < 0.50	[B] < 0.50	[B] < 0.50	< 0.50
Nickel (Dissolved)	U	1450	µg/l	1.0	[B] < 1.0	[B] 1.1	[B] 2.3	2.4
Lead (Dissolved)	U	1450	µg/l	1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	< 1.0
Selenium (Dissolved)	U	1450	µg/l	1.0	[B] < 1.0	[B] 1.3	[B] 2.8	1.6
Tin (Dissolved)	U	1450	µg/l	1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	< 1.0
Vanadium (Dissolved)	U	1450	µg/l	1.0	[B] 1.2	[B] 2.3	[B] 8.0	9.8
Zinc (Dissolved)	U	1450	µg/l	1.0	[B] 2.7	[B] 2.9	[B] 4.4	3.6
Dibutyl Tin	N	1730	µg/l	0.050	< 0.050	< 0.050	< 0.050	< 0.050
Tributyl Tin	N	1730	µg/l	0.0500	< 0.050	< 0.050	< 0.050	< 0.050

Chemtest
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Deviations

In accordance with UKAS Policy on Deviating Samples TPS 03, Chemtest have a procedure to ensure upon receipt of each sample a competent laboratory shall assess whether the sample is suitable with regard to the requested test(s). This policy and the respective holding times applied, can be supplied upon request. The reason a sample is declared as deviating is detailed below. Where applicable the analysis remains UKAS/MCERTs accredited but the results may be compromised.

Sample:	Sample Ref:	Sample ID:	Sample Location:	Sampled Date:	Deviation Code(s):	Containers Received:
1008641		P5	TRM28	27-Mar-2020	B	Plastic Bottle 1000ml
1008642		P6	TRM28	03-Apr-2020	B	Plastic Tub 500g
1008643		P7	TRM28	23-Apr-2020	B	Plastic Tub 500g

Chemtest
The right chemistry to deliver results

Test Methods

SOP	Title	Parameters included	Method summary
1220	Anions, Alkalinity & Ammonium in Waters	Fluoride; Chloride; Nitrite; Nitrate; Total Oxidisable Nitrogen (TON); Sulfate; Phosphate; Alkalinity; Ammonium	Automated colorimetric analysis using 'Aquakem 600' Discrete Analyser.
1415	Cations in Waters by ICP-MS	Sodium; Potassium; Calcium; Magnesium	Direct determination by inductively coupled plasma - mass spectrometry (ICP-MS).
1450	Metals in Waters by ICP-MS	Metals, including: Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Tin; Vanadium; Zinc	Filtration of samples followed by direct determination by inductively coupled plasma mass spectrometry (ICP-MS).
1730	Organo-Leads	Organo-Leads	Solvent extraction / GCMS detection

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Report Information

Key

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D - Broken Container
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Sample Retention and Disposal

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If you require extended retention of samples, please email your requirements to:
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Depot Road
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CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

UKAS TESTING
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Final Report

Report No.:	20-12281-1		
Initial Date of Issue:	18-May-2020		
Client	Priority Geotechnical Ltd		
Client Address:	Unit 12 Owenacurra Business Park Midleton County Cork Ireland		
Contact(s):	Colette Kelly		
Project	P19188 Howth		
Quotation No.:	Q20-19850	**Date Received:**	13-May-2020
Order No.:	12451	**Date Instructed:**	14-May-2020
No. of Samples:	4		
Turnaround (Wkdays):	7	**Results Due:**	22-May-2020
Date Approved:	18-May-2020		
Approved By:			
Details:	Glynn Harvey, Technical Manager		

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Results - Water

Project: P19188 Howth

Client: Priority Geotechnical Ltd		Chemtest Job No.:		20-12281	20-12281	20-12281	20-12281	20-12281
Quotation No.: Q20-19850		Chemtest Sample ID.:		1004518	1004519	1004520	1004521	
		Client Sample ID.:		P1	P2	P3	P4	
		Sample Location:		TRM76	TRM76	TRM76	TRM76	
		Sample Type:		WATER	WATER	WATER	WATER	
		Date Sampled:		06-May-2020	07-May-2020	08-May-2020	11-May-2020	
Determinand	**Accred.**	**SOP**	**Units**	**LOD**				
Chloride	U	1220	mg/l	1.0	95	97	69	85
Sulphate	U	1220	mg/l	1.0	< 1.0	1.3	1.4	4.0
Calcium	U	1415	mg/l	5.0	28	11	< 5.0	< 5.0
Sodium	U	1415	mg/l	0.50	69	71	52	90
Arsenic (Dissolved)	U	1450	µg/l	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Cadmium (Dissolved)	U	1450	µg/l	0.080	< 0.080	< 0.080	< 0.080	< 0.080
Chromium (Dissolved)	U	1450	µg/l	1.0	1.2	1.3	< 1.0	1.5
Copper (Dissolved)	U	1450	µg/l	1.0	< 1.0	< 1.0	< 1.0	2.6
Mercury (Dissolved)	U	1450	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50
Nickel (Dissolved)	U	1450	µg/l	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Lead (Dissolved)	U	1450	µg/l	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Selenium (Dissolved)	U	1450	µg/l	1.0	1.8	2.3	1.3	2.2
Tin (Dissolved)	U	1450	µg/l	1.0	< 1.0	< 1.0	< 1.0	86
Vanadium (Dissolved)	U	1450	µg/l	1.0	1.4	1.6	1.5	2.5
Zinc (Dissolved)	U	1450	µg/l	1.0	1.2	2.0	1.3	< 1.0
Dibutyl Tin	N	1730	µg/l	0.050	< 0.050	< 0.050	< 0.050	< 0.050
Tributyl Tin	N	1730	µg/l	0.0500	< 0.050	< 0.050	< 0.050	< 0.050

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Test Methods

SOP	Title	Parameters included	Method summary
1220	Anions, Alkalinity & Ammonium in Waters	Fluoride; Chloride; Nitrite; Nitrate; Total; Oxidisable Nitrogen (TON); Sulfate; Phosphate; Alkalinity; Ammonium	Automated colorimetric analysis using 'Aquakem 600' Discrete Analyser.
1415	Cations in Waters by ICP-MS	Sodium; Potassium; Calcium; Magnesium	Direct determination by inductively coupled plasma - mass spectrometry (ICP-MS).
1450	Metals in Waters by ICP-MS	Metals, including: Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Tin; Vanadium; Zinc	Filtration of samples followed by direct determination by inductively coupled plasma mass spectrometry (ICP-MS).
1730	Organo-Leads	Organo-Leads	Solvent extraction / GCMS detection

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Sample Retention and Disposal

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Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

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Final Report

Report No.:	20-12152-1
Initial Date of Issue:	18-May-2020
Client	Priority Geotechnical Ltd
Client Address:	Unit 12 Owenacurra Business Park Midleton County Cork Ireland
Contact(s):	Colette Kelly
Project	P19188 Howth
Quotation No.:	Q20-19850
Date Received:	12-May-2020
Order No.:	12451
Date Instructed:	12-May-2020
No. of Samples:	4
Turnaround (Wkdays):	7
Results Due:	20-May-2020
Date Approved:	18-May-2020
Approved By:	
Details:	Glynn Harvey, Technical Manager

Results - Water

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Client: Priority Geotechnical Ltd
Project: P19188 Howth

Chemtest Job No.:				20-12152	20-12152	20-12152	20-12152	20-12152
Chemtest Sample ID.:				1003895	1003896	1003897	1003898	
Client Sample ID:				P5	P6	P7	P8	
Sample Location:				TRM14	TRM14	TRM14	TRM14	
Sample Type:				WATER	WATER	WATER	WATER	
Date Sampled:				13-Mar-2020	20-Mar-2020	09-Apr-2020	07-May-2020	
Determinand	**Accred.**	**SOP**	**Units**	**LOD**				
Chloride	U	1220	mg/l	1.0	[B] 150	[B] 170	[B] 67	
Sulphate	U	1220	mg/l	1.0	[B] 4.0	[B] 7.3	[B] 68	46
Calcium	U	1415	mg/l	5.0	[B] 37	[B] 10	[B] < 5.0	8.5
Sodium	U	1415	mg/l	0.50	[B] 110	[B] 110	[B] 130	59
Arsenic (Dissolved)	U	1450	µg/l	1.0	[B] < 1.0	[B] < 1.0	[B] 1.3	< 1.0
Cadmium (Dissolved)	U	1450	µg/l	0.080	[B] < 0.080	[B] < 0.080	[B] < 0.060	< 0.080
Chromium (Dissolved)	U	1450	µg/l	1.0	[B] 1.5	[B] 2.3	[B] 2.4	1.1
Copper (Dissolved)	U	1450	µg/l	1.0	[B] 3.1	[B] 4.8	[B] 17	9.7
Mercury (Dissolved)	U	1450	µg/l	0.50	[B] < 0.50	[B] < 0.50	[B] < 0.50	< 0.50
Nickel (Dissolved)	U	1450	µg/l	1.0	[B] 1.1	[B] 1.4	[B] 3.9	1.9
Lead (Dissolved)	U	1450	µg/l	1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	< 1.0
Selenium (Dissolved)	U	1450	µg/l	1.0	[B] 4.3	[B] 5.0	[B] 6.7	3.3
Tin (Dissolved)	U	1450	µg/l	1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	< 1.0
Vanadium (Dissolved)	U	1450	µg/l	1.0	[B] 3.2	[B] 4.0	[B] 8.8	6.3
Zinc (Dissolved)	U	1450	µg/l	1.0	[B] 3.7	[B] 6.9	[B] 7.4	3.2
Dibutyl Tin	N	1730	µg/l	0.050	< 0.050	< 0.050	< 0.050	< 0.050
Tributyl Tin	N	1730	µg/l	0.0500	< 0.050	< 0.050	< 0.050	< 0.050

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Deviations

In accordance with UKAS Policy on Deviating Samples TPS 63, Chemtest have a procedure to ensure 'upon receipt of each sample a competent laboratory shall assess whether the sample is suitable with regard to the requested test(s)'. This policy and the respective holding times applied, can be supplied upon request. The reason a sample is declared as deviating is detailed below. Where applicable the analysis remains UKAS/MCERTs accredited but the results may be compromised.

Sample:	Sample Ref:	Sample ID:	Sample Location:	Sampled Date:	Deviation Code(s):	Containers Received:
1003895		P5	TRM14	13-Mar-2020	B	Plastic Tub 500g
1003896		P6	TRM14	20-Mar-2020	B	Plastic Tub 500g
1003897		P7	TRM14	09-Apr-2020	B	Plastic Bottle 1000ml

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Test Methods

SOP	Title	Parameters included	Method summary
1220	Anions, Alkalinity & Ammonium in Waters	Fluoride; Chloride; Nitrite; Nitrate; Total Oxidisable Nitrogen (TON); Sulfate; Phosphate; Alkalinity; Ammonium	Automated colorimetric analysis using 'Aquakem 600' Discrete Analyser.
1415	Cations in Waters by ICP-MS	Sodium; Potassium; Calcium; Magnesium	Direct determination by inductively coupled plasma - mass spectrometry (ICP-MS).
1450	Metals in Waters by ICP-MS	Metals, including: Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Tin; Vanadium; Zinc	Filtration of samples followed by direct determination by inductively coupled plasma mass spectrometry (ICP-MS).
1730	Organo-Leads	Organo-Leads	Solvent extraction / GCMS detection

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C - Sample not received in appropriate containers
D - Broken Container
E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

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customerservices@chemtest.com

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Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

Final Report

Report No.:	20-09332-1		
Initial Date of Issue:	30-Mar-2020		
Client	Priority Geotechnical Ltd		
Client Address:	Unit 12 Owenacurra Business Park Midleton County Cork Ireland		
Contact(s):	Colette Kelly		
Project	P19188 Howth		
Quotation No.:	Q20-19850	**Date Received:**	25-Mar-2020
Order No.:	12451	**Date Instructed:**	25-Mar-2020
No. of Samples:	4		
Turnaround (Wkdays):	7	**Results Due:**	02-Apr-2020
Date Approved:	30-Mar-2020		
Approved By:			
Details:	Glynn Harvey, Technical Manager		

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Results - Water

Project: P19188 Howth

Client: Priority Geotechnical Ltd				Chemtest Job No.:	20-09332	20-09332	20-09332	20-09332
Quotation No.: Q20-19850				Chemtest Sample ID.:	991426	991427	991428	991429
				Client Sample ID.:	P1	P2	P3	P4
				Sample Location:	TRM28	TRM28	TRM28	TRM28
				Sample Type:	WATER	WATER	WATER	WATER
				Date Sampled:	19-Mar-2020	20-Mar-2020	22-Mar-2020	23-Mar-2020
Determinand	**Accred.**	**SOP**	**Units**	**LOD**				
Chloride	U	1220	mg/l	1.0	130	110	210	17
Sulphate	U	1220	mg/l	1.0	< 1.0	< 1.0	3.3	< 1.0
Calcium	U	1415	mg/l	5.0	49	50	55	24
Sodium	U	1415	mg/l	0.50	99	83	150	13
Arsenic (Dissolved)	U	1450	µg/l	1.0	< 1.0	< 1.0	1.1	< 1.0
Cadmium (Dissolved)	U	1450	µg/l	0.080	< 0.080	< 0.080	< 0.080	< 0.080
Chromium (Dissolved)	U	1450	µg/l	1.0	1.1	< 1.0	2.8	< 1.0
Copper (Dissolved)	U	1450	µg/l	1.0	1.1	< 1.0	3.3	< 1.0
Mercury (Dissolved)	U	1450	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50
Nickel (Dissolved)	U	1450	µg/l	1.0	1.9	< 1.0	1.8	< 1.0
Lead (Dissolved)	U	1450	µg/l	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Selenium (Dissolved)	U	1450	µg/l	1.0	2.7	2.4	5.1	< 1.0
Tin (Dissolved)	U	1450	µg/l	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Vanadium (Dissolved)	U	1450	µg/l	1.0	1.4	1.8	4.8	< 1.0
Zinc (Dissolved)	U	1450	µg/l	1.0	14	3.1	2.3	< 1.0
Dibutyl Tin	N	1730	µg/l	0.050	< 0.050	< 0.050	< 0.050	< 0.050
Tributyl Tin	N	1730	µg/l	0.0500	< 0.050	< 0.050	< 0.050	< 0.050

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Test Methods

SOP	Title	Parameters included	Method summary
1220	Anions, Alkalinity & Ammonium in Waters	Fluoride; Chloride; Nitrite; Nitrate; Total Oxidisable Nitrogen (TON); Sulfate; Phosphate; Alkalinity; Ammonium	Automated colorimetric analysis using Aquakem 600 Discrete Analyser.
1415	Cations in Waters by ICP-MS	Sodium; Potassium; Calcium; Magnesium	Direct determination by inductively coupled plasma - mass spectrometry (ICP-MS).
1450	Metals in Waters by ICP-MS	Metals, including: Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Tin; Vanadium; Zinc	Filtration of samples followed by direct determination by inductively coupled plasma mass spectrometry (ICP-MS).
1730	Organo-Leads	Organo-Leads	Solvent extraction / GCMS detection

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Final Report

Report No.:	20-07892-1		
Initial Date of Issue:	20-Mar-2020		
Client	Priority Geotechnical Ltd		
Client Address:	Unit 12 Owenacurra Business Park Midleton County Cork Ireland		
Contact(s):	Colette Kelly		
Project	P19188 Howth		
Quotation No.:	Q20-19850	**Date Received:**	12-Mar-2020
Order No.:	12451	**Date Instructed:**	12-Mar-2020
No. of Samples:	4		
Turnaround (Wkdays):	7	**Results Due:**	20-Mar-2020
Date Approved:	20-Mar-2020		
Approved By:			
Details:	Darrell Hall, Director		

Chemtest
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Results - Water

Project: P19188 Howth

Client: Priority Geotechnical Ltd					Chemtest Job No.:	20-07892	20-07892	20-07892
Quotation No.: Q20-19850					Chemtest Sample ID.:	984484	984485	984486	984487
Order No.: 12451					Client Sample Ref.:	P1	P2	P3	P4
					Sample Location:	TRM14	TRM14	TRM14	TRM14
					Sample Type:	WATER	WATER	WATER	WATER
					Date Sampled:	05-Mar-2020	06-Mar-2020	07-Mar-2020	09-Mar-2020
Determinand	**Accred.**	**SOP**	**Units**	**LOD**					
Chloride	U	1220	mg/l	1.0		260	270	380	110
Sulphate	U	1220	mg/l	1.0		< 1.0	< 1.0	4.9	< 1.0
Calcium	U	1415	mg/l	5.0		I/S	42	45	46
Sodium	U	1415	mg/l	0.50		I/S	180	290	74
Arsenic (Dissolved)	U	1450	µg/l	1.0		1.0	< 1.0	2.5	1.1
Cadmium (Dissolved)	U	1450	µg/l	0.080		< 0.080	< 0.080	< 0.080	< 0.080
Chromium (Dissolved)	U	1450	µg/l	1.0		2.0	< 1.0	15	7.9
Copper (Dissolved)	U	1450	µg/l	1.0		1.3	< 1.0	1.9	1.4
Mercury (Dissolved)	U	1450	µg/l	0.50		< 0.50	2.3	2.8	< 0.50
Nickel (Dissolved)	U	1450	µg/l	1.0		< 1.0	1.1	8.4	5.6
Lead (Dissolved)	U	1450	µg/l	1.0		< 1.0	< 1.0	< 1.0	< 1.0
Selenium (Dissolved)	U	1450	µg/l	1.0		3.4	3.9	7.0	2.4
Tin (Dissolved)	U	1450	µg/l	1.0		< 1.0	< 1.0	< 1.0	< 1.0
Vanadium (Dissolved)	U	1450	µg/l	1.0		2.3	1.7	9.1	5.3
Zinc (Dissolved)	U	1450	µg/l	1.0		23	14	12	7.1
Dibutyl Tin	N	1730	µg/l	0.050		< 0.050	< 0.050	< 0.050	< 0.050
Tributyl Tin	N	1730	µg/l	0.0500		< 0.050	< 0.050	< 0.050	< 0.050

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Test Methods

SOP	Title	Parameters included	Method summary
1220	Anions, Alkalinity & Ammonium in Waters	Fluoride; Chloride; Nitrite; Nitrate; Total Oxidisable Nitrogen (TON); Sulfate; Phosphate; Alkalinity; Ammonium	Automated colorimetric analysis using Aquakem 600 Discrete Analyser.
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1730	Organo-Leads	Organo-Leads	Solvent extraction / GCMS detection

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All results are expressed on a dry weight basis
The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols
For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at the indicated laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

A - Date of sampling not supplied
B - Sample age exceeds stability time (sampling to extraction)
C - Sample not received in appropriate containers
D - Broken Container
E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

All soil samples will be retained for a period of 45 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:
customerservices@chemtest.com

Appendix 3.1

Geophysical surveys

06-07-2021F 21A/0368
FINGAL CO CO PL DEPT

pgl priority geotechnical

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Howth Geophysical Survey

Howth FHC

Project No. P19188_Gp

Client:

Department of Agriculture, Food and the Marine

An Roinn Talmhaíochta, Bia agus Mara

REPORT CONTROL SHEET

Client	Department of Agriculture Food and the Marine					
Consulting Engineers	Malachy Walsh and Partners					
Project Name	Howth Geophysical Survey					
Project Number	P19188_Gp					
Document	P19188_Gp_Rp					
Document Type	Technical Report					
This Report Comprises of	TOC	Text	No. of Volume	No. of Appendices	Drawings	Electronic data
	1	10	1	3	5	*.pdf, *.dwg *.xyz, *.xlsx

Revision	Status	Author(s)	Approved By:	Issue Date
D00	Int. draft	HP	GH	15.06.2020
D01	Draft for issue	HP	GH	16.06.2020

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TABLE OF FIGURES

ACRONYMS:

CD: Chart Datum

DAFM: Department of Agriculture Food and the Marine

GSI: Geological Survey of Ireland

PGL: Priority Geotechnical Ltd.

ITM: Irish Transverse Mercator

MMO: Marine Mammal Observer

OD Malin: Ordnance Datum Malin (OSGM15)

RTK: Real Time Kinematic

SBP: Sub Bottom Profiling

1. INTRODUCTION

1.1 Site Location and Description

PGL were requested by Malachy Walsh and Partners on behalf of the Department of Agriculture Food and the Marine to undertake a combined geophysical survey consisting of sub bottom profiling, magnetometer, and side scan sonar survey at Howth FHC, Co. Dublin. The information was required for site characterisation (depth to bedrock) and for archaeological investigation.

The survey area was as outlined in Figure 1-1 below. Additional lines were collected within the limits of the harbour for additional coverage for archaeological investigation purposes.

The survey area required suitable wind and tidal conditions as the side scan and magnetometer are towed instruments. Sub bottom profiling is also very susceptible to heave artifacts. Survey fieldwork was undertaken on the following dates:

- Sub bottom profiling: 10th and 11th March 2020
- Magnetometer survey: 7th May 2020
- Side scan sonar survey: 8th May 2020

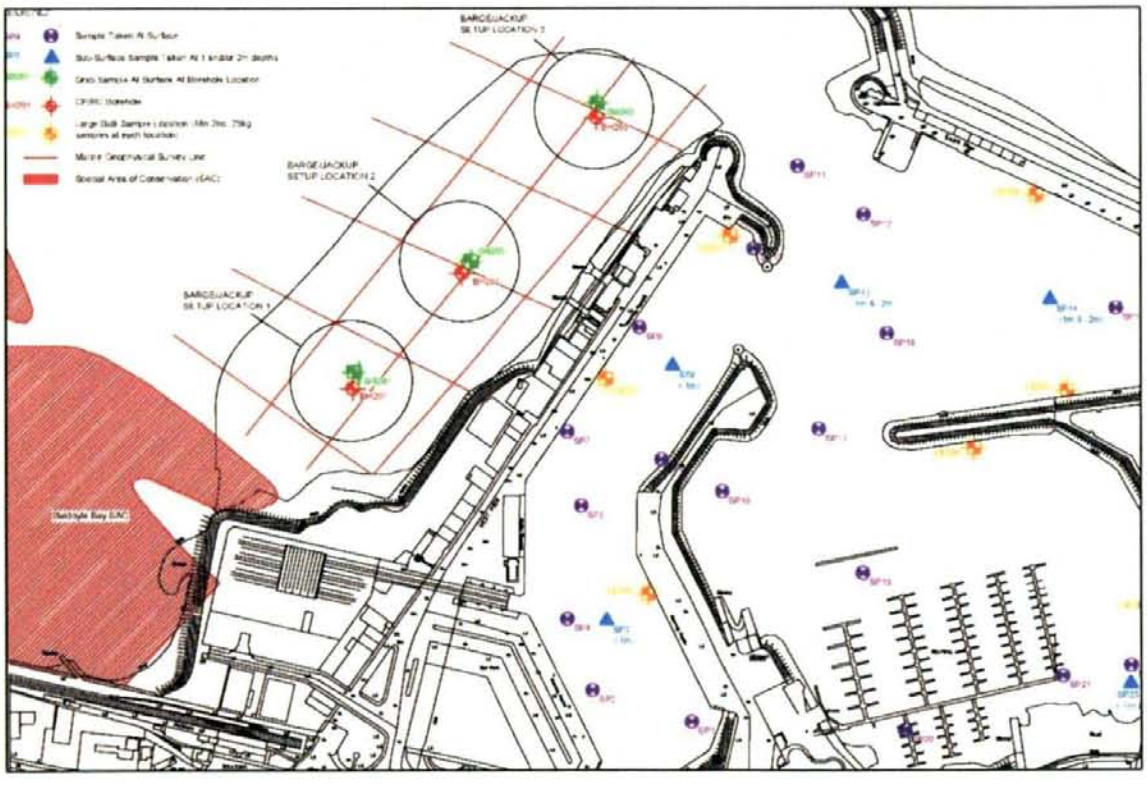


Figure 1-1: Survey area shown to east of harbour. Sub bottom profiling survey profiles shown in red.

1.2 Marine Mammal Observer

During the sub bottom profiling survey, a Marine Mammal Observer (herein referred as MMO) was employed. The MMO report is appended to this report, see **APPENDIX C: Marine Mammal Observer Report.**

1.3 Survey Objectives

The survey objective for the sub bottom profiling survey was to image the sub surface from seabed to rock head. Ground conditions heavily influence sub bottom profiling depth of penetration, no guarantee is made with regard depth of penetration of the system in use.

The objective of the side scan sonar survey was to produce acoustic 2-dimensional images of the seafloor. The method is only capable of detecting archaeological remains that are proud of the seabed.

The objective of the magnetometer survey was to detect metallic objects on or buried within the seabed. The method will not provide an image of the object

1.4 Site Geology

According to the Geological Survey of Ireland 1:100k Geology Map, see Figure 1-2, the survey area is underlain by Waulsortian Limestones with bedrock outcrop apparent to the south and south west of the survey area. The Waulsortian Limestones are described as massive unbedded lime-mudstone.

The south east of Howth FHC is underlain by the Ballysteen Formation describes as a dark muddy limestone, shale.

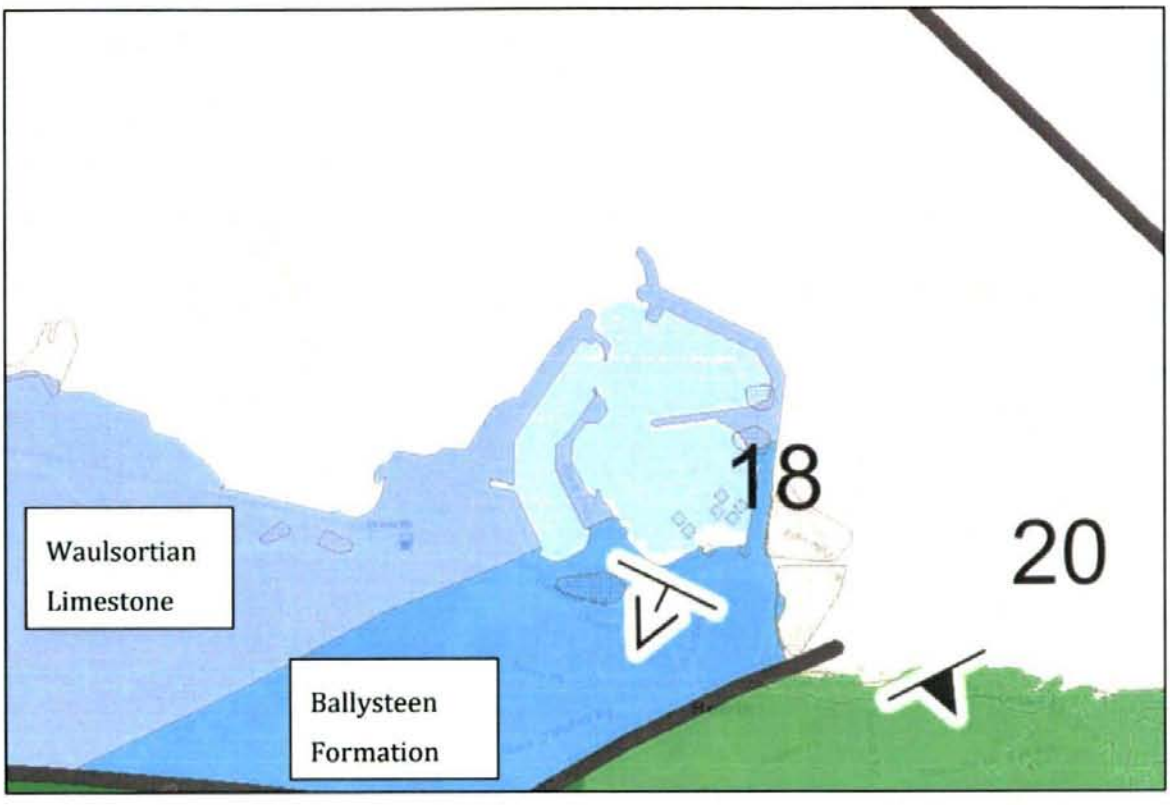


Figure 1-2: GSI 1:100k Solid Geology Map

According the GSI Quaternary Geology map, see Figure 1-3, the surrounding land areas are underlain by a combination of windblown sands (shown in grey), gravels derived from Limestones (shown in green) and till derived from limestones (shown in blue).

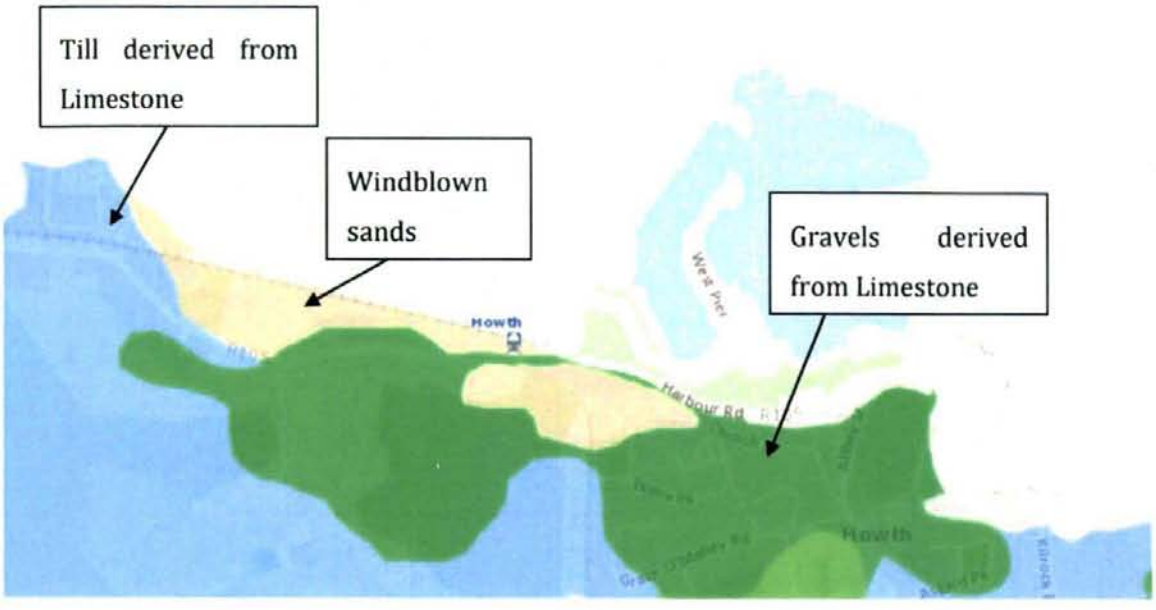


Figure 1-3: GSI Quaternary Geology Map

All above mapping is available for free viewing on the Geological Survey of Ireland website at *https://www.gsi.ie/en-ie/Pages/default.aspx.*

2. SURVEY METHODOLOGY

2.1 Survey Personnel

All survey operations were under the control of Hugh Power, an experienced geophysicist.

2.2 Planned Survey Lines

The survey area was as outlined in Figure 1-1 below. Additional lines were collected within the limits of the harbour for additional coverage.

2.3 Positioning Control

A Hemisphere VS330 was used to collect all positional information throughout both surveys. The GNSS was positioned directly over both transducers (SBP and SBES) for zero layback.

The Hemisphere VS330 was corrected using Trimble VRS now RTK correction stream. Published accuracies of the Trimble VRS network are 0.01 – 0.02 horizontal and 0.01 – 0.03 vertical.

In the VRS correction method a server generates a virtual station close to the user and network corrections are interpolated at this virtual station which in turn transmits corrections across a very short single baseline to the roving receiver.

Hypack™ software was used for navigation purposes during all data acquisition where the planned survey lines were preloaded and online transformation from WGS84 Lat / Lon to Irish Transverse Mercator was undertaken.

2.1 Side Scan Sonar Survey

The side scan sonar survey was undertaken to provide high resolution imagery of the survey area.

Sidescan sonar imaging was obtained using a C-Max digital, dual frequency 100/325kHz, sonar. The higher 325kHz channel was used throughout this survey to provide the highest image resolution.

Data was logged utilizing a rugged CM2 sonar transceiver connected to a PC running MaxView acquisition software. The GNSS signal was interfaced in Max View and Hypack™ survey software where all layback values were applied.

Survey lines were run in a manner to acquire a 100% data overlap and achieve maximum data resolution.

Processing was undertaken utilizing C-Max View processing software and mosaics produced in AutoCAD charts using Hypack™ survey software.

2.2 Magnetometer Survey

For the magnetometer survey a Marine Magnetics SeaSPY magnetometer was used. This magnetometer is an Overhauser style magnetometer. SeaSPY Overhauser sensors have the highest absolute accuracy of any magnetometer: 0.1nT.

This is a towed magnetometer, with the towfish towed 20m from the stern of the boat. The speed of the boat was maintained below 3.0-3.5kts during the survey to reduce any effects of wake on the towfish.

The magnetometer was interfaced with navigation software Hypack™ during acquisition. All offsets were entered within the acquisition software. The towfish position was calculated through Hypack using the position and heading of the boat.

Data was recorded as individual profiles along the predesignated profiles in the Hypack™ standard format. Navigation was provided in real-time to the skipper.

Processing was also undertaken in the Hypack™ software. Where necessary a despiking filter was applied. Each individual profile was inspected for integrity.

The towfish positions were checked against the raw GNSS positions to ensure the integrity of the locations.

2.3 Sub Bottom Profiling Survey

A Knudsen Pinger was used for all sub bottom profiling data acquisition. This system included two separate interchangeable projectors, a low frequency 3.5kHz projector (ideally suited for hard sand seabed) and a 15kHz projector (ideal for soft mud sediments). For this survey, the 3.5kHz projector was installed on the instrument. The system was securely mounted on the starboard side of the survey vessel.

The Knudsen Pinger has a theoretical range resolution of 7.5cm for a typical frequency sweep assuming a speed of sound of 1500m/s. Signal sediment penetration is greatly dependant on external factors, primarily local sediment characteristics and to a lesser extent water depth.

2.3.1 Sub Bottom Acquisition

For data acquisition the Knudson Pinger was interfaced via its proprietary Soundersuite software and with navigation software Hypack™. All offsets were entered into the software. Data was recorded as individual profiles along the predesignated profiles in the Hypack™ standard format, Soundersuite standard KEB format and industry standard SEG-Y format. All data was tagged with positional information during the acquisition process.

Before data acquisition was initialised the MMO was consulted to ensure no presence of marine life in the survey area. A soft start was used slowly increasing power over a 20-minute period.

During data acquisition the following parameters were selected by the onsite geophysicist:

- Tx power level: 2
- Tx pulse length: 4ms
- Tx blanking: 0.80m
- TVG: 40logR @ 40db

The Chirp style waveform used during acquisition is given in Figure 2-1 below. As can be seen the system used a Chirp style waveform which increased from 2kHz to 8kHz, centred on 4kHz.

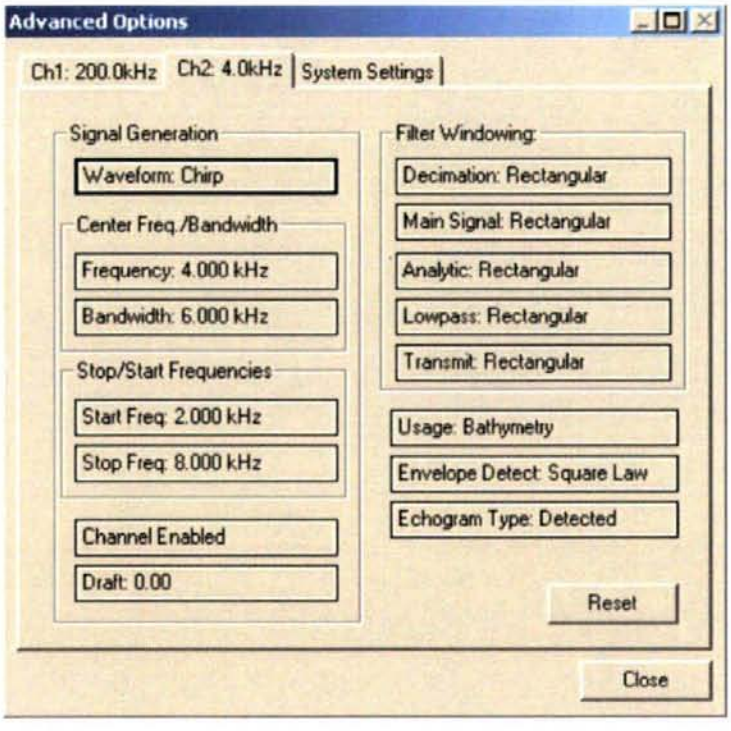


Figure 2-1: Knudsen Pinger waveform details

2.3.2 Sub Bottom Profiler Processing and Interpretation

All seismic reflection profiles were processed in Hypack™ dedicated sub-bottom profiling processing software. The seabed and interpreted reflectors were digitised in the Hypack™ software.

Before digitising of reflectors, a number of processing methods were applied to the seismic data including time varying gain, low and high band pass filter and data stacking.

All processing was carried out under the supervision of Hugh Power.

2.4 List of equipment used

Navigation:	Hemisphere VS330 receiver with RTK corrections (Trimble VRS Now)
Sound Velocity:	Valeport Swift SVP
Sub Bottom Profiling:	Knudsen Pinger Sub Bottom Profiler
Magnetometer:	SeaSPY marine magnetometer
Side Scan Sonar:	CM2 dual frequency side scan

3. SURVEY RESULTS AND FINDINGS

All results are given in Irish Transverse Mercator and to Chart Datum.

Survey results were recorded to OD Malin datum (OSGM15) and subsequently converted to Chart Datum using a value of +2.50 (OD Malin above Chart Datum). This value is taken from previous survey work undertaken for the DAFM at Howth Harbour.

All data has been prepared in AutoCAD, please see file below for reference.

P19188_cc - Standard.zip

All data was recorded over periods of spring high tide for maximum coverage.

3.1 Side Scan Sonar Results

The side scan sonar results have been presented as a georeferenced mosaic image. The georeferenced tiff image is provided for download below. This image covers all areas within Howth Harbour. Individual side scan sonar files can be provided to the client if required.

P19188_SSS.zip

The mosaic is presented in **APPENDIX A: Drawing No. P19188_D01.**

3.2 Magnetometer Results

All magnetometer data was filtered to remove spurious / test readings. In general readings ranged from 49100nT to 49300nT in the outside harbour area (cross section line 1 -12) with some notable spikes present within the data.

Data collected within the western inner harbour varied substantially from the other dataset and is related to the large steel hull fishing trawler vessels moored throughout this area providing large sources of noise. This area has been blanked within the contour plot but is included in cross section line 18 – 22.

The magnetometer survey results have been presented as a contour plot and as cross sections. The contour plot, with location of cross section profiles and survey trackplots is presented in **APPENDIX A: Drawing No. P19188_D02.**

The cross sections are presented in **APPENDIX B: MAGNETOMETER CROSS SECTIONS.**

Additionally, all logged data is supplied in its raw format in the below file.

P19188_seaspy_data.xlsx

3.3 Sub Bottom Profiling Results

The survey profiles in the designated survey area were examined individually by an experienced geophysicist familiar with the sub bottom methodology. The survey area was classed as the area outside of the inner harbour as designated in Figure 1-1.

Trackplots for the acquired sub bottom profiling data are shown in **APPENDIX A: Drawing No. PH20017_D03**.

No geophysical interpretation of the inner harbour profiles has been undertaken. The survey profiles collected within the inner harbour have been presented in the files below for archaeological examination purposes. These profiles include a start / end coordinate and can be cross referenced to **APPENDIX A: Drawing No. PH20017_D03** for location.

SBP Individual Profiles.zip

All data is included below as industry standard sgy format individual files.

P19188 SBP SGY.zip

3.3.1 Geophysical Interpretation

On examination of all files within the designated survey area, a medium to weak reflector was identified within the dataset. It was generally very shallow, c. 2m below seabed, but shallowing to the west and north of the survey area. The reflector was consistent and traceable across all profiles.

Direct investigation undertaken as part of this overall project was examined as part of the geophysical investigation. The reflector as interpreted as part of this survey appears shallower than the depths reported by RC201 and RC202, where rock is reported c. 4.3m and 4.4m below seabed, respectively. However, on both logs a boulder clay is noted at depths consistent with the reflector picked from the sub bottom profiler data.

To the north RC203 reports bedrock at close proximity to the seabed, within 0.5m. This is consistent with the reflector as picked.

It is therefore interpreted that the reflector picked is a combination of top of till, where till is present and top of rock where till is absent. Till material has a high stiffness and as such can mask boundaries beneath.

The distance below seabed was calculated using a speed of sound within the overburden of 1800m/s. This velocity was been used in combination with the direct investigation results.

Two data examples are presented below in Figure 3-1 and Figure 3-2 where an example of the data is shown. The seabed and multiple are also displayed within the data examples. Multiples are artefacts within marine seismic surveys related to reverberation of the seismic signal within the water column, occurring at multiples of water depth.

The results of the sub bottom profiling survey are presented in **APPENDIX A: Drawing No. P19188_D04 and P19188_D05** where the results are referenced to depth below seabed and Chart Datum, respectively.

Tabular datasets for seabed and reflector have been provided below. This tabular dataset gives X,Y,Z for each dataset.

P19188.reflector1.sort3x3chart.datum.x

P19188.reflector1.sort3x3.depth.below

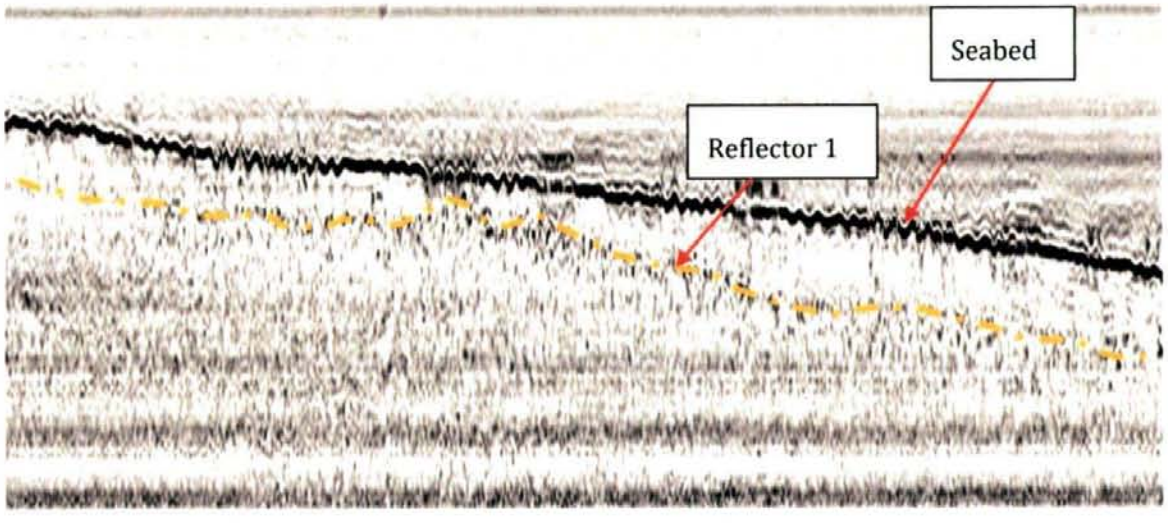


Figure 3-1: Data example from sub bottom profiler survey showing picked reflectors.

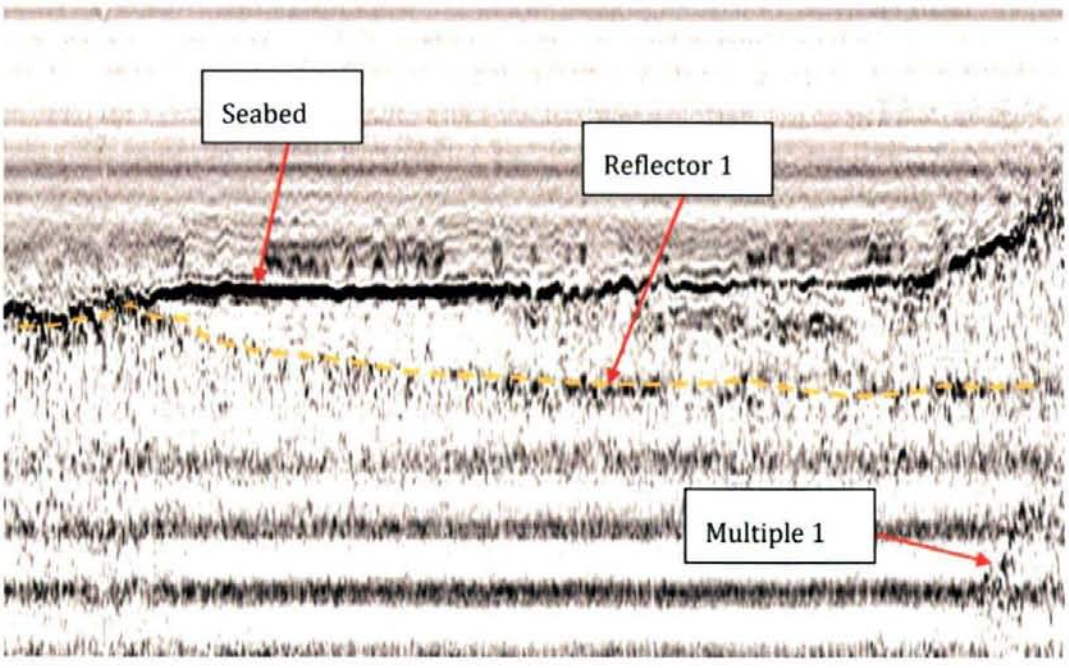


Figure 3-2: Data example from sub bottom profiler survey showing picked reflectors.

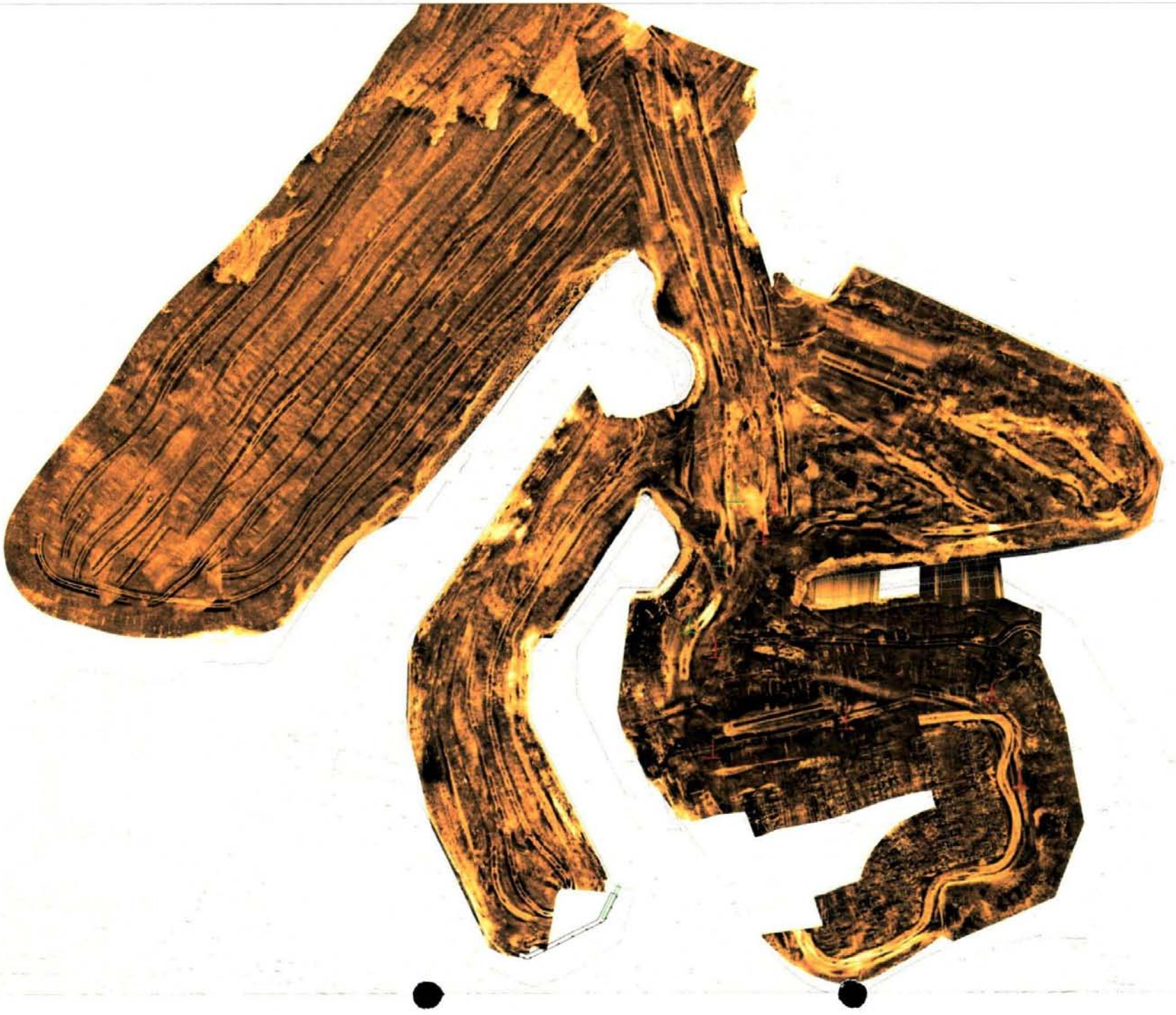
This interpretative report is based on the existing knowledge of ground conditions, typical geophysical responses of known materials and the experience of the author.

APPENDIX A: DRAWINGS

The 4 No. drawings are summarised below:

Drawing Number	Description	Paper Scale
P19188_D01	Side Scan Sonar Mosaic	1:1250 @ A1
P19188_D02	Magnetometer Contour Plot	1:1250 @ A1
P19188_D03	Sub Bottom profiling Trackplot	1:1250 @ A1
P19188_D04	Sub Bottom Profiling Results Depth below seabed	1:1250 @ A1
P19188_D05	Sub Bottom Profiling Results Depth below CD	1:1250 @ A1

06-07-2021F 21A/0368
FINGAL CO CO PL DEPT



SITE:

HOWTH HARBOUR AND SURROUNDING ENVIRONMENT

Sheet Title:

SIDE SCAN SONAR MOSAIC

CLIENT:

DEPARTMENT OF AGRICULTURE, FOOD AND THE MARINE

CONSULTING ENGINEER:

MALACHY WALSH AND PARTNERS

SURVEYED BY:

HYDROGRAPHIC SURVEYS LTD
The Cobbles
Crosshaven
Co. Cork

JOB NUMBER:

P19188

DRAWING NUMBER:

P19188_D01

DRAWN BY:

Hugh Power

SURVEY DATE(S):

8th May 2020

SCALE:	APPROVED
1:1250 ON A1	J.B.L

COORDINATE SYSTEM:	DATUM
ITM	N/A

REVISION:

Rev.01

Survey Site

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The Cobbles
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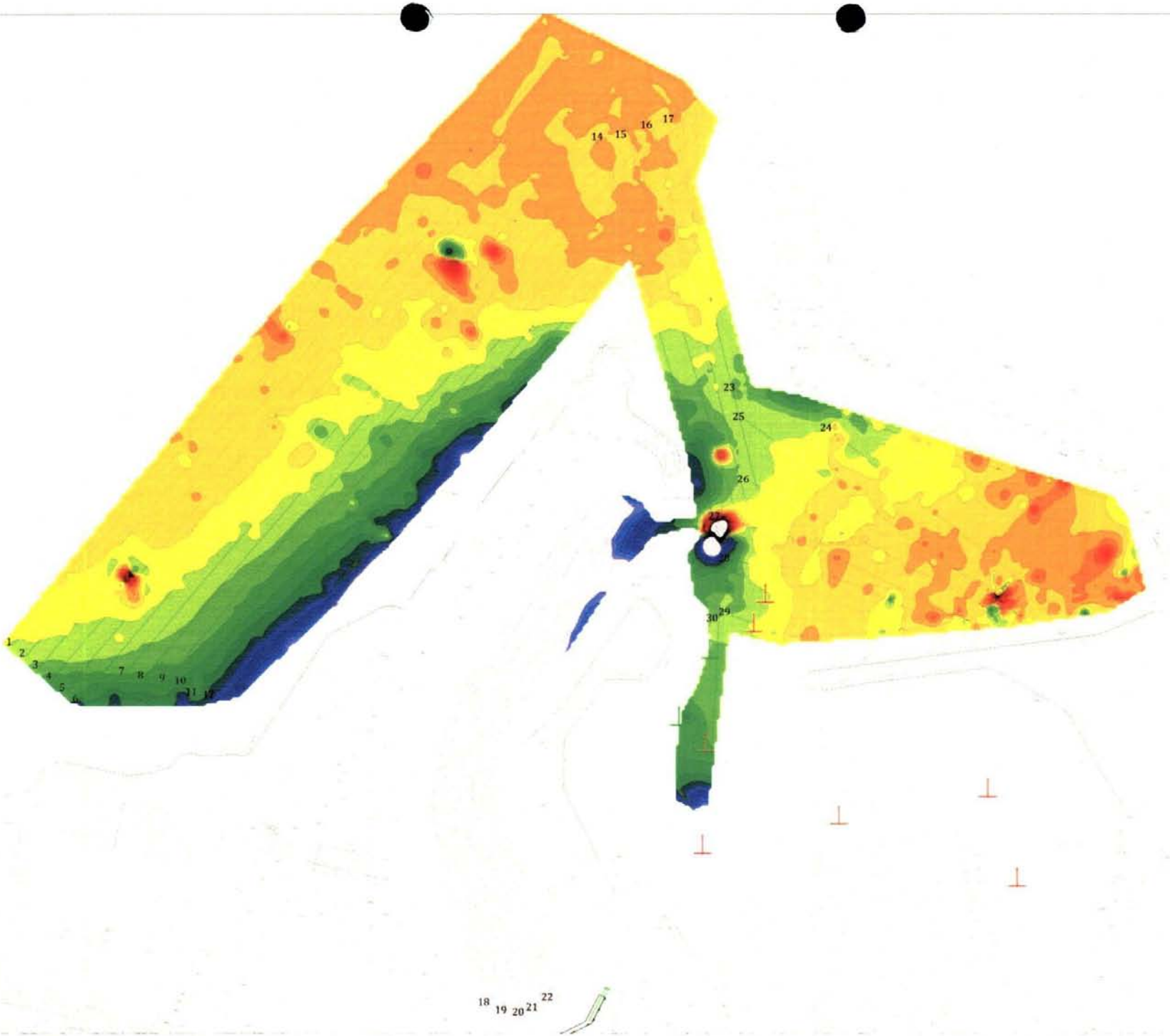
e: info@hydrosurvey.com

HYDROGRAPHIC SURVEYS LTD



SITE:

HOWTH HARBOUR AND SURROUNDING ENVIRONMENT

Sheet Title:

MAGNETOMETER SURVEY WITH CONTOURS AND CROSS SECTION PROFILES

CLIENT:

DEPARTMENT OF AGRICULTURE, FOOD AND THE MARINE

CONSULTING ENGINEER:

MALACHY WALSH AND PARTNERS

SURVEYED BY:

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Co. Cork

JOB NUMBER:

P19188

DRAWING NUMBER:

P19188_D02

DRAWN BY:

Hugh Power

SURVEY DATE(S):

8th May 2020

SCALE:	APPROVED
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COORDINATE SYSTEM:	DATUM:
ITM	N/A

REVISION:

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SITE:

HOWTH HARBOUR AND SURROUNDING ENVIRONMENT

Sheet Title:

SUB BOTTOM PROFILER TRACKPLOTS

CLIENT:

DEPARTMENT OF AGRICULTURE, FOOD AND THE MARINE

CONSULTING ENGINEER:

MALACHY WALSH AND PARTNERS

SURVEYED BY:

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Co. Cork

JOB NUMBER:

P19188

DRAWING NUMBER:

P19188_D03

DRAWN BY:

Hugh Power

SURVEY DATE(S):

10 & 11th March 2020

SCALE:	APPROVED:
1:1250 ON A1	J.B.L

COORDINATE SYSTEM:	DATUM:
ITM	N/A

REVISION:

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SITE:

HOWTH HARBOUR AND SURROUNDING ENVIRONMENT

Sheet Title:

SUB BOTTOM PROFILER REFLECTOR 1 - DEPTH BELOW SEABED

CLIENT:

DEPARTMENT OF AGRICULTURE, FOOD AND THE MARINE

CONSULTING ENGINEER:

MALACHY WALSH AND PARTNERS

SURVEYED BY:

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Crosshaven
Co. Cork

JOB NUMBER:

P19188

DRAWING NUMBER:

P19188_D04

DRAWN BY:

Hugh Power

SURVEY DATE(S):

10 & 11th March 2020

SCALE:	APPROVED
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COORDINATE SYSTEM:	DATUM
ITM	N/A

REVISION:

Rev.01

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Survey Site

SITE:

HOWTH HARBOUR AND SURROUNDING ENVIRONMENT

Sheet Title:

SUB BOTTOM PROFILER REFLECTOR 1 - DEPTH BELOW CHART DATUM

CLIENT:

DEPARTMENT OF AGRICULTURE, FOOD AND THE MARINE

CONSULTING ENGINEER:

MALACHY WALSH AND PARTNERS

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Co. Cork

JOB NUMBER:

P19188

DRAWING NUMBER:

P19188_D04

DRAWN BY:

Hugh Power

SURVEY DATE(S):

10 & 11th March 2020

SCALE:

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APPROVED:

J.B.J.

COORDINATE SYSTEM:

ITM

DATUM:

CHART

REVISION:

Rev.01

PRODUCED BY:

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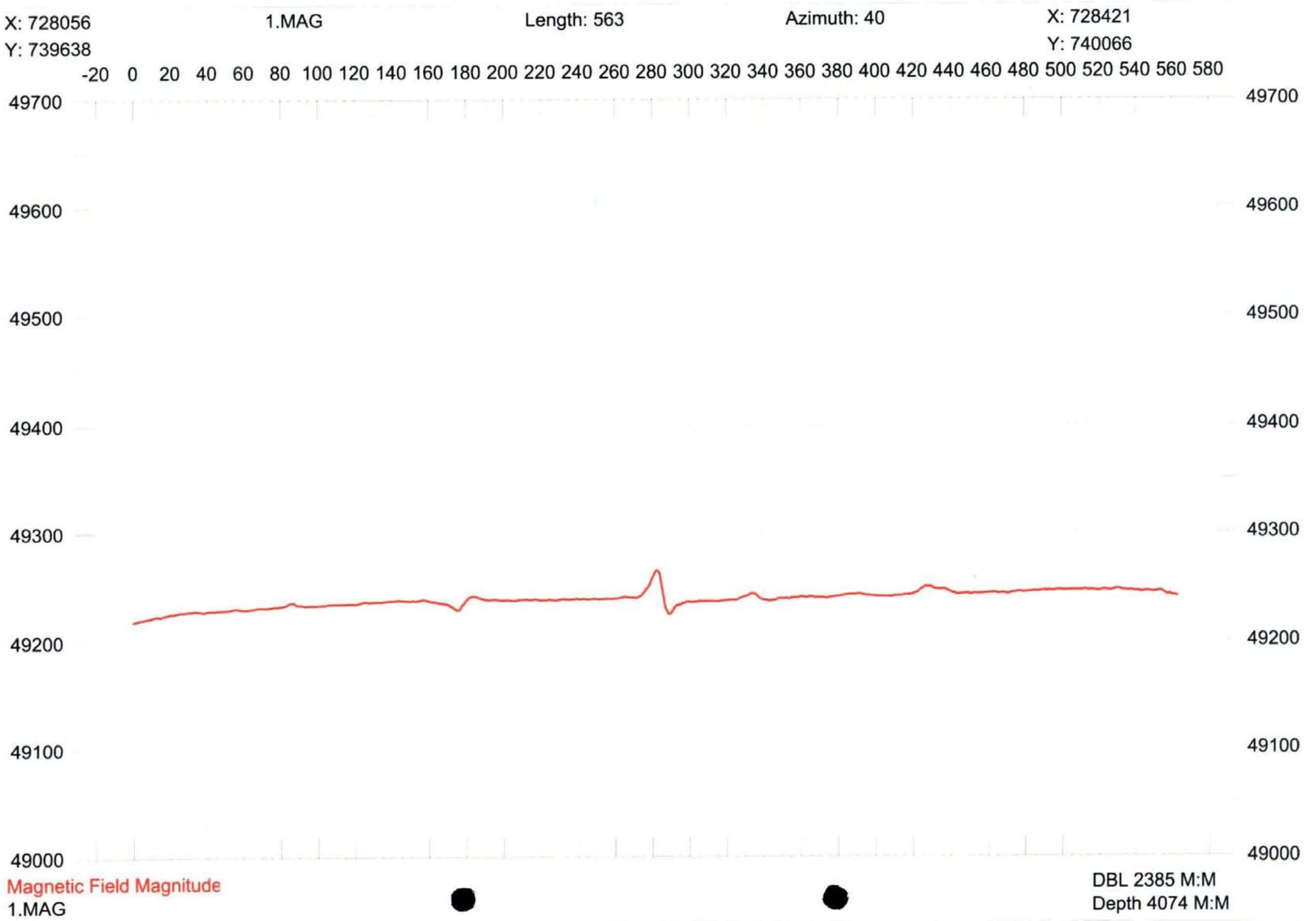
e: info@hydrosurvey.com

APPENDIX B: MAGNETOMETER CROSS SECTIONS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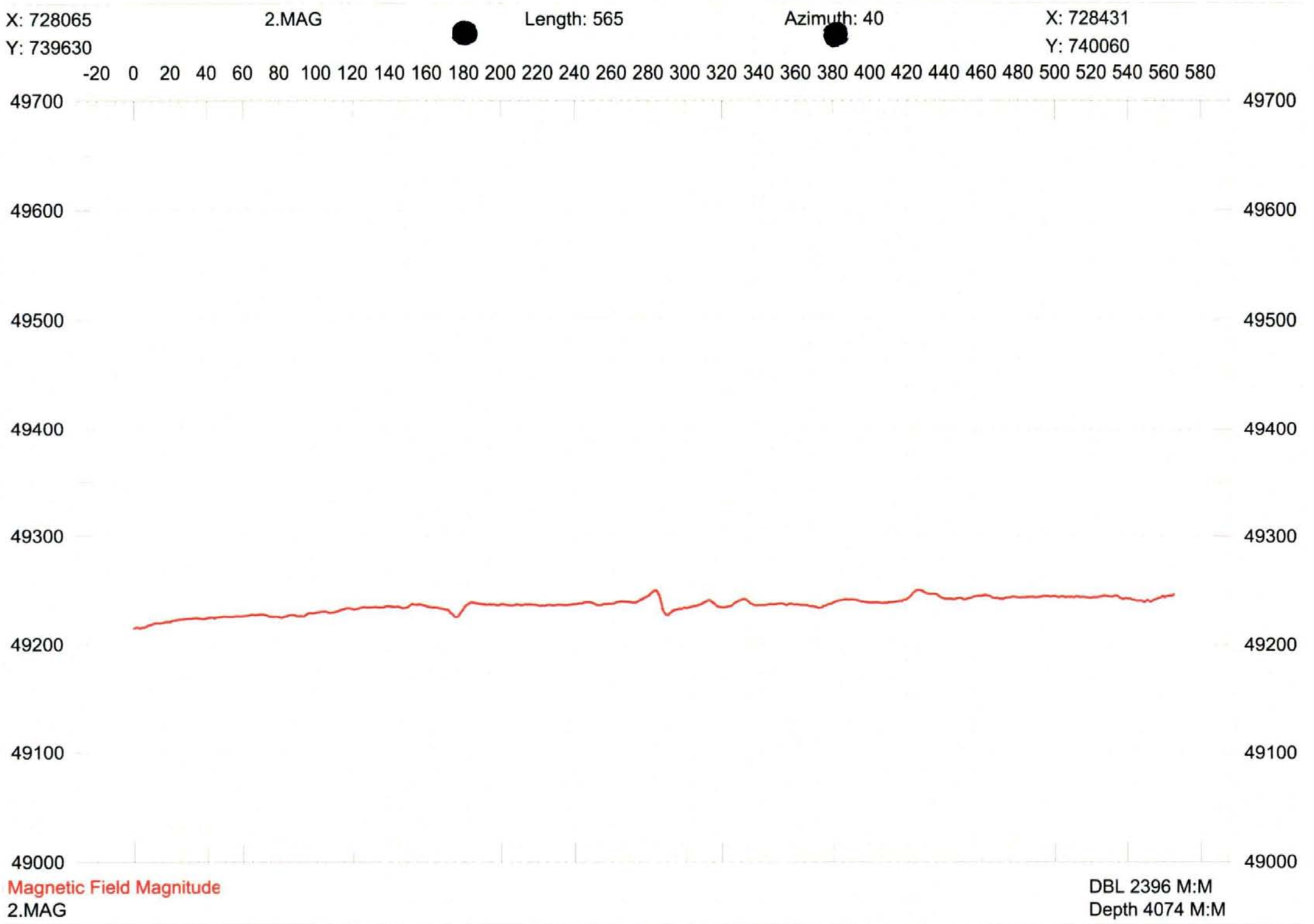
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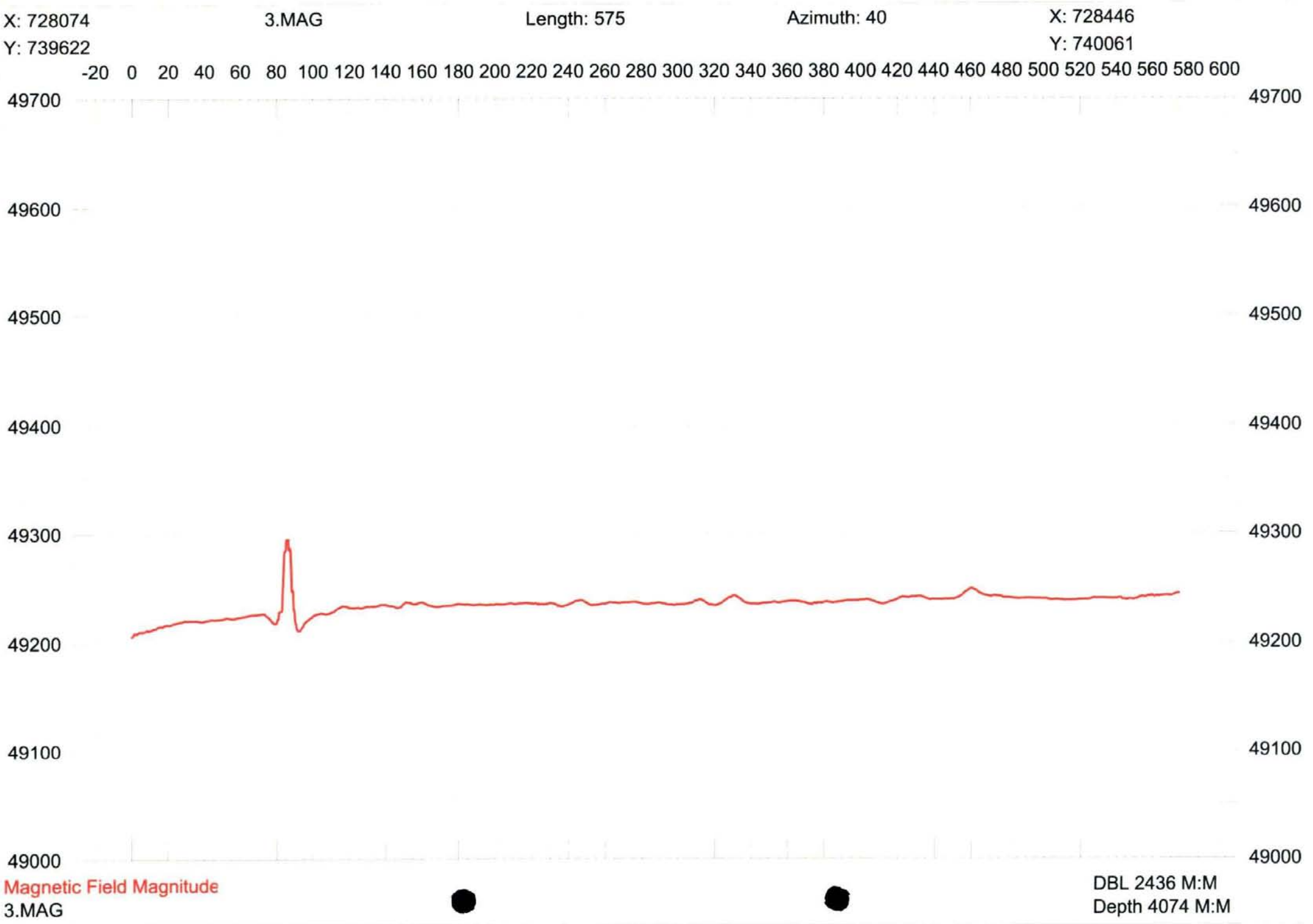
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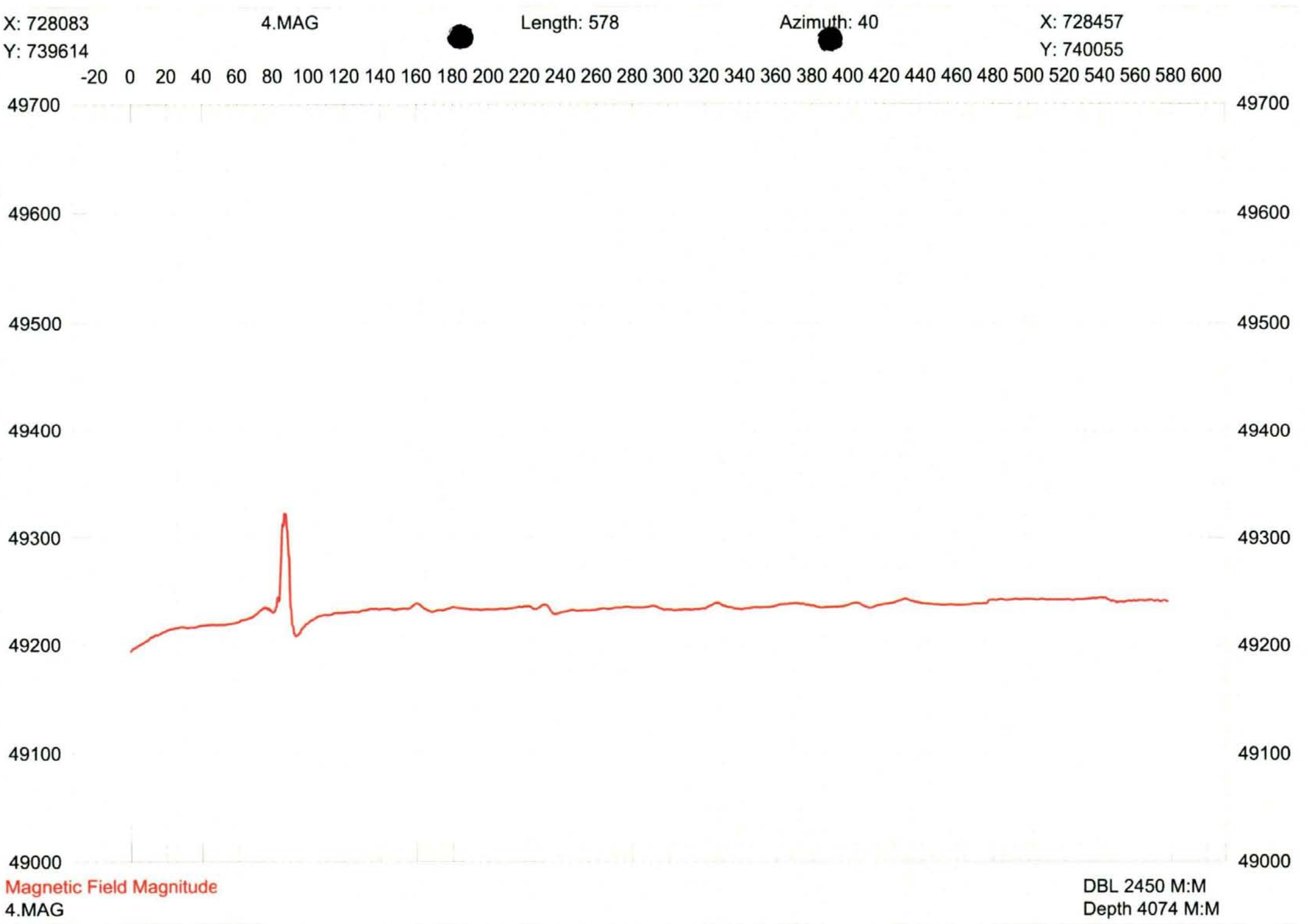
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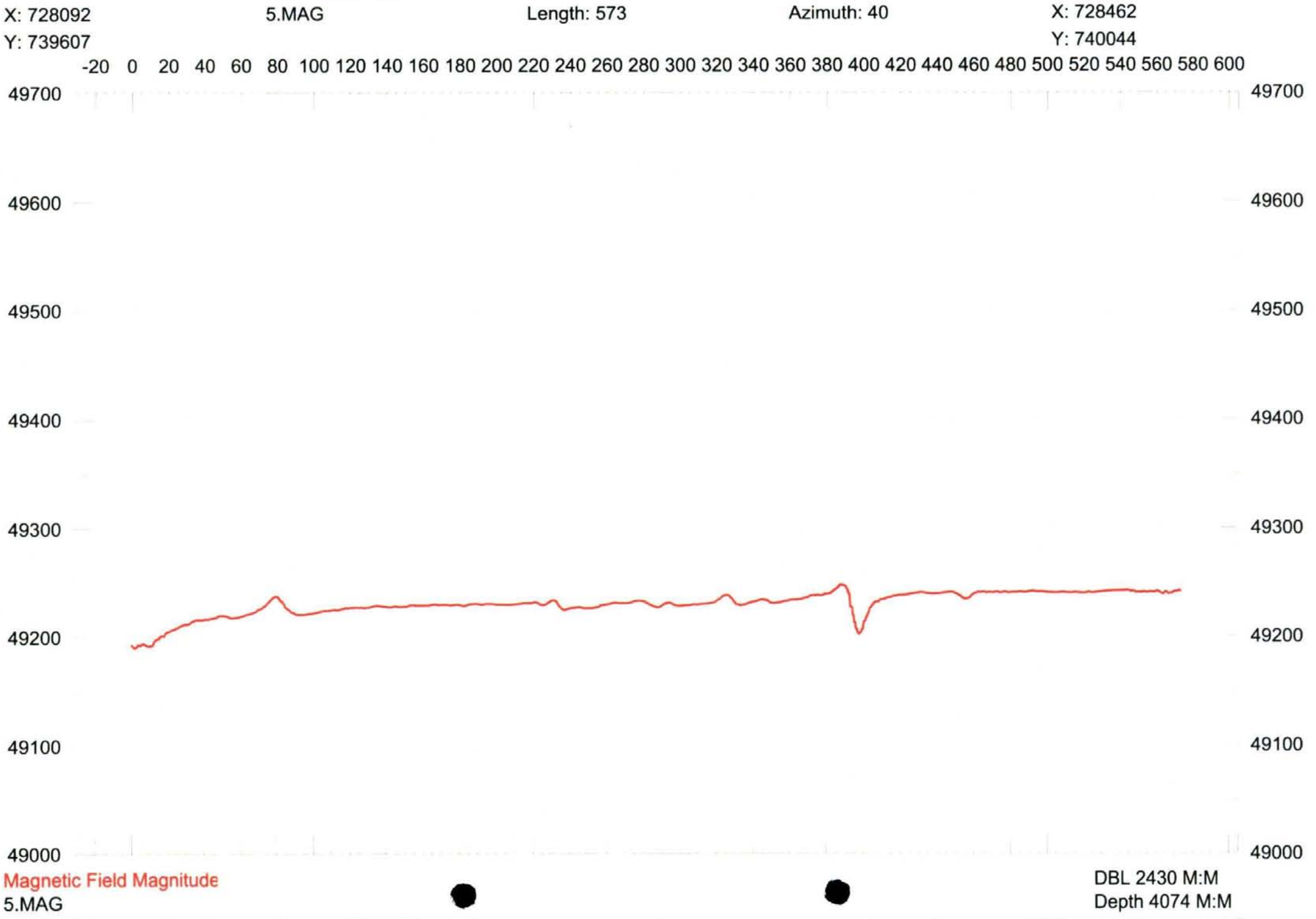
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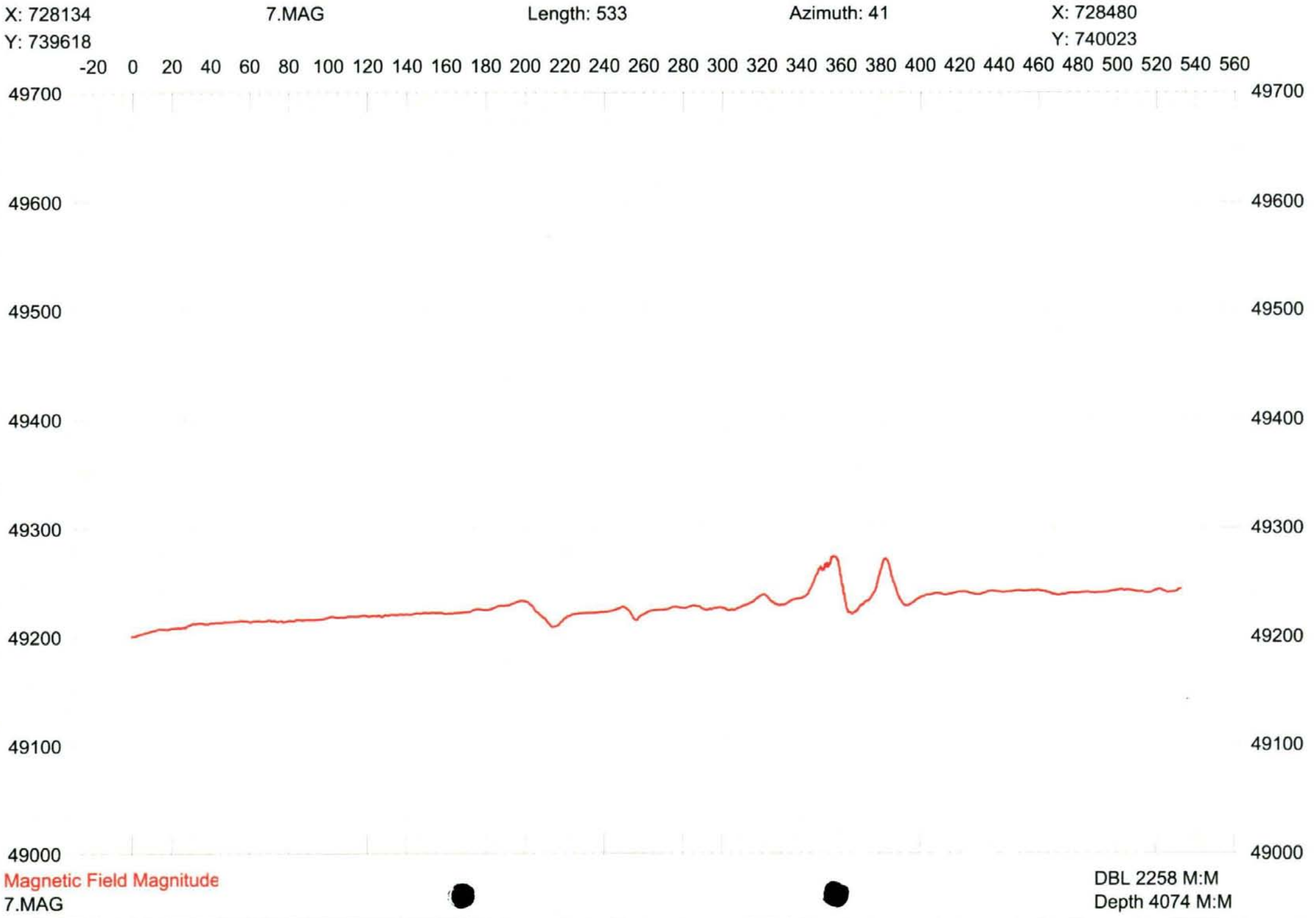
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7.MAG
DBL 2258 M:M
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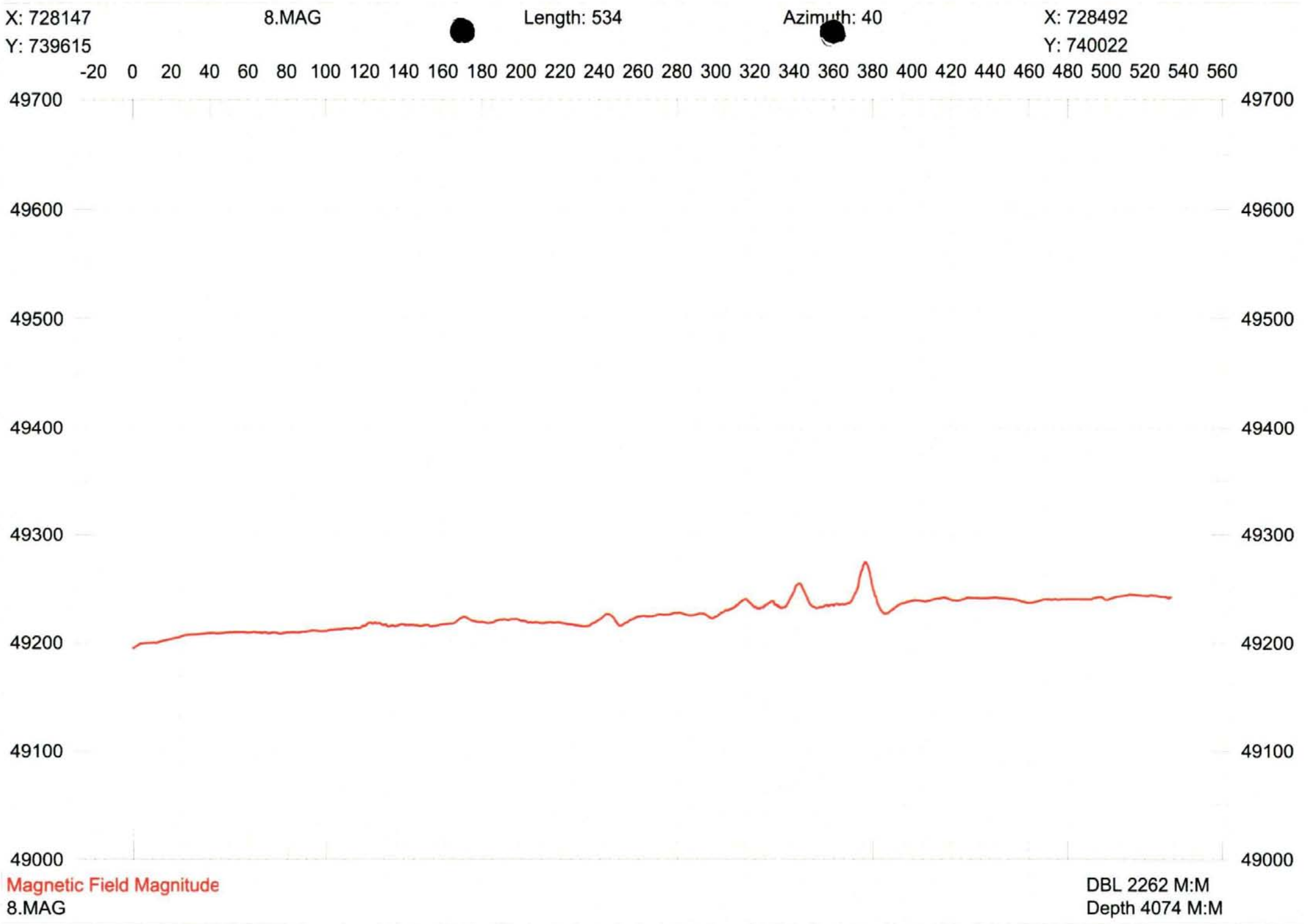
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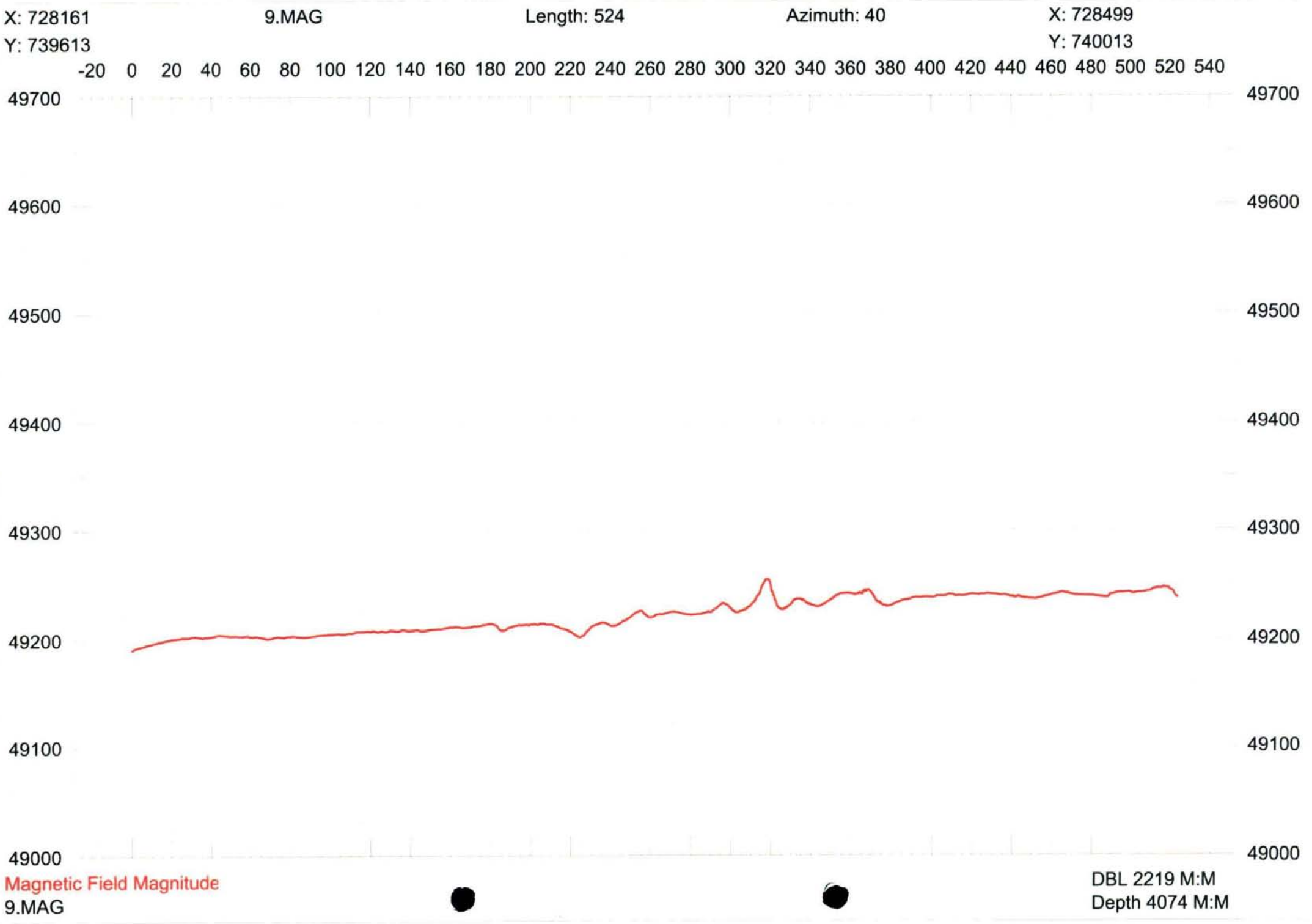
8.MAG
DBL 2262 M:M
Depth 4074 M:M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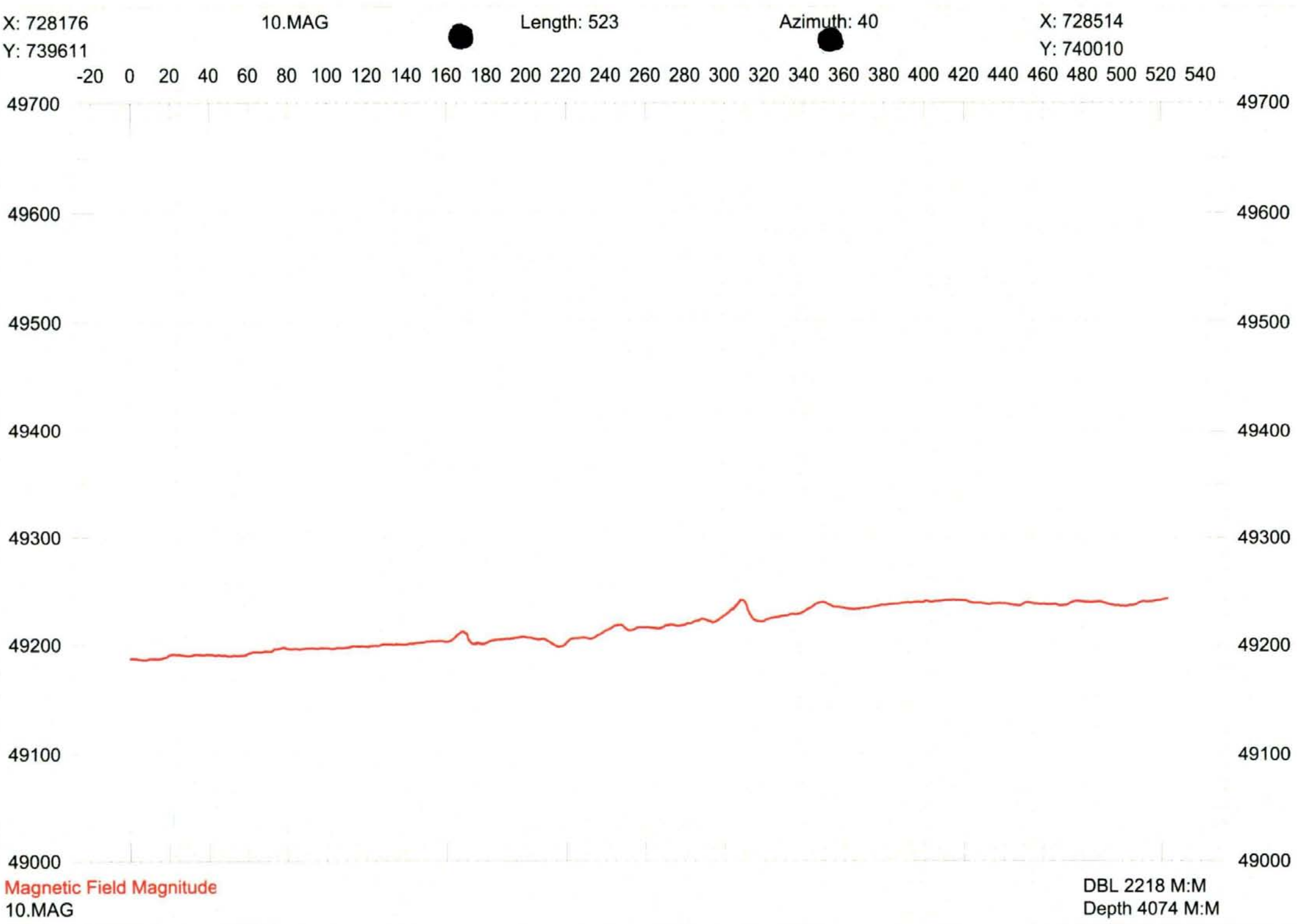
9.MAG
DBL 2219 M:M
Depth 4074 M:M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Y: 740010
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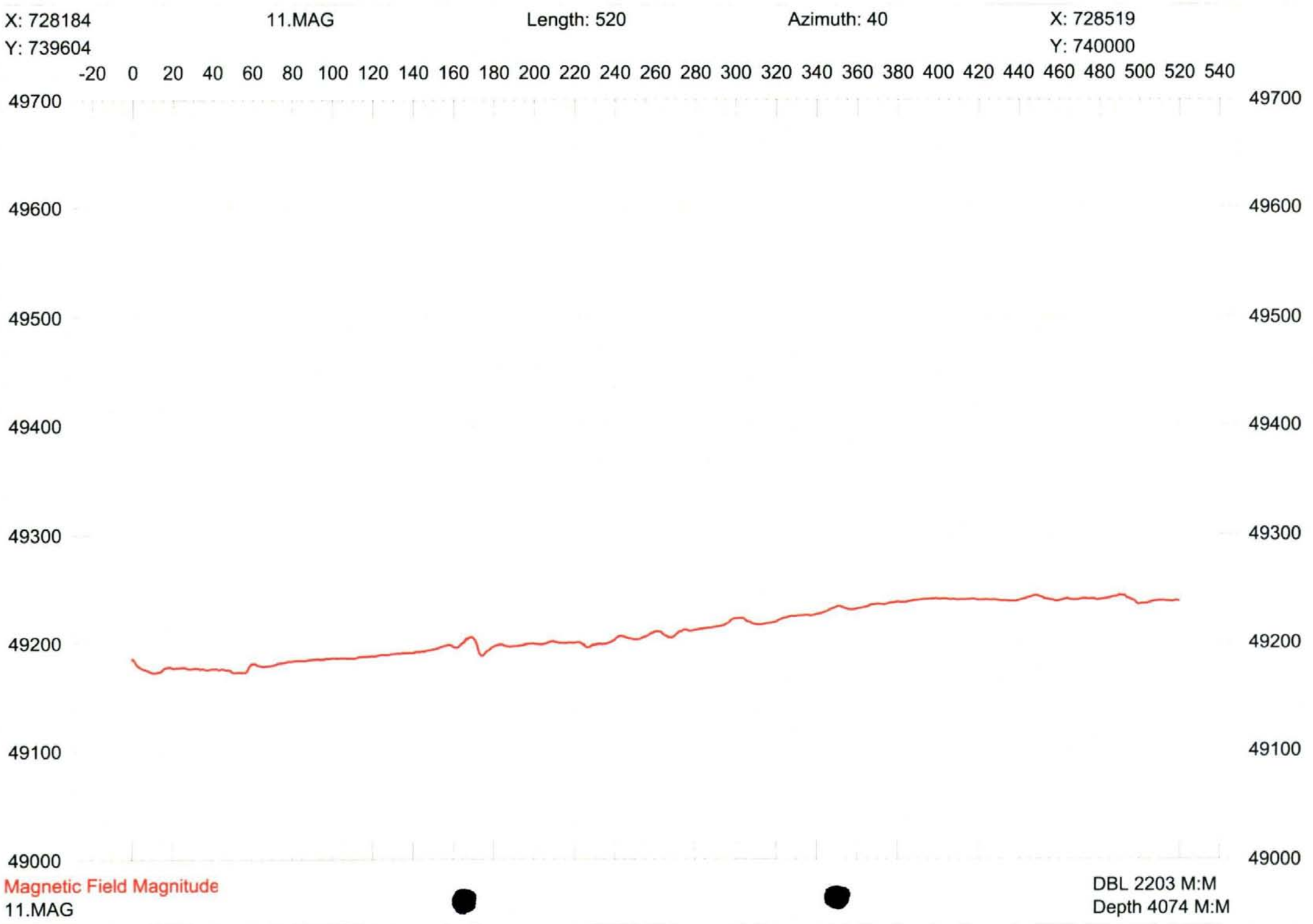
10.MAG
DBL 2218 M:M
Depth 4074 M:M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Y: 740000
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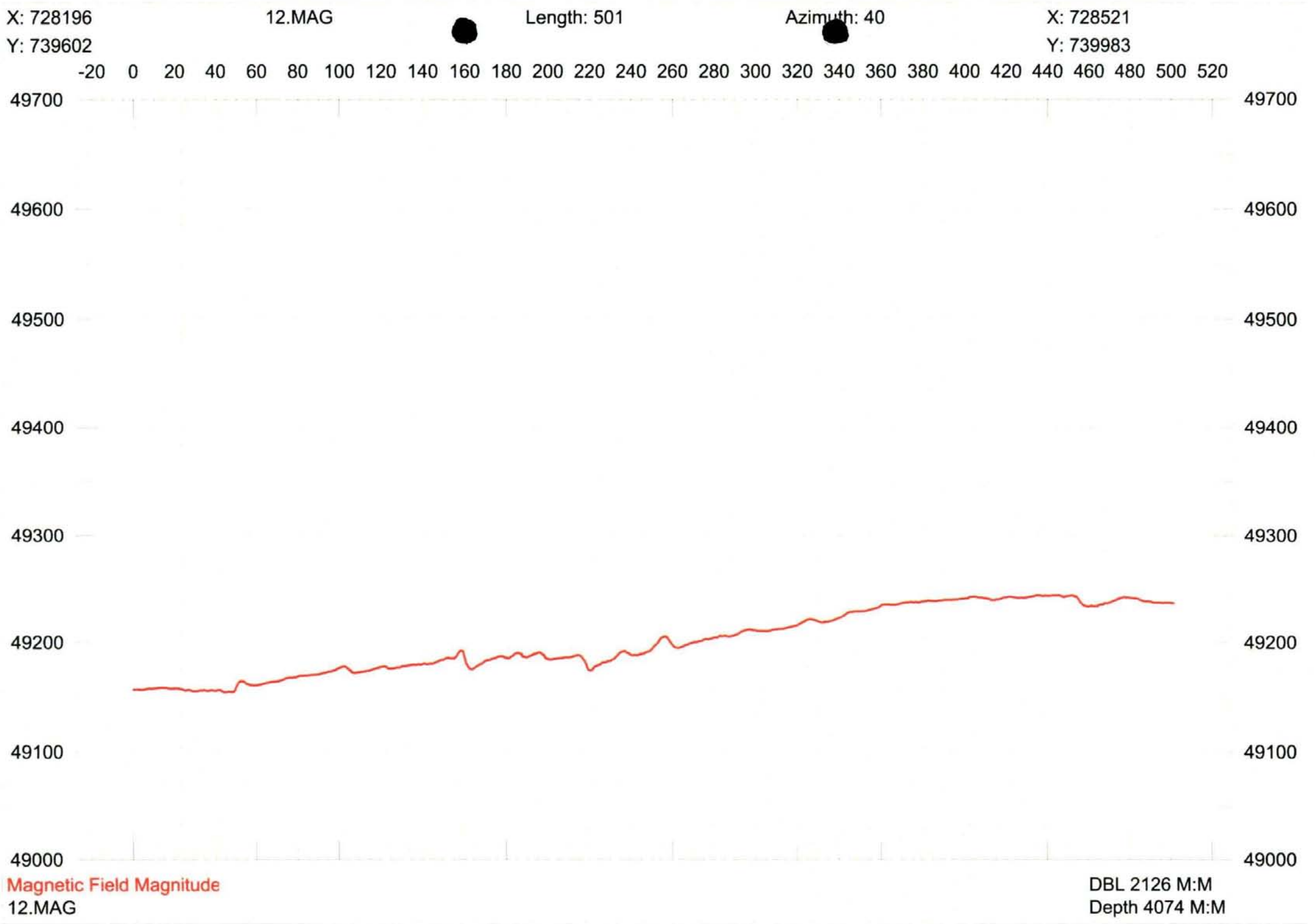
11.MAG
DBL 2203 M:M
Depth 4074 M:M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49100
49000
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12.MAG
DBL 2126 M:M
Depth 4074 M:M


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Y: 739607
13.MAG
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Azimuth: 41
X: 728527
Y: 739968
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Magnetic Field Magnitude
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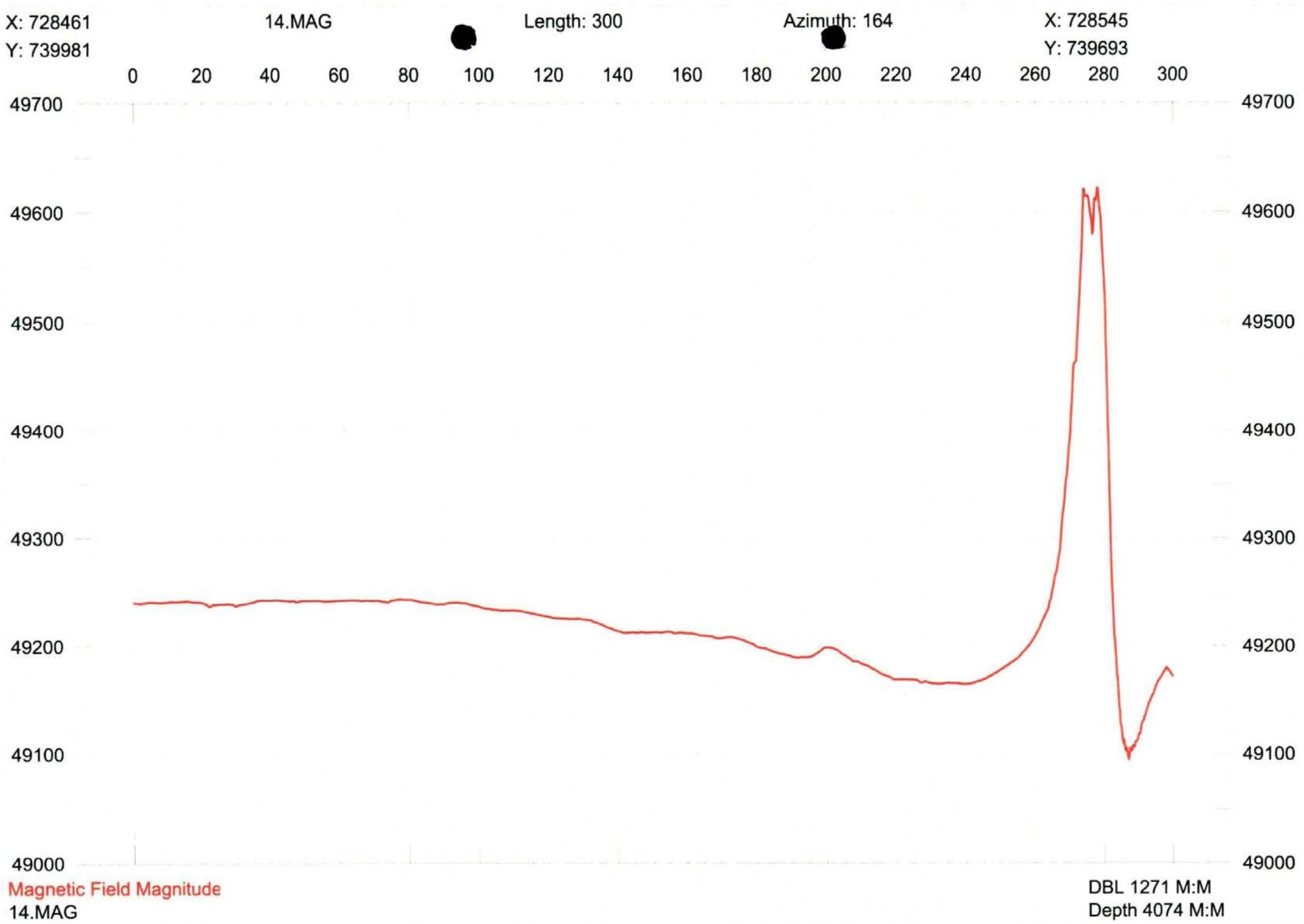
Depth 4074 M:M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Y: 739981
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Azimuth: 164
X: 728545
Y: 739693
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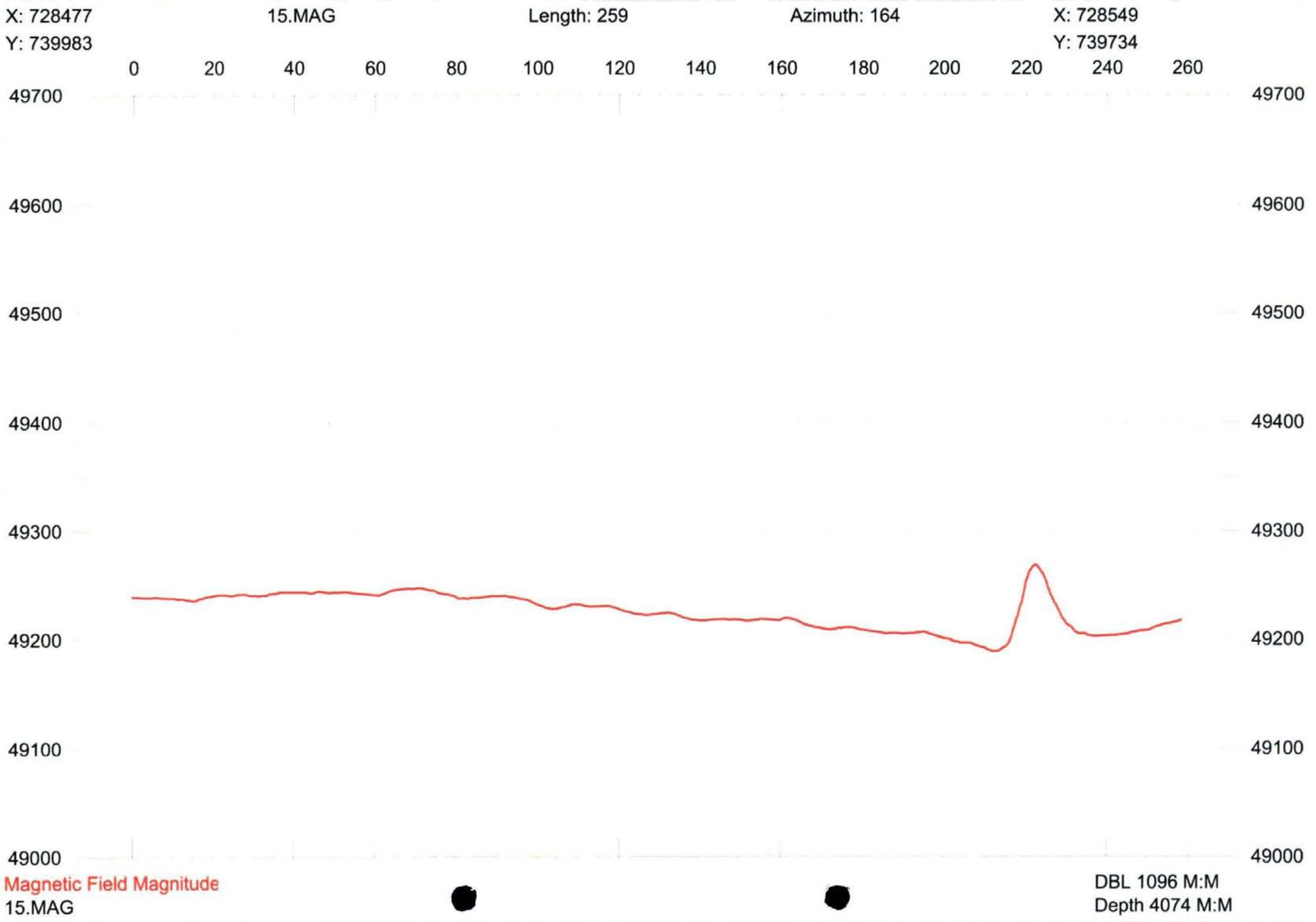
Depth 4074 M:M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Magnetic Field Magnitude
15.MAG
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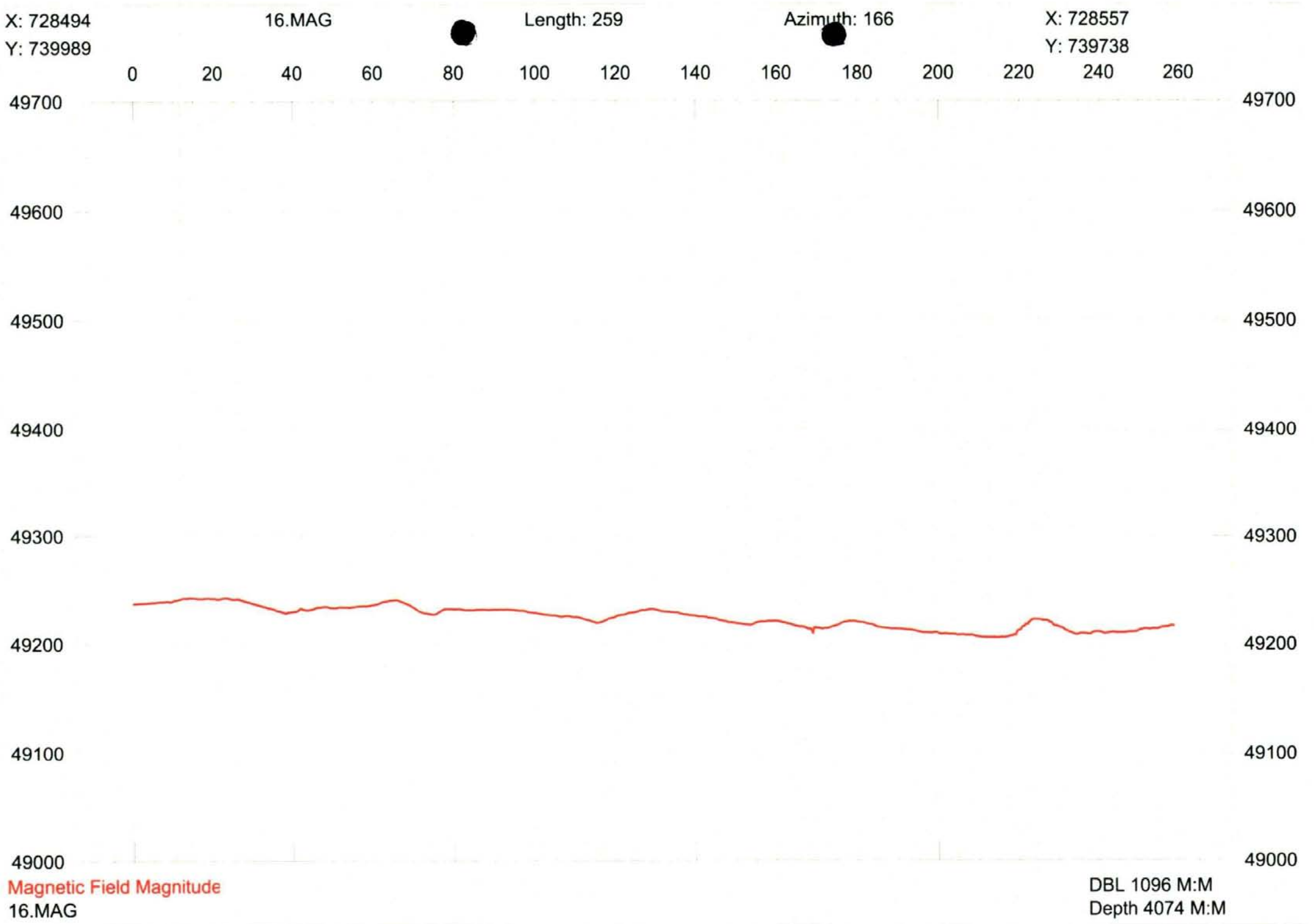
Depth 4074 M:M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Y: 739989
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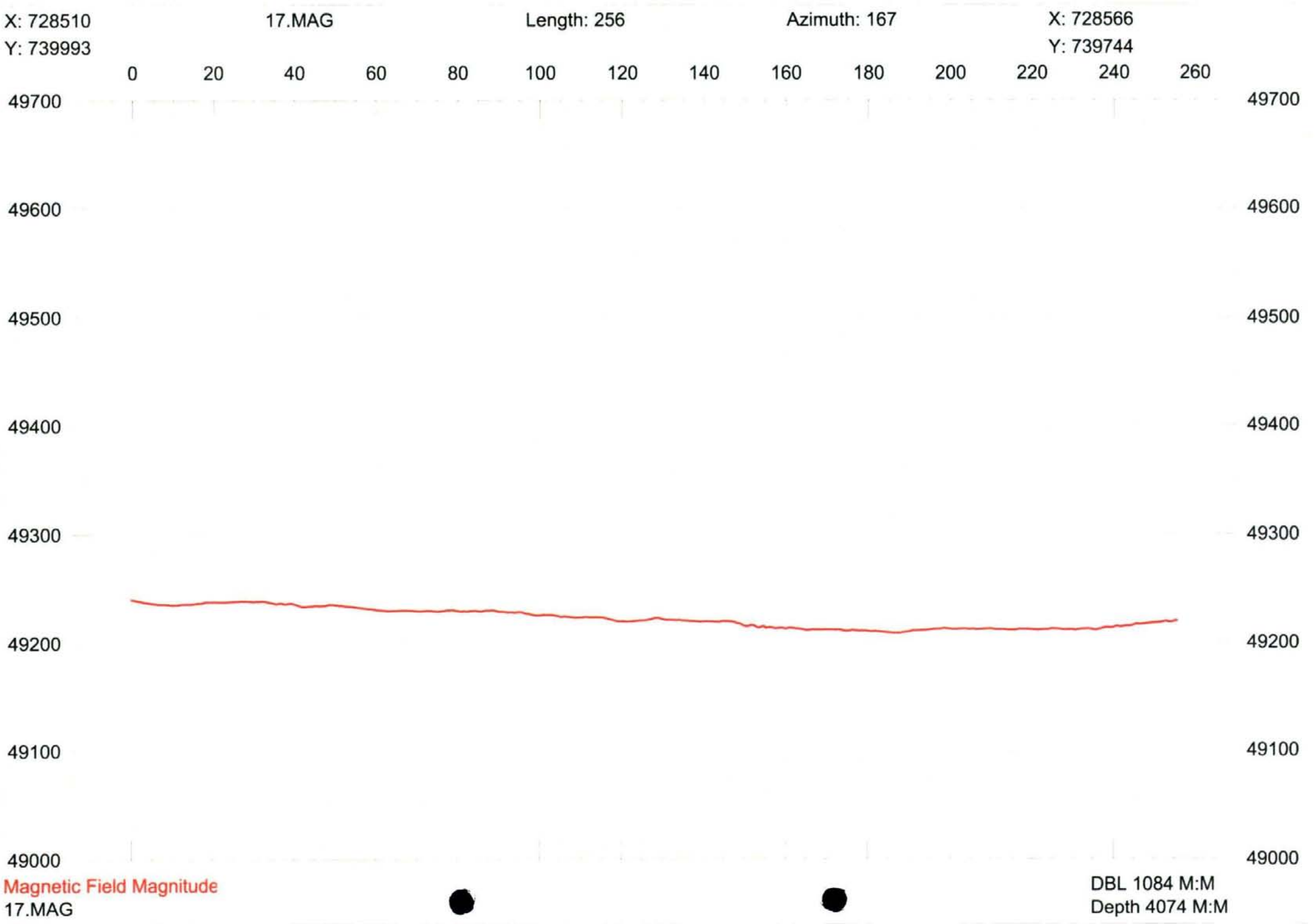
Depth 4074 M:M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Magnetic Field Magnitude
17.MAG
DBL 1084 M:M
Depth 4074 M:M


X: 728383
Y: 739392
18.MAG
Length: 369
Azimuth: 10
X: 728442
Y: 739730
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49700 49600 49500 49400 49300 49200 49100 49000 48900 48800 48700 48600 48500 48400 48300 48200 48100 48000 47900 47800 47700 47600 47500 47400 47300 47200 47100 47000
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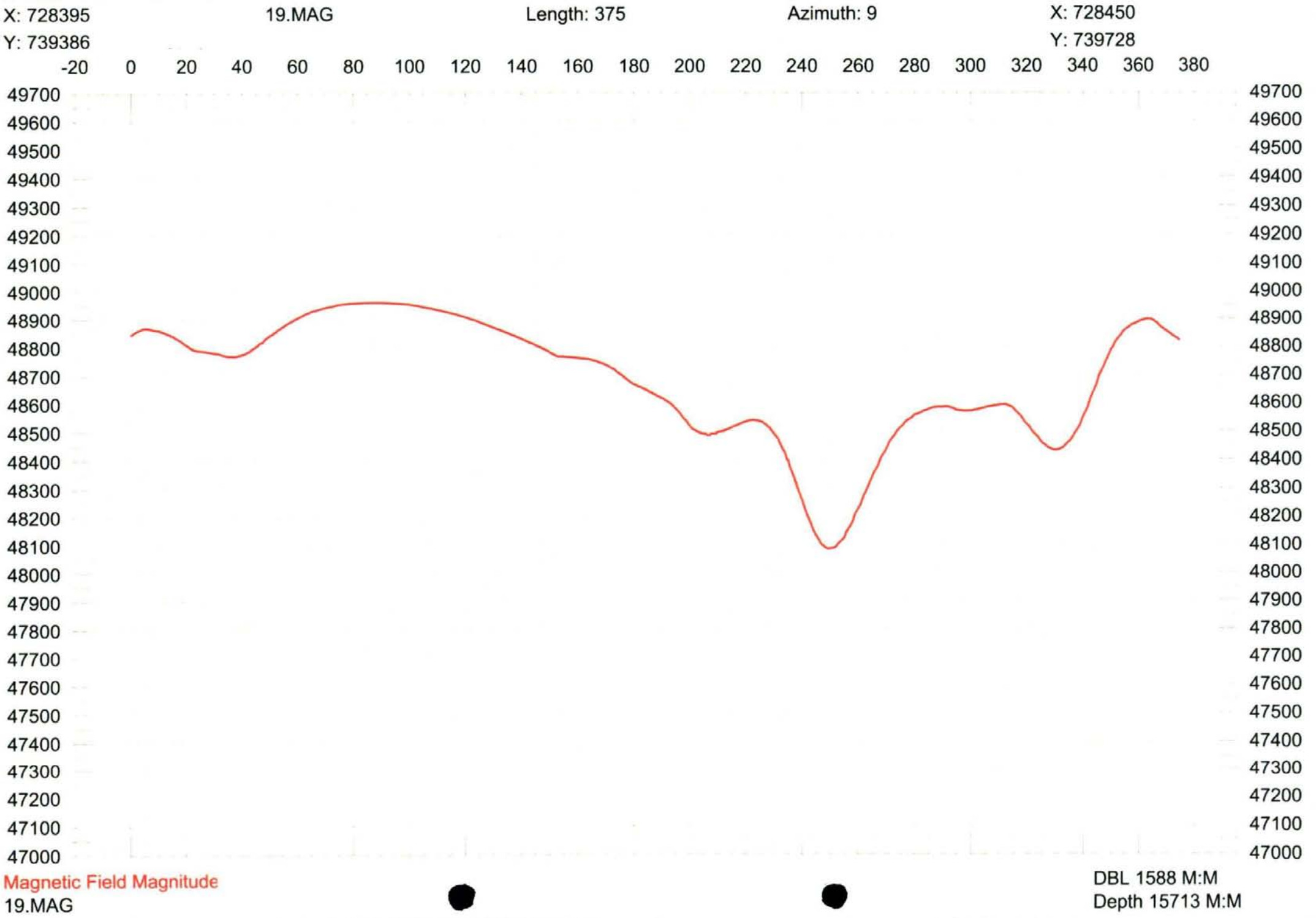
18.MAG
DBL 1547 M:M
Depth 15713 M:M


X: 728395
Y: 739386
19.MAG
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Azimuth: 9
X: 728450
Y: 739728
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Magnetic Field Magnitude
19.MAG
DBL 1588 M:M
Depth 15713 M:M

X: 728406
Y: 739385

20.MAG

Length: 360

Azimuth: 8

X: 728451
Y: 739714

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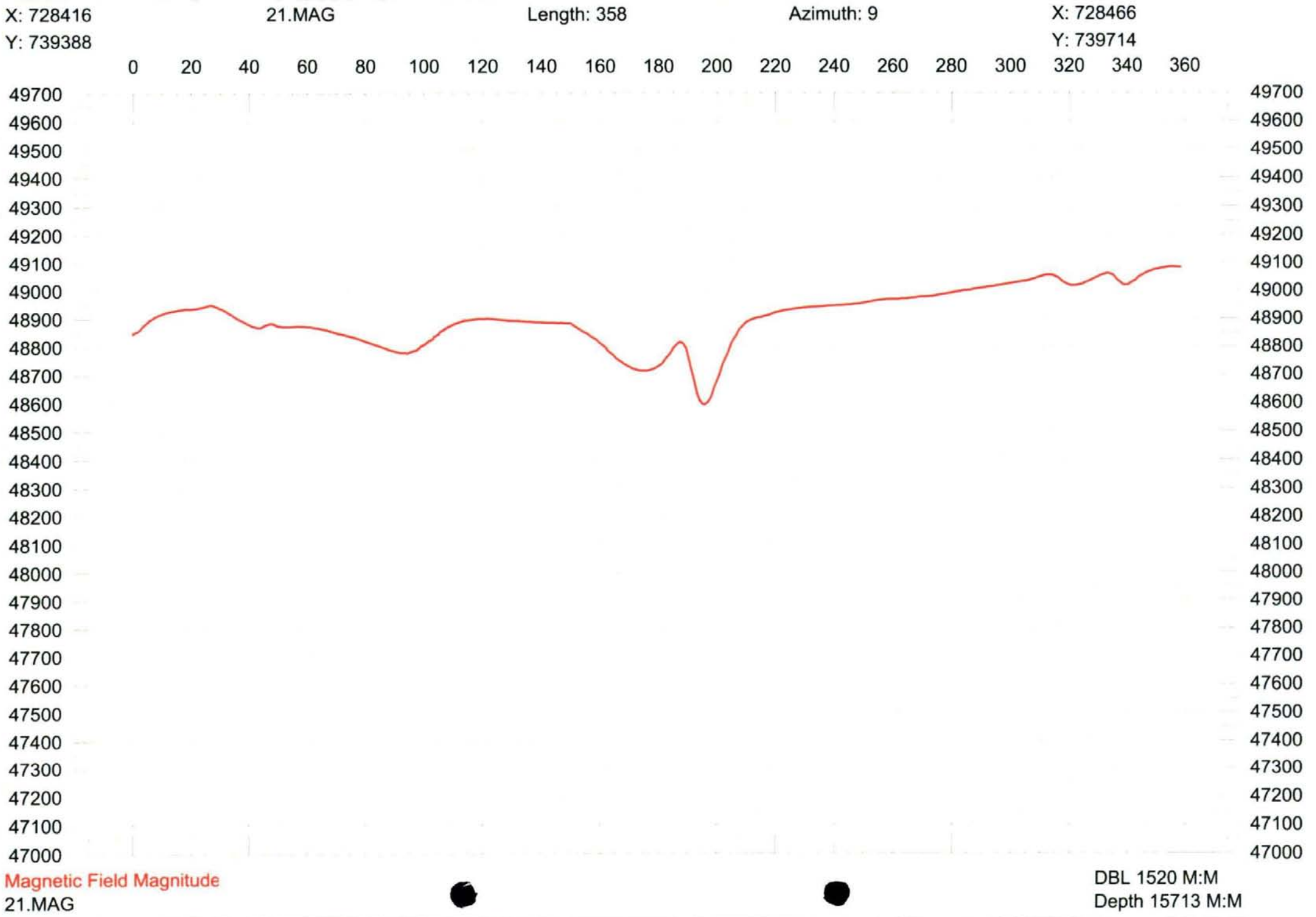
Magnetic Field Magnitude
20.MAG

DBL 1526 M:M
Depth 15713 M:M


X: 728416
Y: 739388
21.MAG
Length: 358
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X: 728466
Y: 739714
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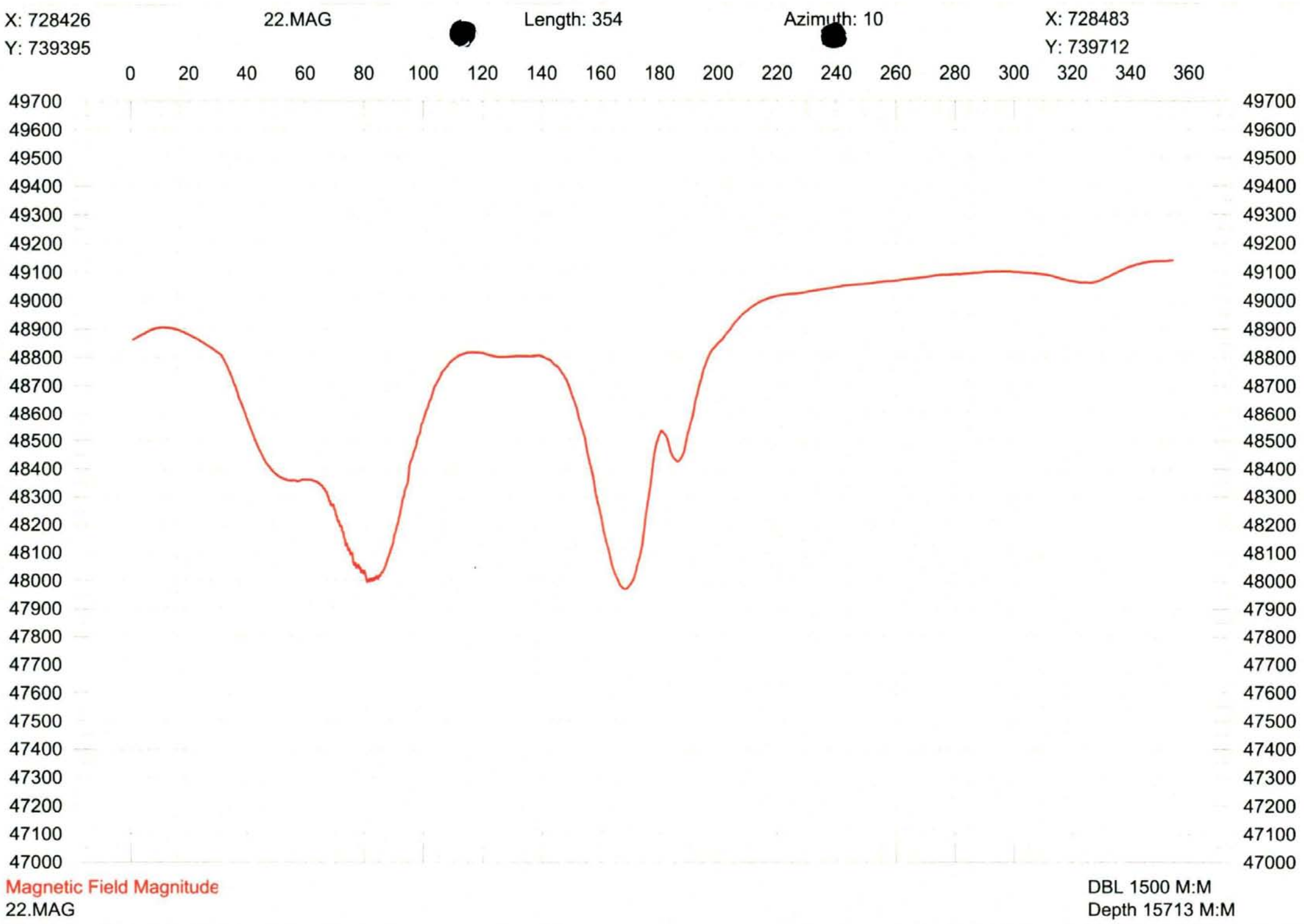
21.MAG
DBL 1520 M:M
Depth 15713 M:M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Azimuth: 10
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Y: 739712
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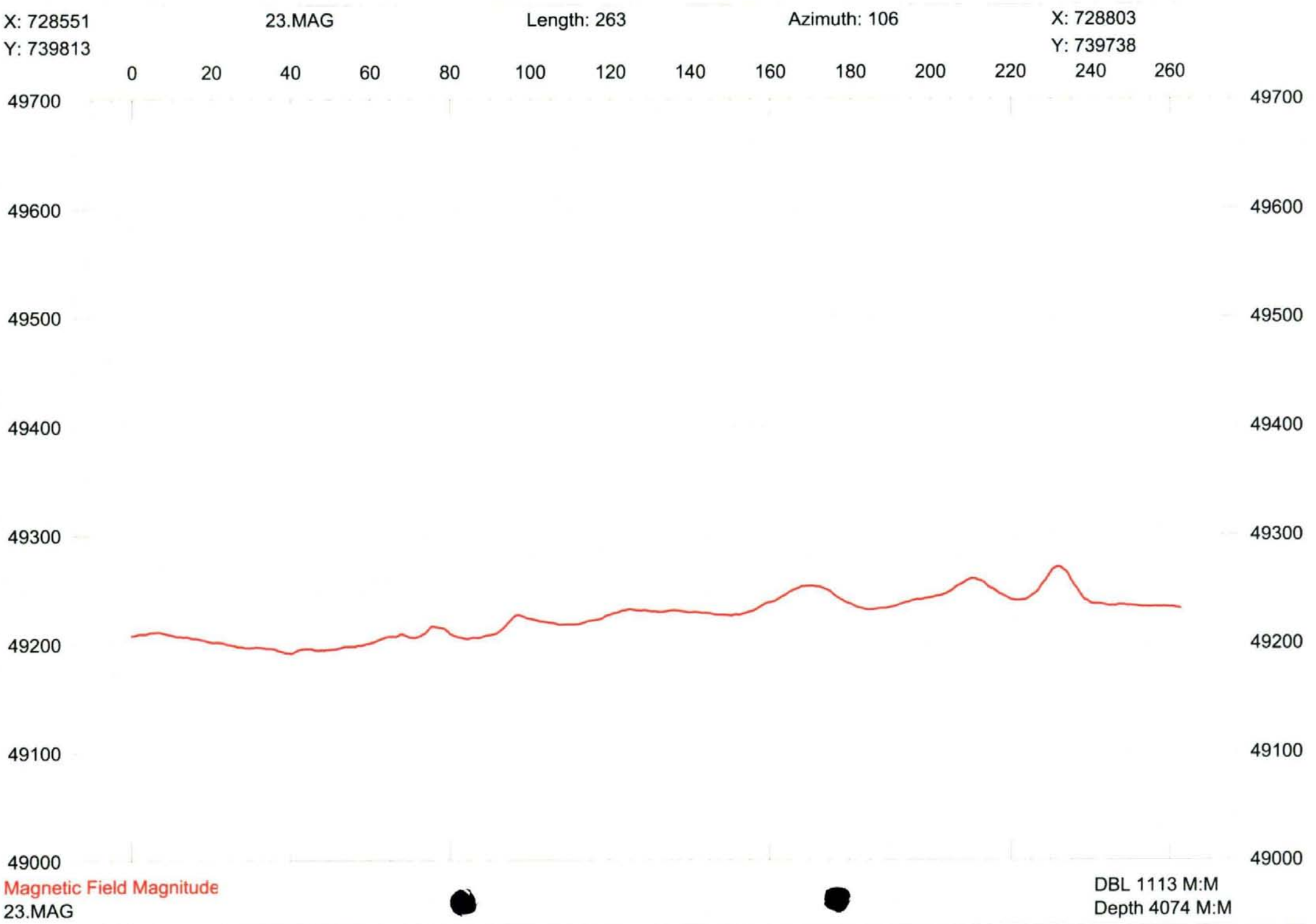
22.MAG
DBL 1500 M:M
Depth 15713 M:M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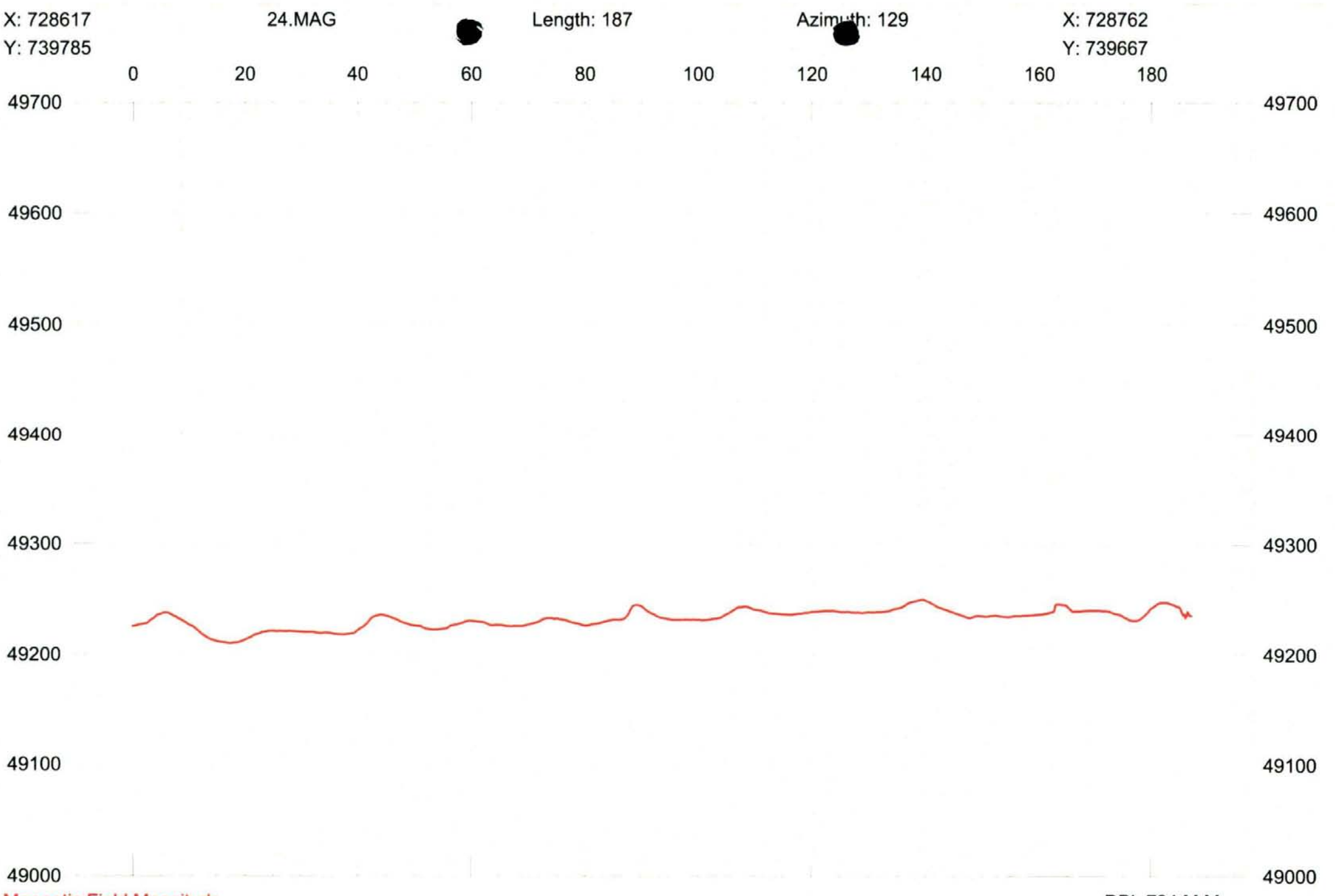
23.MAG
DBL 1113 M:M
Depth 4074 M:M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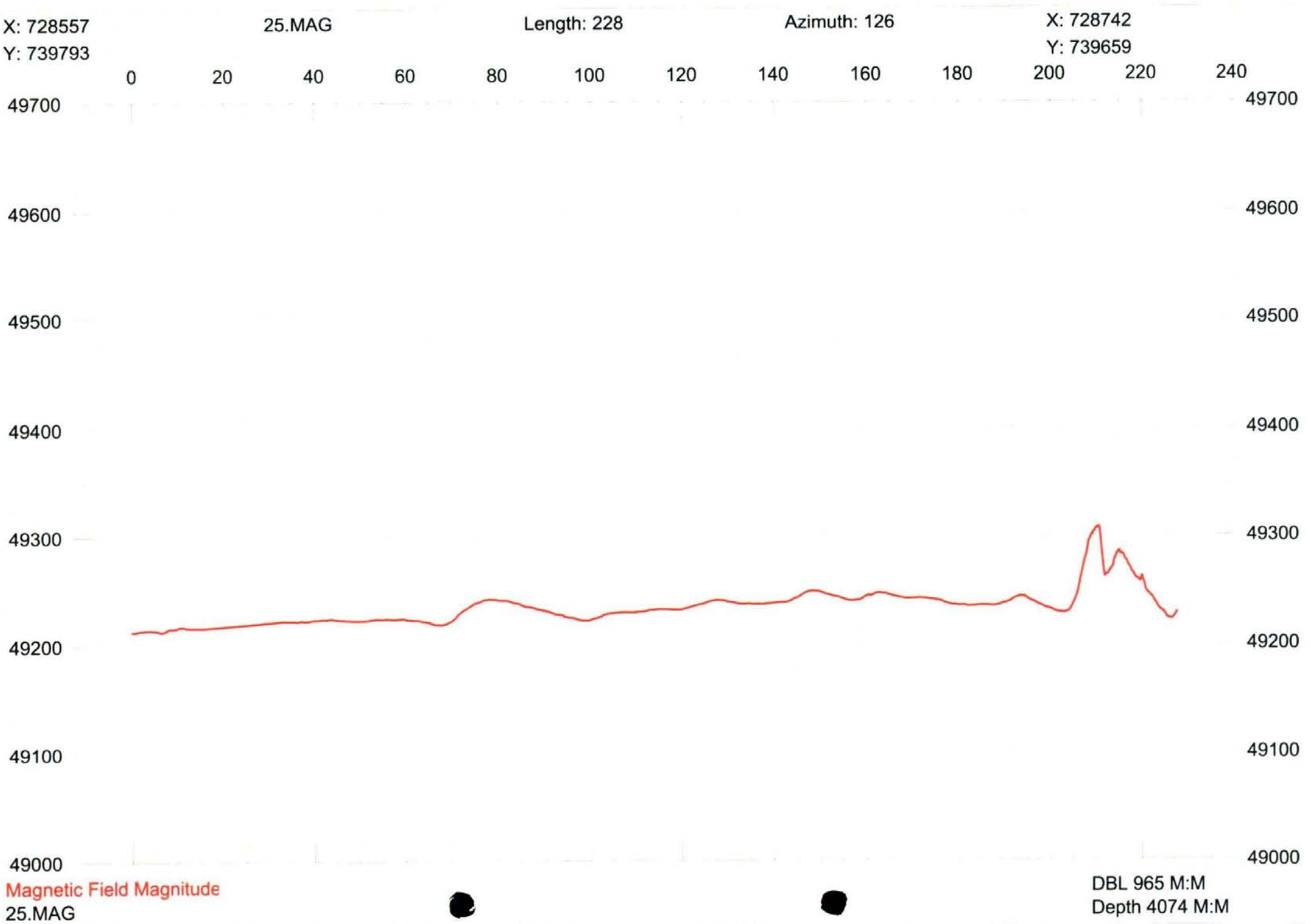
Magnetic Field Magnitude
24.MAG
DBL 794 M:M
Depth 4074 M:M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Azimuth: 126
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Y: 739659
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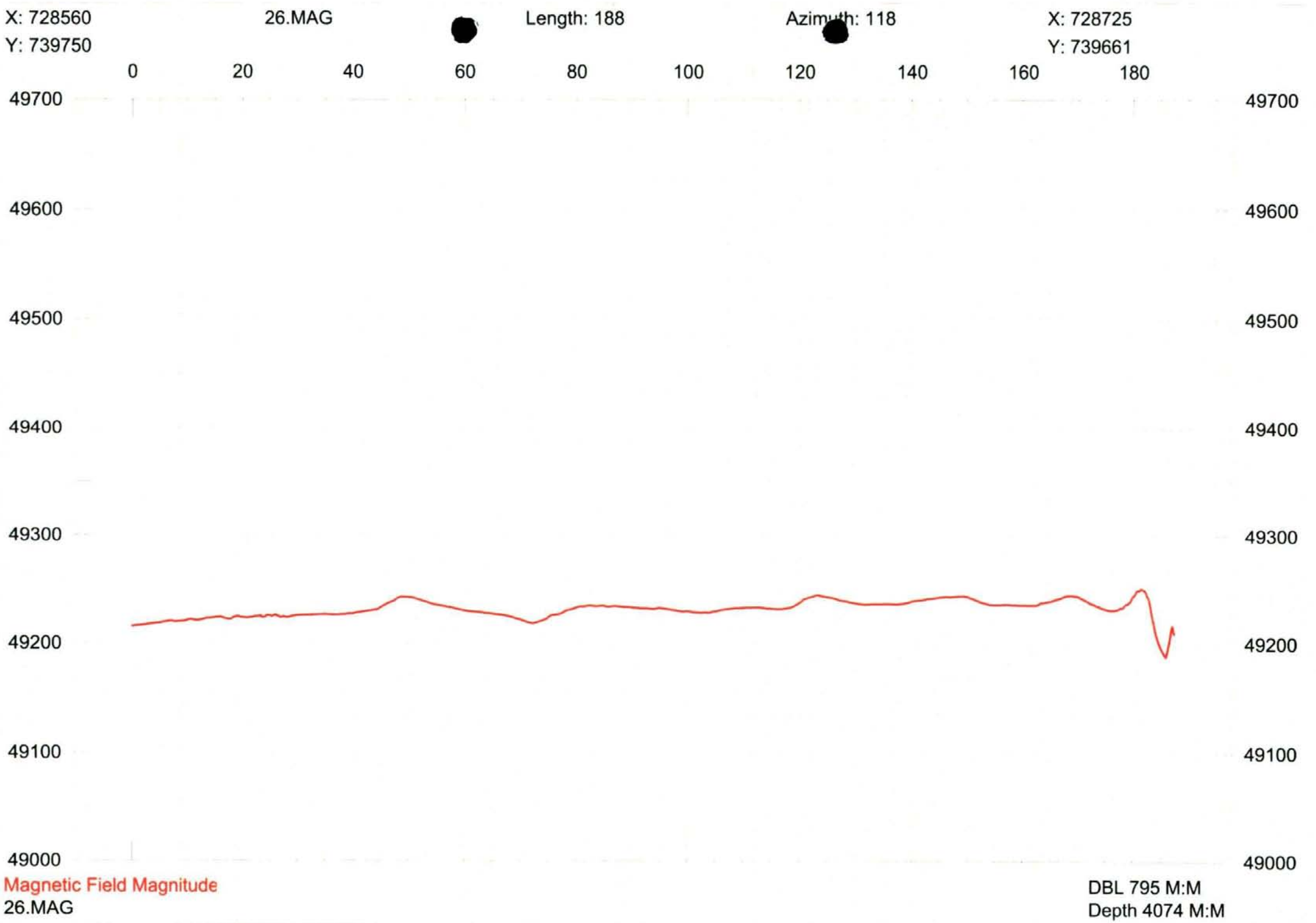
25.MAG
DBL 965 M:M
Depth 4074 M:M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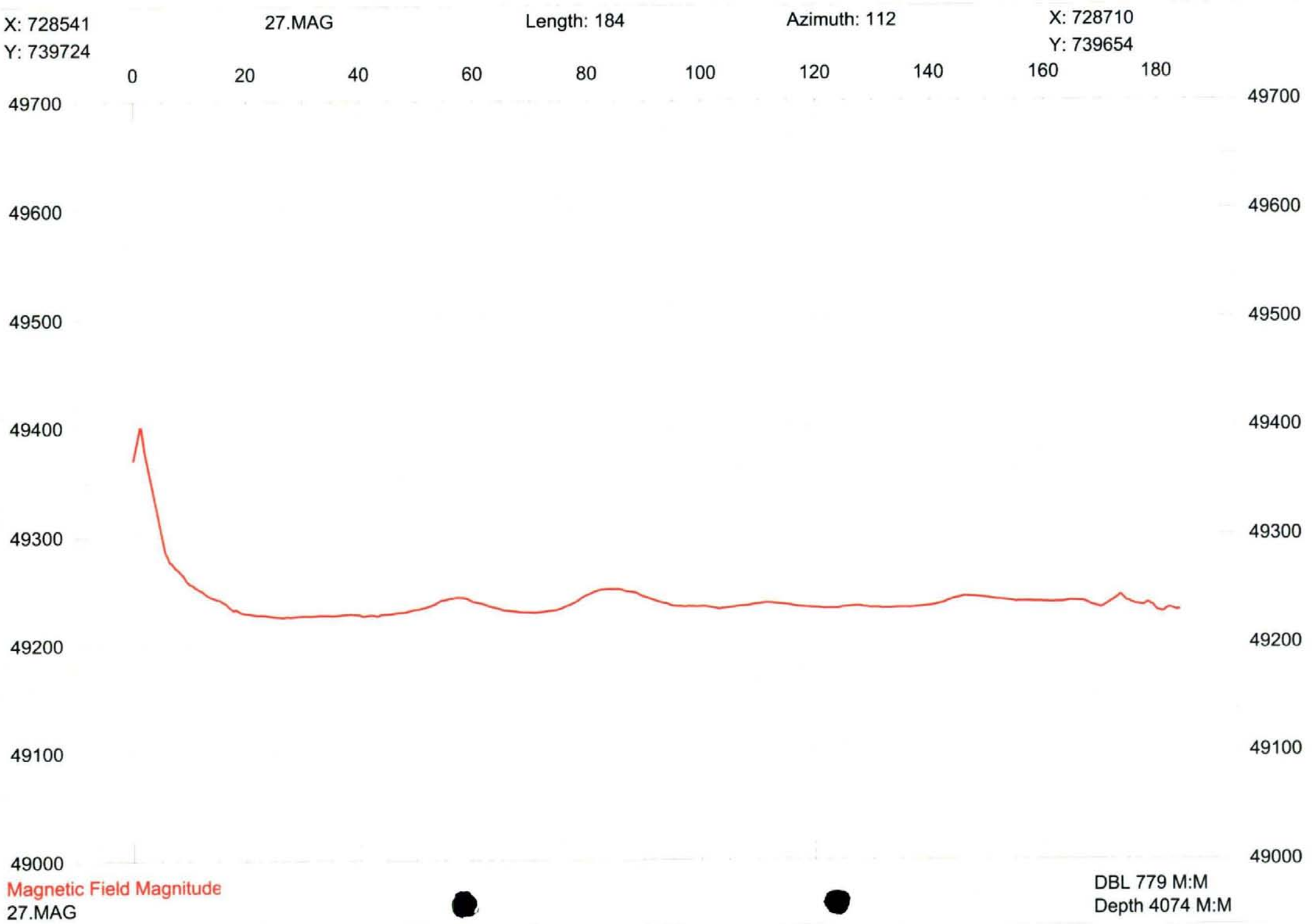
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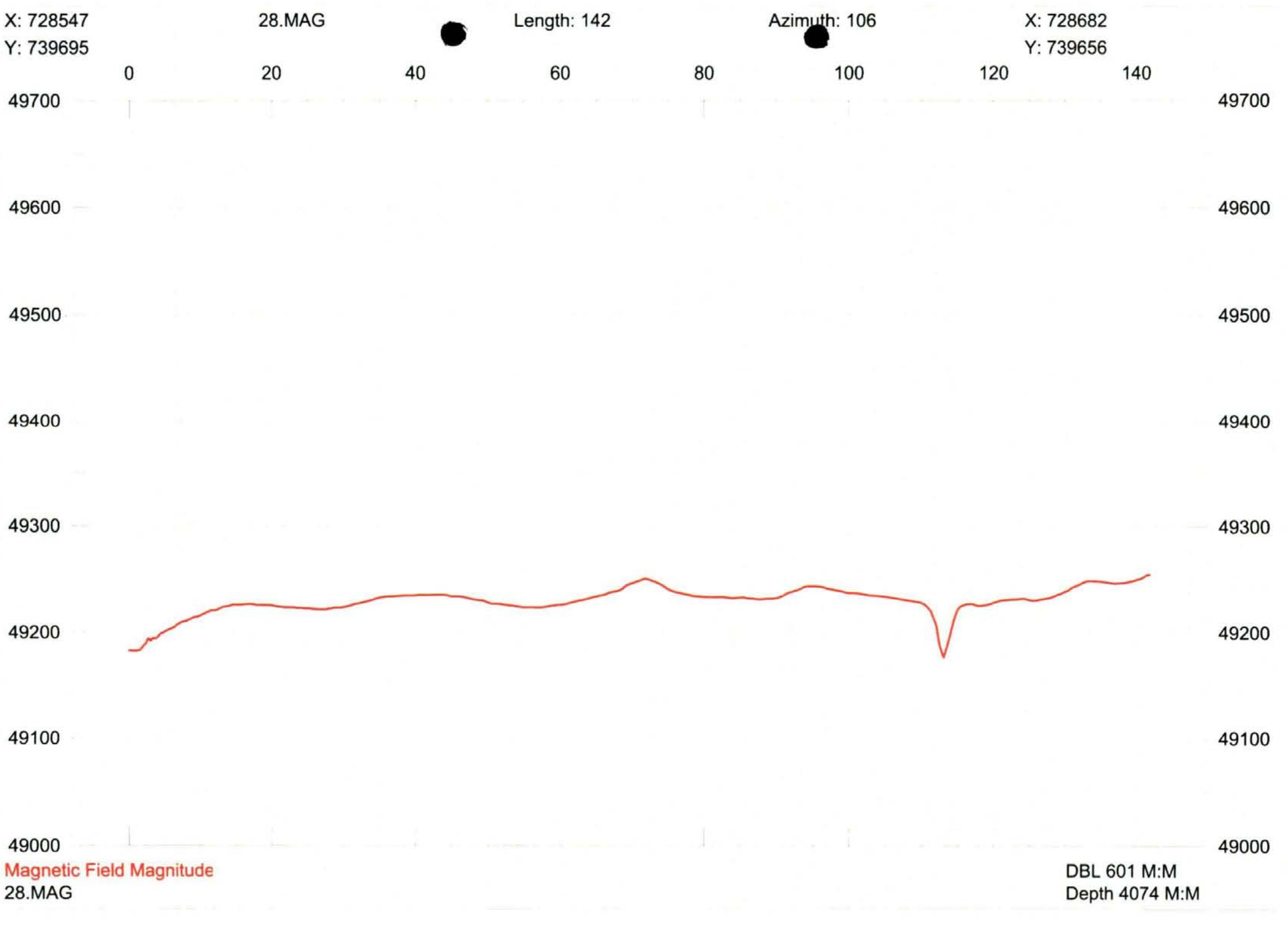
Depth 4074 M:M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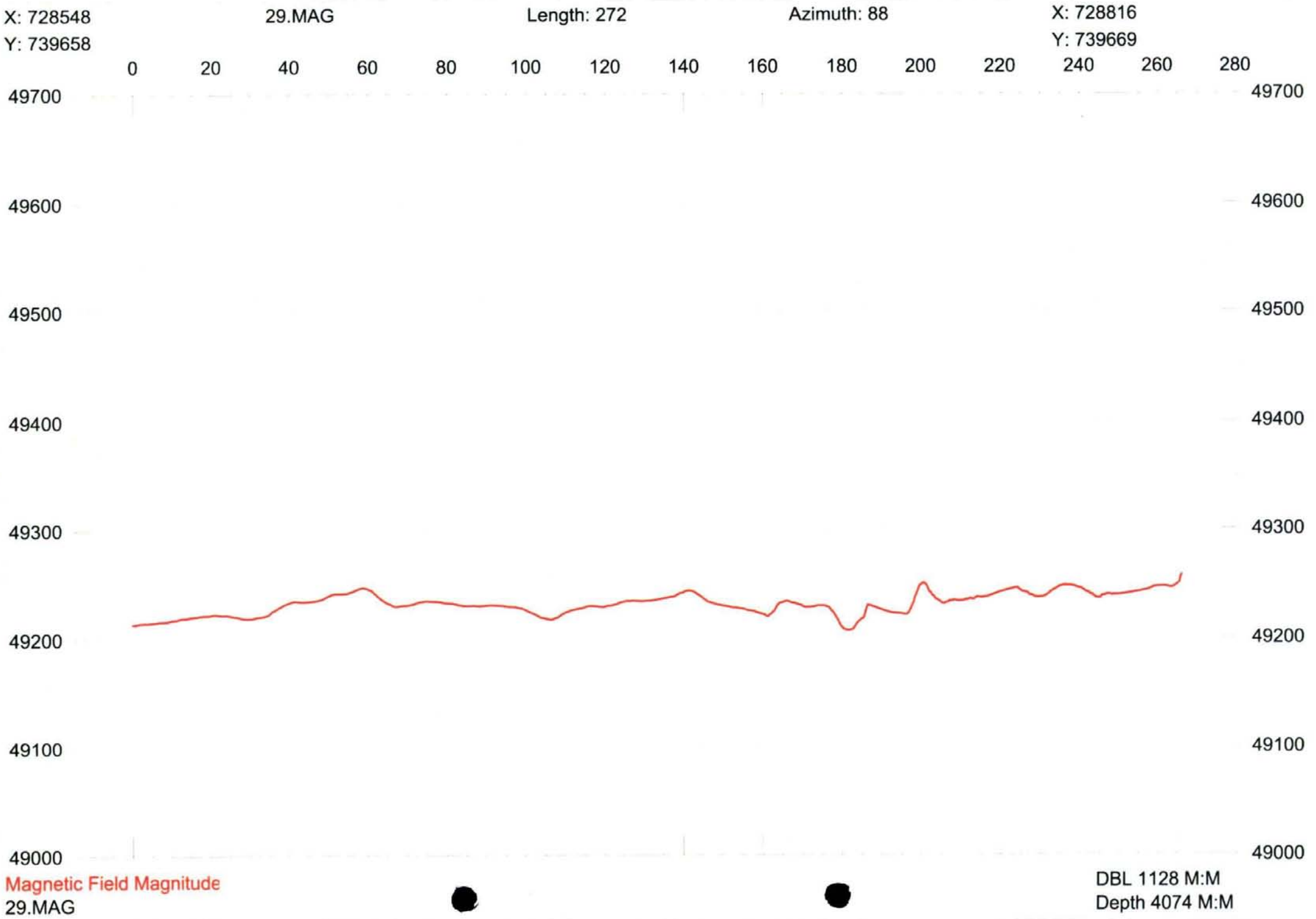
28.MAG
DBL 601 M:M
Depth 4074 M:M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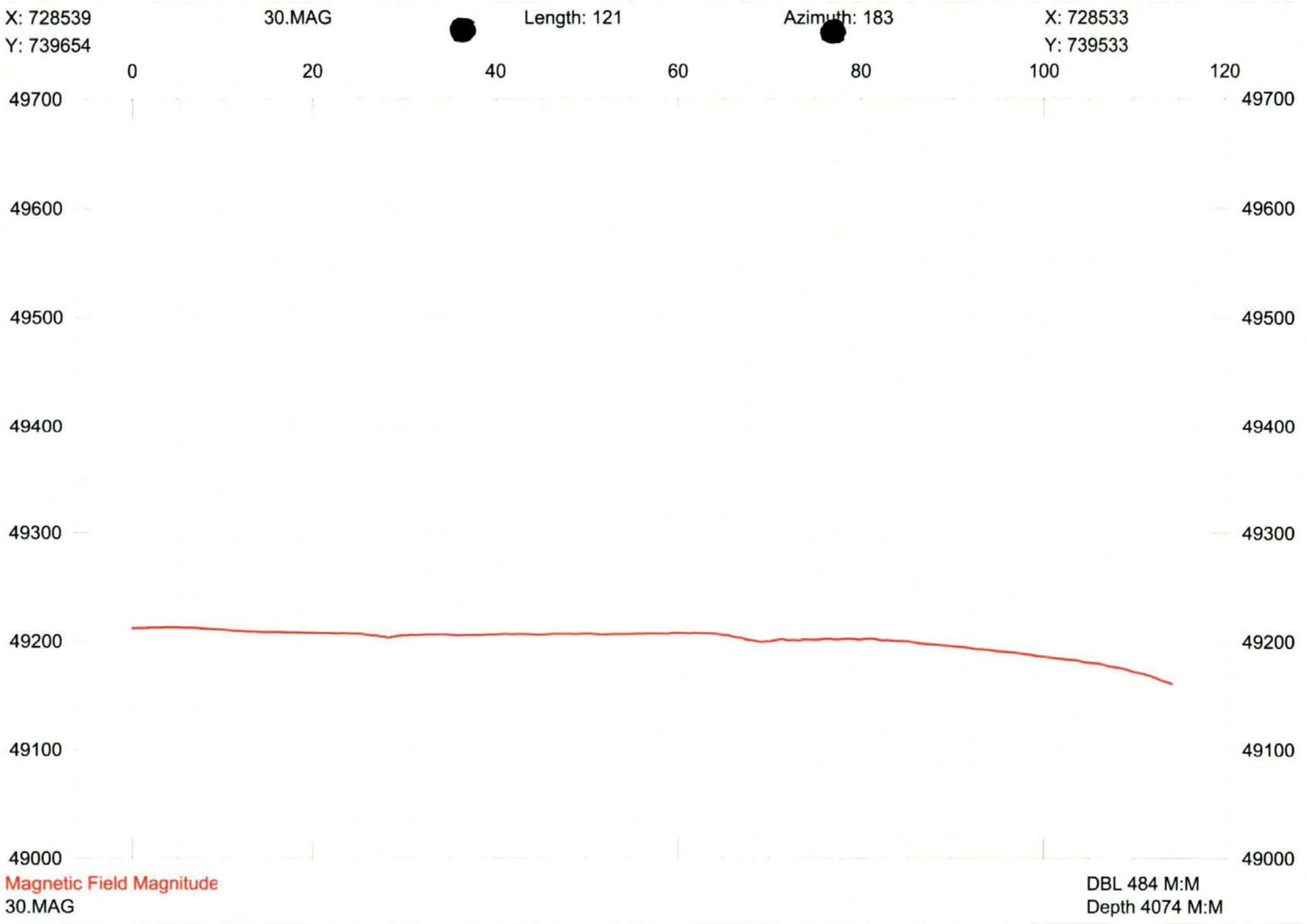
Magnetic Field Magnitude
29.MAG
DBL 1128 M:M
Depth 4074 M:M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Y: 739533
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49500
49400
49300
49200
49100
49000
Magnetic Field Magnitude
30.MAG
DBL 484 M:M
Depth 4074 M:M

APPENDIX C: MARINE MAMMAL OBESRVER REPORT

Final Report: Marine Mammal Mitigation during UTAS Sub-bottom Profiling survey of Howth Harbour

Marine mammal observations and compliance with NPWS guidance to manage the risk to marine mammals from man-made sound sources in Irish waters

Client:	Department of Agriculture Food and Marine
Operator:	Hydrographic Surveys Ltd.
Survey Location:	Howth, Co. Dublin
Survey Vessel:	MV Double or Quits
Survey Date:	10/03/2020 11/03/2020
Project number:	P19188

Author: John Power

Date: 20/03/2020

CONTENTS

EXECUTIVE SUMMARY

Irish waters represent one of the most important marine habitats for cetaceans in Europe (Berrow, 2001) and are utilized by a wide range of marine mammal species. Marine mammals in Ireland are protected under both the 1976 Irish Wildlife Act and the EU Habitats Directive (92/43/EEC). As such, all dredging, drilling, pile driving, blasting and geophysical seismic survey operations are required to adhere to guidelines set forth in the Guidance to Manage the Risk to Marine Mammals from Man-made Sounds Sources in Irish Waters, issued by the National Parks and Wildlife Service (NPWS) of the Department of the Environment, Heritage and Local Government (DEHLG).

As part of subsea investigation for Department of Agriculture Food and Marine (DAFM) in Howth harbour there is a requirement for a geophysical investigation to map depth to and variation in bedrock and provide information on the overlying sediments. The project involved sub-bottom profiling of the survey site using a Pinger system.

Visual observations for marine mammals were conducted preceding and during all survey operations. All observations were conducted during daylight hours and in favourable viewing conditions of a WMO sea state 4 or less, no swell and good visibility.

A pre-shooting watch of 30 minutes was conducted prior to commencement of the ramp-up procedure. Continuous monitoring was also undertake throughout the ramp-up process. The ramp-up process itself lasted for a duration of at least 20 minutes and entailed the gradual and incremental increase of power to the source.

A total of 2 sightings were recorded during the survey at Howth. These consisted of one sighting of a single grey seal on each of the survey days.

The NPWS guidelines were implemented throughout the survey. The ramp-up procedure was initially delayed on the 11th March due to the presence of a grey seal in the survey. The seal was re-sighted during the extended during pre-watch, however due to tidal constraints it was not possible to further delay the ramp-up procedure. This was a recorded as a non-compliance.

No instances of non-compliance with the NPWS guidelines were recorded during the survey on the 10th March.

Due to the high noise level environment in the waters around Howth harbour, it is difficult to determine both the potential impacts on the marine mammals present and the efficacy of the NPWS guidelines. The presence of seals does have the potential to cause delays, loss of production or non-compliances to future projects in this area.

INTRODUCTION

Irish waters represent one of the most important marine habitats for cetaceans in Europe (Berrow, 2001) and are utilized by a wide range of marine mammal species. The waters of the Irish EEZ consist of an area high in biological productivity within the North-East Atlantic and include widespread areas over shallower continental shelf, deep oceanic waters and waters overlying the continental slope (DEHLG, 2009), providing diverse habitats for a range of cetaceans and pinnipeds. At present, there are twenty-five species of cetaceans known to occur in Ireland (Whooley, 2016), along with two species of seals (NPWS, 2013).

In 1937, legal protection for marine mammals in Ireland began with the enactment of the Whale Fisheries Act. The 1976 Wildlife Act provides a legal framework for the conservation of Irish wildlife and their habitats, conferring specific protection on seals, whales, dolphins and porpoises up to 12nmi from the coast (NPWS, 2014). In 1991, the Irish government acknowledged the importance of Irish waters for cetaceans and declared all Irish waters a whale and dolphin sanctuary. The sanctuary covers all waters within the Irish Economic Exclusive Zone (EEZ) which extends 200nmi from the coast (Rogan & Berrow, 1995).

Marine mammals in Ireland are also protected under EC Council Directive (92/43/EEC) on the conservation of natural habitats, and of wild flora and fauna commonly referred to as the EU Habitats Directive. All cetaceans are listed under Annex IV of the Habitats Directive as species requiring strict protection in their natural range (Article 12, EC Council Directive 92/43/EEC). The harbour porpoise (*Phocoena phocoena*) and the bottlenose dolphin (Delphinus delphis), together with both seal species occurring in Irish waters, the grey seal (*Halichoerus grypus*) and the common seal (*Phoca vitulina*), are listed in Annex II and further protected under Article 3 of the Directive, as species whose conservation requires the designation of Special Areas of Conservation (SAC).

As of January 2014, all dredging, drilling, pile driving, blasting, geophysical seismic survey (including airguns, water guns, sparkers, boomers, vertical sonar, sub-bottom profilers, vertical seismic profiling (VSP), checkshot systems) operations in Irish waters (EEZ), as well as multi-beam, single beam, side scan sonar and sub-bottom profiler surveys within bays, inlets, or estuaries or within 1500m to their entrance, are required to adhere to guidelines set forth in the Guidance to Manage the Risk to Marine Mammals from Man-made Sounds Sources in Irish Waters, issued by the National Parks and Wildlife Service (NPWS) of the Department of the Environment, Heritage and Local Government (DEHLG). These guidelines require that a qualified and experienced marine mammal observer (MMO) should be appointed to monitor for marine mammals and to log all relevant events using standardised data forms.

SURVEY DETAILS

Background

As part of subsea investigation for Department of Agriculture Food and Marine (DAFM) in Howth harbour there is a requirement for a geophysical investigation to map depth to and variation in bedrock and provide information on the overlying sediments. The project involved sub-bottom profiling of the survey site using a Pinger system. Due to the potential to cause harm or disturbance to marine mammals, a marine mammal observer was required as directed under the NPWS guidance to manage the risk to marine mammals from man-made sound sources in Irish waters.

Client

Department of Agriculture Food and the Marine, Agriculture House, Kildare St. Dublin 2.

Operator

Hydrographic Surveys Ltd., The Cobbles, Crosshaven, Co. Cork.

Survey Dates and locations

The geophysical investigation was carried out in Howth Harbour, County Dublin, both within the harbour confines and also in a small area just outside the harbour breakwater. Survey work was undertaken in on the 10th and 11th March 2020. Precise survey locations are outlined in *Table 1* below.

Table 1: Extent of foreshore license and sub-bottom profiling survey area

Point number	Latitude	Longitude
1	53.392°	-6.075°
2	53.394°	-6.071°
3	53.391°	-6.063°
4	53.389°	-6.064°
5	53.389°	-6.070°

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Survey Vessels

The survey used a single source vessel, the MV Double or Quits, details are provided below.

Vessel Details

Vessel name:	MV Double or Quits
Survey location:	Howth
Dates:	10/03/2020
	11/03/2020
Length:	10m

MMO QUALIFICATIONS AND CONTACT DETAILS

A single dedicated, fully trained and experienced Marine Mammal Observer was deployed on the survey.

Personal Details

Name:	John Power
Address:	31 Oranbay Apartments, Oranhill, Oranmore, Galway.
Company name:	Emerald Marine Environmental Consultancy
Company Address:	Stradbally, Castlegregory, Tralee, Co. Kerry
Email:	johnpower@emeraldmarine.eu
Phone:	087 1455599

Qualifications

JNCC MMO certificate

STCW-90 Personal Survival Techniques (PST)

Experience

John is a fully qualified and experienced Marine Mammal Observer with a BSc. In Applied Freshwater and Marine Biology from GMIT. He has over 8 years marine mammal mitigation and survey experience in both inshore and offshore waters. Completed projects include; 3D seismic surveys, 2DUHR seismic surveys, site surveys, piling and mooring line installation projects, EIA baseline surveys and NPWS cetacean abundance and distribution surveys.

DETAILS OF SOUND PRODUCING OPERATIONS UNDERTAKEN

Sub-bottom profiling operations were undertake using a pole deployed pinger system. The pinger was mounted using a simple over the side pole mount installation. The pinger system used for the survey was a Knudsen Pinger SBP with specifications as outlined below. The survey was conducted at reduced power due to the water depth. Survey equipment reached a maximum output of 50% rated power output.

Survey Equipment Specifications

Knudsen Pinger SBP

Output power:	<2kW
Peak transmitting voltage response:	157.5dB re 1V/µPa at 1 metre
Pulse length range:	62.5µs to 64ms
Frequency Range:	3.5kHz to 15kHz

Ramp-up procedure

The ramp-up procedure employed for the pinger system involved gradually increasing the power to the system in an incremental pattern over the course of at least 20 minutes. Care was taken to undertake the first survey line as quickly as possible after the 20 minute ramp-up had been completed to minimise excessive unnecessary noise output to the environment.

Survey Operations

Following the ramp-up procedure, survey lines were undertaken immediately at full survey power. All survey lines were conducted during daylight hours and in favourable weather conditions. Survey lines were undertaken at constant speeds of between 2- 4 knots, with line turns of >1 minute recorded. There were no shut downs or breaks in production recorded during the survey, therefore, a single pre-shooting watch and ramp-up procedure was conducted on each survey day. Specific details of survey operations are outlined in *Table 2* below.

Table 2: Details of survey operations.

LOCATION	DATE	TIME RAMP-UP BEGAN	TIME OF FULL POWER	TIME OF START OF LINE	TIME SOURCE STOPPED
HOWTH	10/03/2020	10:12	10:33	10:33	12:02
HOWTH	11/03/2020	10:26	10:46	10:46	11:36

MARINE MAMMAL MONITIORING AND MITIGATION

Monitoring Watches Conducted for Marine Mammals

Visual observations for marine mammals were conducted preceding and during all survey operations. All observations were conducted during daylight hours and in favourable viewing conditions of a WMO sea state 4 or less, no swell and good visibility.

A single pre-shooting watch was conducted at the survey site each day prior to commencement of the ramp-up procedure. Continuous monitoring was also undertaken throughout the ramp-up process.

Observations were conducted from both the source vessel and the breakwater outside the west pier in Howth harbour. While surveying within the harbour confines, observations for marine mammals were conducted from the source vessel. Due to the small size of the source vessel, the number of crew aboard and the restricted view which would be available to the MMO it was determined that shore based observations would be most appropriate for the survey area lying outside the breakwater. The breakwater was chosen as a suitable location due to the close proximity of the survey area to the breakwater and the elevated position offered by the breakwater itself, providing an observation height of approximately 4-5m above sea level and good views of the entire survey area. Nikon Prostaff 7x42 binoculars were used to assist with observations and species identification. A Canon 7d DSLR with a Sigma 100-400mm zoom lens was also used to further aid species identification. Distance estimation was aided with the use of a calibrated distance stick (Heinemann, 1981).

Weather conditions were extremely variable on the 10th March. An initial pre-shooting watch was conducted from the breakwater as the survey plan was to begin with surveying the area lying outside of the breakwater. During the pre-shooting watch the sea state was recorded as WMO sea state 3, while wind force was recorded as Beaufort 5. However, just prior to beginning the soft start weather conditions deteriorated drastically (WMO 4, Beaufort 6). The decision was taken to abandon surveying outside the breakwater and instead survey within the sheltered harbour confines. The sea state was recorded as WMO sea state 1-3 within the harbour, while wind force ranged from Beaufort 5-7 over the course of the survey. No swell or precipitation were recorded during the survey.

Weather conditions were much improved on the 11th March. The pre-shooting watch was conducted from the breakwater as the survey plan was survey the remaining area lying outside of the breakwater. The sea state was recorded as WMO sea state 2, while wind force was recorded as ranging from Beaufort 2-4 over the course of the survey. No swell or precipitation were recorded during the survey.

Marine Mammal Sightings

A total of 2 sightings were recorded during the survey at Howth. These consisted of two sightings of a single grey seal, with one sighting recorded on each survey day. Each sighting was detected by the marine mammal observer during monitoring watches.

The first sighting of a grey seal occurred within the survey area inside the harbour during the ramp-up procedure at 10:20 on the 10th March. As the ramp-up procedure had already begun, no mitigation actions were required. The animal remained in the survey area and was repeatedly re-sighted over a period of 35 minutes. The animal did not move away from the vessel during the ramp up and showed no evident avoidance of the vessel at full power. No unusual behaviour was observed.

The second sighting of a grey seal was recorded at 09:55 on the 11th March during the pre-shoot watch. This resulted in a delay to the ramp-up procedure. The animal was re-sighted at 10:10, however due to tidal restrictions on the survey start time it was not possible to further delay the beginning of the ramp-up procedure. The ramp-up began at 10:26 there-by incurring a non-compliance.

COMPLIANCE WITH GUIDELINES

The NPWS guidelines set forth in the Guidance to Manage the Risk to Marine Mammals from Man-made Sounds Sources in Irish Waters (NPWS, 2014) were implemented during the survey.

The presence of a grey seal in the survey area during the pre-shoot watch on the 11th March resulted in a delay of 19 minutes to the ramp-up procedure. The animal was re-sighted at 10:10, however due to tidal restrictions on the survey start time it was not possible to further delay the beginning of the ramp-up procedure. The ramp-up began at 10:26 there-by incurring a non-compliance.

No instances of non-compliance were recorded on the 10th March. Although a seal was sighted within the survey area, this sighting and all subsequent re-sightings occurred either after the ramp-up procedure had begun or while the source was at full power. As no shut down requirement is specified in the guidelines, no additional mitigation measures were required.

CONCLUSION

The NPWS guidelines set forth in the Guidance to Manage the Risk to Marine Mammals from Man-made Sounds Sources in Irish Waters (NPWS, 2014) were implemented during the survey.

On the 11th March, the presence of a grey seal in the survey area resulted in an initial 19 minute delay to the ramp-up procedure. The animal was re-sighted during the extended pre-watch period however due to tidal restrictions it was not possible to further delay the ramp-up, therefore a non-compliance was recorded. During this re-sighting the animal was observed leaving the survey area and heading into the harbour. The seal was not observed leaving the harbour and may have remained there for the

duration of the survey. The breakwater itself, and its position relative to the survey area, may have mitigated the sound exposure level received by the seal, acting as a physical barrier to sound.

No additional mitigation measures were required during operations on the 10th March. Although a seal was sighted within the survey area, this sighting and all subsequent re-sightings occurred either after the ramp-up procedure had begun or while the source was at full power. As no shut down requirement is specified in the guidelines, no additional mitigation measures were required. The animal did not move away from the vessel during the ramp up and showed no evident avoidance of the vessel at full power. No unusual or evasive behaviour was observed while the source was ramping up or at full power. This raises questions over both the efficacy of the ramp-up procedure as a mitigation measure, and the risk to seals posed by the sound source in this particular situation. However, animals occurring in high noise environments are likely habituated to elevated noise levels, and furthermore, many species display increased tolerance to noxious stimuli in the presence of a food resource.

The waters around Howth harbour are a high noise environment. Howth is an active fishing port and tourist destination, with frequent vessel movements. Any animals, including marine mammals, in the area are therefore subject to a relatively high noise level environment, and possibly somewhat habituated to this environment. It is therefore difficult to determine both the impacts on marine mammals and the efficacy of the NPWS guidelines in such situations. The presence of seals does have the potential to cause delays, loss of production or non-compliances to future projects in this area. This situation is particularly difficult in fishing ports such as Howth where the availability of an easily accessible food source encourages seals to remain in the area despite possible disturbance by survey or construction works.

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APPENDICES

Appendix 1

Table 2: Marine mammal species occurring in Irish waters and their conservation status (Sources: Wall et al., 2013; Whooley, 2016; Temple, et al., 2007)

Common name	Scientific name	Occurrence	Conservation Status (IUCN Europe)
Baleen whales			
Humpback whale	Megaptera novaeangliae	May-Aug	Least concern
Blue whale	Balaenoptera musculus	July-March	Endangered
Fin whale	Balaenoptera physalus	All year	Near threatened
Sei whale	Balaenoptera borealis	All year	Endangered
Northern minke whale	Balaenoptera acutorostrata	All year	Least concern
Northern right whale	Eubalaena glacialis	Vagrant	Critical
Bowhead whale	Balaena mysticetus	Data deficient	Not assessed
Toothed whales and dolphins			
Sperm whale	Physeter macrocephalus	All year	Vulnerable
Pygmy sperm whale	Kogia breviceps	Vagrant	Not assessed
Killer whale	Orcinus orca	All year	Data deficient
False killer whale	Pseudorca crassidens	June-Nov	Not assessed
Long-finned pilot whale	Globicephala melas	All year	Data deficient
Cuvier's beaked whale	Ziphius cavirostris	May-Aug	Least concern
Northern bottlenose whale	Hyperoodon ampullatus	May-Aug	Data deficient
Gervais' beaked whale	Mesoplodon europaeus	Vagrant	Data deficient
Sowerby's beaked whale	Mesoplodon bidens	All year	Data deficient
True's beaked whale	Mesoplodon mirus	All year	Data deficient
Beluga	Delphinapterus leucas	Vagrant	Not assessed
Risso's dolphin	Grampus griseus	March-July	Data deficient
Common bottlenose dolphin	Tursiops truncatus	All year	Data deficient
Short-beaked common dolphin	Delphinus delphis	All year	Data deficient
Striped dolphin	Stenella coeruleoalba	May-Sept	Data deficient

White-beaked dolphin	Lagenorhynchus albirostris	All year	Least concern
Atlantic white-sided dolphin	Lagenorhynchus acutus	All year	Least concern

Porpoises

Harbour porpoise	Phocoena phocoena	All year	Vulnerable

Seals

Grey seal	Halichoerus grypus	All year	Least concern
Common (harbour) seal	Phoca vitulina	All year	Least concern

Appendix 2

Summary of Marine Mammal recording sheets.

Table 3: Operations recording form.

Type of operation or activity Dredging, Drilling, Pile driving, Blasting, other	Date (dd/mm/yyyy)	SOUND-PRODUCING OPERATION OR ACTIVITY			Pre-Start Monitoring effort for marine mammals					Action necessary		
		Time when ramp-up/soft-start began [if any] (GMT/UTC)	Time when equipment reached full power (GMT/UTC)	Time when equipment stopped or shut down (GMT/UTC)	Who carried out the monitoring for marine mammals? (Job Title)	Start time of monitoring for marine mammals [Pre-start-up] (GMT/UTC)	End time of monitoring for marine mammals (GMT/UTC)	Reason for non-detection of marine mammals? (e.g. sea state, swell, glare, poor light, fog, rain, etc.)	Were hydro-phones used? (Yes/No)	Were marine mammals present in the 30/60 mins before start-up? (Yes/No)	If Yes, give time when marine mammals were last seen (GMT/UTC)	If marine mammals were present, what action was taken? (e.g., delay ramp-up/soft start, delay full start-up)
Sub-bottom profiling	10/03/20	10:12	10:32	12:02	MMO	09:19	12:02	-	No	No	-	-
Sub-bottom profiling	11/03/20	10:26	10:46	11:36	MMO	09:37	11:36	-	No	Yes	10:10	Delay ramp-up

Table 4: Effort recording form.

Type of operation or activity	**Date**	**Marine Mammal Observer**	Time you began monitoring for marine mammals	Time you stopped monitoring for marine mammals	Duration of monitoring watch	Duration of the sound-producing operation/activity while you were monitoring for marine mammals (minutes)	Start Lat/Long position	End Lat/Long position	Wind direction & Beaufort wind force	Sea State (WMO)	Swell height 0 = no Swell L = 0-1 m M = 1-2 m H = 2+ m	Visibility P = < 1 km M = 1-5 km G = 5-10 km H = >10 km
Sub-bottom profiling	10/03/2020	John Power	9:19	10:12	53	-	52 23.54N 06 04.11W		NW 5	3	0	G
Sub-bottom profiling	10/03/2020	John Power	10:12	10:32	-	20	52 23.54N 06 04.11W	52 23.54N 06 04.11W	NW 6	1	0	G
Sub-bottom profiling	10/03/2020	John Power	10:32	11:29	-	57	52 23.54N 06 04.11W	52 23.54N 06 04.11W	NW 7	1	0	G
Sub-bottom profiling	10/03/2020	John Power	11:29	12:02	-	33	52 23.54N 06 04.11W	52 23.54N 06 04.11W	NW 7	3	0	G
Sub-bottom profiling	11/03/2020	John Power	9:37	10:10	33	-	52 23.54N 06 04.11W		NW 4	2	0	G
Sub-bottom profiling	11/03/2020	John Power	10:10	10:26	16	-	52 23.54N 06 04.11W		NW 3	2	0	G
Sub-bottom profiling	11/03/2020	John Power	10:26	10:46	-	20	52 23.54N 06 04.11W		NW 3	2	0	G
Sub-bottom profiling	11/03/2020	John Power	10:46	10:54	-	8	52 23.54N 06 04.11W		NW 3	2	0	G
Sub-bottom profiling	11/03/2020	John Power	10:54	11:36	-	42	52 23.54N 06 04.11W		NW 2	2	0	G

Table 5: Summary of sightings recording form.

Sighting number	Date	Time at start of encounter (UTC)	Time at end of encounter (UTC)	Position - degrees latitude	Position - degrees longitude	Species or species group	Description (visual sighting only)	Bearing to animal	Range of animal (metres)	Total number	Number of adults (visual sightings only)	Behaviour (visual sightings only)	Direction of travel (relative to ship)	Direction of travel (compass points)	Airgun/ source activity when animals first detected	Airgun/ source activity when animals last detected	Closest distance of animals from airguns/ source (metres)	What action was taken?	Comments
1	10/03/20	10:20	10:55	52 23.54N	06 04.11W	Grey Seal	large seal, mottled grey colour. Long, gently sloping snout	100	100	1	1	Milling/ slow swim	v	var	s	f	20	n	
2	11/03/20	09:55	10:10	52 23.54N	06 04.11W	Grey Seal	large seal, mottled grey colour. Long, gently sloping snout	315	50	1	1	Milling/ slow swim	v	var	n	n	100	d	re-sighted at 10:10 no further delay implemented

Appendix 3.2

ADCO Underwater Archaeological Impact Assessment

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ADCO

Leading Maritime Archaeology

Underwater Archaeological Impact Assessment

Howth Fishery Harbour Centre dredging project

20D0018, 20R0076

Leading Maritime Archaeology

Underwater Archaeological Impact Assessment
Howth Fishery Harbour Centre dredging project
20D0018, 20R0076

Issued	14/05/2021
Client	**MWP for DAFM**
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Abbreviations

ADCO -	Archaeological Diving Company Ltd
AIA -	Archaeological Impact Assessment
CR -	Cable Route
DAFM -	Department of Agriculture, Food and the Marine
DCHG -	Department of Culture, Heritage and the Gaeltacht
DHLGH -	Department of Housing, Local Government and Heritage
E -	Easting
EIS -	Environmental Impact Statement
ITM -	Irish Transverse Mercator
LA -	Lease Area
LAT -	Lowest Astronomical Tide
MHW -	Mean High Water
MWP -	Malachy Walsh and Partners
N -	Northing
NGR -	National Grid Reference
NIAH -	National Inventory of Architectural Heritage
OD -	Ordnance Datum
SI -	Site Investigations
SMR -	Sites and Monuments Record
UAIA -	Underwater Archaeological Impact Assessment

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Executive Summary

Subject: Howth Harbour Fishery Centre
Location: Howth Harbour
ITM: 718623E 748257N
Status: Harbour area

Introduction

Howth Fishery Harbour Centre is the subject of a development proposal that seeks to re-dredge the harbour basin and to reclaim seabed to the west of the West Pier.

A marine geophysical survey was completed in March and May 2020 by Priority Geotechnical under licence from the Department of Culture Heritage and the Gaeltacht (DCHG) (licence no, 20D0027).

The marine geophysical survey informed the extent of a subsequent underwater archaeological inspection that was completed by the Archaeological Diving Company Ltd and licensed by the DCHG (licence nos 20D0018, 20R0076).

The underwater inspection took place on 18 June 2020 and focused on the proposed reclamation area off the West Pier.

Intertidal inspection of the glacis of the West Pier was also carried out.

Marine geophysical survey

The marine geophysical survey included magnetometry and side-scan sonar survey within the harbour basin and across the proposed reclamation area to the west of the West Pier. The survey was robust and comprehensive, with survey lines closely-spaced together to ensure multiple viewing of the same area of seabed from different angles.

The magnetometry survey recorded a series of targets within the harbour basin that are the internal navigation buoys and are not of archaeological interest.

The side-scan sonar survey, in conjunction with the magnetometer survey recorded a series of targets in the area west of the West Pier.

Underwater inspection

The underwater inspection included the locations of four geophysical survey targets recorded in the 2020 survey, which lay outside the harbour, to the west of the West Pier.

No features of archaeological interest were observed on the seabed, and one of the targets, DT_03, was confirmed to be a large upstanding metal object that is modern in origin. It is a composite steel piece that appears to be counter-weights of a steel crane, perhaps placed there as a temporary mooring. It outside the proposed footprint for the reclamation area and will remain exposed on the seabed. It should be considered a navigation hazard and be removed.

Intertidal inspection

Rock armour protection already populates the southern have of the glacis on the West Pier, obscuring it from view, but a large expanse of the glacis is exposed.

The exposed area lies at the rear of the protected buildings that populate the West Pier.

A series of retaining walls that define the rear-side of the buildings on the West Pier survive, along with a set of steps and two slipways that are built into the glacis.

These elements represent historical features, as does the glacis itself, and warrant detailed recording prior to their burial at part of the reclamation works.

Impact assessment

The dredging of the harbour basin represents a direct and permanent impact on the harbour silts. However, this area was substantially dredged in the 1980s after the harbour was dewatered in 1979 to facilitate those works. It is unlikely that archaeologically significant material will be present in those areas that were dredged previously.

The reclamation of the seabed area to the west of the West Pier is not to include active dredging but will require the deposition of dredged spoils from the basin onto the seabed and the glacis of the West Pier.

The proposed development seeks to bury the exposed part of the glacis. The work will also include certain realignment of the boundary walls to the rear of the buildings along the West Pier. These works represent direct and permanent impacts on an area where there is historic built structure.

Recommendations

There is no archaeological reason for the project not to proceed.

No further archaeological work should be required underwater prior to the proposed works commencing.

A detailed archaeological survey will be completed of the glacis of the West Pier that will extend from the glacis toe to the rear of the buildings that populate the West Pier. The survey will be carried out to create a permanent record of the glacis prior to its burial by reclamation. The survey will include the glacis, the retaining walls, the stone steps and the two historic slipways and their details that are built into the glacis. The survey will be to a high standard, capable of producing metrically accurate plan, section and profile drawings that capture the detail.

Archaeological excavation of one of the retaining walls and its associated area is anticipated since the wall to be demolished formerly served to define the rear-side of a terrace of six houses recorded on the OS 1840 and 1911 maps.

Archaeological monitoring licensed by the National Monuments Service will be conducted of all terrestrial, inter-tidal/foreshore and seabed disturbances associated with the development, with the proviso to resolve fully any archaeological material observed at that point.

The level of monitoring of the dredging operation within the harbour basin should be limited to those areas and depths not achieved previously.

A suitable barrier membrane should be laid down to separate the *in situ* remains of the West Pier glacis from the reclaimed deposits to be laid above. This will help to ensure that the historic elements are preserved *in situ*. A conservation engineer should be consulted to ensure that this element proceeds in accordance with best practice.

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A series of archaeological management measures are included.

The recommendations contained in this report are subject to the approval of the National Monuments Service at the Department of Housing, Local Government and Heritage.

1.0 Introduction

The Archaeological Diving Company Ltd (ADCO) was appointed by the Department of Agriculture, Food and the Marine to carry out an underwater archaeological inspection of the seabed associated with the proposed Howth Fishery Harbour Centre (FHC) development (Figure 1).

The inspection is informed by an archaeological assessment of the development, which was completed by ADCO and is absorbed int the Cultural Heritage chapter for the project EIAR (Chapter 10), and by a marine geophysical survey of the project area completed by Priority Geotechnical in March and May 2020 under licence from the Department of Culture, Heritage and the Gaeltacht (now Department of Housing, Local Government and the Gaeltacht), licence number 20D0027. The marine geophysical survey report is included in the project EIAR, Appendix 10.1.

The underwater inspection took place on 18 June 2020, under licences 20D0018 and 20R0076. Site work was directed by the report author and licence holder. The inspection included dive inspection of targets recorded in the marine geophysical survey, and intertidal inspection of the proposed reclamation area off the West Pier.

The present report is completed in fulfilment of the archaeological licencing requirement and will form a technical chapter in the project EIAR (Appendix 10.2). The report employs figures prepared to illustrate the EIAR chapter 10.

2.0 Project overview

Howth FHC was last dredged in the 1980s. Due to build-up of siltation since then, it is necessary to dredge the existing basins and approach channels in order to provide safe access, navigation and berthing to the vessels currently using the harbour, and to provide for appropriate maintenance of same into the future through a programme of measurement and maintenance dredging.

For the bulk dredge it is proposed to dredge, treat and re-use the material to the West of the West pier in order to create an additional *c.* 40,000 square metres of land area (Figure 2). It is envisaged that, like the rest of the FHC, this infill area will incorporate a mixture of fishing and industrial elements, light industrial / commercial and public realm spaces. The Harbour is broken into the following areas with broad usage patterns:

- West Fishing Basin (*c.* 32,000 cubic metres). This area is used almost solely for fishery activities, access to Syncrolift boat lift and in the North-West corner for ferry boat activities.
- Approach Channel (*c.* 38,000 cubic metres). This is the area between and just south of the heads of the East and West Piers. It is used by all harbour users to enter and exit the harbour.
- Mooring Area (*c.* 68,000 cubic metres). This is an area to the north east of the harbour. It is presently used from March to October by approximately 170 leisure craft on swing moorings.
- Marina Approach Area (*c.* 20,000 cubic metres). Comprises of additional swing moorings the RNLI slipway and all weather lifeboat pontoon and the Public Slipway.
- Marina Area (*c.* 42,000 cubic metres). Within this area there is an area leased to Howth Yacht Club in which is the marina operator of the pontoons and facilities for some 300 leisure craft.

It is proposed that the harbour be dredged to the following depths:

- West Fishing Basin & Approach Channel: 4.0 metres Chart Datum.
- Mooring Area & Marina Approach Area: 3.0 metres Chart Datum.
- Marina Area: 2.5 metres Chart Datum.

3.0 Receiving environment

3.1 Cartographic sources and historical development

The development of Howth and its harbour is well documented and is described in Chapter 10 of the project EIAR. It is necessary here to refer only to key summary points.

Howth has served as an important fishery harbour since the medieval period and probably for much longer than that. The Down Survey of 1654[1] and its accompanying Civil Survey presents a useful series of maps at county, barony and parish level that highlight settlement across the Howth peninsula (Figure 3). The county map records a church and a principal house; the barony map adds further detail that includes a slight loop feature on the coastline, indicative of a landing area; while the most detailed map in the series, the parish map, shows a small castle located next to the looped feature. This is the strongest indication of the association of a castle feature next to the coastline where Howth Harbour sits today.

John Rocque's map of Dublin's 'City Harbour and Environs in 1757', provides a more detailed perspective (Figure 4A). Rocque's map records the developing town, and 'The Harbour' to the

[1] www.downsurvey.tcd.ie

north of the town. The maps does not show a quay *per se*, but rather the caption follows a curvature, and suggests the existence of an eastern breakwater of sorts. The map also clearly highlights the shallow nature of the water, as 'The Harbour' and the boat are both within the intertidal zone, where the Low Water Mark is defined seawards.

Gabriel Beranger's antiquarian drawing of Howth in 1775 is a perspective looking seawards towards Ireland's Eye in the north (Figure 10.4B). The image records a quay wall on the seashore that extends out and curves around to the northwest, recalling Rocque's 'Harbour' caption and providing the first clear suggestion of a pier structure in Howth. The opening of the quay is out of sight, hidden behind the looming ruined church complex of St Mary's in the foreground, but a line of five masts rises above the church's enclosure, and the accompanying stern of a wooden vessel is included in the view. This would indicate that a large sea-going vessel was able to berth within the harbour on its seaward side.

The shallow nature of the sea levels at Howth were well known but this did not deter the identification of Howth as the candidate site for a new harbour that would provide safe haven for the mail packet ships to transit between Dublin and Holyhead.[2] In 1805 Parliament sanctioned a grant of £10,000 to improve the existing harbour. Work began in 1807 under Captain George Taylor, who advocated one pier, perhaps emulating that which existed already. However, and after only constructing a short length, Taylor's work ended early following a devastation wrought by a gale that destroyed some 240 feet of the pier end. The Scottish engineer, John Rennie, was consulted in 1809 and he proposed two piers. The angled north section of the East Pier was apparently constructed on the collapsed rubble of Taylor's design. Rennie appointed John Aird as resident engineer and superintendent of the works, and Aird continued in this role to its completion.[3]

The construction of Howth Harbour is regarded as a project that was innovative in its design and its use of construction technology. The harbour was completed in 1813 and was formally established as a packet station in 1818 when a three-storey lighthouse of ashlar granite was built at the end of the East Pier (Figure 10.5).

Already by 1809, however, it was clear that Howth would be a dry harbour at low water, filled with mud and sand. In addition, easterly gales caused swell at the harbour entrance, making the entrance hazardous to navigate in such conditions. Coupled with the building of bigger ships and the change from sail to steam, these elements combined to make Kingstown (present-day Dun Laoghaire) the more attractive option for the mail boats. In 1834, Kingstown became the official packet station. Howth Harbour was no longer in contention for this market. Instead the harbour reverted to its late medieval forté as an important fishery harbour. It has also become a leisure sailing centre.

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[2] Bernadine Ruddy, 'The 1811 Disturbance at Howth Harbour', in *Dublin Historical Record*, vol. 65.1/2 (2012), pp 47–52.
[3] www.dia.ie/architects/

The historic Ordnance Survey (OS) maps record the harbour after it was completed and since *c.* 1840. The First Edition six-inch map shows the two piers extending seawards to terminate in the northwest-facing harbour entrance (Figure 10.6A). The terminal of each pier was furnished with a rectangular-shaped 'landing place', and a light house was positioned on the terminus of the East Pier. The West Pier had a 'parapet' along its western façade and a small number of buildings constructed close to the pier head. The map also records the shallow nature of the enclosed harbour, with not only sand filling the interior at low water but a large shoal of rock outcrop extended across much of the harbour from the east.

When the twenty-five inch map series was produced in 1911, building on the harbour had developed further (Figure 10.6B). Construction of the railway at the head of the West Pier had been completed, which formalised this section of the coastline, but there is no recording of a formal bathing place. There appears to be less bedrock recorded across the harbour's interior, suggesting works were ongoing to progressively remove the rock, while the West Pier had become populated with a significant number of buildings along its length. A clear sense of this detail is provided by an historical photograph taken by Robert French, published in 1880 (Figure 10.7B).[4] French's photograph was taken at Low Water. It shows the exposed foreshore at the head of the harbour, and an orderly line of buildings on the West Pier that are set back from the active quayside. A number of small cranes are evident on the quay, along with a series of small work boats tied up alongside. Other historic photographs also show the busy nature of the harbour in the late nineteenth century (Figure 10.7A-D).

In more recent times, the harbour was dried out in 1979 and excavated in the early 1980s with the construction of the Middle Pier and the East Pier breakwater. These concrete constructions created the fishing harbour to the west and the marina to the east. Reclamation work has also occurred, including an area of foreshore to the west of the West Pier that is currently used for vessel maintenance, and the intertidal area within the harbour identified on the twenty-five inch OS map, which is currently used for vehicle parking and open recreational space (Figure 10.8). The latest development of the harbour includes the insertion of a floating pontoon in the fishery harbour, and a smaller one next to the RNLI station in the marina. These works create the harbour footprint that exists today.

3.2 Recorded archaeological monuments

Howth Harbour is not a registered archaeological monument, although the harbour and elements of its nineteenth-century structures are registered in the National Inventory of Architectural Heritage (NIAH) and are protected structures (Figure 9).

[4] www.nli.ie/record/vtls000040816

3.3 Previous archaeological excavations

The recorded archaeological excavations in Howth all lie to the south of the harbour and outside the proposed development area for the Howth FHC project. The sites illustrate further the historical development of the settlement as described. Excavations associated with the laying of the sewer pipeline through the village included work along Howth Road and Harbour Road, as well as works associated with a combined sewer outflow and storm tank within Howth carpark in the vicinity of the harbour (Licence E2028). The archaeological observations indicated that the area appears to have been beach or foreshore up until the period when the harbour was developed. Evidence for rubbish deposition was also identified and this was thought to date to the early modern period, after the time when the area was inundated with sand. Tram tracks were exposed and these were associated with a route to the East Pier area. A subsequent phase of excavation completed in 2007 revealed fill material employed in the reclamation of the foreshore. The fill material included quarried granite. A section of old sea wall constructed using granite blocks, and formerly included in historic photographs of the harbour area, was also recorded.

3.4 Historic shipwreck inventory

There are approximately 110 recorded shipwreck events associated with Howth.[5] A recorded shipwrecking event is an historic reference (usually post-1750 in date) to an incident that was observed mostly from land and in relation to the nearest landmark. It is not necessarily an accurate location of wrecking. The record generally refers to the vessel's distress on the surface. If the vessel subsequently sank, the exact position of wreckage is not necessarily known. On other occasions, the records might add that the vessel was subsequently refloated or towed away. The association with Howth in many instances is not more specific, and could in fact refer to wreckings off the north, east or south sides of the peninsula, or indeed to any point within these large sea areas. The entries nevertheless provide a guide to the archaeological potential of shipwreck to be uncovered in the course of seabed disturbance activities.

There are twenty-two recorded entries to wrecking events at Howth harbour (Table 1) which is the focus of the current development proposal. The wrecking events range over time between 1814 and 1915, with 1861 being a year when three vessels were wrecked on the same day (26th August), during a WNW force 9 wind. The *Corisande* (W00875) was a 15-ton iron steam yacht, and the *Mary Anne* (W00898) and *Mary Jane* (W00900) were both 1-ton wooden fishing yawls. All three were small vessels and the WNW wind must have hurtled ferociously through the harbour entrance, damaging all in its path. Earlier that same year, on 9th February 1861, three other entries record loss inside the harbour on the same day; the *Maid of the Mist* (W00895) was a three-masted schooner laden with salt that struck the pier and sank, while a large barque also struck the pier and sank (W00950), and a brig (W00951) was wrecked on

[5] Karl Brady, *Shipwreck Inventory of Ireland* (Dublin, 2008), pp 196–209, at p. 196.

sand. Given the size of the vessels and the similar detail of their loss, it is possible that the entries for W00895 and W00950 are duplications. A sense of the busy nature of the harbour is provided in the historical photographs from the period (Figure 7). Figure 7A shows a large number of vessels along the West Pier.

The records do not indicate whether any of the wreckings were subsequently recovered. One must allow for this possibility given the busy nature of the harbour, but the potential is also there for wreckage to remain *in situ*. Given that the harbour basin was drained and excavated in the 1980s, the potential for such remains to be still present is reduced within the footprint of the 1980s dredging.

The entry for the *James* (W00886) highlights the potential for wreckage outside the harbour walls, as it was wrecked 'outside the pier' in 1842. The *Emily* (W0880) was a fishing lugger from Peel that was driven on to stone 'at the back of the pier' when leaving the harbour and broke up in 1872. The tragic loss of the *Marie Ann* (W00897) also occurred outside but close to the harbour, on the same day as three vessels were lost inside the harbour (9th February 1861). The *Mary Ann* was a 91-ton brig from Drogheda that became stranded on Balscadden Rocks, within 50 yards of the harbour. The entry records very foul weather with a NE force 12 blowing. Five of the ship's crew were lost.

There were also wrecking events associated with the West Pier. The *Nannie* (W00903) 'was lying on a slip outside Howth harbour, in ballast' when she wrecked at the West Pier in 1903, while in 1907 Barge No. 619 (W00906) was being towed into the harbour when she was driven ashore on to rocks at the West Pier and wrecked. Both these entries have relevance in the current context given the proposal to reclaim an area beside and west of the West Pier. The southerly section of this western zone has already been reclaimed, which may reduce the potential for such remains to be uncovered in the course of the proposed works, but they nevertheless highlight the presence of potential wreckage in the development area.

Reference	Name	Date of Loss	Place of Loss	Description
W00865	*Alice/Alicia Maria*	10/12/1893	Howth Harbour	20-ton fishing lugger moored in ballast. Lost after collision with another lugger
W00870	*Bryan*	24/12/1819	Howth Harbour	A vessel of Dublin, totally wrecked
W00875	*Corisande*	26/08/1891	Howth Harbour	This iron steam yacht weighing 15 tons was owned by R.G. Nash, of Howth, Co. Dublin. It was lying in Howth Harbour, when it was wrecked in a WNW force 9 wind
W00876	*Dispatch*	06/11/1872	Howth Harbour	Smack of Pwillheli, sank *en route* to Pwihelli and wrecked.
W00880	*Emily*	16/10/1872	Howth, back of the pier	Fishing lugger of Peel, drifted onto stones during an easterly gale whilst leaving Howth Harbour and broke up

Reference	Name	Date of Loss	Place of Loss	Description
W00884	*Friendship*	14/02/1824	Howth Pier	Sloop of Bray *en route* from Whitehaven to Bray when she was wrecked at the back of the pier. The crew were saved
W00885	*Ino*	23/04/1866	Howth Harbour	Schooner of Liverpool with cargo of salt. Struck between the pier and sank
W00886	*James*	17/11/1842	Outside Howth Pier	Vessel, under Captain Metcalfe, was wrecked 'outside Howth pier'. The crew were saved
W00887	*James McCleary*	15/12/1814	Howth Pier	Brig, under Master William Crangle sank during a westerly storm
W00895	*Maid of the Mist*	09/02/1861	Howth Harbour	Three-masted schooner with cargo of coal, struck the pier and sank
W00897	*Mary Ann / Mary Anne*	09/02/1861	Balscadden Rocks, 50 yards from Howth Harbour	91-ton brig of Drogheda was carrying five crew and a cargo of coals when she stranded in NE force 12. The five crew were lost
W00898	*Mary Anne*	26/08/1891	Howth Harbour	Wooden fishing yawl, weighed one ton. It was owned by B. Murphy, of Howth, Co. Dublin. It was lying in Howth Harbour, when it was wrecked in a WNW force 9 wind
W00900	*Mary Jane*	26/08/1891	Howth Harbour	Wooden fishing yawl weighed 1 ton. It was owned by J. Vaughan, Howth, Co. Dublin. It was lying in Howth Harbour, when it was wrecked in a WNW force 9 wind
W00903	*Nannie*	26/02/1903	West Pier, Howth	Unregistered wooden lugsail used for fishing. She was 11 years old and weighed 1 ton. The master and owner was R. Harford of Howth. The vessel was lying on a slip outside Howth harbour, in ballast. There was no one aboard when she foundered and became a total loss in a WSW force 10
W00906	*No. 619*	24/12/1907	West Pier, Howth	Barge driven ashore on rocks while being towed to the harbour. Wrecked
W00909	*Peep of Day*	12/11/1902	Howth Harbour	Unregistered wooden yawl was used for fishing. She was laid up in Howth Harbour, in ballast. She collided with the unregistered fishing yawls *Maggie* and *Your Name* of Dublin in a NE force 10 and became a total loss
W00913	*St Catherine*	12/11/1915	Howth Harbour	30-tonne wooden fishing ketch, moored in ballast, went ashore, total wreck
W00950	Unknown	09/02/1861	Howth Harbour	Large barque, struck the pier and sank inside the harbour
W00951	Unknown	09/02/1861	Howth Harbour	Brig, wrecked on sand
W00953	Unknown	22/11/1865	Howth Harbour, close to the East Pier head	Board of Works lighter, capsized during violent squall, crew saved.