Petersfield Town Council

Siltation and Erosion Survey

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Introduction

1.0 Introduction

The A.G.A Group has been instructed by the Client (Petersfield Town Council) to carry out a siltation and erosion survey of Petersfield Heath Lake and suggest prescriptions for improvements to the site. The Petersfield Heath Lake is located to the south east of the town at N.R.G: SU 752 228 (*Figure .1).*

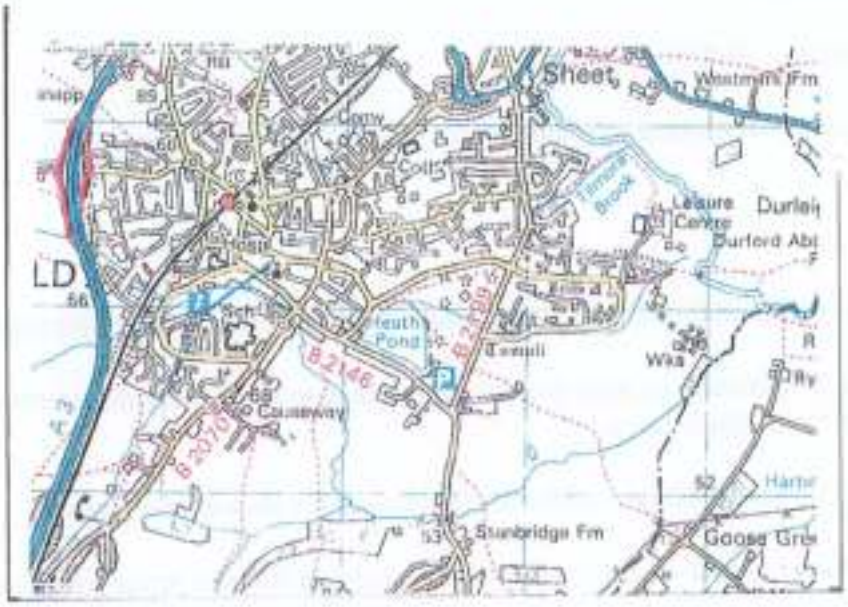

Figure 1 – Petersfield Heath Lake location map

There is little technical information on the lake available either from the Council or the Environment Agency but the lake is approximately 22 acres in size, approximately 89,100m^2 (4050m^2 x 22). The lake is used for fishing and is stocked with significant populations of Carp *(Cyprinus Carpio)* and Bream *(Abramis brama).*

The lake is used for water sports such as angling, canoeing and boating, it is also the focal point for a lot of bank side activity attracting many visitors who walk round it, walking dogs and feeding waterfowl.

The lake is an extensive but shallow groundwater and precipitation fed lake dug out in the 18th century *(Plate 1)*. It was deepened by suction dredging in the 1980's and there is a single outlet drain controlled by a sluice, and the first section stretch of the drain is culverted.

Plate 1 - Petersfield Heath Lake, shallow groundwater and precipitation fed

There is a Management Plan (2005) in place to maintain the Heathland which surrounds the lake to 'good ecological status'.

The existing plan also deals with some aspects of the lake management dealing briefly with issues such as the control of erosion and the encouragement of marginal vegetation by reducing the shading around the lake. There are however only 4 pages given over to the management of the lake in a document of 95 pages.

The A.G.A Group has carried out both an erosion and siltation survey of the lake to assess current issues and prescribe remedies to improve the site. There has been a recent algae problem at the lake which has since abated but raised questions over the water quality at the time and in the future.

Aims and Objectives

2.0 Aims and Objectives

This survey had been commissioned by Petersfield Town Council with three main aims and objectives (listed below).

1) To carry out a full siltation survey of the site to assess silt levels in the pond.

2) To assess the erosion issues at the lake and discover to what extent this is driving the siltation issue if one exists.

3) To prescribe management prescriptions to both reduce the silt in the lake, decrease bank erosion and to enhance the ecological potential of the site.

Methodology

3.0 Methodology

To carry out a siltation survey on Petersfield Heath Lake, the lake was split into a $20m^2$ grid this enabled a gauge as to where the siltation was at its greatest, working both up and down and across the lake to give a fair representation of the total volume of silt in the basin. This was achieved by a two man team sectioning the lake and taking depth readings every 20 meters, not only the depth of the water but also of the depth of the silt on the bottom. The lake although relatively shallow is still over 2 meters deep in places so a boat was used to access the centre of the lake which is both the deepest part and contains the greatest depth of silt. A diagram showing the exact methodology is shown below *(figure. 2)* graphically illustrating how the lake was sectioned.

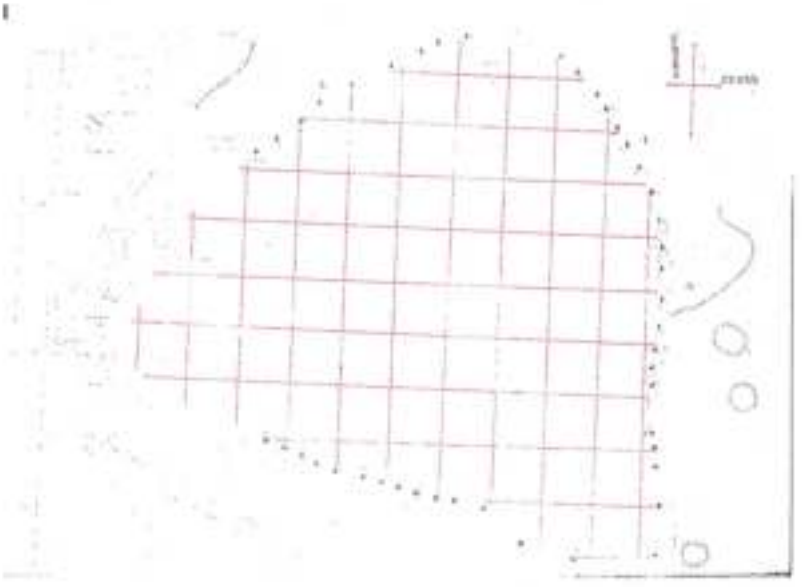

Figure 2 – $20m^2$ sectioning of Petersfield Heath Lake for siltation survey

This is a best practice method for carrying out siltation surveys and enables a good understanding of how the lake is reacting in regards to sediment transport on and across the bottom of the lake.

The bank erosion survey was carried out on an observational basis along the margins of the lake; this involved identifying potential key areas which are marked on the diagram *(Figure 3)* where erosion may be considered a problem. This component of the plan was to survey present bank erosion features. The objective did not include a comparison of existing bank erosion with historical bank erosion rates since this data is not available.

The survey details existing bank and erosional features around certain sections of the lake, it is worth noting here that there are a number of erosion mitigation techniques already in place at certain points around the lake which have worked to a lesser or greater degree. These include spiling *(Plate 2)* and railway sleepers used to provide a hard revetment to reduce further bank erosion; unfortunately the geomorphology of the area is made up of loose un-consolidated sandy material and these measurers are proving ineffectual.

Plate 2 – Existing erosion control measures employed at certain points around Petersfield Heath Lake.

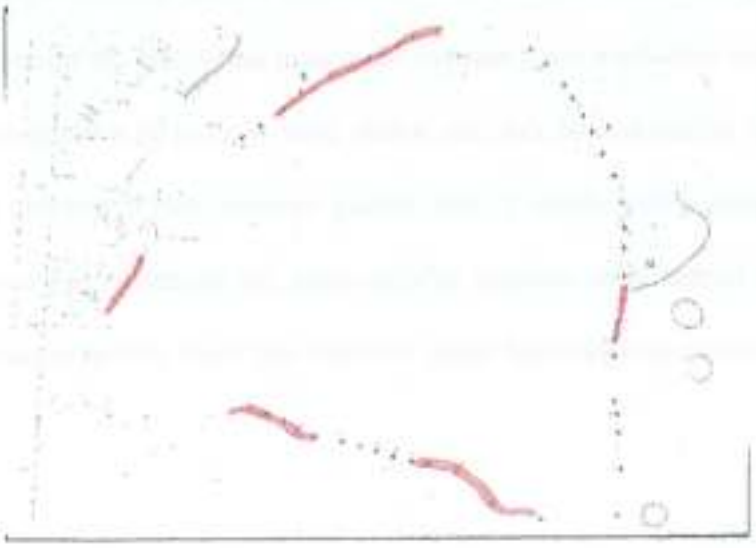

Figure 3 – Areas where bank erosion is considered a problem

The silt is coming from a number of sources; most prominently leaf fall in autumn due to the large number of deciduous trees surrounding the lake. Bank erosion is another issue and there are numerous points around the lake where erosion is considered a significant input into the silt content. There are also large amounts of sediment in the run off after heavy precipitation events due to the sandy unconsolidated substrate. These inputs along with bird and fish excrement are contributing significant large amounts of silt into the lake system with adverse effects.

Results

4.0 Results

The detailed measurements of the siltation survey is presented as *Appendix 1-4*, the data shows that the figures are representing is that the lake is both deepest and contains most silt towards the centre of the lake. There is a pronounced sand bar to the eastern corner of the lake and silt deposits tended to be more concentrated in the centre of the lake with little or no silt in the margins.

Figure 4 and 5 show graphically the amount of silt in the lake at various survey points working both across and along the pond. These diagrams show the elevated levels of silt found particularly in the centre of the pond and give some idea of the issues the lake may have.

Not all sections of the lake were heavily silted and parts of the lake such as the area around the island and to the south side of the lake were virtually silt free *(Plate 3)*. The maximum silt levels recorded were 65cm in places with the average result 20.11cm if accounting for the lake as a whole.

From this we can ascertain that if lake is 89,100m^2 x 0.2011m will give us the total volume of silt in the Petersfield Lake. 89,100 x 0.2011= 17,918m^3

Plate 3 – Island section of the lake where silt levels were decreased

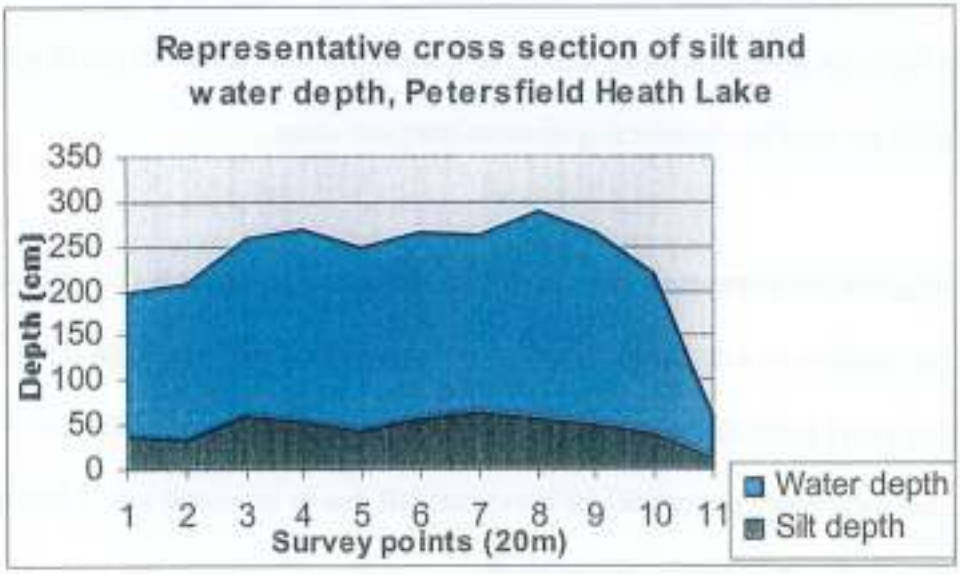

Figure 4 – Representative cross section of silt and water depth, Petersfield Heath Lake

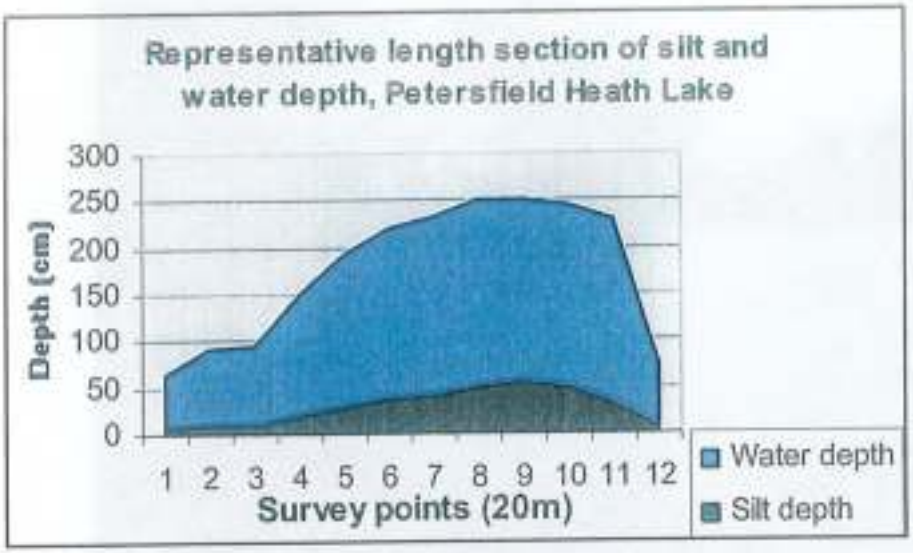

Figure 5 – Representative length section of silt and water depth, Petersfield Heath Lake

The erosion of the margins of the lake is contributing directly to the siltation load; this can be seen at a number of areas around the lake (*plates 4-6).* The erosion problems around the lake have as previously discussed (*Page 6*) been mitigated against to some extent but there are numerous areas where these measures have not been put in place and the banks are eroding considerably in some marginal areas.

Where mitigation measures have been used they are 'hard' revetments that although serving their purpose to a degree have had no positive biodiversity or habitat inputs to the site. The plates produced below illustrate clearly the erosion issues facing the lake; this becomes exacerbated in periods of heavy rainfall due to increased runoff into the lake which carries with it high sediment loads.

Evidence of this has been found at locations around the site *(Plate 7)* and mitigation must be considered to resolve the problem of high sediment yield runoff entering the lake system. The image highlights the issue caused by the surrounding landscape and any management proposal will have to consider this problem when looking at the lake system.

Plate 4 – Lack of defences has led to erosional features in the margins

Plate 5 – Erosion feature to the North of the lake where bank erosion was considered to be worse

Plate 6 – Eroded landscape feature to the West of the lake exacerbated by high runoff

Plate 7 – Evidence of intense runoff erosion feature feeding directly into the lake

A further issue which is directly affecting the silt input in the lake and also affecting the overall health of the lake system is marginal shading from large trees situated around the lake margins (*Plate 8*). This shading is having a detrimental effect on the health of the lake in a number of ways: firstly, as the trees are mainly deciduous there is a lot of leaf fall in autumn months which is decomposing in the lake thus increasing the silt input.

Secondly, the lack of light in the margins does not encourage plants to establish and grow; it also impedes the warming of the water. It is only in the presence of sunlight and warmth that phytoplankton (microscopic plants such as algae) can flourish and grow. This growth is essential and forms the base of the aquatic food web in the lake *(Figure 6)*.

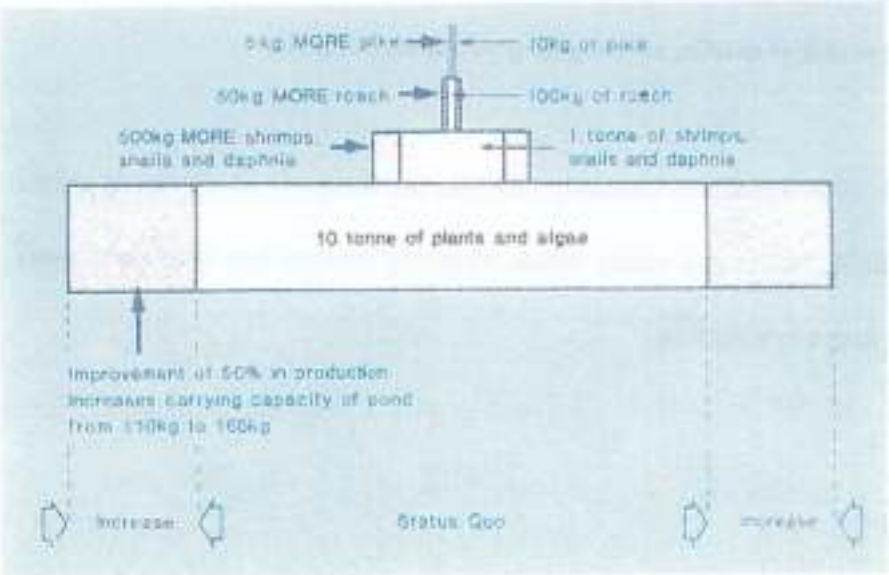

Figure 6 – Aquatic food web

The marginal shading from the tree canopy is very pronounced over large sections of the lake, illustrated in *Plate 8.*

Plate 8 – Marginal tree canopy shading affecting the productivity of the site

Further to this, the roots from trees currently run over the footpath at numerous points around the lake raising health and safety issues, stopping erosion into lake via run-off will go some way to preventing this.

Conclusion

5.0 Conclusion

After carrying out an extensive siltation and erosion survey the A.G.A Group found there to be a significant quantity of silt in the Petersfield Heath Lake. This is due to a number of reasons but primarily the amount of silt in the lake is caused by leaf fall into the lake, as the margins of the lake are surrounded by deciduous trees.

There are other inputs into the system exacerbating the silt content as well including bank erosion in places and runoff carrying high sediment loads as well as bird and fish excrement. It should also be noted that the lake lies on the water table so fluctuations in groundwater levels will also have an impact on lake depth levels which vary seasonally.

Lakes are dynamic in form and hence constantly changing due to a number of factors such as weather conditions and precipitation. This survey is then only a snapshot in time of the conditions of the lake on one particular day, that being said however without intervention the silt levels can only increase to make the lake shallower over time.

However as the Heath Lake sits on a water table all may not be as it may first seem. When the water table is high, this is causing the bottom sediment of the lake to be in a dynamic state.

This dynamic state is possibly exaggerating the volume of silt in the bottom of the lake due to the material at the bottom being unable to consolidate over time. The material is therefore in suspension for large periods of the year, thus not allowing for the usual processes of compaction and consolidation that takes place in lakes that are formed in an impermeable substrate.

As the base is fluid for large periods of the year much of what is perceived to be silt is likely to be sandy substrate. A short survey of the bed over say 20 sampling points when the water table is at its lowest, towards the end of dry summer period would allow a comparison to be made. This might easily reduce the silt figure by 60%.

Prescriptions

6.0 Prescriptions

The A.G.A Group would recommend that a number of actions be taken to both reduce silt where appropriate and condition the lake substrate as part of a strategy to improve water quality. The amount of silt is questionable because of this factor of a dynamic bed when the high water table is supporting the fine sediments that are the lake bed.

The costs of removing the silt, especially if this were to include natural fine sediment that is effectively the natural bottom would be prohibitively expensive. There is however an opportunity to remove some limited amounts of silt at an affordable cost.

Dredging the lake might facility a better environment for the fish community; however it should be noted that the lake is by nature a shallow bowl, hand dug in a depression to facilitate the watering of cattle etc in the 18th Century. It may well be more appropriate to manage the fish community and other biological factors in a way which is commensurate with the lake rather than change the ecological status of the lake to suit the requirements for angling, boating, etc.

It is understood that a tree survey has been carried out on the site; it is recommended this survey is used to assess the appropriate management of problem trees. The plan at least should include all trees imputing excess leaf into the lake system thus exasperating the siltation problem. This is seen as a medium to long term solution to the silt problem because even if the lake is dredged, without the pollarding or removal of tree canopies over the lake the silt problem will persist.

A further and serious concern is the detrimental impact that the trees positioned on or close to the margins of the lake are having on the aquatic ecology and biodiversity value of the Lake. Tree canopy shading has two effects, the lack of light does not encourage plants to establish and grow, and it also does not warm the water up. It is only in the presence of sunlight and warmth that phytoplankton (microscopic plants such as algae) can flourish and grow. This is a serious issue the A.G.A Group would advise addressing to increase the ecological potential.

The continued erosion of banks at the site is another serious issue which needs to be taken into account and it seems that to improve and extend the mitigation measures already in place might not be to go far enough. The spiling (hard revetment) appears to be not working terribly effectively in the localised areas where it is situated and increasing the number would not offer a long term solution.

Coir rolls on the other hand would provide good habitat for wildlife and improve the ecological potential of the site while alleviating the erosion problems. The A.G.A Group suggest a prescription which would address all the issues in a holistic, cost effective approach.

By placing coir revetments 5m out from the existing bank and then backfilling with the sediment from the lake (removing silt) it would not only address the erosion and siltation problem but also build out the banks from under the trees to allow more light into the vegetated margins *(Figure 7)*. This will also go some way to stopping transport towards the lake of fine material from the footpath.

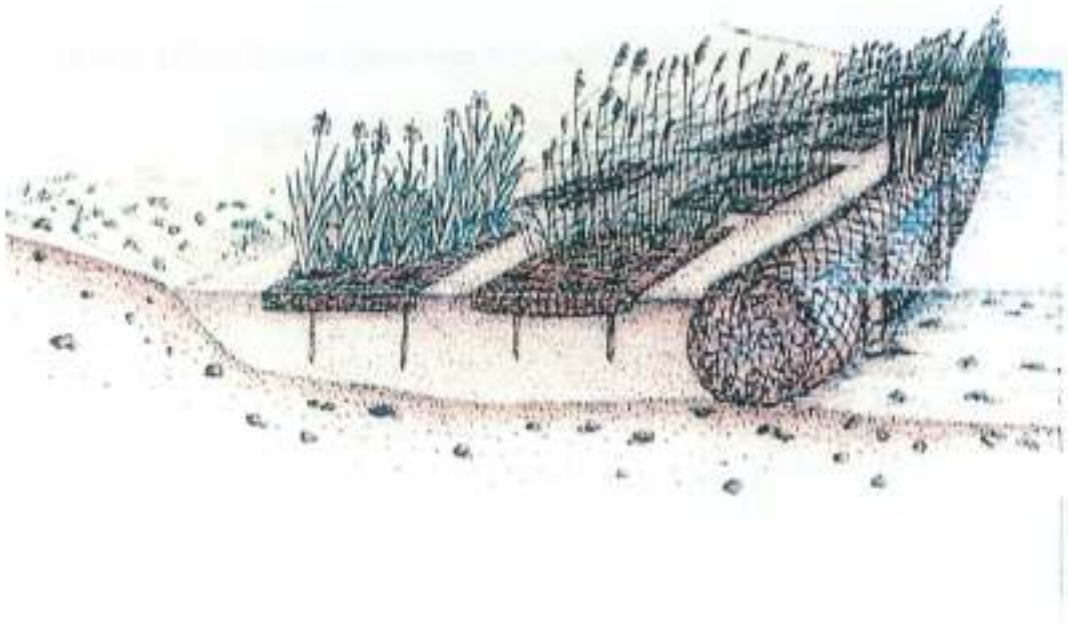

Figure 7 – Proposed solution to both bank erosion and silt intrusion

This would serve to improve the amenity and reduce the risk of future erosion problems by keeping the bank away from footpath and making room for anglers, whilst reducing the impact from walkers. The A.G.A Group has put this proposal forward as a solution to both control erosion and silt inputs into the lake and increase the biodiversity and natural habitat of the site.

These pre-vegetated coir fibre modules have been widely tested and have proven to be very successful in improving water quality, increasing biodiversity, stabilising banks and reducing sediment transport *(Plate 10)*. This action along with the tree management plan will allow a lot more sunlight into the margins and increase productivity on the lake.

Other benefits to the proposal are that if the silt is only being moved locally then no consents will be required for the transport and disposal of the material.

Plate 10 - Coir-fibre rolls six months after installation.

Fish populations in the lake also need to be assessed in the management strategy and the possibility of reducing stocks if the survey coupled with water quality supports this action. The AGA Group would recommend a full fish survey including weight, length and age analysis to gauge accurately the dynamics of the fish population.

The concept of removing stock as a way of improving the angling catches from a fishery can in our experience be a difficult one for anglers to come to grips with; however it can reduce stress levels of fish populations and return the lake into a more natural hierarchy and structure, along with this is an improvement in angling catches.

The A.G.A Group Consultancy is based around the experience of its Principle Consultant Mr Ash Girdler who is a Chartered Biologist, Chartered Environmentalist and Fellow of the Institute of Fisheries Management.

The A.G.A. Group carry out contracted work in the lake, pond and river restoration sector using bio-engineering and natural techniques. They are acknowledged to be leaders in the field whose clients include:

Environment Agency

Wildlife Trusts

Local Authorities

Private Estates and Landowners

Norfolk Broads Authority

English Nature

Bryant Homes

ISS Waterers

Appendix. 1 - Silt levels in the cross section, Petersfield Heath Lake

A	B	C	D	E	F	G	H	I	J
0	2	5	4	6	38	4	3	6	10
12	22	32	7	23	35	10	5	10	5
5	35	60	42	40	62	10	6	12	4
7	18	45	35	52	55	40	4	5	7
		9	9	60	45	60	7	7	5
			4	54	56	55	7	4	3
				42	65	53	2	8	4
				35	56	57	2	5	5
				35	50	48	5		
				10	40	35	2		
					15	5	2		

Appendix. 2 – Water levels in cross section, Petersfield Heath Lake

A	B	C	D	E	F	G	H	I	J
14	40	45	69	45	159	60	45	38	50
80	196	147	184	183	174	110	50	55	45
60	112	110	205	193	197	140	52	62	55
40	56	160	198	203	213	220	55	71	47
		60	135	230	205	240	55	89	43
			50	207	210	190	79	66	46
				230	198	185	80	43	52
				190	235	203	71	46	51
				197	215	196	81		
				65	180	152	109		
					45	42	49		

Appendix. 3 – Silt levels in length section. Petersfield Heath Lake

A	B	C	D	E	F	G	H	I	J
10	10	1	5	5	2	5	5	5	5
10	30	9	15	10	10	15	15	25	5
12	30	17	15	8	36	5	21	15	10
8	25	35	20	19	42	10	25	15	15
4	25	21	30	29	35	5	25	10	8
	10	32	30	37	30	20	20	20	5
		44	45	41	30	32	15	25	10
		52	45	50	20	30	4	15	5
		39	45	55	25	54	5	5	
		42	42	50	24	21			
		33	38	30	20	5			
		10	5	5	7				

Appendix. 4 - Water levels in length section, Petersfield Heath Lake

A	B	C	D	E	F	G	H	I	J
60	62	15	42	60	41	45	50	50	50
154	125	45	65	81	94	130	75	55	50
157	151	154	90	86	187	110	145	125	70
133	82	189	145	130	210	90	170	150	65
69	75	162	160	164	200	130	190	165	55
	40	183	175	184	185	154	185	190	60
		192	200	192	185	160	168	185	55
		194	200	202	157	176	145	185	45
		201	200	195	171	220	60	60	
		201	187	195	149	165			
		191	190	200	137	55			
		43	64	68	50				