

Hydrological Summary

Rickmansworth Aquadrome Project



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Introduction

Hydrology is the study of water movement, distribution and management. Rickmansworth Aquadrome is part of a complex network of water and is impacted by many watercourses which interact with each other. The River Gade, River Chess and River Colne all meet and interact with the Grand Union Canal in Rickmansworth upstream of the Rickmansworth Aquadrome site (Fig 1). Therefore, all these watercourses affect the hydrology of the site.

The Rickmansworth Aquadrome Project is working to model the complex hydrology at the nature reserve to better understand local flood pathways and to model the various restoration design options. Modelling, in this sense, uses a highly technical computer programme to replicate the existing situation established from significant data collection. Once the model has been created, it is subjected to a range of flooding scenarios to gain insight into the consequences and how the landscape can be expected to react. Further to this, interventions can be inserted into the model, for example, creating a flood storage area to see how the consequences differ. This then informs the appropriate design of works and maintenance going forward.

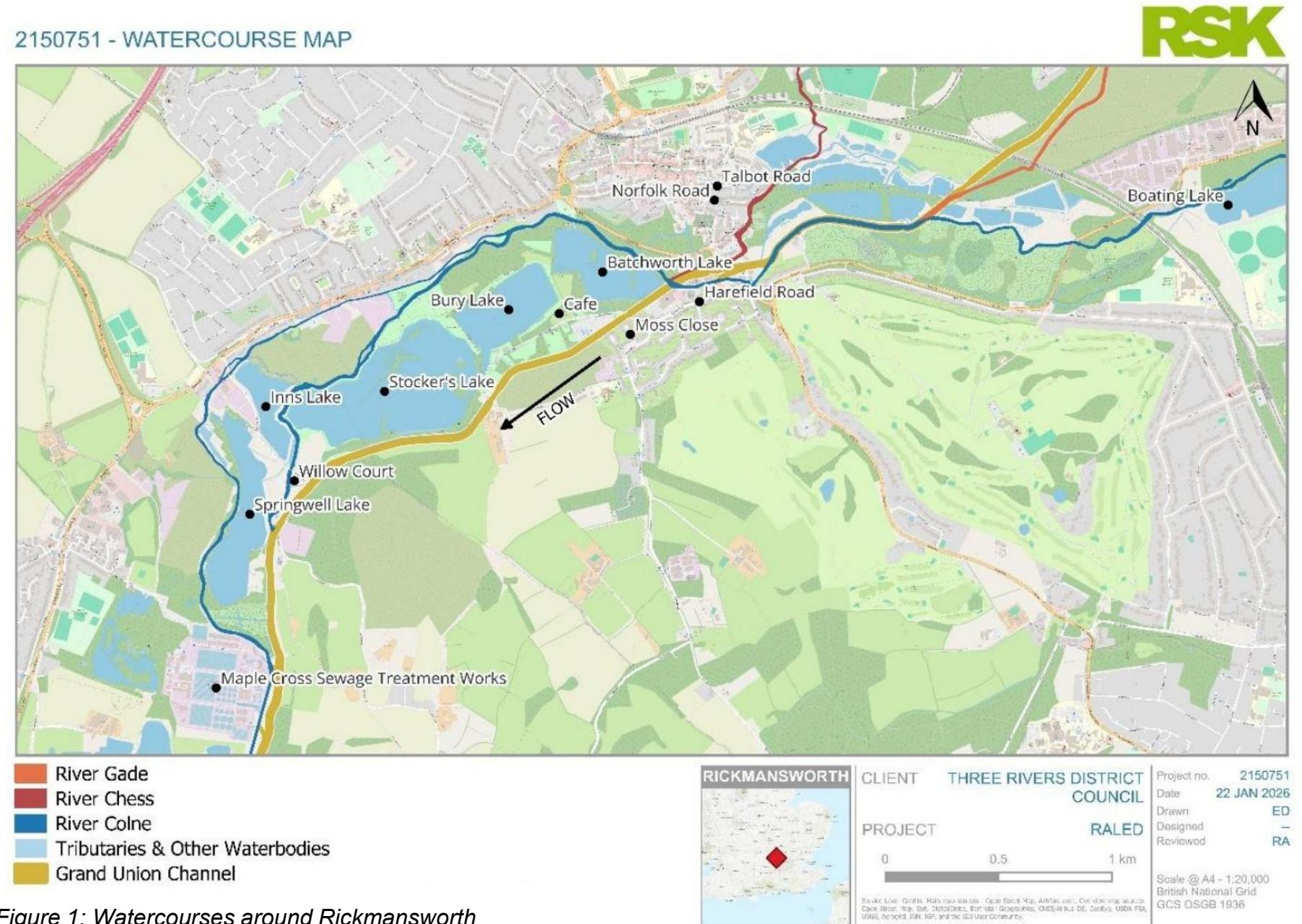


Figure 1: Watercourses around Rickmansworth

Flooding

There have been many historic flood events affecting the Rickmansworth area; the information about those events was reviewed by the Environment Agency (EA) in the creation of the Upper Colne Flood Modelling update (October 2025). Hydraulic models like this are collections of mathematical equations that estimate the flow of water and represent the situation on the ground. The data was obtained from recent flood investigation reports by the relevant Lead Local Flood Authorities (Hertfordshire), and Strategic Flood Risk Assessments from relevant Local Planning Authorities.

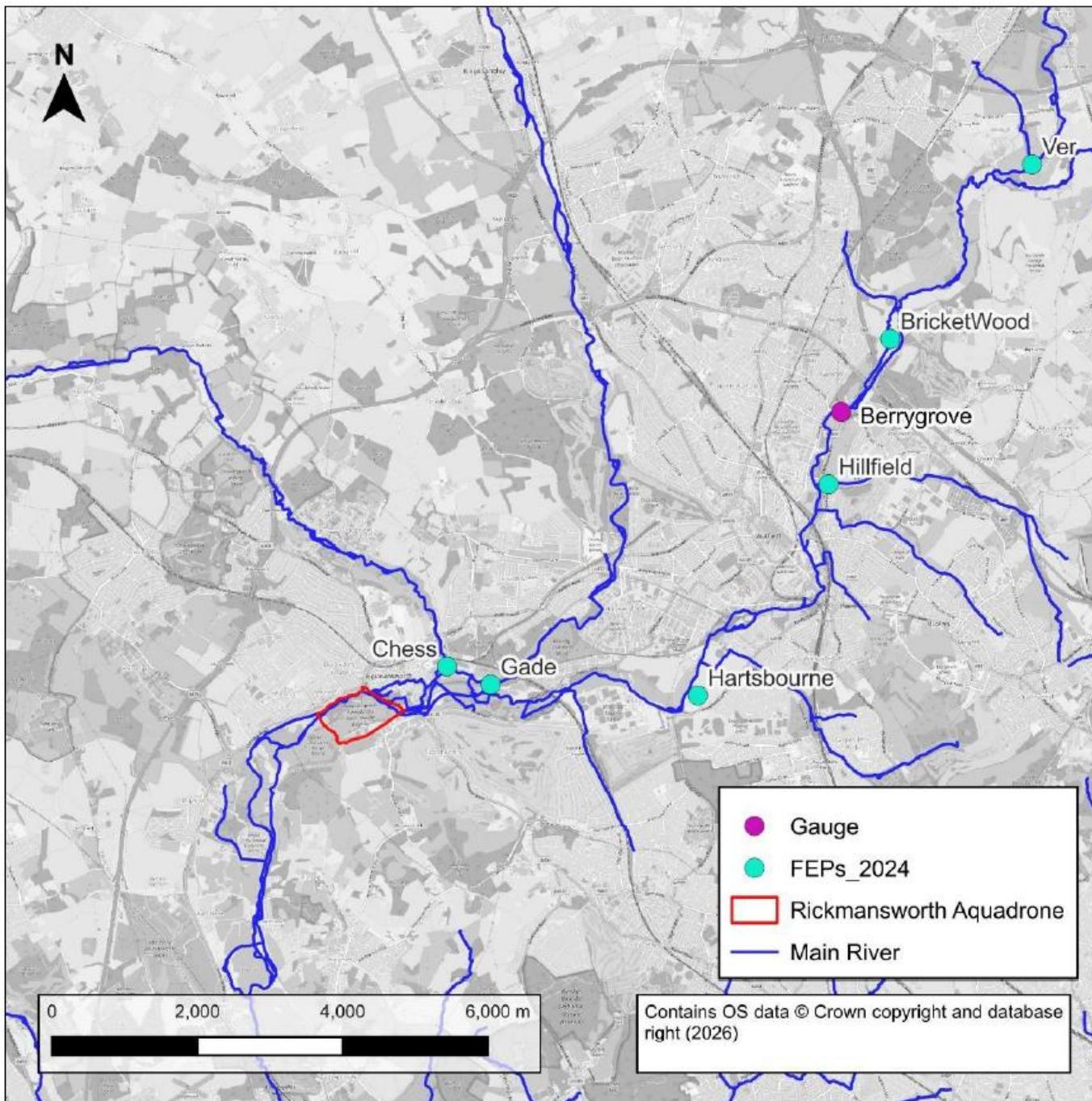


Figure 2: Upper Colne catchment main rivers and instrument locations

EA gauging stations present along the river, such as the one at Berry Grove (Fig. 2) collect live information on the water levels.

Key complexities of flooding at Rickmansworth include:

- Complex hydrology that can lead to complicated water level information
- Overland flood water from kilometres upstream
- A mixture of water from the rivers Chess, Colne, Gade and the canal which each have different flows, water levels and interactions
- Overtopping of water from adjacent lakes (Fig. 3).



Figure 3: Flooding at the Aquadrome

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Flooding

A “2-year return period” is equivalent to a “50% AEP,” is defined as a flood that has a 1 in 2 or 50% chance of happening in any year. It does not, but is often misunderstood to, mean a flood that only happens every 2 years. Therefore, a 5-year event, is defined as a flood that has a 1 in 5, or 20% chance of happening in any year, and there are much rarer events like the 100-year event.

Related to this is the impact of climate change and how this uncertainty is built into the flood model, the EA consider this to account for a 21% increase in water flow in Rickmansworth and this must be built into modelling.

Return Period or Annual Exceedance Probability (AEP) are interchangeable terms used to describe the size or extent of flooding in a flood model.

For this document, focus will be on the 1 in 2 year event (Fig. 4). During these events, the Aquadrome floods including the ground around the café. The flooding around the café stems from Batchworth Lake, where water spreads into the floodplain. The flooding spreads along a drainage ditch before spreading north into the floodplain. This area of flooding is then added to by flooding from the corner of Bury Lake, whereby flooding extends south towards the café. Flooding within the Aquadrome land to the north of Batchworth and Bury Lakes is a combination of flood waters stemming from the northern corners of these lakes and from flooding breaching out of the southern bank of the River Colne.

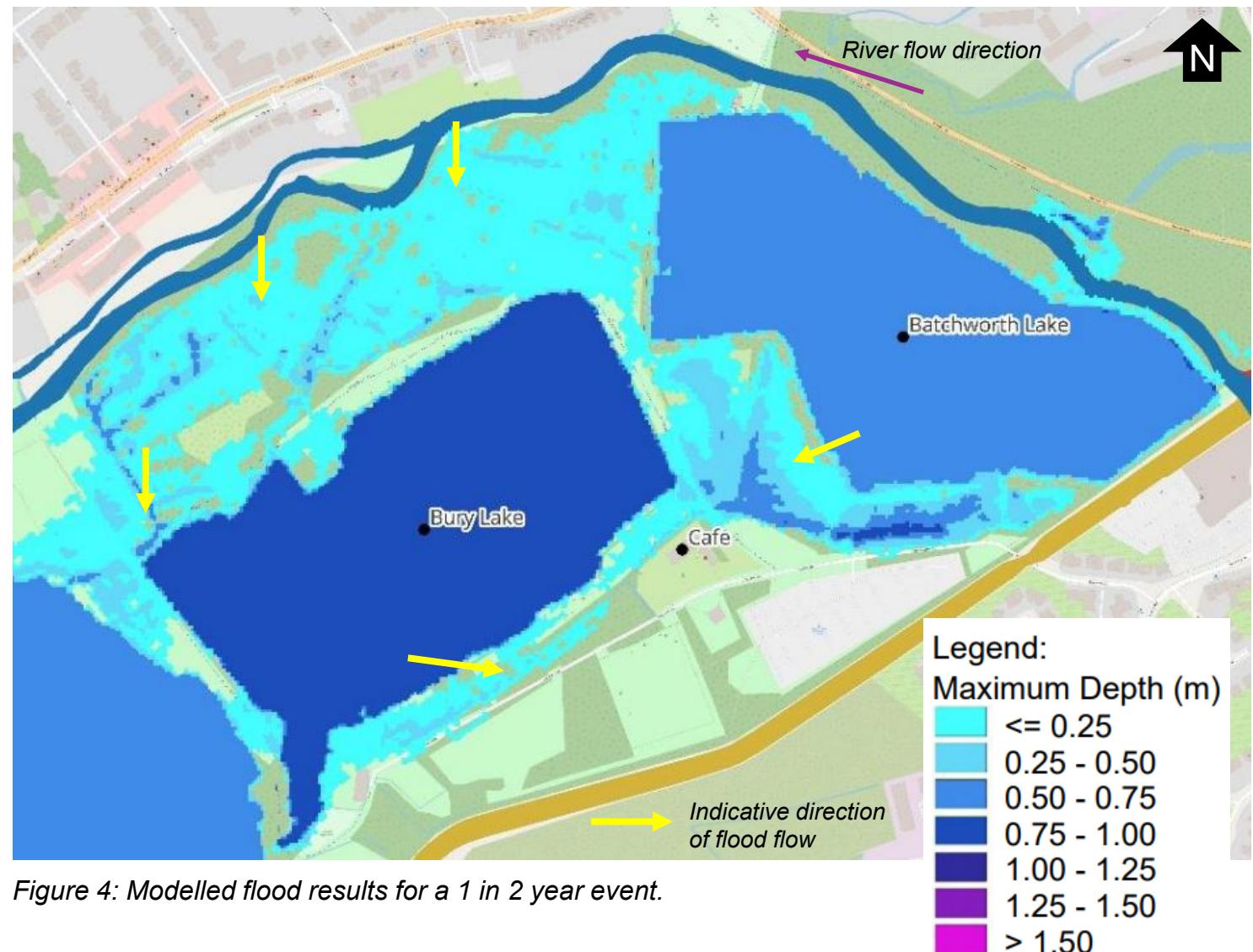


Figure 4: Modelled flood results for a 1 in 2 year event.

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Modelling Methodology Overview

The EA Upper Colne Catchment model is based on a 90km long catchment. The channels included are modelled as 1D, meaning the water flows in one direction, and the overland flow (for example on floodplains) is modelled as 2D as water flows in multiple directions. The model was calibrated against specialised equipment that measures the water level, known as river gauges.

There are limitations of the EA model due to the relatively low resolution and detail being at catchment scale. An assumption for the Aquadrome set the lake depths to 0.1m as no underwater mapping, known as bathymetry, was included; the lakes are known to be significantly deeper and therefore the impact of flow could be very different to the model.

Building from the limitations and recommendations issued by the EA, the council's contractor for the Rickmansworth Aquadrome Project, RSK, are developing an advanced model specifically for the Aquadrome site using industry leading approaches. Multiple additional datasets are feeding into this including the bathymetry and light detection and ranging (LiDAR) mapping of the floodplain (Fig. 5 & 6).

The bespoke model will account for the site's complexity to provide an accurate and detailed estimate of the impact of flooding within the Aquadrome. This approach has been reviewed and approved by the EA and ensures a more detailed and realistic output than the EA model alone.

Bathymetry is the mapping of underwater depth and terrain; it is equivalent to underwater topography.

LiDAR is a survey method using light to measure ranges (or distances) to the earth from the instrument. Together with accompanying data, a precise, 3D image of the ground surface is created. (Fig. 6)



Figure 5: Hydron taking measurements



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Figure 6: LiDAR map of the Aquadrome, the red/orange shows areas of higher ground. Whereas the pale green shows areas of lower ground.

Landscape & Environmental Design Implications

As the Aquadrome sits within an urbanised setting, there are significant constraints to be accommodated within the proposed improvements.

The constraints include:

- Asbestos presence (Fig. 7)
- Utilities, including a medium press gas pipeline, buried telecom lines, and other communications infrastructure
- Ecology, including the presence of invasive non-native species (Fig. 8), protected species (e.g. bats or water voles) (Fig. 9), and habitats
- Nearby heritage assets



Figure 7: Asbestos presence

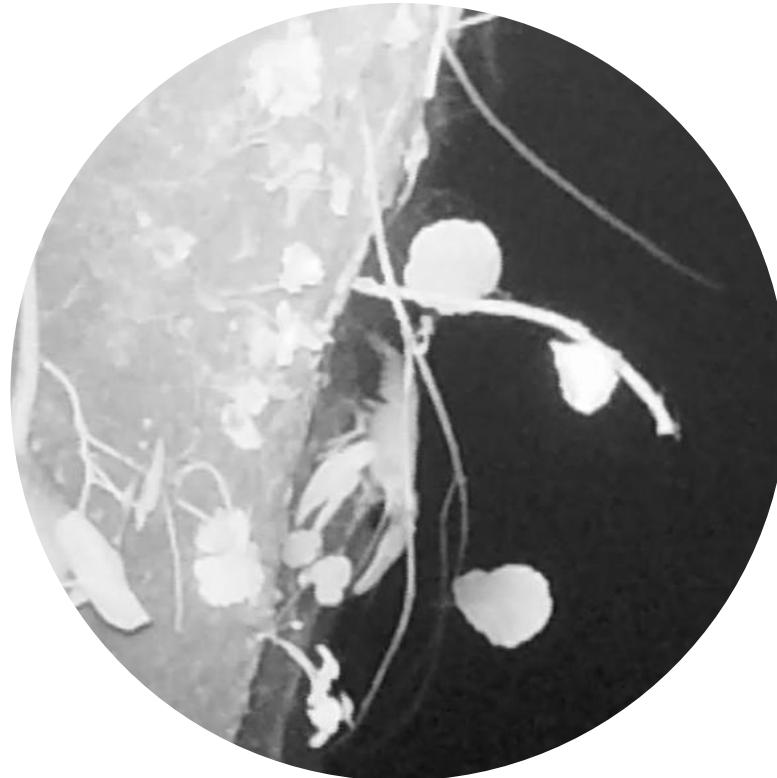


Figure 8: INNS - Signal Crayfish in the Colne



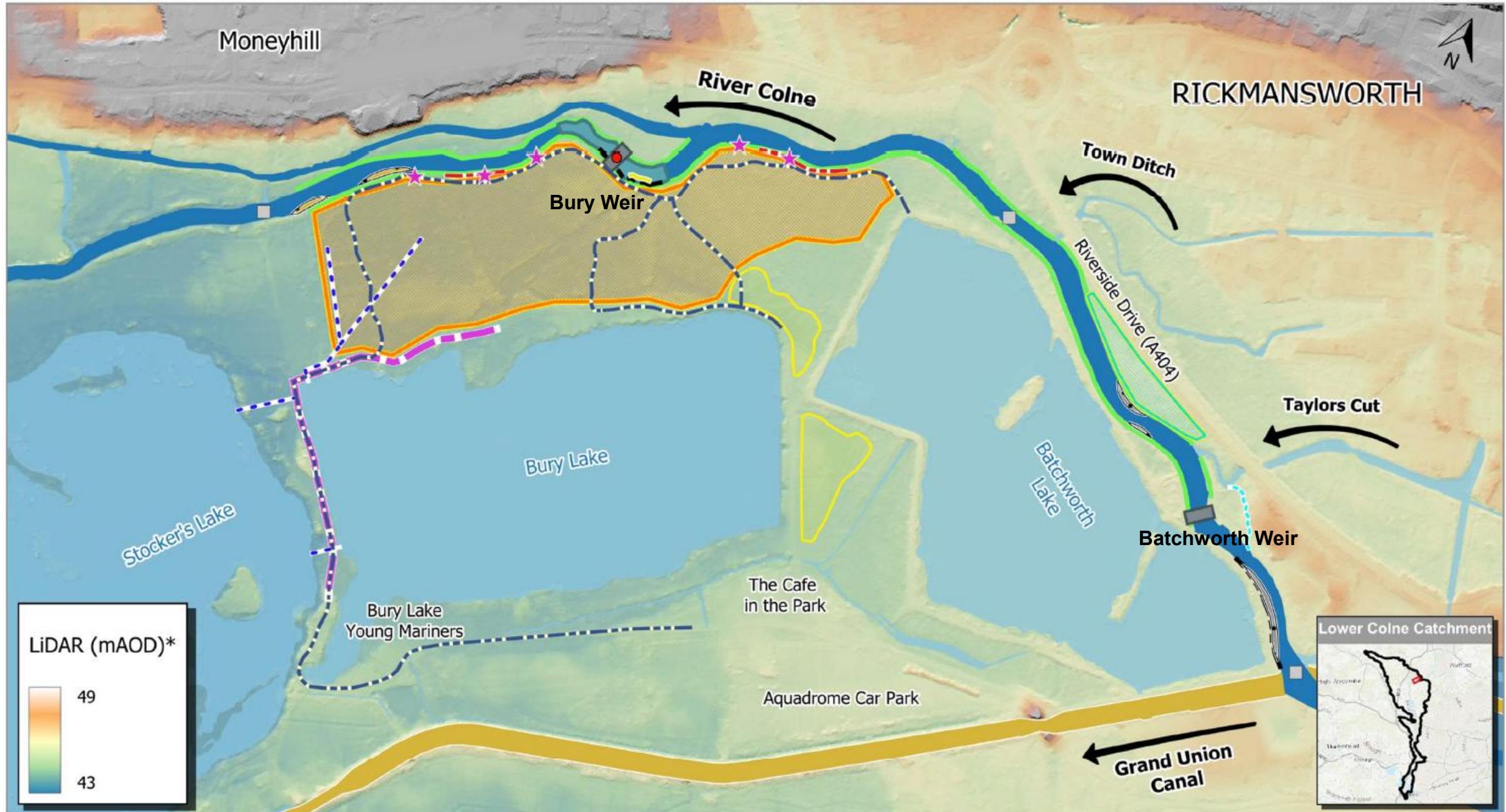
Figure 9: Water Voles within Rickmansworth

The proposed interventions have been brought forward based on baseline scientific evidence, feasibility considerations, and the opportunities and constraints identified. The aims of the improvements include, but are not limited to:

- Diversification of floodplain habitat to enhance biodiversity and landscape experience
- Re-meandering and naturalisation of parts of the river channel
- Enhancement and restoration of areas of wet woodland and the creation of more seasonal and climate resilient access to nature
- Creation of new wetlands (e.g. The Meadow) for flood storage and for habitat creation
- Accessibility improvements to various paths on site through a combination of re-levelling, boardwalks and bridge replacement.
- All improvements will be resilient and sustainable; for example, by using recycled plastic in place of wood for boardwalks.

Proposed Design

(for detailed information please refer to the RALeD Technical Design note)



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- | | | | |
|------------------------|--------------------------|----------------------------------|----------------------------|
| Berms | Bank reprofiling | Improvement to existing footpath | Existing Structures |
| Bank Protection berm | Wet woodland development | High flow pathways | Bridges |
| Channel narrowing berm | Bank protection | Refilled bed | Weir |
| Floodplain lowering | Exclusion fencing | Retain existing channel | |
| Weir removal | INNS management | Grand Union Channel | |
| Embankment lowering | Treeworks | Tributaries & Other Waterbodies | |
| | Footpath raising | | |

*mAOD - Meters above ordnance datum. This gives the actual elevation of the groundwater level referenced to the mean sea level at the UK Ordnance datum at Newlyn, Cornwall

Figure 10: Indicative locations of proposed designs



Proposed Design

The concept designs for the Aquadrome Project will deliver a coordinated package of measures to restore natural chalk stream processes, improve ecological connectivity, enhance wet woodland hydrology, and maintain safe public access. These have been proposed due to recommendations from the various studies conducted within the site establishing the current situation on the ground and how this can be improved.

The key components of the proposed design are summarised as follows (Fig. 10):

Creation of a Bypass Channel: This will see the creation of an additional section of river channel of approximately 60m long, this will commence upstream of Batchworth Weir and then join Taylors Cut downstream of Batchworth Weir. This will allow fish (Fig.11) to pass up and down stream around the structure which otherwise impedes movement.

Regrading of the channel bed: Focused around the Bury Weir location, this will ensure a stable transition. This will help to redistribute energy naturally, ensure hydraulic continuity and support a chalk stream system.



Figure 11: Brown Trout

Weir Removal: The condition of the smaller weir, known as Bury Weir, is deteriorating so much so in summer 2025 the weir notched itself creating a gap in the middle (Fig. 12). The weir prevents fish for swimming up stream, prevents the river from following naturally and causes siltation. The river would return to a more natural chalk river state with improved ecological connectivity if the weir were removed.

Siltation is the excessive accumulation of sediment on the riverbed and is often caused by soil erosion. This negatively impacts water quality, smothers fish eggs and bury habitat that aquatic invertebrates rely on.

Invasive Non-Native Species Management (INNS): Throughout the site, INNS management will take place to support the establishment of native/naturalised plant communities. An example INNS is Himalayan Balsam.

Figure 12: Bury Weir with notch in the middle

Proposed Design

Installation of in-channel berms: These are low shelves within rivers aiming to mimic natural systems (Fig. 13 & 14). They will be constructed in targeted locations to add curves and bends into the river channel. This will offer long-term stability, increased habitat complexity and safeguard sensitive banks from ongoing disturbance.

Floodplain Habitat Creation: Two areas of wetland creation (Fig. 10) are proposed to assist with water storage, topographic diversity and habitat enhancements. The wetlands will be gently shaped with shallow basins ensuring they hold water intermittently – remaining wetter during winter and spring and drying during summer months.



Figure 13: Indicative illustration of river restoration, including in-channel berms



Figure 14: Example berms installed in the river at the Bury Grounds

Riverbank Management (also known as Riparian Management): Along the length of the River Colne there will be targeted removal of trees or tree limbs overhanging the river channel to reduce shading and increase light penetration. This will promote vegetation establishment, trapping of fine sediment and therefore encourage natural channel narrowing. Shading will be retained to maintain cooler water temperatures and provide refuge for sensitive species.

Creation of Water Flow Pathways: These are pathways for water to take during high flow events. It will enhance hydrological connectivity between the wet woodland and lakes, building on the existing ditch network the connectivity will be improved to facilitate the controlled movement of floodwater.

Creation of a Raised Footpath: This will be on areas of the path that are particularly low-lying and subject to flooding as Bury Lake overtops towards Stockers Lake. The aim is that the path will maintain year-round access while also increasing floodplain water-storage capacity.

Proposed Design



Figure 15: Indicative illustration of the woodland walk, with the river to the left and wet woodland to the right

Embankment Lowering: There are five locations along the River Colne where it is proposed to breach the embankment allowing water to flow between the river and the wet woodland. This would reinstate natural hydrological connectivity which has been lost due to the high riverbanks; this will be beneficial for the wet woodland habitat. The proposed points align with natural low points and to maintain safe access over each breach point a bridge or boardwalk will be installed (Fig. 15).



Figure 16: Indicative illustration of the lake bank protection

Bank Protection: At targeted locations along the river corridor and around the lakes (Fig. 16), the banks will be stabilised to mitigate previous erosion and vegetation establishment will be encouraged. To protect these improvements fencing will be installed in discrete, high-pressure areas.

The proposed designs are subject to the approval of a Flood Risk Activity Permit (FRAP) issued by the EA. A FRAP will only be issued if the designs are deemed to not increase flood risk to the system. It is for this reason that detailed flood modelling at this stage is vital.

Glossary

Bathymetry	is the mapping of underwater depth and terrain; it is equivalent to underwater topography.
Berms	are low shelves within river channels that help to create a bend or arch which mimics the natural shape of rivers.
Chalk Stream/Rivers	are one of the rarest freshwater habitats. The rivers are fed by groundwater making the water rich in minerals which remains at a fairly constant temperature. They have clear water and are very biodiverse.
Embankments	are raised, compacted earth/stone which is designed to act as a barrier against water passing. Their aim is often to prevent flooding and protect against erosion.
Floodplains	are flat areas of land adjacent to rivers which flood for a portion of the year. In natural systems floodplains stretch from the riverbanks to the base of the valley on either side.
Glides	are deeper areas of water with slower, smooth-surfaced water.
Hydraulic models	are collections of mathematical equations that estimate the flow of water and represent the situation on the ground. They estimate water flow, pipe networks, tidal systems, open coast processes and floodplains.
Hydrology	is the study of water movement, distribution and management. Hydrologists apply scientific knowledge, and mathematical principles to mitigate and solve water-related problems
Invasive Non-Native Species (INNS)	Lots of plant and animal species have been introduced to the UK by people and otherwise would not have been present. The majority of these are harmless to people and the environment; however, the ones that are harmful are called invasive non-native species.
LiDAR (Light Detection and Ranging)	is a survey method using light to measure ranges (or distances) to the earth from the instrument, for example a drone. Together with accompanying data, a precise, 3D image of the shape and surface characteristics of the ground is created.
Naturalised Species	are a type of non-native species, introduced by humans but have then established self-sustaining populations without harming the environment or requiring human intervention.
Notching	is creating a "notch" or gap into a weir, to allow a flow of water through which wildlife can pass
Re-meandering	is a river restoration technique that aims to return the river to a more natural shape, similar to what it would have been before artificial straightening.
Return Period	or Annual Exceedance Probability (AEP) are interchangeable terms used to describe the size or extent of flooding in a flood model.
Riffles	are shallower areas of turbulent water creating high oxygen habitats.
Riparian	this term relates to the area on and around the banks of the river.
Topography	is the study of the shape of the land.
Weirs	are low structures within a river channel designed to raise the water level upstream and regulate its flow.
Wet Woodland	is a type of rare habitat with frequently wet soil and distinct species of trees.

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