Lower Crane Restoration Pilot Project Report

River Crane Smarter Water Catchments Project

February 2023

Working in partnership

Thames Water

Crane Valley Partnership

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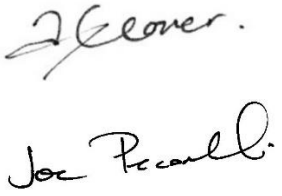
Prepared by	Azra Glover and Joe Pecorelli (Zoological Society London)	 21/02/2022
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This document has been created for the purposes of Thames Water's Smarter Water Catchments initiative. Although Thames Water remain the primary client, this document will be made available to all partners associated with the project, in line with the true partnership ethos of the project. The work detailed in this report is based on the information available at the time. Any findings and/or recommendations will inform future phases of the project.

Acknowledgements

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- Steve Marshall (Wild Future Outdoors Ltd. on behalf of Richmond Council)
- Prof Angela Gurnell and Dr Lucy Shuker (Cartographer)
- Rob Gray (FORCE)
- John Waxman (Crane Valley Partnership)
- Mick Massie

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1 Aims of this report

The aims of this report are to:

- Outline the objectives and design of the lower Crane restoration pilot
- Record any lessons learnt in the delivery of the project
- Record first observation on the ecological impact of the scheme and the community response to it
- Make recommendations for future monitoring
- Monitor and assess the outcomes of the pilot and use it as a local and regional demonstration site to help inform future river restoration work across the catchment

2 Background

The Lower River Crane Restoration Steering Group (Richmond Council, Environment Agency, Friends of the River Crane Environment (FORCE) and the Crane Valley Partnership (CVP)) chose this site as a pilot to assess the impact of river restoration techniques on a small scale. The CVP's Vision for the Lower River Crane Landscape included this site within its initial design ideas of opportunities to restore stretches of the River Crane. The vision looked to enhance target areas to demonstrate the potential of river regeneration to humans, wildlife, and water quality.

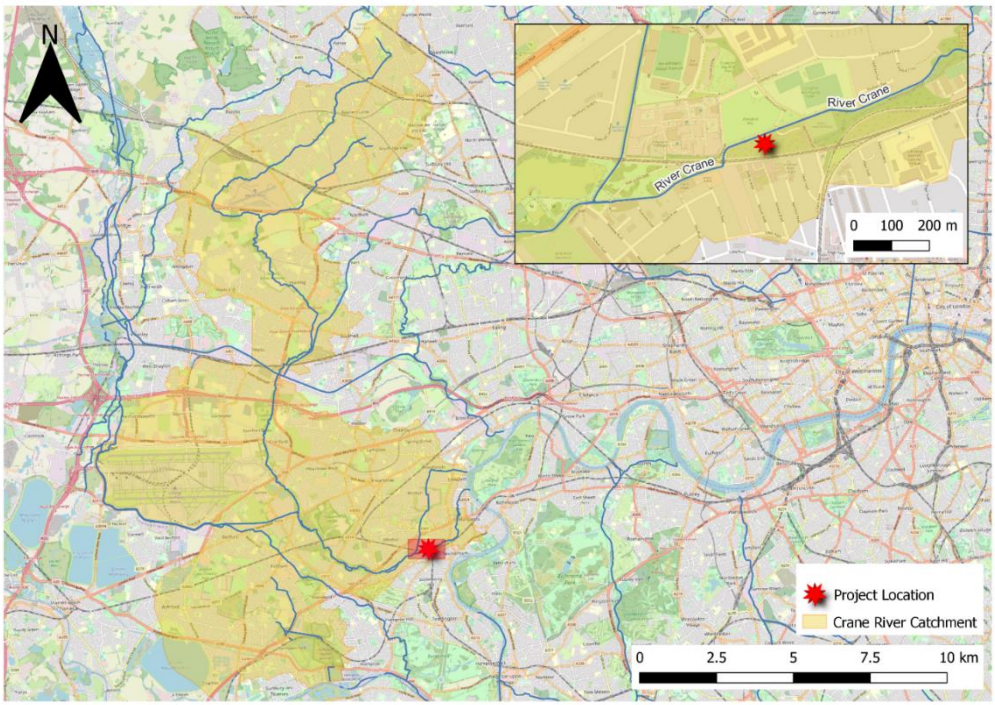


Figure 2.1: Map of the restoration site location within the Crane River Catchment.

The project is located on the previously unmanaged area of grassland and scrub at the western end of the Twickenham Rifle Club site. The site, owned by LBRuT, is closed to public access. Prior to restoration, the area was covered mainly in bramble with the river flowing through a 1920's built channel. The channel consisted of approximately 80% bare concrete and 20% silt and rubble, and so was seen as an ideal location to test out a number of replicable restoration techniques.

Figure 2.2: Image of lower Crane channel at the restoration site prior to improvement works. Credit: ©Wild Future.

A feasibility and options appraisal report carried out by Atkins prior to restoration in April 2019 highlighted that the Lower River Crane's significantly modified and artificially straightened structure, comprising of a concrete bed and banks, was limiting habitat diversity. The report emphasised that water depth throughout the Lower River Crane was largely shallow with poor flow diversity. In-channel and riparian vegetation were generally restricted to overhanging trees and terrestrial grass and scrub species (Figure 2.2). Some patches of marginal macrophytes were observed within the study area of the report at Craneford Way playing fields. The Atkins report indicated that this heavy modification was likely to significantly limit both instream and riparian habitat quality and biodiversity. Nonetheless, the watercourse was shown to provide a continuous 'green and blue' corridor throughout a predominantly urban environment. Furthermore, prior to restoration works, the Crane water body (2016 survey) had an overall Water Framework Directive (WFD) status of 'Poor', with an ecological status of 'Poor' (including biological quality elements) and chemical status of 'Good'.

3 The Project

3.1 Restoration Project Summary & Key Information

Project Location: Twickenham	**Watercourse:** River Crane
Project Start Date: Autumn 2019 (pre-works surveys), February 2022 (work commenced).	**Project Completion Date:** March 2022
Techniques: Removal of concrete bank, creation of backwater habitat and installation of vegetation berm. Plans to create viewing area.	**Total Cost:** ~£110k
Led by: London Borough of Richmond Upon Thames	**Funders:** Environment Agency, Richmond upon Thames London Borough Council.
Upstream Grid Reference: TQ152734.	**Project Area:** Total project area = 273m^2 (berm = 60m^2, backwater = 76m^2, banks = 137m^2).

3.2 Project Objectives

The objectives of this restoration project were:

- The removal of part of the concrete bank to: 1) increase flood storage in the Crane by holding more water at this location and slowing flows further down the catchment, 2) reduce flood risk and 3) provide the capacity to support more diverse vegetation
- The installation of a berm to help benefit biodiversity including fish and invertebrates
- Addition of gravels to provide a more natural bed substrate suitable for fish habitat
- The creation of a viewing area to provide a location to enjoy a more natural outlook on this section of the River Crane
- Gauge public perception of the restoration project to inform future plans in the area
- Learn from the technical and logistical elements of the construction work to inform future projects in the Crane

Figure 3.1: Aerial image of restoration site.

3.3 Design

Backwater: Approximately 18.1m of concrete removed along the length of the channel, with a maximum 6m wide area of bank removed for the creation of a backwater habitat (dug to the same depth as the existing riverbed and a minimum 4m width at the upstream end of the backwater habitat.

Berm design: 30m rock roll berm back filled with a mixture of imported and site won clay/loam soil and material and covered in 2m wide coir pallets tethered to rock rolls. The berm was planted with yellow iris, marsh marigold, purple loosestrife, lesser pond sedge, soft rush and hemp agrimony.

Gravels: 20 tonnes of gravels graded 20-60mm were spread across an approximate 20m (L) x 8m (W) x ~0.075m (depth) to create a more natural bed habitat.

Access: At present, the site remains closed for public access but can be viewed through a wire fence. There are plans to potentially lower this to improve the view of the site for the public.

Additional habitat creation: The soil and concrete arising from the works was used to create reptile hibernacula and an invertebrate bank along the boundary of the Richmond upon Thames London Borough Council land.

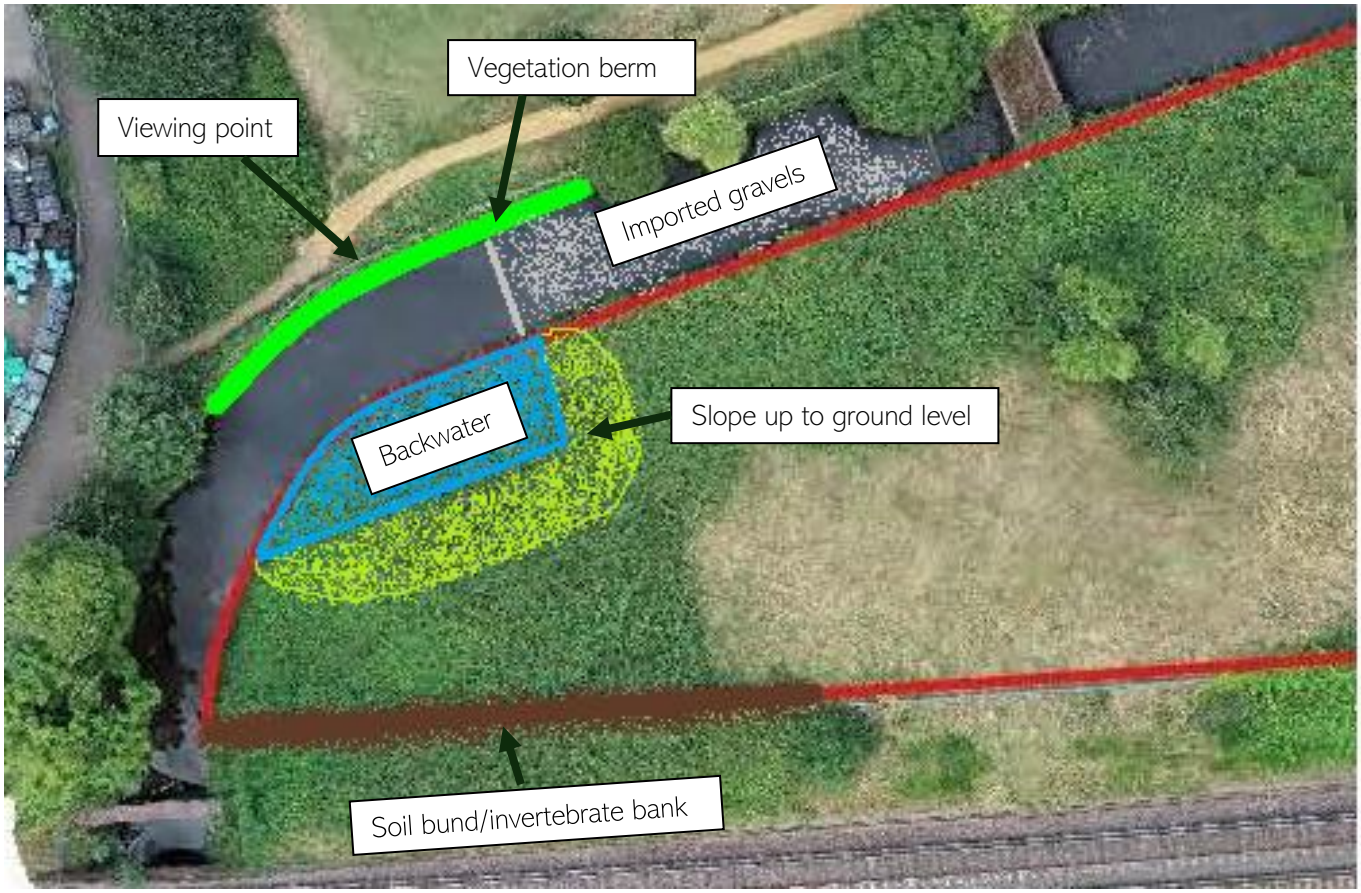


Figure 3.2: Aerial image of restoration site with key design features indicated.

4 Lessons learnt from project delivery

As with many river restoration projects, especially within urban catchments, there were a number of unknowns and unforeseen issues that had the potential to impact overall cost and success of this restoration project. The key lessons learnt from addressing these issues and their implications on project cost and impact have been highlighted below:

Soil Quality and Composition

Imported soil quality was limited due to high clay content soil supply issues resulting in a lower clay content than originally planned. However, the quality of soils and materials removed from site during excavation were of a better quality and higher clay composition than expected. As a result, these were mixed with the imported soils to create a more suitable substrate for use within the vegetation berm. In hindsight less material would have been imported, and more of the excavated, higher clay content soils would have been utilised to improve substrate composition and resilience to high flows as well as to reduce project costs.

Removal of Concrete Banks

Limited information was available regarding the composition and thickness of the bed concrete and banks prior to construction. However, the width of concrete at the base of the channel walls/banks was not as thick as expected, subsequently making these easier to remove than expected.

Figure 4.1: Digger removing soil and material to create the backwater.

Design and Preparation vs Restoration Work

The size of this pilot restoration project, and therefore the split of time/resources between design, preparation and the restoration work itself was dependent on three key factors: 1) the maximum financial budget, 2) the amount of spoil that would be generated (both in terms of the financial cost of disposal and the physical space available to accommodate any left on site); and (3) due to the nature of the project being a trial, the level of success was unknown before breaking ground and it was subsequently a conscious decision to make the trial the minimum viable size to demonstrate the techniques that had been selected.

Although in principle, a larger restoration project would have likely been better value in terms of increasing the proportion of the overall cost spent on restoration .e.g. creating a longer berm, addition of larger volumes of gravel substrates, or removal of a longer section of the concrete bank, the choice was made instead to pay the premium involved in having a smaller trial. This in turn maximised the benefits of this project in terms of learning from the techniques employed and informing further restoration works at this site as well as future projects within the catchment.

Figure 4.2: Temporary road and construction site built for the duration of the restoration project. Left image credit: ©Wild Future.

Planting

Within the new grassland and banks of the backwater, a large proportion of the wildflowers, plants and seed plugs that were planted/hydroseeded were unsuccessful. This was primarily due to germination rates being lower and slower than expected caused by the prolonged drought period and intense hot weather throughout June, July and August. The hydroseeded area was the main area of disappointment, with slow ground coverage resulting in an increased amount of disturbed ground species that germinated, significantly increasing maintenance requirements. In contrast, plant plugs in the backwater and berm were very successful (see Appendix 3).

Maintenance may therefore have to be considered more carefully, potentially increasing watering at the site to promote planting success. In addition, adjusting the timing of planting to take place immediately after works were completed would stabilise banks but also help to prevent undesirable plant species establishing at the site.

Timing of the project could also be adjusted/delayed to late summer, with an aim to complete by late September/early October to promote more successful seed growth and ensure better resilience to low flows and more intense dry weather conditions.

Figure 4.3: (Top left) Pre-restoration, (Top right) Immediately following excavation work, (Bottom) Post-completion summer 2022. Credit: ©Wild Future.

Additional substrate suitability

The 20 tonnes of imported gravel only achieved approximately 60% of the coverage planned, at the downstream end of the berm. The edges and higher areas were planted with the same species as the berm. Initial surveys have shown that the new gravel has been successful as fish and invertebrate habitat, and the Environment Agency are keen to see more gravel imported to extend these benefits.

Heavy rain in early winter has mobilised large proportions of the gravel that was added as part of this restoration project into a bar across the channel at the downstream end (see Figure 4.4), with some being lost downstream of this site completely. Where planting has been carried out along the southern edge of the channel, added gravels have remained stable. Therefore, discussions are underway for an additional 40 tonnes of larger sized gravels to be added to the site.

Figure 4.4: (Left) Bar created by gravels that have been washed out of the restoration site due to heavy rainfall and subsequent high flows. (Right) Gravels retained within the planted areas of the restoration site. Credit: ©Wild Future

5 Ecological Impact

5.1 Fish

Fish surveys had not previously been conducted at this site. Kick and sweep net surveys were carried out after restoration work had been completed (08/09/2022) finding the presence of stone loach ranging between 45mm and 60mm within the newly planted vegetation banks and berm.

Figure 5.1: Stone loach caught during field survey within the vegetation berm habitat.

5.1 Aquatic invertebrates

Two invertebrate samples were carried out as part of this investigation; before and after restoration works.

Figure 5.2: (Left) Invertebrate netting of the marginal vegetation surrounding the backwater habitat area. (Right) True Mayfly (*Ephemeridae)* recorded during invertebrate sample.

Pre-works survey

The first macroinvertebrate survey was carried out on the 01/07/2020 prior to works commencing when approximately 80% of the riverbed was bare concrete and 20% was silt and rubble cover. For this reason, a kick sample was not appropriate and instead, a 20-minute hand search was carried out with a standard kick net, as well as lifting larger stones, and netting in the silt. Very little habitat and consequently low invertebrate numbers were found. However, the presence of *Acroloxidae* (river limpet) and *Hydroptilidae* (microcaddis) suggest water quality conditions that could sustain good invertebrate abundance and diversity if the habitat were to be improved. Although a standard Riverfly Monitoring Initiative (RMI) sampling methodology could not be carried out, the sample was still scored (see Appendix 1). The only scoring taxa present in the sample was *Gammarus* (<10 individuals found altogether), producing an overall RMI score of 1.

Post-works survey

A follow-up macroinvertebrate survey was carried out following restoration works on 08/09/2022. Standardised RMI sampling methods were used, with a 3-minute kick sample carried out across the channel, accounting for the areas of gravel, berm, and bankside vegetation. Six of the eight RMI pollution-sensitive target invertebrate groups were present, producing an overall RMI score of 8.

Backwater

Invertebrates in backwater habitat were also sampled, with results indicating the presence of species closely associated with pond habitats rather than riverine habitats such as water boatmen (*Corixidae)* and pond skaters (*Gerridae).* This data demonstrates that at the time of sampling, this area of the restoration site was providing a very different function and habitat to the reed beds, gravels and vegetation berm of the main river channel. This was due to the low flow conditions impounding the water within the backwater.

Overall, the increase in species diversity and abundance at this study site demonstrates that the introduction of gravel substrates and planting of native species has been a great success. From initial investigation and data collection, the works appear to have successfully created an ecologically diverse section of the River Crane from a previously confined concrete channel.

5.2 Terrestrial invertebrates

A walkover invertebrate survey was carried out at the study site post-restoration on the 13/07/22. Results of this survey can be found in Appendix 2.

6 Hydromorphological Impact

MoRPh surveys capture the types and abundances of sediments, hydraulic and physical habitats, vegetation structural components, human interventions and pressures across the bank tops, bank faces and riverbed of short lengths of river called modules.

Cartographer carried out River Condition Assessments (RCAs) using the observations recorded in five MoRPh surveys for each of the 'Treatment' (restored) and Downstream (not restored) subreaches of the lower Crane site (see Figure 5.3). The RCA methodology (Gurnell et al., 2020) outputs a Final Condition Class ranging from Good to Fairly Good, Moderate, Fairly Poor and Poor for each subreach.

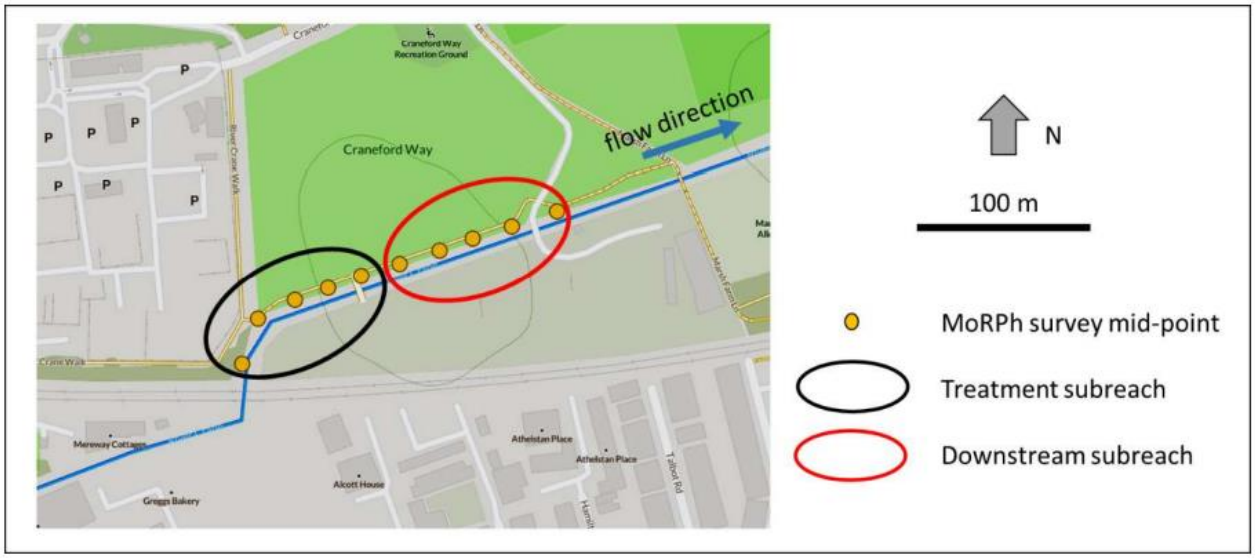


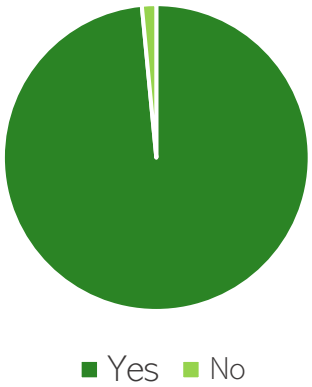
Figure 5.3: 'Treatment' and 'Downstream' subreaches and MoRPh survey mid-points at Craneford Fields.

Results of the RCA show that the restoration practices at the lower Crane restoration site have resulted in an increase of one class in the Final River Condition Assessment from **Poor in the downstream reach** to **Fairly Poor in the 'Treatment' reach**. For further details please see full report.

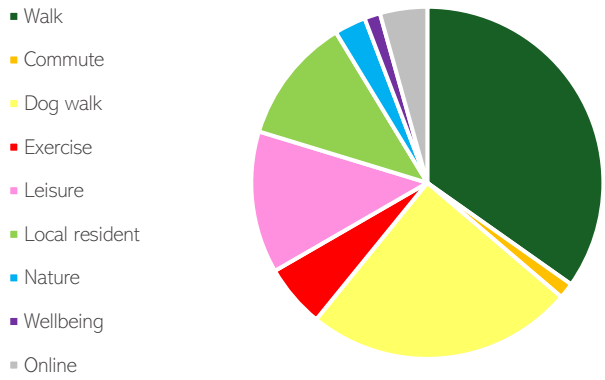
7 Community Response

A community response survey was created using Survey Monkey – a total of 66 respondents completed the survey from August 15th - September 15th 2022.

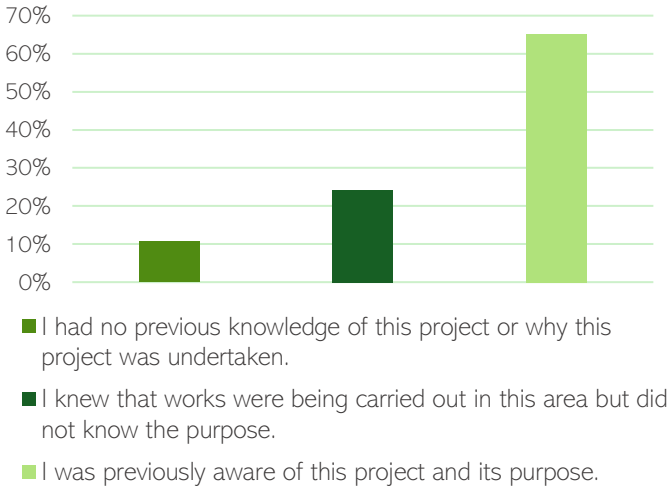
Do you live locally to the River Crane?



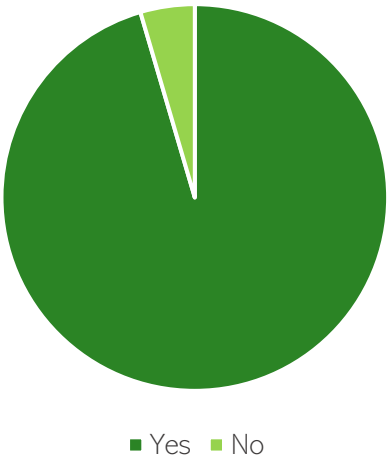
What was the purpose of your visit to this area today?



Were you previously aware of this project and the function/purpose of the newly restored site?



Would you like to see more of this kind of restoration work carried out along the rivers in this catchment?

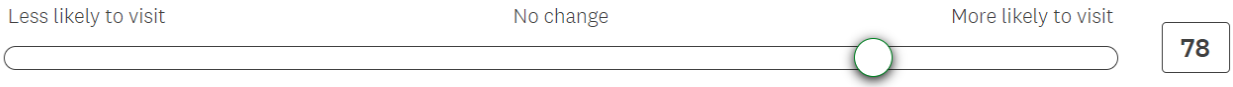


Do you agree with the following statement: The creation of a backwater habitat and planting of native species has improved this area.

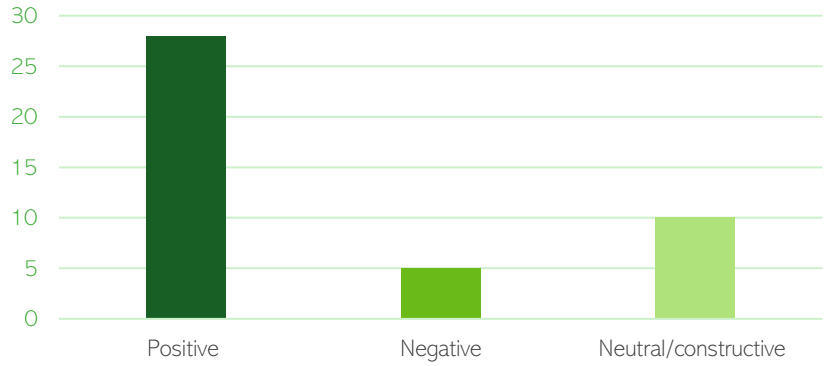
★ ★ ★ ★ ⯪

Average = 4.45 stars

Are you more likely to visit/spend time at this location as a result of these restoration efforts? (0 = less likely to visit, 100 = more likely to visit).



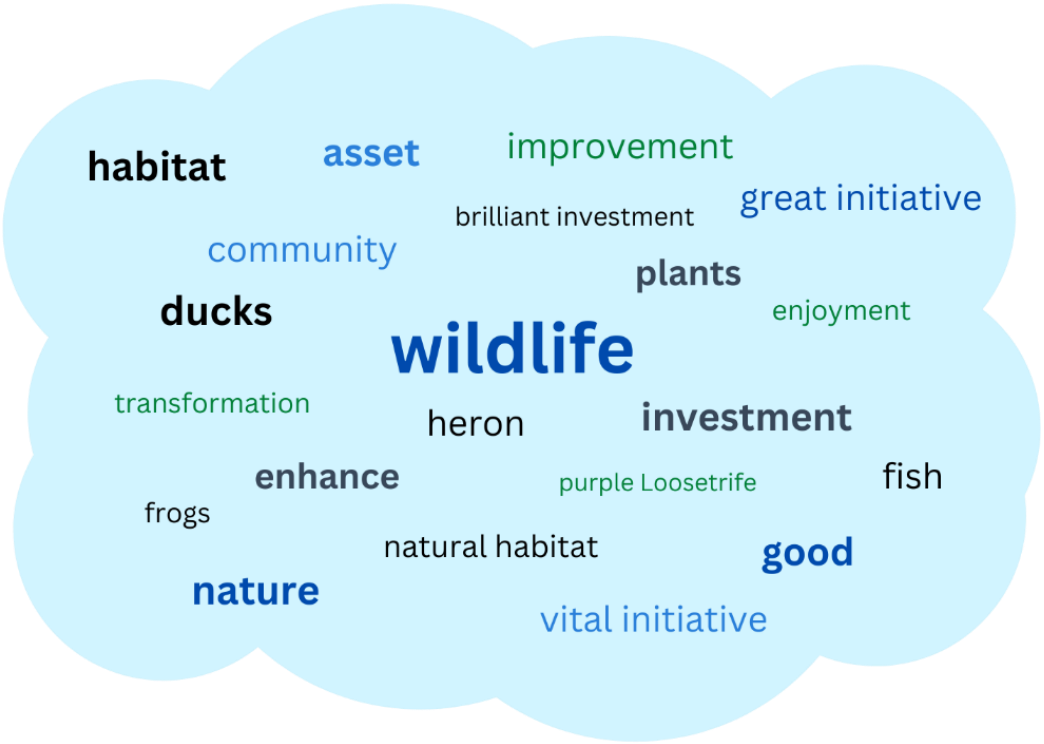
Do you have any comments/additional information that you would like to share regarding this restoration project?



** Please note: Answers were analysed and grouped into the categories of being generally positive, negative, or neutral/mixed/constructive. Two responses were removed from data interpretation as they were related to the restoration works upstream rather than directly to this restoration project.*

Key words from positive feedback responses:

*(*words/phrases appearing more than once within overall feedback)*



Key recommendations from responses:

8 Future Monitoring and Recommendations

The lower Crane restoration project is still in its early stages of development. Although construction at the site has been completed, plants, invertebrates, terrestrial organisms and fish associated with this restoration project will likely need time to colonise and establish themselves within the newly created habitat areas before success can be measured.

However, based on the promising indications of diverse aquatic invertebrate communities and the presence of fish there is strong evidence that ecological benefits are already being provided as a direct result of the improvements created by this restoration project. Based on this early success, as well as on the lesson that were learnt through the design and construction process, the following recommendations can be made for the monitoring of this site, recommendations for future works in the lower Crane and for the restoration of similar sites.

Recommendations for monitoring

- Continued annual, summer monitoring of plants, invertebrates and fish are required to gauge impact of this restoration work as the site matures.

- Monitoring of the backwater habitat under 'normal' flow conditions should be undertaken. During periods of higher flows, the backwater has the potential to act as a refuge habitat for fish and invertebrates and should therefore be revisited.
- Monitor the movement of the gravels (through marking the upstream extent and assessing movement downstream) to gather further information on substrate suitability and the potential need to stabilise existing gravel substrates and/or consider larger substrate (e.g., cobble or boulder) augmentation within the channel.

Recommendations for future restoration work in the lower Crane

- Workshopping of project aims for the ecology of the lower Crane to establish key priorities for the future of the reach. For example, if the restoration of connectivity for fish is prioritised, partners will need to consider barriers to fish migration as well as what habitat requirements for species that will make use of the channel. Flows and channel profile lack sinuosity with deep pool habitats being few and far between.
- Investigate if LBRuT can register the lower Crane as an opportunity site for Biodiversity Net Gain (BNG) funding once BNG comes into force in November 2023.
- This pilot project has demonstrated that even a relatively small-scale intervention in the lower Crane can have a notable positive transformative effect - improving the hydromorphology and ecology of a reach as well as enhancing its visual amenity. It follows that a series of low-cost opportunistic interventions of this type along the lower Crane could have a significant cumulative impact on the watercourse as a whole, potentially reducing the need to rely on several large-scale river reprofiling projects that might be more difficult to finance and/or accommodate (in the confines of the urban landscape).

General recommendations for river restoration works

- Soils should be screened carefully prior to being imported. Soils at the restoration site should be tested to see if, like in this instance, materials that have been excavated can be reused within the project to reduce the amount that needs to be imported from external sources/providers.
- Engage with the public throughout multiple stages of restoration works to make project aims, objectives and subsequent benefits such as habitat and biodiversity enhancements, flood alleviation and water quality improvement clear to local communities from the outset.

Furthermore, based in part on the feedback from the public perception survey carried out as part of this report, the council are now considering the following for the site:

- Reducing the height of the fencing to allow a better viewing opportunity.
- Providing a permanent information board to show the purpose and outcomes of the scheme.
- Do further works in the associated open space to promote wildlife – e.g., kingfisher nesting site; marginal hedges; meadow and bramble management; bat boxes etc.
- Install more bed material into the river, including larger cobbles and boulders to vary the structure and aid more material retention.
- The use of this as a release site for appropriate species such as slow worms and grass snakes.

In addition, the council are actively looking at where further restoration projects can be carried out along the lower Crane, utilising the findings of this project.

9 Appendices

Appendix 1: Invertebrate sampling results

Pre-restoration:

Date: 01/07/2020

Time: -

Species		Count	Score
SHRIMPS	Shrimps (Gammarus)	<10	1
OTHER	*Acroloxidae* (River limpet)	*Present*	-
	Simuliidae (Blackfly larvae)	*Present*	-
	Erpobdellidae (Leech)	*Present*	-
	Asellidae (Water louse)	*Present*	-
	Hydroptilidae (Microcaddis)	*Present*	-
	Dendrocoelidae (Flatworm)	*Present*	-
		RMI	1

Post-restoration:

Date: 08/09/2022

Time: 11:30am

Species		Count	Score
CADDIS FLIES	Caseless	2	1
	Cased	6	1
UPWINGED	*Baetidae* (Olives)	2	1
MAYFLIES	*Ephemeridae* (Mayfly)	32	2
	Ephemerellidae (B.W.O)	3	1
	Heptagenildae (Yellow May)	0	0
STONEFLIES	Stoneflies	0	0
SHRIMPS	Shrimps (Gammarus)	90	2
OTHER	Leeches	*Present*	-
	Snails	*Present*	-
	Asellidae (water louse)	*Present*	-
	Caenidae	8	-
		RMI	8

Appendix 2: Terrestrial invertebrate survey results

Terrestrial invertebrates were surveyed by Mick Massie on 13/07/2022 with results recorded on iNaturalist. The following species were identified during the survey:

- Western Honey Bee (*Apis mellifera)*
- *Ground Spider (*Genus: *Drassodes)*
- Clover Root Weevil (*Sitona lepidus)*
- Banded Rhopalid (*Stictopleurus punctatonervosus)*
- Bumblebee *(*Subgenus: *Bombus)*
- Cabbage bug (*Eurydema oleracea*)
- Ant Damselbug (*Himacerus mirmicoides*)
- Broad Damselbug (*Nabis flavomarginatus*)
- 24-spot Ladybird (Subcoccinella vigintiquatuorpuncta)
- Green Shield Bug (*Palomena prasine*)
- Long-winged Conehead (*Conocephalis fucus*)
- Tortoise Bug (*Eurygaster testudinaria*)
- 16-spot ladybird (*Tytthaspis sedecimpunctata*)
- Zealot Ground Spider (Genus: *Zelotes*)
- Draparnaud's Glass Snail (O*xychilus draparnaudi)*
- Millipede *(Cylindroiulus caeruleocinctus)*
- Leafhoppe*r (Graphocraerus ventralis)*
- 7-Spot Ladybird *(Coccinella septempunctata)*
- Gatekeeper Butterfly *(Pyronia Tithonus)*
- Kentish Snail *(Monacha cantiana)*
- Red-tailed Bumble Bee (*Bombus lapidarius*)
- Adonis Ladybird Beetle (*Hippodamia vairegata*)
- Rounded Snail *(Discus rotundatus)*
- Oblong Running Spider *(Tibellus oblongus)*
- Rosel's Bush-Cricket *(Roeseliana roeselii)*
- Cricket-bat Orbweaver *(Mangora acalypha)*
- White-lipped Snail *(Cepaea hortenis)*
- Cucumber Spider *(Araniella cucurbitina)*

Appendix 3: Fixed Point Photography

APRIL 2022

MAY 2022

JUNE 2022

JULY 2022

AUGUST

Working in partnership