The River Thame Catchment:

Identifying Important Freshwater Areas

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The work was funded by Thames Water through their Community Investment Fund.

Photo on cover: A bird's eye view of the newly created wetland at Eythrope (©Waddesdon Estate)

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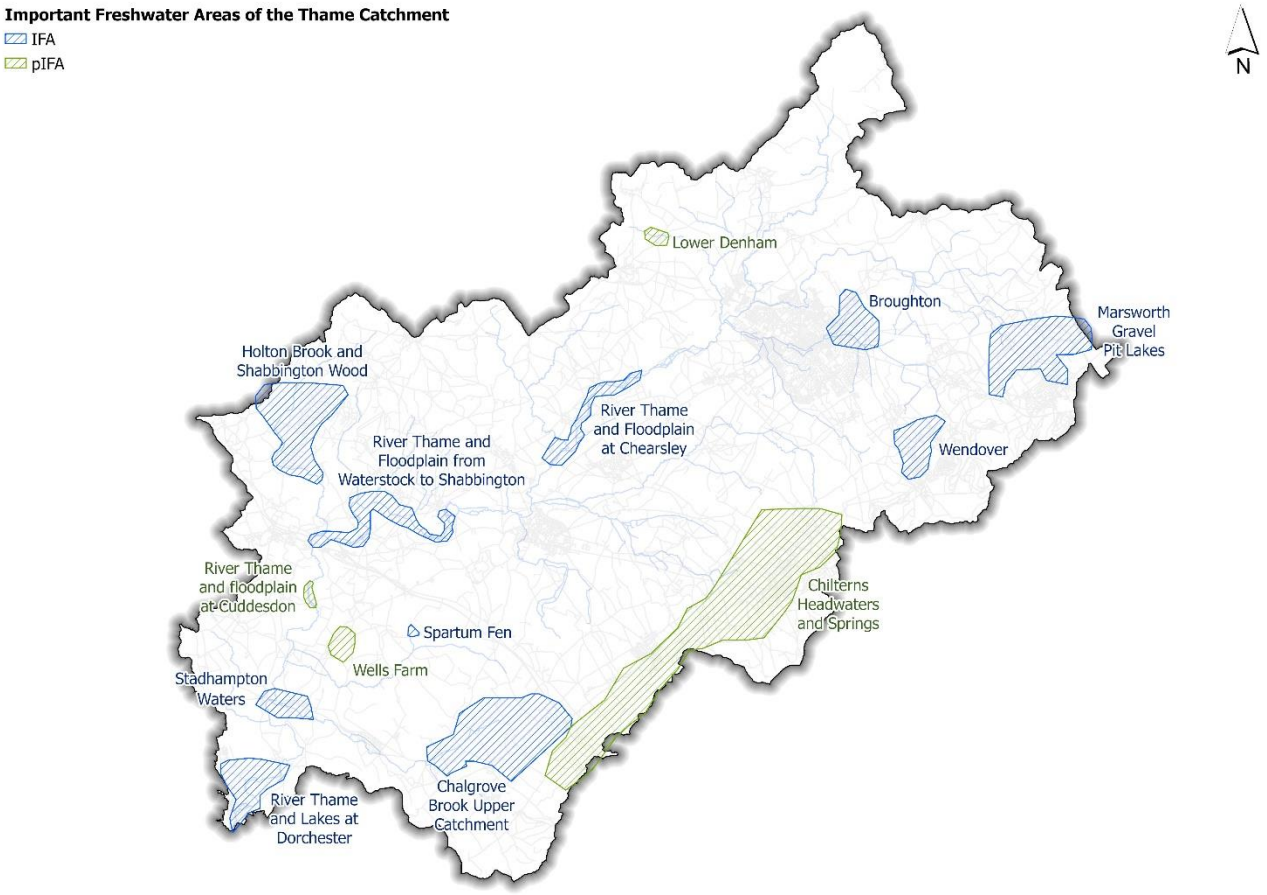
Summary

This report describes the results of the first **Important Freshwater Areas analysis** for the River Thame Catchment, to support the development of practical habitat creation and management projects to enhance and restore freshwater wildlife in the catchment.

Important Freshwater Areas are locations of regional or national importance for freshwater biodiversity typically comprising groups of important freshwater habitats or wetlands, or areas with significant concentrations of freshwater Species of Conservation Concern (SOCC). The IFA analysis method can be applied at any geographical scale. In this report, we present a **catchment-scale IFA analysis**.

Specifically, within the River Thame Catchment, 10 areas were identified as Important Freshwater Areas at the catchment-scale (these are called 'catchment IFAs') comprising the River Thame and its floodplain, semi-natural woodland with clean water ponds, gravel pit lakes, chalk streams and fen. The **River Thame Catchment IFAs** identified are shown in the map below.



River Thame Catchment Important Freshwater Areas (IFAs) and potential Important Freshwater Areas (pIFAs)

In addition, four potential catchment IFAs (pIFAs) were identified, which require further investigation. **Birds of conservation concern** data collected by BTO volunteers was also analysed and, in line with the results of the IFA analysis, again shows the importance of the River Thame floodplain for wildlife.

From the IFA analysis presented in this report, results of previous projects and local knowledge, we know that the River Thame Catchment is relatively depleted in freshwater biodiversity compared to its neighbouring River Ock and Ray catchments, and there are few remaining areas of semi-natural habitat

(e.g. woodland, unimproved grassland etc). This is due to a wide range of stressors, including water pollution and intensive current and historic land use.

However, on a more positive note, there are **excellent opportunities** to restore freshwater habitats and their associated wildlife throughout the catchment, in particular along much of the length of the River Thame on the floodplain corridor (see just two examples below). The wide floodplain, of low value for farming because of flooding, and the critical support of many large and small landowners along the river corridor, are both key elements to support the development of successful restoration projects.

Based on the analysis, recommendations were made to improve freshwater biodiversity in the catchment, focusing on creating new clean water habitats and floodplain mosaics, and increasing knowledge of populations of SOCC. Species reintroduction should be considered at newly created or managed sites to restore catchment diversity and increase the resilience of existing SOCC populations in the catchment.

Scrapes creation using a rotary ditcher in the Waterstock IFA in 2019 has extended the feeding habitat of the nationally-declining Curlew. At that site, a fish refuge, a pond directly connected to the river, was also created in 2019, further enhancing the range of freshwater habitats at the site.

The Eythrope wetland complex, which was dug during 2018 and 2019, and is the first of its kind in the catchment. This wetland mosaic now provides c. 1 hectare of new habitat for wetland birds, otter, amphibians, aquatic plants and invertebrates. A large backwater was also created to provide nursery area for river fish and increase the resilience of fish populations to river pollution incidents.

1. Introduction

1.1 The Important Freshwater Area (IFA) concept

The Important Freshwater Area (IFA) concept underpins action to protect freshwater biodiversity and develop projects to best protect, restore and improve connectivity for freshwater. It has been developed by Freshwater Habitats Trust, working with national freshwater species and habitats experts, major land-owning and managing organisations and statutory bodies.

At the heart of the concept is the key principle that, to stem the decline in freshwater biodiversity and prevent further extinctions of freshwater species, both regionally and nationally, it is essential that we protect the remaining high-quality areas, the Important Freshwater Areas (IFAs), and strategically restore and create new high quality habitats to extend these areas, and so improve connectivity and resilience. Thus, the IFA analysis provides a basis for targeting the development of practical conservation projects, informed by the concept of natural ecosystem function.

Identification of the Important Freshwater Areas requires the collection, collation and analysis of data of both species and habitats of importance. The IFA are then identified against a set of criteria and depending on the data available, considerable expert knowledge.

At the River Thame Catchment level, the IFA identification process is a working tool to identify areas which are clearly of high importance (IFAs), and those areas which are likely to require further investigations (potential IFAs). Thus, the tool has the purpose of focusing effort on protecting and building out from existing hotspots and encouraging further biological and other investigations to address gaps.

For further information about the IFA concept and analysis, and reports for other regions of the UK, see here: freshwaterhabitats.org.uk/research/important-freshwater-areas.

1.2 The River Thame Catchment

The River Thame Catchment straddles Oxfordshire and Buckinghamshire, and also include a small area of Hertfordshire (Figure 1). It has a typical landscape for lowland England, with large areas of intensively-managed arable land and pasture, and settlements dotted throughout. Aylesbury is the largest town, sitting in the upper reaches of the River Thame.

The catchment has very few remaining areas of semi-natural habitat, and generally waterbodies suffer from poor water quality[1] due to surrounding intensive agricultural land use, urban run-off and sewage outfalls. Good water quality is key to sustain healthy populations of freshwater plants and animals. However, the catchment, with its extensive floodplain and many sympathetic landowners, offers many opportunities for habitat creation and restoration. Recent surveys and farm walkovers have revealed little known areas of good habitats as well as populations of uncommon species, changing the perception of the area from a wildlife perspective. There is still much to discover.

[1] Water pollution include road and agricultural run off and effluents from sewage treatment work. High level of nutrient pollution (nitrate and phosphate) was reported in the River Thame Conservation Trust's Water Quest, see here: https://riverthame.org/our-projects/clean-water-quest/

For further information about the River Thame Catchment and the Catchment-based Approach (CaBA) partnership, which is jointly coordinated by Freshwater Habitats Trust and River Thame Conservation Trust, see here: https://riverthame.org/thame-partnership/

Figure 1. The River Thame Catchment, and its location in the River Thames Catchment (inset).

1.3 Objectives of IFA mapping in the Thame Catchment

The objectives of the Important Freshwater Areas (IFA) analysis for the Thame Catchment are to:

- develop a better understanding of where high-quality habitat and species of conservation concern are located and support their protection.
- support a focused approach to developing practical restoration and conservation works in the catchment, including all waterbody types, so helping to prioritise work to maximise benefits for freshwater biodiversity.
- identify data gaps and priorities for the surveying and monitoring of freshwater biodiversity in the Thame Catchment, to inform practical work.

This is the first IFA analysis for the catchment and it should be revised when new information becomes available on species or habitats, and in consultation with stakeholders.

2 Method

2.1 Overview

The steps involved in identifying the locations of high priority areas for protecting freshwater biodiversity are as follows (see following sections for further information):

1. Collect available biological, physico-chemical and geographical data.
2. Collate and verify the datasets.
3. Analyse/map data to identify sites/areas that are of high value for their freshwater species and habitats (IFAs).
4. Prioritise sites according to constraints and opportunities, and develop practical plans to protect, build out, and improve connectivity between these areas.
5. Consult widely and engage with local groups before developing projects in these locations.

This document reports on steps 1-3, pending consultation with stakeholders.

2.2 The data

Data to support the identification of Important Freshwater Areas comes from a variety of sources including:

- **Species data:** Data for Species of Conservation Concern (SOCC), i.e. over 1,000 species which have conservation status of Nationally Scarce and above on national lists, as well as IUCN status lists. Indicator and regionally important species can also be included. The data used are 'recent', i.e. from 1988-2017.
- **Habitat and site data:** This includes, depending on what is available for a particular area, the location of habitats of principal importance (i.e. Priority habitats), clean water sites, Water Framework Directive sites with specific biological quality elements at High status and designated sites (e.g. SSSIs, SACs) of importance for freshwater.
- **Landscape, land-use and geology data:** Including the extent of floodplain, semi-natural land-uses like woodland and unimproved grassland.

2.3 Data sources

Relevant data is now open access and published by government departments, agencies, public bodies and local authorities (see data.gov.uk). Water Framework Directive data is available from the Catchment Data Explorer (environment.data.gov.uk/catchment-planning).

Species data can be obtained from the following, often complementary sources:

- National Biodiversity Network (NBN)

- Local record centres: for the River Thame Catchment analysis, we obtained data on SOCC from Thames Valley Record Centre (TVERC) and Buckinghamshire and Milton Keynes Environmental Record Centre (BMERC)
- Botanical Society of Britain and Ireland (BSBI)
- National specialist recording groups
- Local expert recorders and organisations

2.4 Key datasets

2.4.1 Species of Conservation Concern (SOCC)

Freshwater plant and animal Species of Conservation Concern (SOCC) are those which are either rare or declining according to national or international legislation, and species status lists including:

- The International Union for Conservation of Nature (IUCN)
- National Red lists, which are increasingly standardised on IUCN-type criteria.
- Species of principal importance are those listed in the Natural Environment and Rural Communities (NERC) Act 2006. These species are also commonly called Priority species. The English list includes 943 species of principle importance, and about 10% of these are aquatic or associated with freshwaters.
- Species requiring special protection are also listed in schedules of the Wildlife and Countryside Act (WCA) 1981 and in Annexes of the Habitats Directive.

The Joint Nature Conservation Committee provides definitions for the various conservation designations (http://jncc.defra.gov.uk/page-3425) and collates the various conservation designations for species of conservation concern and keeps an up to date spreadsheet which is available on their website (http://jncc.defra.gov.uk/page-3408).

For the Important Freshwater Areas analysis, a list of Species of Conservation Concerns (SOCC) was drawn up, including aquatic or 'wet' species and those which are dependent on an aquatic species (e.g. the Frogbit Smut). In total, the current Important Freshwater Areas list of Species of Conservation Concern includes 346 plant, 593 invertebrate and 28 vertebrate species (Table 1) and this is the list that was used for the River Thame Catchment analysis. The list was developed in discussion with species experts during the first consultation stages of the Important Freshwater Areas project and is available from Freshwater Habitats Trust on request.

Groups which are still to be added include fungi, algae and aquatic micro-invertebrates. The data available for these groups is relatively scarce or difficult to access, or their conservation status is unclear, although progress is ongoing.

Table 1. Summary of the national list of Species of Conservation Concern used to identify IFAs

Taxonomic group	Number of Species of Conservation concern
Invertebrates: water and semi-aquatic beetles	275
Plants: flowering plants	205
Plants: mosses, liverworts, ferns, quillworts, horsetails	129
Invertebrates: true flies	125
Invertebrates: caddis flies	75
Invertebrates: mayflies and stoneflies	29
Invertebrates: true bug	27
Invertebrates: dragonflies and damselflies	24
Invertebrates: molluscs	22
Vertebrates: fish	20
Invertebrates: crustaceans, spiders, lacewings, alderflies, anemones, bryozoans, leeches, worms	16
Lichens	12
Vertebrates: amphibians and reptiles	5
Vertebrates: mammals	3

2.4.2 Indicator and other species

In addition, a small selection of species which are not of conservation concern are also included in the SOCC data because they are indicators of particularly rare or sensitive to good water quality. This list includes:

- Stoneworts - because they are indicator of a Habitat Directive Annex I habitat type[2] and clean water habitats.
- Indicator species of Exposed Riverine Sediments[3].
- Water shrews - because they are very vulnerable to pollutants (including pesticides), drainage schemes and bank clearance. The level threats for this species is currently uncertain because they are never very abundant and therefore difficult to monitor[4].

Regional designations can also be included, e.g. regionally important dragonfly species as defined by the British Dragonfly Society[5].

2.4.3 Habitats of principal importance (Priority Habitats)

Habitats of principal importance are those that have been identified as needing special protection nationally and are commonly referred to as Priority Habitats. These habitats are designated as priority for

[2] Habitat Directive 3140: Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp.
[3] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/290577/sw1-034-tr-e-e.pdf#
[4] http://www.mammal.org.uk/species-hub/full-species-hub/full-species-hub-list/species-water-shrew/
[5] https://british-dragonflies.org.uk/areas/united-kingdom/england/thames-valley-and-buckinghamshire/

conservation nationally because they either support high value species and biological communities or they have declined in extent or quality.

Each country in the UK now has its own list of habitats of principle importance. In England, habitats of principle importance are listed on Section 41 of the Natural Environment and Rural Communities (NERC) Act 2006 (England). Those habitats of principal importance relevant to freshwaters and wetlands which were included in the Important Freshwater Areas analysis described in this report are listed in Table 2 below.

Table 2. Freshwater and wetland habitats of principal importance

Habitat name	Descriptions
Rivers	A wide range of river types are included, encompassing all natural and near-natural running waters in the UK. This habitat type includes headwater streams, chalk streams, active shingle rivers and streams, and rivers with high hydromorphological or ecological status.
Eutrophic standing waters	Naturally nutrient-rich waterbodies typically found in lowland England including natural lakes, reservoirs and gravel-pit lakes but excluding small standing waters like field ponds. Often degraded by nutrient enrichment.
Mesotrophic lakes	Relatively infrequent in the UK, these lakes have medium levels of nutrients. They are largely confined to the margins of upland areas in the north and west. Mesotrophic lakes are extremely important for a suite of rare aquatic plants and fish.
Oligotrophic and dystrophic lakes	These low nutrient lakes usually have catchments on hard, acid rocks and are found mostly but not exclusively in the uplands. They support relatively sparse plant communities dominated by specialist plants like shoreweed.
Ponds	This habitat type covers High Quality Ponds defined according to a set of biological criteria, estimated to represent about 20% of the total pond resource. Priority ponds are often 'nested' within other habitat types, including grassland, heathland, woodland, wetlands, sand dune systems and floodplain mosaics.
Blanket bog	Blanket bogs are peatland habitats which are exclusively rain-fed. They are extensive primarily in the uplands and in western England but can in other upland areas where conditions are cool and wet.
Lowland raised bog	Peatland ecosystems in areas such as the heads of estuaries, along river floodplains or in natural depressions where waterlogging leads to the accumulation of peat, eventually forming a dome above the groundwater level which are fed primarily by rain water. In England mainly but not exclusively found in the north-west.
Coastal and floodplain grazing marsh	Grazing marshes are periodically inundated grassland with a network of ditches which are often rich in plants and animals depending on clean water and have a long history as wetland habitats. Grazing marshes are particularly important for wetland birds. This Priority habitat was recently reviewed and is now called 'Floodplain Wetland Mosaic'.
Lowland fens	Fens are peatlands which receive water and nutrients from the soil, rock and ground water as well as from rainfall. Species-rich fens can support very diverse communities of plant and animals. Larger fen sites are largely confined to the East of England, but smaller fens occur throughout the country.
Upland flushes, fens and swamps	Fens located on peat or mineral-based substrate in upland situations, which receive water and nutrients from surface and/or groundwater sources as well as rainfall. This habitat type is widespread but local and often occurs in small patches as part of upland wetland mosaics.

Habitat name	Descriptions
Reedbeds	Reedbeds are wetlands dominated by stands of the common reed *Phragmites australis.* They often occur as part of a mosaic of habitats including fen, wet woodland and wet grassland. Reedbeds tend to support species poor plant and invertebrate communities but are one of the most important habitats for birds in the UK.
Purple Moor Grass and Rush Pastures	Pastures defined by their plant community - purple moor grass and rushes - which often occur in a mosaic with other habitat types like wet heath, grassland and wetlands. Most commonly, but not exclusively, found on acid soils in lowland areas of south-western England.
Wet woodland	A relatively broad woodland type which occurs on poorly drained or seasonally-wet soils usually, but not exclusively, with alder, birch and willow. Often found as part of a mosaic of other woodland or wetland habitats, e.g. in fens or on floodplains.
Aquifer-fed naturally fluctuating water bodies	In England, this habitat type is only relevant to the meres of Norfolk which occur over chalk in Breckland and have extreme fluctuations in water level, including periods of drying out.

2.4.4 Water Framework Directive 'high' ecological status

Water Framework Directive assessment classifies waterbodies according to the ecological health of their biological communities and physico-chemical characteristics into five categories: High, Good, Moderate, Poor and Bad. The overall ecological status is established using a 'one out, all out' policy. For example if a waterbody has High status for its macroinvertebrate community but Moderate status for macrophytes (plants), its overall status will be Moderate.

Water Framework Directive 'High status' can be defined as the biological, chemical and morphological conditions associated with no or very low human pressure. There are very few rivers and only one lake classified as 'High' status in England. However, the various biological and physico-chemical elements used to give an overall WFD status can be reviewed individually including fish, macroinvertebrates, plants (macrophytes and some groups of algae), water quality and hydrogeomorphology. Sites which are 'High' status for an individual element (e.g. fish and invertebrates) are, by definition, as good as they can get for that element. Inherently these are sites of high conservation interest which require protection.

Water Framework Directive data is available for a selection of waterbodies in most landscapes: essentially rivers, larger streams and lakes, and those small water bodies that are specifically cited in European protected areas (i.e. Special Areas for Conservation), of which there are none in the River Thame Catchment. It should also be noted that there are usually one or just a few monitoring points in each of the waterbodies monitored, usually in the lower reaches, and so WFD assessment does not necessarily reflect the quality of the headwaters.

2.5 Criteria for identifying Important Freshwater Areas

The identification of IFAs is based on a set of criteria based on species and habitats. As species data for the River Thame Catchment was relatively poor, with relatively few recent records, and the density of Priority or water-dependent designated habitats was relatively low, so potential IFAs (pIFAs) were also identified. These areas do not currently meet the criteria to be an IFA but should be a priority for future

surveys or landowner engagement. Knowledge of the freshwaters and the catchment generally was important in interpreting the analysis, again due to the reasons listed above.

The IFA analysis distinguishes between SOCC with a restricted national distribution (e.g. Marsh Stitchwort), and those which are still relatively widespread but are included on priority and red lists because of widespread declines (e.g. *Bullhead*). The conservation of restricted species is a high priority in order to prevent local extinctions and maintain the species pool at catchment scale.

To be considered as an Important Freshwater Area, a location must meet criteria according to Table 3, at the scale at which the analysis takes place (i.e. here at river catchment scale).

Table 3. IFA criteria

Criteria	Sub-criteria	Comment
Water-dependent designated site	None	Water-dependent nationally designated sites are automatically IFAs
	AND/OR	
Species	Diversity hotspot (number of SOCC in a 1km square) Presence of a restricted SOCC	Both sub-criteria need to be met
	AND	
	(i.e. both species and habitat criteria must be met)	
Habitat	WFD High biological element Priority Habitat High concentration of clean water sites	At least one of these criteria must be met The extent and density of clean can sometimes be used as a proxy for species data
	OR	
Other, for data deficient areas	Site proposed by expert knowledge, or that qualify because of another reason (e.g. the last remaining population for a particular species, or a high quality habitat not officially recognised as Priority habitat).	

3 The Important Freshwater Areas of the Thame Catchment

3.1 Waterbodies

The River Thame Catchment includes the main river, which is fed by 22 main tributary streams, in turn fed by a multitude of smaller streams and headwaters (Figure 2). These small running waters have been compared to the 'capillaries' of the human blood circulation system[6], and although often dismissed because of their small size, they are critical for biodiversity and influence the characteristics and quality of the main river. The catchment also contains a multitude of ponds but few large areas of standing waters, except for several large reservoirs and gravel pit lakes.

Note also that many of the smaller waters, like small or temporary ponds, headwaters, small fens, flushes and springs are often not well mapped, at any geographical scale. These habitats, particularly when undegraded, can support very diverse and/or unique communities compared to larger waters, and contribute significantly to catchment species diversity. In the River Thame Catchment, this is particularly relevant to the Chiltern escarpment and the few remaining areas of semi-natural land use, e.g. unimproved floodplain grassland and woodland.

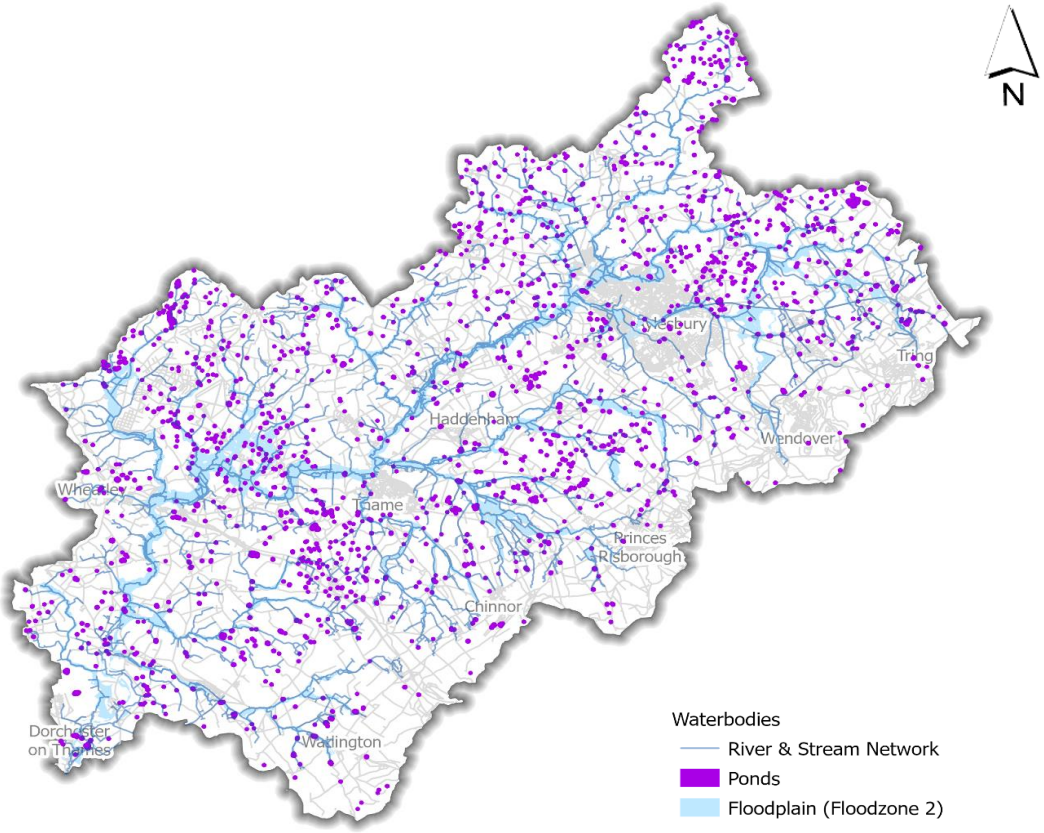


Figure 2. Running and standing water network across the River Thame Catchment. Pond size has been accentuated to make them visible at this scale. Location information on remnant fens, springs and flushes was not available at the time of data collation.

[6] https://freshwaterhabitats.org.uk/wp-content/uploads/2014/11/SWB-workshop-report_final.pdf

3.2 Statutory and non-statutory sites designations

The River Thame Catchment has very few statutory designated sites (Figure 3), reflecting the intensive land use and small extent of semi-natural habitats like woodland and floodplain wetland. The majority of statutory designated sites are situated along the Chiltern's escarpment and have been designated due to their woodland habitat and species. Four of the catchment's 36 SSSI are noted for their freshwater or water-dependent habitats or species: Spartum Fen, Tring Reservoirs, Weston Turville Reservoir and Rushbeds Wood & Railway Cutting. However, sites not designated for their freshwaters can also provide a habitat for freshwater species of conservation concern. Shabbingdon Wood SSSI is a key example of this. Although designated for rare butterflies and woodland habitat, it contains many high-quality ponds which support populations of Great Crested Newt and Common Toad, and some of the only clean water streams in the catchment[7].

There are a small number of county or local wildlife sites[8] in the catchment, including the floodplain at Waterstock and the Dorchester gravel pits, both of which are particularly relevant for freshwaters (not mapped). In addition, there are several small nature reserves. These sites do not receive nationally designated protection but are managed sympathetically for wildlife.

Along the South East boundary of the catchment runs the Chiltern Hills, an Area of Outstanding Natural Beauty. Although this designation protects the natural beauty of the landscape rather than specifically wildlife, the Chiltern AONB has a range of projects aimed at improving biodiversity.

Conservation Target Areas (CTAs[9], Oxfordshire) and Biodiversity Opportunity Areas (BOAs[10], Buckinghamshire), and Hertfordshire Ecological Network[11] maps are also available and do cover some of the catchment. Although useful, these do not specifically refer to freshwaters and are very broad. A draft Nature Recovery Network (NRN) map was recently published by TVERC[12]. The Oxfordshire NRN includes the Oxfordshire County IFA map, which covers the Waterstock area in the River Thame Catchment. Buckinghamshire is one of the 'official' national pilot areas but the NRN map has not yet been published.

3.3 Land ownership

Most of the land in the catchment is privately owned and includes several large estates. Forestry England owns areas of woodland in the North West and South East of the catchment, which are working forests also managed for wildlife and amenity. The floodplain between Chearsley and Cuddesdon is an RSPB's Futurescape area, because it supports regionally important waders including Curlew and Lapwing (Figure 4).

Currently, most of the catchment is intensively managed for agriculture, with few areas in conservation management. There is however much recent interest amongst both farmers and landowners in improving catchment biodiversity, including on larger estates. A few sites are owned by NGOs including

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[7] https://riverthame.org/our-projects/clean-water-quest/

[8] Local wildlife site GIS layers are not readily available online, see here for Buckinghamshire: https://en.wikipedia.org/wiki/List_of_local_nature_reserves_in_Buckinghamshire and here for Oxfordshire: http://www.tverc.org/cms/sites/tverc/files/South%20Oxon%20Living%20List%202019.pdf

[9] https://www.wildoxfordshire.org.uk/wp-content/uploads/2013/08/Oxfordshire_CTAs_WFD-Catchments-2015.pdf

[10] https://bucksmknep.co.uk/biodiversity-opportunity-areas-map/?location=Chiltern

[11] https://www.hertswildlifetrust.org.uk/sites/default/files/2018-07/Hertfordshire%27s%20ecological%20networks%20report%20-%20Final%20Aug%202014.pdf

[12] https://www.wildoxfordshire.org.uk/biodiversity/oxfordshires-nature-recovery-network/

the Beds, Bucks and Oxon Wildlife Trust (BBOWT) and the National Trust. BBOWT's largest reserve is College Lake on the eastern edge of the catchment.

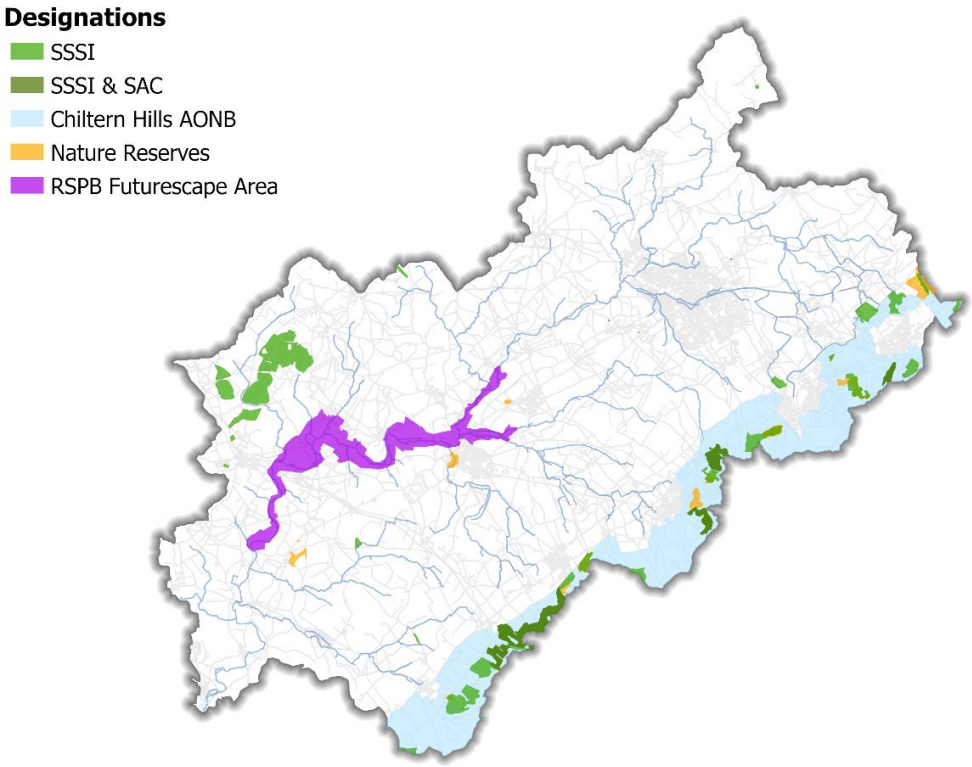


Figure 3. Nationally designated sites and nature reserves in the River Thame Catchment. SSSI, SACs and AONB are designated and protected by law. Nature reserves may not be afforded the same protection, unless they have statutory designations.

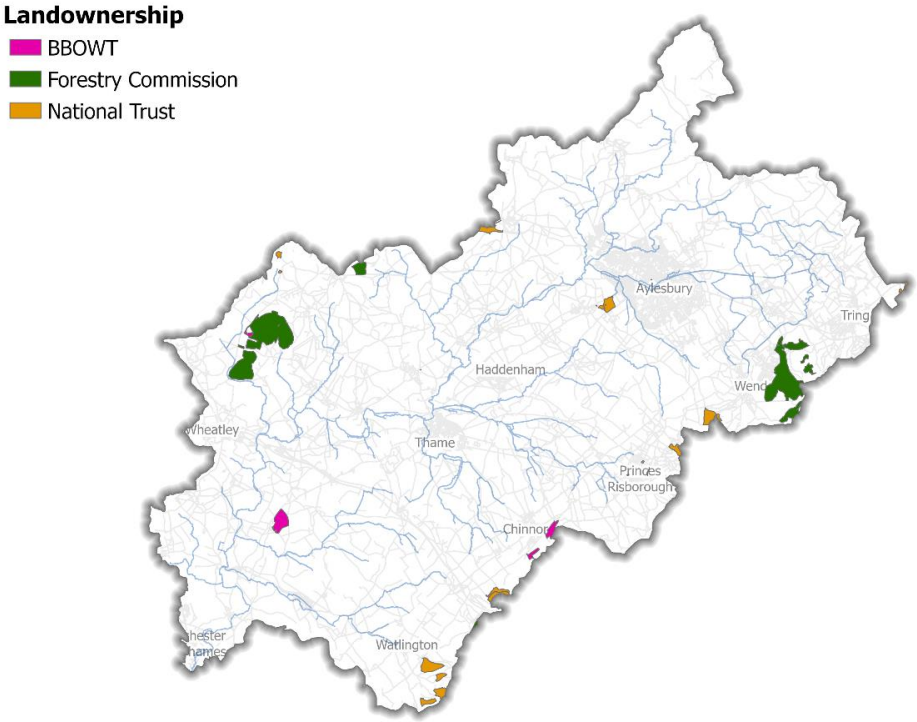


Figure 4. Key land ownership for nature conservation in the River Thame catchment.

3.4 Water Framework Directive classification High status sites

None of the 19 WFD waterbodies in the Thame Catchment (streams and River Thame only) are classified as 'High' or 'Good' for their overall ecological quality. Looking at the individual biological elements of WFD assessment and classification (Figure 5), there are three WFD waterbodies with 'High' status for invertebrates, and one waterbody with 'High' status for fish, but none for aquatic or wetland plants (macrophytes or algae).

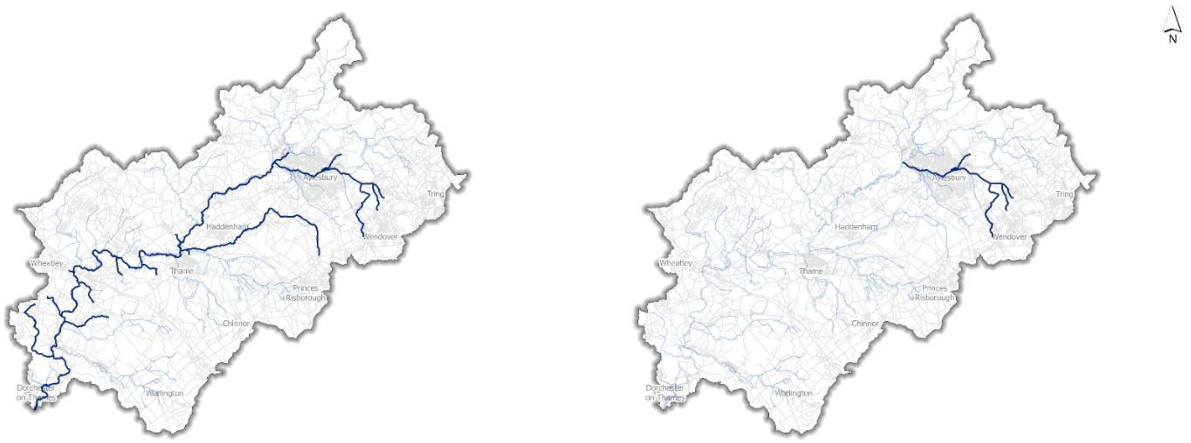


Figure 5. 'High' Water Framework Directive status for freshwater invertebrates (left) and for fish (right). Four WFD waterbodies reach high status for invertebrates and one WFD waterbody reaches high status for fish.

3.5 Habitats of Principal Importance (Priority habitats)

The Priority habitat data consists mostly of the nationally mapped dataset. Inevitably, relatively large-scale mapping tends to exclude small freshwater habitats, like flushes and springs. There are also inaccuracies - for example, Spartum Fen SSSI is mapped as woodland – but the national dataset gives a good overall view of the likely extent of high quality habitat.

The Chilterns AONB is currently leading on a project to identify and manage some headwater streams, Water in a Dry Landscape, which should improve our understanding of headwaters on the Chiltern escarpment.

Based on available information, water-dependent Priority habitats in the River Thame Catchment include (Figure 6):

- **Chalk streams:** Lewknor Brook, Horsenden Stream, Chalgrove Brook . It is likely that other streams on the Chiltern escarpment may also be considered chalk streams.
- **Lowland fens:** A couple of small areas of fen are located in the headwaters of the Stoke and Wendover Brook. These habitats are very likely to be degraded due to the surrounding intensive agricultural land use. Spartum Fen SSSI is one of the sites being restored as part of the Oxfordshire Fen Project.
- **Floodplain grazing marsh:** This habitat tends to be situated along the main river, which has the largest floodplain, but there is also floodplain grazing marsh habitat mapped along some smaller tributary

streams, including the Chalgrove and Kingsey Cuttle Brook. Depending on the quality of the grassland, these areas could be a focus of floodplain wetland mosaic creation.

- **Reedbed:** There are small pockets of Reedbed in the catchment. The largest, and only area mapped as priority habitat, is situated outside Wendover.

In addition, there are areas mapped as **semi-improved grassland** dotted across the landscape, which were including in Figure 6 as they may be a focus for further investigations and habitat enhancement.

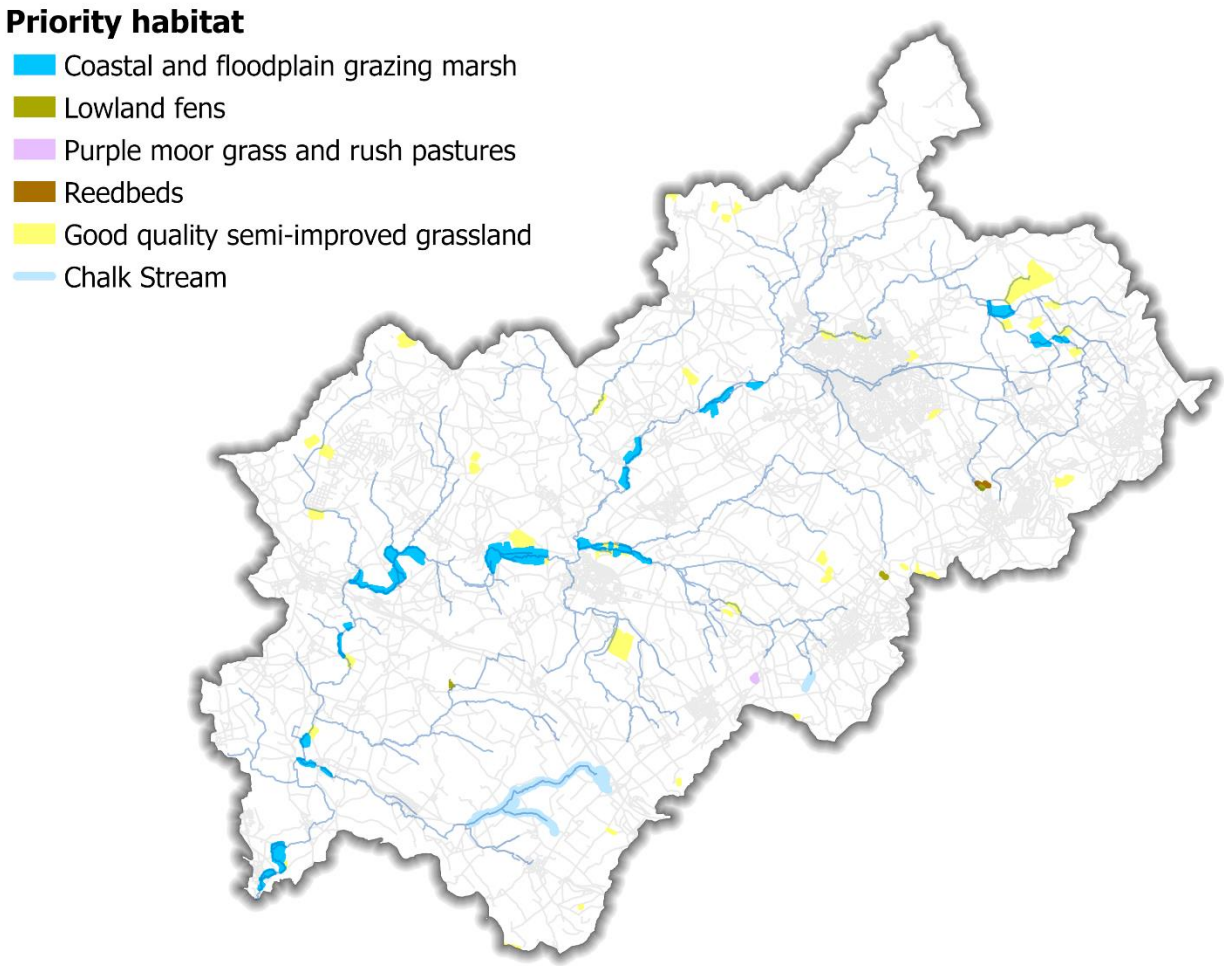


Figure 6. Water-dependent Priority habitats and semi-improved grassland. Semi-improved grassland has been included due to its potential to contain high-quality smaller waters and potential for habitat creation and restoration.

3.6 Species of Conservation Concern (SOCC)

3.6.1 Overview

A total of 99 SOCC occur in the River Thame Catchment - see Appendix 1 for a species list and further information in the following sections. Table 4 shows, split by taxonomic group, the number of species and records, conservation designations, and whether species are widespread or restricted in their national distribution.

Note that both water vole and otter records were removed from the analysis. This is because water voles have been extinct in the catchment for some time. In contrast, otters are now widespread and there are sightings along the whole length of the River Thame.

Based on the available information, key findings for the River Thame Catchment in terms of freshwater SOCC are:

- Generally, the **collated species dataset** was poor relatively to other IFA catchment or regional analyses, and this may be due to (i) low recording effort or (ii) low species diversity in the River Thame Catchment, or (iii) a combination of both. Considering the intensive land use in the catchment, the poor water quality of many waterbodies, and the low proportion of semi-natural habitat or designated sites, it is likely that freshwater species diversity in the catchment is indeed depleted. On the other hand, much of the catchment is under-recorded and it is very likely that more surveys would potentially make significant changes to the IFA analysis. This is even more likely now that new floodplain habitat has been created and landowner engagement (essential to access private land) has significantly increased in the past 10 or so years.
- Unsurprisingly, there are major differences between groups in terms of the **number of records**: some groups are better recorded than others, either because they are more widespread (e.g. Grass Snake) or because there is more active recording for those groups, sometimes due to development pressure (e.g. amphibians). In contrast, species level identification of invertebrates requires specialist skills which may not be accessible locally, particularly for more obscure groups like flies, and so many of these records are relatively old and sometimes dubious.
- About two third of species have **restricted** distribution and these are all either invertebrates or plants. In contrast, all vertebrate species are relatively widespread. Whilst trends in conservation tend to now focus more on habitat than species, clearly understanding and maintaining landscape-scale diversity should be a key objective of nature conservation strategies.
- Some species have become **extinct** or are likely to have become extinct in the catchment. Both Fen Violet and True Fox-sedge were present at the same fen site, but it was drained and replaced by a pheasant shoot (David Morris, BSBI recorder, pers. comm.). Given the poor water quality of waterbodies in the catchment, it is also likely that populations of true aquatic species, particularly but not exclusively those occurring in rivers and streams, are no longer present. For example, Opposite-leaved Pondweed has not been recorded in the catchment since 1999 and the last records for the four species of submerged pondweeds are almost 15 years old. Recommendations have been made for targeted resurveys in Section 6.2. Note that some plant species have long-lived seedbanks and may return of their own accord if the right habitat is created or improved (e.g. floodplain waterbodies). Examples of this include Pinkhill Meadow and the River of Life wetland complexes, both on the floodplain of the River Thames. For other species, active introductions would be required

to restore populations, and so catchment diversity. Propagules or vegetative material could be collected from adjacent river catchments (e.g. River Ray or River Thames).

- The SOCC dataset includes 14 **Priority species**, but records are mostly for relatively widespread species like Common Toad, Great Crested Newt and Bullhead, or for species which are now likely or confirmed extinct. There are two Priority invertebrates: White-clawed Crayfish and Scarce Four-dot Pin-palp. The latter record, from 2003, may require confirmation. White-clawed Crayfish is most likely extinct in larger watercourses, as in many parts of lowland England, but there are rumours of recent records in the Chiltern headwaters.
- Fourty of the Thame Catchment SOCC have **Nationally Scarce** status, which means that they are only found in 16 to 100 hectads (10 x 10 km squares) in Great Britain, making them particularly important for conservation nationally as well as at the catchment scale.
- Overall, the largest group of SOCC was **invertebrates** (47 species), with beetles (34%) and true flies (30%) making up the largest proportion. All but three invertebrate species are restricted or even very restricted in distribution. Invertebrates are often overlooked in freshwater conservation projects because of the lack of detailed knowledge of their ecology or expertise locally but they are normally, as in the Thame Catchment, a very large proportion of the total freshwater biodiversity.
- There were 46 **plants** in the Thame SOCC dataset, the bulk of which were flowering plants. Of these 26 are relatively widespread but have declined significantly in England because of habitat loss or degradation (see England Red Data Book for vascular plants).

Table 4. Number of species and records for the main SOCC taxonomic groups and overview of conservation designations

Taxon Group	No. of species	No. of records	Restricted species	Widespread species	Global Red List	UK RDB	England RDB	W&C Act	Priority species (Eng.)	Nationally Scarce plants	Nationally Scarce inver-tebrates	Habs Dir Ann I indicator	Habs Dir Ann II
Plants													
Moss	2	2	1	1						1		1	
Stonewort	5	24		5						1		5	
Flowering plant	39	384	20	19		12	29	1	6	4		11	
Invertebrates													
Beetle	15	19	15						1		13		
Caddis fly	2	3	2								2		
Crustacean	1	13	1					1	1				1
Dragonfly	5	14	3	2									
Mayfly	3	10	3								2		
Mollusc	3	15	3								3		
True bug	3	3	3								3		
True fly	11	26	11								11		
Vertebrates													
Amphibian	2	379		2	1			2	2				1
Reptile	1	71		1				1	1				
Fish	4	145		4	3				2				3
Mammal	3	41	1	2	1			1	1				1
Total:	**99**	**1149**	**64**	**37**	**5**	**12**	**29**	**6**	**14**	**6**	**34**	**17**	**6**

3.6.2 Habitat

An analysis of the habitat preference for the SOCC of the River Thame Catchment (Figure 7) shows that over a quarter of species live exclusively in standing waters and 12% exclusively in running waters (Figure 7). About a quarter are wetland species (i.e. fens, marshes, and other 'wet ground' habitats). Just under a quarter of species live in both running and standing water species and 20% use a wide range of habitat types.

This pattern – which is similar for other areas where the IFA analysis has taken place – highlights the importance of considering *all* waterbody/wet habitat types to protect freshwater biodiversity at catchment scale. The restoration of natural processes, and the creation or enhancements of wetland mosaics, particularly on floodplain and including both running and standing waters and transition habitat, can potentially support the greatest diversity of wildlife.

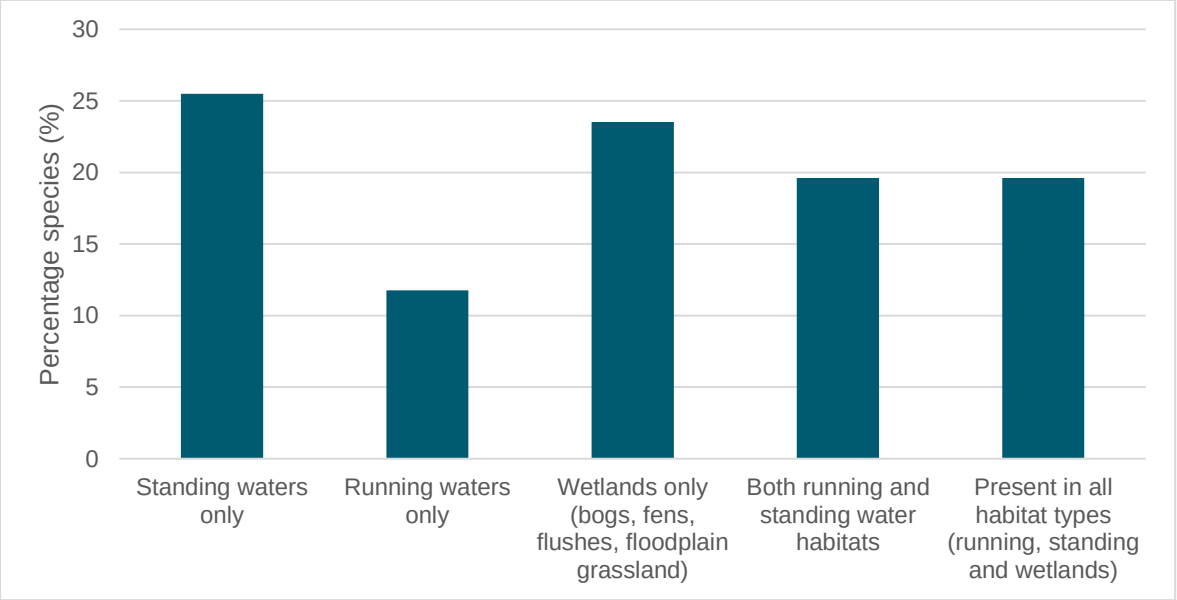


Figure 7. Proportion of SOCC associated with different types of freshwater and wetland habitats.

3.6.3 Species records and distribution

Records of SOCC are present throughout much of the catchment (Figure 8), but there are a few areas where no SOCC have been recorded. This could reflect a lack of suitable habitat, poor water quality or limited public access.

Analysing the data in terms of widespread and restricted species can help prioritise sites further by highlighting those areas which support rare plants and animals most likely to suffer from local extinctions. Clusters of restricted species can be seen around Spartum Fen, Menmarsh Gravel Pit Lakes and Shabbington Wood. The bulk of records for the River Thame Catchment consist of species such as Common Toad, Bullhead and Great Crested Newt – all widespread species and less vulnerable to extinction. This shows that some caution needs to be used in interpreting areas of high concentration of records as these do not automatically represent high diversity areas.

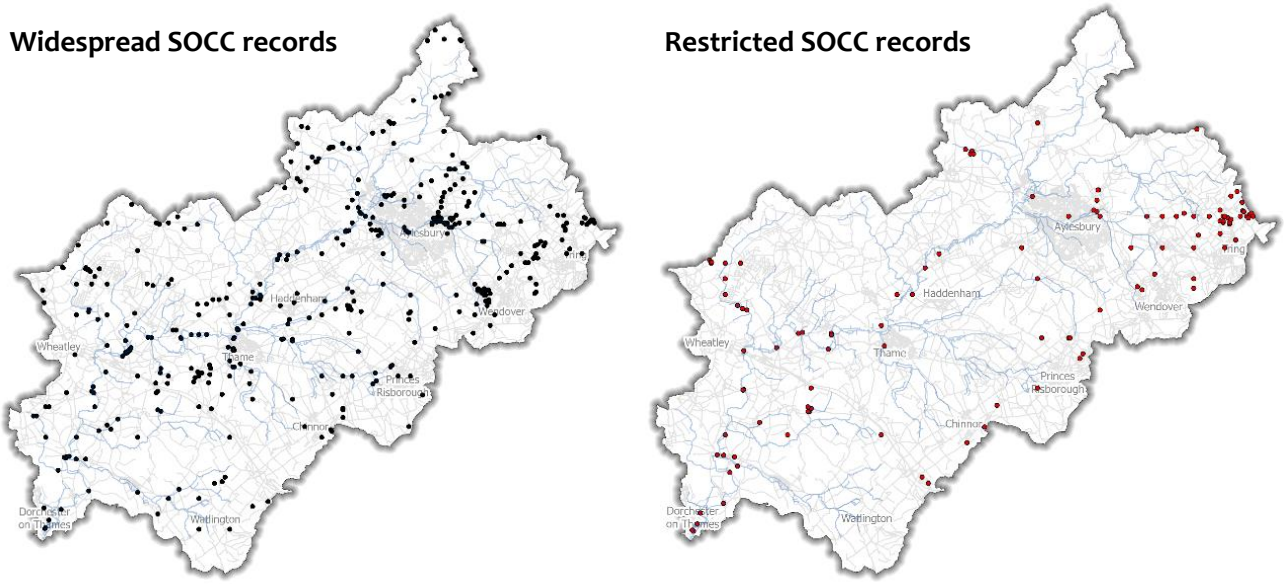


Figure 8. Records of SOCC with widespread (left, e.g. Bullhead) and restricted distribution (right, e.g. Tubular Water-dropwort) present in the River Thame Catchment.

3.7 SOCC hotspots

Although areas rich in records of SOCC usually indicate high diversity sites, in some cases they may simply reflect frequent recording of a small number of species. For this reason, species density (the number of SOCC per 1 km square) provides better information to identify IFAs and these referred to as 'SOCC hotspots' in this report.

In the River Thame Catchment, SOCC hotspots include a diverse range of habitats including pond complexes, fens, gravel pit lakes and river (and floodplain) sites, highlighting the importance of all freshwater habitat types within the landscape (Figure 9). Menmarsh Gravel Pit Lakes was one of the locations with the greatest number of SOCC. This area has a wide range of freshwater habitats, reinforcing the importance of diverse wetland mosaics, including both running and standing waters, for freshwater biodiversity. Spartum Fen, a small fen site, had the highest number of species with restricted distribution reflecting the specialism of many fen species and highlighting the importance of protecting this specific habitat type to avoid local or catchment extinctions.

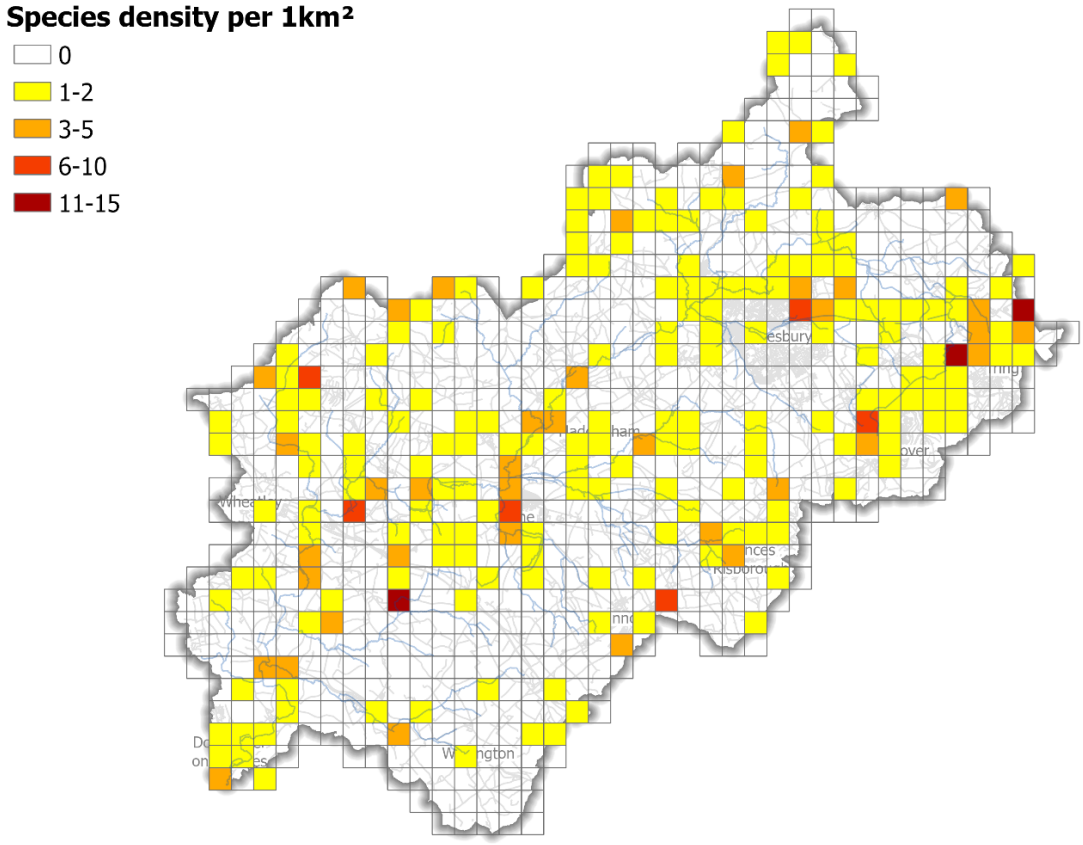


Figure 9. Number of SOCC plant and animals per 1km square.

4 Additional data: birds

4.1 Introduction

Over the past three years, the River Thame Conservation Trust has collected bird species data through British Trust for Ornithology (BTO) volunteer surveys, covering the whole catchment. This has now become a significant dataset, which has supported the designation of the Waterstock County Wildlife Site.

Bird species records are not included in the IFA analysis as birds have extensive distribution ranges and records do not necessarily reflect whether species are using an area to feed, breed or are just passing through. Birds are good indicators of the wider landscape quality (e.g. for wetland birds, the extent of water habitats), but they are less sensitive to water quality, and so are not good indicators of habitat quality for wetland plants or invertebrates. Data on bird distribution can, however, add valuable information in prioritising conservation action for freshwaters within the Thame Catchment, particularly for floodplains.

The bird species data has been collected via two surveys developed by the British Ornithological Society:

- Atlas: species abundance per 2x2 km^2 tetrad.
- WeBS: species abundance along the main river corridor via transects.

As Important Freshwater Areas analysis focuses SOCC, the analysis of the bird species records similarly included only bird species of conservation concern, i.e. those identified by national or international legislation as threatened or rare, and those associated with freshwater habitats.

4.1.1 Bird hotspots

To identify birds of conservation concern species hotspots within the catchment, the datasets were combined to represent total species per 2x2 km^2. Species abundance has not been included in the analysis, although this should be considered in future analyses.

Water-associated bird species of conservation concern are present in almost all 2x2 km^2 in the catchment. Squares where no species were found are those where there is a gap in the monitoring network, so they have not yet been surveyed.

Based on the current analysis, the hotspots for birds based on SOCC in the River Thame Catchment were areas with some of the largest expanses of water, including either the River Thame floodplain or lakes (Figure 10):

- Waterstock to Shabbington river floodplain, which is also a River Thame Catchment IFA
- Stone to Aylesbury river floodplain, including Eythrope and Thames Water's Aylesbury sewage treatment works. This is not currently an IFA but the new wetland at Eythrope will be monitored, and the area should be a high priority for survey and habitat creation and enhancement for birds and other species groups.
- Dorchester Gravel Pit Lakes, included in a River Thame Catchment IFA

- Tring reservoirs and Menmarsh Gravel Pit Lakes, also included in a River Thame Catchment IFA

This analysis shows that bird data can be useful and complementary to the IFA analysis, particularly for developing freshwater enhancement projects near bird hotspots.

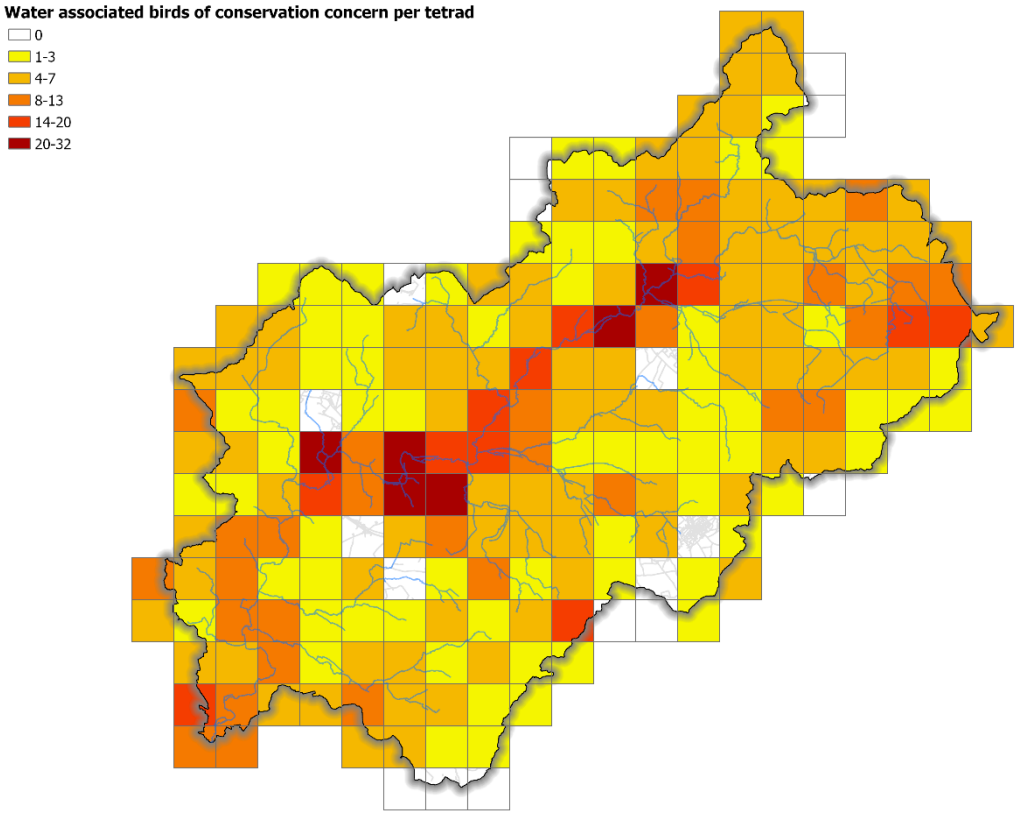


Figure 10. Birds of conservation concern hotspots in the River Thame Catchment.

5 Important Freshwater Areas (IFAs) of the River Thame Catchment

A total of 10 IFAs and 4 potential IFAs were identified in the River Thame Catchment. These are listed, with their qualification criteria, in Table 5 and mapped in Figure 11. A brief description of each IFA is included in Table 6 and further information for each IFA or pIFA is provided in Appendix 2.

IFAs cover all the different freshwater habitat types in the River Thame Catchment, including ponds and lakes, river and associated floodplain, headwater streams and fen. Note that in many cases, these are broad areas, and IFA boundaries should be indicative rather than prescriptive.

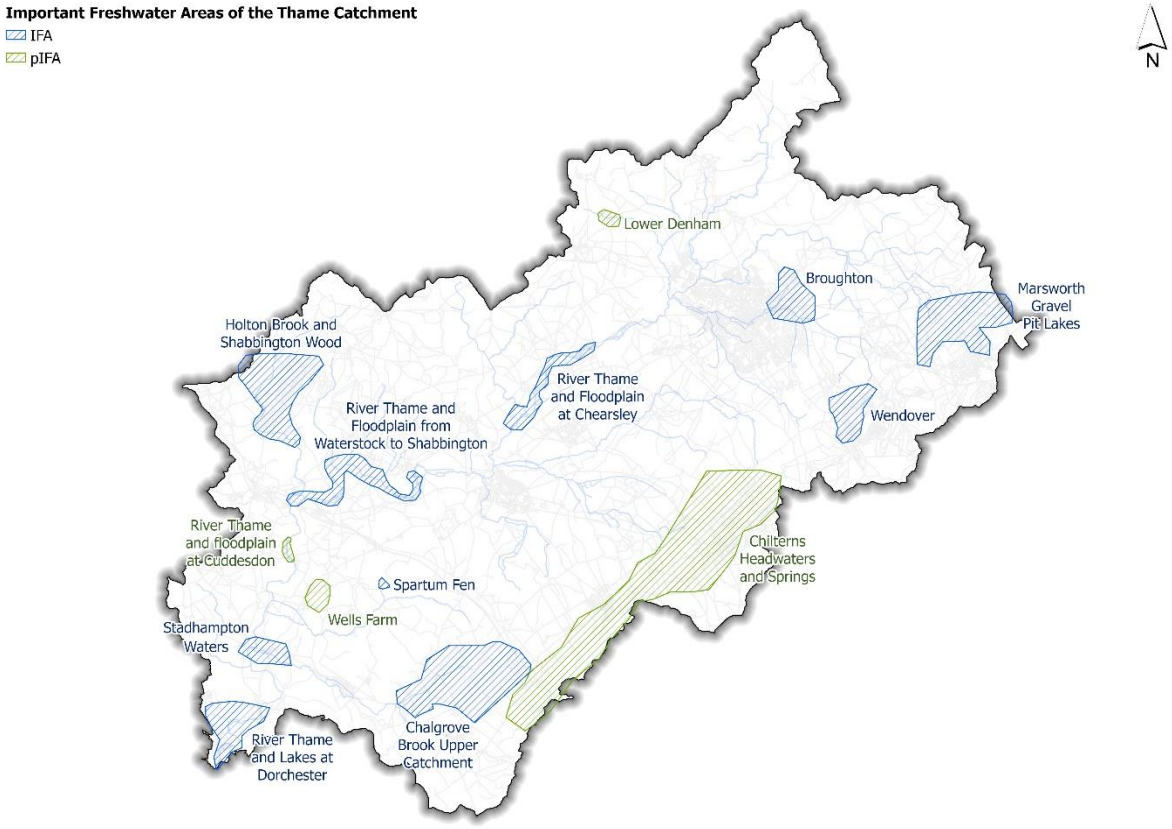


Figure 11. Important Freshwater Areas (IFAs) and potential IFAs of the River Thame Catchment (referred to as 'catchment IFAs'). Note that catchment IFAs do not necessarily have the same level of importance at larger geographical scales, e.g. county or national IFAs.

Table 5. Criteria for the designation of IFAs and potential IFAs (pIFAs) in the River Thame Catchment

IFA/ pIFA	Name	Qualification				
		SOCC hotspot	Restricted species present	Water-dependent Priority habitat	WFD 'High' status	Contains a designated Sites
IFA	Broughton	Yes	Yes	Yes	Yes	-
IFA	Chalgrove Brook Upper Catchment	-	Yes	Yes	-	-
IFA	Holton Brook and Shabbington Wood	Yes	Yes	-	-	-
IFA	Marsworth Gravel Pit Lakes	Yes	Yes	-	-	Water-dependent SSSI
IFA	River Thame at Chearsley		Yes	Yes	Yes	-
IFA	River Thame at Dorchester	-	Yes	Yes	Yes	-
IFA	Spartum Fen	Yes	Yes	Yes	-	Water-dependent SSSI
IFA	Stadhampton Waters	-	Yes	Yes	Yes	-
IFA	River Thame and Floodplain from Waterstock to Shabbington	Yes	Yes	Yes	Yes	County Wildlife Site on floodplain
IFA	Wendover	-	Yes	Yes	Yes	-
pIFA	Chilterns Headwaters and Springs	-	Yes	Yes	-	-
pIFA	Lower Denham	-	Yes	-	-	-
pIFA	River Thame Floodplain at Cuddesdon	-	Yes	Yes	Yes	-
pIFA	Wells Farm	-	Yes	Yes	Yes	-

Table 6. Catchment IFA overview

Catchment IFA name	Description	Species or habitat of note	Existing activity	Recommendations/next steps
Broughton	To the east of Aylesbury, this area has a high pond density but is subject to development pressure	Records for a number of rare marginal plants including Tubular Water-dropwort. Also abundant records for amphibians and grass snake	Unknown	Liaise with Buckinghamshire Council. Consider for resurvey, either by professionals or with volunteers
Chalgrove Brook Upper Catchment	From the source of the brook to Cuxham, the brook is largely surrounded by intensive arable land use	One of the few waterbodies with Brown Trout in the River Thame Catchment Chalk stream	Very active group (Watlington Environment Group) in the upper parts of the catchment. Proposal for habitat restoration in a number of locations	Liaise with Watlington Environment Group and the Environment Agency
Holton Brook and Shabbington Wood	An extensive area of woodland including clean streams and ponds. Most ponds have been created since 2011	This IFA is a stronghold for great crested newt and common toad and also probably dragonflies. The very rare plants (Fen Violet and True Fox-sedge) are now extinct but there are recent records for Tubular Water-dropwort. Also many older records of rare flies (e.g. soldier flies)	In the woodland, ongoing creation, management and monitoring of ponds, with a focus on Great Crested Newt, by New Conservation Partnership and Freshwater Habitats Trust, in collaboration with Forestry England	Consider invertebrate surveys, including dragonflies. Set up a volunteer-led conservation group in Shabbington Wood, if supported by Forestry England, to help with damaging public access. Engage with surround landowners to reconnect habitat corridor with Otmoor and restore natural processes
Marsworth Gravel Pit Lakes	Gravel pit lakes and reservoirs in the eastern part of the catchment	Rare plants and invertebrates, including Hairy Dragonfly and Marsh Helleborine. Some uncommon aquatic plant species and stoneworts, reflecting lake habitat and clean water in the gravel pit lakes. White-clawed Crayfish likely to be extinct.	Area contains a BBOWT reserve, which is actively managed for wildlife and has lots of activity.	Liaise with BBOWT. Focus for habitat creation/buffering on surrounding land. Consider for resurvey, professional or volunteer, particularly for aquatic plant species which are very rare at catchment scale

Catchment IFA name	Description	Species or habitat of note	Existing activity	Recommendations/next steps
River Thame and Floodplain at Chearsley IFA	This IFA includes River Thame itself, which is braided in this area, and its extensive floodplain managed as permanent pasture	A rare river invertebrate, Lister's River Snail and old records of pondweeds in the river itself. Many records of European Bullhead.	Farmer group recently established in area	Focus for channel and floodplain enhancement work, working with farmer cluster coordinated by River Thame Conservation Trust. Use Eythrope and Waterstock new wetlands as demonstration sites
River Thame and Lakes at Dorchester IFA	Gravel extraction on the river floodplain have provided additional standing water habitat, near the River Thames	Common Club-tail Dragonfly record, near its large population in the R. Thames around Little Wittenham. Striped Mayfly and a few other river aquatic invertebrates - probably reflecting proximity to River Thames, and so in some parts surveyor effort	Floodplain restoration work being undertaken in partnership between the Earth Trust, Hurst Meadow Trust and private landowners	Liaise with Hurst Meadow Trust and the Earth Trust. Engage with gravel pit lake owners to highlight their importance and assess the feasibility of enhancements for freshwater wildlife
River Thame and Floodplain from Waterstock to Shabbington IFA	River, extensive floodplain and many smaller waters including scrapes	A hotspot for otter and records for rare invertebrates, plants and fish, as well as amphibians	Existing RTCT/FHT/BTO volunteer engagement, with a focus on birds and amphibians	This area should be a focus for channel and floodplain enhancement work, and pond and scrape creation and management
Spartum Fen SSSI IFA	A small remnant fen with ponds, surrounded by intensive agriculture	A range of rare plant and invertebrate species typical of wetlands	Oxfordshire Fen Group in collaboration with Freshwater Habitats Trust working on the restoration of the fen hydrology and scrub management	Liaise with Oxfordshire Fen Group and surrounding landowners to try and deintensive the landscape and improve water quality

Catchment IFA name	Description	Species or habitat of note	Existing activity	Recommendations/next steps
Stadhampton Waters IFA	Complex of habitat including river, streams, ponds (including the village pond), ditches and wet grassland	Recent record for Fine-lined Pea Mussel and older records for nationally scarce pond invertebrates and eel.	Wildlife-friendly landowners and engagement with lower Thame farmer cluster. An area where RTCT/FHT engagement and projects are ongoing.	Focus for further channel and floodplain enhancement work
Wendover IFA	A lake, ditches and streams, most of which is in a wildlife trust reserve	A hotspot for Common Toad and Great Crested Newt, and older records for Long-Staked Pondweed	No known activity	Liaise with BBOWT, and search for aquatic species and or propagules (seed banks)
Chilterns Headwaters and Springs pIFA	A large IFA which covers many small headwater streams with their source in the Chiltern AONB, and some chalk pit lakes	A range of fen and flush plant and invertebrate species, mostly - but not exclusively, quite old. Also amphibians, Bullhead and Grass Snake	Headwater project, funded by HLF (Water in a Dry Landscape). Active environmental community group in Princes Risborough (REG).	Liaise with AONB Cherry, Chalk and Chairs HLF project and Chilterns Chalk Streams project.
Lower Denham pIFA	Small patch of wet meadow on stream floodplain	No records after 2005 but Tubular Water-dropwort and Round-fruited Rush populations may still be extent	River Thame Conservation Trust running community engagement project with local communities of Waddesdon and Quainton	Consider for re-survey and a site visit to assess potential for habitat creation and restoration works in or around the pIFA
River Thame and Floodplain at Cuddesdon pIFA	Multiple river channels which used to be part of a mill system, and extensive floodplain including scrapes	Fine-lined Pea Mussel in the river as well as Brook Lamprey	Farmer cluster group established in area	Focus for channel and floodplain enhancements. Consider for resurvey

Catchment IFA name	Description	Species or habitat of note	Existing activity	Recommendations/next steps
Wells Farm pIFA	A reserve of the wildlife trust where animals are kept in winter. Enhancement work took place as part of catchment project	Older record for rare reed and water beetle, more recent record for grass snake and amphibians	Managed by BBOWT as wintering ground for livestock. Public access. Habitat enhancement work as part of Catchment Restoration Fund project in early 2010s	Consider for re-survey and site visits to assess existing work, and potential for habitat creation and restoration work

6 Recommendations and conclusion

6.1 General recommendations

The Important Freshwater Areas analysis aims to support a strategic, landscape-scale approach for the protection and restoration of freshwaters and their biodiversity. Broadly:

- The IFAs should be the focus of action to **protect** existing high-quality habitats and freshwater species. This could include work to improve water quality or habitat heterogeneity, or create clean water habitats within the IFAs (e.g. clean water ponds).
- Work to **create, restore and manage** habitat should also focus in and *around* IFAs, improving connectivity and allowing for the *natural* colonisation of new or enhance habitat from remaining SOCC populations in the catchment.
- **Inform** habitat creation and restoration projects by highlighting the presence of uncommon plant and animal species and thus:
    - Provide the **opportunity** to enhance the design of new habitats or the management of existing habitats for a wider range of species. For example, a new backwater in the upper River Thame Catchment created primarily for fish was designed with an extensive drawdown zone, a critical feeding habitat for wetland birds and new habitat for plants and animals of muddy edges or shallow water.
    - Avoiding **conflicts** between species requirements. For example, reconnecting the river to its floodplain may lead to the degradation of floodplain habitat because of poor river water quality, affecting populations of sensitive plants and animals. If these populations are known, then they can be taken into consideration at the planning stage, avoiding local extinctions.
- Support the prioritisation of sites for **species re-introductions**. Such work should follow IUCN guidelines and seek expert advice to enhance the chances of success. In the River Thame Catchment, current species data is insufficient to identify plants and animals which could be re-introduced. Further analysis of historical data, as well as re-surveys and consultation with species experts, should be carried out prior to making species-specific recommendations to restore biodiversity in the catchment. Note that some plant species have long-lived seedbanks and may return of their own accord if the right habitat is created or improved (e.g. floodplain waterbodies and clean water ponds, or 'Ghost Ponds' restoration[13]). For other species, active introductions would be required to restore populations and so catchment diversity and, potentially, propagules or vegetative material could be collected from adjacent river catchments (e.g. River Ray or River Thames).
- Supports the prioritisation of biological or non-biological **surveys in both IFAs and pIFAs** to (see further recommendations in Section 6.2):
    - **Confirm** (i) the presence of SOCC where records are uncertain or relatively old, and (ii) habitat quality.

[13] https://norfolkpondsbig50.org/2019/11/13/ghost-ponds-explained/

- **Extend** knowledge of freshwater biodiversity in the catchment, supporting future conservation action.
- Identify **data-deficient** areas within the catchment which could be the focus of further surveys.

- **Raise awareness** of high quality, or high quality potential, freshwater habitats and their conservation with stakeholders, including those involved in the CaBA partnership, local planning authorities, landowners and the general public. This is particularly important for plants and invertebrates, which generally are not as 'visible' or well-known as fish, birds and other vertebrates. These species represent a high proportion of catchment biodiversity.

6.2 Improving knowledge of freshwater habitat and species in the Thame Catchment

Survey and monitoring of freshwater species (not only for SOCC) and habitat is critical to better understand the benefit of practical conservation work and support the protection of wildlife in the River Thame Catchment. For example, information collected by BTO volunteers supported the designation of the Waterstock floodplain as a County Wildlife Site, providing additional protection from development and making landowners aware of the importance of their land for nature conservation. As a result of this work, this area has recently seen the creation of wader scrapes and backwaters for fish – practical improvements which will bring benefits to population of many plants and animals, in addition to wetland birds.

Both volunteer and professional surveys should be considered, depending on the skill level required and how much support is available for citizen scientists. Various projects have shown that volunteers often struggled to carry out standardised surveys including all freshwater plants and invertebrates, which are essential to effectively monitor the quality of habitats. However, these same projects have also shown that volunteers can be trained to identify and survey for individual plant and animal species. The 'upskilling' of existing BTO and other existing recorders could be considered so that they can provide records for a wider range of taxonomic groups in the areas they already have access to. New survey and monitoring techniques, and in particular environmental DNA, could also prove to be a useful tool for volunteers to accurately survey and monitor sites, particularly for vertebrates (fish, amphibians and mammals).

It is recommended that in the short to medium term, in the River Thame Catchment, surveys focus on:

- **Wetland plants:** Plant species surveys are particularly useful because they are comparatively quick for experienced surveyors (professional or volunteers), so relatively low cost, provide high quality data and fit with a range of existing national monitoring programmes (e.g. BSBI[14]). Plants are also generally a good indicator of habitat quality and are critical as a habitat for animals, particularly invertebrates. Surveys should seek to, in consultation with BSBI county recorders and other local experts: (i) selectively confirm existing SOCC records (particularly older records of rare species) and (ii) survey data-deficient areas, particularly on the floodplain, and in or around IFAs.

[14] https://bsbi.org/

- **Amphibians and reptiles:** With adequate training and support, these groups can be surveyed by volunteers. In spring, recording frog and toad spawn could help provide a more complete view of where populations of these species occur. Collaboration with existing Amphibian and Reptile Groups (ARGs) operating in the catchment should be sought. Existing information to support volunteer recording is available from the Freshwater Habitats Trust and Amphibians and Reptile Conservation Trust websites[15].
- **Water quality:** Water quality testing of waters not currently monitored by statutory agencies (i.e. all waterbodies other than 'main river') can provide a relatively quick and easy proxy to identify high quality habitats and can be carried out by volunteers. Further surveys, in addition to existing monitoring and project-focus work, should be considered and seek to provide catchment-wide coverage across all freshwater habitat types.
- **Dragonfly and damselfly:** Standardised or semi-standardised surveys of adult dragonfly identification by volunteers, if supported by experienced recorders (including volunteers), focused on the floodplain and the IFAs in the first instance, and newly-created waterbodies, could provide useful new information on habitat quality.

6.3 Where next?

This first IFA analysis for the River Thame Catchment provides a baseline for freshwaters in the River Thame Catchment, including all waters. Clearly, there are gaps in the data which could easily be addressed with both volunteer and professional surveys and monitoring. However, the results also highlight a depleted species pool resulting from the intensive land use, essentially either urban or agricultural, and leading to widespread water pollution and (mostly) historic habitat degradation.

On a more positive note, the wide, relatively natural river floodplain and high level of engagement from riparian and other landowners means that significant positive action is possible in the short term. Recent habitat creation on the floodplain at Eythorpe, Waterstock and other areas along the river to improve fish passage are the first steps in restoring biodiversity in the River Thame Catchment – and there are many more opportunities being developed by the River Thame Partnership. There is also great potential to actively restore populations of species which have become extinct locally or at catchment scale, particularly plants.

The ambition for the catchment from a biodiversity perspective could be that, in 10 years' time, the next River Thame Catchment IFA analysis shows that the River Thame floodplain is an IFA along most of its length, dotted with wetland mosaics and extensive grazing, perhaps even beavers! Headwaters along the Chilterns escarpment are protected and restored and new clean water habitats, off floodplain, provide stepping stones, linking to high quality sites within and outside the catchment. Areas of the catchment which are currently of low quality for agricultural use because they are often flooded or waterlogged have been de-intensified, and natural processes, including hydrology, have been restored to provide ecosystem services and a thriving habitat for wildlife, and for everyone to enjoy.

[15] http://www.narrs.org.uk/ and https://freshwaterhabitats.org.uk/projects/pondnet/spawnsurvey2020/

Appendix 1. List of freshwater SOCC recorded in the River Thame Catchment (1988-2017)

Common Name	Taxon Name	Taxon Group
Strap-leaved Earth-moss	*Ephemerum recurvifolium*	Plant - Moss
Greater Water-moss	*Fontinalis antipyretica*	Plant - Moss
Opposite Stonewort	*Chara contraria*	Plant - Stonewort
Delicate Stonewort	*Chara virgata*	Plant - Stonewort
Common Stonewort	*Chara vulgaris*	Plant - Stonewort
Smooth Stonewort	*Nitella flexilis*	Plant - Stonewort
Lesser Marshwort	*Apium inundatum*	Plant - Flowering plant
Flat-sedge	*Blysmus compressus*	Plant - Flowering plant
Star Sedge	*Carex echinata*	Plant - Flowering plant
True Fox-sedge	*Carex vulpina*	Plant - Flowering plant
Whorl-grass	*Catabrosa aquatica*	Plant - Flowering plant
Marsh Helleborine	*Epipactis palustris*	Plant - Flowering plant
Common Cottongrass	*Eriophorum angustifolium*	Plant - Flowering plant
Marsh Cudweed	*Gnaphalium uliginosum*	Plant - Flowering plant
Opposite-leaved Pondweed	*Groenlandia densa*	Plant - Flowering plant
Water-violet	*Hottonia palustris*	Plant - Flowering plant
Frogbit	*Hydrocharis morsus-ranae*	Plant - Flowering plant
Round-fruited Rush	*Juncus compressus*	Plant - Flowering plant
Fat Duckweed	*Lemna gibba*	Plant - Flowering plant
Mudwort	*Limosella aquatica*	Plant - Flowering plant
Mousetail	*Myosurus minimus*	Plant - Flowering plant
Whorled Water-milfoil	*Myriophyllum verticillatum*	Plant - Flowering plant
Fringed Water-lily	*Nymphoides peltata*	Plant - Flowering plant
Tubular Water-dropwort	*Oenanthe fistulosa*	Plant - Flowering plant
Grass-of-Parnassus	*Parnassia palustris*	Plant - Flowering plant
Marsh Lousewort	*Pedicularis palustris*	Plant - Flowering plant
Common Butterwort	*Pinguicula vulgaris*	Plant - Flowering plant
Grass-wrack Pondweed	*Potamogeton compressus*	Plant - Flowering plant
Shining Pondweed	*Potamogeton lucens*	Plant - Flowering plant
Perfoliate Pondweed	*Potamogeton perfoliatus*	Plant - Flowering plant
Long-stalked Pondweed	*Potamogeton praelongus*	Plant - Flowering plant
Lesser Spearwort	*Ranunculus flammula*	Plant - Flowering plant

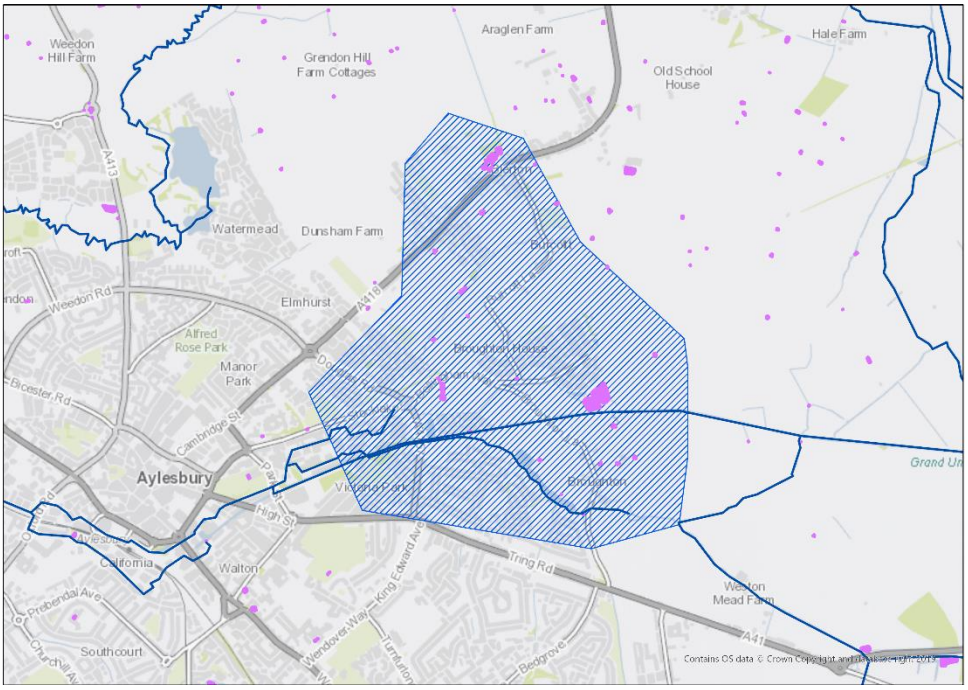
Common Name	Taxon Name	Taxon Group
River Water-crowfoot	*Ranunculus fluitans*	Plant - Flowering plant
Pond Water-crowfoot	*Ranunculus peltatus*	Plant - Flowering plant
Stream Water-crowfoot	*Ranunculus penicillatus subsp. pseudofluitans*	Plant - Flowering plant
Marsh Ragwort	*Senecio aquaticus*	Plant - Flowering plant
Ragged-Robin	*Silene flos-cuculi*	Plant - Flowering plant
Greater Duckweed	*Spirodela polyrhiza*	Plant - Flowering plant
Marsh Stitchwort	*Stellaria palustris*	Plant - Flowering plant
Marsh Arrowgrass	*Triglochin palustris*	Plant - Flowering plant
Marsh Speedwell	*Veronica scutellata*	Plant - Flowering plant
Fen Violet	*Viola persicifolia*	Plant - Flowering plant
a ground beetle	*Bembidion decorum*	insect - beetle (Coleoptera)
a ground beetle	*Bembidion octomaculatum*	insect - beetle (Coleoptera)
Scarce Four-dot Pin-palp	*Bembidion quadripustulatum*	insect - beetle (Coleoptera)
a scavenger water beetle	*Cercyon bifenestratus*	insect - beetle (Coleoptera)
a scavenger water beetle	*Chaetarthria seminulum*	insect - beetle (Coleoptera)
a marsh beetle	*Elodes elongata*	insect - beetle (Coleoptera)
a marsh beetle	*Elodes minuta*	insect - beetle (Coleoptera)
an algivorous water beetle	*Haliplus mucronatus*	insect - beetle (Coleoptera)
a scavenger water beetle	*Helophorus dorsalis*	insect - beetle (Coleoptera)
a variegated mud beetle	*Heterocerus marginatus*	insect - beetle (Coleoptera)
a diving beetle	*Hydroporus marginatus*	insect - beetle (Coleoptera)
a diving beetle	*Nebrioporus depressus*	insect - beetle (Coleoptera)
a wetland weevil	*Notaris scirpi*	insect - beetle (Coleoptera)
a diving beetle	*Rhantus frontalis*	insect - beetle (Coleoptera)
a weevil	*Rhinoncus perpendicularis*	insect - beetle (Coleoptera)
a diving beetle	*Scarodytes halensis*	insect - beetle (Coleoptera)
a caddisfly	*Limnephilus griseus*	insect - caddis fly (Trichoptera)
a caddisfly	*Potamophylax rotundipennis*	insect - caddis fly (Trichoptera)
Common Hawker	*Aeshna juncea*	Insect - dragonfly (Odonata)
Hairy Dragonfly	*Brachytron pratense*	Insect - dragonfly (Odonata)
Golden-ringed Dragonfly	*Cordulegaster boltonii*	Insect - dragonfly (Odonata)
Common Club-tail	*Gomphus vulgatissimus*	Insect - dragonfly (Odonata)
Scarce Blue-tailed Damselfly	*Ischnura pumilio*	Insect - dragonfly (Odonata)

Common Name	Taxon Name	Taxon Group
a mayfly	*Baetis fuscatus*	insect - mayfly (Ephemeroptera)
a mayfly	*Ephemera lineata*	insect - mayfly (Ephemeroptera)
a mayfly	*Kageronia fuscogrisea*	insect - mayfly (Ephemeroptera)
a pond-skater	*Aquarius paludum*	insect - true bug (Hemiptera)
a Sphagnum bug	*Hebrus pusillus*	insect - true bug (Hemiptera)
a lesser water cricket	*Microvelia pygmaea*	insect - true bug (Hemiptera)
a long-headed fly	*Campsicnemus pumilio*	insect - true fly (Diptera)
a dance fly	*Hilara quadriseta*	insect - true fly (Diptera)
a house fly	*Lispe caesia*	insect - true fly (Diptera)
a hoverfly	*Orthonevra brevicornis*	insect - true fly (Diptera)
a crane fly	*Phalacrocera replicata*	insect - true fly (Diptera)
Variable Little Snailkiller	*Pherbellia griseola*	insect - true fly (Diptera)
a snail-killing fly	*Pherbellia nana*	insect - true fly (Diptera)
a crane fly	*Pilaria fuscipennis*	insect - true fly (Diptera)
a snail-killing fly	*Psacadina verbekei*	insect - true fly (Diptera)
Banded General soldierfly	*Stratiomys potamida*	insect - true fly (Diptera)
FleckedGgeneral soldierfly	*Stratiomys singularior*	insect - true fly (Diptera)
a long-headed fly	*Telmaturgus tumidulus*	insect - true fly (Diptera)
a crane fly	*Thaumastoptera calceata*	insect - true fly (Diptera)
Long-horned soldierfly	*Vanoyia tenuicornis*	insect - true fly (Diptera)
White-clawed Crayfish	*Austropotamobius pallipes*	Invertebrate - crustacean (Decapoda)
Fine-lined Pea Mussel	*Pisidium tenuilineatum*	Invertebrate - mollusc (Bivalvia)
Smooth Ramshorn Snail	*Gyraulus laevis*	Invertebrate - mollusc (Gastropoda)
Large-mouthed Valve Snail	*Viviparus contectus*	Invertebrate - mollusc (Gastropoda)
Common Toad	*Bufo bufo*	Amphibian
Great Crested Newt	*Triturus cristatus*	Amphibian
Grass Snake	*Natrix natrix*	Reptile
European Eel	*Anguilla anguilla*	Fish
Bullhead	*Cottus gobio*	Fish
Brook Lamprey	*Lampetra planeri*	Fish
Brown Trout	*Salmo trutta*	Fish
Water Vole	*Arvicola amphibius*	Mammal
Otter	*Lutra lutra*	Mammal
Water Shrew	*Neomys fodiens*	Mammal

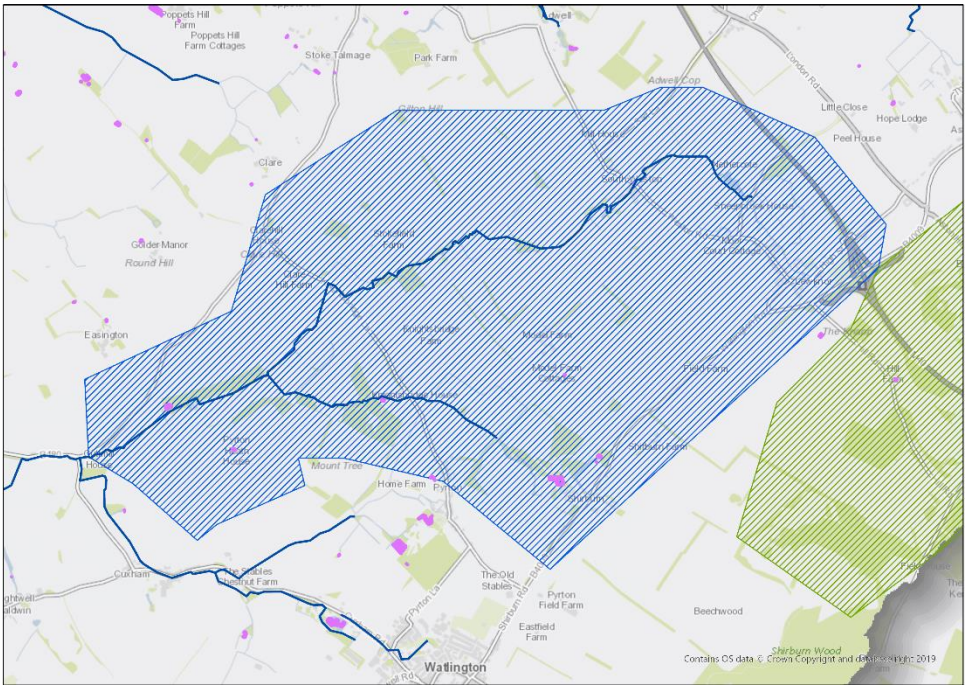
Appendix 2. Map for individual River Thame Catchment IFAs

Please see Table 6 for supporting information on each catchment IFA and recommendations. Data on each IFA is held by the River Thame Conservation Trust. Running waters are mapped in dark blue and standing waters in pink. IFAs boundaries are shown by harshed lines. *Important note: the IFA and pIFA boundaries below are indicative, rather than 'hard' boundaries, and the maps below should be interpreted as such.*

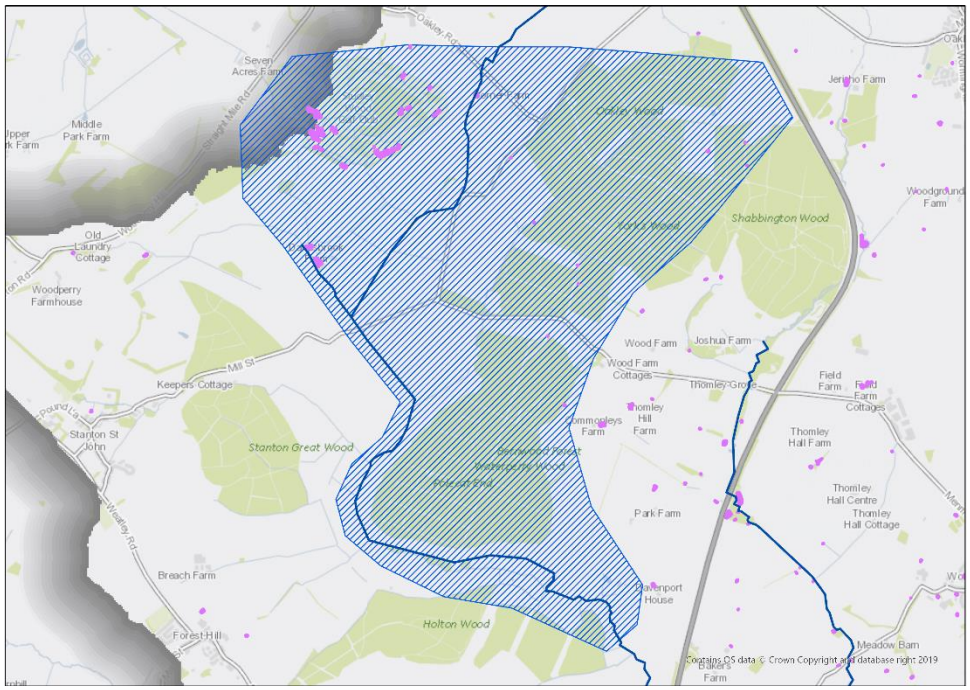
Broughton Catchment IFA



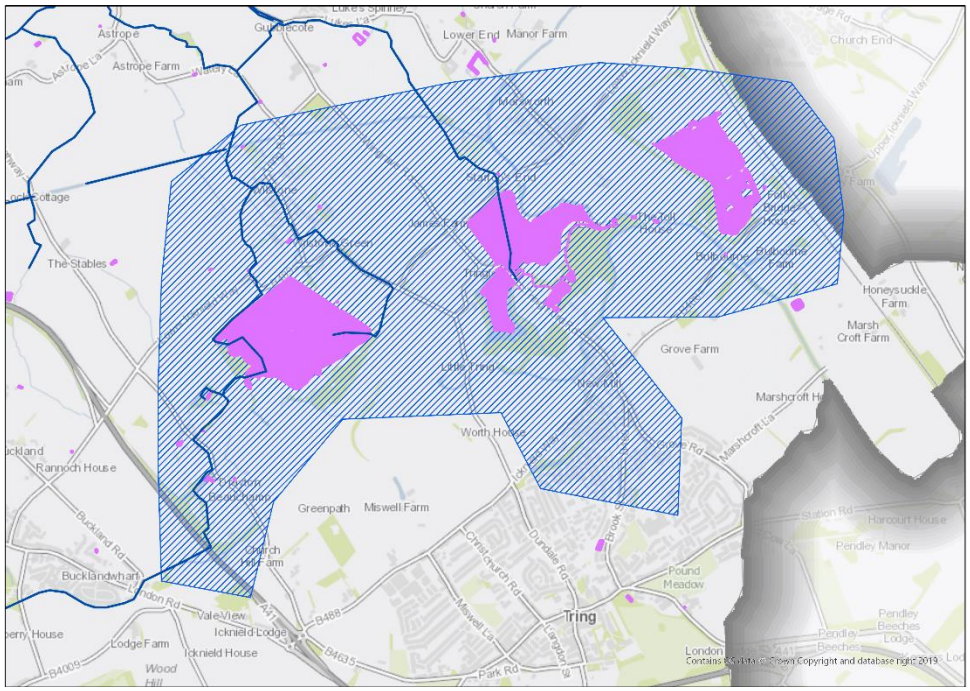
Chalgrove Brook Upper Catchment IFA



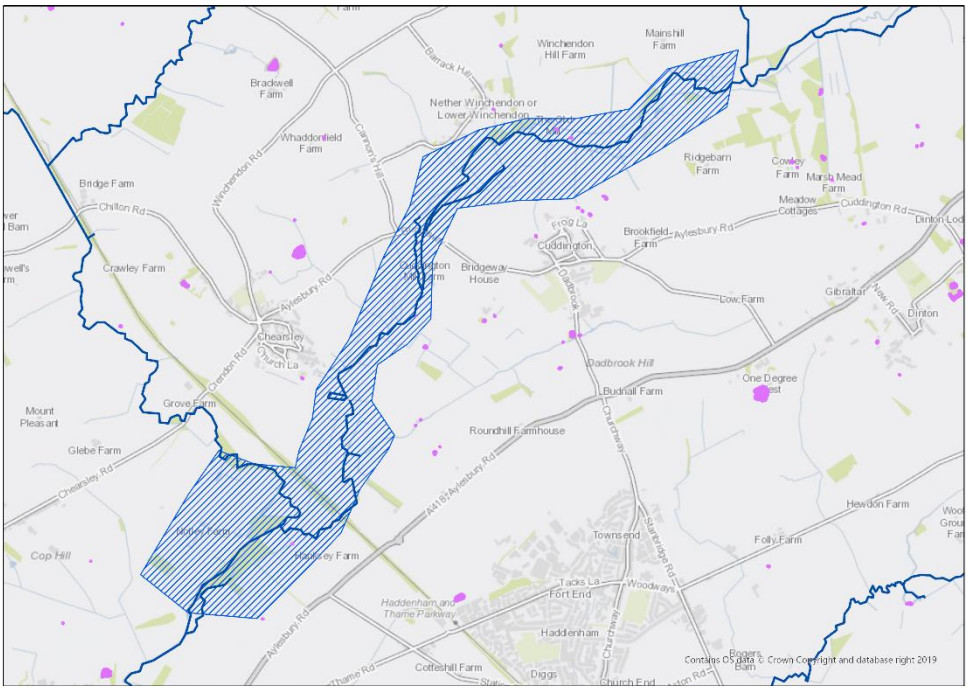
Holton Brook and Shabbington Wood Catchment IFA



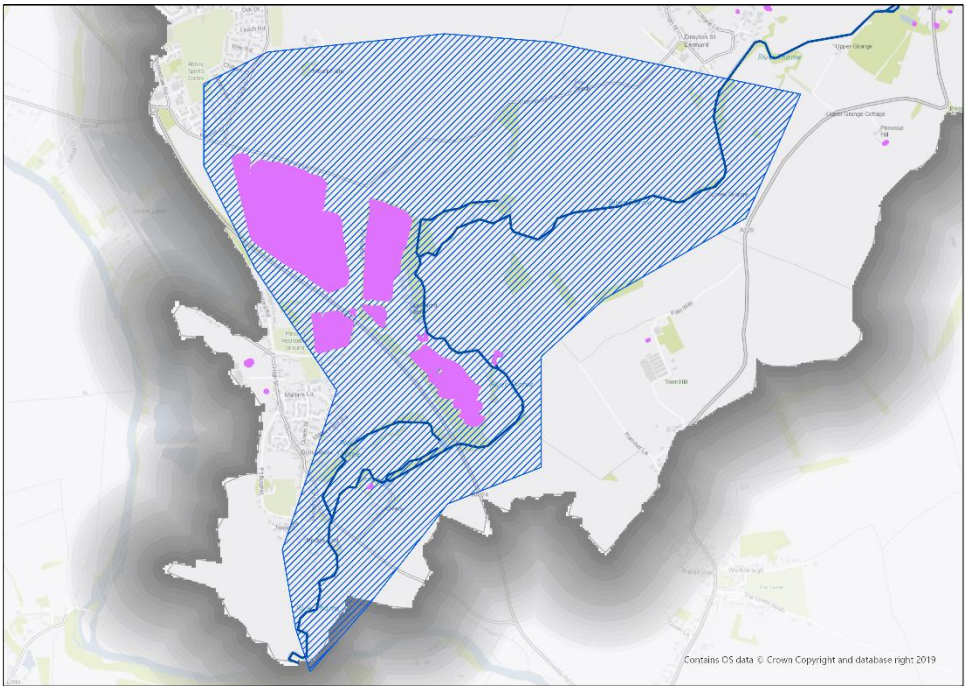
Marsworth Gravel Pit Lakes Catchment IFA



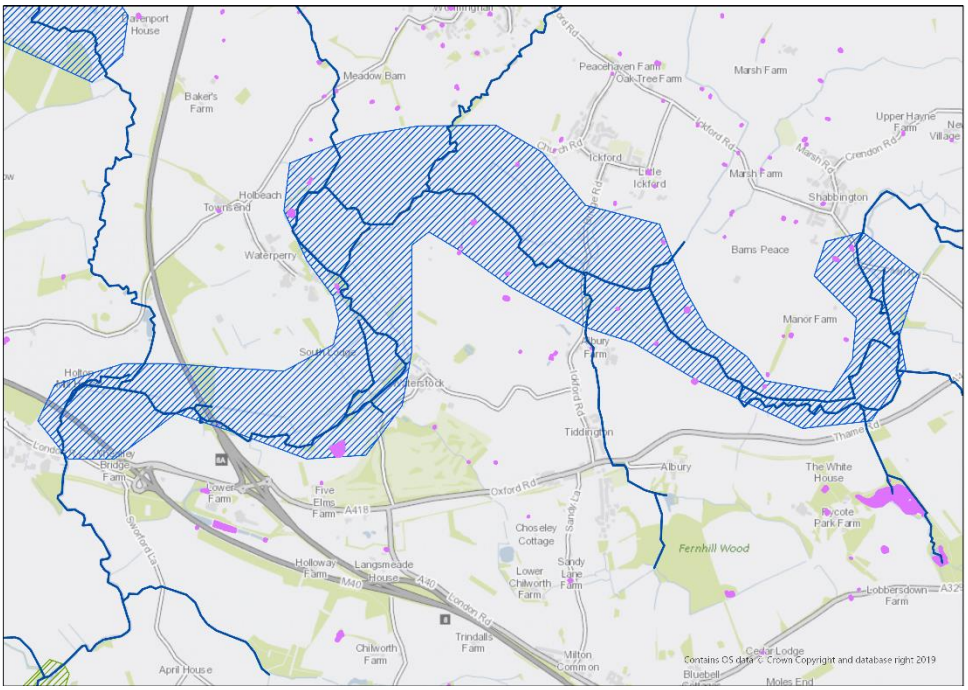
River Thame and Floodplain at Chearsley Catchment IFA



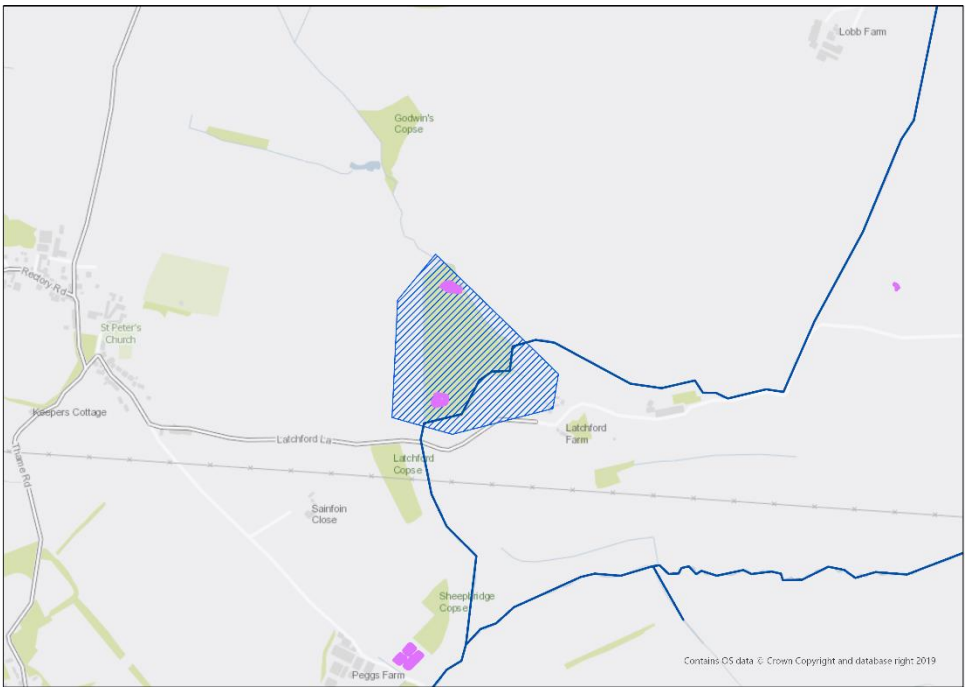
River Thame and Lakes at Dorchester Catchment IFA



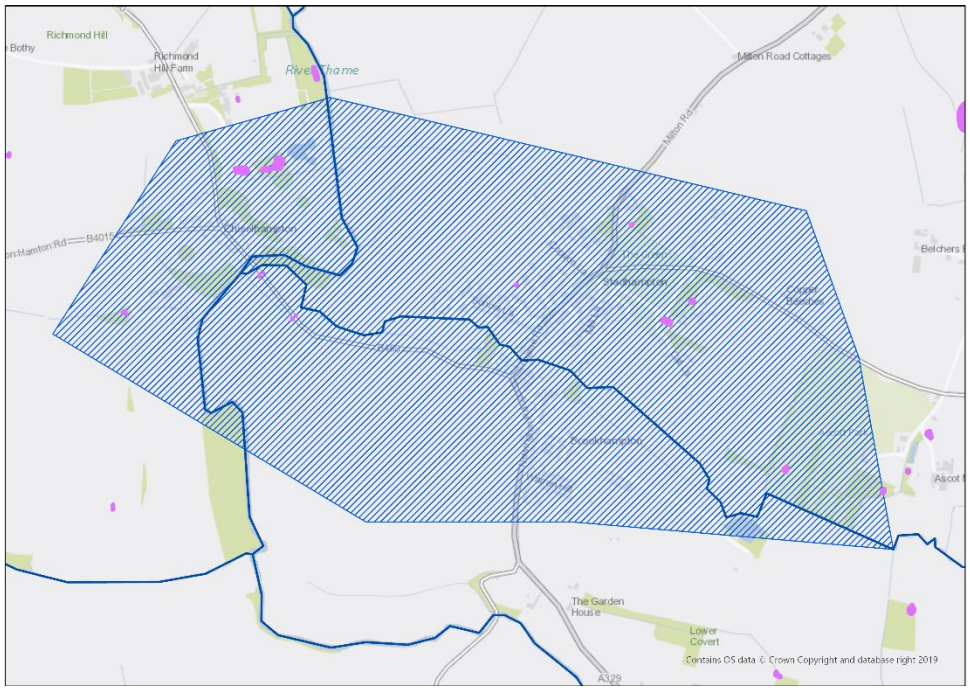
River Thame and Floodplain from Waterstock to Shabbington Catchment IFA



Spartum Fen SSSI Catchment IFA



Stadhampton Waters Catchment IFA



Wendover Catchment IFA