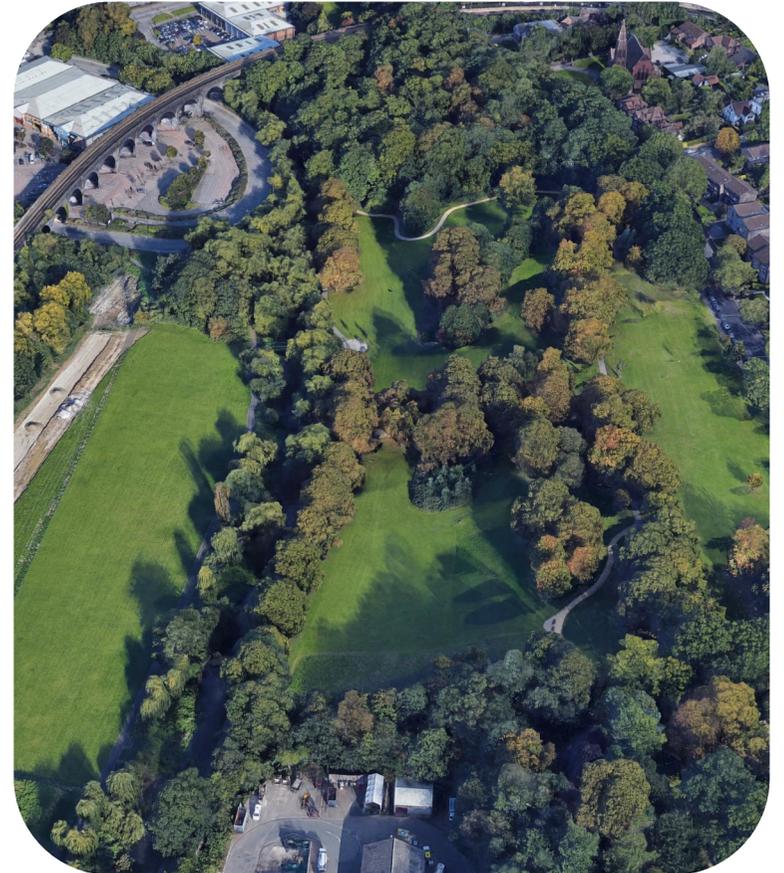
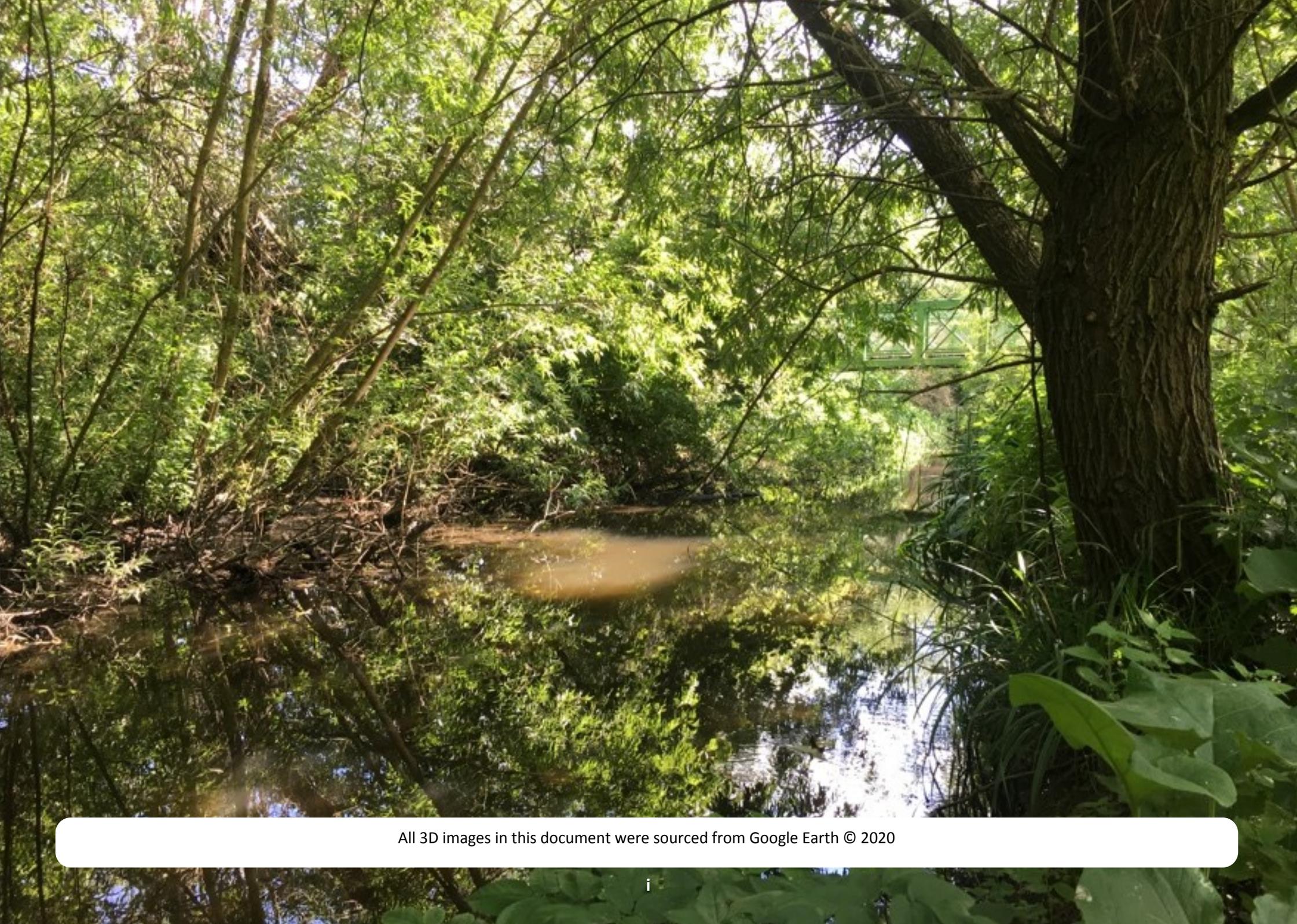


Oxhey Park

River Improvement Plan



**WATFORD
BOROUGH
COUNCIL**



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Site Plan



Oxhey Park land ownership

Habitat and Geomorphology

The following text summarises the results of the botanical survey and modular river surveys undertaken by the project team. The full results of each survey can be found within the appendices of this report.

Land Use



Oxhey Park is comprised of 14 hectares of Parkland owned by Watford Borough Council. The Park was formed in 1924 after the land of the former Wiggshall Estate was divided in order to provide new housing, allotments and a formal open space for the residents of Watford. Today the park offers site users a children's play area, an outdoor gym and a network of footpaths that run past the river, through a wooded del and across grassy slopes. The land to the North of the River Corridor has been chosen for the development of Oxhey Activity Park. The

development is currently underway and will provide a café with a riverside terrace, toilets, play areas, walking and cycling routes and recreation facilities for skateboarding, scooters, blading, mountain bikes and BMX. The Friends of Oxhey Park, a local group formed in 2003, assist Watford Borough Council with the management and development of the park and meet on the second Sunday of each month to undertake management activities.



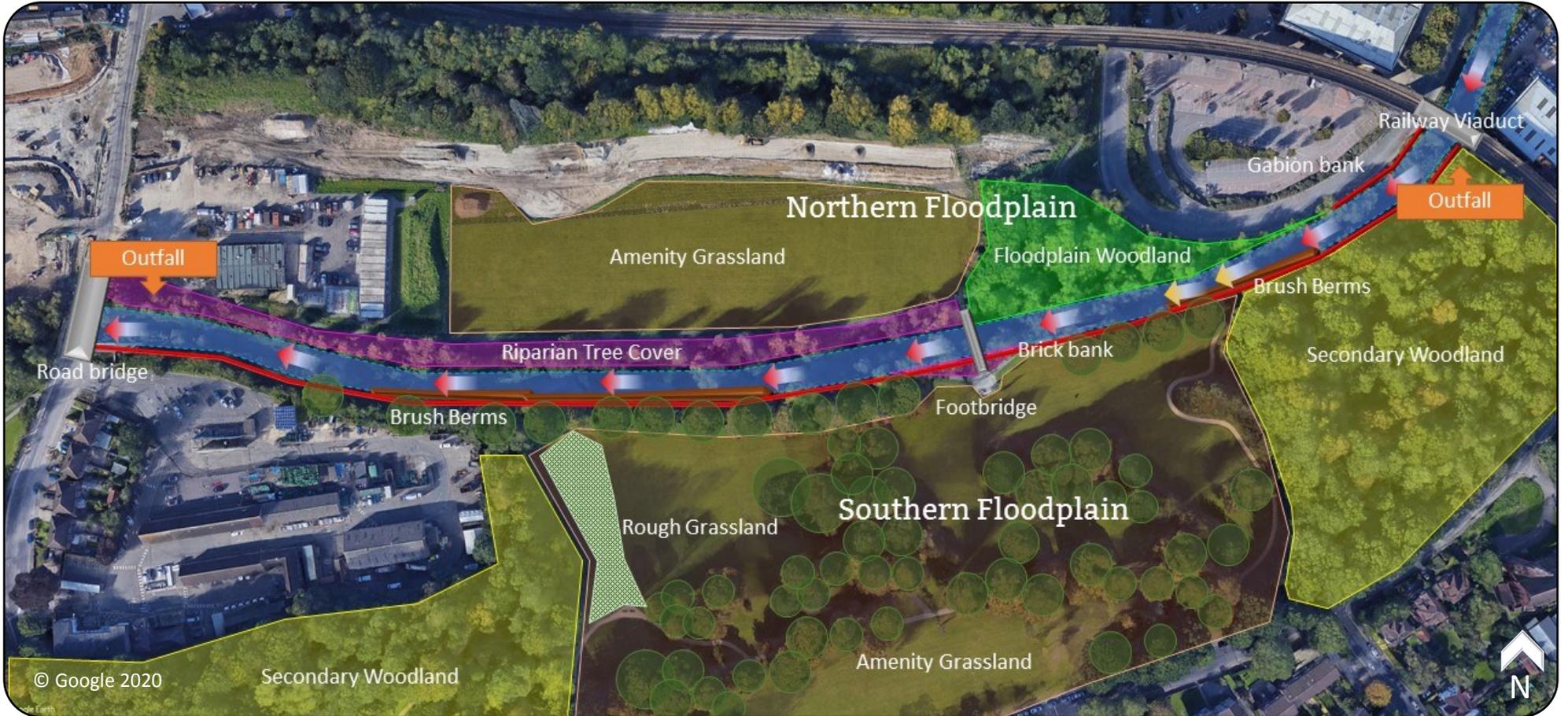
River Profile and Course

The river follows its original course through the site but has been extensively modified over the past 200 years. It is believed that the first modifications to the river corridor would have dated back to the days of the Wiggshall Estate, with the grounds of the house extending to formalised banks of the river. Historic maps show a distinct change from a sinuous river channel in the early 19th Century to a more canalised watercourse in the early 20th Century. Historic pictures from the early 1900's illustrate that the river

channel used to be of much greater width and depth, forming a slow flowing leat, where boating and swimming were popular activities. Today the channel is less deep and wide and neither swimming or boating would be viable.

Historically, the Colne used to run in two channels that converged at the Wiggshall estate. The second channel was a manmade feature known as The Watford Cut. The Watford cut was a brick banked leat that diverted away from the original course of the river, to the north of Watford, just upstream of Waterfields Recreation Ground. The feature flowed south through Watford, providing power to important industrial sites, such as Watford Mill before reaching Oxhey Park, just south of where Thomas Sawyer Way is now located. The majority of the Watford Cut was filled in during the 1980s following the decommissioning of its watermills and other industrial sites in the early 20th century. The only section of the feature that remains today, is what is now the main River Colne running through Waterfields Recreation Ground. Downstream of this section, the river joins its original course which flows to the west of Watford Town Centre and onto Oxhey Park.

Since the infilling of the Watford Cut, the main river channel has never truly recovered nor has its natural flow been fully restored. The combination of infilling



© Google 2020

Legend:

- 1

Bank revetment
- 2

Floodplain Woodland
- 3

Formal trees
- 4

Secondary Woodland
- 5

Amenity Grassland
- 6

Rough Grassland
- Flowing Water
- Wooded Debris Feature

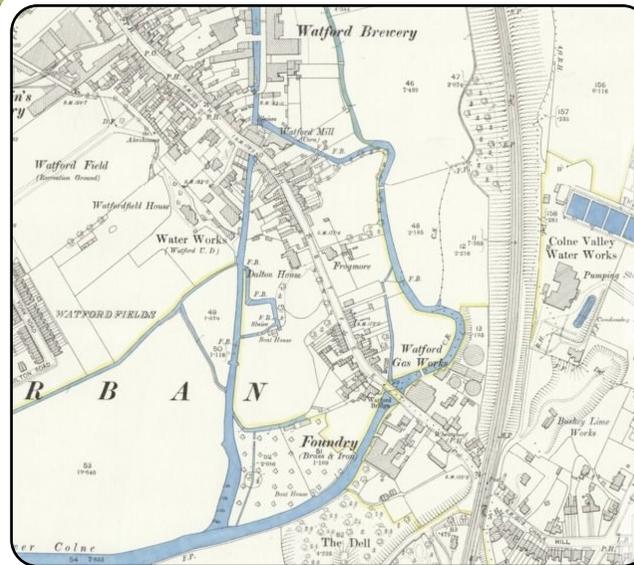
Oxhey Park habitat map

the cut, coupled with historic modifications to the river channel throughout Watford, has resulted in a watercourse with an unnatural profile and depleted flows. This has been catalysed in recent years by increasing water demand and levels of water abstraction across the Colne Catchment, which has resulted in low flow conditions becoming common place.

Today, the river still has a heavily modified profile. The southern bank of the river has a 2 meter tall, vertical profile and is brick lined, with a concrete foot-path running in close proximity to the bank top. A set-back embankment is also present along the most upstream extent of the watercourse. The northern bank of the river is more variable. The most upstream section is comprised of a 3 meter tall gabion wall leading directly to the Dalton Way. As the river progresses through the site, it moves further apart from Dalton Way, exposing a low-lying (<1m) mudflat with abundant willow cover. As the river flows further west, the bank is comprised from earth, increases in height (2m) and extends on to an area of grassland which is now being developed to provide the Oxhey Activity Park. The riverbed, is for the most part, flat and uniform throughout the majority of the site due to the canalised nature of the river channel.

Due to the variable nature of the river's modified profile, efforts have been made to re-naturalise and to standardise it. This has been achieved by diligent work by local volunteers, led by Community Connections Project CIC and The Wild Trout Trust. The improvement works have consisted of the installation

of brush berms, flow deflectors, gravel bars and riffles, in addition to the introduction of native plant species. The works have improved the river's cross-sectional profile in many locations, by providing shallow margins and a deeper central channel. The provision of berms on alternative sides of the watercourse also helps to mimic natural sinuosity and to provide greater variation in flow types. The introduction of gravels has worked to improve the river's longitudinal profile by mimicking the natural features of a more dynamic watercourse and providing a more variable riverbed.



Ordnance Survey 25-inch map. Hertfordshire Sheet XLIV.6 1896 (detail). Showing the location of the Watford Cut and main river Colne.



(Above) The Watford Cut merging with the main river in the early 1900s.



(Above) The same location today.

Floodplain Habitat

Northern Floodplain



The majority of the Northern Floodplain is in flood zone 3 and is of lower topography than the southern floodplain. This area of the park can be inundated with water as river levels rise and generally provides wetter habitat than the land to the south of the river corridor.

The eastern compartment of the northern floodplain has been developed in recent years. The compartment once provided extensive floodplain habitat and was the location where the Watford Cut converged with the main River Colne. Much of this area is no longer within the boundaries of the park and is now comprised of a car park and a section of the Dalston Way. A small fragment of the former landscape still exists and is comprised of low-lying mudflats with extensive beds of Crack Willow. The area would have once provided a more extensive wetland, but declining water levels in recent times and the infilling of the Watford Cut have altered this part of the landscape permanently. Today the compartment offers an area of regionally scarce floodplain woodland and a secluded refuge for wildlife which contrasts the formal nature of the rest of the park.

The central and western compartments of the northern floodplain are comprised of amenity grassland and are dry in nature with poor connectivity to the river corridor. A thin, wooded fringe of mixed deciduous trees and shrubs lines the river corridor, providing a buffer strip between the intensively mown grass and the natural river corridor. These compartments are currently being developed to provide the Oxhey Activity Park which will provide recreation facilities for skateboarding, scooters, blading, mountain bikes and BMX.

Southern Floodplain



The southern floodplain is comprised primarily of amenity grassland that slopes from the south of the park towards the river corridor. The grassland is interspersed by tree lines of native and ornamental species, small copses, ancient parkland trees, patches of scrub and rough grassland. Due to the sloping and elevated nature of the park, only a small portion of land, comprised of a footpath and narrow strip of grass, falls within the flood zone of the river. This factor, coupled with the formal nature of the park, means that there are few opportunities for wetland habitat creation or enhancement in this area.

One of the notable features of the Southern floodplain is a secondary woodland known as 'The Dell'. The Dell is dominated by Sycamore and Ash in the canopy with occasional Beech, Pendunculate Oak and Wild Cherry. Elder and Wych Elm are prominent in the understorey with occasional patches of Holly. Dog's Mercury is abundant in the ground flora with Wood False-brome, Ivy, Rough Meadow-grass, Cow Parsley, Stinging Nettle, and Enchanter's Nightshade in addition to more notable species such as Wood Sedge.

Bank Face Habitat

The northern bank of the river varies in its composition throughout the site. Towards the north east of the site, the riverbank is comprised of a vertical gabion wall of around three meters in height. Despite its artificial nature, silt and sediment has accumulated to form a bench at the toe of the bank that has become rapidly colonised by crack willow. Despite the willows over shading the river to a certain degree, they work to provide a more natural edge to the corridor and offer far better structural habitat than the gabion wall does.



Moving downstream towards to centre of the site, the bank is comprised of low lying (<1m) mudflats that extend up to 50 meters away from the river corridor. The mudflats are densely populated with crack willows which overhang the channel and provide an area of cover which contrasts the sparsely vegetated southern bank of the river. Extensive areas of tall herbs and grasses are also present along the river bank, with traces of emergent vegetation at the toe of the bank.



Overhanging willow and emergent plant life

Moving downstream further towards the west of the site the bank increases in height (>1m) but still retains a gently sloping gradient. Occasional vegetated side bars are present at the toe of the bank and provide areas of lush emergent linear leaved vegetation. The top of the bank is lined with a fringe of deciduous trees which occasionally overhang and trail into the river corridor, providing cover for fish and perches for birds such as kingfishers and herons.

The southern bank of the river is comprised of a vertical brick wall. This is bordered by a set back embankment toward the east of the site. The brick wall provides little habitat for wildlife aside from occasional areas of moss, lichens and stinging nettles. In recent years local volunteer groups have worked to increase the structural habitat complexity of the southern bank by creating berms and flow deflectors from brush wood at the toe of the bank. The brush-wood features have stabilised silt in the margins of the river to form low-lying benches. The features have also been planted with a diverse array of native aquatic plant species and now provide complex littoral habitat. In other areas trees have been left to grow in front of the brick bank which have also worked to stabilise sediment, providing a more natural frontage to the bank face and improved structural habitat.



Habitat improvement works

River Bed Habitat, Substrate and Flow

Throughout the majority of the site, the river is a low energy watercourse with a uniformly smooth flow type. The river becomes progressively deeper as it flows west, with the upper reaches being around

0.3m deep and the lower reaches being around 0.6m deep. The river's substrate is comprised primarily of silt which is most abundant in the sections of river towards the top and the bottom of the site. The dominance of fine substrate reflects that the river has a poor ability to appropriately sort and grade sediment into morphological features and that the river is still recovering from the impacts of modification. Areas such as these do not provide favourable conditions for diverse fish and invertebrate populations to thrive, which require clean well oxygenated gravels.



Wide, slow flowing channel, dominated by fine substrate

The central section of river channel offers greater variation in substrate type with gravel pebble becoming more abundant. This is due to the habitat improvement works that have been undertaken in recent years, which have increased the scour of the riverbed, resulting in clean gravels being exposed. Gravel substrate has also been imported to form riffle habitat and side bars and is slowly migrating along the river corridor. The habitat features

installed have worked to provide a greater variation in depth and a more natural profile to an otherwise uniform and featureless river channel.

Natural geomorphological features are occasionally interspersed throughout the river corridor and show the river is attempting to recover after many years of modification. These take the form of vegetated and unvegetated side bars and berms found in the margins of the river where sediment falls out of suspension and settles. Due to the straightened and low energy nature of the river channel, these features take a long time to stabilise, aside from when they are aided by the presence of brush wood or trees protruding from the banks of the river.



Natural banks form where trees grow in channel

As a general rule of thumb, the river offers more advanced aquatic plant communities as it progresses towards the west of the site. This is due to the lower section of river having less tree cover and more abundant sunlight which has led to the proliferation of both emergent and submerged plant species. The

eastern, upper reach of the river provides very little diversity in regards to submerged aquatic vegetation, with most areas offering filamentous algae covering otherwise bare substrate. The algae is indicative of slightly eutrophic conditions, caused by residual pollution resulting from both agricultural and urban runoff. Much less emergent vegetation is also present due to the dominance of Crack Willow on the banks of the river.

Artificial Structures

Surface Water Outfalls

Two outfalls are present along the river channel and their locations are illustrated on page 4. The outfall immediately downstream of the railway viaduct has been observed to regularly pollute the watercourse, with 18 pollution incidents being logged since 2016 (CVFC Pollution Monitoring Application, 2019). Site users regularly complain about the foul smell and visual signs of pollution as they enter the recreation ground from upstream.

The pollution can be attributed to domestic sewerage misconnections and links between the foul and surface water sewerage system. Thames Water have identified that the outfall is served by a catchment area of over 2,500 properties and have committed to conducting tracing exercises to locate the sources of pollution. Until the sources are identified and rectified, the river will continue to receive persistent pollution in this location. Poor water quality may have an even larger impact on the river at this site than poor habitat quality and is directly responsible for

limiting the diversity and abundance of riverine wildlife at Oxhey Park.



The outfall showing typical signs of pollution

Bridges

Three bridges span the river: a railway viaduct to the north of the site; and the Wiggshall road bridge to the south of the site and a small footbridge towards the centre of the site. The two major bridges cause a high degree of shading and the watercourse beneath them is devoid of plant life, but should not cause any severe habitat connectivity issues as they are short in length and do not impede the passage of wildlife.

Invasive Species

Himalayan balsam often colonises the banks of the river, but does not dominate over native species due to diligent regular management from the Friends of Oxhey Park volunteer group. If the regular management were to cease, Himalayan balsam would rapidly recolonize and spread throughout the site. Small patches of Japanese Knotweed have also been found at the site in the past and have been successfully treated. The site should be surveyed for invasive plant species each year using the CVFC invasive species reporting application and management works carried out accordingly.

American signal crayfish burrows were found within the small area of earth bank to the north west of the site. The species is common place in the Colne Catchment. Crayfish burrowing mobilises sediment which has a negative impact on both water quality and habitat. If deemed a priority, the species should be monitored via the Rediscovering the River Colne Environmental Monitoring Project.

American Mink are known to be present throughout Hertfordshire and the Colne Catchment. Mink are aggressive predators that predate on the endangered water vole. One reason that mink cause such a problem for the species is that female and young mink are small and agile enough to follow a water vole into its burrow, leaving very few areas of refuge for the species. It is widely accepted that the presence of American Mink is one of the main reasons for the decline of water vole populations across the catchment.



Site Ecology

Site Criteria

The section of the river is designated as a Local Wildlife Site (84/04/01) for Flowing waters (rivers and streams); species. Local Wildlife Sites are non-statutory sites designated at a county level as being of conservation importance and often recognised in Local Authority development plans. The aim of this identification is to protect such sites from land management changes, which may lessen their nature conservation interest, and to encourage sensitive management to maintain and enhance their importance.

The site is designated for the following features: 'Section of the River Colne supporting a good diversity of marginal and aquatic vegetation. Species recorded include Branched Bur-reed (*Sparganium erectum*), Water Forget-me-not (*Myosotis scorpioides*), Water Mint (*Mentha aquatica*), Gypsywort (*Lycopus europaeus*), Water-cress (*Rorippa nasturtium-aquaticum*), Common Club-rush (*Schoenoplectus lacustris*) and Unbranched Bur-reed (*Sparganium emersum*).' Aside from Unbranched Bur-reed, all of these species are still present at the site and were recorded at the time of survey.

Bats

Herts and Middlesex Wildlife Trust installed remote bat detectors at four different locations adjacent to the river in Watford. The detectors were deployed

for four nights from 01/07/2019 to 05/07/2019. The detector deployed at Oxhey park recoded three species of bat: common pipistrelle, soprano pipistrelle and daubentons. The presence of common pipistrelle and soprano pipistrelle are to be expected and are common throughout the Colne Valley. A higher number of species were recorded at sites further away from the town centre. The bat population is likely to be limited at Oxhey Park due to its close proximity to the town centre, associated light pollution and poor water quality.

Water Voles

No signs of water voles were recorded during the most recent survey undertaken by the project team (HMWT, 2019). The nearest known population of water voles is about 3km downstream, at Croxley Hall Fishery. Overall, there is probably enough reasonable habitat to allow water voles to move through Watford, but relatively few places that would allow a population to establish and thrive. The recent habitat improvement works delivered at Oxhey Park have significantly improved water vole habitat throughout the river corridor and efforts should continue to re-naturalise the banks of the river and to decrease shading.

Otters

The otter survey conducted by the project team (HMWT, 2019) did not identify any evidence of otters

at the site. Otter spraint was recorded at two sites upstream however, one being less than a kilometre away near Watford Tesco's. It is presumed that the spraint was deposited by Otters prospecting up the River Colne from what is believed to be an established population in the mid-Colne Valley. Otter populations are likely to increase in Watford should the Colne's fish populations become more resilient.

Coarse Fish

Historically the river would have provided a full assemblage of coarse fish species in addition to salmonids, such as brown trout. Due to persistent pollution incidents and habitat degradation, fish stocks are believed to have dwindled to record lows until 2018 when the river was restocked by the Environment Agency. The stocking consisted of 2,000 barbel, 750 chub and 750 dace. All of these species are still present and were observed by the project team whilst conducting surveys on site.

Bird Life

At the time of survey, the project team identified the following bird species at the site: Blackbird, Dunnock, Goldfinch, Long-tailed tit, Carrion crow, Jackdaw, Jay, Grey wagtail, House sparrow, Blue tit, Great tit, Collared dove, Wood pigeon, Grey heron and Moorhen (HMWT, 2019)

Site Water Quality

River flies

A range of aquatic invertebrates are present and emerge in their flying form in spring and summer to provide an essential food source for fish, birds and bats. The river fly population is currently limited due to poor water and habitat quality.

River fly Monitoring

Water quality is monitored on a monthly basis at the site via the Anglers Riverfly Monitoring Initiative (ARMI). ARMI is a citizen science initiative that facilitates regular monitoring of river water quality by trained volunteer monitors, to complement the more detailed work carried out by the EA.

The method involves taking a three minute kick sample using transects that are reflective of the habitat available at the monitoring site. Eight target groups of aquatic invertebrate 'indicator species' are monitored and a score is generated based on their abundance and the number of individuals recorded. The score can be used to detect any severe perturbations in river water quality providing an evidence base to address sources of pollution.

Oxhey Park Results

The monitoring site immediately upstream of Oxhey Park (Lower Highstreet Bridge) returns the poorest ARMI results in the Colne Catchment. The site scores an average of 1.67 and regularly breaches the trigger

levels set by the Environment Agency. Scores returned from all ARMI sites in Watford illustrate an overall trend in declining water quality as the river progresses through Watford.

The outfall that pollutes the river most frequently is located to the north of the site, just downstream of the railway viaduct. Regular checks have shown that the outfall shows signs of pollution on most days including a strong smell of sewerage, discolouration of the watercourse and sewage rag on the bed of the river. A water sample from the outfall has also been provided to Affinity Water for further analysis. The chemical analysis identified a range of hazardous substances in the effluent of the outfall with the potential to harm aquatic life and affect human health.

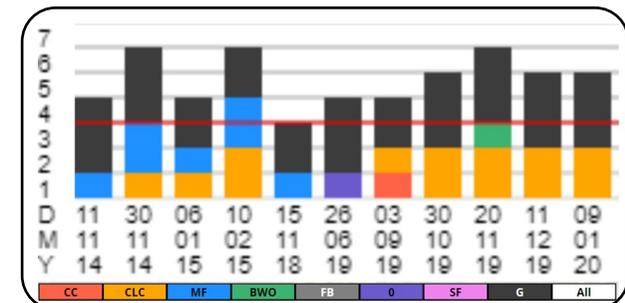
The pollution can be attributed to domestic sewerage misconnections and links between the foul and surface water sewerage system. Thames Water have identified that the outfall is served by a catchment area of over 2,500 properties and have committed to conducting tracing exercises to locate the sources of pollution. Until the sources are identified and rectified, the river will continue to receive persistent pollution in this location. Poor water quality is likely to have an even larger impact on the river at this site than poor habitat quality and is directly responsible for limiting the diversity and abundance of riverine wildlife at Oxhey Park.

Additional Monitoring Activities

The *Rediscovering The River Colne Project* intends to extend the river fly monitoring network to reflect all sites in Watford and to facilitate additional monitoring activities to improve understanding of pollution in Watford. The project facilitates a regular meeting, known as *WatfordWater Quality Forum*, between Watford Borough Council, Thames Water, The Environment Agency, Groundwork, The CVFC and Community Connections Projects CIC. The forum works to identify and deliver improvements to surface water and wastewater infrastructure in Watford.



ARMI results for all Watford sites (upstream)



Water Framework Directive (WFD)

What is the WFD?

During the 1990s the European Commission recognised that we needed an integrated and comprehensive way of managing the water environment and so the Water Framework Directive (WFD) came into existence. It has been part of UK law since 2003.

The original aim of the WFD was for all rivers, lakes, reservoirs, streams, canals, estuaries, coastal and groundwater (known as water bodies) to be in good ecological health by 2015. However, the EU has recognised that it will be an almost impossible task to reach this goal by 2015, so in most cases this deadline has been extended to 2021 or 2027.

What is a healthy water body?

A healthy water body has thriving populations of fish, invertebrates, plants and diatoms (microscopic algae). They depend upon a healthy flow of water and a variety of natural habitats. All of these are affected by the levels of pollution and nutrients in the water, and the shape and structure of the water body. The Environment Agency uses many different measures to assess the ecological health of a water body. They include:

- the variety and numbers of different types of animals and plants living in the water body

- the state of the water itself, such as the temperature.
- the amount of oxygen, how acidic or alkaline it is (the pH), and the concentration of nutrients like ammonia and phosphate
- the concentration of polluting chemicals from human activity, such as arsenic, cyanide and the breakdown products of pesticides
- and for Heavily Modified and Artificial Water Bodies, whether it could be made more natural without interfering with the way it is used.

These are combined to come up with an overall classification for each water body. The classifications are:



When the status of a water body is Moderate, Poor or Bad, the Environment Agency investigate the reasons why it is not in good ecological health.

Current WFD Status

- The overall WFD classification for *The Colne (Ver to Gade)* waterbody is **moderate**.
- It's chemical classification is **good**.
- Its ecological classification is **moderate**.

Reasons for Not Achieving Good Status

The Colne (Ver to Gade) waterbody is currently not achieving *good status* due to the following factors:

1. Changes to the river's natural flow and water levels due to abstraction from the water industry.
2. Continuous pollution from waste water related to the water industry.
3. Physical modifications to the watercourse arising from urban transport and infrastructure.

Activities Listed in this plan which address these issues

1. Pool/Riffle creation (P15-16)
Wooded debris installation (P15-16)
Wet woodland enhancement (P13)
2. Pollution Tracing Exercise (P8)
Improved water quality monitoring (P11,16)
Watford Water Quality Forum (P11,16))
3. Wet woodland enhancement (P13)
Wooded debris installation (P15)
Pool / Riffle creation (P13,15,)
Tree works (P13,15)

Habitat Improvement Recommendations

Northern Floodplain

Eastern Compartment

Wet woodlands are woods which are frequently or seasonally wet either through the action of flooding; from streams or rivers (floodplain woodlands); from springs; from geological features which 'pool' water (e.g. clay soils); or from surface water runoff. Floodplain woodlands are one of the most dynamic natural habitats in the UK but, along with wet woodlands, they are almost extinct in lowland Britain. Wet woodlands are not just a dense wall of trees. They have between 30 and 70% tree cover and include open areas and other dry and wet habitats such as scrub, reedbeds and seasonal ponds.

Wet woodland is important nationally and locally for a number of priority species including the Otter, the Black poplar tree, Marsh warblers, Spotted flycatchers, Common cranes, Lesser spotted woodpeckers, Woodcock, Nightingale, Willow tit, the Weevils *Melanapion minimum* and *Thynchaenus testaceus*, the Craneflies *Lipsothrix ecucullata*, *L.nervosa*, *L.errans* and *L.nigristigma* and the Netted carpet moth *Eustromia reticulate*. Ghyll woodlands are particularly important for mosses, ferns and liverworts, although all wet woodlands are host to a wide range of plant species.

In order to identify sites where wet woodland creation is viable the following criteria should be met:

1. Sites with naturally occurring springs or where rivers flood onto the floodplain.
2. Sites which are obviously trying to revert to woodland and scrub naturally.
3. Sites with little or no existing conservation interest such as improved grassland, species poor grazing marsh or intensive arable land.
4. Sites which are obviously waterlogged (low lying land).
5. Sites near to existing hedgerows, copses or ancient woodland.
6. Sites where (wet) woodland is shown on old or tithe maps.
7. Sites which have no value as farm land.
8. Old river meanders / field corners which are hard to farm and can be fenced off

The site meets all the above criteria and therefore wet woodland creation appears to be the most viable option for this location. The following actions should be undertaken to create wet woodland at the site.

1. 20% of the willows should be coppiced and thinned each year to provide space for the introduction of new species.

2. Once an area is cleared opportunities should be identified to create small scrapes which will retain water. This will provide niches for a wider variety of wildlife.
3. Amphibian hibernacula should be created on the peripheries of the scrapes, with materials arising from tree works.
4. An appropriate mix of wet woodland whips should be introduced to all designated tree planting areas. Trees should be planted with 5m spacings, including some clumps. It is recommended that planting takes place at the start of autumn, after the dry season but before flooding is likely to occur. Different species should be utilised to match dryer 'edge' habitats and wetter pond habitats.

The following species should be considered for the canopy: Alder (*Alnus glutinosa*); Crack Willow (*Salix fragilis*); Oak (*Quercus robur*); Black Poplar (*Populus nigra ssp.betulifolia*); Ash (*Fraxinus excelsior*); and White Willow *Salix alba*.

The following species should be considered for the understorey: Grey willow (*Salix cinerea*); Elder (*Sambucus nigra*); Osier (*Salix viminalis*); Hawthorn (*Crataegus monogyna*); Goat



Legend:



1
Brush berm



2
Deflector/pool/riffle



3
Introduce gravels



4
Improve wet woodland



5
Coppice trees on rotation



6
Woodland management



7
Grassland management

Oxhey Park habitat improvement map

Willow (*Salix caprea*); Holly (*Ilex aquifolium*); Hazel (*Corylus avellana*); Blackthorn (*Prunus spinosa*); and Guelder Rose (*Viburnum opulus*).

5. After 5 years, 20% of the wet woodland should be re-coppiced annually in accordance with the specific requirements of each species.

Western Compartment

Habitat improvement works have not been identified for western compartment of the northern floodplain as it is currently being developed as the Oxhey Activity Park.

Southern Floodplain

Grassland

The grassland can be enhanced through targeted wildflower meadow strip creation and management. At present there is some evidence of wildflower, or rough grassland strips being created. If these and new strips are to reach their botanical potential they will need to be managed appropriately. The current rough grass strip in the north western corner is quite rank with coarse grass and competitive species. All current and new wildflower strips should receive the following management:

- Cut and clear in July and October it would improve its botanical diversity.
- Leave 10% of the strip uncut after each cutting episode to provide a refuge for invertebrates.

- Introduce Yellow-rattle (*Rhinanthus minor*) after the October cut. This semi-parasitic plant will reduce grass competition to the benefit of the wildflowers.
- Cut 50% each year in October on rotation.

There is a strip going across the top of the currently short mown slope that is full of Common Knapweed. This could be incorporated into the meadow cutting regime to add more native flowering plants to the park.

The Dell

The woodland is young and needs time to develop. Greater structure could be created by rotational coppicing of the younger trees to create spaces for variations in local conditions and edge habitat. Cut material should be used to create dead wood habitat piles. The dominance of Sycamore will be hard to address and it is not proposed that attempts be made to eradicate it. Greater diversity in the canopy could be encouraged by planting trees which are components of National Vegetation Classification W8 woodland that are currently not present, but these will need to be carefully husbanded in order to avoid being out competed by the Sycamore. The woodland is an ideal place to erect bat and bird boxes. Young woodland contains fewer roosting and nesting resources so augmenting these with artificial structures will benefit bat and bird populations. Bat boxes should be placed in deep shade with good flight paths to attract maternity colonies of woodland specialist bats.

River Channel

The following issues affecting the river channel have been identified in this location:

1. The river lacks marginal and riparian vegetation due to its modified cross-sectional profile and reinforced banks.
2. There is little variation in the depth and little sinuosity due to the channel's straightened longitudinal profile.
3. There is little variation in flow type, with the flow of the river being predominantly smooth and slow flowing due to the enlarged nature of the river channel.
4. The river channel is not suited to low flow conditions and is susceptible to the effects of climate change.
5. The riparian zone lacks suitable habitat for bat roosting.
6. Anglers often trample on important habitat in order to access the river channel.
7. The river suffers from reoccurring pollution issues that limit aquatic biodiversity.

Many of these issues have already been identified and the recent habitat improvement works at the site have worked to improve on all of these factors. The continuation of the following works are recommended.

1. Brushwood berms should be installed in the margins of the river to create a sinuous low flow channel. This will significantly improve the river's cross-sectional profile, providing a narrower and faster flowing central channel where morphological processes occur freely in addition to providing sheltered areas in the margins of the river for aquatic plants to grow.
2. The newly formed banks should be planted with an appropriate array of native aquatic plant species. This will provide suitable habitat for water voles, nesting wildfowl and complex littoral cover for juvenile coarse fish.
3. Flow deflectors should be created with materials arising from tree works to encourage the scouring of the river bed. This will reduce the deposition of silt on the river bed in addition to providing sheltered areas in the margins of the river for plant life to establish.
4. Locally sourced gravel substrate should be introduced to form riffle habitat, thus creating greater variation in depths and flow types.
5. Tree coppicing and removal work should be carried out along the north eastern bank to provide a 60:40 light shade ratio. This will encourage both submerged and emergent aquatic plant species to establish.
6. The encroachment of the woodland elsewhere should be prevented by periodic coppicing of

vegetative margin balance and prevent an increase in shading to the channel.

7. The activity of angling should be formalised, with set pegs marked for fishing. This will prevent fragile habitats from being impacted by the activity. An angling club could also be approached to take on the fishing rights for the site.
8. Bat boxes should be erected on suitable trees by the water course. Bat boxes should be Schwegler 2F-DP and located in deep shade and dappled sunlit glades, with good flight access, to attract target species e.g. Daubenton's, soprano pipistrelle and Nathusius' pipistrelle.

Further Management Recommendations:

1. Eradicate the Himalayan Balsam by constant pulling during summer months.
2. Introduce mink monitoring rafts within the river. These should be sited away from public areas to avoid disturbance.
3. Undertake a regular litter pick of the river channel to prevent the accumulation of litter and sewage rag.

Water Quality

Improved Water Quality Monitoring

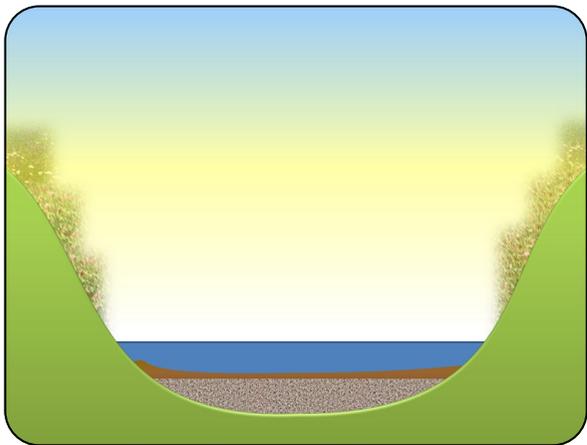
The two outfalls at the site should be included within The Rediscovering The River Colne's Environmental Monitoring Project. It is recommended that an annual outfall safari should be undertaken for all surface water outfalls in the Watford area to ascertain their baseline condition. This should be followed up with monthly river fly monitoring and chemical analysis at key sites within the project area to ascertain the regularity in which pollution incidents occur and their effect on the aquatic environment. Please see the Rediscovering the River Colne's Environmental Monitoring Feasibility Study report for further information.

Watford Water Quality Forum

A forum has been created through the rediscovering the Colne Project to provide a long term strategy for resolving water quality issues in Watford. The Watford Water Quality Forum provides a regular meeting between Thames Water, The Environment Agency, Watford Borough Council, Groundwork, The Colne Valley Fisheries Consultative and Community Connections Projects CIC in order to identify and rectify issues with waste water infrastructure in Watford.

Design Considerations

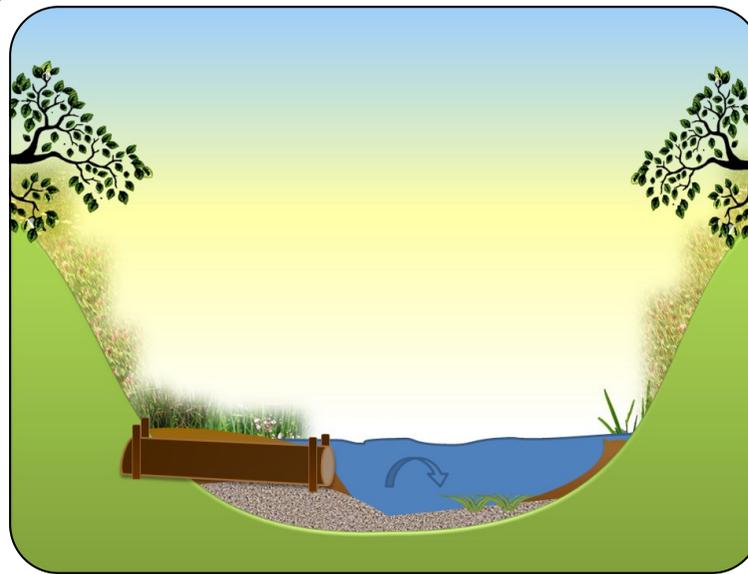
Brush Berms and Flow Deflectors



The river channel has a modified profile and uniform depth. Siltation occurs in over shaded areas where emergent plant species are not present to stabilise loose silt in the margins of the river.

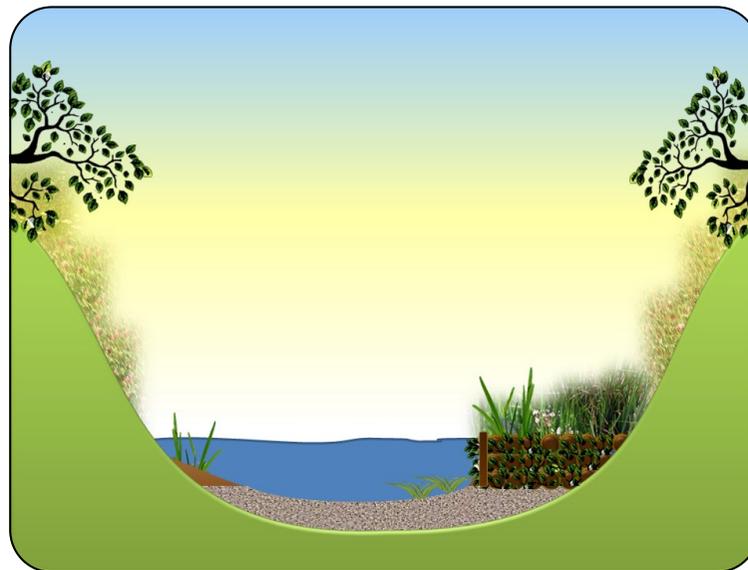
Over shading trees can be coppiced and repurposed to create brush berms and flow deflectors within the channel to mimic natural sinuosity, stabilise sediment and to create a variety of depths and flow types.

These features can be easily installed by local volunteer teams. An environmental permit must be obtained from the Environment Agency in order to undertake this activity.



Flow deflectors are used to pinch the width of the river which reduces siltation, creates scour and facilitates a variety of different flow types.

They are created by securing tree trunks to the bed of the river with chestnut posts and galvanised steel wire. A pool feature can also be created downstream of each deflector's location to provide a variety of depths. Materials won from excavating pools can be repurposed to create riffles or side bars, which further increase physical habitat complexity.

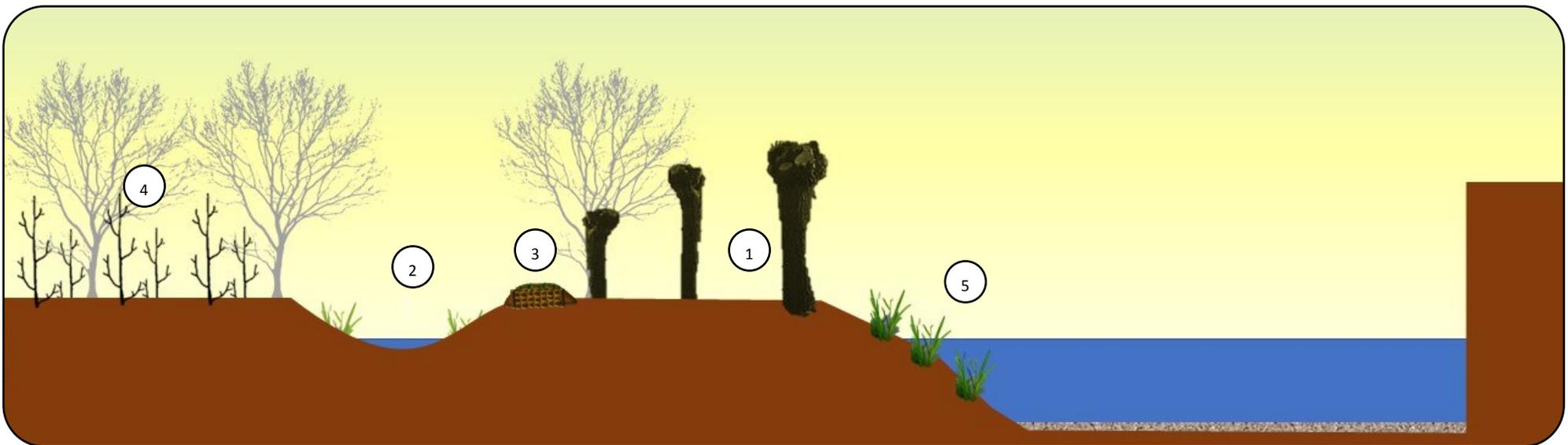


Brush berms can also be installed to pinch the width of the river and can be used to mimic natural sinuosity. They provide useful low lying areas for aquatic plants to colonise in addition to providing physical structures for aquatic wildlife to shelter.

They are created by using tree branches to reshape the river, which are secured in place with chestnut posts and galvanised steel wire.

Wet Woodland Enhancement

1. Divide the area into five compartments and coppice one per year to open up more space for tree planting and pond creation.
2. Identify the most low lying areas and dig small ponds using hand tools to create areas of standing water. Consider planting shade tolerant plants if natural colonisation is slow.
3. Create amphibian hibernacula with materials won from coppicing. These are created by digging a shallow (30cm) trench, stacking branches lengthways within the trench and then covering the structure over with excavated soil and soft vegetation.
4. Plant whips with a mixture of canopy and understory species. Leave 5m between each whip, but occasionally plant in clumps of similar species.
5. Ensure the river bank has a mixture of overhanging tree cover and open areas where emergent plants, tall herbs and grasses can establish. Consider introducing plug plants if natural colonisation is slow.
6. Move on to the next compartment the following year and repeat this process until a diverse wet woodland is established.
7. Once all ponds and hibernacula are created and all whips are planted, continue to coppice each compartment on 5 year rotation and in line with individual requirements of each species.



Site Action Plan

River channel improvements: Wooded Debris Features, Gravel installation, Minor Tree Works, Bat Box Installation

Activity	Action	Comments	Delivered by:
Wooded Debris Installation Gravel installation Minor Tree Works	1. Produce design illustrating chosen locations of brush berms, flow deflectors, hinged trees, pools and riffles, minor tree works.	The following construction drawings should be produced should be produced: 1. Site plan <i>Illustration showing the location of each improvement proposed on site.</i> 2. Cross sections and longitudinal sections for each improvement	Groundwork
Wooded Debris Installation Gravel installation Minor Tree Works	2. Apply and obtain bespoke environmental permit to cover works.	The following documentation is required for an Environmental Permit application. 1. The construction drawings listed above 2. Site management plan <i>Document containing all aspects of site management.</i> 3. Construction Methodology <i>Method of construction for each activity proposed.</i> 4. Water Framework Directive Compliance Assessment <i>WFD compliance evaluated for each activity proposed.</i> 5. Environmental Risk Assessment <i>Environmental risk and mitigation identified for each activity.</i> 6. Site Risk Assessment <i>Risk to workers/site users and appropriate mitigation identified.</i>	Groundwork
Wooded Debris Installation Gravel installation Minor Tree Works	3. Undertake improvement works with local volunteers.	Likely Construction Methodology Trees in shaded locations should be coppiced to provide materials for the creation of brush berms and flow deflectors. Willow should not be used as it will regrow and require persistent management.	Community Connections Projects CIC

Brush Berms

Community Connections Projects CIC

Design Considerations:

In order to ensure that brush berms do not cause blockages or excessively limit the water storage capacity of the channel they should be installed following these specifications:

1. Brush berms should extend no further than one third of the width of the river channel in any location.
2. Brush Berms should be no higher than 25% of the river's banks in any location they are placed.
3. Brush berms should be spaced at least 10meters apart to avoid creating pinch points in the river.
4. All berms should be installed via the method specified below

Installation method

1. The area of the berm is marked out by two rows of chestnut or hazel posts.
2. This area is backfilled with wooded debris (hawthorn). The heavy trunk ends of branches are placed facing upstream. The light 'leaf' ends are faced downstream so that the berm is hydrodynamic. As the berm is filled, new pieces of wood are locked and woven in behind existing pieces so that the berm will hold together as one structure when river levels rise.
3. When the berm is positioned correctly, it is secured by looping galvanized steel wire over each pair of posts surrounding the berm (bank side to river side). Additional steel staples are also used to secure the wire to the posts. Alternatively chestnut batons may be used to provide a more natural/biodegradable finish.
4. The loops of wire are then strained so that they are held tightly over the berm.

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Community Connections Projects CIC

5. Each row of chestnut posts is hammered down with a fencing maul, permanently securing all material positioned in the berm under the loops of strained wire they are attached to.
6. Finally the berm is checked for material that may come loose and cause blockages elsewhere in the river channel. Excess wood sticking out from the berm is also trimmed to improve hydrodynamics.

Flow Deflectors

Design considerations

1. In order to ensure that flow deflectors do not cause blockages or excessively limit the water storage capacity of the channel they should be installed follow these specifications:
2. Deflectors should extend no further than one third of the width of the river channel in any location.
3. Deflectors should be no higher than 25% of the river's banks river in any location they are placed.
4. All deflectors should be installed via the method specified below.

Installation Method

1. A cross section of tree trunk/branch is obtained and positioned facing upstream from the margins of the river.
2. Every meter, two pairs of posts are hammered into the river bed on either side of the deflector so that it is secured firmly along its length.
3. Galvanized steel wire is looped around both sets of posts and secured with heavy duty metal staples. The wire is then strained so that it is strung tightly between each pair of posts, with no slack.
4. Each pair of posts is then hammered further into the river bed so that the strained galvanized steel wire pins the deflector perma-

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Gravel Installation

Design considerations

1. All gravels should be locally sourced and be of a similar size and shape to those found elsewhere in the river.
2. Gravel riffles should smoothly slope to a crest. The crest should be sufficiently below the water surface to ensure that it never becomes exposed, even in low flow conditions. No gravel features should ever impound the flow of the river.
3. Side bar features should not extend further than 30% of the channel width and should be built no higher than the surface level of the river.

Installation Method

1. Gravels should be tipped into the river by hand (wheel barrow or sacks).
2. All gravel features should be constructed using hand tools to the specifications agreed by the Environment Agency.

Bat Boxes

4. Install bat boxes with local volunteers

Design Considerations

1. Bat boxes should be Schwegler 2F-DP
2. Should be located in deep shade and dappled sunlit glades, with good flight access, to attract target species.
3. Should be located on the Northern bank of the river and in 'The Dell' to avoid disturbance.
4. Bat boxes should ideally be placed between 3m-6m in height on a tree.
5. Bat boxes should be located approximately 20m apart across the site.

Installation Method

1. Batboxes should be installed by a minimum of two people (one to attach box to tree, one to hold ladder / supervise).
2. Bat boxes are attached to trees simply by mounting on a screw or nail.

Herts and Middlesex Wildlife Trust

Floodplain Improvements: Wet Woodland Enhancement

Activity	Action	Comments	Delivered by:
Wet Woodland Enhancement	1. Produce indicative design	1. Produce a design illustrating the five compartments of the mud flats area (In order to coppice on 5 year rotation)	Community Connections Projects CIC
		2. Mark areas which are desirable for pond creation (choose the most low lying and wet areas.)	Friends of Oxhey Park
		3. Mark areas where tree planting is required (choose the most open areas and mark the location where each species will be introduced.)	
		4. Mark the locations where amphibian hibernacula will be installed.	
		5. Agree plan with Watford Borough Council and Friends of Oxhey Park.	
Wet Woodland Enhancement	3. Order tools and materials for pond creation as required through out the project.	Tools and materials required:	Community Connections Projects CIC
		1. Digging tools (spades, pick axes)	Friends of Oxhey Park
		2. Grading tools (rakes, tampers)	
		3. PPE (Gloves, helmet, eyewear, footwear)	
Wet Woodland Enhancement	4. Enhance 1 of the 5 compartments each year in accordance with the indicative design.	4. Tree whips	
		1. Coppice existing willows and remove new saplings.	Community Connections Projects CIC
		2. Use hand tools to excavate low lying areas to provide areas of open water.	Friends of Oxhey Park
		3. Introduce shade tolerant aquatic plant species to the margins of each pond.	
		4. Plant whips with 5 meter spacing and in occasional clumps of the same species in order to provide a canopy and understory.	
		5. Repeat process the following year in the next compartment .	
6. After 5 years, re-coppice 1 compartment per year and maintain ponds.			

Ongoing management actions

Activity	Action	Comments	Delivered by:
Grassland Management	1. Create new wildflower strips	<ul style="list-style-type: none"> Create new wildflower meadow strips in appropriate locations. 	Community Connections Projects CIC Friends of Oxhey Park
	2. Improve management of existing wildflower strips.	<ul style="list-style-type: none"> Manage all new and existing wildflower strips accordingly: <ol style="list-style-type: none"> Cut and clear in July and October it would improve its botanical diversity. Leave 10% of the strip uncut after each cutting episode to provide a refuge for invertebrates. Introduce Yellow-rattle (<i>Rhinanthus minor</i>) after the October cut. This hemi-parasitic plant will reduce grass competition to the benefit of the wildflowers. Cut 50% each year in October on rotation. There is a strip going across the top of the currently short mown slope that is full of Common Knapweed. This could be incorporated into the meadow cutting regime to add more native flowering plants to the park. 	
Woodland Management (The Dell)	3. Improve management of The Dell.	<ol style="list-style-type: none"> Coppice younger trees to create spaces for variations in local conditions and edge habitat. Cut material should be used to create dead wood habitat piles. Greater diversity in the canopy could be encouraged by planting trees which are components of National Vegetation Classification W8 woodland that are currently not present, but these will need to be carefully husbanded in order to avoid being out competed by the Sycamore. Erect bat and bird boxes. Bat boxes should be placed in deep shade with good flight paths to attract maternity colonies of woodland specialist bats. 	Community Connections Projects CIC Friends of Oxhey Park

Activity	Action	Comments	Delivered by:
Manage the riparian zone of the river corridor	1. Coppice riparian tree cover as required.	2. Coppice riparian tree cover to maintain 60:40 light/shade ratio.	Community Connections Projects CIC Friends of Oxhey Park
Control INNS	2. Survey and control invasive species each year.	The site should be surveyed using the CVFC INNS application and control work conducted accordingly.	Community Connections Projects CIC Friends of Oxhey Park
Clear litter	4. Conduct annual river clean up	Undertake a litter pick of the river channel once a year	Community Connections Projects CIC Friends of Oxhey Park
Monitor Water Quality	5. Conduct RMI, chemical analysis and outfall safari	Continue to monitor water quality at the site in accordance with the recommendations of the Environmental Monitoring Project.	Community Connections Projects CIC Friends of Oxhey Park

Estimated Costs

River channel improvements: Wooded Debris Features, Gravel installation, Minor Tree Works, Bat Box Installation

Activity	Items	Cost	Total
Design and Permitting for Wooded debris work	Design Work	£1,000	£1,500
	Permitting	£500	
Construction of wooded debris features, gravel features and minor tree works	Staff time (15 days)	£3,750	£3,750
	Materials	£3,000	£3,000
Installation of bat boxes	Staff time (4 days)	£1,000	£1,300
	Materials	£300	
TOTAL			£9,550

Floodplain enhancement works: Wetwoodland Enhancement

Design Work	Design Work	£250	£250
Delivery of improvement works (for all 5 years)	Staff time (25 days or 5 days per year)	£6,250	£6,250
	Materials	£5,000	£5,000
Installation of bat boxes	Staff time (4 days)	£1,000	£1,300
	Materials	£300	
TOTAL			£12,800

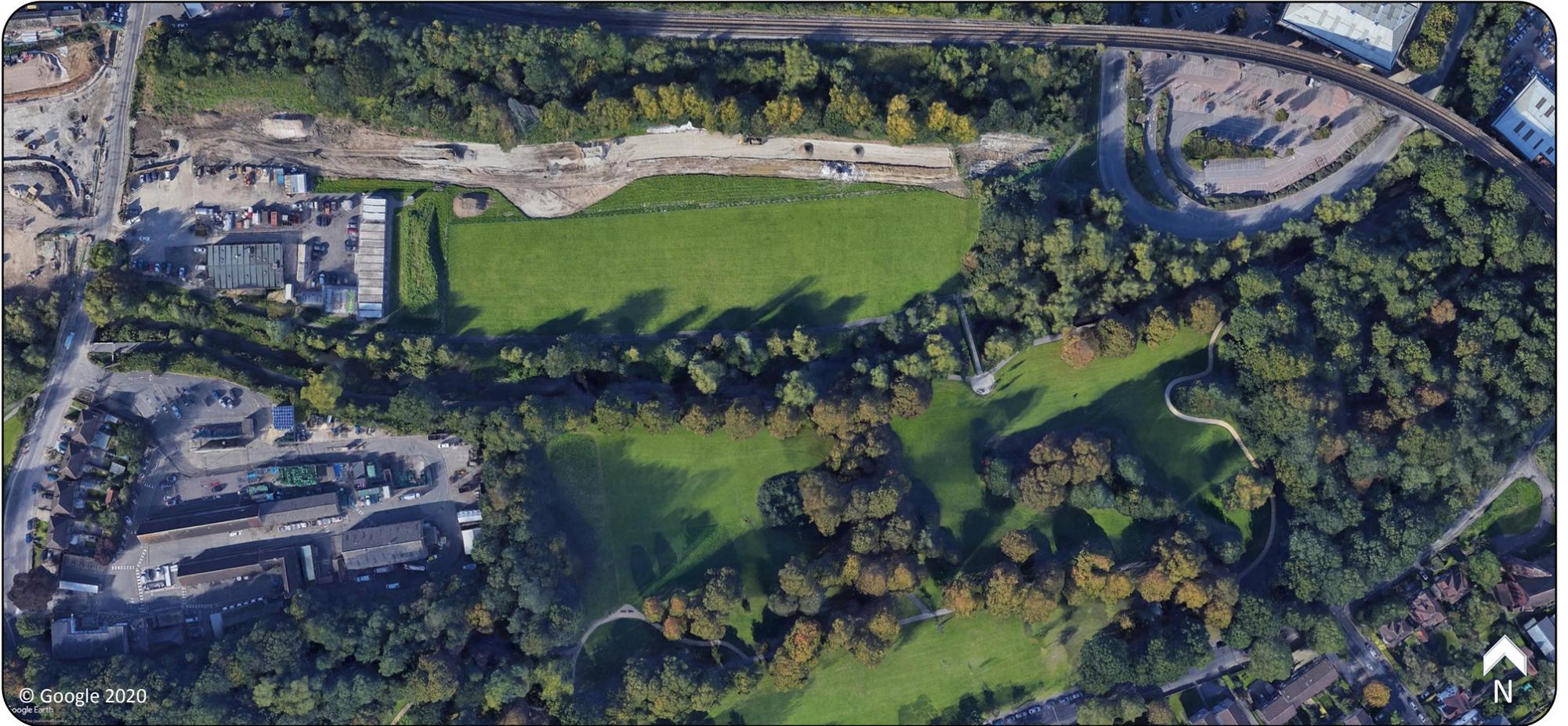
Total Project Costs

River channel improvements	£9,550
Floodplain enhancement	£12,800
TOTAL	£22,350

Ongoing Maintenance Cost s

Floodplain Management: Management of the Dell and grassland (6 days staff time)	£1,500
River Management: INNS management and litter pick (5 days staff time)	£1,250
TOTAL	£2,750

Site Access Plan



Plant access is not required. All improvements listed in this plan can be delivered using hand tools.

Utilities Search



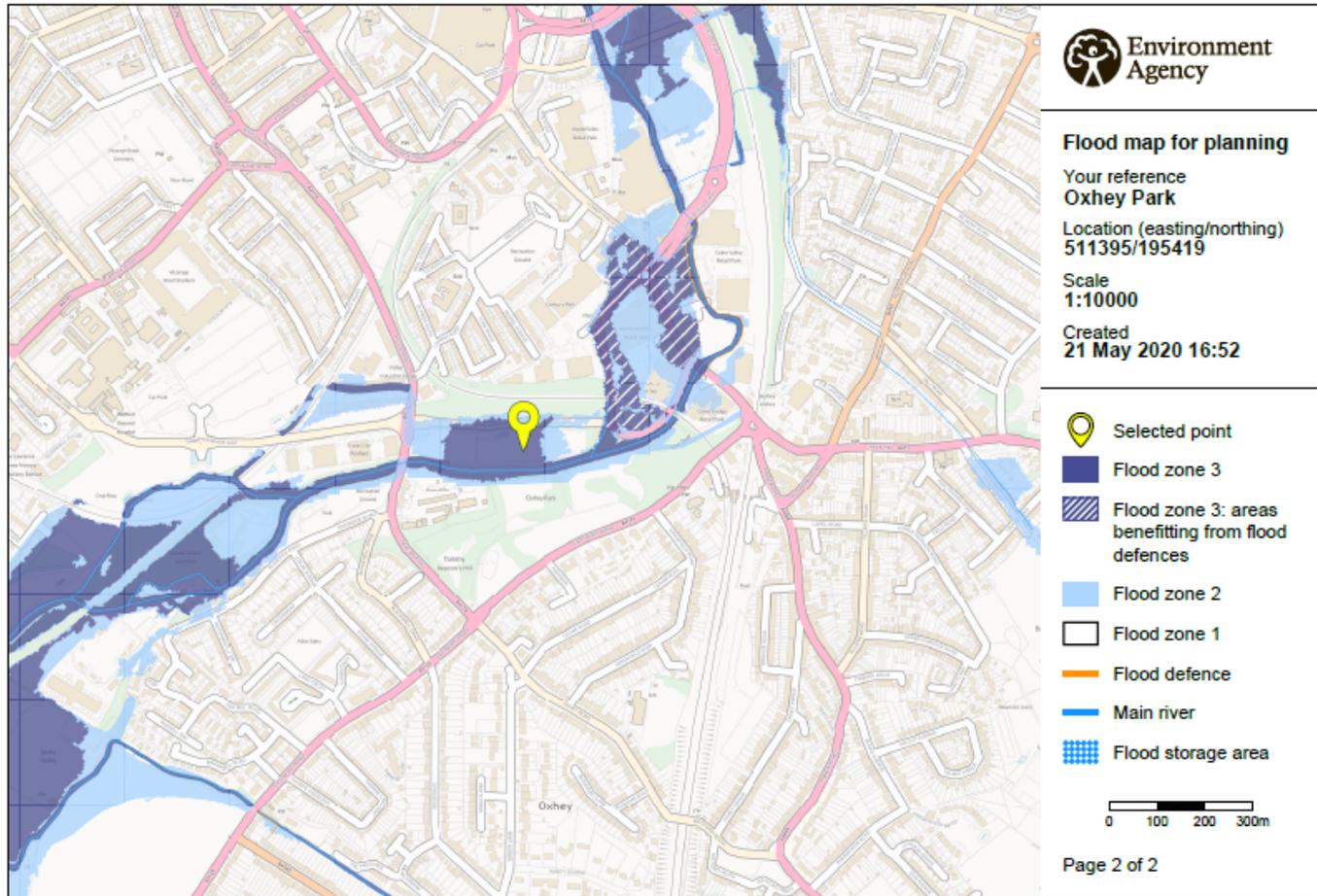
Sewers—Surface

Sewers—Foul

National Grid underground Cable

The locations of utilities should be interpreted as an initial guide in order to inform further design work. It is recommended that a new utilities search is conducted by the appointed contractor before construction works commence

Flood Map



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The majority of the northern floodplain is in flood zone 3, with some areas benefitting from flood defences. The provision of a wet woodland and ponds within this area will aid natural flood risk management.

The majority of the Southern floodplain does not fall within a flood one due to the high topography of Oxhey Park.

Any works proposed within the main river channel should not encourage out of channel flow and should not cause any significant obstruction or impoundment.

References

1. Herts and Middlesex Wildlife Trust (2019) Water Vole survey of the River Colne through Watford.
2. Herts and Middlesex Wildlife Trust (2019) Botanical survey and management for River Colne in Watford.
3. Groundwork South (2019) Oxhey Park modular river survey 2019.
4. Community Connections Projects CIC (2019) Riverfly Monitoring Report.
5. www.oxheypark.com (2020).
6. www.oxheyactivitypark.co.uk (2020).



Acknowledgements

This plan has been prepared by Groundwork South, host of the Colne Catchment Action Network, as part of the Rediscovering The River Colne Project, with funding from Watford Borough Council. We would like to thank the following organisations for making the production of this plan a truly collaborative process: Watford Borough Council, the Mayor of Watford Peter Taylor, The Environment Agency, Community Connections Projects CIC, The Colne Valley Fisheries Consultative, Herts and Middlesex Wildlife Trust, Thames Water, Affinity Water, Knutsford Green Gym, The Friends of Oxhey Park & The Wild Trout Trust