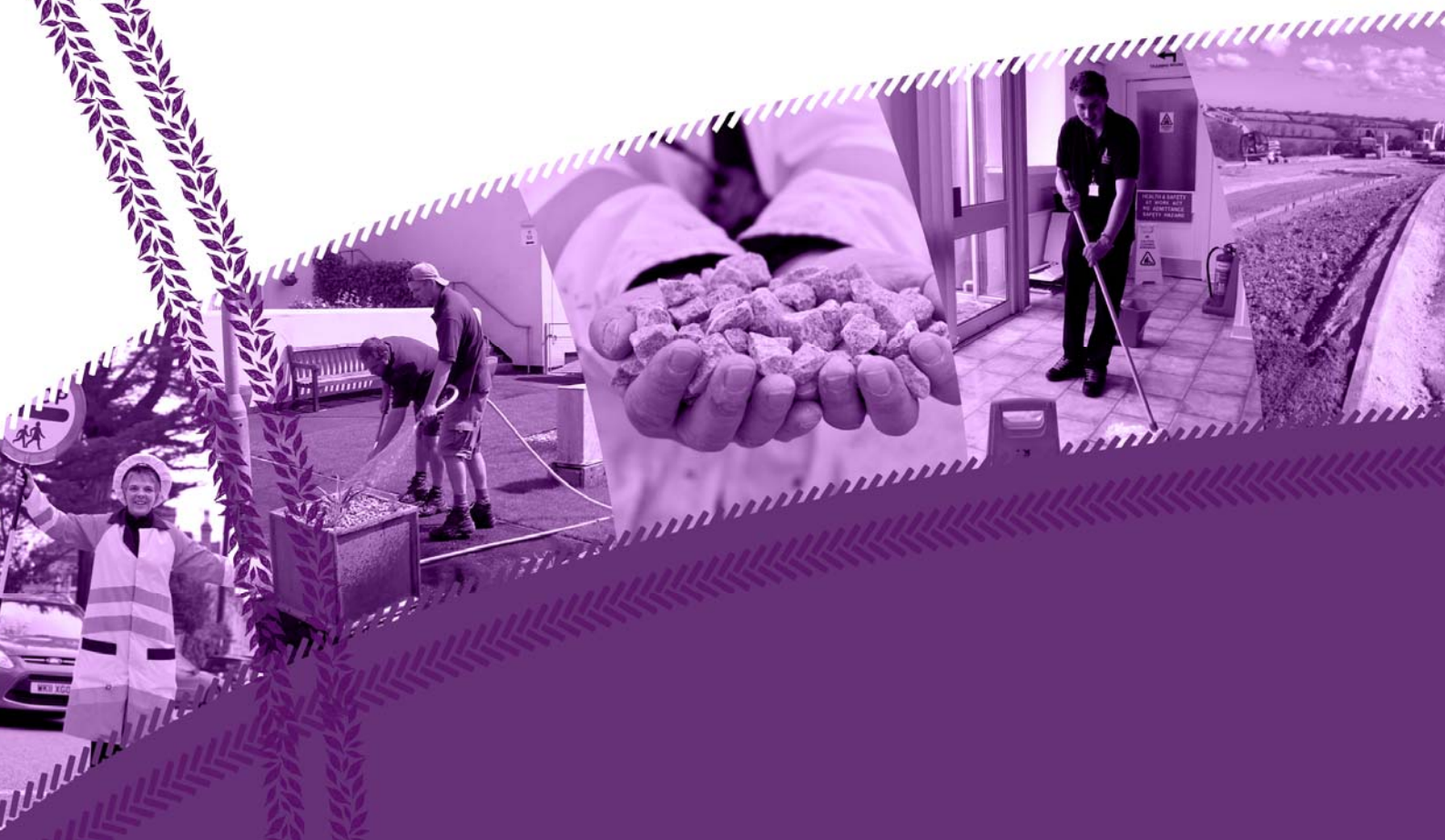
Coronation Lake, Helston.

Investigation of site

Project No: 63684

Revision No.0

CORMAC Solutions Ltd
CORMAC Consultancy
Engineering Services Laboratory



Revision
1
Revision Date
29/01/2013

Originator	Initial
ERB	
Checked	**Initial**
BOC	
Authorised for Issue	**Initial**
RNH	
Purpose of Issue	
For Approval	
Nature of Change	

Executive Summary

The Engineering Services Laboratory of CORMAC Solutions Ltd was instructed to carry out work on behalf of the Environmental Project Team of Cornwall Council. The site is Coronation Boating Lake, Porthleven Road, Helston, Cornwall where a number of issues regarding the condition of the lake need addressing

Coronation Boating Lake is situated in the base of the Cober River valley adjacent to Porthleven Road in the southwest of Helston at Grid Reference 165459 27171.

The site is a 16100m^2 lake built in 1912 as a boating lake and surrounding park. The lake is surrounded by a boundary wall which forms the edge of a wide pathway that circumnavigates the lake. On the western side of the lake and path runs the River Cober which lies approximately 2 to 3m below the level of the pathway. The eastern boundary is Porthleven road.

The lake is part of a larger public amenity space with playground, café and public open space. The lake has a small pump that pumps water in to the lake from the River Cober at the northwest end of the lake. The overflow/discharge point for the lake is at the southern end of the site. This discharges directly into the River Cober which flows into Loe Pool, 1.6km to the southeast.

The quantity of silt calculated from the GPR indicates approximately 6300m^3 of silt that has reduced the water level by the maximum of a metre. The chemistry of this would not be suitable for use on a residential land use due to elevated levels of arsenic and mercury, however by mixing with other waste streams such as compost etc it may become suitable for re-use on commercial properties for highway landscaping rather than disposal

It is not recommended that all of the silt be removed due to the intermittent condition of the clay liner. The compressed silt layer seems to be doing a similar job and it is recommended that at least 300mm of silt be left above the position of the clay liner. This should be made clear to the contractors so every effort can be made to keep this layer intact

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Appendices

1.0 Introduction

1.1. Terms of Reference

The Engineering Services Laboratory of CORMAC Solutions Ltd was instructed to carry out work on behalf of the Environmental Project Team of Cornwall Council. The site is Coronation Boating Lake, Porthleven Road, Helston, Cornwall where a number of issues regarding the condition of the lake need addressing

1.2. Scope of Work

The scope of the work addresses four main issues with the lakes current condition

i) The presence of a significant algal bloom each summer
ii) Reduction in depth of water due to quantity of silt
iii) Lake leaking possibly due to the condition of original clay liner
iv) Condition of boundary wall

The work by the Engineering Services Laboratory was undertaken in two phases. The first phase was to determine the depth of the silt, the condition of the clay liner and the geochemistry of the silt with the view to either disposal or re-use of the silt.

The second phase of the work was intended to involved the partial draining of the lake to enable an inspection of the boundary wall and determine the bearing pressures at the base of the wall to assist in recommendations for a suitable method of rebuild/reconstruction. Additional information came to light that meant the draining of the lake was not required.

Site Description

2.1. Location

Coronation Boating Lake is situated in the base of the Cober River valley adjacent to Porthleven Road in the southwest of Helston at Grid Reference 165459 27171.

2.2. Current Land Use

The site is a 16100m^2 lake built in 1912 as a boating lake and surrounding park. The lake is surrounded by a boundary wall which forms the edge of a wide pathway that circumnavigates the lake. On the western side of the lake and path runs the River Cober which lies approximately 2 to 3m below the level of the pathway. The eastern boundary is Porthleven road.

The lake is part of a larger public amenity space with playground, café and public open space. The lake has a small pump that pumps water in to the lake from the River Cober at the northwest end of the lake. The overflow/discharge point for the lake is at the southern end of the site. This discharges directly into the River Cober which flows into Loe Pool, 1.6km to the southeast.

2.3. Surrounding Area

The site is on the southwestern edge of Helston and is therefore surrounded by fields used predominately for grazing to the west, residential properties with a garage and filling station to the east, parkland associated with the Penrose Estate to the south and to the north the redeveloped cattle market site, and light commercial units such as supermarkets and small garages.

3.0 Site History

Prior to development of the site as a boating lake the land was called Lower Green (1880 Ordnance Survey map – Figure 2) and was used for grazing and often flooded. The 1908 map (Figure 3) shows very little change apart the existence at the north eastern part of Lower Green as a Cattle Market. The cattle market was in existence in one form or another until the late 1990's. This area has recently been redeveloped along with the construction of a lakeside café.

Some commercial properties have changed use. A filling station located approximately 100m north of the site is now the site of a supermarket.

4.0 Site Investigation & Inspection

4.1 Ground Penetrating Radar Survey and silt sampling

The first phase was undertaken on 27th September 2012. This involved taking 15 samples from the surface of the silt. The positions of the samples are shown on Figure 4.

In addition Northumbrian Surveys Ltd were sub-contracted to provide 6 survey line cross sections across the lake using Ground Penetrating Radar. The results of the ground Penetrating Radar enabled an estimation of the quantity of silt present and a review of the condition of the original clay liner.

The Ground Penetrating Radar report is included within Appendix C.

The report indicates that the volume of silt totals approximately 6400m^3 and that it varies in depth between 0.1m and 1.4m deep.

The water depth varies between 0.4m to 1.4m deep with the depth to the original clay liner at 0.6m to 2.4m.

The sections show that the clay liner is highly variable in its condition. In the shallow areas of the lake the clay liner is visible as a distinct layer but as visible in certain parts of Section A and D the clay liner is intermittent.

The clay liner at depth is a little more indistinct but this is likely to be a reflection of the difficulty determining between the clay liner and compressed silt.

4.2 Current condition of lake wall.

The lake wall shows several locations where sections have collapsed completely into the lake and others where the concrete is degrading. There are several pipes off the south western boundary wall that appear to be blocked. Scott Perry (Structural Engineer) visited the site and assessed the walls condition. The report issued is quoted below

“The perimeter retaining wall appears to be in better condition at the side next to the river with no sign of tilting or cracking at the edge of the lake. There are some local areas where the hollow concrete blocks that form the wall have deteriorated, but this can be repaired locally.

The side of the lake next to the road is not in such good condition, with several areas where the wall is tilting towards the lake allowing cracks to open up at the edge of the past and in some of the worse cases local settlement of the footway. The wall at this location appears to be constructed from a narrow cast in-situ concrete strip. It appears that the concrete is founded on soft material which has allowed the wall to tilt. Some local repairs have been carried out where a new, wider concrete wall has been cast to repair the damaged sections of wall. These appear to be in good condition and similar repairs would be suitable for the worse affected areas of wall.

The walkway out to the island is deteriorating with significant erosion of the corners and sides of the concrete structure. This appears to be made from locally claimed river bed gravels mixed with cement to form a weak concrete mix. This is now progressively deteriorating, however it may be possible to repair the walkway keeping the original structure as a core".

Based on previous investigation on the site of the Old Cattle Market it is known that the underlying ground conditions are very soft to a depth of approximately 7m.

The loading of the wall from the use as a footpath with occasional use for maintenance vehicles would produce minimal loading and therefore the suggestion for a new wider concrete wall would recommended.

4.3 Water ingress and egress to the lake

Water is now pumped out of the River Cober next to the water wheel and discharges at the southern point of the lake back into the River Cober. Prior to the pump it is understood water from springs across the river, on privately owned land, were piped into the lake. The original pump was replaced back in the 1990's and anecdotal evidence suggests that the pump was replaced with a much lower capacity pump that was likened to one more suitable for a large fish pond.

The main outfall has a fairly small plywood panel blocking the water with minimal space for water outflow. Underneath the manhole cover is a chamber with space for three boards that can be removed and lower the water level accordingly. One of these boards is missing and removal of the existing plywood would reduce the water level by approximately 20-30cm. It would appear the plywood has been install relatively recently to prevent larger items entering the chamber.

Unfortunately the size of the gap either side of the plywood can easily be blocked by leaf accumulation and/or a plastic bag. The additional overflow pipes along the northern edge of the lake appear to be blocked and or insufficient.

It is highly likely that with a reduced inflow into the lake and minimal outflow that the lake does not have sufficient flow through it and is not far from being essentially still/stagnant. It is recommended that the existing overflow pipes are cleared/repaired/replaced as required and a larger capacity pump is installed. This should result in increased flow of cold oxygenated water through the lake and in itself would reduce the capacity for algal bloom growth as the temperature of the water would not increase as rapidly.

The main outflow chamber arrangement appears to be sufficient, however the problem is the access into it and due to very frequent blockages is incapable of being maintenance free. A design that ensures the constant free movement of the water whilst also ensuring larger items are not drawn into the main chamber should be installed.

If there was a blockage the newly repaired/replaced overflow pipes should ensure the lake does not overflow.

The pump could also be run using a counter balance so at times of significant rainfall the pump switches off and therefore saves energy before switching back on when the water levels drops past a certain level.

The ultimate aims for the lake are to stop the algal bloom reoccurring every year and to make the boundary wall safe. Additional aims reflect the quantity of sediment present and the associated reduced depth of the lake and the impact that maybe having on the algal bloom

The quantity of silt calculated from the GPR indicates approximately 6300m^3 of silt that has reduced the water level by the maximum of a metre. The chemistry of this would not be suitable for use on a residential land use[1] due to elevated levels of arsenic and mercury, however by mixing with other waste streams such as compost etc it may become suitable for re-use on commercial properties for highway landscaping rather than disposal

It is not recommended that all of the silt be removed due to the intermittent condition of the clay liner. The compressed silt layer seems to be doing a similar job and it is recommended that at least 300mm of silt be left above the position of the clay liner. This should be made clear to the contractors so every effort can be made to keep this layer intact.

5.0 Costings for repair and remediation

A site visit was undertaken with Andrew Daddow and Chris Wood of CORMAC Contracting to determine the costs for dredging 3000m3 of silt, rebuild/repair of perimeter wall and the renewal of the pumping system.

The values presented below as likely to be conservative as a detailed design phase has not yet been reached.

Description	Value	Comments
Prelims	£40,000	
Dredging Lake	£175,000	Inc. deposition into designated area within opposite car park and disposal off site; 3000m3 assumed 50% contaminated
Rebuild Perimeter Wall	£120,000	Based on 150m rebuild
Renewal of pumping system	£45,000	Allowance made for ducting for float
Total	**£380,000**	

6. REFERENCES

1. Contaminated land Exposure Assessment (CLEA), Environment Agency 2009

2. BS EN ISO 14689-1 (Identification and description, 2003) & BS 14688-1 and 2 (Principles for classification, 2004). Geotechnical Investigation: identification and classification of soil

Prepared by:

E Blakesley

E Blakesley
Geoenvironmental Engineer
CORMAC Solutions Ltd,
CORMAC Consultancy
13 February 2013

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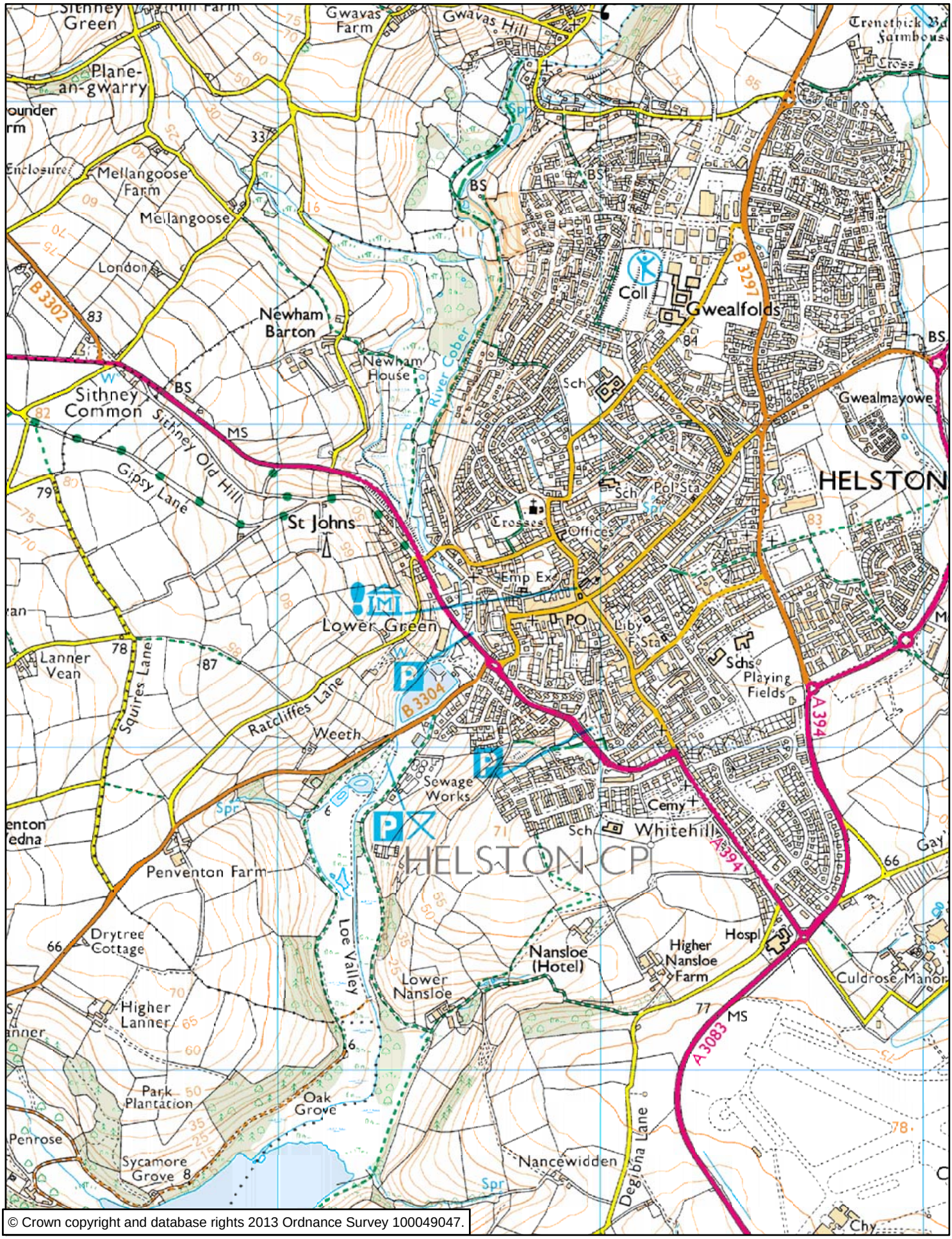
APPENDIX A

Figures

Title: Site Location Plan
Drawing No. 63684/1 Rev.A
Location: Coronation Boating Lake, Helston, Cornwall.
Scale 1:15,000

CORMAC SOLUTIONS



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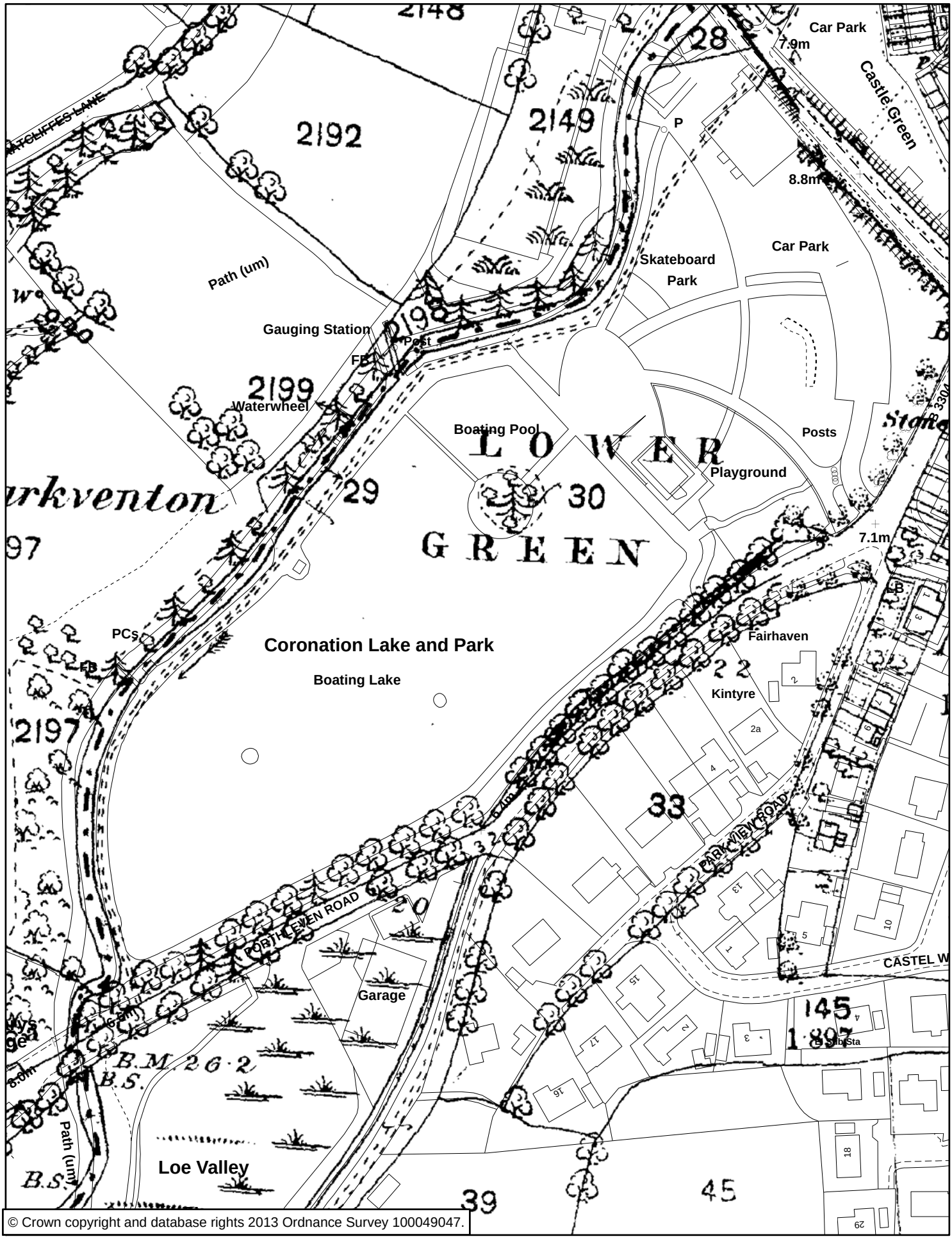
Drawing No. 63684/2 Rev.A
Location: Coronation Boating Lake, Helston, Cornwall.
Scale 1:1,500



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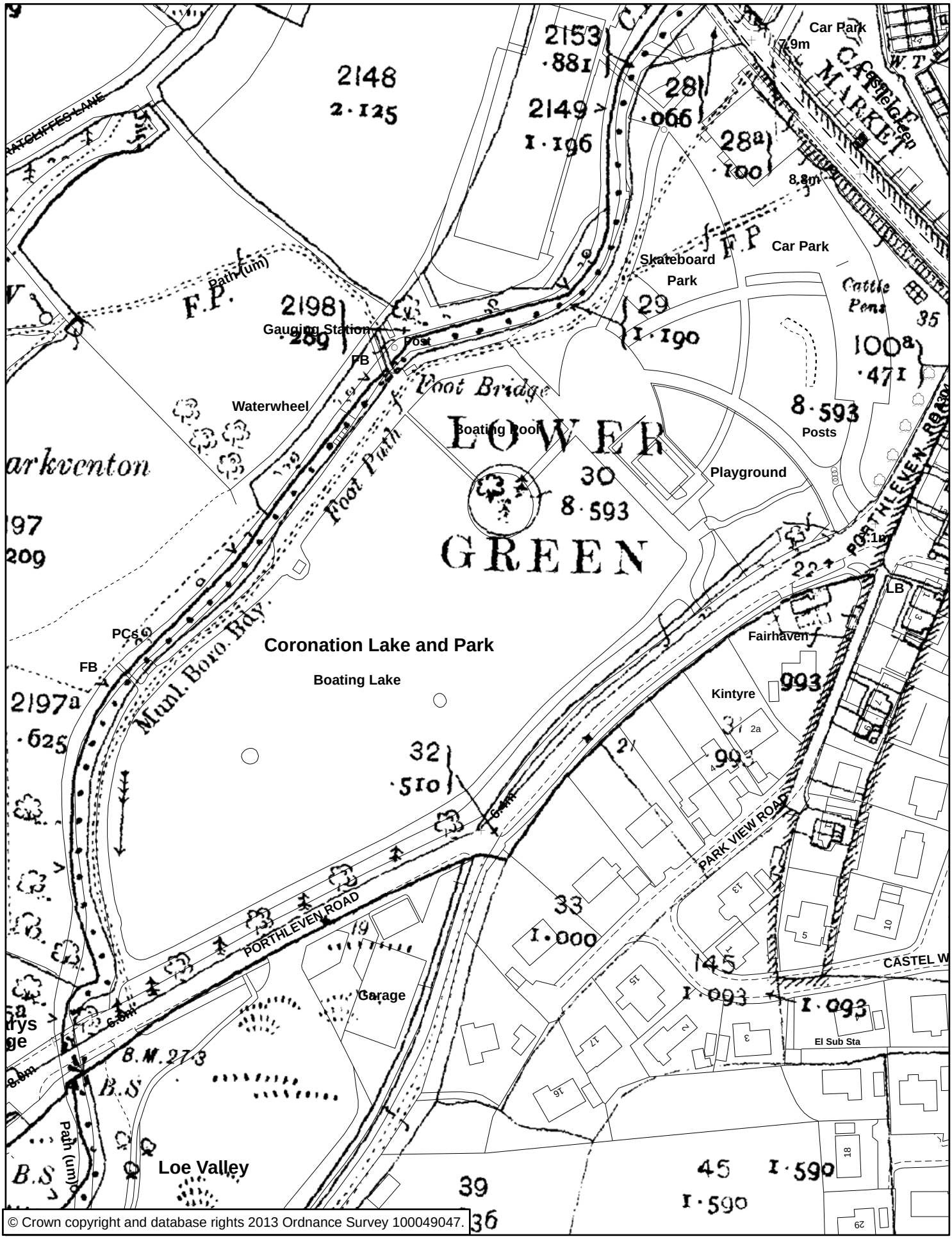
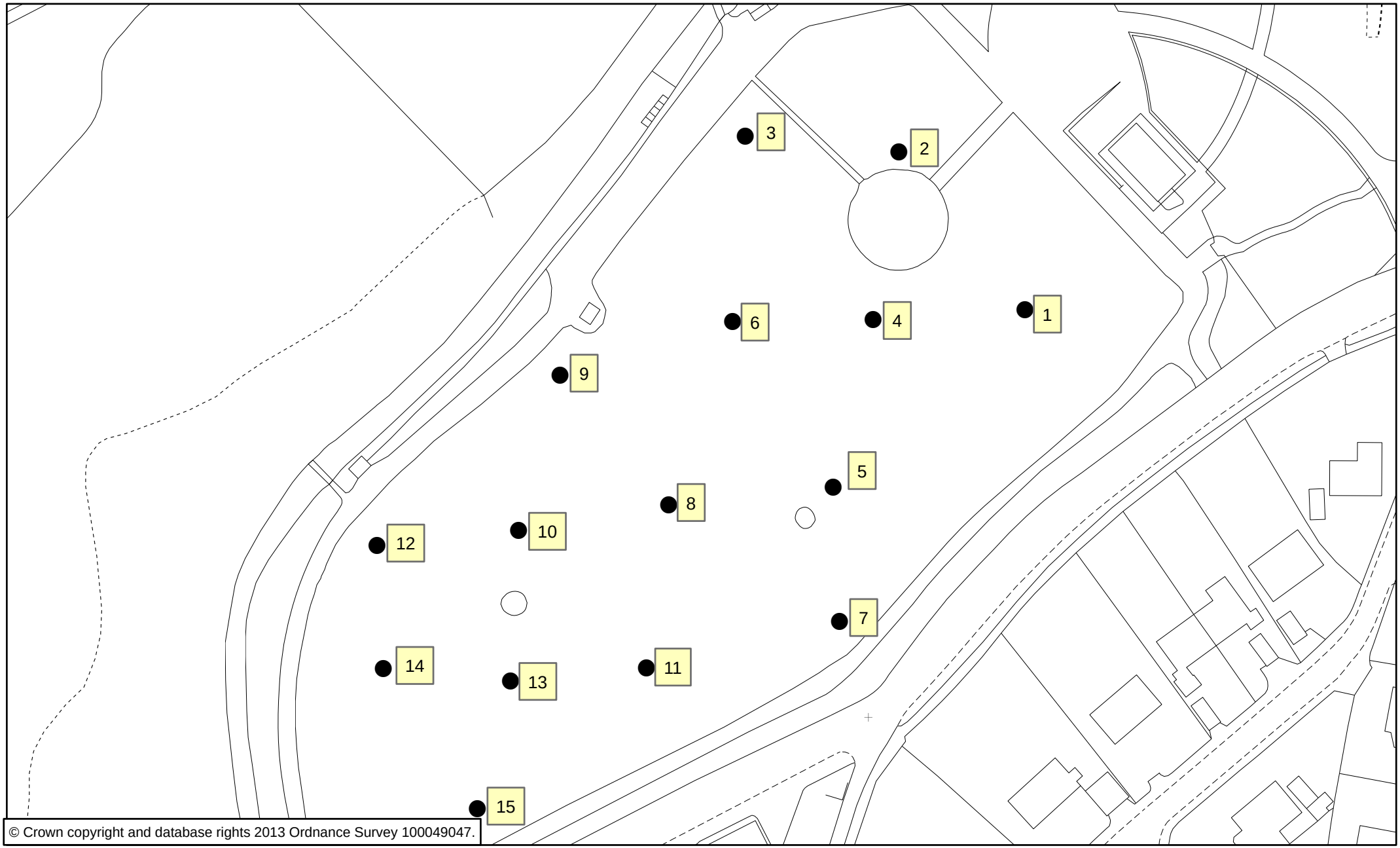
Scale 1:1,500



Title: Locations of silt samples
Drawing No. 63684/4 Rev.A
Location: Coronation Boating Lake, Helston, Cornwall.
Scale 1:1,000



Engineering Services Laboratory

APPENDIX B

Geochemical Results

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THE ENVIRONMENTAL LABORATORY LTD

F.A.O. Emma Blakesley
Engineering Services Laboratory
Western Group Centre
Ragnor Road, Scorrier, Redruth
Cornwall, TR16 5EH

Reporting Date: 10/10/2012

ANALYTICAL REPORT No. AR40778

Samples Received By:-	Laboratory Courier
Samples Received:-	01/10/12
Your Job No:	53684
Site Location:	Coronation Lake
No Samples Received:-	15
Date of Sampling	27/09/12

Report Checked By:-

Steve Knight
Director

Authorised By:-

Mike Varley BSc, CChem, CSci, FRSC
Chief Chemist

Any comments, opinions, or interpretations expressed herein are outside the scope of UKAS accreditation (Accreditation Number 2683)

THE ENVIRONMENTAL LABORATORY LTD

Unit A2, Windmill Road, Ponswood Industrial Estate, St Leonards On Sea, East Sussex, TN38 9BY

Tel: 01424 718618 Fax: 01424 729911

2683 2683

ANALYTICAL REPORT No. AR40778

Location: Coronation Lake

Your Job No: 53684

Reporting Date: 10/10/12

F.A.O. Emma Blakesley
Engineering Services Laboratory
Western Group Centre
Ragnor Road, Scorrier, Redruth
Cornwall, TR16 5EH

Soils

		Characteristic	Silt Loam	Silt Loam	Silt Loam	Silt Loam	Silt Loam	Silt Loam	Silt Loam	Silt Loam	Silt Loam	Silt Loam
		Date Sampled	27/09/12	27/09/12	27/09/12	27/09/12	27/09/12	27/09/12	27/09/12	27/09/12	27/09/12	27/09/12
		TP/BH	5501	5502	5503	5504	5505	5506	5507	5508	5509	5510
		Depth (m)	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface
		Our ref	49055	49056	49057	49058	49059	49060	49061	49062	49063	49064
Stone Content	(%)		6	<1	<1	<1	<1	<1	<1	<1	<1	<1
Arsenic**	(mg/kg)		281.8	100.8	150.7	194.7	174.0	229.2	302.1	215.1	123.1	225.2
Cadmium**	(mg/kg)		1.6	2.3	1.6	2.3	2.2	2.2	2.5	2.0	1.3	2.4
Chromium**	(mg/kg)		24	28	15	18	24	32	31	33	19	39
Lead**	(mg/kg)		265	229	145	209	292	341	385	331	186	352
Mercury**	(mg/kg)		1.0	0.7	1.7	1.5	1.3	2.4	1.4	1.5	1.4	1.9
Nickel**	(mg/kg)		24	27	16	19	24	33	32	32	19	38
Copper**	(mg/kg)		639	395	730	696	822	1167	996	969	672	1108
Zinc**	(mg/kg)		450	660	447	473	584	725	721	677	445	810
Selenium**	(mg/kg)		4.2	3.0	3.2	3.2	5.0	6.1	6.7	6.2	3.0	5.3
pH Value**	(Units)		7.2	6.8	7.0	6.9	6.3	6.4	6.4	6.4	6.2	6.1
Soil Organic Matter*	(%)		3.6	4.8	7.8	7.3	4.1	5.8	6.9	4.3	4.6	5.8
Water Soluble Phosphate	(mg/l)		<5	<5	<5	<5	6.8	<5	<5	<5	<5	<5
Available Phosphorus	(mg/l)		24.4	38.0	24.4	22.8	31.6	31.0	27.6	35.8	26.0	36.4
Available Potassium	(mg/l)		110.0	148.0	96.0	72.0	158.0	144.0	131.0	158.0	97.0	151.0
Nitrate	(mg/l)		<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Nitrite	(mg/l)		<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Total Nitrogen	(%)		0.5	0.3	0.4	0.4	0.2	0.4	0.8	0.2	0.5	<0.1

All results expressed on dry weight basis

** - MCERTS accredited test

* - UKAS accredited test

GM

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Tel: 01424 718618 Fax: 01424 729911

ANALYTICAL REPORT No. AR40778

Location: Coronation Lake

Your Job No: 53684

Reporting Date: 10/10/12

2683 2683

F.A.O. Emma Blakesley
Engineering Services Laboratory
Western Group Centre
Ragnor Road, Scorrier, Redruth
Cornwall, TR16 5EH

Soils

		Characteristic	Silt Loam	Silt Loam	Silt Loam	Silt Loam	Silt Loam
		Date Sampled	27/09/12	27/09/12	27/09/12	27/09/12	27/09/12
		TP/BH	5511	5512	5513	5514	5515
		Depth (m)	Surface	Surface	Surface	Surface	Surface
		Our ref	49065	49066	49067	49068	49069
Stone Content	(%)		<1	<1	<1	<1	<1
Arsenic**	(mg/kg)		192.8	95.0	104.4	127.9	70.4
Cadmium**	(mg/kg)		2.2	1.1	1.5	1.6	0.9
Chromium**	(mg/kg)		29	15	15	23	19
Lead**	(mg/kg)		288	147	161	215	135
Mercury**	(mg/kg)		1.2	0.8	0.7	1.1	0.5
Nickel**	(mg/kg)		29	13	15	24	21
Copper**	(mg/kg)		882	431	512	698	334
Zinc**	(mg/kg)		717	356	472	591	423
Selenium**	(mg/kg)		5.1	2.0	2.8	3.8	2.3
pH Value**	(Units)		6.4	6.5	6.3	6.5	6.6
Soil Organic Matter*	(%)		5.6	6.7	7.6	7.8	6.3
Water Soluble Phosphate	(mg/l)		<5	<5	<5	<5	<5
Available Phosphorus	(mg/l)		37.4	24.6	23.2	26.8	21.8
Available Potassium	(mg/l)		183.0	73.0	76.0	112.0	80.0
Nitrate	(mg/l)		<5	<5	<5	<5	<5
Nitrite	(mg/l)		<5	<5	<5	<5	<5
Total Nitrogen	(%)		0.3	0.4	0.3	0.3	0.3

All results expressed on dry weight basis

** - MCERTS accredited test

* = UKAS accredited test

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UKAS TESTING 2683 mCERTS 2683

ANALYTICAL REPORT No. AR40778

Location: Coronation Lake

Your Job No: 53684

Reporting Date: 10/10/12

F.A.O. Emma Blakesley
Engineering Services Laboratory
Western Group Centre
Ragnor Road, Scorrier, Redruth
Cornwall, TR16 5EH

Soils	Characteristic	Silt Loam	Silt Loam	Silt Loam	Silt Loam	Silt Loam	Silt Loam	Silt Loam	Silt Loam	Silt Loam	Silt Loam
	Date Sampled	27/09/12	27/09/12	27/09/12	27/09/12	27/09/12	27/09/12	27/09/12	27/09/12	27/09/12	27/09/12
	TP/BH	5501	5502	5503	5504	5505	5506	5507	5508	5509	5510
	Depth (m)	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface
	Our ref	49055	49056	49057	49058	49059	49060	49061	49062	49063	49064
Naphthalene**	(mg/kg)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Acenaphthylene**	(mg/kg)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Acenaphthene**	(mg/kg)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Fluorene**	(mg/kg)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Phenanthrene**	(mg/kg)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Anthracene**	(mg/kg)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Fluoranthene**	(mg/kg)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Pyrene**	(mg/kg)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Benz(a)anthracene**	(mg/kg)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chrysene**	(mg/kg)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(b)fluoranthene**	(mg/kg)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(k)fluoranthene**	(mg/kg)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene**	(mg/kg)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Indeno(123-cd)pyrene**	(mg/kg)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dibenz(ah)anthracene**	(mg/kg)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(ghi)perylene**	(mg/kg)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Total PAH**	(mg/kg)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5

All results expressed on dry weight basis
** - MCERTS accredited test

GM

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Tel: 01424 718618 Fax: 01424 729911

UKAS TESTING 2683 mCERTS 2683

ANALYTICAL REPORT No. AR40778

Location: Coronation Lake

Your Job No: 53684

Reporting Date: 10/10/12

F.A.O. Emma Blakesley
Engineering Services Laboratory
Western Group Centre
Ragnor Road, Scorrier, Redruth
Cornwall, TR16 5EH

Soils	Characteristic	Silt Loam	Silt Loam	Silt Loam	Silt Loam	Silt Loam
	Date Sampled	27/09/12	27/09/12	27/09/12	27/09/12	27/09/12
	TP/BH	5511	5512	5513	5514	5515
	Depth (m)	Surface	Surface	Surface	Surface	Surface
	Our ref	49065	49066	49067	49068	49069
Naphthalene**	(mg/kg)	<0.5	<0.5	<0.5	<0.5	<0.5
Acenaphthylene**	(mg/kg)	<0.5	<0.5	<0.5	<0.5	<0.5
Acenaphthene**	(mg/kg)	<0.5	<0.5	<0.5	<0.5	<0.5
Fluorene**	(mg/kg)	<0.5	<0.5	<0.5	<0.5	<0.5
Phenanthrene**	(mg/kg)	<0.5	<0.5	<0.5	<0.5	<0.5
Anthracene**	(mg/kg)	<0.5	<0.5	<0.5	<0.5	<0.5
Fluoranthene**	(mg/kg)	<0.5	<0.5	<0.5	<0.5	<0.5
Pyrene**	(mg/kg)	<0.5	<0.5	<0.5	<0.5	<0.5
Benz(a)anthracene**	(mg/kg)	<0.5	<0.5	<0.5	<0.5	<0.5
Chrysene**	(mg/kg)	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(b)fluoranthene**	(mg/kg)	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(k)fluoranthene**	(mg/kg)	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene**	(mg/kg)	<0.5	<0.5	<0.5	<0.5	<0.5
Indeno(123-cd)pyrene**	(mg/kg)	<0.5	<0.5	<0.5	<0.5	<0.5
Dibenz(ah)anthracene**	(mg/kg)	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(ghi)perylene**	(mg/kg)	<0.5	<0.5	<0.5	<0.5	<0.5
Total PAH**	(mg/kg)	<0.5	<0.5	<0.5	<0.5	<0.5

All results expressed on dry weight basis
** - MCERTS accredited test

GM

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2683 2683

THE ENVIRONMENTAL LABORATORY LTD

SAMPLE RECEIPT AND TEST DATES

Our Analytical Report Number	AR40778
Your Job No:	53684
Sample Receipt Date:	01/10/12
Reporting Date:	10/10/12
Registered:	01/10/12
Prepared:	02/10/12
Analysis complete:	10/10/12

TEST METHOD SUMMARY

PARAMETER	Analysis Undertaken on	Date Tested	Method Number	Technique
Arsenic**	Air dried sample	10/10/12	118	ICPMS
Cadmium**	Air dried sample	10/10/12	118	ICPMS
Chromium**	Air dried sample	10/10/12	118	ICPMS
Lead**	Air dried sample	10/10/12	118	ICPMS
Mercury**	Air dried sample	10/10/12	118	ICPMS
Nickel**	Air dried sample	10/10/12	118	ICPMS
Copper**	Air dried sample	10/10/12	118	ICPMS
Zinc**	Air dried sample	10/10/12	118	ICPMS
Selenium**	Air dried sample	10/10/12	118	ICPMS
pH Value**	Air dried sample	09/10/12	113	Probe
Soil Organic Matter*	Air dried sample	09/10/12	111	Titration
Water Soluble Phosphate	Air dried sample	10/10/12	118	ICPMS
Phosphorus	Air dried sample	10/10/12	118	ICPMS
Potassium	Air dried sample	10/10/12	118	ICPMS
Nitrate	Air dried sample	10/10/12	209	Colorimetry
Nitrite	Air dried sample	10/10/12	209	Colorimetry
Total Nitrogen	As submitted sample	11/10/12	138	Colorimetry
Speciated PAH**	As submitted sample	04/10/12	133	Gas Chromatography

* = UKAS Accredited test
** - MCERTS Accredited test
Determinands not marked with * or ** are not accredited
MCERTS accreditation covers samples which are predominantly sand, clay, loam or combinations of these three soil types

Any comments, opinions, or interpretations expressed herein are outside the scope of UKAS accreditation (Accreditation Number 2683)

APPENDIX C

Geophysical Survey Report

REPORT

ON

GEOPHYSICAL SURVEY

AT

HELSTON CORONATION BOATING LAKE
HELSTON, CORNWALL

FOR

CORMAC CONSULTANCY
CORMAC,
CORNWALL COUNTY COUNCIL

CARRIED OUT BY

NORTHUMBRIAN SURVEYS
ORCHARD HOUSE
CATTON
NR. ALLENDALE
HEXHAM
NE47 9QR

CONTENTS

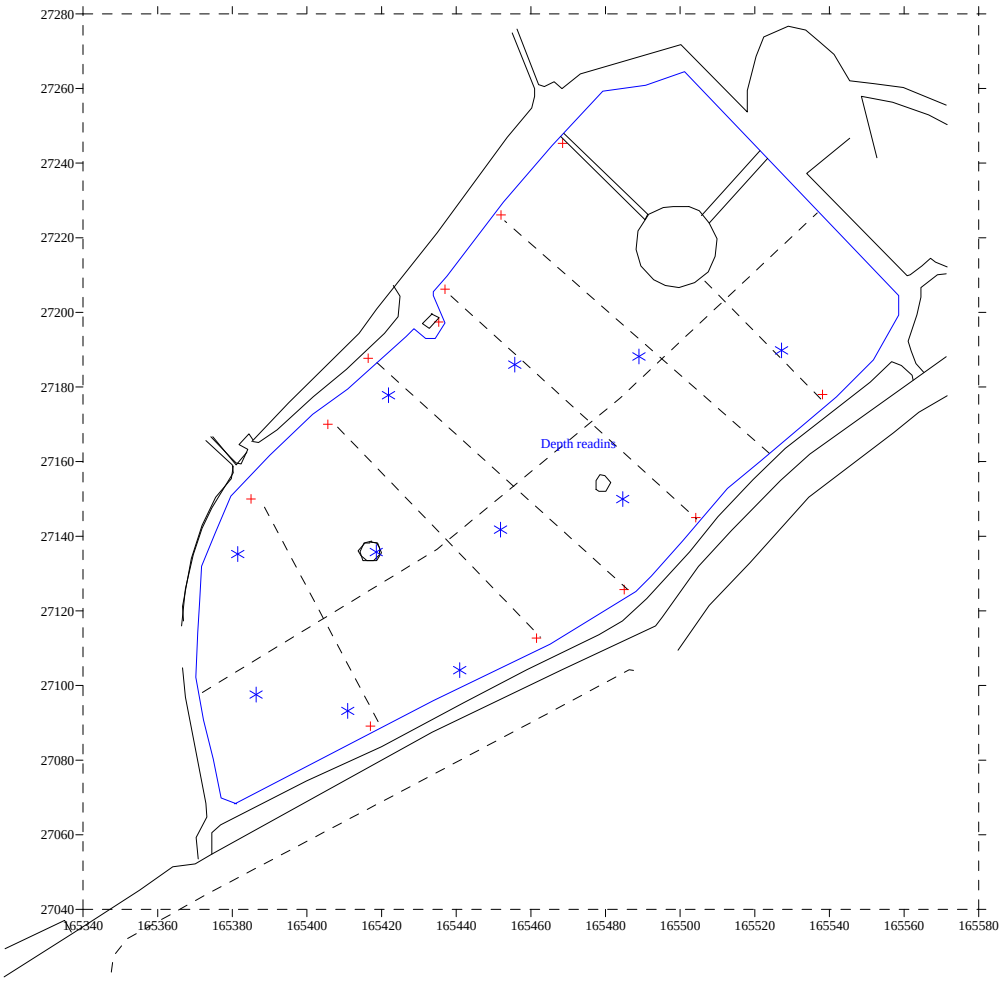
INTRODUCTION

Northumbrian Surveys were contracted by Cormac Consultancy, to carry out a Geophysical Survey, on the Coronation Boating Lake on the outskirts of Helston, Cornwall.
The purpose of the survey was to try to determine of depth of sediment on the lake bed. The survey was undertaken on the 27th September 2012.

EQUIPMENT and SURVEY PROCEDURE

The system used was a G.S.S.I. 'Sir 3000' radar system, with a 400 MHz antenna. Tests were carried out using other antennae but the 400 MHz was thought to give the best results. The system was placed in a rowing boat with the antenna on the deck. The boat was rowed back and forth across the lake. Six cross profiles were acquire at approx. equal distances and 1 profile along the length of the lake. The ends of the profiles were surveyed in using GPS. Fifteen depth reading were taken while Emma Blakesley the Cornwall County Council Engineer took silt samples from the lake.

Data was processed using Radan 6.5 processing software.



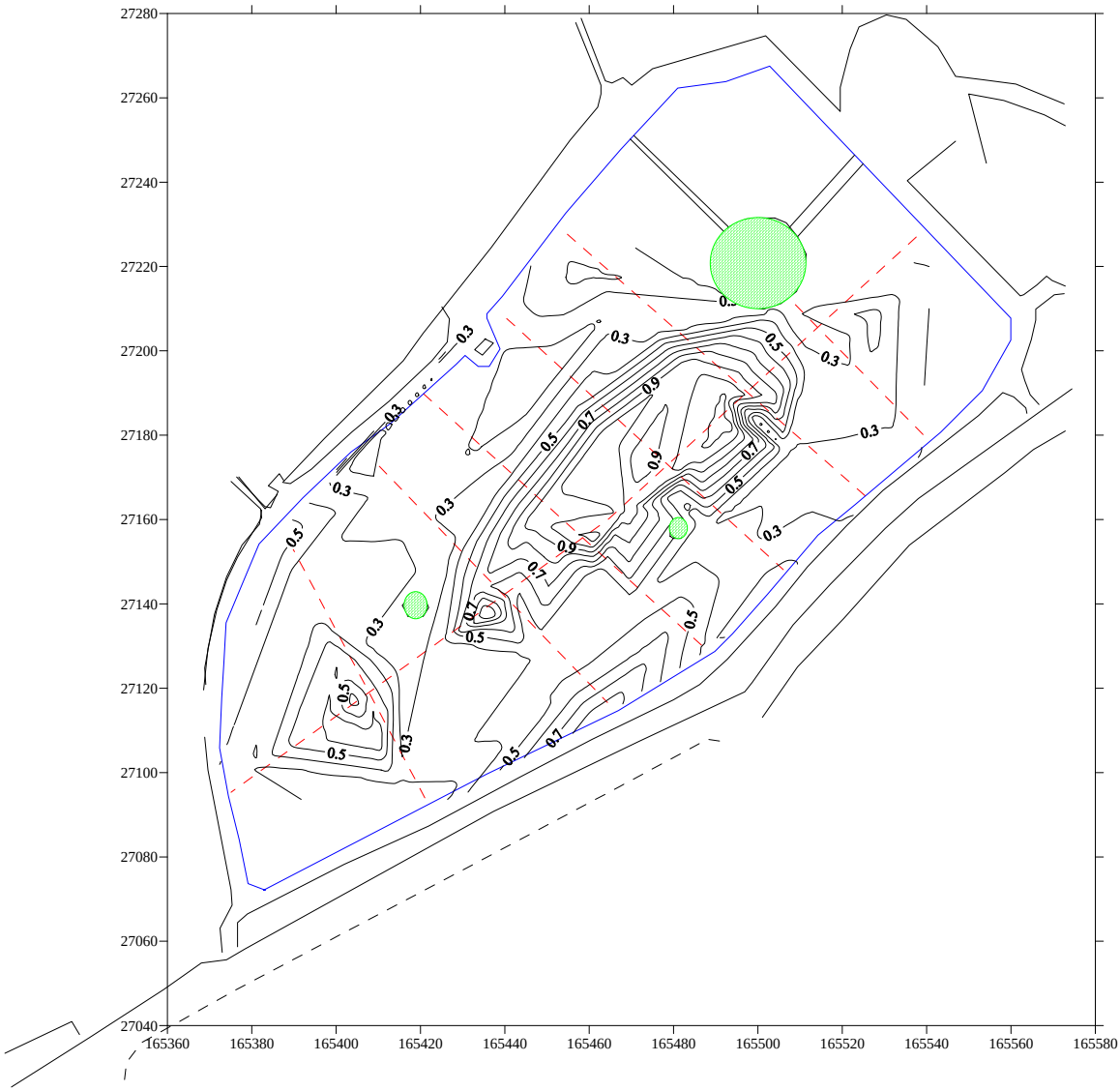
Survey Diagram

RESULTS

The data shows what I believe to be the silt boundary and the clay liner. The depth to the clay liner varies approx. 0.6m to 2.45, and the depth to the silt approx. 0.4m to 1.43m. The depth of the silt appears to vary between 0.1 and 1.1m. The table below shows position and depth of silt and clay liner together with the estimated thickness of the silt. All figures and drawing are worked on depths being picked at 10m intervals along the 7 GPR profiles. The depths were calculated using the water depths taken on site.

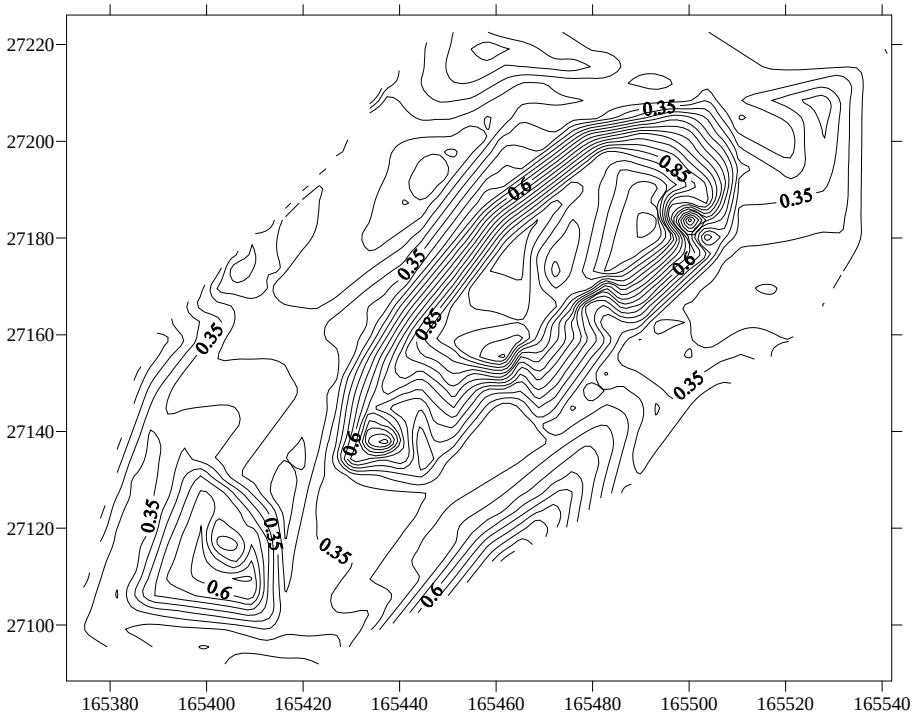
East	north	depth to silt	depth to clay	depth of silt
165539.5	27175.54	0.56	0.75	0.19
165532.4	27182.31	0.67	0.97	0.3
165524.8	27189.71	0.83	1.19	0.3600001
165517.6	27197.59	0.8	1.1	0.3
165509.7	27205.47	0.76	1	0.24
165505.9	27209.72	0.72	1	0.28
165370.6	27096.28	0.38	0.77	0.39
165380.3	27101.95	0.4	0.69	0.29
165389.8	27106.99	0.56	1.1	0.54
165398.9	27113.3	0.48	1.1	0.62
165408.1	27119.29	0.55	1.1	0.55
165416.3	27125.9	0.74	0.95	0.21
165425.4	27130.95	0.76	1.14	0.38
165435.8	27137.56	0.86	1.9	1.04
165442.4	27143.23	1	1.48	0.48
165451.6	27149.22	1.1	1.9	0.8
165461	27155.21	1.3	2.45	1.15
165468.6	27162.14	1.5	2.5	1
165477.4	27169.07	1.35	2.33	0.9799999
165485.6	27175.06	1.2	2.3	1.1
165494.1	27181.05	1.1	2.2	1.1
165503.5	27188.3	0.9	1.77	0.87
165511.1	27195.23	0.8	1.2	0.4
165519.6	27201.85	0.75	1	0.25
165527.5	27208.78	0.56	1	0.44
165535.7	27215.4	0.55	0.8	0.25
165542.3	27221.38	0.66	0.85	0.19
165418.8	27088.4	0.5	0.7	0.2
165414.4	27097.7	0.8	1.1	0.3
165409.8	27107.31	0.66	1.34	0.68
165404.3	27117.08	0.64	0.98	0.34
165400.5	27126.85	0.7	1.3	0.6
165395.5	27136.3	0.6	1	0.4
165390.6	27145.6	0.5	0.84	0.34
165385.2	27156	0.5	1.1	0.6
165462.4	27112.04	0.76	1.68	0.92

165455.3	27119.91	1	1.53	0.53
165447.1	27127.79	1	1.4	0.4
165440.5	27135.83	1	1.7	0.7
165433.1	27144.02	1	1.65	0.65
165426.2	27151.43	0.66	0.93	0.27
165419.4	27159.3	0.5	0.78	0.28
165411.7	27166.87	0.5	0.75	0.25
165404.8	27174.59	0.57	0.7	0.13
165485.6	27125.74	0.6	1	0.4
165477.9	27132.05	0.67	1.29	0.6199999
165470.1	27138.82	0.94	1.37	0.43
165461.8	27146.23	1.07	1.47	0.4
165453.3	27153.79	1.29	2.2	0.9100001
165446.4	27159.94	1.43	2.38	0.9500002
165438.3	27166.87	1.01	1.4	0.39
165430.6	27174.59	0.6	0.8	0.2
165422.9	27181.36	0.6	0.85	0.25
165417.5	27185.62	0.5	0.78	0.28
165504.5	27144.81	0.65	1.1	0.45
165496.5	27151.58	0.86	1.17	0.3099999
165488.4	27158.36	0.9	1.2	0.3000001
165480.4	27165.92	1	1.4	0.4
165471.9	27173.17	1.38	2.2	0.8200001
165464.2	27179.95	1.2	2.3	1.1
165457.1	27186.41	0.7	1.2	0.5000001
165448.3	27193.81	0.5	0.6	0.1
165440.2	27200.43	0.5	0.7	0.2
165434.2	27205.79	0.48	0.68	0.2
165523.4	27162.14	0.5	0.77	0.27
165515.5	27168.92	0.65	0.89	0.24
165507.6	27175.85	0.83	1.12	0.29
165499.5	27183.57	0.83	1.1	0.27
165492	27189.87	1	2.11	1.11
165483.1	27197.44	0.8	1.74	0.94
165475.2	27204.05	0.7	0.97	0.27
165467	27211.3	0.4	0.62	0.22
165458.3	27218.86	0.56	1	0.44
165450.1	27226.11	0.6	0.93	0.33



contour map showing thickness of silt

The calculations below are based of the contour map below using Golden Software Surfer 8 program. It produces the map using the profile coordinates only. The above map is the same overlaid onto a lake drawing.



Grid Volume Computations using surfer

Fri Oct 12 13:01:44 2012

Upper Surface

Grid File Name:	D:\work\helston\depth of silt.grd
Grid Size:	80 rows x 100 columns
X Minimum:	165370.6
X Maximum:	165542.3
X Spacing:	1.7343434343433
Y Minimum:	27088.4
Y Maximum:	27226.11
Y Spacing:	1.743164556962
Z Minimum:	0.11026756739772
Z Maximum:	1.1171962696126

Lower Surface

Level Surface defined by Z = 0

Volumes

Z Scale Factor:	1

Total Volumes by:

Trapezoidal Rule:	6415.0486619184
Simpson's Rule:	6417.9453745338
Simpson's 3/8 Rule:	6418.3431017695

Cut & Fill Volumes

Positive Volume [Cut]:	6415.0486619184
Negative Volume [Fill]:	0
Net Volume [Cut-Fill]:	6415.0486619184

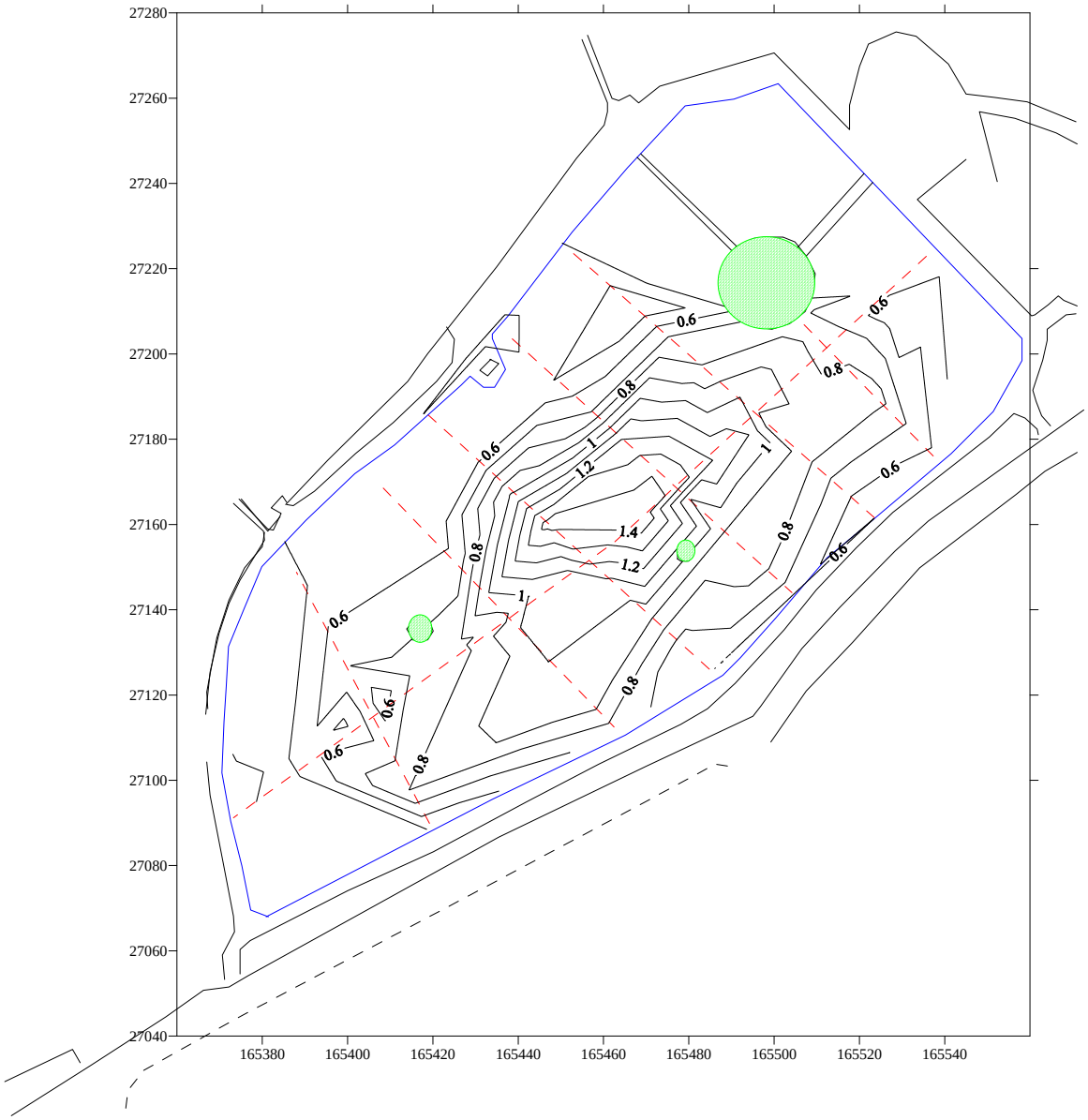
Areas

Planar Areas

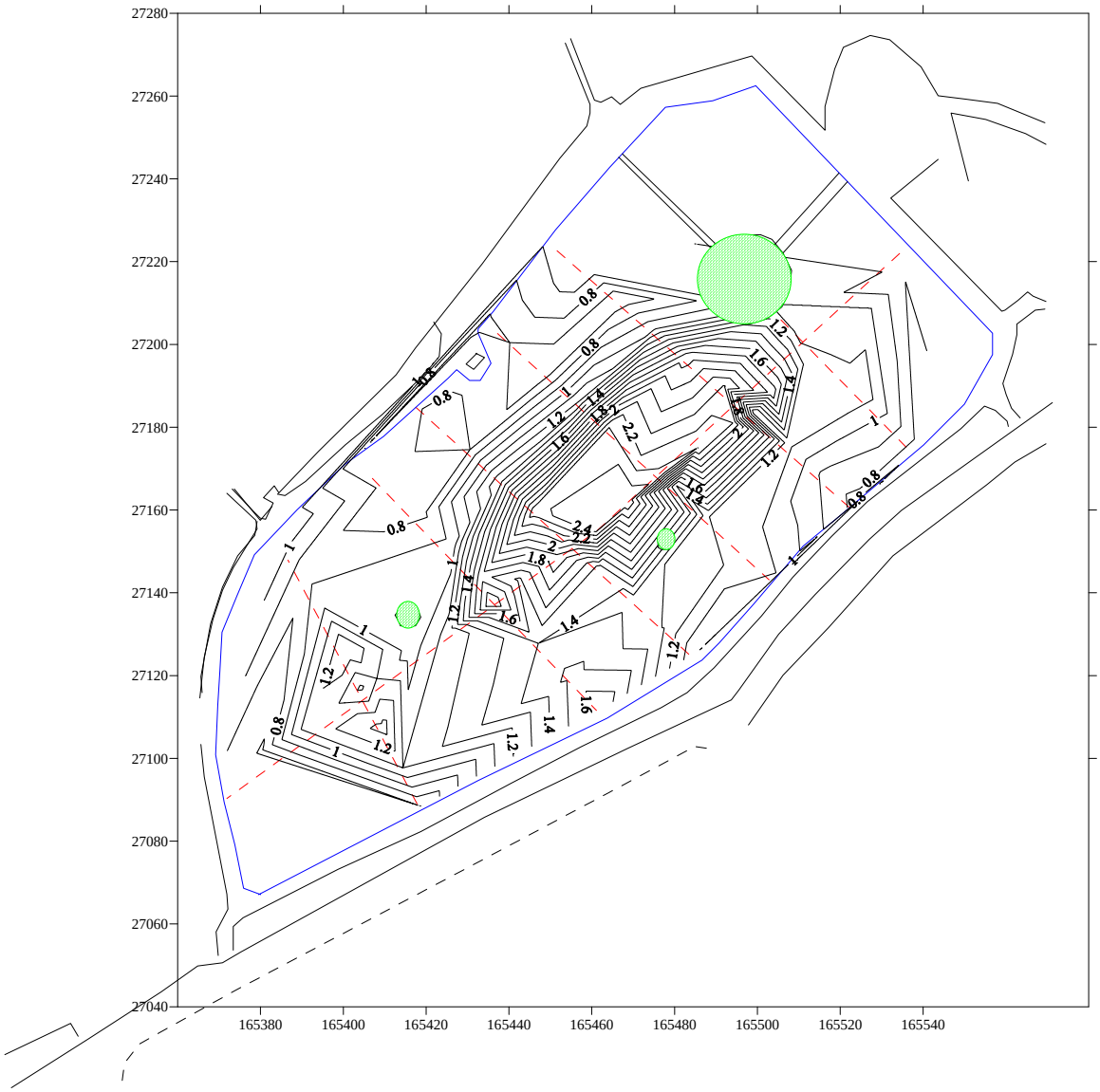
Positive Planar Area [Cut]:	14082.279888248
Negative Planar Area [Fill]:	0
Blanked Planar Area:	9562.5271117494
Total Planar Area:	23644.806999997

Surface Areas

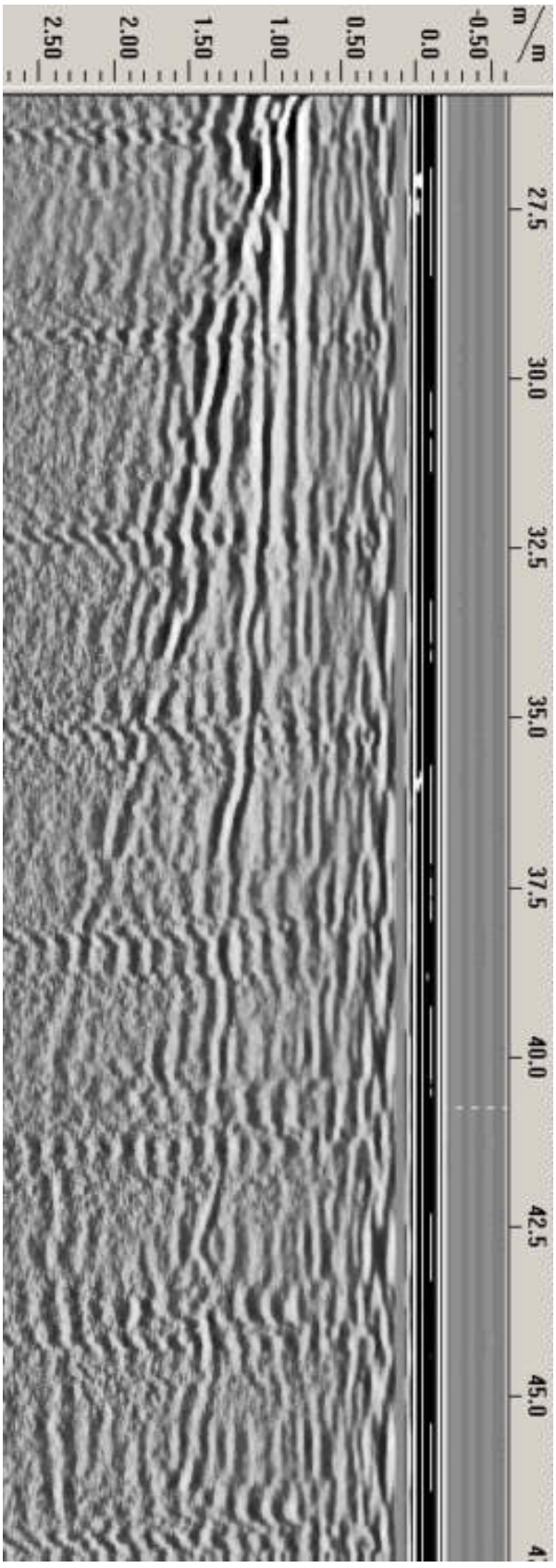
Positive Surface Area [Cut]:	14089.82807549
Negative Surface Area [Fill]:	0



contour map showing depth to silt

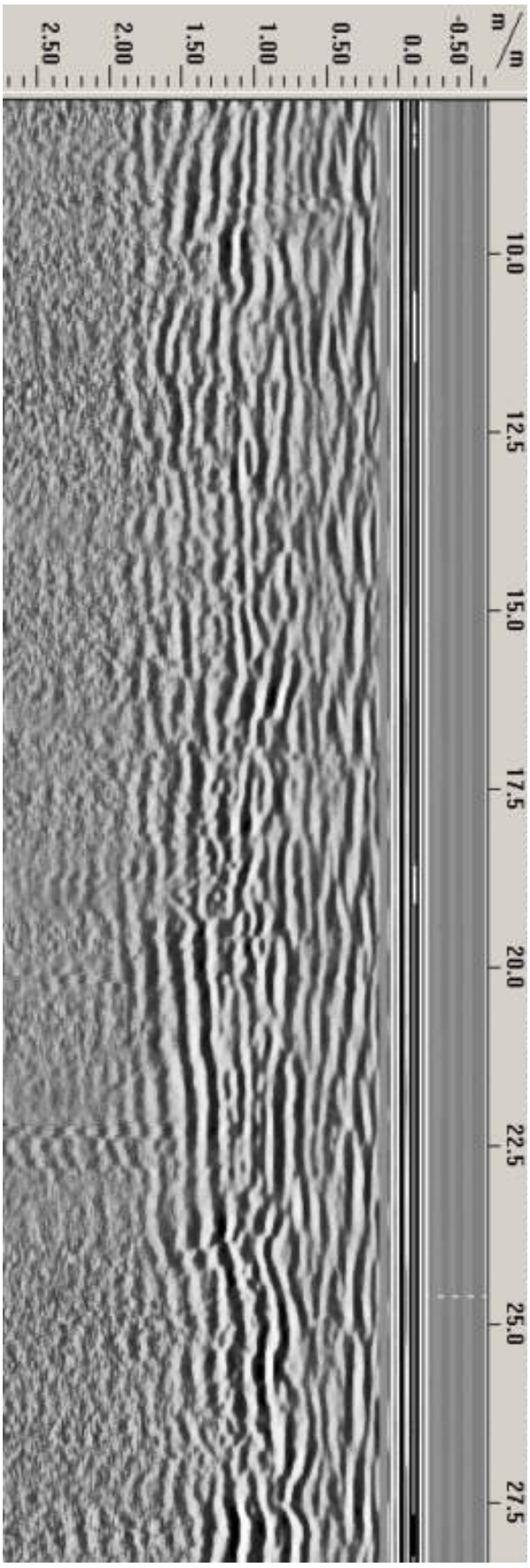


contour map showing depth to clay liner



Profile D NW/SE

The above profile shows 2 distinct horizons the deeper on being picked as the clay liner and the other as top of the silt. Figures along the top are distance in meters.

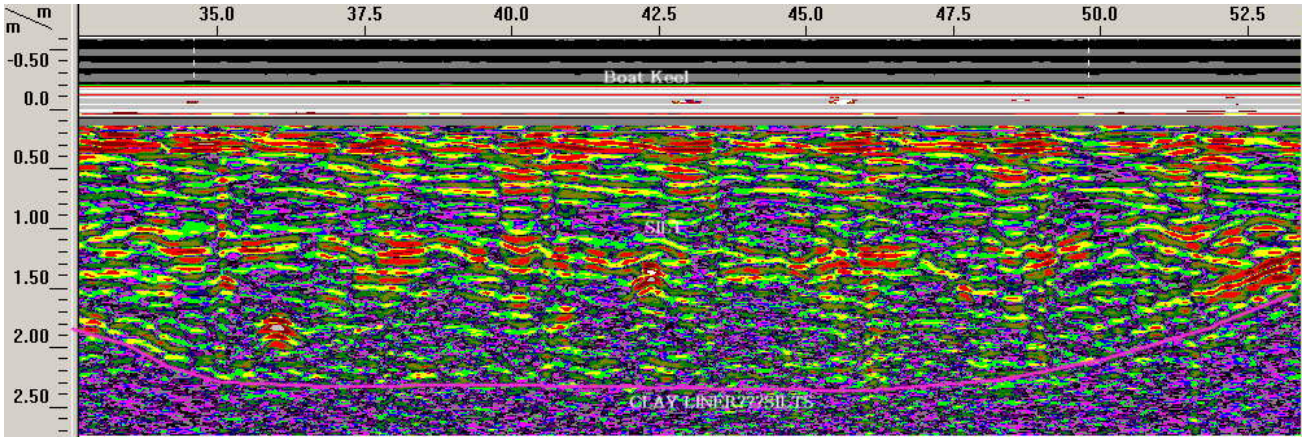


Profile A SE/NW

The above profile is across the shallower SW end of the lake. Again 2 distinct horizons can be seen but much closer together.

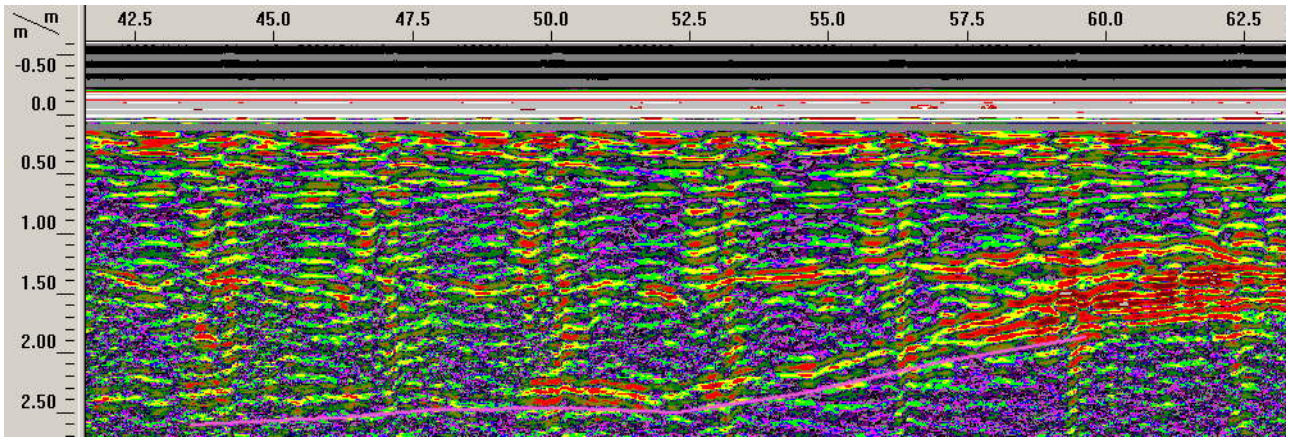
Clay liner

In the centre of the lake where the water is deepest the clay liner horizon can just be seen. It is possible that it is weak and damaged blending into the geology beneath, a possible area of leakage.

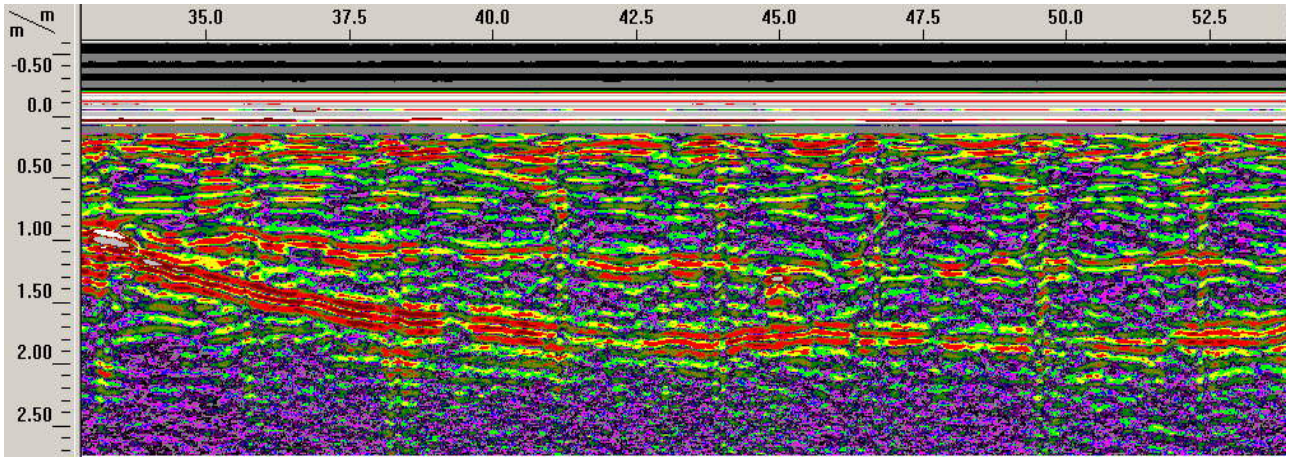


Central area of profile E

SE *NW*



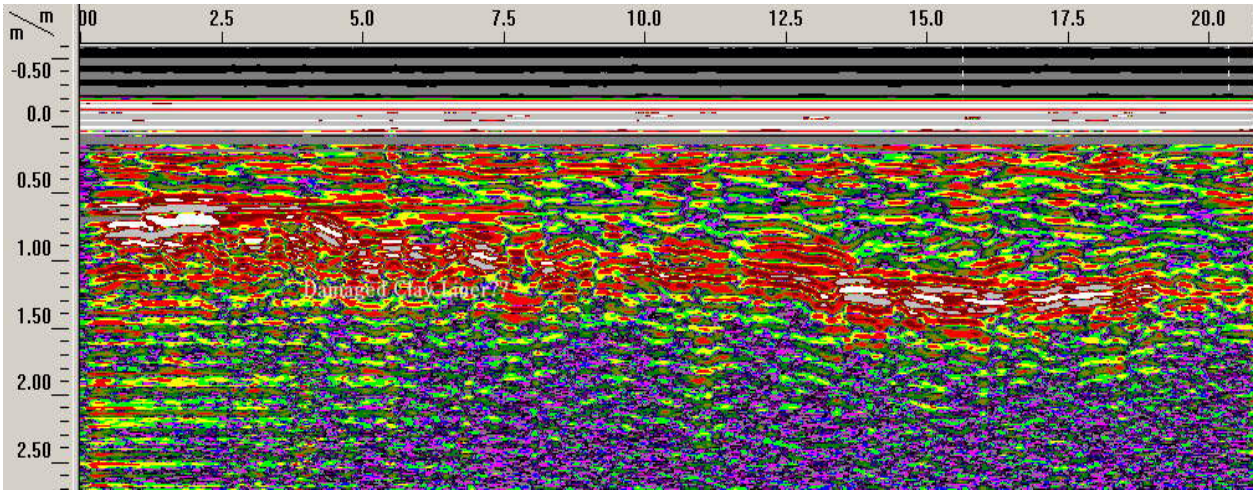
Central area of profile D



Central area profile B

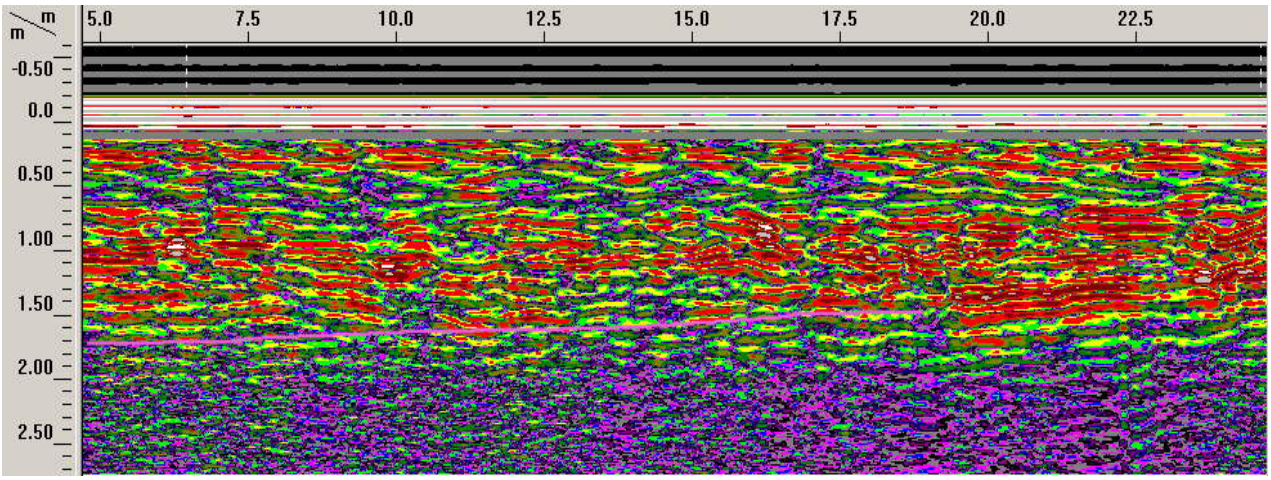
Above profile shows good section of clay liner in centre of lake.

In some of the shallower areas the Liner is clearly seen but appears fractured and damaged. The profile below shows a disjointed and broken horizon to the NW of the profile.



NW end of Profile D

Profile A below shows a very weak horizon, where the clay and silt are difficult to distinguish between.



SE end of Profile A

It would appear that there are two possible faults in the clay liner. The first in the deeper part of the lake where it is difficult to distinguish the liner from the geology beneath. The second is that in some of the shallower areas where the liner can be seen but appears to be broken. This is seen on two of the profiles shown above.