Appendix 7.26: Phytobenthos, Cyanobacteria and Zooplankton Survey Report

City of London

BASELINE SURVEY OF PHYTOBENTHOS, CYANOBACTERIA AND ZOOPLANKTON IN 13 PONDS ON HAMPSTEAD HEATH

FINAL REPORT

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CONTENTS

1 INTRODUCTION

APEM Ltd was commissioned by City of London to undertake phytobenthos, cyanobacteria and zooplankton surveys at the Hampstead and Highgate Chains of ponds located on Hampstead Heath, London. The surveys are desired by City of London to inform on the current composition and quality of these aquatic ecology indicators in each pond and to provide evidence to support an environmental impact assessment for flood and water quality works.

This document presents the results of baseline surveys undertaken during May and July 2013.

1.1 Background

Atkins have undertaken a full review of all aquatic ecological baseline data for the Hampstead and Highgate Chains of ponds to determine its suitability for use in informing options for pond/water quality enhancement, the environmental impact assessment and detailed design process 2013/2014.

Following the review, it was considered appropriate that a full suite of ecological surveys be undertaken on all ponds within the Hampstead and Highgate Chains to provide a robust baseline.

The ponds included in the surveys for phytobenthos, cyanobacteria and zooplantkon are as follows:

Highgate Chain

- Highgate No 1 Pond
- Highgate Men's Bathing Pond
- Model Boating Pond
- Bird Sanctuary Pond
- Kenwood Ladies' Bathing Pond
- Stock Pond

Hampstead Chain

- Hampstead No. 1 Pond
- Hampstead No. 2 Pond
- Mixed Bathing Pond
- Viaduct Pond
- Vale of Health Pond

English Heritage Ponds

- Wood Pond
- Thousand Pound Pond

1.2 Report aims

The aim of this report is to deliver scientific data pertaining to current phytobenthos, cyanobacteria and zooplankton assemblages within 13 of the Hampstead and Highgate ponds. It is envisaged that this data will subsequently serve as the basis of a baseline data-set; as it is

considered that the current data set is temporally limited. The data compiled will be utilised to inform an ecological impact assessment for the proposed flood and water quality works.

2 METHODS

Surveys for phytobenthos, cyanobacteria and zooplankton were undertaken at the 13 ponds listed in Table 2.1. Grid references for each sample location are provided along with the date of both early and late season surveys.

Table 2.1 Locations and dates for phytobenthos, cyanobacteria and zooplankton surveys during 2013

Chain	Pond	Phytobenthos grid reference	Cyanobacteria & zooplankton grid reference	Early season survey date	Late season survey date
Highgate Chain	Highgate No 1 Pond	TQ2796186355	TQ2796886346	21/05/2013	10/07/2013
	Highgate Men's Bathing Pond	TQ2776786563	TQ2787686435	21/05/2013	11/07/2013
	Model Boating Pond	TQ2775586787	TQ2773086738	21/05/2013	11/07/2013
	Bird Sanctuary Pond	TQ2770786851	TQ2770286774	21/05/2013	10/07/2013
	Kenwood Ladies' Bathing Pond	TQ2768286885	TQ2768286885	21/05/2013	09/07/2013
	Stock Pond	TQ2754887135	TQ2713787249	21/05/2013	10/07/2013
Hampstead Chain	Hampstead No. 1 Pond	TQ2724285938	TQ2719885870	22/05/2013	16/07/2013
	Hampstead No. 2 Pond	TQ2722786058	TQ2724786120	22/05/2013	12/07/2013
	Mixed Bathing Pond	TQ2726686156	TQ2726786145	22/05/2013	17/07/2013
	Viaduct Pond	TQ2690186414	TQ2694086461	22/05/2013	16/07/2013
	Vale of Health Pond	TQ2658586383	TQ2664686429	22/05/2013	15/07/2013
07/English Heritage Ponds	Wood Pond	TQ2749087135	TQ2713987245	21/05/2013	09/07/2013
	Thousand Pound Pond	TQ2728287190	TQ2725687201	21/05/2013	09/07/2013

The survey methods employed for each aquatic ecology element are described below. An ARC GIS map of sampling locations for each pond is provided in Section 3 along with the site descriptions.

2.1 Phytobenthos

Early season phytobenthos samples from the 13 ponds were collected in May 2013 while the late season samples were collected in July 2013; see Table 2.1 for sample locations. The WFD compliant methodology for diatom analysis is known as DARLEQ (**D**iatom **A**ssessment of **R**iver and **L**ake **E**cological **Q**uality) and was developed by Kelly *et al*. (2008) through the DARES/DALES projects. Protocols under DARLEQ govern sampling, sample processing and enumeration, and there are guidance documents provided by WFD-UKTAG illustrating the method to be followed to provide Ecological Quality Ratios (EQRs) from diatom samples for both lakes and rivers (UKTAG, 2008a; 2008b). While EQRs have not been calculated at this stage (see below), WFD-compliant methods have been followed at all stages to allow EQRs to be calculated in the future.

Sampling methods followed guidelines within the updated DARES/DALES documents (as available from http://craticula.ncl.ac.uk/DARES/methods.htm) to meet the European Standard EN 13946:2003 (Water quality – Guidance standard for the routine sampling and pre-treatment of benthic diatom samples from rivers). At most locations emergent macrophytes were sampled, but where emergent macrophytes were not present, cobbles or submerged macrophytes were sampled (see Section 3). Samples were preserved in the field by addition of Lugol's iodine solution. At each sampling location a DARES/DALES sample form was filled in detailing site characteristics. All sampling equipment was thoroughly washed before and after each use to avoid contamination.

Preserved diatom samples were transported to APEM laboratories for processing. On arrival the samples were logged into the diatom database which assigns each sample a unique APEM number, allowing tracking of the sample through the preparation and enumeration process. Samples were cleaned using APEMs in-house UKAS[1]-accredited method based on the hot peroxide (H_2O_2) method. Diatom slides were prepared using thickness 0 coverslips of 19 mm diameter, mounted with Naphrax on unwashed microscope slides. Prior to permanent mounting, the density of diatom valves was checked by examining a coverslip at 400 × magnification for densities in the region of 30 valves per field of view.

Slides were enumerated on a high power light microscope using a 1000 × oil immersion lens and phase contrast illumination. The microscope was fitted with a correctly calibrated eyepiece graticule with a resolution of 1 μm, and apparatus for photomicroscopy to aid in the identification of difficult specimens. The floras and identification guides used were Krammer and Lange-Bertalot (1999-2004), together with various reports from the Diatom Ring-test of UK and Ireland. At least 300 non-planktonic valves that contribute to the LTDI (Lake Trophic Diatom Index) were enumerated per sample. The database used for data entry has a facility to calculate the numbers of valves that contribute to the LTDI, ensuring sufficient valves are always enumerated. All planktonic taxa present were also recorded and identified to the lowest taxonomic level possible.

[1] UKAS Testing Laboratory 4441

The results presented in Section 4.1 are LTDI (version 1) values for each season, together with the percentage of motile valves and the number of taxa recorded. A full species list for each sample is presented in Appendix I.

Development of a WFD ecological status classification through calculation of an EQR requires a minimum of three samples ideally collected over three years (e.g. spring 2013, autumn 2013 and spring 2014) and consequently EQRs have not been calculated. Additionally, for calculation using the DARLEQII program lake typology based on mean annual calcium carbonate (mg/l) concentration (or µeq/l) is also required.

2.2 Cyanobacteria

Samples for phytoplankton analysis were collected by immersing a clean phytoplankton sample bottle (amber glass, 500 ml capacity) to a depth of ca. 30 cm until full. Samples were preserved with Lugol's iodine in the field and kept cool and dark during transport back to APEM's laboratory facilities.

On arrival the samples were logged into the phytoplankton database which assigns each sample a unique APEM number, allowing tracking of the sample through the preparation and enumeration process. Samples were kept in the dark and below 25°C while being stored prior to analysis.

Quantitative analysis of phytoplankton included the identification and enumeration for each sample following APEM UKAS[2] accredited methodology which is equivalent to the SNIFFER WFD80 methodology (2007). Briefly, this method involves the analysis of a subsample of the collected water sample using an inverted microscope (Utermöhl technique).

Taxon lists were produced for each sample, and abundances calculated as numbers per ml. Results are presented in Section 4.2 by algal group. A full species list with abundances is presented in Appendix II.

2.3 Zooplankton

Zooplankton samples were collected using a method based on Clesceri *et al.* (1998). The trawl net used had a 250 µm mesh, a diameter of 250 mm and a length of 0.5 m, and was attached to a rope marked with 1 m intervals. Bankside samples were collected at each of the 13 ponds. At each sampling location three surface trawls of 5 m length were used to collect the sample. The zooplankton net was thrown out to a distance of ca. 5 m from the bankside or boat, allowed to sink to ca. 1 m depth and then pulled back to the samplers at a rate of approximately 30 cm s^{-1}. The sample was rinsed down into the cod end of the trawl net by dipping the body of net into the water and out again a few times (ensuring that no water entered the mouth of the net), and then spraying the outside of the net with lake water. The cod end was then unscrewed from the net and the sample rinsed into a labelled collection vessel and preserved with 90 % Industrial Methylated Spirits (IMS).

Preserved zooplankton samples were transported to APEM laboratories for processing. On arrival the samples were logged into the zooplankton database which assigns each sample a unique APEM number, allowing tracking of the sample through the preparation and

[2] UKAS Testing Laboratory 4441.

enumeration process. Samples were sieved prior to enumeration using a 53 µm mesh sieve and rinsed with water to remove the preservative.

Samples were transferred to a petri dish etched with 1cm gridlines for microscopic analysis, and where necessary individual zooplankton picked out of the dish using fine foreceps or a pipette and placed on microscope slides for identification. Identification was to species level for Cladocera and Copepoda where possible, using a range of keys, while Copepod nauplii were enumerated but not identified further. Other groups such as Rotifera are not readily identifiable when preserved[3], and so were only identified when obvious features were present. Nomenclature was according to the Furse List of aquatic fauna, produced by the Centre for Ecology and Hydrology (CEH). Identification was undertaken for a sub sample of around 200 individual zooplankton per sample (unless the sample contained a total of fewer than 200 specimens, in which case the entire sample was identified). For samples containing a greater number of zooplankton than 200, subsamples were taken following APEM's in-house method, which involves diluting the sample to an appropriate volume, ensuring the zooplankton are equally distributed within the sample, before removing an appropriate volume to enumerate (usually 1 to 6 mL). The volume enumerated must be noted in addition to the volume in which the entire sample was suspended in order to obtain abundance estimations. Subsamples were dispensed into a petri dish etched with 1 cm gridlines, identified and enumerated as described above.

Taxon lists were produced for each sample, and abundances calculated per m^3 of lake water. Summary data of abundances by group (e.g. rotifers, Cladocerans, Copepods and Ostracods) are presented in Section 4.3, while a full species list for each sample with abundances is provided in Appendix III.

[3] This is an unavoidable consequence of the method; samples cannot be analysed unpreserved due to degradation affecting identification.

3 SITE DESCRIPTIONS

Site descriptions are presented for each chain of ponds. An image of the diatom (phytobenthos) sampling location is provided, along with an ARC-GIS image illustrating the location of the relevant sampling locations.

3.1 Highgate Pond Chain

The ponds within this chain are described in downstream to upstream order.

3.1.1 Highgate No.1 Pond

Highgate No. 1 Pond is located at the southern extent of the Highgate Chain. The pond is generally shallow (typically <2m deep) with soft silt substrate and abundant submerged macrophytes. Vegetation cover on the banks varied with some areas characterised by trees and bushes, and others by grassy banks, some emergent macrophytes were present in the littoral zone and these were the substrate sampled for the phytobenthos sample during both surveys (see Figure 3.1). The cyanobacteria and zooplankton samples were collected from the same location.

Figure 3.1 (a) Phytobenthos sampling location at Highgate No.1 Pond; and (b) sampling locations for phytobenthos, cyanobacteria & zooplankton

3.1.2 Highgate Men's Bathing Pond

The pond is generally deep (typically >2.5m) with soft substrate. The majority of the pond is surrounded by bankside trees or re-enforced banks. Very few emergent macrophytes were present due to the shading from bankside trees and unsuitable conditions along the re-enforced banks. The early season phytobenthos sample was collected from sedge stems, while the late season sample was collected from sweet flag stems. The samples for cyanobacteria and zooplankton were collected from the opposite side of the pond in an area of open water. See Figure 3.2 for sample locations.

Figure 3.2 (a) Phytobenthos sampling location at Highgate Men's Bathing Pond; and (b) sampling locations for phytobenthos, cyanobacteria & zooplankton

3.1.3 Model Boating Pond

The pond is generally over 2m in depth and there appears to be a silt substrate throughout. The banks are entirely re-enforced and there is very little bankside vegetation. Planted gabions have been installed along some of the banks and as small islands. There are two small reed beds at the northern end of the pond, and these were sampled for the phytobenthos during both survey visits, while the cyanobacteria and zooplankton samples were collected on the North West side of the pond (Figure 3.3).

Figure 3.3 (a) Phytobenthos sampling location at the Model Boating Pond; and (b) sampling locations for phytobenthos, cyanobacteria & zooplankton

3.1.4 Bird Sanctuary Pond

The depth of the pond is generally 1m deep and there appears to be a silt and sand substrate throughout. The banks are dominated by emergent macrophytes and trees. The pond is not open for fishing and is protected by metal railings. The phytobenthos sample was collected from sedge during the early season survey and sweet flag during the late season survey. Cyanobacteria and zooplankton samples were collected at the southern edge of the pond (Figure 3.4).

Figure 3.4 (a) Phytobenthos sampling location at Bird Sanctuary Pond; and (b) sampling locations for phytobenthos, cyanobacteria & zooplankton

3.1.5 Kenwood Ladies' Bathing Pond

The depth of the pond is generally >2m and appears to have a silt substrate throughout. The banks of the pond are dominated with bankside trees. There are patches of emergent vegetation located along the eastern side of the pond, and this is where all samples were collected.

Figure 3.5 (a) Example of substrate sampled at Kenwood Ladies' Bathing Pond; and (b) sampling locations for phytobenthos, cyanobacteria & zooplankton

3.1.6 Stock Pond

This is the northernmost pond in the Highgate Chain. The pond is not open for fishing and is protected by metal railings. The pond is generally <1m deep and appears to have a silt substrate throughout. The southern areas of the pond are particularly shallow and have high densities of detritus and coarse woody debris. The banks are heavily shaded by bankside trees and therefore emergent macrophyte growth was limited (Figure 3.6). Stems of sedge were sampled during the early season survey, while reeds were sampled during the late season

survey to collect phytobenthos samples. Cyanobacteria and zooplankton samples were collected from the south western shore.

Figure 3.6 (a) Phytobenthos sampling location at Stock Pond; and (b) sampling locations for phytobenthos, cyanobacteria & zooplankton

3.2 Hampsted Pond Chain

The ponds within this chain are described in downstream to upstream order.

3.2.1 Hampstead No.1 Pond

Hampstead No.1 Pond is located at the southern boundary of the Hampstead Chain. The pond is generally >2m in depth and has a gravel and silt substrate throughout. The margins of the pond are dominated by bankside trees and emergent macrophytes in the littoral zone, while submerged macrophytes are abundant throughout the pond. The phytobenthos sample was collected from sedge stems during the early season survey and from sweet flag stems during the late season survey. The cyanobacteria and zooplankton samples were collected from the western shore.

Figure 3.7 (a) Phytobenthos sampling location at Hampsted No. 1 Pond; and (b) sampling locations for phytobenthos, cyanobacteria & zooplankton

3.2.2 Hampstead No. 2 Pond

The pond is generally 1 to 2m in depth and appears to have a silt substrate throughout. The southern and northern banks are re-enforced and therefore have very little emergent vegetation. The eastern and western banks are moderately shaded by bankside trees with emergent macrophytes in the littoral zone. The phytobenthos sample was collected from sedge stems during the early season survey and from sweet flag stems during the late season survey. The cyanobacteria and zooplankton samples were collected from the western shore (Figure 3.8).

Figure 3.8 (a) Phytobenthos sampling location at Hampsted No. 2 Pond; and (b) sampling locations for phytobenthos, cyanobacteria & zooplankton

3.2.3 Mixed Bathing Pond

The pond is generally over 2m deep and appears to have a silt substrate throughout. The centre of the pond is buoyed off for swimming and is free of macrophytes. On both survey occasions the phytobenthos sample was collected from the submerged stems of lilies located on the south eastern shore, and the samples for cyanobacteria and zooplankton were collected nearby (Figure 3.9).

Figure 3.9 (a) Phytobenthos sampling location at the Mixed Bathing Pond; and (b) sampling locations for phytobenthos, cyanobacteria & zooplankton

3.2.4 Viaduct Pond

Viaduct Pond is situated in an isolated area away from all other ponds in the chain. The depth is approximately 1m throughout and the substrate appears to be dominated by silt. The pond is heavily choked with submerged macrophytes. The margins of the pond are dominated by emergent macrophytes and bankside trees. The early season phytobenthos sample was collected from sedge, while the late season sample was collected from sweet-grass. The cyanobacteria and zooplankton samples were collected on the southern shore (Figure 3.10).

Figure 3.10 (a) Phytobenthos sampling location at the Viaduct Pond; and (b) sampling locations for phytobenthos, cyanobacteria & zooplankton

3.2.5 Vale of Health Pond

The Vale of Health Pond is also situated away from all other ponds in the chain. The general depth of the pond was approximately 1.5 to 2m deep and there appeared to be a silt and sand substrate throughout. The margins of the lake were dominated by bankside trees with patches of emergent macrophytes. The early season phytobenthos sample was collected from sedge, while the late season sample was collected from reeds. The cyanobacteria and zooplankton samples were collected on the eastern shore.

Figure 3.11 (a) Phytobenthos sampling location at the Vale of Health Pond; and (b) sampling locations for phytobenthos, cyanobacteria & zooplankton

3.2.6 Wood Pond

Wood Pond is located at the top of the Highgate Chain of ponds and is owned by English Heritage. The pond was generally 1.5m to 2.5m in depth and appeared to have silt and gravel substrate throughout. The margins of the pond were dominated by emergent macrophytes with occasional bankside trees. Sections of the southern boundary of the pond had re-enforced banks. The early season phytobenthos sample was collected from sedge, while the late season sample was collected from reeds. The cyanobacteria and zooplankton samples were collected on the northern shore (Figure 3.12).

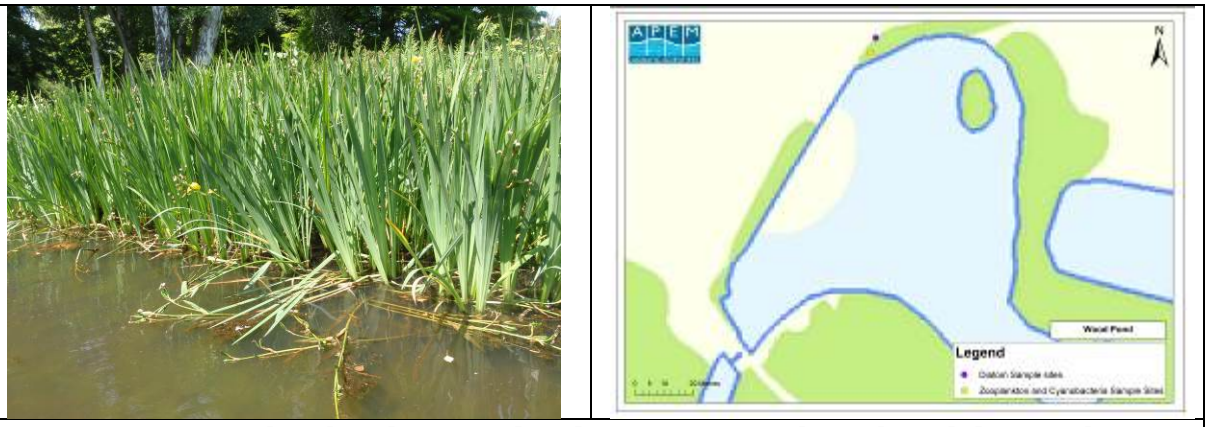

Figure 3.12 (a) Phytobenthos sampling location at Wood Pond; and (b) sampling locations for phytobenthos, cyanobacteria & zooplankton

3.2.7 Thousand Pound Pond

Thousand Pound Pond is situated at the northern end of the Highgate Chain of ponds and is owned by English Heritage. The pond is generally 1.5m to 2.5m in depth and appeared to have a silt and gravel substrate with occasional bricks also observed. The margins of the pond were dominated by bankside trees and open amenity grassland. The banks were found to be re-enforced along the bank with amenity grassland. The phytobenthos sample was collected from cobbles during both survey occasions, and the cyanobacteria and zooplankton samples were collected from the northern shore (Figure 3.13).

Figure 3.13 (a) Phytobenthos sampling location at Wood Pond; and (b) sampling locations for phytobenthos, cyanobacteria & zooplankton

4 RESULTS

Results of the phytobenthos surveys are presented in Section 4.1 cyanobacteria in Section 4.2, and zooplankton in Section 4.3.

4.1 Phytobenthos

A total of 204 diatom taxa were identified from the samples collected during 2013. Summary results from the analysis of the phytobenthos samples collected from the 13 ponds during both survey occasions are presented in Table 4.1. The LTDI indicates trophic status, with lower values corresponding to low nutrient concentrations, and higher values indicating higher nutrient concentrations. The three most common taxa for each sample are presented in Table 4.2, while a full species matrix including all samples is presented in Appendix I. Mean LTDI (V1) for each pond is illustrated in Figure 4.1.

Table 4.1 Lake Trophic Diatom Index (V1) (LTDI), % motile valves, % planktonic taxa and number of taxa recorded for the phytobenthos samples collected during 2013

Chain	Pond	Sample Date	LTDI (1)	% Motile valves	% Planktonic taxa	No. taxa
Highgate Chain	Highgate No.1 Pond	21/05/2013	72.70	50	8	23
		10/07/2013	50.74	12	18	36
	Men's Bathing Pond	21/05/2013	39.84	16	13	46
		11/07/2013	39.67	5	58	33
	Model Boating Pond	21/05/2013	52.16	13	4	37
		11/07/2013	57.43	9	47	49
	Bird Sanctuary Pond	21/05/2013	60.77	13	33	63
		10/07/2013	61.17	12	14	41
	Ladies' Bathing Pond	21/05/2013	48.43	21	21	62
		09/07/2013	68.25	19	36	44
	Stock Pond	21/05/2013	52.39	13	53	71
		10/07/2013	63.41	12	15	45
Hampsted Chain	Hampstead No.1 Pond	22/05/2013	78.07	60	22	47
		16/07/2013	73.11	18	23	34
	Hampstead No.2 Pond	22/05/2013	71.42	44	17	51
		12/07/2013	56.04	18	31	40
	Mixed Bathing Pond	22/05/2013	70.45	31	10	50
		17/07/2013	87.46	5	23	34
	Viaduct Pond	22/05/2013	50.08	68	39	59
		16/07/2013	64.49	15	32	54
	Vale of Health Pond	22/05/2013	56.53	33	35	51
		15/07/2013	62.58	28	14	54
English Heritage Ponds	Wood Pond	21/05/2013	27.00	5	23	44
		09/07/2013	52.21	9	7	44
	Thousand Pound Pond	21/05/2013	78.55	24	13	50
		09/07/2013	83.47	16	9	45

Table 4.2 Top three dominant LTDI contributing taxa present in the phytobenthos samples collected during 2013

Chain	Pond	Sample date	Diatom taxa
Highgate Chain	Highgate No.1 Pond	21/05/2013	*Navicula minima* (23%); *Nitzschia inconspicua* (22%); *Achnanthidium minutissimum* type (16%)
		10/07/2013	*Achnanthidium minutissimum* type (34%); *Rhoicosphenia abbreviata* (16%); *Gomphonema angustum/pumilum* type (11%)
	Men's Bathing Pond	21/05/2013	*Achnanthidium minutissimum* type (54%); *Nitzschia palea* var. *debilis* (5%); *Nitzschia paleacea* (4%)
		11/07/2013	*Achnanthidium minutissimum* type (25%); *Cocconeis placentula* (7%); *Gomphonema angustum/pumilum* type (2%)
	Model Boating Pond	21/05/2013	*Achnanthidium minutissimum* type (39%); *Amphora pediculus* (11%); *Rhoicosphenia abbreviata* (9%)
		11/07/2013	*Gomphonema angustum/pumilum* type (11%); *Cocconeis placentula* (10%); *Rhoicosphenia abbreviata* (6%)
	Bird Sanctuary Pond	21/05/2013	*Planothidium frequentissimum* (14%); *Fragilaria capucina* var. *mesolepta* (11%); *Rhoicosphenia abbreviata* (10%)
		10/07/2013	*Rhoicosphenia abbreviata* (24%); *Gomphonema olivaceum* (12%); *G. angustum/pumilum* type (11%)
	Ladies' Bathing Pond	21/05/2013	*Diatoma tenue* (18%); *Achnanthidium minutissimum* type (8%); *Fragilaria bidens* (7%)
		09/07/2013	*Planothidium frequentissimum* (18%); *Rhoicosphenia abbreviata* (17%); *Achnanthidium minutissimum* type (12%);
	Stock Pond	21/05/2013	*Planothidium frequentissimum* (7%); *Diatoma tenue* (5%); *Melosira varians* (4%)
		10/07/2013	*Gomphonema parvulum* var. *exilissimum* (19%); *Rhoicosphenia abbreviata* (16%); *Gomphonema angustum/pumilum* type (9%)
Hampsted Chain	Hampstead No.1 Pond	22/05/2013	*Navicula saprophila* (10%); *N. reichardtiana* (10%); *Planothidium frequentissimum* (7%)
		16/07/2013	*Staurosirella pinnata* (25%); *Pseudostaurosira brevistriata* (22%); *Nitzschia paleacea* (8%)
	Hampstead No.2 Pond	22/05/2013	*Gomphonema clavatum* (13%); *Navicula reichardtiana* (12%); *Nitzschia paleacea* (10%)
		12/07/2013	*Achnanthidium minutissimum* type (21%); *Rhoicosphenia abbreviata* (13%); *Nitzschia paleacea* (11%)
	Mixed Bathing Pond	22/05/2013	*Melosira varians* (13%); *Nitzschia dissipata* (11%); *Gomphonema parvulum* (7%)
		17/07/2013	*Rhoicosphenia abbreviata* (48%); *Cocconeis placentula* var. *euglypta* (14%); *Gomphonema angustatum* (7%)
	Viaduct Pond	22/05/2013	*Nitzschia palea* var. *debilis* (30%); *Nitzschia archibaldii* (10%); *Achnanthidium minutissimum* type (9%);
		16/07/2013	*Fragilaria capucina* var. *mesolepta* (13%); *Fragilaria bidens* (9%); *Cocconeis placentula* (6%)
	Vale of Health Pond	22/05/2013	*Nitzschia paleacea* (21%); *Achnanthidium minutissimum* type (14%); *Nitzschia palea* var. *debilis* (5%)
		15/07/2013	*Nitzschia paleacea* (13%); *Gomphonema parvulum* var. *exilissimum* (9%); *Fragilaria nitzschiodes* (7%)
English Heritage Ponds	Wood Pond	21/05/2013	*Achnanthidium minutissimum* type (20%); *Fragilaria capucina* var. *gracilis* (17%); *Gomphonema parvulum* var. *exilis* (10%)
		09/07/2013	*Staurosirella pinnata* (37%); *Achnanthidium minutissimum* type (12%); *Pseudostaurosira brevistriata* (7%)
	Thousand Pound Pond	21/05/2013	*Amphora pediculus* (25%); *Achnanthes ricula* (22%); *Karayevia clevei* (9%)
		09/07/2013	*Achnanthes grana* (35%); *Fragilaria bidens* (10%); *Karayevia clevei* (9%)

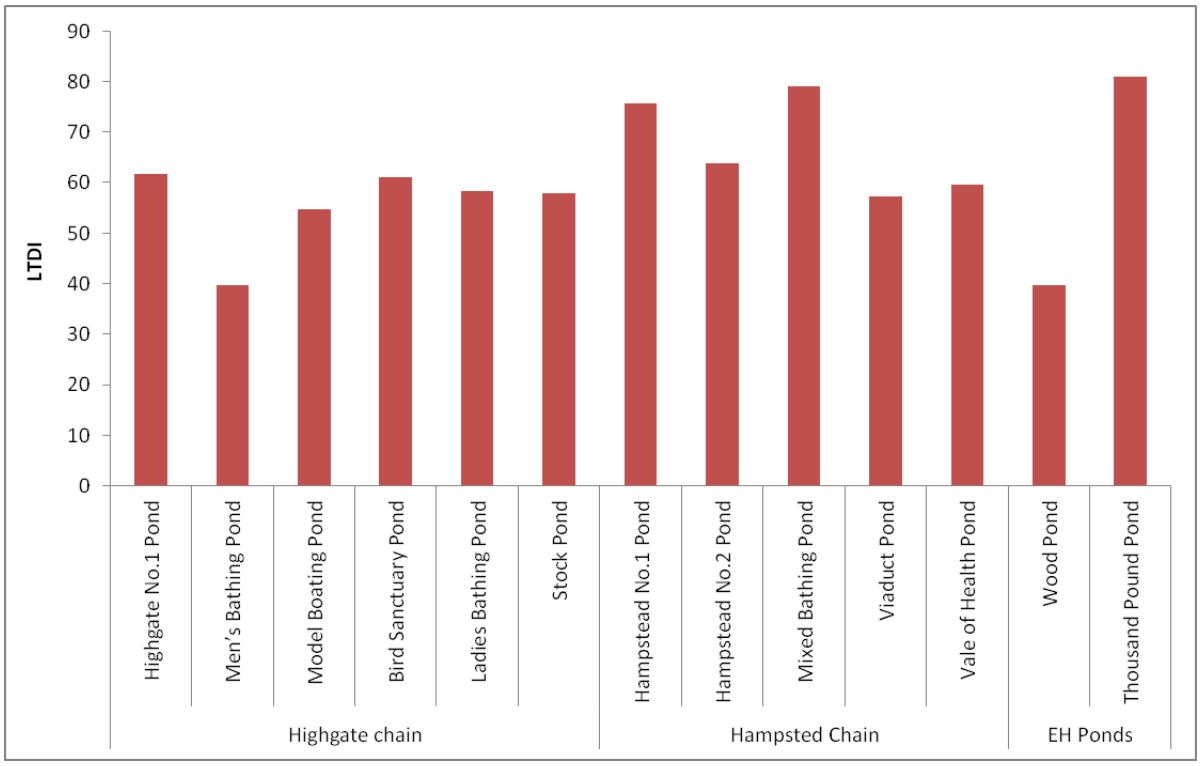

Figure 4.1 Mean LTDI (V1) from the two phytobenthos samples collected during 2013

4.2 Cyanobacteria

A total of 66 taxa were identified from the phytoplankton samples collected during 2013. A summary of the abundance (cells/l or colonies/l) of the different phytoplankton groups identified is shown in Table 4.3, and the total Abundance is illustrated in Figure 4.2. Table 4.4 shows the percentage contribution of the different groups during each sampling occasion. Table 4.5 indicates the cyanobacteria taxa present in each sample, together with the percentage composition of that taxa to the total cyanobacterial population present.

Table 4.3 Abundance (cells/l or colonies/l) of the various phytoplankton groups identified in the samples collected during 2013

Chain	Pond	Sample Date	Cyano-bacteria	Chloro-phyta	Prasino-phyta	Chryso-phyta	Desmids	Eugleno-phyta	Crypto-phyta	Dino-flagellates	Diatoms	Σ
Highgate Chain	Highgate No.1 Pond	21/05/2013	167	1,667	23,500	0	0	0	13,167	0	4,167	42,667
		10/07/2013	73,197	1,943,528	0	0	0	0	333,176	166,588	277,647	2,794,135
	Men's Bathing Pond	21/05/2013	8,963	1,207,885	74,000	0	1,556	111	15,222	0	14,778	1,322,515
		11/07/2013	50,207	126,650	0	0	0	0	187,412	0	4,828,427	5,192,696
	Model Boating Pond	21/05/2013	1,347	2,204,331	0	0	2,333	8,833	1,699,198	0	6,333	3,922,376
		11/07/2013	1,188,060	1,981,280	0	0	53,689	145,164	0	0	536,890	3,905,083
	Bird Sanctuary Pond	21/05/2013	0	48,833	864,977	0	0	0	1,551,186	0	0	2,464,996
		10/07/2013	6,044	481,916	0	53,546	0	0	2,891,493	0	9,150,471	12,583,470
	Ladies' Bathing Pond	21/05/2013	0	214,833	0	0	667	167	0	0	18,500	234,167
		09/07/2013	333	1,227,374	0	0	0	56,418	3,165,174	111	2,333	4,451,744
	Stock Pond	21/05/2013	0	1,318,408	0	0	59,000	167	324,847	167	2,748,333	4,450,922
		10/07/2013	0	5,664,106	126,650	0	0	0	583,169	1,749,175	252,327	8,248,777
Hampsted Chain	Hampstead No.1 Pond	22/05/2013	0	0	137,000	0	0	0	2,298,916	0	0	2,435,916
		16/07/2013	292,522	0	0	0	0	0	0	71	374,823	667,417
	Hampstead No.2 Pond	22/05/2013	30,986	2,333	0	0	0	0	1,471,577	0	5,333	1,510,230
		12/07/2013	45,453	4,331,290	0	0	0	0	1,665,881	111	288,758	6,331,493
	Mixed Bathing Pond	22/05/2013	0	0	0	0	0	222	60,000	0	133,382	193,604
		17/07/2013	0	293,981	0	0	111	3,000	7,038,347	0	4,111	7,339,550
	Viaduct Pond	22/05/2013	333	3,111	0	33,318	222	11,222	111,778	0	77,635	237,620
		16/07/2013	0	4,247,996	0	83,294	222	420,804	3,581,644	833,052	442,248	9,609,259
	Vale of Health Pond	22/05/2013	0	47,333	0	0	0	0	7,315,558	0	9,333	7,372,225
		15/07/2013	0	375,221	0	0	0	0	26,773	0	910,285	1,312,279
English Heritage Ponds	Wood Pond	21/05/2013	0	119,778	0	4,000	0	3,333	0	1,033,068	333	1,160,513
		09/07/2013	1185	0	0	5,333	0	254,715	1,082,823	333	595,892	1,940,282
	Thousand Pound Pond	21/05/2013	0	112,222	33,000	26,222	0	0	31,444	222	166,588	369,699
		09/07/2013	333	2,111	0	60,889	333	0	266,541	111	93,889	424,208

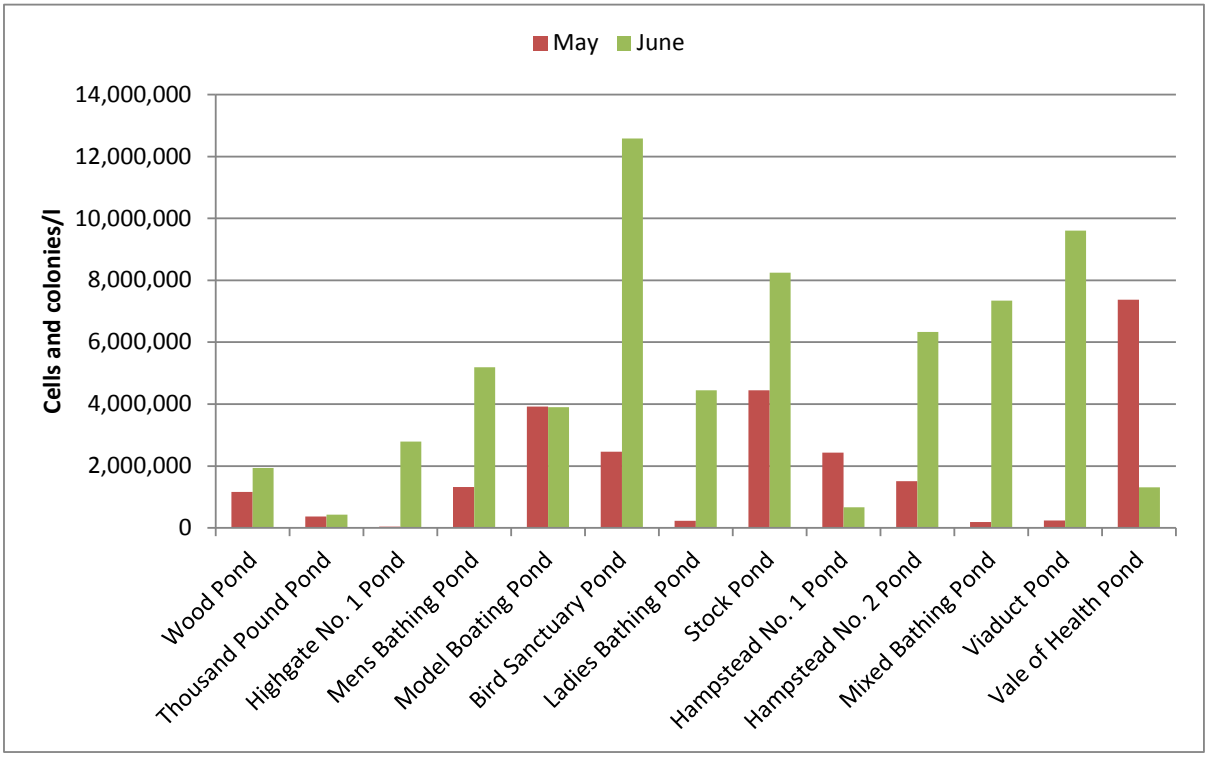

Figure 4.2 Total abundance of phytoplankton (cells and colonies/l) in Hampsted Heath Ponds during May and June 2013

Table 4.4 Percentage contribution by each phytoplankton group. Cells highlighted green are the dominant group within the sample

Chain	Pond	Sample Date	Cyano-bacteria	Chloro-phyta	Prasino-phyta	Chryso-phyta	Desmids	Eugleno-phyta	Crypto-phyta	Dino-flagellates	Diatoms	Σ
Highgate Chain	Highgate No.1 Pond	21/05/2013	0.4	4	55	0	0	0	31	0	9.6	42,667
		10/07/2013	2	70	0	0	0	0	12	6	10	2,794,135
	Men's Bathing Pond	21/05/2013	1	91	6	0	0.1	<0.1	1	0	1	1,322,515
		11/07/2013	1	2	0	0	0	0	4	0	93	5,192,696
	Model Boating Pond	21/05/2013	<0.1	56	0	0	<0.1	0.2	43	0	0.2	3,922,376
		11/07/2013	30	51	0	0	1	4	0	0	14	3,905,083
	Bird Sanctuary Pond	21/05/2013	0	2	35	0	0	0	63	0	0	2,464,996
		10/07/2013	<0.1	4	0	0.4	0	0	23	0	73	12,583,470
	Ladies' Bathing Pond	21/05/2013	0	92	0	0	0.3	0.1	0	0	8	234,167
		09/07/2013	<0.1	28	0	0	0	1.3	71	<0.1	0.1	4,451,744
	Stock Pond	21/05/2013	0	30	0	0	1	<0.1	7	<0.1	62	4,450,922
		10/07/2013	0	69	2	0	0	0	7	21	3	8,248,777
Hampsted Chain	Hampstead No.1 Pond	22/05/2013	0	0	6	0	0	0	94	0	0	2,435,916
		16/07/2013	44	0	0	0	0	0	0	<0.1	56	667,417
	Hampstead No.2 Pond	22/05/2013	2	0.2	0	0	0	0	97	0	0.4	1,510,230
		12/07/2013	0.7	68	0	0	0	0	26	<0.1	5	6,331,493
	Mixed Bathing Pond	22/05/2013	0	0	0	0	0	0.1	31	0	69	193,604
		17/07/2013	0	4	0	0	<0.1	<0.1	96	0	0.1	7,339,550
	Viaduct Pond	22/05/2013	0.1	1	0	14	0.1	5	47	0	33	237,620
		16/07/2013	0	44	0	0.9	<0.1	4	37	9	5	9,609,259
	Vale of Health Pond	22/05/2013	0	0.6	0	0	0	0	99	0	0.1	7,372,225
		15/07/2013	0	29	0	0	0	0	2	0	69	1,312,279
English Heritage Ponds	Wood Pond	21/05/2013	0	10	0	0.4	0	0.3	0	89	<0.1	1,160,513
		09/07/2013	0.1	0	0	0.3	0	13	56	<0.1	31	1,940,282
	Thousand Pound Pond	21/05/2013	0	30	9	7	0	0	9	0.1	45	369,699
		09/07/2013	0.1	0.5	0	14	0.1	0	63	<0.1	22	424,208

Table 4.5 Cyanobacteria taxa present in the 2013 samples. Values in brackets indicate percentage of cyanobacterial population

Chain	Pond	Sample date	Cyanobacteria taxa
Highgate Chain	Highgate No.1 Pond	21/05/2013	*Oscillatoria* sp. (100%)
		10/07/2013	*Anabaena flos-aquae* (71%); *Aphanizomenon* sp. (29%)
	Men's Bathing Pond	21/05/2013	*Anabaena* sp. (83%); *Snowella* sp. (17%)
		11/07/2013	*Anabaena flos-aquae* (74%); *Planktothrix agardhii* (19%); *Oscillatoria* sp. (5%); *Microcystis* sp. (1%)
	Model Boating Pond	21/05/2013	*Anabaena* sp. (100%)
		11/07/2013	*Oscillatoria* sp. (95%); *Aphanizomenon* (5%); *Anabaena planctonica* (0.05%)
	Bird Sanctuary Pond	21/05/2013	
		10/07/2013	*Anabaena flos-aquae* (100%)
	Ladies' Bathing Pond	21/05/2013	
		09/07/2013	*Oscillatoria* sp. (100%)
	Stock Pond	21/05/2013	
		10/07/2013	
Hampsted Chain	Hampstead No.1 Pond	22/05/2013	
		16/07/2013	*Anabaena planctonica* (66%); *A. flos-aquae* (44%)
	Hampstead No.2 Pond	22/05/2013	*Anabaena* sp. (100%)
		12/07/2013	*Anabaena flos-aquae* (51%); *A. planctonica* (40%); *Aphanizomenon* sp. (9%); *Microcystis* sp. (<0.1%)
	Mixed Bathing Pond	22/05/2013	
		17/07/2013	
	Viaduct Pond	22/05/2013	*Oscillatoria* sp. (100%)
		16/07/2013	
	Vale of Health Pond	22/05/2013	
		15/07/2013	
English Heritage Ponds	Wood Pond	21/05/2013	
		09/07/2013	*Oscillatoria* sp. (70%); *Microcystis* sp. (30%)
	Thousand Pound Pond	21/05/2013	
		09/07/2013	*Planktothrix agardhii* (100%)

4.3 Zooplankton

A total of 20 zooplankton taxa (two rotifers, 13 cladocerans and five copepods) were identified from the samples collected during 2013. Summary results from the analysis of the zooplankton samples are presented in Table 4.6, while a full species matrix for each sample is presented in Appendix III. Figure 4.3 illustrates the total abundance in each sample during both surveys.

Table 4.6 Abundance of zooplankton groups present within the 2013 samples

Chain	Pond	Sample Date	Rotifers (no.s/m^3)	Cladocerans (no.s/m^3)	Copepods (no.s/m^3)	Σ
Highgate Chain	Highgate No.1 Pond	21/05/2013	244	1,535	543	2,322
		10/07/2013	0	634	23	657
	Men's Bathing Pond	21/05/2013	95	54	1,222	1,371
		11/07/2013	0	3	38	41
	Model Boating Pond	21/05/2013	59	36	421	516
		11/07/2013	0	10	23	33
	Bird Sanctuary Pond	21/05/2013	0	407	136	543
		10/07/2013	0	577	183	760
	Ladies' Bathing Pond	21/05/2013	0	761	14	775
		09/07/2013	0	251	115	366
	Stock Pond	21/05/2013	0	140	199	339
		10/07/2013	24	27	27	78
Hampsted Chain	Hampstead No.1 Pond	22/05/2013	10	251	81	342
		16/07/2013	0	43	26	69
	Hampstead No.2 Pond	22/05/2013	163	1,833	136	2,132
		12/07/2013	1	4	16	21
	Mixed Bathing Pond	22/05/2013	0	883	312	1,195
		17/07/2013	39,476	50	272	39,798
	Viaduct Pond	22/05/2013	0	231	136	367
		16/07/2013	234	122	221	577
	Vale of Health Pond	22/05/2013	0	5	1	6
		15/07/2013	211	584	204	999
English Heritage Ponds	Wood Pond	21/05/2013	367	1,222	543	2,132
		09/07/2013	18	177	131	326
	Thousand Pound Pond	21/05/2013	8	11	22	41
		09/07/2013	1	18	39	58

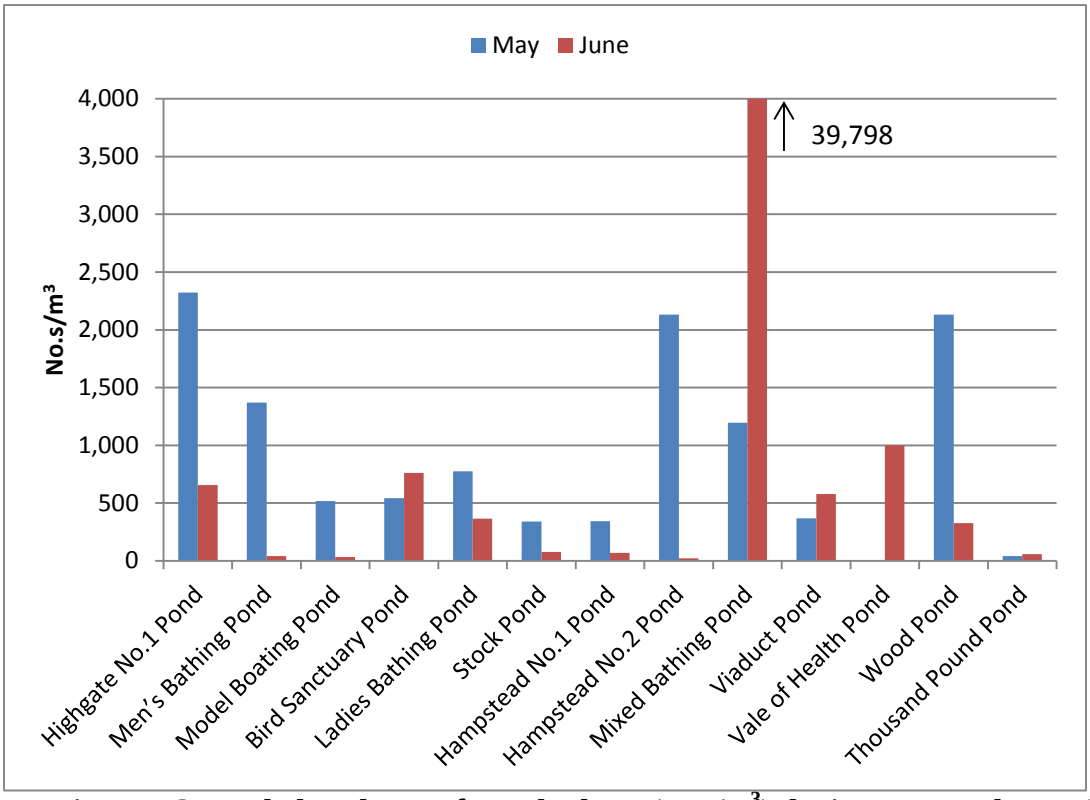

Figure 4.3 Total abundance of zooplankton (no.s/m^3) during May and June 2013

5 DISCUSSION

5.1 Phytobenthos

The phytobenthos samples collected during 2013 were relatively diverse, with 204 diatom taxa identified, and the number of taxa per sample ranged from 23 (Highgate No. 1 Pond) to 71 (Stock Pond). The Lake Trophic Diatom Index (LTDI) values ranged from 27.00 (Wood Pond in May) to 87.46 (Mixed Bathing Pond in July). This range of values would be associated with slightly mesotrophic to substantially eutrophic conditions. As Table 4.1 illustrates, LTDI values were quite variable between early and late season surveys in some lakes (e.g. Highgate No. 1 Pond, Ladies' Bathing Pond, Stock Pond, Hampsted No. 2 Pond, Wood Pond). This is not uncommon in phytobenthos samples, and is the main reason why multiple samples are required to produce a reliable indication of trophic status (WFD UK-TAG, 2008a).

Mean LTDI is illustrated in Figure 4.1, and it is apparent that there is no clear spatial trend either along each pond chain (upstream to downstream) or amongst the three chains of ponds. Most of the 13 ponds have an LTDI between approximately 55 and 64, values which would be associated with moderately eutrophic waterbodies. The Men's Bathing Pond in the Highgate Chain and Wood Pond (an EH pond) are indicated as having a lower mean LTDI (both approximately 39.6), which would indicate a moderately mesotrophic status. The Mixed Bathing Pond, Hampsted No. 1 Pond (both Hampsted Chain) and Thousand Pound Pond (an EH pond) have the highest mean LTDI values, between 75 and 81, which suggests that these are the most eutrophic ponds on the Heath.

Eutrophic ponds are often associated with a high number of motile taxa, however as Table 4.1 indicates this is not the case for many of the ponds on Hampsted Heath, with several of the dominant taxa found (see Table 4.2) having attached (non-motile) growth forms (e.g. *Achnanthidium minutissimum* type, *Rhoicosphenia abbreviata*, *Planothidium frequentissimum*, *Gomphonema angustum/pumilum* type, *G. olivaceum*, *Amphora pediculus*). Most of these taxa are, however, tolerant of nutrient enrichment, though some, especially *G. olivaceum* and *Amphora pediculus* do not tolerate organic pollution (Kelly *et al*., 2005). Of the dominant motile taxa present most are tolerant of eutrophic conditions and can tolerate moderate to heavy organic pollution (e.g. *Nitzschia inconspicua*, *N. palaeacea*, *Navicula saprohila*), although there are a number of varieties and species-complexes present that are more typical of moderate eutrophication (e.g. *Nitzschia palea* var. *debilis*, *Gomphonema parvulum* var. *exilissimum* and *Gomphonema angustum/pumilum* type). Only a few taxa indicative of oligotrophic to mesotrophic conditions are dominant, but notably the Ladies Bathing Pond in May was dominated by such an assemblage including *Diatoma tenue* and *Fragilaria bidens*. By July, however, the assemblage had changed to one more typical of eutrophic conditions.

Planktonic taxa (these do not contribute to calculation of the LTDI) were encountered in all samples, though in variable numbers. They were particularly common in the Men's Bathing Pond, the Stock pond and the Model Boating Pond. Some of the most common planktonic taxa recorded (present in many ponds and occasionally in high numbers) were *Cyclostephanos dubius* and *Cyclotella meneghiniana*, both of which are associated with eutrophic water.

Of note is the taxonomic composition of Thousand Pound Pond. During both surveys *Karayevia clevei* was found at an abundance of 9%. This taxon is only rarely found at greater than 4% abundance in lakes, and is known to prefer eutrophic hardwater conditions. It will tolerate only mild to moderate organic pollution (Kelly *et al.,* 2005). Similarly, *Achnanthes grana* (synonym *Planothidium granum*) was also abundant, particularly during July. This taxon is also only rarely found in high numbers, and consequently little is known about its environmental preferences (Kelly *et al., 2005*).

5.2 Cyanobacteria

Analysis of the phytoplankton samples indicated that nine different groups (roughly corresponding to Divisions) of phytoplanktonic organisms were present in the ponds, with 66 taxa identified from these groups. As Table 4.3 indicates some of these groups were present in the majority of lakes (e.g. Chlorophyta, Cryptophyta and diatoms) while others (e.g. Prasinophyta and Chrysophyta) were more discrete in their distribution.

It can be see from Table 4.3 and Figure 4.2 that the total abundance of phytoplankton varied substantially both between ponds (e.g. compare Thousand Pound Pond and Stock Pond) and between surveys (e.g. Bird Sanctuary Pond). Most ponds showed an increase in phytoplankton abundance during the July survey; however Hampsted No. 1 Pond and the Vale of Health Pond showed a decrease in total abundance, while the Model Boating Pond stayed roughly the same (Figure 4.2).

During the May survey the Vale of Health Pond had the highest phytoplankton abundance (ca. 7,400,000 units[4]/l), of which 99% was composed of Cryptophytes (see Table 4.4), specifically the genus *Rhodomonas*. During the July survey, the highest total abundance was recorded in the Bird Sanctuary Pond where the population of ~ 12,600,000 units/l was dominated by a mixed assemblage of diatoms (see Table 4.4).

With regard to Cyanobacteria in the samples, taxa from this division were reported from all ponds with the exception of Stock Pond, the Mixed Bathing Pond and the Vale of Health Pond. It should be remembered, however, that this report does not include samples from the main blue-green season (August to October) and that blue-green algae may be present in significantly higher densities in these ponds later in the year. Nine different cyanobacteria taxa were identified in the samples, and species of concern included *Microcystis* sp., *Anabaena flos-aquae* and *Oscillatoria* sp. as these could potentially be toxic, and could prevent swim events if they formed a bloom.

As Table 4.4 indicates, Cyanobacterial taxa were not dominant in any of the ponds during either survey, and they typically formed only a minor constituent of the phytoplanktonic community. Exceptions were the Model Boating Pond during July when they accounted for 30% of the population and Hampsted No. 1 Pond during July when they accounted for 44% of the community. Table 4.5 indicates that the July cyanobacteria population in the Model Boating Pond was dominated by *Oscillatoria* sp. with a recorded abundance of 1,124,470 cells/l. Environment Agency (EA, 2000) warning thresholds for *Oscillatoria* vary by species, ranging from 30,000 to 1,750,000 cells/l. Depending on the species present, the cyanobacterial population in the Model Boating Pond during July could have exceeded the warning threshold. Hampsted No. 1 Pond was dominated by *Anabaena planctonica*, with a

[4] The term 'units' is used here to include both cells and colonies.

smaller contribution from *Anabaena flos-aquae* (see Table 4.5). Only the latter species has a warning threshold, and at an abundance of 99,451 cells/l the warning threshold was not exceeded. Other blue-green algae guidance values are available, e.g. WHO (2003). The guideline value from WHO (2003) is 20,000 cells/ml (20,000,000 cells/l), and this value is not approached by the abundances in the 2013 samples.

Nonetheless, the occurrence of blue-green taxa outside of the typical season suggests the possibility of a degree of eutrophication influencing the composition of the phytoplankton population. Nuisance species, especially *Aphanizomenon*, *Microcystis* and *Anabaena* are typically rare in lakes where the phosphorus concentration is consistently less than 10 µg/l (Reynolds, undated). Other factors, however, may also be influencing the phytoplankton community composition including water temperature; blue-green algae are slow growing taxa, and do not compete well at low water temperatures, so an increase in water temperature early in the year could promote their growth. Otherwise, they typically grow well during the warmer summer months as zooplankton do not readily consume blue-green algae as they do many of the other groups. Accordingly, lakes with a very high zooplankton community may provide an environment conducive to the growth of cyanobacteria.

5.3 Zooplankton

Analysis of the zooplankton samples resulted in 20 different taxa being identified, with cladocerans being the most diverse division, having 13 different taxa recorded. Cladocerans and copepods were found in all of the ponds, while rotifers were not reported from Bird Sanctuary Pond or Ladies' Bathing Pond from either survey, and were only reported for both surveys from Hampsted No. 2 Pond, Wood Pond and Thousand Pound Pond (Table 4.6).

Total abundance was highly variable between ponds (compare Thousand Pound Pond and Mixed Bathing Pond) and between surveys, e.g. Hampsted No. 2 Pond (Figure 4.3). Most ponds showed a decrease in total abundance of zooplankton in the July survey, however increases were reported from Bird Sanctuary Pond (in both Cladocerans and Copepods), Mixed Bathing Pond (large increase in rotifers), Viaduct Pond (rotifers and copepods) and Vale of Health Pond (increase in rotifers, cladocerans and copepods) while Thousand Pound Pond remained roughly the same.

In terms of the species observed, for the rotifers, while the mass occurrence reported from the Mixed Bathing Pond in July 2013 was of *Conochilus hippocrepis*, a colonial, planktonic species, all other samples were found to contain low numbers of the predatory *Asplancha* genus. *Conchilus* is a gazer (Virro, 2001), and is typically reported from small, fishless ponds from oligotrophic to eutrophic status (Dieguez & Balseiro, 1998). Among the cladocerans, *Daphnia longispina* was found in 19 samples, and was particularly abundant in the May samples from Highgate No. 1 Pond and Wood Pond. *Bosmina coregoni* and *Ceriodaphnia dubia* were each reported from 14 of the ponds, though in smaller numbers. *Polyphemus pediculus*, a predatory cladocerans that feeds exclusively on smaller zooplankton, particularly rotifers was present in several samples, and was most abundant in the May samples from Ladies' Bathing Pond and Hampsted No. 2 Pond. Both of these ponds showed a decrease in the abundance of rotifers and cladocerans during the July survey. The most common copepods were *Eudiaptomus gracilis* and *Cyclops* sp., of these *Cyclops* sp. was the most abundant, particularly in the Men's Bathing Pond in May.

At several of the ponds the highest zooplankton abundance in May corresponds to the lowest phytoplankton abundance, followed by a July increase in phytoplankton and a decrease in zooplankton (e.g. Highgate No. 1 Pond, Men's Bathing Pond, Ladies' Bathing Pond, Stock Pond, Hampsted No. 2 Pond, and Wood Pond). This would suggest that in these locations the zooplankton exert a degree of pressure on the phytoplankton community. In the Vale of Health Pond the reverse was recorded, where there was high phytoplankton abundance in June, but very low zooplankton abundance, and by July zooplankton had increased and phytoplankton decreased. This also suggests a degree of pressure exerted on the phytoplankton by the zooplankton. In other ponds zooplankton and phytoplankton abundance mirrored each other, typically an increase from May to July e.g. (Bird Sanctuary Pond, Mixed Bathing Pond and Viaduct Pond), while Hampsted No. 1 Pond showed a decrease in both between May and July. For these ponds, it suggests that zooplankton abundance is insufficient to exert pressure on the phytoplankton. In the Model Boating Pond, zooplankton abundance had decreased by July while phytoplankton abundance remained similar between the two surveys. This pond was dominated by chlorophyte taxa during both surveys, but there was also a high abundance of *Oscillatoria*, a cyanbacteria considered unpalatable to zooplankton.

5.4 Thousand Pound Pond

While analysis of the diatom data indicated that Thousand Pound Pond was one of the most eutrophic on the Heath, it is notable that zooplankton and phytoplankton populations were consistently low compared to the other ponds investigated. Results from the fish surveys indicate a high number of rudd in this pond (APEM 2013a). This omnivorous species feeds solely on zooplankton and macroinvertebrates when young (less than 1 year), but older individuals will also graze on macrophytes during the growing season, especially *Elodea* (Van Donk & Otte, 1996) and other soft-bodied plant species. The fish data from the 2013 survey indicates that rudd greater than 1 year form the majority of the population present suggesting that rudd in Thousand Pound Pond may well be grazing, and potentially impacting the macrophyte population. It would be expected however, that this would promote further development of the phytoplankton population, which does not appear to be the case. It may be that the high tree density surrounding the pond provides a heavy level of shading which limits phytoplankton growth, or that public feeding (of fish and/or wildfowl) with bread is contributing to a high organic load in the pond, and this is facilitating the growth of taxa tolerant of organic pollution. As these taxa are also often tolerant of eutrophic conditions it may be that the trophic status of the pond is being artificially increased. Additionally, as the environmental preferences of one of the dominant taxa are poorly known (see Section 4.1) it may also be that the LTDI is over-estimating the nutrient status due to poor calibration for a key taxa at this location.

6 CONCLUSIONS

Analysis of the phytobenthos samples from 2013 indicates that the Men's Bathing Pond (Highgate Chain) and the Wood Pond (NE pond) are the least nutrient enriched ponds, while the Mixed Bathing Pond and Hampsted No. 1 Pond (both Hampsted Chain) and Thousand Pound Pond (NE pond) are the most nutrient enriched. A range of taxa indicative of oligotrophic-mesotrophic to eutrophic conditions were present, though most assemblages were dominated by eutrophic tolerant taxa. The assemblage at Thousand Pound Wood appeared unusual in that it had an unusually high abundance of two taxa.

Analysis of the phytoplankton samples indicated that Thousand Pound Pond had the lowest phytoplankton abundance, while the Bird Sanctuary Pond had the highest. The ponds were quite varied in the composition of their phytoplankton, though Chlorophytes, Cryptophytes or diatoms dominated in the majority of samples. Cyanobacteria taxa were present in all ponds bar Stock Pond, the Mixed Bathing Pond and the Vale of Health Pond. They contributed only a minor component of the populations in the majority of cases, but in the July samples for Hampsted Pond No. 1 and Model Boating Pond they formed a greater part of the community. In Model Boating Pond, the abundance of *Oscillatoria* exceeded the EA (2000) warning threshold during 2013.

As these surveys were conducted out of the key blue-green season there remains the possibility that the abundance of blue-green taxa could increase substantially in the latter part of the year (the climate this year could be particularly conducive to the development of cyanobacterial blooms with long periods of warm, calm weather) and pose a risk to the amenity value of the ponds (particularly with regard to swimming).

Analysis of the zooplankton samples indicated that Thousand Pound Pond had the lowest abundance and the Mixed Bathing Pond had the highest, although this was due to the mass occurrence of a colonial rotifer. Cladocerans and copepods were present in every pond, while rotifers were more restricted in their distribution.

Data recorded for Thousand Pound Pond is contradictory, with the phytobenthos suggesting a highly eutrophic waterbody, but phytoplankton and zooplankton abundance were both low. The presence of a large rudd population in the pond may be a contributing factor, although it is also possible that shading, public feeding and possibly poor calibration for a rare species in the DARLEQ model also contribute to the contradictory information obtained. As the pond appears to be quite low in macrophyte biomass, which could reduced the refugia available for zooplankton species.

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APPENDIX I

Diatom taxa recorded from 2013 phytobenthos samples

Site ID	1399	1400	1401	1402	1403	1404	1405	1406	1407	1408	1409	1410	1411	1769	1770	1771	1772	1773	1774	1775	1776	1777	1778	1779	1780	1781
Site name	Vale of Health Pond	Hampstead No.1 Pond	Highgate No.1 Pond	Hampstead No.2 Pond	Wood Pond	Ladies' Bathing Pond	Thousand Pound Pond	Bird Sanctuary Pond	Model Boating Pond	Men's Bathing Pond	Stock Pond	Mixed Bathing Pond	Viaduct Pond	Thousand Pound Pond	Bird Sanctuary Pond	Stock Pond	Wood Pond	Hampstead No.2 Pond	Highgate No.1 Pond	Ladies' Bathing Pond	Men's Bathing Pond	Model Boating Pond	Viaduct Pond	Hampstead No.1 Pond	Vale of Health Pond	Mixed Bathing Pond
Date	22/05/2013	22/05/2013	21/05/2013	22/05/2013	21/05/2013	21/05/2013	21/05/2013	21/05/2013	21/05/2013	21/05/2013	21/05/2013	22/05/2013	22/05/2013	09/07/2013	10/07/2013	10/07/2013	09/07/2013	12/07/2013	10/07/2013	09/07/2013	11/07/2013	11/07/2013	16/07/2013	16/07/2013	15/07/2013	17/07/2013
Achnanthes conspicua	2		18	1													1					1			3	
Achnanthes grana	1						16	2			2			118		4			1							
Achnanthes hungarica																						2	13			
Achnanthes pusilla																	3									
Achnanthes ricula		3					80				2			22		1								2		
Achnanthes sp.							1							1				1				2	3			
Achnanthidium biasolettiana													2													
Achnanthidium minutissimum type	70	11	55	4	83	32	17	14	127	197	21	12	45	12	16	10	42	90	125	54	174	14	9	16	22	6
Amphipleura pellucida					2		1																			
Amphora inariensis	1					4		2	8																	
Amphora libyca						1		1																		
Amphora ovalis											2					2				1						
Amphora pediculus		5	9	5		7	90	19	37	5	7	1	4	18	2			1	1	10		1	2		12	
Amphora veneta				1									1										1			
Asterionella formosa							3	1			45					2										
Aulacoseira islandica subsp. islandica										1																
Aulacoseira sp.					1			3	1	2	3				4	1		2		23	106	72	3		3	3
Aulacoseira subarctica						8																				
Caloneis bacillum	2						1		2		1			4		1										
Centric undif.	29		1	2		2		2	1	3	6	1			15		1	25			5	83	17	1	1	5
Cocconeis neothumensis		3																								
Cocconeis pediculus		2						1										12	12		1		2	2		1
Cocconeis placentula		5						10									1				46	57	28			
Cocconeis placentula var. euglypta	1	8	1		2	1		18	2						5			10	13	8				25	8	58
Cocconeis placentula var. lineata		8						2				2			2			29	27	3				16		16
Cocconeis placentula var. pseudolineata			1					9	2						1											
Craticula accomoda																			1							
Craticula halophila		3																								
Ctenophora pulchella	1				14												1									
Cyclostephanos dubius	48					1	1			10		1		2		3		4	3	1	284	60			8	1
Cyclotella comensis						3		1																		
Cyclotella meneghiniana					1						78		1			3							50			
Cyclotella pseudostelligera	3							2			15		7													
Cyclotella sp.	28					3		1		3	78		11			10		19	5				36	16		
Cymatopleura solea								1																		
Cymbella affinis								2	12						2			1		2	1	2				
Cymbella aspera						2			3			1								1		1				
Cymbella cistula																	1									
Cymbella microcephala fo. microcephala														4			3									
Cymbella sp.																				3						
Cymbella tumida																		1							1	
Diatoma elongatum						1																				
Diatoma moniliformis						1				1			2						3				1			
Diatoma tenue	3				6	71		5	1	4	32		1	1									1			
Diploneis parma																				1						
Encyonema caespitosum							1			1																
Encyonema minutum													12										1			
Encyonema reichardtii													1													
Encyonema silesiacum				2	2	11		3	6	6	5	15	11	2						1	1				3	
Encyonema sp.															2		1								2	1
Epithemia adnata					2		2		4								16									
Epithemia sorex									14				3		1				1				6	6		
Eunotia bilunaris	1				2			1			1				5		2					3	1			
Eunotia bilunaris var. mucophila	11					1																				
Eunotia exigua																	2									
Eunotia formica					7	4		4						2			3									
Eunotia implicata					27						3						11									
Eunotia minor					8										2		21			7						
Eunotia sp.											2						1			1		1				
Eunotia subarcuatoides	1																									
Fragilaria bidens		2				29		4		2	3	3	1	34					2	2			38			

Fragilaria capucina	7				1	6									2			3		2	3			3		
Fragilaria capucina var. gracilis	13	1		10	70	3	2		1		8	8	5				16			2	3				1	
Fragilaria capucina var. mesolepta	19	15		5		14	2	53		1	3	13	16				2			2	2		58			
Fragilaria capucina var. rumpens																2	1	1								
Fragilaria nitzschioides																								23		
Fragilaria perminuta						1																				
Fragilaria sp.																	1		2							
Fragilaria vaucheriae		3		3	7	7			25	4				1		4					2	3		4	12	
Gomphonema acuminatum	5			10		1		6			12	5	1			2							2			
Gomphonema affine										3	4	4				5								4	3	
Gomphonema angustatum										2		1				2		1						1		29
Gomphonema angustum						3		19		2	9															
Gomphonema angustum/pumilum type	2		3			2		9		6	15	4			37	34	3	39	39	2	16	62	3	2	1	11
Gomphonema augur																		4			1		3		2	2
Gomphonema clavatum				49		2		7				8			18	7	3		5	12	2	2	3		2	
Gomphonema gracile					3		1							2	9		2	2		2		6	1		7	
Gomphonema grovei var. lingulatum							3	1		1				7												
Gomphonema insigne												2														
Gomphonema minutum																		5	1	3				10	4	
Gomphonema olivaceoides		2	15	7						4						3										
Gomphonema olivaceum		10	3	19				13	4	12	17	21	2		42	31		1	3	13	2	2		2		15
Gomphonema parvulum			2	21	2	1		4		9	6	26				25			3							
Gomphonema parvulum var. exilissimum	5	8	1		40	7	3	16		3	7	25	5	4	21	72	8	6	9	13		8	4	5	31	3
Gomphonema sp.	2	2			4						1	2		2	1	1		1					1			
Gomphonema tergestinum											6															
Gomphonema truncatum	3				9				1		5	6	1										7			
Gyrosigma acuminatum				1																						
Karayevia clevei							33				1			30	1	2			1				3			
Luticola goeppertiana																						1				
Luticola mutica																								1		
Melosira varians				4	1	21	1	10	1	5	28	47	1	1	1	11	3			22	3	11	12		1	21
Navicula [small species]			2							1	2			2					3				6			
Navicula atomus		2		1				2																		
Navicula capitata	2			5	1					1	1			1										1		
Navicula capitatoradiata									2	2											1	1				
Navicula cari																						1				
Navicula cincta		1								2														1		
Navicula claytonii													7													
Navicula cryptocephala				4	1		4	2			2	3	5	1	3	4	5				3		2			
Navicula cryptotenella		2		1		5		1	10	2	1	10		1	2	9			1		4			2		2
Navicula cryptotenelloides									5																	
Navicula gregaria		9		4	1	1	2	2	2	10	8	1	32	4		1						1			1	
Navicula ignota var. acceptata													3													
Navicula ingenua							13							2				2								
Navicula joubaudii																				1			1			
Navicula lanceolata													1						3				1			
Navicula menisculus				2				2				2		3						8				1	1	5
Navicula minima	1	14	77	4		3	17	2		2	5	5	3	5		12		7		12		4	3	2	9	2
Navicula molestiformis	1	1											1													
Navicula phyllepta																									1	
Navicula radiosa							1	8			1						1									
Navicula reichardtiana	3	40	3	46				1	1								1		2			2	1	6	3	
Navicula rhynchocephala										1	2													1		
Navicula saprophila	2	41	9	1		1				1		5	37									1				
Navicula schoenfeldii																									12	
Navicula slesvicensis											1									1						
Navicula sp.		2					1														1					
Navicula subminuscula																								1		

Navicula submuralis							4																		
Navicula tripunctata		4		2		5		3	3			1			1			1			3				
Navicula trivialis											1														
Navicula veneta		10		1							2	1											1		1	
Nitzschia acicularioides																						2			1	1
Nitzschia acicularis	1														2							3				
Nitzschia acula														1												
Nitzschia amphibia	1		1								4	2		2	1	2	2	1	1	7			2			2
Nitzschia archibaldii	8	6		1	1	10		3		2	15	6	50		4	1			2			1			1	
Nitzschia bacillum						2	1			1		1														
Nitzschia capitellata								2			1															
Nitzschia dissipata	12	6	2	8		2	5	1	2	1	17	38	3	5					1				5		1	
Nitzschia dissipata var. media		3											1											1	1	
Nitzschia draveillensis						2							2		4											
Nitzschia fonticola				3		7		2		1		5	2	1		1				3		2	2	2	1	1
Nitzschia frustulum		6		2	1		1	10			1	3	9				3			3						
Nitzschia gracilis				3	1	1	2						2													
Nitzschia incognita	1					2							3													
Nitzschia inconspicua		25	76	2									3				1	2	1			1	4	13	6	1
Nitzschia lacuum	1					4								1						2						
Nitzschia liebetruthii				2	1	3	2					1	5		2											
Nitzschia linearis				1			1																			
Nitzschia linearis var. subtilis						1							2	2								3	1			
Nitzschia palea		3		1			1				1		4	3		1							3		1	
Nitzschia palea var. debilis	23	25	2	29	3	11	12	8	4	17	14	12	153	7	3	9		13	14	27	1	5	6	9	7	1
Nitzschia paleacea	100	27		35	1	18	2	7	4	16	4	9	9		16	2		48	16	19	12	21	17	32	46	3
Nitzschia perminuta	1	2			5		1						4			1		2			1					
Nitzschia pura						1					1															
Nitzschia recta	1			1		1	1	2			1	1	1	1		1										
Nitzschia sigma												1														
Nitzschia sinuata var. delognei	1																									
Nitzschia sociabilis							1		3		1			3											1	
Nitzschia sp.		2		1		1					3	2	1		1		5	1		2	2			2	2	
Nitzschia subacicularis				2	1			1																		
Nitzschia sublinearis							1						4													
Nitzschia supralitorea		1				1	1		3			2									4	1				
Nitzschia tubicola																							1			
Pennate undif.	1										1					3	3		3	2	3	2				2
Pinnularia appendiculata	1					1																				
Pinnularia gibba																	3									
Pinnularia sp.																	1			1			2			
Pinnularia subcapitata																	3									
Pinnularia viridis																	1									
Placoneis clementis							4							3												
Placoneis elginensis								1																		
Planothidium delicatulum			1																							
Planothidium ellipticum		1																								
Planothidium frequentissimum	2	28	12	9		18	9	68	2		44	7	1	5	6	4	3	2		84		25	16	2		1
Planothidium lanceolatum						1		1		6	2		1	1	19	6		1		10					3	
Planothidium sp.																					3					
Pseudostaurosira brevistriata	17	3					4			1					1		23	4				8	13	87	2	
Reimeria sinuata													1													1
Rhoicosphenia abbreviata		23	38	12		3		47	29	1	7	6	1	4	84	63	2	58	61	78	13	33	10	12	17	193
Rhopalodia gibba							1		1																	
Rossithidium pusillum					7																					
Sellaphora pupula												3										1			1	
Sellaphora seminulum		2		1	1		5		1				1	1	2		4						7			1
Simonsenia delognei							1																			
Skeletonema sp.																						23				
Stauroneis legumen								1																		
Stauroneis phoenicenteron					1																					
Stauroneis smithii							1																			
Staurosira construens																			2							
Staurosira construens fo. subsalina			9											7												
Staurosira construens var. venter	7																									
Staurosira elliptica	20			2				2			2											3		1	20	

Staurosirella pinnata	4	3			1		3	2	1					4			130	7				12	6	97	17	
Stephanodiscus hantzschii	1			1		2		1			2		1		4	5		17		6	5	5	13	9	6	2
Stephanodiscus minutulus	1					2				2	15	2			1			4						13	9	2
Stephanodiscus parvus	11	14		7		28		35		7	39	2				20		10	4	8		18				
Stephanodiscus sp.				1		2			1	2	12		1													
Synedra acus	2	1									6		3						1				1			
Synedra delicatissima					3						3		14													
Synedra famelica					2		1																			
Synedra nana					24						9						2									
Synedra parasitica var. subconstricta								1			1														1	
Synedra sp.															3	1										
Synedra tenera				6	38	5	2				11	1	4			1	10									
Synedra ulna				1	2						1		1	1		3					1	2	11		1	1
Synedra ulna var. biceps					13	3		2																		
Tabularia fasciculata	3			24	4	7		8	1		2	22	2		1			2	1		1	2	1	2	9	
Thalassiosira pseudonana										2															10	
Tryblionella apiculata																				1						
Tryblionella hungarica							1																			
Tryblionella levidensis																						2				

APPENDIX II

Phytoplankton data

May data Cells or units/l	Wood Pond, 21/05/2013	Thousand Pound Pond, 21/05/2013	Stock Pond, 21/05/2013	Men's Bathing Pond, 21/05/2013	Highgate No. 1 Pond, 21/05/2013	Vale of Health Pond, 22/05/2013	Ladies' Bathing Pond, 21/05/2013	Bird Sanctuary Pond, 21/05/2013	Model Boating Pond 21/05/2013	Viaduct Pond, 22/05/2013	Hampstead No. 2 Pond, 22/05/2013	Hampstead No. 1 Pond, 21/05/2013	Mixed Bathing Pond, 21/05/2013
CYANOBACTERIA	0	0	0	0	0	0	0	0	0	0	0	0	0
Merismopedia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0
Snowella sp.	0	0	0	1,556	0	0	0	0	0	0	0	0	0
Anabaena sp.	0	0	0	7,407	0	0	0	0	0	0	0	0	0
Anabaena sp.	0	0	0	0	0	0	0	0	1,347	0	30,986	0	0
Anabaena flos-aquae	0	0	0	0	0	0	0	0	0	0	0	0	0
Anabaena planctonica	0	0	0	0	0	0	0	0	0	0	0	0	0
Oscillatoria sp.	0	0	0	0	167	0	0	0	0	333	0	0	0
Planktothrix agardhii	0	0	0	0	0	0	0	0	0	0	0	0	0
CHLOROPHYTA	0	0	0	0	0	0	0	0	0	0	0	0	0
Chlorolobion sp.	0	111,889	0	222	0	0	4,667	0	0	0	0	0	0
Closteriopsis sp.	0	0	0	0	0	0	4,667	0	0	0	0	0	0
Closteriopsis acicularis	86,667	0	0	0	0	0	0	0	699,670	0	0	0	0
Coelastrum sp.	0	0	0	111	0	0	0	0	0	0	0	0	0
Crucigenia sp.	0	0	0	0	0	0	0	0	199,906	0	0	0	0
Lagerheimia sp.	0	0	99,953	0	0	0	4,667	0	0	0	0	0	0
Monoraphidium arcuatum	0	0	1,049,505	0	0	0	75,500	0	0	0	0	0	0
Monoraphidium contortum	26,778	0	0	0	667	0	23,667	48,000	0	0	0	0	0
Monoraphidium convolutum	0	0	12,494	0	0	0	0	0	0	0	0	0	0
Oocystis sp.	0	0	0	0	0	0	0	0	0	3,111	0	0	0
Pediastrum boryanum	0	0	0	456	0	0	0	0	4,274	0	0	0	0
Pediastrum simplex	0	0	0	0	0	0	0	0	0	0	0	0	0
Pediastrum tetras	0	0	290	773	0	0	0	0	0	0	0	0	0
Scenedesmus sp.	6,333	0	0	0	0	19,000	101,667	0	1,099,481	0	0	0	0
Scenedesmus communis	0	0	156,000	6,333	0	0	0	0	0	0	0	0	0
Sphaerocystis sp.	0	111	0	556	1,000	0	0	0	0	0	2,333	0	0
Tetrastrum sp.	0	0	167	0	0	28,333	0	0	200,833	0	0	0	0
Botryococcus braunii	0	222	0	0	0	0	0	0	167	0	0	0	0
Chlamydomonas sp.	0	0	0	1,199,434	0	0	0	0	0	0	0	0	0
Eudorina sp.	0	0	0	0	0	0	0	833	0	0	0	0	0
PRASINOPHYTA	0	0	0	0	0	0	0	864,977	0	0	0	0	0
Ankyra sp.	0	33,000	0	74,000	23,500	0	0	0	0	0	0	137,000	0
CHRYSOPHYTA	0	0	0	0	0	0	0	0	0	0	0	0	0
Dinobryon divergens	4,000	0	0	0	0	0	0	0	0	0	0	0	0
Mallomonas sp.	0	26,222	0	0	0	0	0	0	0	33,318	0	0	0
DESMIDS	0	0	0	0	0	0	0	0	0	0	0	0	0
Closterium sp.	0	0	59,000	0	0	0	667	0	0	222	0	0	0
Closterium idiosporum	0	0	0	0	0	0	0	0	2,333	0	0	0	0
Staurastrum sp.	0	0	0	1,556	0	0	0	0	0	0	0	0	0
EUGLENOPHYTA	0	0	0	0	0	0	0	0	0	0	0	0	0
Euglena sp.	0	0	167	0	0	0	0	0	0	3,111	0	0	0
Lepocinclis sp.	222	0	0	0	0	0	0	0	8,833	222	0	0	0
Phacus sp.	3,111	0	0	111	0	0	0	0	0	3,111	0	0	222
Trachelomonas sp.	0	0	0	0	0	0	0	0	0	4,778	0	0	0
Dictyochophyceae	0	0	0	0	0	0	167	0	0	0	0	0	0
CRYPTOPHYTA	0	0	0	0	0	0	0	0	0	0	0	0	0
Cryptomonas sp.	0	1,556	24,988	2,667	13,167	19,000	0	205,667	0	48,778	222,167	0	26,889
Rhodomonas sp.	0	29,889	299,859	12,556	0	7,296,558	0	1,345,519	1,699,198	63,000	1,249,411	2,298,916	33,111
DINOFLAGELLATES	0	0	0	0	0	0	0	0	0	0	0	0	0
Ceratium hirundinella	399,811	111	0	0	0	0	0	0	0	0	0	0	0
Peridinium sp.	566,399	0	167	0	0	0	0	0	0	0	0	0	0
Peridinium bipes	66,635	0	0	0	0	0	0	0	0	0	0	0	0
Peridinium cinctum	0	111	0	0	0	0	0	0	0	0	0	0	0
Gonyostomum sp.	222	0	0	0	0	0	0	0	0	0	0	0	0
DIATOMS	0	0	0	0	0	0	0	0	0	0	0	0	0
Aulacoseira sp.	0	99,953	3,500	0	2,000	0	1,667	0	1,667	0	0	0	133,270
Melosira sp.	0	0	1,667	0	0	0	0	0	0	0	0	0	0
Melosira varians	0	0	0	0	667	0	0	0	2,333	0	0	0	0
Nitzschia sp.	0	0	0	0	0	0	7,167	0	2,333	6,333	0	0	0
Cymbella sp.	0	0	167	0	167	0	0	0	0	0	0	0	0
Gyrosigma sp.	0	0	0	111	0	0	0	0	0	0	0	0	0
Asterionella formosa	0	0	1,175,000	13,556	1,000	0	8,167	0	0	0	0	0	0
Fragilaria capucina	0	0	10,000	1,111	0	0	0	0	0	0	4,167	0	0
Synedra sp.	333	49,976	25,833	0	333	9,333	1,500	0	0	4,667	0	0	111
Tabellaria sp.	0	16,659	0	0	0	0	0	0	0	0	1,167	0	0
CENTRIC DIATOM <20um	0	0	1,532,167	0	0	0	0	0	0	66,635	0	0	0

July data Cells or units/l	Wood Pond, 05/07/2013	Thousand Pound Pond, 05/07/2013	Stock Pond, 05/07/2013	Men's Bathing Pond, 05/07/2013	Highgate No. 1 Pond, 05/07/2013	Vale of Health Pond, 05/07/2013	Ladies' Bathing Pond, 05/07/2013	Bird Sanctuary Pond, 05/07/2013	Model Boating Pond, 05/07/2013	Viaduct Pond, 05/07/2013	Hampstead No. 2 Pond, 05/07/2013	Hampstead No. 1 Pond, 05/07/2013	Mixed Bathing Pond, 05/07/2013
CYANOBACTERIA	0	0	0	0	0	0	0	0	0	0	0	0	0
Microcystis sp.	352	0	0	694	0	0	0	0	0	0	1	0	0
Anabaena flos-aquae	0	0	0	37,179	70,085	0	0	6,044	0	0	23,077	99,451	0
Anabaena planctonica	0	0	0	0	0	0	0	0	595	0	18,519	193,071	0
Aphanizomenon sp.	0	0	0	0	3,111	0	0	0	62,995	0	3,856	0	0
Oscillatoria sp.	833	0	0	2,667	0	0	333	0	1,124,470	0	0	0	0
Planktothrix agardhii	0	333	0	9,667	0	0	0	0	0	0	0	0	0
CHLOROPHYTA ETC	0	0	0	0	0	0	0	0	0	0	0	0	0
Chlorella sp.	0	0	0	0	0	0	0	0	0	999,529	1,776,940	0	166,588
Chlorolobion sp.	0	0	0	0	0	0	0	0	0	666,352	0	0	0
Closteriopsis sp.	0	0	0	0	0	143	0	0	0	0	0	0	0
Closteriopsis acicularis	0	333	0	0	0	0	0	0	0	0	0	0	0
Coelastrum sp.	0	0	249,882	0	0	0	55,529	0	0	0	0	0	41,647
Crucigenia sp.	0	0	0	62,471	0	0	0	0	856,739	0	333,176	0	0
Kirchneriella sp.	0	0	166,588	0	0	0	0	0	0	0	0	0	0
Monoraphidium arcuatum	0	0	666,352	0	166,588	0	0	107,092	107,092	0	0	0	0
Monoraphidium contortum	0	1,444	0	0	1,665,881	53,546	0	107,092	160,639	2,248,939	0	0	83,294
Monoraphidium convolutum	0	0	333,176	0	111,059	0	0	0	321,277	0	0	0	0
Pediastrum sp.	0	0	0	0	0	0	0	0	71	0	0	0	5
Pediastrum boryanum	0	0	0	1,709	0	183	51,258	0	0	0	0	0	3
Scenedesmus sp.	0	0	2,332,233	0	0	214,185	1,110,587	267,731	428,369	0	1,332,705	0	1,333
Scenedesmus communis	0	0	0	0	0	0	0	0	0	333,176	0	0	889
Sphaerocystis sp.	0	0	0	0	0	80,319	0	0	0	0	0	0	0
Tetraedron sp.	0	0	832,940	62,471	0	26,773	0	0	0	0	0	0	0
Tetrastrum sp.	0	0	1,082,823	0	0	0	0	0	107,092	0	333,176	0	0
Chlamydomonas sp.	0	0	0	0	0	0	0	0	0	0	555,294	0	0
Eudorina elegans	0	0	0	0	0	71	0	0	0	0	0	0	222
Botryococcus sp.	0	333	111	0	0	0	222	0	0	0	0	0	0
Pandorina sp.	0	0	0	0	0	0	9,778	0	0	0	0	0	0
PRASINOPHYTA	0	0	0	0	0	0	0	0	0	0	0	0	0
Ankyra	0	0	0	0	0	0	0	0	0	0	0	0	0
CHRYSOPHYTA	0	0	0	0	0	0	0	0	0	0	0	0	0
Dinobryon divergens	5,333	60,889	0	0	0	0	0	53,546	0	0	0	0	0
Mallomonas sp.	0	0	0	0	0	0	0	0	0	83,294	0	0	0
DESMIDS	0	0	0	0	0	0	0	0	0	0	0	0	0
Closterium sp.	0	333	0	0	0	0	0	0	53,546	222	0	0	111
Staurastrum sp.	0	0	0	0	0	0	0	0	143	0	0	0	0
EUGLENOPHYTA	0	0	0	0	0	0	0	0	0	0	0	0	0
Euglena sp.	2,667	0	0	0	0	0	0	0	0	0	0	0	0
Lepocinclis sp.	1,167	0	0	0	0	0	444	0	37,714	4,333	0	0	2,667
Phacus sp.	1,000	0	111	0	0	0	444	0	357	83,294	0	0	333
Trachelomonas sp.	249,882	0	583,058	0	0	0	55,529	0	107,092	333,176	0	0	0
CRYPTOPHYTA	0	0	0	0	0	0	0	0	0	0	0	0	0
Cryptomonas sp.	0	66,635	249,882	0	0	26,773	2,776,468	321,277	0	0	0	0	583,058
Rhodomonas lacustris	1,082,823	199,906	1,499,293	187,412	333,176	0	388,706	2,570,216	0	3,581,644	1,665,881	0	6,455,288
DINOPHYTA	0	0	0	0	0	0	0	0	0	0	0	0	0
Ceratium furcoides	0	0	0	0	0	0	111	0	0	111	0	71	0
Ceratium hirundinella	167	0	0	0	0	0	0	0	0	0	0	0	0
Peridinium sp.	167	111	0	0	166,588	0	0	0	0	832,940	111	0	0
DIATOMS	0	0	0	0	0	0	0	0	0	0	0	0	0
Hantzschia sp.	0	0	0	0	0	0	0	0	0	0	1,333	0	0
Nitzschia sp.	0	0	0	0	0	0	0	4,979,794	0	416,470	0	321,277	0
Cymbella sp.	0	111	0	0	0	0	0	0	0	111	0	0	0
Asterionella formosa	0	83,778	2,444	18,000	0	0	667	0	0	0	0	0	0
Fragilaria capucina	0	8,889	0	0	0	0	0	0	0	17,778	0	0	0
Synedra sp.	1,667	1,111	0	2,000	0	0	667	2,571	0	7,889	0	0	0
Tabellaria sp.	10,333	0	0	0	0	0	0	0	0	0	9,778	0	0
CENTRIC DIATOM <20um	583,058	0	249,882	4,747,760	277,647	910,285	0	4,015,963	0	0	277,647	0	0
Aulacoseira sp.	833	0	0	60,667	0	0	1,000	152,143	535,462	0	0	53,546	4,111
Melosira sp.	0	0	0	0	0	0	0	0	1,429	0	0	0	0

Appendix III

Zooplankton data

		Highgate Pond No.1	Highgate Pond No. 1	Mens Bathing pond	Mens Bathing Pond	Model Boating pond	Model Boating Pond	Bird Sanctuary pond	Bird Sanctuary Pond	Ladies'' Bathing pond	Ladies' Bathing Pond	Stock pond	Stock Pond	Hampstead no. 1 pond	Hamstead No. 1 Pond	Hampstead no. 2 pond	Hamstead Pond No. 2	Mixed Bathing pond	Mixed Bathing Pond	Viaduct pond	Viaduct Pond	Vale of Health pond	Vale of Heath Pond	Wood pond	Wood Pond	Thousand Pound pond	Thousand Pound Pond
	Sample Date	21/05/2013	10/07/2013	21/05/2013	11/07/2013	21/05/2013	11/07/2013	21/05/2013	10/07/2013	21/05/2013	09/07/2013	21/05/2013	10/07/2013	22/05/2013	16/07/2013	22/05/2013	12/07/2013	22/05/2013	17/07/2013	22/05/2013	16/07/2013	22/05/2013	15/07/2013	21/05/2013	09/07/2013	21/05/2013	09/07/2013
Rotifers	Conochilus hippocrepis																		39476								
	Asplanchna sp.	244		95		59							24	10		163	1				234		211	367	18	8	1
Cladocerans	Diaphanosoma brachyurum												3														7
	Sida crystallina		5																								
	Ceriodaphnia dubia		290			14		373	523			2	8	3	27	924		14		7				54	18	8	
	Ceriodaphnia reticulata									27																	
	Daphnia ambigua																										10
	Daphnia longispina	1535	23	54		23	4				251	20	10	58	14	394		869	45	207	61	5	244	1168	145		
	Scapholeberis mucronata		154									61	1														
	Simocephalus exspinosus											20															
	Simocephalus serrulatus																3										
	Moina macrocopa								27																		
	Bosmina coregoni		136		1		5	7	20				3			27	1		5	17	61		340		14	3	
	Eurycercus lamellatus				1								3	14													
	Polyphemus pediculus		27					27	7	733		36		177	3	489											1
Copepods	Nauplii-Copepoda										3																
Calanoids	Diaptomus/Eudiaptomus sp.				20		1										5	95					41				
	Eudiaptomus gracilis	81		95		231		48	109	14	44	84	10	14	11	27			244	17	170	1		353	124	15	22
Cyclopoids	Cyclops sp.	462	23	1127	18	190	19	88	75		68	115	15	68	15	109	11	217	23	119	51		136	190	7	7	18
Harpacticoids	Harpacticoida						3						3						5				27				
Non-zoops	Asellidae												1														
	Asellus aquaticus													3													
	Collembola						1																				
	Chaoboridae													3													
	Chironomidae						1													3							
	Ostracoda		14									2	1	3													1
	Gastropoda				1																						1
	Ancylus fluviatilis																		9								
	Succineidae																1										
	Oligochaeta																								2		
	Hydracarina																										1
	Hydra sp.									14																	4
	Nematoda											2															