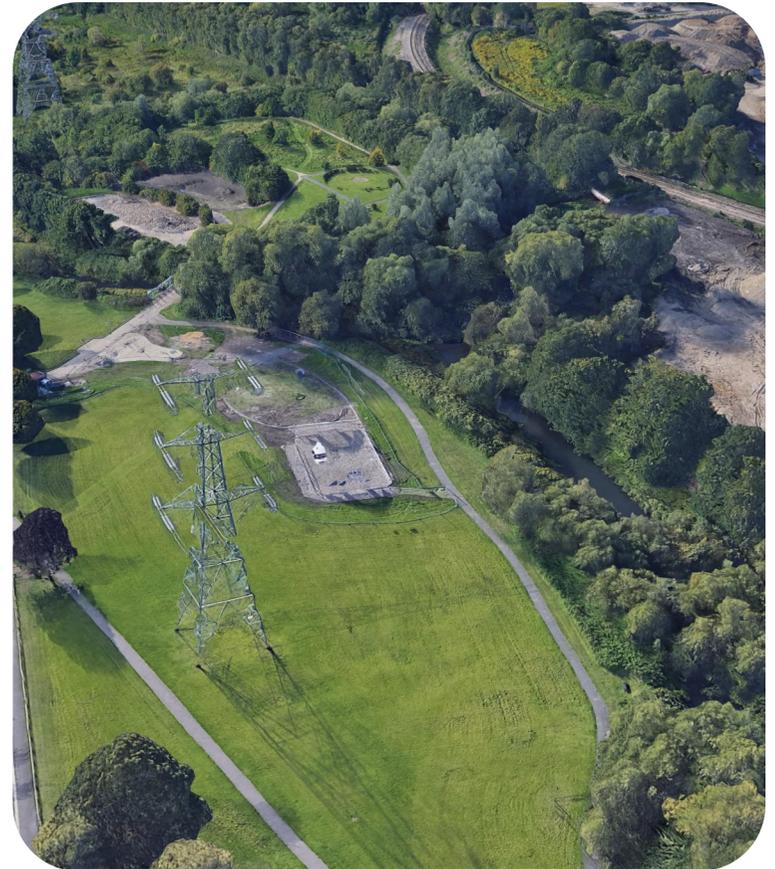


Riverside Recreation Ground

River Improvement Plan



**WATFORD
BOROUGH
COUNCIL**



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Introduction

The Rediscovering the River Colne Project

Rediscovering the River Colne is a ground breaking project that aspires to bring the River Colne to the heart of Watford and its people. The project will see the Colne corridor become a positive asset within the borough, enabling it to reach its full potential for both local people and wildlife.

The project aims to provide sustainable solutions to resolve the issues affecting the river and to regenerate the public spaces it flows through, providing a healthy river corridor, with clean water, diverse wildlife and low flood risk that is accessible to all and of high amenity value to local people.

The project builds on the knowledge of key stakeholders in the Colne Catchment Action Network in order to remain in keeping with Watford's diverse communities, natural assets and local wildlife, whilst linking into catchment wide initiatives that contribute to improving the health of the river network from the Chiltern Hills to the River Thames.

The Colne Catchment Action Network (ColneCAN)

The Colne Catchment Action Network is one of over a hundred catchment partnerships operating across the UK as part of The Catchment Based Approach policy framework launched by Defra in 2013. ColneCAN brings together water companies, local authorities, charities, anglers, conservationists, local residents and businesses to ensure catchment-wide thinking and local action. The partnership unites local stakeholders in achieving six aims for improving the river catchment: to control invasive species, to involve people with their local waterbodies, to improve wildlife corridors, to improve water quality, to manage flow, and to work together.

Note to Local Planners

This plan aims to assist local planning authorities in developing policies for river environmental protection. We encourage local planners to include policies to protect the River Colne's water quality, biodiversity and landscape in addition to making provisions for access and recreation around the river corridor. We urge local authorities to consider the role of The Town and Country Planning Act 1990, S106 funding and the Community Infrastructure Levy to facilitate the environmental improvements identified in this report.

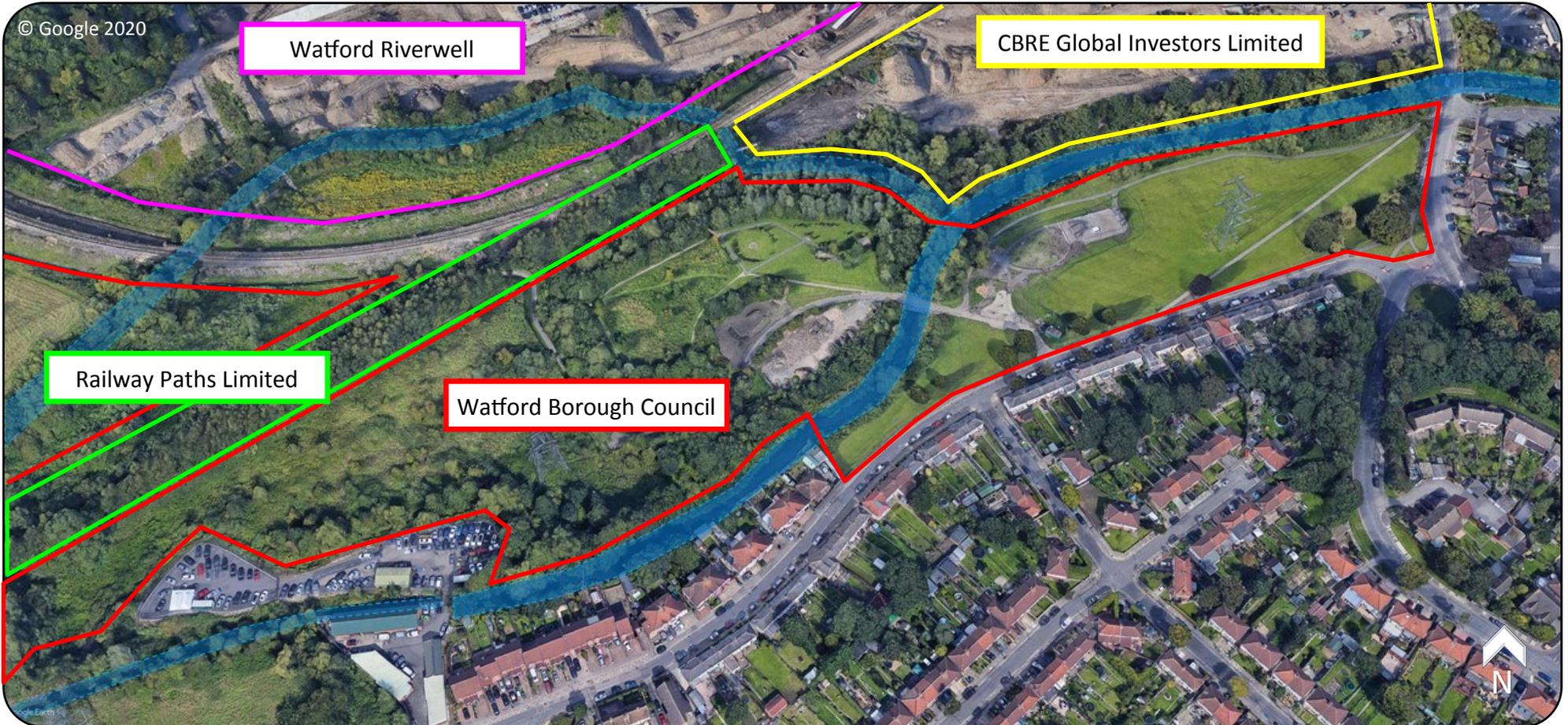
Riverside Recreation Ground

Riverside Recreation Ground is located on the banks of the River Colne, in South Watford. The site offers an open grass area for informal leisure activities, in addition to a skate park and a multi-use games area. The park is owned by Watford Borough Council but other privately-owned land lies to the peripheries of the river corridor. The River Colne flows in two channels along the northern and southern perimeters of the site, but the ecological value of the river corridor has declined over the past two centuries due to the sites industrial history, the occurrence of regular pollution incidents and a lack of management. Urgent intervention is required to ensure The Colne reaches its full ecological potential and does not continue to deteriorate.

The section of the river is designated as a Local Wildlife Site 84/04/01 for flowing waters (rivers and streams) and is described as a "section of the River Colne supporting a good diversity of marginal and aquatic vegetation." 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 designation is to protect sites from land management changes, which may lessen their nature conservation interest, and to encourage sensitive management to maintain and enhance their importance.



Site Plan



Riverside Recreation Ground 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

The land appropriated for Riverside Recreation Ground is shown on the Watford Plan of 1842 as part of the Wiggshall Estate and the site of a former silk factory. The landscape has changed dramatically over the past two centuries, with the island between the two river channels now being significantly raised and comprised of historic landfill. The surrounding landscape has also changed as the urban peripheries of Watford have expanded, with modern development encroaching to the boundaries of the river corridor. Today, the park is split into two basic eastern and western compartments. The eastern half is managed as amenity grassland with relatively good access to the river. The western half has poor access to the river, with a fence line and thick fringe of scrub, blocking access and views of the watercourse.

The land to the North of Riverside Park is owned by CBRE Global Investors Limited and provides an area of low-lying floodplain adjacent to the river channel that is not accessible to the general public. The land to the west of Riverside Park is owned by Kier Homes and is currently being developed as a new, private residential area and will be accessible for residents

only. A former railway line also runs through the site, which is owned by Railway Paths limited, but is not open to the general public.

River Profile and Course

The river splits into two channels at Riverside Park that converge downstream at Lairage Land Local Nature Reserve. This is believed to have resulted from the construction of the former silk mill located at the site. Water mills were often located on islands with one channel serving as a mill leat, where water was retained to drive machinery, and the other channel acting as a smaller bypass channel. The former mill leat is located on what is still marked as the main river channel on most maps. The reality today is starkly different, with the 'main river' being almost dry for half of its length and the former millstream being in comparatively good condition, with a superior flow, habitat and geomorphology. For this reason, mill stream should now be regarded as the main river channel

Section 1: Historic mill leat/former main river

The former mill leat is impounded by a sluice gate that was first installed to retain a head of water to power the silk mill. The upper extent of the channel has an enlarged profile but provides low lying (<1m), well vegetated, earth banks with good structural

habitat complexity. The channel looks as if it has been deepened historically to provide more volume for water storage, which is typical of former mill leats. The channel may have also been dredged in more recent times, as modified river channels of this nature are prone to heavy siltation. As the channel progresses westwards, it splits into two branches that run in parallel until they converge downstream at Lairage Land Local Nature Reserve.

As section 1 progresses further towards the sluice gate it becomes increasingly deep and slow flowing, with thick layers of silt accumulating upstream of the structure. This channel is choked with emergent vegetation and has a very undefined profile. The sluice gate retains a significant head of water and is currently not operational. This has resulted in the loss in ability to control flows downstream of the structure and comparatively high water levels upstream of the structure. A relatively small amount of flow is able to pass through the undershot sluice and as a result of this the channel downstream is drying out, with very low water levels and abundant vegetation growing across the full width of the riverbed. The section of the channel immediately below the sluice has brick banks and is exposed to a high degree of human pressure due to the presence of residential properties and a mechanics yard in the riparian zone. As the channel progresses towards

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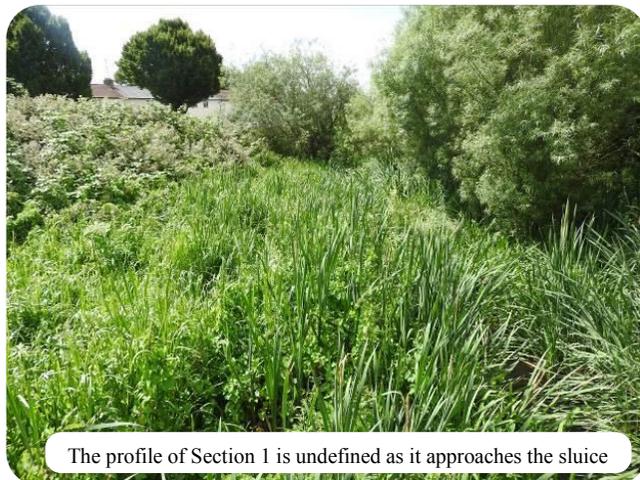
Legend:



Riparian woodland Secondary woodland Bramble scrub Amenity grassland Wildflower meadow Flood meadow Flowing water Revetment No fish passage

Riverside Recreation Ground habitat map

Lairage Land, it becomes less modified with earth banks and a natural profile. The lower extent of the channel also increases in depth as it flows closer to its confluence with the main river channel (section 2).



The profile of Section 1 is undefined as it approaches the sluice

Section 2: Main River Channel/Former millstream

Section 2 splits from Section 1 via a vertical weir. The weir retains a hydraulic head of around half a meter, meaning there is a significant difference between the water levels of the two channels. Section 2 has a natural profile with well vegetated, low lying earth banks and a gravel bed with some significant geomorphological features. The river's planform profile is relatively sinuous in comparison with other reaches in Watford.

As the river progresses westwards, it passes through a short culvert, under a former railway line, before

emerging at the Watford Riverwell site. The river has a noticeably incised profile at the Riverwell site and it appears that the river has recently been unsympathetically reprofiled. The banks of the river are especially steep, with little vegetation present, meaning that they will be exposed to erosion during high flow events. The bed of the river also appears as if it has been significantly lowered. Remnants of the former gravel bed are visible in the margins of the river, which shelf steeply to a silty riverbed. A second weir is present at the most downstream extent of the site, which causes an impoundment and retains a head of slow flowing water upstream.



Section 2 has a more natural profile

Floodplain Habitat

Eastern Floodplain

The southern floodplain at Riverside Park is registered as historic landfill and provides a considerable area of amenity grassland. Despite the majority of

this area falling within flood zone 3, no wetland features exist nor can be created due to the presence of landfill. Crack willows, bramble and cow parsley line the top of the river banks, providing a considerable riparian buffer strip between the amenity area and the river corridor. Few other habitat features are present on site aside from occasional formal trees lining the park's border with Riverside Road. Downstream from the park, the floodplain has been engulfed in the urban peripheries of Watford and is home to residential properties, a car mechanics and an electricity substation.

Western Floodplain

The western floodplain is a capped landfill site and is of significantly higher topography than the surrounding landscape. This has resulted in a floodplain with poor connectivity to the river corridor and with no wetland features. The compartment offers far greater botanical diversity than the eastern floodplain. It may have been reseeded with a wildflower mix at some point because wildflowers are evident throughout the short mown and longer grassland. The bottom of the compartment is short mown and as the land slopes upwards, an area has been left to develop into a wildflower meadow. Species typical of NVC MG5b grassland were found here such as Red Fescue, Lady's Bedstraw, Common Knapweed, Ox-eye Daisy, Rough Hawkbit, Salad Burnet, Wild Carrot, Yarrow, Bird's-foot Trefoil, Yellow-rattle, Meadow Vetchling, Field Scabious and Red Clover. This area hints at what could be created on other areas

of the land holding if resources allow. It could also be managed better because the amount of False Oat-grass suggests that it is being cut too late. A diverse woodland fringe surrounds this grassland containing a good range of hedgerow/scrub species such as Hawthorn, Blackthorn, Wild Privet, Dogwood and Wild Cherry.



Wild flower meadow

Northern Floodplain

The majority of the northern floodplain has recently been developed to provide new retail units on Thomas Sawyer Way, but a significant compartment (0.25ha) of relatively undisturbed floodplain remains. The floodplain falls in flood zone 3 and is low lying and wet in nature, with good connectivity to the river corridor. The compartment provides a valuable flood meadow with Crack Willow interspersed amongst lush beds of Butter Burr, Stinging Nettles, Cow Parsley, native Hog Weed and occasional Flag Iris. The compartment offers wildlife a secluded refuge, away from publicly accessible areas and has good potential

for improvement.

Bank Face Habitat

Section 1

The bank face habitat of the river varies as it progresses downstream. The section upstream of the mill stream offtake is characterised by low lying banks with a gentle gradient. The bank top is lined with mature Crack Willows with Stinging Nettle, Cow Parsley and Bramble beneath. The channel itself provides good populations of emergent vegetation at the toe of the bank, such as Branched Bur-reed, Common Reed, Gypsywort, Water Mint, Reed Sweet-grass and Yellow Flag-iris, and a nice balance has been struck between woody growth on the banks, space/light levels for waterside plants and access for people.

Downstream of the offtake, the balance between shade and light is less preferential, with the majority of the channel being exposed to full sunlight, aside from the shade provided by a few small willows on the western bank of the river. The top of the eastern bank is dominated by bramble scrub which is rapidly expanding across the bank face due to the lack of completion from other hard vegetation. The banks of the river are slowly encroaching into the channel itself, due to the accumulation of silt at the toe of the bank and across the riverbed. This has provided suitable areas for emergent plants to colonise, which now extend across the full width of the riverbed, effectively choking the watercourse.

As the river progresses further towards the sluice

gate it becomes progressively more shaded with willows once again dominating the bank top, with little ground cover or emergent plant life aside from Stinging Nettle. Due to the raised water level, very little of the bank face is exposed and shallow areas where marginal plants can establish are not common. Downstream of the sluice gate the river has brick lined, vertical banks as it flows through more urban areas which steadily become more natural, vegetated and low lying as the channel progresses towards its confluence with the main river at Lairage Land.

Section 2



Typical bank face habitat for Section 2 at Riverside Park

Section 2 offers distinctively better bank face habitat than section 1 and offers good potential water vole habitat. The profile of the channel is less modified and low-lying banks with a gentle gradient are present between the start of the channel to the location where the former railway line crosses the river. The Northern bank face is populated with occasional crack willow, interspersed with large areas of

Butterbur and Stinging Nettle and more occasional Flag Iris, Cow Parsley and Hogweed. The Southern bank of the river is more sparsely vegetated, due to its more shaded nature, and is dominated by Stinging Nettles with occasional areas of short creeping herbs, Butterbur and willow. The entire southern bank is overlooked by a large embankment, which forms part of the landfill site. A secondary woodland has established on the embankment which provides additional canopy of trees which overhang the river corridor.

Downstream of the railway bridge at the Riverwell site, the banks of the river are in less favourable condition and currently do not provide suitable habitat for water voles. The channel appears to have been recently reprofiled with the northern bank of the river being of an especially steep gradient. The steep profile of the bank is not beneficial for aquatic plant species as it will be free draining and dry. The combination of the steep nature of the bank and lack of vegetation may leave it open to erosion and prone to collapse during high flow events. The Northern Bank is currently dominated by tall herbs, such as stinging nettles and has occasional overhanging tree cover. The southern bank is less steep but still has a considerable gradient. It is clear that much of the bank is comprised of 'new' materials that have been deposited on the bank face during the construction of the Riverwell site. Much of the bank face is now comprised of gravels and loose earth which is too free draining and dry for most aquatic plant species. The bank is currently vegetated with tall herbs and grasses, short creeping herbs and occasional cover

from the odd willow, but also provides large areas of exposed bare earth. Like the northern bank, this area is also likely to be prone to erosion.



Typical bank face habitat at the Riverwell site

River Bed Habitat, Substrate and Flow

Section 1

As section 1 progresses towards the sluice gate at the southern end of the site, it is a low energy watercourse with a uniformly smooth flow type. The river is deep (>1m) in most locations, with a thick layer of silt covering the former gravel bed of the river. This does not provide favourable conditions for fish spawning or diverse river fly communities, which require clean well oxygenated gravel substrate. The riverbed provides few habitat features as geomorphological processes do not freely occur due to the modified profile and impounded nature of the channel. Both submerged and emergent vegetation types are present in areas with good light levels but can become problematic when the river is exposed to full

sunlight. The area near the footbridge has become choked with emergent plant species. This is due to the flow of the river not being strong enough to deter the growth of plants in the centre of the river channel and the accumulation of silt on the riverbed providing shallower areas for plants to take hold.

Below the sluice-gate the river does not have sufficient flow or water depth for natural geomorphological processes to freely occur. Due to the meagre amount of water passing beneath the undershot sluice, the river is dry in nature and the successional process is rapidly occurring. This has resulted in much of the gravel bed becoming covered in fine sediment, which has become stabilised as emergent plant species have taken root and colonised the bed of the river. Despite the channel not providing a free-flowing and natural watercourse, it does offer good habitat for water voles due to its slow flowing nature and abundant levels of soft vegetation.

Section 2

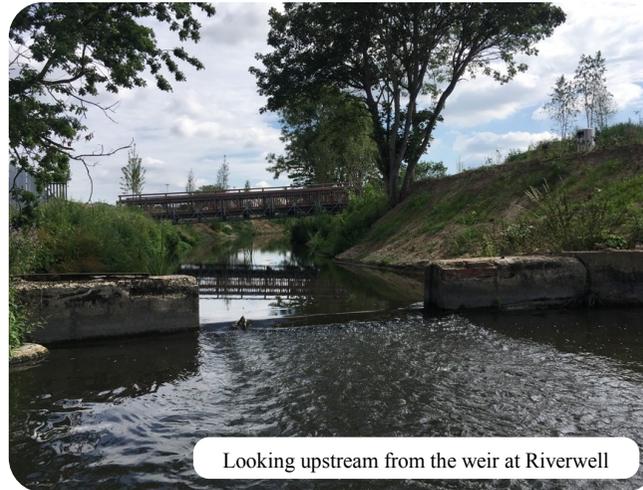


Section 2 is more energetic with coarser substrate and better habitat

Section 2 is a more dynamic and energetic reach of river than section 1. It begins as a fast flowing, shallow (0.2m) channel, with riffle features and rippled flow before becoming a deeper and smoother flowing watercourse as it progresses westwards. The riverbed is comprised of a range of substrate types including cobble, gravel pebble and silt, but for the most part is dominated by sand and fine gravels. This provides much better fish spawning habitat than section 1, although the abundance of more coarse substrate types would be preferential. Areas of loose silt are also present in the margins of the river and become more extensive as the river flows towards the Riverwell site downstream.

Fallen tree branches and other wooded debris interact with the riverbed in a number of locations and provide beneficial structural habitat, in addition to assisting morphological processes. Tree roots are sometimes present in the margins of the river, providing refuge for juvenile fish and invertebrates against predation and high flows. Submerged vegetation is not common, with the riverbed appearing bare in most locations aside from occasional patches of algae on larger rocks and stones. Emergent vegetation is also uncommon within the riverbed and is mostly found growing from the earth banks of the river. This may be due to the fact that the cross-sectional profile of the riverbed does not vary in depth much, leaving the margins of the river exposed to high flows. This issue could be resolved via the placement of wooded debris in the margins of the river.

At the Riverwell site, downstream of Riverside Park, the bed of the river appears to have been dredged. The more variable, coarser substrate found upstream is no longer present and the riverbed rapidly turns to loose silt. Occasional areas of gravel are present in the margins of the river, illustrating the former bed level in this location. The alteration of the riverbed has resulted in the river's natural gradient being lost and a change in the hydrology of the watercourse. This is further influenced by presence of a weir, at the tail end of the site, which impounds flows and increases siltation. Levels of fine sediment are also high in this location as the rivers banks are exposed to erosion (high gradient and loose substrate). No submerged vegetation was present at the time of survey, but emergent plants had been introduced to the margins of the river by local volunteers led by Community Connections Projects CIC.



Looking upstream from the weir at Riverwell

Artificial Structures

Sluice Gate (Section 1)

As previously explained, the sluice gate is a historic feature that is no longer operational. Its original purpose was to retain a head of water to drive the mill wheel of a silk mill. Today the structure continues to have a profound affect on the hydrology of the river, backing up water levels in excess of 100 meters upstream and lowering water levels for over 300m downstream. This has resulted in the lower river channel drying out and local residents complaining to Watford Borough Council about its condition.

It might be suggested that if the sluice gate was opened further, flows could be restored to the lower channel in addition to reducing the level of impoundment to the upper channel. The reality is that, due to the flow split between sections 1 and 2, any alteration to the sluice would be likely to impact the hydrology of section 2. Section 2 currently provides much better habitat and geomorphology than section 1 and the quality of this channel should not be sacrificed for the benefit of section 1. If this idea was to be perused, a hydrologist would have to be procured to undertake fluvial modelling to assess the feasibility of the proposal.

The sluice gate will pose as a barrier to fish passage. Undershot sluice gates are extremely problematic for coarse fish to traverse due to the velocity of flow that passes through them and the occurrence of debris blockages. Fish passage is also affected by

the lack of flow downstream of the structure and the limited depth of water in the channel. A more feasible option would be to resolve the barriers to fish migration on Section 2, in order to bypass the sluice gate entirely.

Weir 1 (Section 2)

Weir 1 controls flows from section 1 to section 2. The structure is comprised of historic masonry and retains a head of water of around 0.5 meters. Remnants of a more extensive structure suggest that sluice gates also used to be present on the crest of the weir. This would have allowed the mill operators greater control over the flow split between the two channels than exists today.

The structure is likely to pose as a barrier to fish passage, due to its vertical nature and height. It is recommended that a non-technical fish passage solution is identified due to the strategic importance of this location. Fish passage upstream from this point is unimpeded for a number of kilometres and rectifying this barrier would ensure the Watford Colne is reconnected with the wider catchment once more. Removing barriers to fish migration will make the Colne's fish stocks more resilient and will eventually negate the requirement for additional fish stockings in Watford, so long as water quality is improved. Potential solutions to make the barrier passable for coarse fish could involve notching the structure, creating a bypass channel, installing a rock ramp or installing a pre barrage to reduce the hydraulic head of the weir.



Weir 2 (Section 2)

Weir 2 is located near the western perimeter of the Riverwell site. The weir is comprised of a sloping concrete structure and vertical wall and would have also once housed sluice gates to control the river's flow. Today the weir is likely to limit fish passage but probably won't prevent it completely. Some physical features of the structure may cause juvenile fish issues (e.g. low water depth) but are less likely to affect adult fish and larger species with strong swimming abilities.

Bridges

There are two road bridges, one footbridge and one former railway bridge at the site. All bridges shade the river channel to a certain degree, but are relatively short in length, so are unlikely to cause any issues in regard to habitat connectivity.

Surface Water Outfalls

Three outfalls are present in the area covered by this

Recreation Ground Outfall

The outfall is located on the western bank of the river adjacent to the A4178. Two pollution incidents have been recorded at this location in 2017 and 2019 using the CVFC Pollution Reporting Application. The pollution can be attributed to domestic sewerage misconnections and links between the foul and surface water sewerage system.

Riverside Road Outfall

This outfall is located near the car garage on riverside road. No pollution incidents have been recorded in this location.

Riverwell Outfall

The outfall within the footprint of the Riverwell development has been recorded as one of the most polluted in the Colne Catchment. Five pollution incidents were recorded at the site between 2018-19 using the CVFC pollution reporting application. Sewage fungus is always visible downstream of the outfall and the presence of sewage rag lining the riverbed is a regular occurrence.

The outfall at the Riverwell site is served by an oil and grit separator which is not suitable for treating heavily polluted water. Since the creation of this facility half a century ago, the surface water catchment it serves has grown significantly and the number of interactions with the foul water system has grown significantly too. This has reduced the effectiveness of the oil and grit interceptor as it was not initially designed to treat the volume of water

passing through the system, nor was it designed to treat raw sewage. Thames Water and Kier Homes (Riverwell developer) have met with the Rediscovering The River Colne project team in order to set out a way of replacing the facility. A range of options are currently being discussed to prevent domestic sewage reaching the facility in the first place and to replace the facility itself to ensure polluted surface water can be more efficiently treated.



The Riverwell Outfall

Invasive Species

Himalayan balsam is present throughout the river channel on site, but does not dominate over native species due to regular management from Community Connections Projects CIC. If the regular management were to cease, Himalayan balsam would rapidly recolonize and spread throughout the site. Small patches of Japanese Knotweed are also present throughout the river corridor. 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 primary reasons for the decline of water vole populations across the catchment.



American Signal Crayfish



Himalayan Balsam



© Snowdonia National Park Authority

American Mink

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 detectors upstream and downstream of Riverside Recreation Ground detected three species of bat: common pipistrelle, soprano pipistrelle and daubentons. The closest detector downstream, at Lairage Land, also recorded these species in addition to Nathusius' pipistrelle. The presence of pipistrelles 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 sites closer to the town centre due to their urban nature, 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. Riverside Park currently offers many areas of potentially good habitat for water voles and offers more seclusion than other sites in Watford.

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 just over 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

The 2017 EA fisheries surveys conducted in Watford (upstream at Radlett Road) found that chub, dace, gudgeon, perch, roach and pike were present. The results showed that the average density of fish at the site had declined to just a quarter of the density recorded in 2015. The river was restocked by the EA in 2018 at Oxhey park. The stocking consisted of 2,000 barbel, 750 chub and 750 dace. Intervention is required to resolve reoccurring water pollution issues at the site in addition to improving spawning and recruitment habitat for coarse fish.

Bird Life

At the time of survey, the project team identified the following bird species at the site: Blackbird, Dunnock, Goldfinch, Wren, Long-tailed tit, Blue Tit, Great Tit, Carrion Crow, Wood Pigeon. (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 River fly 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.

Riverside Park Results

The nearest monitoring site upstream of Riverside 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. Scores from sites downstream of Watford show that water quality improves once the river leaves the town and flows through more rural areas with no urban pollution.

Additional Monitoring Activities

Riverside Park contains a number of outfalls which have been recorded to regularly pollute the river (see page 4). Currently there is no water quality monitoring at the site, meaning that the impact of pollution events often goes unnoticed.

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 Watford Water 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. Please see the Rediscovering The River Colne Environmental Monitoring Project Feasibility Study for further detail.

Colne: Bushey Mill Lane Bridge - 5.71

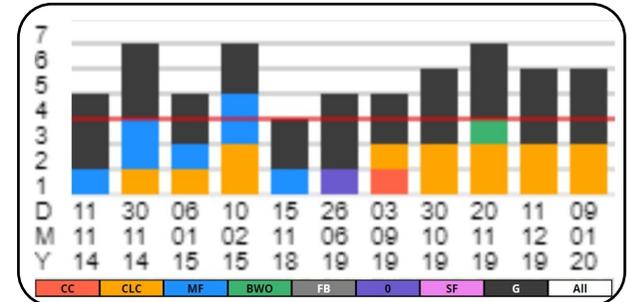
Colne: Knutsford Playing Field - 3.39

Colne: Link Road Bridge - 4.73

Colne: Radlett Road Playing Fields - 3.92

Colne: Lower High St. Bridge - 1.65

ARMI results for all Watford sites (upstream)



ARMI results for closest site upstream (LHSB)



River fly samplers taking a kick sample

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. Wooded debris installation (P15)
2. Riverwell surface water infrastructure improvements (P9-10, 17)
Watford Water Quality Forum (P12, 17)
Additional Monitoring Activities (P12, 17)
3. Wooded debris installation (P15)
Fish passage improvements (P8-9, 17)
Pond creation (P15)
Improved riparian management (P15)



Habitat Improvement Recommendations

Floodplain Improvements

Eastern Floodplain

The majority of the Western floodplain is amenity grassland used for public recreation and therefore does not provide many opportunities for improvement for wildlife. Due to the floodplains classification as historic landfill, it is not possible to create any extensive wetland features to complement the river corridor.

Western Floodplain

The western floodplain is a capped landfill site of sloping topography and therefore does not present any opportunities for wetland enhancement. The grassland and woodland compartments provide valuable terrestrial habitats that could be further enhanced through an improved management regime. The following management actions should be undertaken:

1. As much of the grassland as possible should be managed as a wildflower meadow.
2. Cut and clear in mid-July and October to simulate traditional hay meadow management.
3. Leave 10% of the area uncut in any one cutting episode to provide refuge for invertebrates.
4. Rotate uncut sections or strips around the

October cut to reduce vigour of the grasses.

5. Periodically coppice woody growth on bank of eastern compartment to keep banks open for people to see the river and to encourage emergent vegetation. Leave largest Willows to develop to full extent.

Northern Floodplain

The northern floodplain would be most suited to backwater and pond creation due to its low lying and damp nature. This option unfortunately has to be discounted, as access to the Northern floodplain is extremely poor and no pathways exist to get plant such as excavators onto the site (see site access plan, page 29). The site can be accessed by crossing the river (section 2) on foot however, so habitat improvements undertaken with hand tools or small machines are still viable:

1. It is recommended that a series of scrapes of varying size and depth are created in close proximity to the river corridor to provide habitat for amphibians and water voles. The ponds will also be colonised by invertebrate species and serve as feeding grounds for local bat communities.
2. The willows in the compartment should be periodically coppiced to stimulate regrowth and prevent over shading.

It should be noted that land owner permission should be sought before undertaking any works in this area (CBRE Global Investors Limited)

River Channel

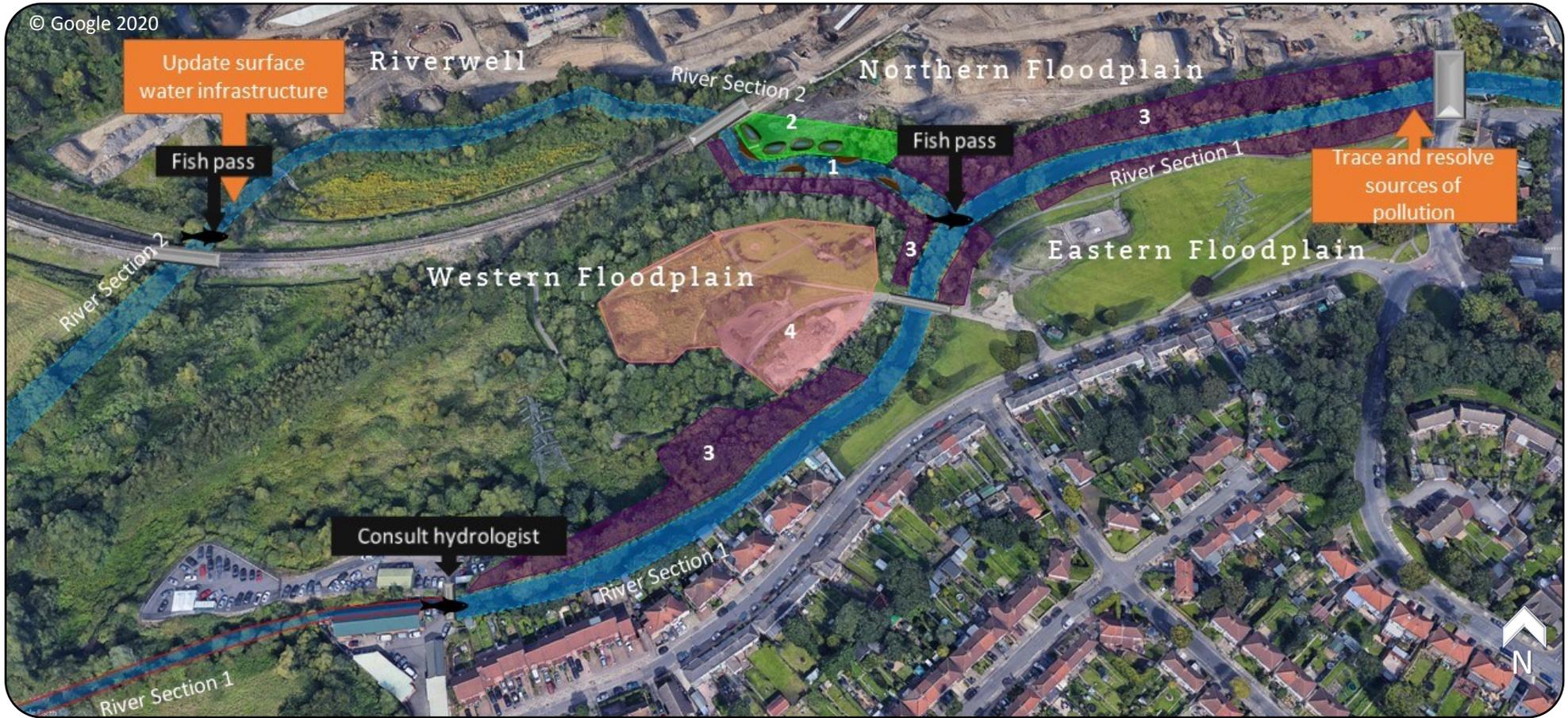
The following issues affecting the river channel have been identified in this location:

1. There is little variation in the depth across the channels cross sectional and longitudinal profile.
2. There is little variation in flow type, with the flow of the river being predominantly smooth and slow flowing.
3. The river channel is not suited to low flow conditions and is susceptible to the effects of climate change.
4. A number of historic control structures alter the rivers hydrology and pose as barriers to fish passage.
5. The river suffers from reoccurring pollution issues that limit aquatic biodiversity.

In order to improve the river in this location the following interventions are required:

1. Riparian trees should be coppiced rotationally to maintain the current vegetative balance and levels of light and shade on site.

© Google 2020



Legend:



Wooded debris



Pond creation



Coppice trees on rotation



Extend wildflower area



Install fish pass

Riverside Recreation Ground habitat improvement map

2. A mixture of brushwood berms should be installed in section 2 to stabilise loose sediment in the margins of the river. This will significantly improve the rivers crosssectional profile, providing a narrower and faster flowing central channel where morphological processes occur freely and sheltered areas in the margins of the river for aquatic plants to grow. If natural colonisation is slow, plant species from elsewhere onsite should be translocated.
3. Flow deflectors should be created with materials arising from tree works to encourage the scouring of the riverbed. This will reduce the deposition of silt on the riverbed, scour out deeper pools and provide sheltered zones in the margins of the river for plant life to establish.
4. The weir at the beginning of Section 2 should be modified so it no longer obstructs the passage of coarse fish.
5. The Weir at the Riverwell site should be modified so it no longer obstructs the passage of coarse fish. This could be achieved in combination with restoring the natural gradient of the riverbed upstream of the structure.
6. The outdated surface water asset at the Riverwell site should be replaced with a solution that prevents regular pollution incidents from occurring.
7. If restoring flow to Section 1 is desired, a consultant should be engaged to model the

feasibility of adjusting the flow split between the two channels.

8. The surface water assets at the Riverwell site should be replaced with a solution that prevents regular pollution incidents from occurring.
9. Watford Water Quality Forum to instigate a pollution tracing exercise for the 'recreation ground outfall'.

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 outfalls at the site should be included within The Rediscovering The River Colne's Environmental Monitoring Project. It is recommended that an "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.

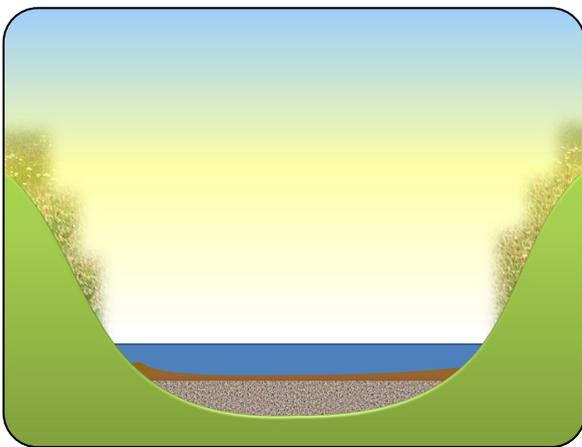
Watford Water Quality Forum

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 wastewater infrastructure in Watford. The group is currently in discussion in regard to resolving the pollution problems attributed to the outfall at the Riverwell site and designs for improved infrastructure are being reviewed and decided upon.



Design Considerations

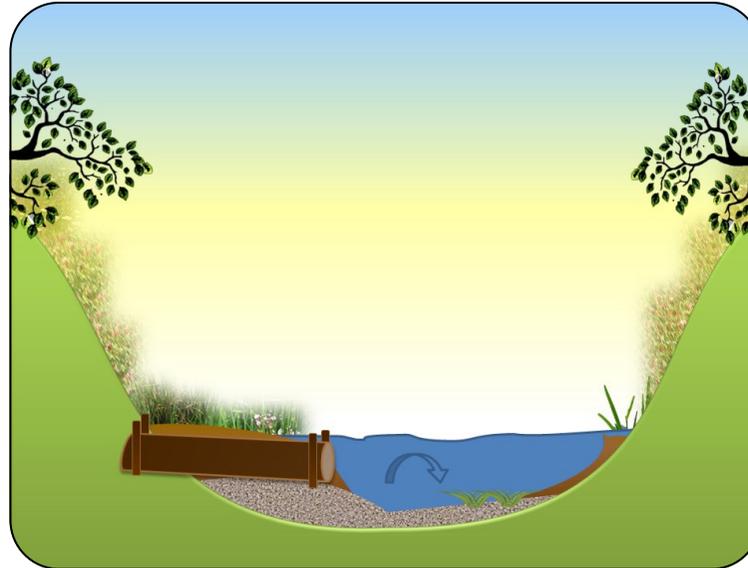
Brush Berms and Flow Deflectors



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.

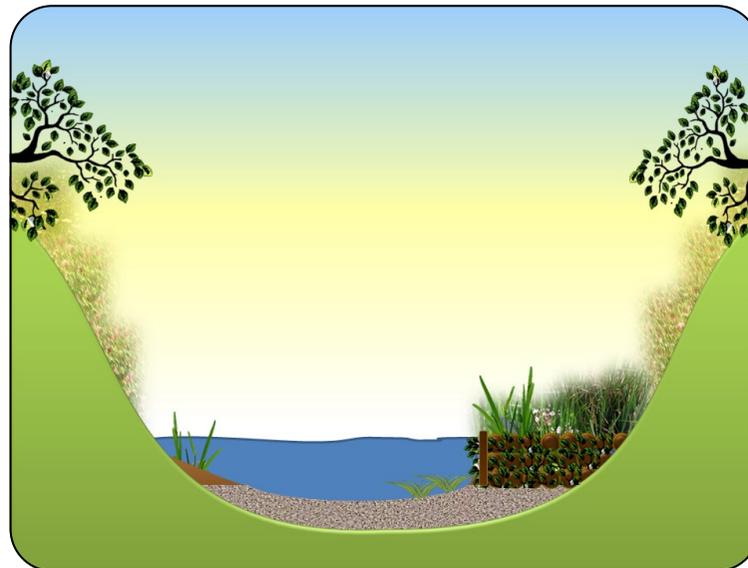
Over shading trees can be coppiced and repurposed to create brush berms and flow deflectors within the channel to mimic natural sinuosity, stabilise sediment and to create a variety of depths and flow types.

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. Or chestnut batons.

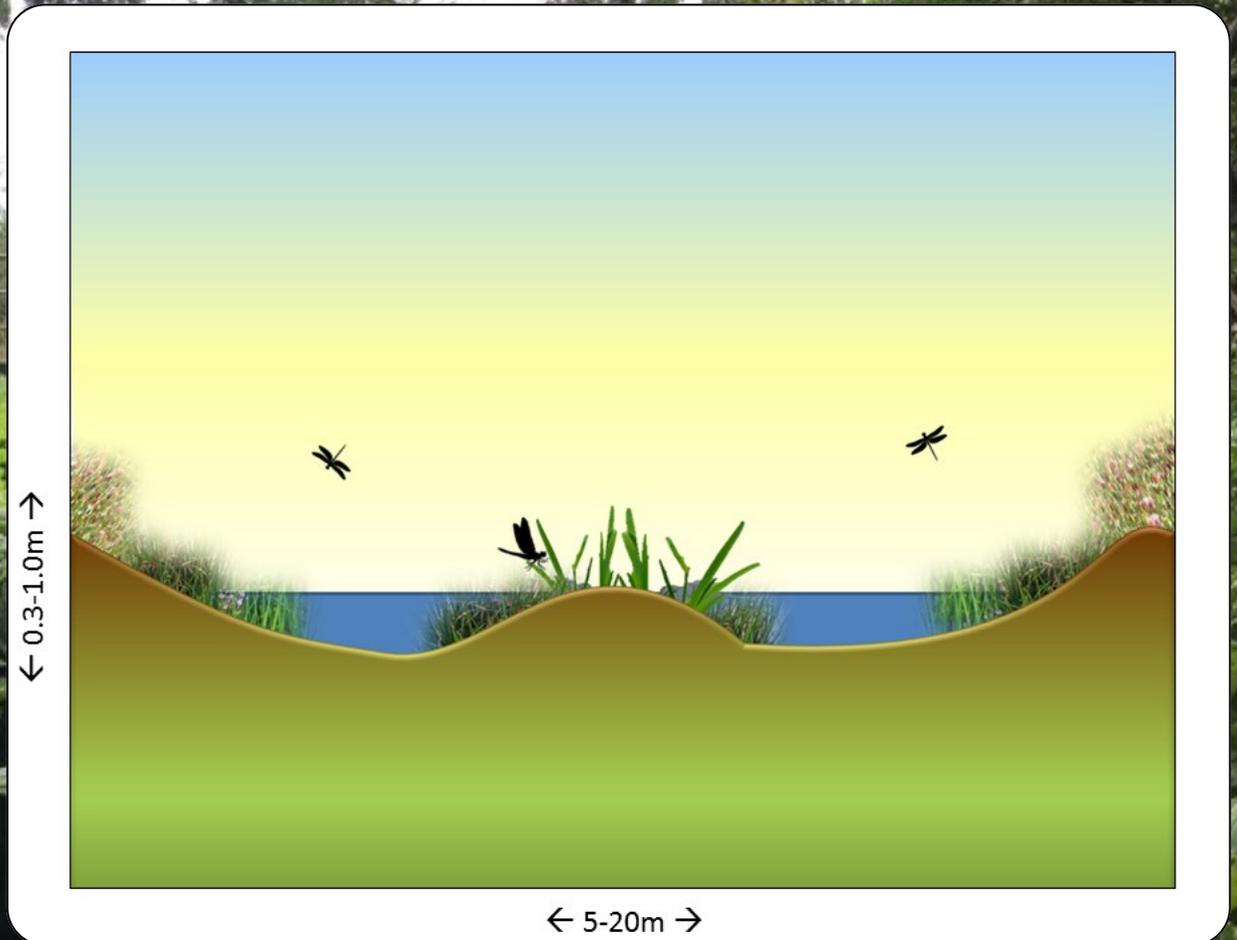
Wetland Scrapes

Scrapes are shallow ponds with gently sloping edges that hold rain or flood water seasonally and remain damp for the majority of the year. They provide valuable habitat for a range of wildlife and can be created in areas of damp grassland and floodplain.

Fields in wet areas have often historically been ploughed and drained resulting in uniform topography and few low lying areas. This has resulted in many important seasonal habitats for wildlife becoming lost. Wetland scrapes mimic these habitats, providing a space for wildlife to flourish during wet months of the year. They support high densities of invertebrates which provide an important food source for birds and amphibians and can provide a diverse range of plant species for the benefit of other species such as water voles and dragon flies.

Design Considerations

- Scrapes are created by using a hand tools to create shallow depressions of varying depth between 0.3 and 1.0 meters deep.
- The banks should slope gently to allow the colonisation of aquatic plant species and to allow wildlife to safely enter or exit.
- Each scrape should be a minimum of 20m².
- Cattle grazing provides good management providing it is not too intensive and does not coincide with the bird nesting season.



Fish Passage Improvements

Non-technical fish passes are required for the two weirs highlighted by this report.

The two structures obstruct the passage of fish due to the following features.

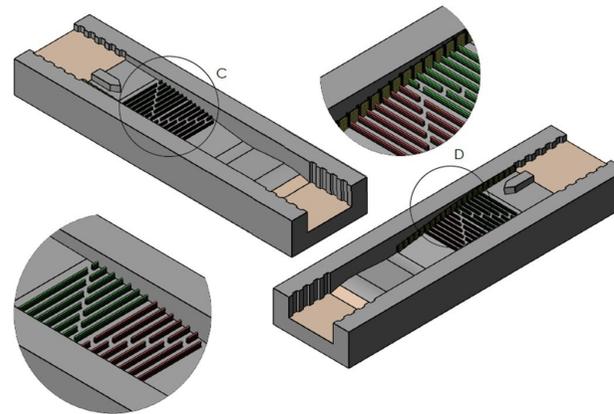
- The hydraulic head of weir 1 is too great to allow a fish to 'leap' over it.
- The water depth at the crest of each structure is potentially too shallow to allow fish to swim over them.
- The water depth at the face of weir 2 is potentially too shallow for fish to swim up it.
- The velocity of flows passing over each structure during high flow conditions may be too high to allow fish to pass.

In order to rectify these issues either a baffle type fish pass or a prebarrage should be considered for each of the barriers. Both of these options work to increase the depth of water passing over each structure in order to provide more favourable conditions for fish passage.



Pre-Barrage

Pre-barrages are created via installing a series of notched walls downstream of a weir in order to back up water over the weir crest. This reduces the hydraulic head of the structure and increases the water depth over a structure by breaking it into small sections that can be traversed individually. Each section also provides a resting location to give fish time to recover when fighting fast flowing water. This type of pass would be most appropriate for weir 1.



Baffle-Type Passes

Baffle-type passes work via installing a series of baffles on the sloping face of a weir in order to increase water depth and decrease water velocity. A fish is able to pass through each set of baffles via a series of notches running from the crest to the foot of the structure. This type of pass would be most appropriate for weir 2.

Site Action Plan

River channel improvements: Wooded Debris Features and Minor Tree Works.

Activity	Action	Comments	Delivered by:
Wooded Debris Installation Minor Tree Works	1. Produce design illustrating chosen locations of brash berms, flow deflectors, hinged trees and minor tree works.	<p>The following construction drawings should be produced should be produced:</p> <ol style="list-style-type: none"> 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 Minor Tree Works	2. Apply and obtain bespoke environmental permit to cover works.	<p>The following documentation is required for an Environmental Permit application.</p> <ol style="list-style-type: none"> 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 Minor Tree Works	3. Undertake improvement works with local volunteers.	<p>Likely Construction Methodology</p> <p>Trees in shaded locations should be coppiced to provide materials for the creation of brash berms and flow deflectors. Willow should not be used as it will regrow and require persistent management.</p>	Community Connections Projects CIC

Brush Berms

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.
4. The loops of wire are then strained so that they are held tightly over the berm.

Continued from previous page

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.

Community Connections Projects CIC

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 permanently to the bed of the river.

River channel improvements: Fish Passage Improvements

Activity	Action	Comments	Delivered by:
Procurement	1. Procure contractor to undertake project design and permitting.	Three contractors to tender for the initial phase of the project. The tender should cover the following activities: <ol style="list-style-type: none"> 1. Fish passage improvement for weir 1 2. Fish passage improvement for weir 2 	Groundwork
Survey work	2. Undertake site survey work	<ul style="list-style-type: none"> • Each structure should be surveyed by the contractor in order to produce detailed designs 	Contractor
Survey work	3. Undertake sediment analysis if required.	<ul style="list-style-type: none"> • In some instances a sediment analysis is required for fish passage improvement works if they are likely to mobilise sediment. Contractor to advise. 	Contractor
Design work	4. Produce designs for each fish pass.	<p>The following construction drawings should be produced should be produced</p> <ol style="list-style-type: none"> 1. Site plan <i>Illustration showing the location of each improvement proposed on site</i> 2. Topographical Survey <i>Survey of site topography around key construction areas.</i> 3. Cross sections, longitudinal sections and illustrative drawings for each modified weir. <i>A cross sectional diagram produced for key areas.</i> 	Contractor
Permitting	5. Apply and obtain bespoke environmental permit to cover works.	<p>The following documentation is required for an Environmental Permit application.</p> <ol style="list-style-type: none"> 1. The construction drawings listed previously. 2. Site management plan <i>Document containing all aspects of site management.</i> 	Contractor

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|--|----|--|------------------------------------|
| | 3. | Construction Methodology
<i>Method of construction for each activity proposed.</i> | Community Connections Projects CIC |
| | 4. | Sediment analysis results
<i>With interpretation illustrating what materials can be used for.</i> | |
| | 5. | Water Framework Directive Compliance Assessment
<i>WFD compliance evaluated for each activity proposed.</i> | |
| | 6. | Environmental Risk Assessment
<i>Environmental risk and mitigation identified for each activity.</i> | |
| | 7. | Site Risk Assessment
<i>Risk to workers/site users and appropriate mitigation identified.</i> | |

Procurement	6.	Procure contractor to deliver construction phase.	Three contactors to tender for construction phase of project. The tender should cover the following activities: 1. Fish passage solution for weir 1 2. Fish passage solution for weir 2	Groundwork
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Construction	6.	Construct fish passes at weirs 1 & 2.	A construction methodology for this activity is not yet available as the design for each fish pass has not been finalised.	
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Floodplain Improvement: Pond Creation

Activity	Action	Comments	Delivered by:
Design	1.	Produce indicative design	Community Connections Projects CIC
	2.	Produce a plan illustrating the location, size and depth of each pond/scrape.	
Preparation	3.	Order tools and materials for pond creation as required through out the project.	Community Connections Projects CIC
		Tools and materials required: 1. Digging tools (spades, pick axes)	
		2. Grading tools (rakes, tampers)	
		3. PPE (Gloves, helmet, eyewear, footwear)	
		4. Plug plants (if required).	

Pond creation	4.	Build two ponds per year.	1.	Ponds should be installed through conducting regular volunteer work-days at the site over the 10 year duration of <i>Rediscovering The River Colne</i> .	Community Connections Projects CIC
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Ongoing management actions

Activity	Action	Comments	Delivered by:	
Improved wildflower meadow management.	<ol style="list-style-type: none"> Expand wildflower meadow over a wider area of the western floodplain. Improve management of existing wildflower strips. 	<ul style="list-style-type: none"> As much of the grassland as possible should be managed as a wildflower meadow. Cut and clear in mid-July and October to simulate traditional hay meadow management. Leave 10% of the area uncut in any one cutting episode to provide refuge for invertebrates. Rotate uncut sections or strips around the area. Introduce more Yellow-rattle after October cut to reduce vigour of the grasses. 	Community Connections Projects CIC	
Riparian Woodland management	3.	Maintain current vegetative balance and light levels throughout the site.	<ul style="list-style-type: none"> Divide the riparian woodland into 5 management compartments Coppice 1 compartment per year. 	Contractor
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
Clear litter	4.	Conduct annual river clean up	Undertake a litter pick of the river channel once a year	Community Connections Projects CIC
Monitor Water Quality	5.	Conduct RMI, chemical analysis and outfall safari	Monitor water quality at the site in accordance with the recommendations of the Environmental Monitoring Project.	Community Connections Projects CIC

Estimated Costs

River channel improvements: Wooded Debris Features

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 (10 days)	£2,500	£32,500
	Materials	£3,000	£3,000
TOTAL			£9,550

River channel improvements: Fish Passage Works

Design and Permitting for Fish Passage Works	Design Work	£8,000	£9,000
	Permitting	£1,000	
Construction of fish passes	Weir 1	£10,000	£30,000
	Materials	£20,000	
TOTAL			£39,000

Floodplain enhancement works: Pond Creation

Design Work	£250
Construction of ponds	£4,000
TOTAL	£4,250

Total Project Costs

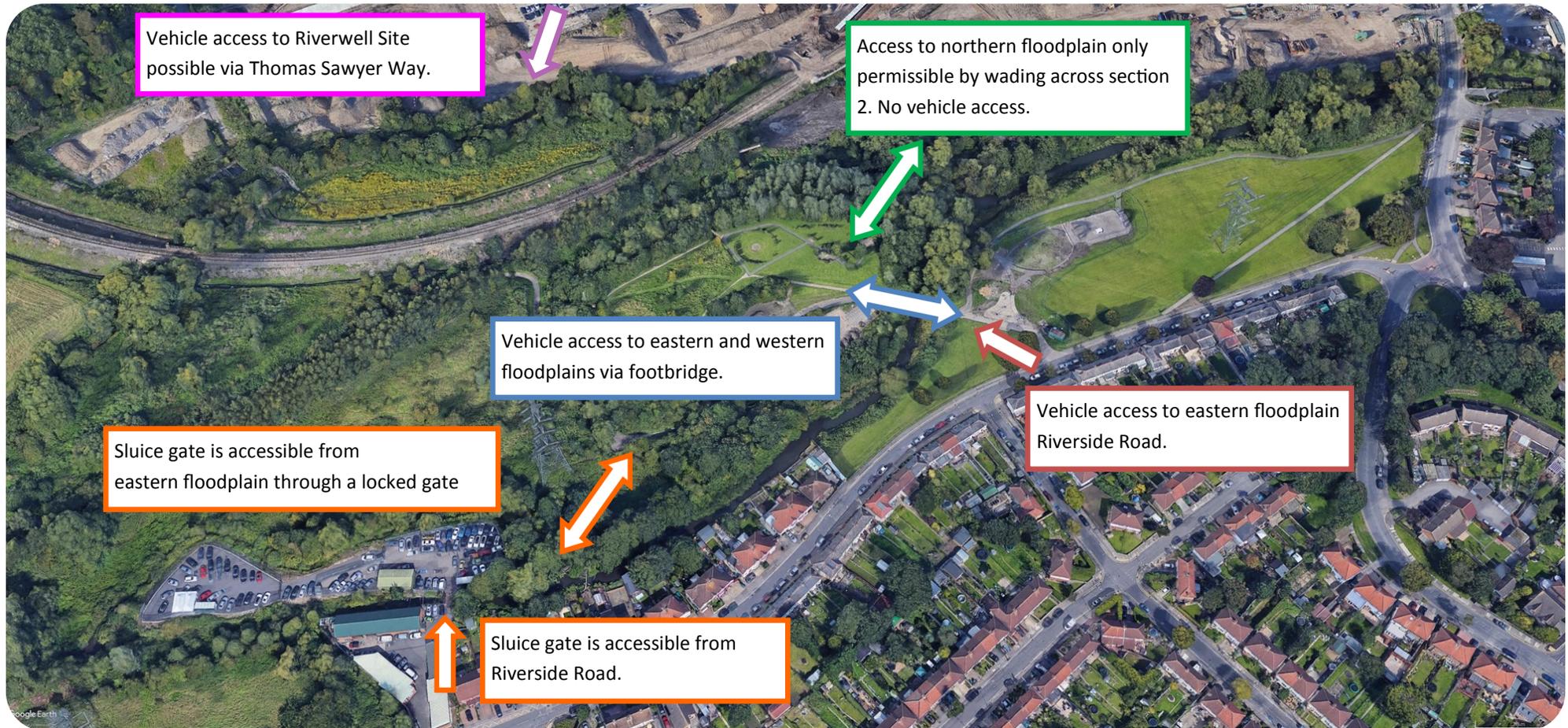
Activity	Cost
Wooded debris features	£250
Fish passage works	
Pond creation works	£4,000
TOTAL	£22,350

Ongoing Maintenance Cost s

Activity	Cost
Grassland management (no cost, simply alter current management actions)	£0
Riparian woodland management	£5,000
Invasive species management	£2,000
River clean up	£300
Water Quality Monitoring (Delivered via Environmental Monitoring Project)	£0
TOTAL	£7,300

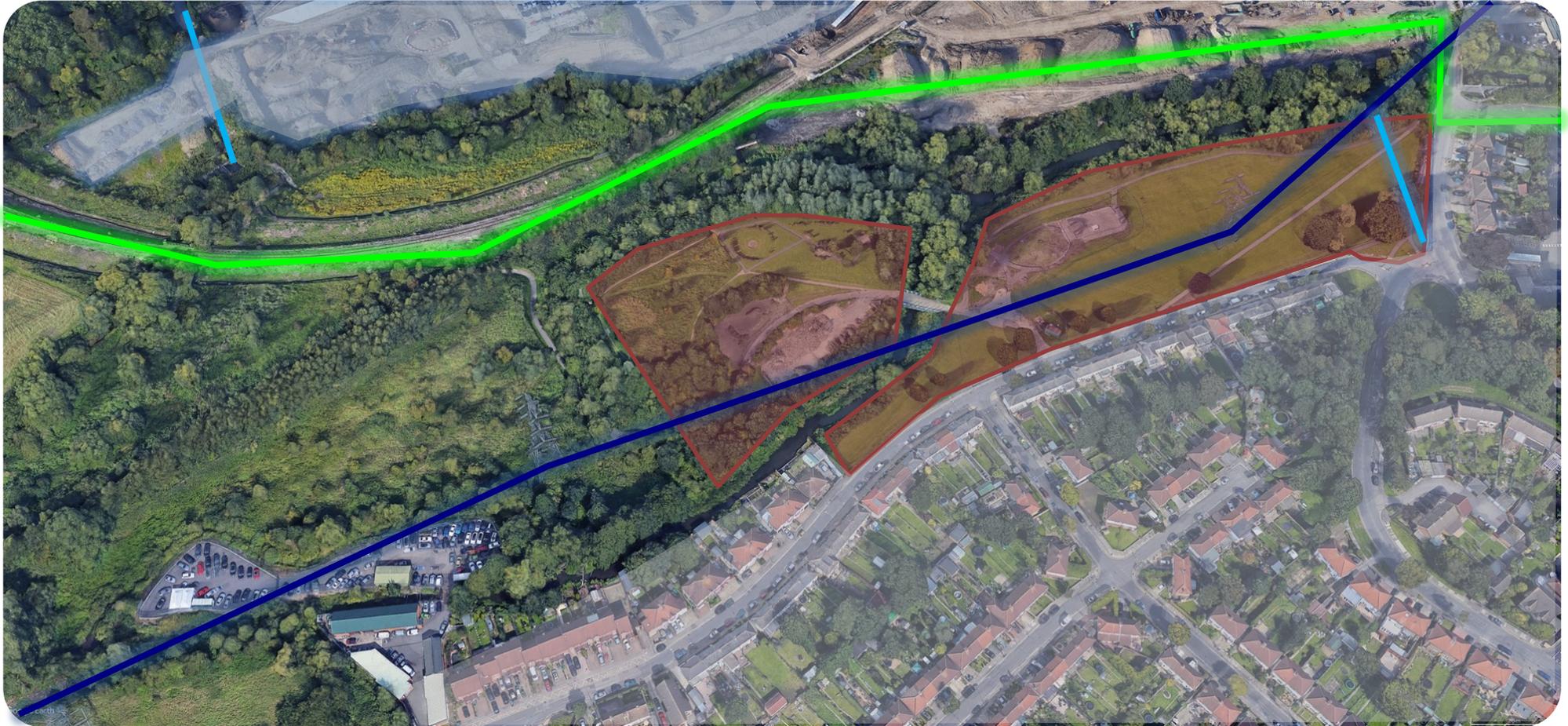


Site Access Plan



Small plant/vehicle access will be required for fish passage improvements. All other improvements listed in this plan can be delivered using hand tools.

Utilities Search



Historic landfill

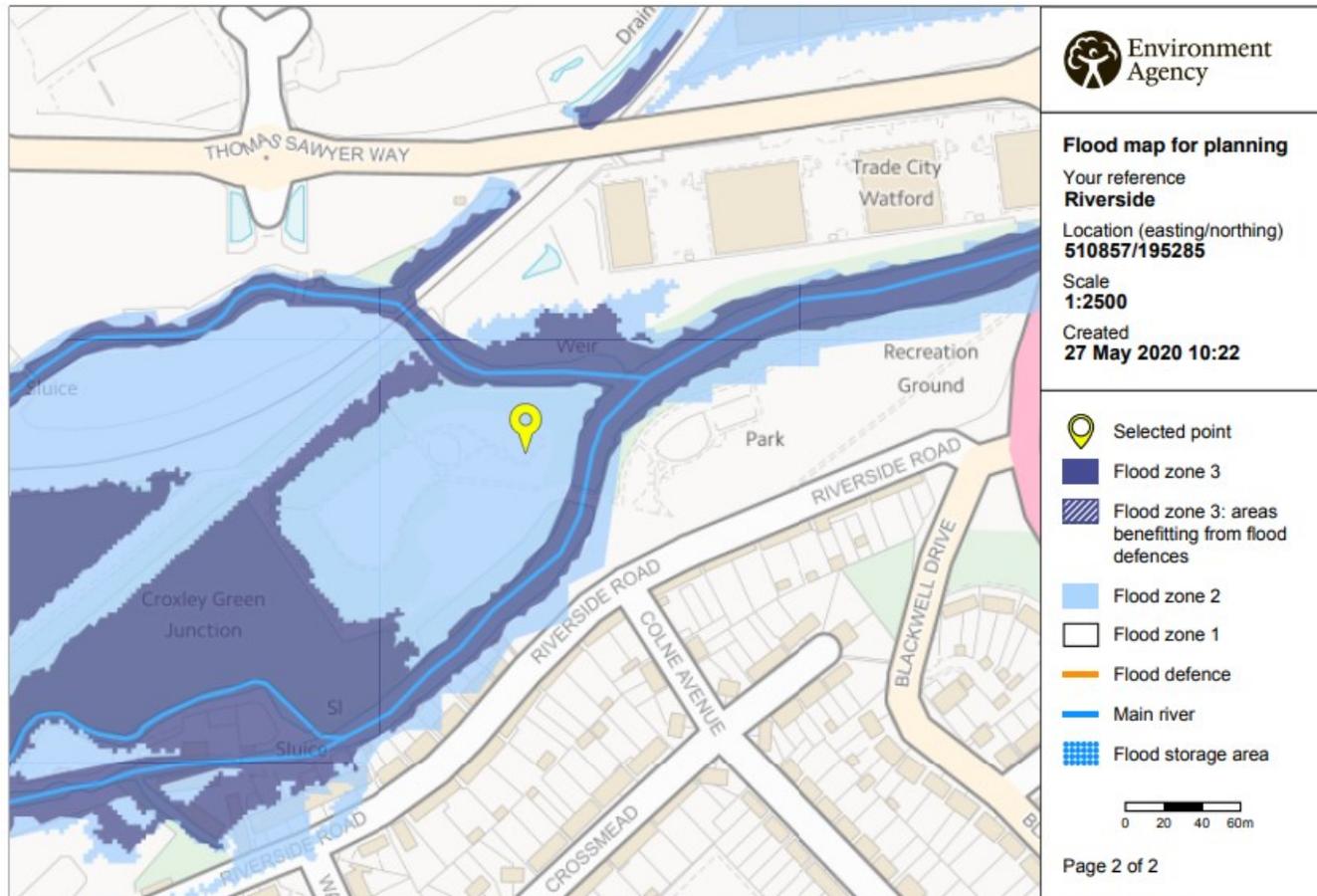
Sewers—surface

National Grid underground cable

National Grid overhead lines

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

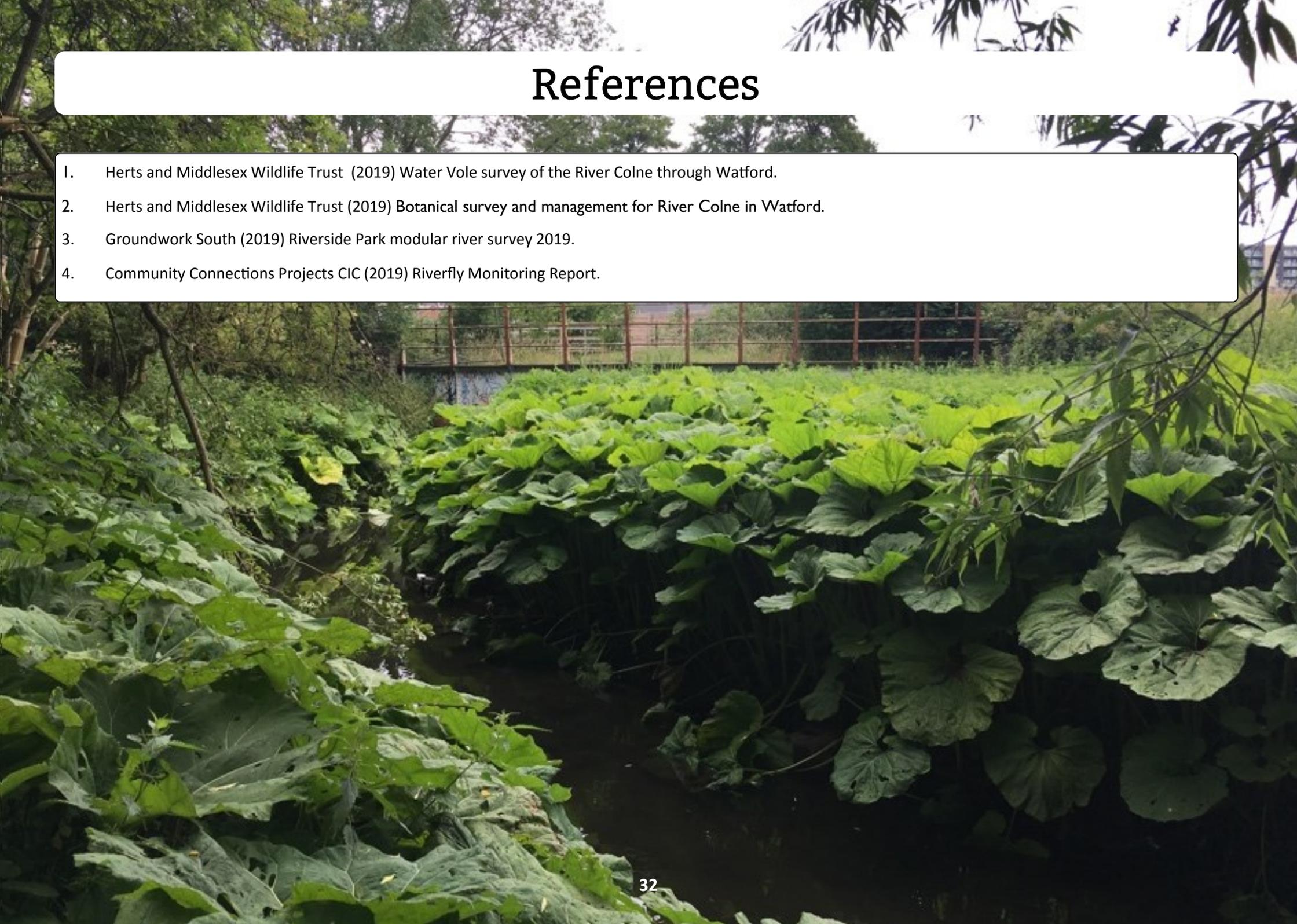


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- The majority of the eastern floodplain falls in flood zone 1.
- The majority of the western floodplain falls in flood zones 1 and 2.
- The majority of the northern floodplain falls in flood one 1, but the area of flood meadow where pond creation is proposed falls within flood zone 3.
- The Riverwell site falls in flood zones 1 (north of river) and 2 (south of river).

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) Riverside Park modular river survey 2019.
4. Community Connections Projects CIC (2019) Riverfly Monitoring Report.





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 and Affinity Water.