

Appendix 1

Seven Sisters Management Work Plan

Adrian Brooker

Summer 2010

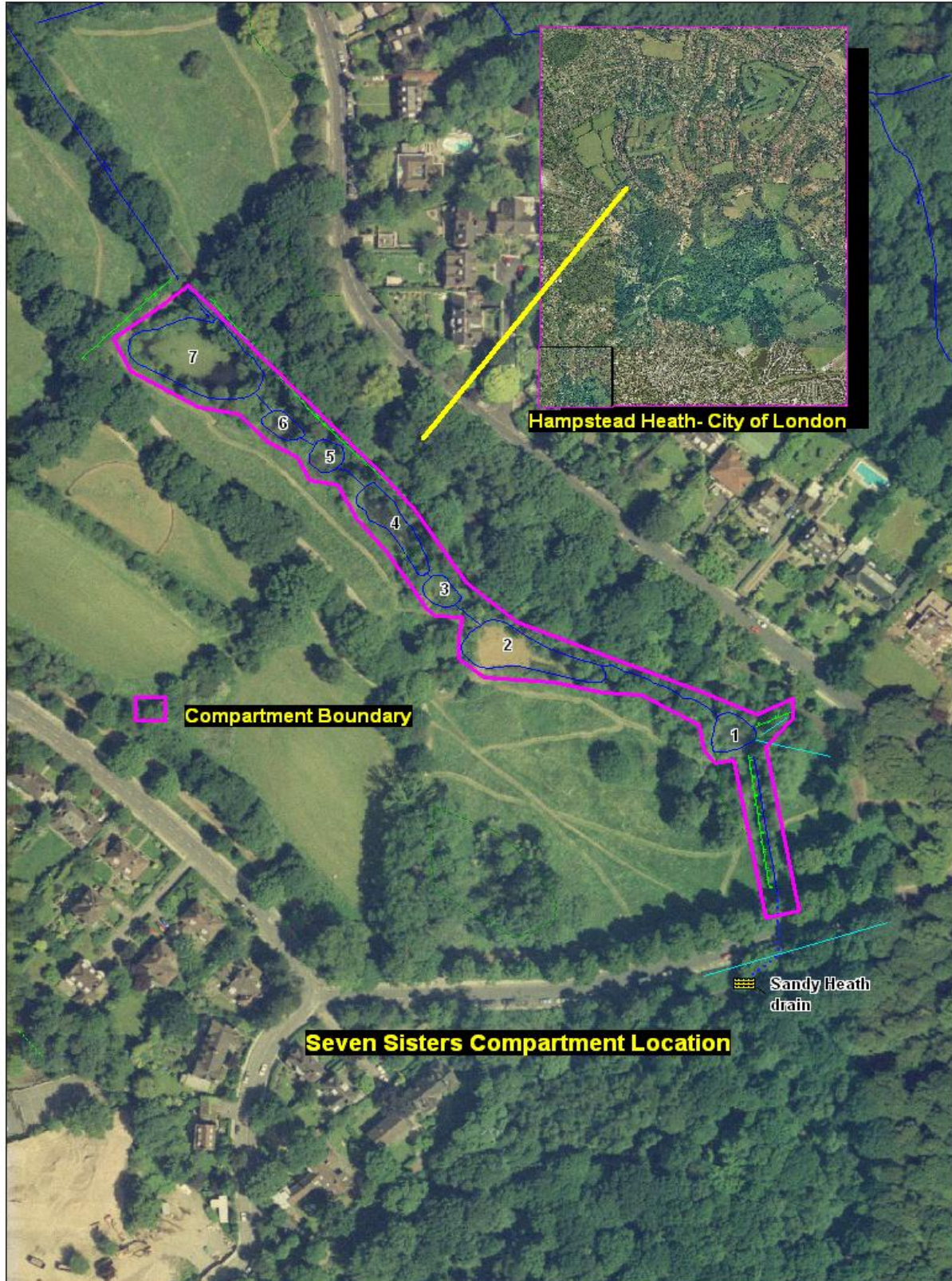


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1.0. Site description

Map 1: Seven Sisters compartment location



1.1 Location

The Seven Sisters are the northern-most ponds on Hampstead Heath. They are located on the Heath Extension and form a chain of 7 ponds. The ponds lie along a SE-NW streamline with pond 1 centred at grid reference 526270,187327 and pond 7 centred at grid reference 526066,187480. The ponds form part of the tributary for the River Brent. The compartment covers some 0.58 hectares with the actual ponds covering approximately half this area (0.26 hectares). The largest pond, pond 7, is 0.15 hectares. The 2009 Hampstead Heath vegetation survey shows the area as being mostly within compartment numbers 1,298 through to 1,305. The ponds occur in an area of old farmland and field systems with old hedgerows and hedge banks bordering the compartment.

Ponds 4-7 are enclosed within chestnut fencing. Pond 3 is partially fenced with chestnut fencing but also has natural hurdle fencing on the west side to reduce dog access. Ponds 1 and 2 are not fenced. The compartment has within its bounds ponds, a streamline connecting them, a damp meadow, and scrub habitat particularly along the woodland edge. The compartment boundary can be seen on Map 1 and is largely defined by the fence line around much of the area.

The compartment is bordered by an old hedge line, now joined with secondary woodland to the east, and a rough meadow running along the western edge. The northern boundary is the path to the north of pond 7. The southern boundary stretches away to the south from the first Extension pond along the inflow stream line to Wildwood Road.

1.2 Geology, Soils, Hydrology

The ponds are located on an area of Claygate Beds and are largely fed by runoff water from Sandy Heath via a pipe under the road. There is a small ditch which receives the water from this roadside pipe and carries it to pond 1. This ditch runs alongside an old field boundary which was replanted in 1970's or 1980's and then again in 1996. There are also two small drainage ditches which bring in very small amounts of water from around the horse ride. Surface water and a small amount of ground water also go into the ponds. Pond 7 also receives water from a land drain which is connected to a drainage ditch running along the west edge of the compartment. The ponds have high levels of total phosphorus content as shown in the table below. This level of phosphorus would put the ponds into the hyper eutrophic (highly nutrient enriched) category according to the Organisation for Economic Co-operation and Development¹ (OECD, 1982) study of northern hemisphere lakes. According to the OECD a level of phosphorus above 0.1 mg/l would put a pond or lake into the hyper-eutrophic category, along with a chlorophyll level of more than 0.025mg/l and reduced water clarity.

Ref	Location	Date		
		2006	2007	2008
040	Extension pond 1-Composite	0.138 mg/l	0.310 mg/l	0.344 mg/l
041	Extension pond 3	0.433 mg/l	1.010 mg/l	0.151 mg/l
042	Extension pond 7-Composite	0.414 mg/l	1.360 mg/l	0.389 mg/l

The ponds feed into each other via a stream and man made overflows. The northern-most pond, pond 7, discharges its water into a stream system which continues along the Extension hedgerows, exiting into an underground culvert on Hampstead Way. As the ponds are largely reliant on runoff water, there is seasonal fluctuation in pond levels, including complete drying out. The streamline connecting ponds 1 and 2 has varied water levels and for much of the stream length the water is not visible, due to accumulation of debris.

1.3 Ecology

The habitats within the compartment consist of ponds, streamline, damp meadow and scrub/woodland fringe. A number of shrub islands are also within the compartment. The distribution of some of these habitats is shown on Map 2 in section 3.0.

Flora

There is quite a diverse flora associated with the Seven Sisters ponds, with a mixture of naturally colonising and planted vegetation. Records show a variety of vegetation planted within the last 15 years, although much of it has not recently been recorded. Invasive species, such as parrots feather and New Zealand pygmyweed have been previously recorded and may, along with other species, be present in the seed bank. The section below lists some of the plants that are currently thought to be present in Seven Sisters compartment. This list is not intended to be exhaustive, but gives an overview of species found in a particular habitat.

Aquatic vegetation:

Aquatic plants found include water starwort, broad-leaved pondweed and a variety of native and ornamental lilies. Filamentous algae, duckweed and blooms of blue-green algae are some of the less desirable vegetation, particularly on Pond 7. Rigid hornwort may be present as it was introduced into Pond 7 in 2008. Parrots feather was prevalent in 2000.

Emergent vegetation:

These include bulrush, reed sweet grass, bur-reed, flag iris, celery leaved buttercup, marsh marigold and water mint. New Zealand pygmyweed and parrots feather have been found and managed in the past.

Damp meadow:

Meadowsweet, giant butterbur (planted in 1997), purple loosestrife, water figwort, marsh woundwort and soft rush are all common. Water avens, which was planted in 1995, is still present. Goat willow occurs in the damp meadow, but is coppiced yearly along with the cutting the grassland. Toad rush, water mint, coltsfoot, pendulous sedge and water pepper are also found.

Other species of interest in dryer parts:

Wood violets occur between ponds 2 and 3 and ponds 6 and 7. Hairy sedge, male fern, broad buckler fern, Spanish bluebell, rosebay willowherb, hogweed, primrose (planted), and wood forget me not have all been recorded. Broad leaved helleborine has been found within the compartment and is frequent in the nearby grassland.

Plants of woodland fringe and scrub:

There is a wide variety of tree species found along the woodland fringe including oak, hazel, birch, crack willow, goat willow, grey willow, hawthorn, elder, blackthorn, wild cherry, rowan, holly, ash, alder buckthorn and whitebeam. Bramble is ubiquitous in the area and woody nightshade, foxglove and the planted primrose are frequent. One fungus of interest is the earthstar fungus *Geastrum triplex* which occurs along the woodland fringe section of pond 3. A wild service tree grows on the boundary of the compartment and there is a possibility of suckers appearing within it.

Shrub islands plants:

The shrub islands are located in pockets to the edges of the ponds. There is also a band of shrubs planted at intervals along the western fence line. Species present include hawthorn, blackthorn, elder and hazel. Along the fence line section tutsan, honeysuckle, dog and guilder rose have been planted.

Streamline:

There is very little vegetation associated with the streamline section, due to excessive shading of nearby scrub and tree growth.

Fauna

Marsh frogs, first recorded in 2000, were illegally introduced into the ponds and now have a breeding colony. Common frogs are also present with 35 clumps of spawn recorded in 2009.

Surveys by Alan Reynolds have recorded the following 11 species of dragon- or damselflies as frequenting the ponds, most of which are also likely to be breeding there: Common blue damselfly, blue-tailed damselfly, azure damselfly, large red damselfly, brown hawker, migrant hawker, southern hawker, common darter, ruddy darter, broad bodied chaser, emperor dragonfly and a single emerald damselfly. Previous records from Ruth Day in 1996 and 1997 reveal a similar fauna.

Mandarin ducks often use the ponds to overwinter and over 40 have been observed at one time on pond 7. The ponds are also a very good site for moorhens to breed, due to being largely fenced off. Kingfishers are also seen to frequent the ponds, often perching on the outflow pipe.

Lesser marsh grasshopper, common field grasshopper and meadow grasshopper have been recorded from the grassland to the west of the ponds.

Invertebrates

Two noteworthy ground beetles associated with wetland habitats have been recorded in the vicinity of the ponds ². *Pterostichus longicollis* and *Bembidion clarki* are both classed as Nb species, which means they are recorded in only 31-100 10Km squares nationally.

A stonefly has been recorded ³ from the area around the Heath Extension. Stoneflies are generally intolerant of pollution and usually associated with running water of good quality. The Stonefly recorded, *Nemoura cinerea*, is however tolerant of still water and the nymph lives in the substrate at the bottom of the water column.

1.4 Public and educational uses

Ponds 1 and 2 are regularly used by dogs for swimming. Pond 2 had dog access points fitted in the north-west corner in the 1990's and is the most frequently used. Pond 3 was previously used for dog swimming, but since the installation of natural fencing this has largely ceased. The frequent dog access previously resulted in a good deal of erosion on the pond banks, which has been repaired in various localities with wooden stakes. The ponds are encircled by a path network which is regularly used by walkers and birdwatchers. Numerous viewing points of the ponds are available and the Heath's dragonfly monitoring scheme uses a number of these for survey purposes.

1.5 History

Six of the ponds (numbers 2-7) were dug by unemployed immigrant labourers in 1908-09. The first of the chain appears on early maps and is thought to be over 250 years old. Old maps show a stream running down the east side but no ponds.

Pond 1 suffered a major oil leak in the 1990's with what was believed to be transformer oil. The pond edges of ponds 2 and 3 were partially reinforced with elm stakes and backfilled with soil in the 1990's to repair the damage caused by dog swimming. Pond 2 also had sheet piling fitted along the north west bank in the 1990's. The scrub on the east bank of ponds 3-7 has been cut and cleared on rotation every 3-4 years. The western damp meadow by the same ponds is cut every year in winter. The southern ends of ponds 1-7 have all had some degree of coppicing undertaken in the last four years.

The southern marginal area of pond 1 was planted with flag iris and reed sweet-grass at the time of coppicing. Ponds 4, 5 and 6 were mechanically dredged in September 1997, with the arisings spread out on the adjacent meadow area. The ponds and the pond margins have all had a variety of vegetation introduced to them in the last 15 years including hornwort and white water-lily into pond 7. The north end and west sides of pond 7 were coppiced in 2008 and 2009 respectively. Natural fencing was erected between ponds 3 and 4 in 2005. Sections alongside the western chestnut fence line were planted with shrubs including blackthorn and honeysuckle in the late 1990's. Parrots feather and New Zealand pygmyweed have been intensively managed in the past.

1.6 Natural and human-induced trends

Ponds 1 and 2 are used regularly by dogs to swim in, with pond 2 having dog access points fitted in the north west corner. The ponds suffer from seasonal drying out, with pond 2 often containing no standing water in the summer months. The water level is greatly influenced by the inflow of water from Sandy Heath and the extent of emergent vegetation.

1.7 External influences

The ponds are located adjacent to a road and residences and may suffer from pollution from road runoff. An incident near the road in the 1990's caused a major leak of transformer oil into the first Seven Sisters pond. A solid core sample taken from the bottom of the pond in 2008 revealed very low levels of hydrocarbon pollution (eurofins 15mg/kg dry weight). Further sampling was undertaken in 2010, with samples taken from the sediment, water body and a further soil core sample. The results are shown in the table below.

SAL Reference					197353 001	197353 002	197353 003	197353 004
Customer Sample Reference					Sediment 1	Sediment 2	Sediment 3	Sediment 4
Determinand	Method	Test Sample	LOD	Units				
Total Petroleum Hydrocarbons	T8	AR	1	mg/kg	40	29	180	98

SAL Reference					197353 006
Customer Sample Reference					Water
Determinand	Method	Test Sample	LOD	Units	
Total Petroleum Hydrocarbons	T8	AR	0.1	mg/l	<0.1

SAL Reference					197353 005
Customer Sample Reference					Core Soil
Determinand	Method	Test Sample	LOD	Units	
Total Petroleum Hydrocarbons	T8	AR	1	mg/kg	61

The above results indicate a maximum level of total hydrocarbon content of 180mg/kg. This figure does not give an indication of the relative composition of the hydrocarbons in terms of aromatic or aliphatic make-up. Different hydrocarbon compounds possess a varied degree of toxicity in terms of human health. Regulations with regards hydrocarbon levels in soil have recently been changed from the ICRC trigger level approach to a risk assessment approach. This includes analysing the proportions of different hydrocarbon compounds as well as the likelihood of the public coming into contact with these compounds.

As the levels of hydrocarbon in the water sample were below the limit of detection there is thought to be a very low risk of damage to human health through contact with the water. The sediment samples were all taken from the bottom of the water body and it would be relatively difficult for the public to come into contact with this. To reduce this risk further it is advised to fence off the northern part of the pond with wooden fencing (the remainder has limited access), which would prevent disturbance to the sediment layer. Further investigation would be required if carrying out dredging works on the pond. From the list of Waste (England) Regulations 2005 it is unlikely that this amount of hydrocarbon would be considered dangerous waste if consideration is made to dredge the pond.

2.0. Evaluation

2.1 Natural landscape

The aquatic and marsh vegetation of the Seven Sisters ponds is quite diverse and attracts numerous species of dragonfly and other invertebrates of ecological interest. Breeding and overwintering wildfowl as well as kingfishers frequent the ponds. Common frogs use the ponds to breed.

The Heath does not have many shallow ponds, which can have a greater ecological value than larger ones, due to the range of emergent and aquatic vegetation. The problem associated with shallower ponds is that they can dry out, and require management to prevent excessive plant growth from covering the entire pond. A report commissioned by the City of London undertaken by Alan Reynolds⁴ concludes that the Seven Sisters ponds have the potential to support a greater species diversity of dragonflies than at present. Management recommendations from the report, which would also benefit other invertebrates, are:

- Maintain the ponds' open aspect with a minimum of overhanging trees
- Overall aim to get 14-17 species recorded including emerald damselfly breeding
- Maintain sufficient open water and prevent encroachment of invasive species
- Maintain a variety of vegetation to include emergent and marginal vegetation and floating and submerged vegetation

The varied damp meadow vegetation should provide a resource for other invertebrates, such as butterflies, and should be sustained and prevented from reverting to scrub. The eastern edge of the compartment provides woodland fringe habitat with a mixture of scrub and wild flowers. This area should be prevented from succeeding into woodland and from encroaching and shading the pond area.

The shrub islands should provide habitat and protection for birds, but will lose their value as such if they become tall and leggy.

The stream area has the potential to attract additional species of invertebrates and plants. It can also act as a buffer and silt trap between the first pond and the rest of the pond chain. The stream could possibly provide habitat for species such as stonefly. Although the stream is likely to dry out at some stage during the summer months, log weirs may provide an extra habitat through pooling.

2.2 Public and educational uses

The ponds benefit ecologically from not having public access to a large part of the compartment. They are situated in an attractive setting and management should ensure that the ponds remain visible to members of public. Pond 2 should retain its dog access point, to prevent disturbance of other ponds. This access also maintains a stretch of open water. No further access is recommended to the compartment than at present. It is also recommended that pond 1 has a low hurdle fence fitted to prevent dogs getting covered in sediment, and disturbance to sediment layers caused by them. Any disturbance in this pond could be detrimental to the rest of the pond chain through pollution escaping down the chain.

2.3 History and built environment

The ponds are thought to be over 100 years old, and it is believed that there may have been a pond in the location of the Pond 1 for 250 years⁵. This continuity of ponds should remain and succession to marsh should be prevented.

2.4 Vision

Maintain a series of small shallow ponds and manage them to provide a suitable habitat for aquatic invertebrates.

- Maintain the open aspect of the ponds to encourage increased invertebrate fauna
- Aim to support 14-17 species of dragonfly around the ponds
- Prevent scrub encroachment onto the grass areas and maintain as small meadows
- Prevent the ponds from drying out through succession, and prevent the spread of non-native invasive species
- Increase the potential for species such as stonefly through management of the streamlines
- Increase the extent of floating vegetation
- Ensure the public can view the ponds but retain (or create for pond 1) fencing around all ponds except pond 2

2.5 Relevance to achieving the 2007-2017 Hampstead Heath Management Plan

The following policies from the Natural Landscape chapter of the Part II Management Plan for the Heath are particularly relevant to the Seven Sisters ponds:

Policy 1: The Heath will be managed to maintain and preserve its unique wild and natural aspects and its ecology, and enable quiet enjoyment and appreciation of the natural world by visitors

Policy 29: The existing hedgerows will be managed to protect and enhance their nature conservation importance

Policy 30: Traditional methods such as hedge laying will be used where appropriate to maintain and manage the Heath's hedgerows

Policy 34: The spread of scrub will generally be limited and will be managed to prevent it becoming woodland

Policy 36: The existing ponds, streams, ditches and wetlands will be managed to protect and enhance their nature conservation importance

Policy 37: Recreational use of the ponds will be managed to minimise adverse ecological effects

Policy 38: A range of pond plants will be reintroduced to as many ponds as possible. Work will initially trial various planting techniques and will be on a phased

basis in accordance with priorities set by the overall strategy for ponds and watercourses

Policy 39: Opportunities will be sought to reduce shading of ponds by bank-side trees and shrubs and thereby enhance the visual amenity of some ponds, improve water quality, facilitate the growth of marginal flora and encourage dragonflies and other fauna

Policy 40: In tandem with work to reduce eutrophication and manage recreational pressures, species diversity of the ponds will be improved through establishment of vegetation and other measures aimed at particular groups of fauna

Policy 41: Ponds will be dredged as and when necessary

Policy 43: Wet or seasonally wet ditches and streams will be maintained and restored where appropriate. No further ditches or streams will be piped unless it is absolutely necessary for safety or access reasons or in order to prevent excessive erosion

The following policy from the Hydrology chapter of the Part I Management Plan for the Heath is particularly relevant to the Seven Sisters ponds:





Essential Action HY1: Manage the Heath's ponds and watercourses to enhance their nature conservation value, reduce flood risk and address water quality problems




3.0 Prescription and Work Programme

Map 2: Seven Sisters habitats and prescription




3.1 Regular management tasks

Objective	Prescription	frequency	Month(s)	Years	Who by	Priority: low, medium or high
Maintain Damp Meadow 	Late winter/early spring cut and clear from western edge of ponds 2-7.	Once	Feb/early March	Yearly	Cons Team	Medium
Rotational scrub clearance from pond edges to maintain low scrub and wildflower area and prevent encroachment into the pond. 	Cut/coppice scrub and grub bramble from N, S and eastern edges of ponds 1 and 2.	Every 4 years	Winter	2010,14	Cons Team	Medium
	Cut/coppice scrub and grub bramble from N,S and E edges of ponds 3-4			2011,15		
	Cut/coppice scrub and grub bramble from N,S and E edges of ponds 5-6			2012,16		
	Cut/ coppice and grub bramble from N and W sides of pond 7			2013,17		
Maintain shrub islands 	Lay shrub section along northern edge of pond No.2 to increase bank protection and periodically improve public viewing. These sections to be layed due to them being largely linear as opposed to scrub block below. This layed section may be kept pruned yearly if extra viewing is desired. It will however require a period of a few years regrowth before laying again.	Every 10 years	Winter	2012,22	Cons Team	Low
	Lay shrub section along fence line of ponds 4-6			2011,21		
Maintain shrub islands 	Selectively coppice shrub islands to maintain thick vegetation. Coppice 1 island a year	Every 10 years	Autumn/ Winter	1 island a year, every year	Cons Team	Low



<p>Lay hedge section alongside streamline to maintain as hedge and allow more light to stream.</p> 	<p>Lay hedge running alongside stream running southbound from pond 1.</p>	<p>Every 10 years</p>	<p>Winter</p>	<p>2011</p>	<p>Cons Team</p>	<p>Low</p>
<p>Maintain open water</p> 	<p>Remove 50%-75% of emergent vegetation from ponds 2-6 every 10 years. Maintain a minimum of 50% open water.</p> <p>This can be achieved manually through the use of volunteers, with 1 pond being cleared every 2 years.</p> <p>However if a digger is available it may be more practical to clear the ponds 2-6 in one year and then repeat 10 years later. This is dependent on budget available.</p> <p>The arisings can be spread along the meadow section to the west of ponds 4-6. This is no longer original meadow as previous arisings have been placed here in the past.</p>	<p>Every 10 years</p>	<p>October</p>	<p>Pond 2 2010</p> <p>Pond 3 2012</p> <p>Pond 4 2014</p> <p>Pond 5 2016 2010</p> <p>Pond 6 2018</p>	<p>Cons Team</p>	<p>High</p>
<p>Thicken up remnant hedgerow running from extension No.1 pond east towards Wildwood road</p> 	<p>Lay short hedgerow section running from pond 1 east towards Wildwood road</p>	<p>Every 10 years</p>	<p>Winter</p>	<p>2011</p>	<p>Cons Team</p>	<p>Low</p>
<p>Monitor Dragonflies</p>	<p>Commission expert to carry out dragonfly monitoring</p>	<p>Every 3-5 years</p>	<p>Summer</p>	<p>2012</p>	<p>External Contract</p>	<p>Medium</p>

3.2 One-off tasks

Objective	Prescription	Month(s)	Year	Who by	Priority	Est. cost
Increase light to streamline 	Coppice young tree and scrub growth from the western edge of the stream and remove shrub growth and debris from the stream. This may require management again at a future stage, depending on the success of the pooling of the stream.	September	2010 2011/12	Cons Team	Low	Local Budget
Create pools and silt traps	Place 3-4 shallow log weir's along the streamline from ponds 1 to 2 to cause pooling.	Any	2010 2011/12	Cons Team	Medium	Local Budget
Remove silt from Pond no.1 and no.7	Dredge sediment from base of ponds 1 and 7. This should be done in conjunction with sediment management on the Heath's pond chain.	Every 20-25 Years			Medium	Min. £10000
Increase extent of flora along damp meadow section	Plug native wildflowers such as meadowsweet into sparse areas along the damp meadow section of the pond edge. Use propagation from existing species on the Heath where possible.	Spring/Autumn	2011	Cons Team	Low	Local Budget
Increase extent of emergent vegetation on No.7 pond	Plant iris beds sourced from nearby grassland into shallow sections around pond 7.	Spring	2011	Cons Team	Low	Local Budget
Reduce access to Pond No.1	Build natural fencing around northern section of pond 1 to prevent access to pond and thus decrease likelihood of disturbance to sediment.	Autumn	2010 2012	Cons Team	High	Local Budget

4.0 Review

To be filled in as time goes by.

Author	Date	Task	Observation, event or alteration to task
A.Brooker	7/04/2011	Increase light to streamline 	Not done 2010. Do Nov/Dec 2011 or Jan/Feb 2012
A.Brooker	7/04/2011	Create pools and silt traps	Not done 2010. Do Nov/Dec 2011 or Jan/Feb 2012
A.Brooker	7/04/2011	Reduce access to Pond No.1	Not done 2010. Do 2012
A.Brooker	7/04/2011	Maintain open water 	Ponds 2 + 5 done in 2010. Regime for others the same

5.0 References

1. Haycock Associates, 2006. Hydrological and Water Quality Investigation and Modelling of the Hampstead Heath Lake Chains and Associated Catchments: List of Tables, p viii.
2. Hackett D, 2008. Invertebrate survey of Hampstead Heath 2007, pg 4.
3. Hackett D, 2007. Invertebrate survey of Hampstead Heath 2006, pg 4.
4. Reynolds A, 2006. A survey of the Seven Sisters ponds on Hampstead Heath Extension in 2006.
5. Wolton D, M^cDowell D, 1998. Hampstead Heath: The Walkers Guide. Headley Brothers Ltd. Pg 156.