ECOLOGICAL SURVEY INCLUDING MANAGEMENT RECOMMENDATIONS, CRAYS POND, DECEMBER 2014

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Background

This report summarises the results of the most recent ecological survey for Crays Pond undertaken in 2014, and compares the results of this survey with those of previous years, most especially 2010 the most recent previous more or less comprehensive survey. Other available data for years other than 2010 and 2014 have been collated to further inform the current and historical condition of the pond.

Survey Dates, Methods and Personnel

In 2014 the pond was surveyed on 22 May by Rod d'Ayala (RdA) and Robert Aquilina (RA) the survey including a full netting survey primarily targeting aquatic invertebrates with other species such as amphibians being recorded on an incidental basis. Wetland plants were recorded from in and around the pond by a walk over survey. This walk over survey included a partial survey of the terrestrial plants in the pond surrounds. The previous comprehensive survey was undertaken on 28 June 2010 (RdA) and 7 July 2010 (RdA and RA). The scope of the survey was as 2014, except the 2010 survey included a more comprehensive terrestrial plant survey. Both 2010 and 2014 included a basic water chemistry analysis using a field meter. In both years observations were made about the physical structure and layout of the site. In 2010, for survey purposes both the terrestrial and aquatic parts of the site were broken down into smaller habitat based units.

One of the reasons for repeating the survey in 2014 was to assess any changes in the ecology of the pond following in 2012 stopping the road run off from the adjacent crossroads entering the pond.

Survey Results

(With reference Appendices 1 and 2)

Water Chemistry

In 2010 and 2014 two samples were taken from the pond and for each sample its pH and conductivity were measured. The latter measure is, in the absence of detailed analysis identifying the concentration of particular compounds such as nitrates and phosphates, an approximation of the cleanliness of the water. In 2010 the first pond sample was taken where the two main road drains entered the pond off the crossroads, with the equivalent sample in 2014 being taken from the south bank of the pond. The second pond sample (taken in both 2010 and 2014) was from more or less diagonally opposite the first, on the far side of the pond from a "natural" well created by a hollowed out vertical branch of the large fallen tree. The results of these simple surveys are shown in Table 1 below.

In 2014 two additional samples were also taken from outside the pond, from the ditches / gullies that collect run-off from the road. One of these was from the original blocked ditch (bunded in 2012) fed by water off the crossroads, this location being an indicator of the water chemistry where road run-off accumulates, located in a very similar location to one of the 2010 pond samples. The second exterior sample was from the new (2012) main roadside gully designed to take water off the road and soak away into the ground rather than enter the pond.

Table 1 - Water Chemistry Results, July 2010 and May 2014

Location	Date	pH	Conductivity (Micro Siemens)	Temp. (C)	Notes
North West Road Drain (Blocked 2012)	22/05/2014	6.58	1065	n/r	Similar location to N W Corner of Main Pond sampled 07/07/2010
Main Pond - North West Corner	07/07/2010	6.9	840	n/r	Sample from main pond, near to main road run off entry point.
Main Pond - South Bank	22/05/2014	6.96	562	14.6	Sample from main pond.
"Tree Well", South East Corner	07/07/2010	6.9	690	n/r	Relatively isolated location in main pond
"Tree Well", South East Corner	22/05/2014	6.97	570	n/r	Relatively isolated location in main pond
North (Original) Gully	22/05/2014	7.22	237	17.2	Shallow water, after very recent rain.
(New) South Gully	22/05/2014	n/a	n/a	n/a	Dry, not surveyed

For the main pond basin (though the samples were not taken from the same location) the conductivity (a simple measure of water quality) shows a significant decrease. The relatively isolated "well" of water in the south east corner of the pond also shows a decrease in conductivity for the same period. Decreasing conductivity is an indicator or cleaner water.

After recent rain (the same day and/or overnight) the north gully held some standing water with a low conductivity more or less akin to that of rainwater. After a period with frequent

rain this is not unexpected as the road will have been washed clean and any water in the gully have a conductivity close to that of rain water – though it may still pick up other compounds damaging to life in ponds.

More pollution would be expected in the winter months when the roads are salted / gritted. It appears (local sources and personal observation RdA) that the drainage gullies work very well as it is believed no road run-off from these drains has reached the pond (by direct flow) since they were created in 2012. Similarly there has been no water entering the pond from the road from the two other pipe routes, blocked in 2012.

The blocked more or less permanently wet road drain in the north western corner of the pond is still fed by road run off and as far as it is known continued to be topped up by road run off since its outflow into the main basin was blocked. In 2014 it had a very high conductivity (over a 1000 micro-Siemens) – suggesting a build up pollutants which previously would have entered the pond.

Overall, though using only a simple measure, it appears that stopping the flow of run-off from the road into the pond by either blocking drainage pipes / ditches gullies and/or creating soak away gullies has resulted in the water in the pond being significantly cleaner in 2014 than in 2010.

Fish

No fish were seen in the pond in 2010 and 2014, though the absence of any sightings does not mean they are not present. The presence or absence of fish is not always easy to confirm without targeted surveys. The last record for fish (RdA and/or RA) was for 2005 when (introduced) Goldfish were present, apparently in high numbers and very easy to see. Fish are major predators of small animals (invertebrates, amphibian eggs and larvae) and in some cases (e.g. Carp) plants as well. In large numbers fish can also contribute to poor water quality - by enrichment of water through their faeces and causing high rates of suspended material through the continual disturbance of bottom silts.

Wetland Plants

The term wetland plant has been used in order to encompass all damp or water loving plants, i.e. species both in and close to the pond, rather than the more specific term aquatic plant perhaps better used (as it is in this report) to mean species growing on top of or under the water itself.

There are records for a total of 28 wetland plants in or around the margins of the pond for the five years with records from 2005 to 201 inclusive, with the most records (more comprehensive surveys) in the years 2005, 2010 and 2014. The recorded species includes 2 non-native species (Nuttals Waterweed and Parrots Feather), one non-local native (Fringed Water Lily) and 25 local native species. Most of the species are common and widespread.

However, Fringed Water Lily is uncommon – but a species that is often introduced into ponds and quite commonly grown in garden ponds. None of these three species were recorded in 2014. Parrots Feather (probably the worst of these potentially invasive species) was deliberately targeted for removal and is known to have been successfully eradicated. As far as it is known the other two species have not been targeted for removal but are apparently not present currently. Their loss of these three plant species should not be considered a problem for a "natural" pond. The native species Ivy Leaved Duckweed *Lemna trisulca* is apparently uncommon but also under-recorded and probably not as restricted as records would suggest.

In addition to these vascular plants one other good wetland species, the aquatic liverwort *Riccia fluitans* was also recorded. Records for this species would suggest it is not common, but it too is probably under recorded and locally and further afield in the South Chilterns, is known from several ponds (RdA).

Table 2 below shows a simple analysis of the number of wetland plant species recorded each year in the main survey years - 2005, 2010 and 2014. The analysis includes the Liverwort *Riccia fluitans* - but excludes the Rush not recorded to species in 2014. In the other years (2007 and 2012) with incomplete surveys for wetland plants no additional species were recorded. 21 of the 28 species were recorded in two or more years, showing a good continuity of species present and survey effort. There were five unique species in 2010 and 2 unique species in 2014. The 2005 survey revealed no unique wetland plant species.

Table 2 – Number Of Wetland Plants Recorded In 2005, 2010 and 2014

Total Number Of Species: 2005 – 17 Species**; 2010** – 25 Species**; 2014** – 19 Species

Year(s)	Number Species	Comment
Unique in 2005	0	
Unique in 2010	5	Broad Leaved Pondweed, Starwort, Nuttals Waterweed, Jointed Rush, Celery Leaved Buttercup
Unique in 2014	2	Water Figwort, Least Duckweed
Found 2 of 3 Years	7	Including: Non-Native Parrots Feather and Non-Local Native Fringed Water Lily
Found All 3 Years	14	Including range of widespread wetland plant
Total	**28**	**Total slightly less than typical un-impacted pond (30 species)**

The apparently sporadic presence of some of these more common wetland species is of note. For example Common Water Plantain *Alisma plantago-aquatica* was recorded for the first

time in 2014. Celery Leaved Buttercup was first and only recorded in 2010 – perhaps the dominance of tall emergent plants or increased shade levels from trees have contributed to its (possibly temporary?) loss in 2014. The very common water plant Starwort *Callitriche* sp was only recorded in 2010 – if present in 2010 it seems likely it was also present in previous years and in 2014 – even if in small amounts. Two rushes were only recorded in 2010 i.e. Hard Rush *Juncus inflexus* and Jointed Rush *Juncus articulatus*. Perhaps these too were overlooked in 2014 – this year did include small Rushes not recorded to species. One other apparent absence of note in 2014 was Broad Leaved Pondweed – a bottom rooted floating leaved plant. This and the other "missing" species should be looked for in 2015 to see if they are truly absent. If management is undertaken one or more of these species may reappear.

The wetland flora of the pond is dominated by species typical of nutrient rich conditions – reflecting the past (if not current) condition of the pond. As the water quality of the pond improves in terms of both nutrient levels and also pollutants, the type of species present and their relative abundance may change.

In 2014 the in-pond habitats were more as less as in 2010. The deeper part of the pond was dominated by the submerged plant Hornwort, a good native species. The open and sunny western bank was dominated by a stand of tall emergent plants – apparently denser in 2014 than in 2010. The northern, eastern and most of the southern banks of the pond were clothed in and to some extent overhung by trees On the north side of the pond, a few metres out in the deeper water was the interesting habitat of a more or less solid floating mat of taller wetland plants. This kind of structure is not good habitat for most "typical" aquatic invertebrates but can support its own community of wetland species potentially including quality indicators such as Hoverflies and Soldier Flies. Again in 2014 these wetland invertebrates were not sampled as part of the survey. Given the large expanse of open water habitats there is no need to be concerned about the current extent, or indeed a future expansion of this floating mat.

Terrestrial Surrounds

A limited range of typical native open habitat and woodland plant species was found in both the 2010 and 2014 surveys. The 2010 survey was more comprehensive than that in 2014 so any comparison of the flora over the two years is difficult. The impression is that the terrestrial flora has changed little – the overall structure of the wooded parts of the site is apparently little changed or the same.

The results of the 2010 survey suggest the grassland habitats were richer in plant species than its wooded parts. The 2010 report includes a more detailed discussion of the terrestrial surrounds, to which the reader is referred.

The major change in the surrounds between 2010 and 2014 has been the creation of the two roadside gullies, created to act as soak aways for road water off the crossroads. The gully closest to the crossroads takes most of the water, with the southernmost gully apparently being mostly dry. Even after heavy rain the gullies soon drain the road with no water entering

the pond directly. The main gully has an obvious layer of accumulated oil on the surface of the gully, chemicals no longer entering the pond.

Shorty after being dug both gullies were planted with a mix of native local wetland plants. The planting was experimental, with the idea to create an alternative attractive wetland habitat (many of the species were larger and/or more colourful flowering species) which would act as a silt trap and perhaps use up some of the dumped nutrients. 17 species were introduced, with a different mix of species in each gully. A wide diversity of species was introduced to see which species survived the potentially harsh conditions, including high levels of pollutants and (the unknown) how long and how frequently standing water is present in each of the gullies. Some of the species planted were deliberately chosen as they are tolerant to some extent at least to drying out.

Of the 17 species planted 4 or 5 were present in or around the margins of the pond already, 1 was present in the grassland around the pond, 11 had no known records in the pond and 1 species was only recorded for the main pond in 2014. The gullies were surveyed properly in 2013, and 11 of the 18 species were still present. In 2014 no formal survey was carried out so the total of 4 species found is known not to be indicative of the number of species still present (RdA, personal observation). It is not possible to give an accurate assessment of the survival rate of the introduced species from the existing data. (In 2015 a detailed survey should be undertaken to see which species are still present and how well they have established.)

It will be interesting to see if any of the plant species introduced into the gullies, colonise habitats around the existing pond as it seems one species (Water Figwort) may have done so already.

Aquatic Invertebrates

In 2010 the pond was not subject to a full survey but a very good indicative sample was collected and 22 species were identified. In 2014 the pond was the subject of a more thorough sample with a total of 38 species being identified. The latter result is a much better (and more typical) number of species for a mid-succession pond of this size and type. Table 3 below shows a summary of the number of species recorded in either in one or both of the surveys. In 2012 a few species were collected / identified in passing but nowhere near a proper sample collected thus it is only included in passing in the analysis. It should be noted that the density of plants in the pond makes sampling difficult.

Over the two main survey years a total of 50 species were identified, with only a fifth of these being recorded in both surveys. Over half these species (29) were recorded in 2014 only and a quarter of the species only in 2010. The 2010 sample was not necessarily as comprehensive as 2014, but was a good sample and a simple observation over the two years would be an apparent greater abundance of numbers and type of species present in 2014. In 2012 a brief

partial survey identified seven species with three of these species not being recorded in either 2010 or 2014.

Table 3 - Number Of Aquatic Invertebrates Recorded In 2010, 2012 and 2014					
Only Found 2010	**Only Found 2014**	**Found 2010 & 2012**	**2010 & 2014**		**2010, 2012 & 2014**
12 (24%)	29 (58%)	9 (18%)	50 (100%)		53

Table 4 below shows an analysis by family of the aquatic invertebrates present in 2010 and 2014. The total number of species recorded increased from 22 in 2010 to 37 (perhaps 39) in 2014. A near doubling of numbers of species recorded is a notable improvement. Looking at the number of species by family mirrors this improvement with several showing a significant improvement e.g. Bugs increasing from 4 to 7, Beetles 3 to at least 8 and Molluscs from 1 to 7. Flatworms were not recorded at all in 2010 but 2 species were present in 2014. Some families were unchanged e.g. Water Slaters (there is only 1 common species), Shrimps (there are only two common species with often only one present in many ponds) and Worms (not recorded to species). The other feature of the data is that a high percentage of the species present in 2010 were also present in 2014, i.e. there has been an increase in the number of species without major changes in the previous range of species present. The families of Flies present changed over the two surveys, with 3 different families present each year.

The species group that shows an opposite trend are Dragonflies and Damselflies which dropped from 5 to 1 species seen between 2010 and 2014. Two of the species seen in 2010 were vagrant species that breed along / in riverside habitats along the Thames, with three potential resident breeding species. This is of note itself, but even more important is that no *Odonata* nymphs were recorded at all in either year – i.e. adults are present and perhaps try to breed but for reasons unknown fail to do so successfully. (It is also possible that their nymphs have proved difficult to sample given the density of vegetation in the pond but it would have been expected for a small number to be caught.) The displaying adults, if not emerging from Crays Pond, must therefore be flying in from other local ponds. If they are essentially vagrant in nature the number of species and individuals is likely to vary a lot depending on conditions in the source pond (or ponds) and other overall factors such as weather. The apparent lack of breeding suggests there is one or more factor that is still reducing the quality of the pond (water quality or continued presence of fish?) and/or the improvements to the pond are too recent for significant numbers of *Odonata* to be present yet.

Table 4 – Summary Aquatic Invertebrate Records – 2010 and 2014					
Species Group	**Date**	**2010**	**2014**	**2010 & 2014**	**Comment**
	Species	**Number of Species**			
Aquatic Invertebrates	Mollusca	1	7	7	No large species present
Aquatic Invertebrates	Shrimp	1	1	1	Only two common species
Aquatic Invertebrates	Slater	1	1	1	Only one common species
Aquatic Invertebrates	Dragonfly / Damselfly	5	1	5	Adults only both years, no nymphs netted.
Aquatic Invertebrates	True Bugs	4	7	9	Pond Skaters rare
Aquatic Invertebrates	Mayfly	1	1	1	Very common widespread species
Aquatic Invertebrates	Flies	3	3	6	
Aquatic Invertebrates	Water Beetles	3	8 (or 10)	9 (or 11)	Not a high number of species
Aquatic Invertebrates	Caddis	1	2	2 (or 3)	
Aquatic Invertebrates	Flatworm	0	2	2	
Aquatic Invertebrates	Leeches	1	3	4	Includes Fish Leech
Aquatic Invertebrates	True Worms	1	1	1	Not recorded to species
TOTALS	**All Species Groups**	**22**	**37 (or 39)**	**48 (or 51)**	

Assuming the large increase in species between 2010 and 2014 is not only down to the differences in sampling effort (e.g. less time on site) and/or relative catch success (some species not being caught even though normally sufficient effort expended) – then there must be one or more factors making conditions better for invertebrates.

One of the possible factors leading to an increase in the number of aquatic invertebrates in the pond, both in terms of the number of species and/or number of individuals is the reduction in number and/or loss of fish. Fish are top predators and a common feature of fish ponds is a

generally low number of invertebrates with some families (especially Water Beetles and Dragonflies) being more badly impacted than others. Given the size and type of pond at Crays Pond, the number of species of Water Beetles is still not high in 2014, though it is increasing. (As discussed above Dragonflies and Damselflies are not common and apparently do not breed at all.)

The other possible factor influencing the number of species in the pond is water quality. Prior to 2012 the pond received road run off directly from four pipes. The quality of this run-off would have been poor (at least on a seasonal basis), and have a detrimental impact on the water quality in the pond and the number of species it was capable of supporting. In 2012 the road drains were either blocked so that water no longer entered the pond - or drains removed altogether and water simply allowed to soak away into the ground with pollutants such as oils being deposited in the road side swales. The apparent improvement in water quality two years after this work may have created conditions for new species to colonise the pond (especially mobile species such as Beetles and Bugs) and/or species already in the pond to increase in terms of the number of individuals present (hence the apparently large increase in less mobile species such as Molluscs and recording of Flatworms not seen in 2010).

The absence of some of the larger / typical snails (including the Great Pond Snail and/or Wandering Snail) in such a high profile pond species is unusual. (The Great Ramshorn was recorded in 2014, but not in previous years.) The two large snails are frequently present in "public" ponds as a result of either being deliberately or accidentally introduced with plants. They can be intolerant of poor water quality and easy targets for predation. The range of plants present in Crays Pond suggests it has suffered less from plant introductions than many other ponds in similar circumstances, and thus perhaps also fewer accidental or deliberate invertebrate introductions.

Amphibians

The only known amphibian recorded in Crays Pond is the Common Frog. The absence of records for any other species, with not even a single record for even a ubiquitous species such as the Smooth Newt is remarkable. As far as it is known the pond has not been the subject of targeted amphibian surveys e.g. nocturnal torching surveys between late March and mid-June so if present in small numbers they may have been overlooked. However, if newts were present some evidence for them would have been expected given the number of surveys undertaken on the pond. If the pond had in the past and/or was currently a Toad breeding pond they would have been obvious during their migration at least, with some killed on the road. Apparently no such records have been forthcoming.

Even Common Frogs are apparently rare and not present every year. Frogs (either as adult, tadpoles and eggs) were recorded in the surveys of 2005, 2007 and 2014 (RdA). There was no evidence for them in 2010. RdA also holds an earlier 1979 record (source Oxfordshire Biological Records Centre), with again no record for other amphibians for this year.

Factors working against amphibians include poor water quality (discussed above) though unless very bad, poor water quality does not necessarily stop amphibians using ponds. Of equal and perhaps more importance was the presence of fish in the pond (at least until 2005), as they predate eggs and larvae of all species and perhaps deter newts from even using the pond. A busy road on two sides of the pond means there is a high likelihood of adults being killed during migration to the pond from these directions in spring and perhaps newly emerged young being killed later in the year when they disperse. The other habitats beyond the pond (excluding the road) are not necessarily friendly for amphibians (houses and an intensively managed field) providing little in the way of good terrestrial cover when they are not in the pond. There is however safe access from the east and south so this does not fully explain or can it be entirely the cause of the absence of amphibians. The woodland strip on three of the pond banks is sufficient cover for some over-wintering adults – and the rough scrubby area to the east of the pond may also provide additional terrestrial habitat.

It would be useful to undertake surveys for amphibians every year for the next two or three years to confirm or otherwise the number and status of amphibian species present in the pond and any colonisation of the pond by new species as (hopefully) the conditions continue to improve.

Water Birds

The pond, according to the existing records, supports few water birds. The only recorded species is the Moorhen, though it seems unlikely that Mallard at least do not visit occasionally. Water birds have been documented as significant vectors for the movement of aquatic invertebrates and if it is true that Crays Pond is visited infrequently then one mechanism for colonisation may be missing.

Management Issues

Water Quality

The installation of the two roadside gullies and blocking of two other road water drains a major source of road run off with its nutrients and other potential pollutants has been removed. Clean water (or as clean a water as possible in a degraded environment) is very important for all ponds. Road drainage must continue to be intercepted and not allowed to flow directly into the pond again.

Fish

Fish are top predators and if any are still present in the pond then their numbers should be reduced and/or removed altogether to maximise value of the pond for wildlife as a whole.

Any fish have been introduced, and mostly if not entirely will include small non-native species such as Goldfish.

Other Issues

The 2010 survey identified possible issues relating to the balance of habitats in and around the pond which are noted again in this report. The pond edges are on uniformly shaded by trees on three and a bit sides and it is recommended that some work is carried out to open up parts of the bank either on a cyclic or permanent basis. Similarly there is only a small amount of shallow more open water and the creation of more of this habitat, without losing the other good habitats on site is recommended. This work is now more important and worthwhile as the previous main problem for the pond (poor water quality) has been addressed and is now improving. It is important to emphasise the need to maintain the bulk of the habitats on site, adjusting their extent and structure rather than undertaking large scale removal or making other major changes. The results of the survey show that overall the pond is in good condition and apparently improving in quality, in contrast to many of the ponds we survey.

Suggested Management, Surveys and Monitoring

(With reference to Map 1)

Roadside Gullies

Now installed and planted up the roadside gullies should continue to protect the pond from damage without any major work. In the longer run they may silt up and thus need to be dug out on a cyclic basis. Any spoil removed should not be dumped where its leachates can find their way into the pond.

The introduced wetland plants if they become established would provide an attractive and ecologically interesting addition to the plants already growing in the pond. However, there is without management a tendency for the more dominant terrestrial species to dominate the banks and in the drier areas and/or at drier times of year the bottom of the gullies - and potentially outcompete these wetland species. It is suggested the vegetation in the gullies is cut down in it its entirety in the autumn – with as required / opportunity allows selective cutting of ranker competitive terrestrial plants at other times of year (for a period time at least) to allow the wetland species to become well established. All cut material should be picked up and stacked on ongoing habitat piles.

Some of the introduced species not present on site may in time “naturally” colonise the pond and/or its surrounds. As the species introduced into the gullies are all local native species this should not be a problem. A more positive policy to deliberately introduce one or more of the species into the pond could be considered, but not undertaken before the suggested management to the pond (see below) has been undertaken and it is seen what new or recurring species may be stimulated to grow again.

Water Quality

Initial indications are that following the cessation of allowing road run off into the pond the quality of water is improving. It would ideal if a system of regular monitoring was set up, at least once a year (at a similar time to the 2010 and 2014 surveys) or more frequently (e.g. also in winter) to record the type and rate of changes. Fixed locations would need to be used and a methodology agreed e.g. the type of equipment used. A simple field meter could be used (as in 2010 and 2014) or samples collected for off-site analysis at an approved lab (or similar). Very detailed water analysis on an occasional basis (e.g. through the Environment Agency Laboratory) could also be useful. Sample locations could include the roadside swales, bunded inflow ditches and one or more locations in the pond itself.

Species Surveys and/or Monitoring

The following species surveys / monitoring are suggested.

Dragonflies and Damselflies - Given the apparent absence of any species of dragonfly or damselfly in the pond a survey could be undertaken of the species of adult seen in the pond for the next two or three years (i.e. 2015, 2016 and perhaps 2017) including if breeding behaviour is observed some netting surveys to establish if egg laying successfully leads to nymphs being present – as well as searches of pond side plants looking hatching adults and/or empty exuviae as proof of successful emergence.

Amphibians - For the next three years at least (2015 to 217) surveys throughout the spring and summer to identify which species of amphibian are present and their status on site (number of adults, breeding or not). The survey methods could include daytime and nocturnal visual searches and netting surveys for eggs and/or larvae.

Fish - Targeted survey to confirm or otherwise the continued presence of the type and number (if possible) of fish in the pond. If still present devise appropriate plans to control their population and/or remove them entirely from the pond.

Habitat Management

The following suggested management is recommended for selected parts of the pond and its surrounds:

Open Western Bank - In the central open treeless part of the western bank undertake regular yearly rotational cutting to maintain a more diverse structure including shorter vegetation and more open water habitats. In winter 2014 / 2015 cut 75% of the area i.e. the whole of the central part leaving two outer strips as cover. In subsequent years divide the area into four blocks, cutting 2 of these in the autumn (September / October), alternating the blocks cut

each year. To “protect” the shallows from too much disturbance and provide an area of permanent cover leave a fringe of taller plants c. 1 metre wide parallel with the bank of the pond above the managed zone (this zone being cut on an occasional basis only).

Weeping Willow on Western Bank – This mature non-native standard tree is a dominant landscape feature of the site, which casts high level of shade over the adjacent section of pond. The best management of the tree in an ecological sense would be to reduce this level of shade by either pollarding the tree or felling it. The prominence of the tree means decisions about its future need to be made for more than one reason and hence no firm suggestion is made in this report. If felling was an acceptable option it is suggested it could be replaced with a smaller less dominant native species, for example Rowan.

Willows on Western Bank – The mature Willows towards the north of the western bank should be coppiced more or less in their entirety (leaving a small number of short stems) in the winter of 2014 / 2015 and subsequently manage the trees by rotational cutting (perhaps on a three or four year cycle) in the autumn / winter. All cut material to be stacked on site on ongoing habitat piles.

Trees on Northern Bank – Review the number and type of trees and if required carry out some very light clearing including coppicing shrubs and/or clearing overhanging branches including over the main stand of Sedge located approximately half way along the bank, to increase the light levels for this plant. The management of this bank should be very light, sufficient to maintain it as open woodland. All cut material to be stacked on site on ongoing habitat piles.

Eastern Bank - There is scope to create a more varied structure on this side of the pond, including 3 management zones.
Zone 1: Clear on a permanent basis clear 3 pond side bays covering c. two thirds of the length of the bank on this side of the pond. These bays to be created in winter 2014 / 2015. Subsequently manage these bays as open habitats with no scrub.
Zone 2: Divide the next zone including the fingers of scrub between the open pond side bays into four units and manage these blocks on rotation cutting on a four year cycle. This clearing work to be started in winter 2014 / 2015 or 2015/2016 depending on available resources.
Zone 3: Retain a strip of dense unmanaged wood including under storey and canopy trees along the boundary of the site (this habitat also extending along the outer margin of the southern bank).
All cut material to be stacked on site on ongoing habitat piles.

Southern Bank – The management of this bank should continue the current regime i.e. maintaining a partially open strip adjacent to the pond and a dense continuous unmanaged woodland strip along the boundary of the site (see above). It is suggested that in any one year no more than 20% of the near pond trees / scrub are managed in any one year. All cut material to be stacked on site on ongoing habitat piles.

Potential Problem Plant Species

Continue to watch for potentially problematic plants in the pond. These include Parrots Feather (non-native eradicated in c. 2010), Nuttals Water Weed (not seen in 2014) and the native but not local Fringed Water Lily (also not seen in 2014). If these or other problem species are seen they should either be removed immediately or plans made to do so as soon as possible.

Appendices 1 and 2 – Survey Results

Provided as Excel spreadsheet, attached separately to main text report.

Appendix 1- All Survey Results, 2005, 2007, 2010, 2012 and 2014.

Appendix 2 - Summary Table For Surveys, 2005 to 2014

Note: The Freshwater Habitats Trust (formerly Pond Conservation) may hold earlier data for Crays Pond. It would be interesting to compare the results of their survey(s) against the more recent and current data.

Appendix 3 – General Pond Ecology

This brief document is included to provide background information about the ecology of ponds following relatively recent research into ponds, the findings of this research still being not generally known. Much of the traditional perceived truths about ponds are in fact gross simplifications and in many instances if followed would be damaging to the ecological value of ponds.

General Pond Ecology

To ensure that this report, including any specific management recommendations are clearly understood it is useful to provide summary information about the general ecology of ponds. Major advances have been made in the understanding of pond ecology in recent years (research by Pond Conservation) and much of the traditional perceived wisdom about what makes a good pond and how ponds should be managed has been shown to be at best simplistic and at worst potentially damaging for their ecological value.

The definition of a pond is a natural or artificial more or less still water body up to two hectares (c. five acres) in area that holds water for four months of the year or more. Ponds may have well defined in and/or out flows, with moving water at these location but more or less still water for the main part of the water body. Larger water bodies (one generic term being Lakes) are often deeper with significant wave action and thus erosion of the shores. This definition means there are in fact many more ponds worthy of study and conservation than most people would realise.

The traditional view of a good pond for wildlife is often a permanent water body with deep water and some but not too many water plants (i.e. plenty of open water), perhaps a narrow fringe of taller water plants around its edge and some but not too much shade from trees i.e. relatively few trees stopping the sun reaching most of the water. Ducks (or other kinds of water birds) and/or fish if not pre-requisites are often seen to be desirable features. The pond surrounds are usually managed to some extent at least, if not actually kept "tidy" in a formal manner.

In reality this is only one type of pond – in this case the model for the most useful functional pond that supplied people with many of our domestic, agricultural or industrial needs. Ecological research has shown that in reality all ponds can be good for wildlife, however small or large, permanent or temporary, shallow or deep, shady or sunny, whatever the quantity or type of silts or pond bottom substrate. Habitats in ponds that would in the past have automatically been condemned, such as dead wood or sprawling living trees are potentially good features - as too are areas that dry out. All of these habitats can support different, sometimes specialist or rare species. Under the right conditions the classic pond much favoured by man, as described above, can support a high number of animal and plant species. It is the many non-"standard" ponds (including early and/or late succession ponds) that are more likely to support the rare, unusual or specialist species.
The three main factors that control the ecological quality and potential species richness of a pond are as follows:

- clean (i.e. unpolluted) water - the volume and regularity of supply is less critical
- good (i.e. wildlife friendly) surrounds which provide both supporting or complementary habitats in their own right as well as buffering the pond from any damaging external influences
- variety of structure or habitat within the pond, produced by presence of different plants, variable basin shape and depth, bottom substrate, water chemistry, quantity and type of silt, density of shade or light levels etc.

Thus many ponds that do not fit the "traditional" image of a good pond are in fact potentially very good for wildlife, and their existing ecological value would be destroyed if they were managed according to the traditional model. Many traditional ponds will in fact never achieve their maximum ecological potential. Typically for functional reasons the volume and permanence of water is often more important than its quality and the most "useful" ponds are often situated in less wildlife friendly landscapes and/or they have a very simple (but very functional) structure.

A fourth factor that may influence the number of species in a pond is:

- its proximity to other wetland habitats with an existing wetland fauna and flora

However, ponds don't need to be near other ponds or aquatic habitats to be good wildlife sites and species richness alone is not the only useful or valid measure of ecological quality.

The other key research finding about ponds is that on a wider scale (i.e. not individual ponds but the whole range of ponds in any given landscape area) ponds support more species of plant and macro-invertebrate (two of the better studied groups of aquatic life) than other freshwater habitats i.e. rivers, streams, lakes and ditches. Ponds also support up to twice as many rare or uncommon species of these two species groups than other freshwater habitats - with these rare or uncommon species being much more likely to be found in early or late succession ponds. The large number of species found in ponds is perhaps not too surprising as ponds are extremely variable habitats (every pond is different) and many are small stand-alone habitats often benefiting from cleaner water than larger freshwater habitats.

Overall, the larger freshwater habitats such as rivers, streams, lakes and ditches tend to have less complexity of habitats and/or being either large or continuous provide fewer opportunities for specialist species or species with low tolerance of competition. Being continuous and well-connected habitats with much bigger water catchments, they are very likely to suffer from poor water quality as a result of polluting land management activities within their catchment area. Ponds however often have small self-contained catchments, which are or could more easily be relatively immune from outside negative problems such as chemicals or other problems associated with run off or drainage from intensively managed or polluted land.

The only way to tell if a pond is good for wildlife, or not, is to carry out surveys, with particular species groups being best surveyed for at particular times of year and/or by particular methods. It is not usually possible to tell just by the "look" of the pond, based on its relative fit to the traditional model of the best pond.