



Werrington Brook Improvements: Aubretia Avenue Reach Post- enhancement Survey

Version 1.0

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Executive summary

A survey of Werrington Brook at Aubretia Avenue, Peterborough was conducted after completion and recovery of enhancement works. The water and habitat quality had improved to above the Good/Moderate threshold (Water Framework Directive) after the development works, indicating an improvement in the ecological communities at Werrington Brook. Only one site (Site 4) furthest downstream of the works was found to have decreased water and/or habitat quality, this could be attributed to any of the following; recent weed cutting, recent pollution events and lesser channel modifications at this site than those further upstream.

Aquatic plant diversity increased extensively after enhancement works (aside from Site 4) thereby increasing the complexity of the habitat for aquatic invertebrates, fish and other wildlife in addition to increasing the aesthetic and amenity value of the area. It is recommended that another survey is completed in September 2020 due to the compounding factors affecting Site 4.

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Introduction

The fifth phase of the Werrington Brook Improvement Project was focused on the channel adjacent to Aubretia Avenue in Werrington, Peterborough and continued downstream to Cuckoo's Hollow Lake (Figure 1). This habitat enhancement scheme was completed in July 2018 and built onto the improvements in the previous reach of Werrington Brook, upstream of Site 1, that were completed in 2016. The improvements included the creation of berms, riffles, pools, new meanders and a surface water outfall treatment wetland. These works aimed to provide additional habitats for aquatic species and other wildlife through the creation of a more natural stream environment that improved water quality. A pre-enhancement survey was conducted in September 2017 (see previous report 'Werrington Brook Restoration Interim Report') and the post habitat enhancement survey on 19th September 2019.

Sites and Methods

Four sites were surveyed for macro-invertebrates in September 2019 to assess the success of the project; Upstream Larkspur Bridge (Site 1; TF1790903185), Wysteria Way Green (Site 2; TF1784503398), Welbourne Outflow (Site 3; TF1763503486) and Upstream Cuckoo's Hollow Footbridge (Site 4; TF1757703726). The locations of these sites are shown in Figure 1. Site 1 is a control site and located in an area upstream of the 2018 improvement works. Macrophyte (plant) data was again collected at each site as per the pre-enhancement survey and fish presence also noted. Photographs both upstream and downstream were taken at each site (see Appendix 2).

A survey of aquatic macro-invertebrates, using the 3 minute standard kick and 1 minute hand search sampling protocol (in accordance with UKTAG methodology) with a standard FBA pattern pond-net, was conducted on the 19th September 2019 post habitat enhancement. Samples were analysed using standard protocols and the data obtained presented in Appendix 1.



Figure 1: Map showing the Werrington Brook Survey site locations. Site 1 is the control upstream of the 2018 improvement works.

Data Analysis and Interpretation

As an aid to interpretation, the Walley, Hawkes, Paisley & Trigg¹ number of taxa (WHPT-NTAXA²), Average Score Per Taxon (WHPT-ASPT³) index scores and Community Conservation Index (CCI⁴) scores for the macro-invertebrate samples were calculated. LIFE (Lotic invertebrate Index for Flow Evaluation) and PSI (Proportion of Sediment-sensitive Invertebrates) scores were also calculated to provide measures of the flow conditions and the quantity of fine sediment present on the river bed respectively. Complete ecology data for all surveys are presented in Appendix 1. Photographs of each site are presented in Appendix 2.

In order to allow comparisons between sites and across different seasons, the predictive software RICT (River Invertebrate Classification Tool) was used to generate observed/expected (O/E) ratios for the two WHPT indices, LIFE and PSI. O/E ratios provide a standardised measure of the pressure to which the respective metric is related (i.e. sedimentation for PSI etc.) resulting from anthropogenic influences. O/E ratios of less than 1.0 may indicate stress and the lower the calculated ratio, the greater the degree of stress. O/E ratios for WHPT-ASPT, WHPT-NTAXA, LIFE, and PSI calculated from the samples taken before enhancement work commenced are compared to those calculated from samples taken post-enhancement and presented in Figures 2-3.¹

Results

Macroinvertebrates

Water and habitat quality at Sites 1, 2 and 3 increased after the 2018 improvement works. The O/E ratios for these sites are now above the Good/Moderate threshold for both WHPT-ASPT and WHPT-NTAXA, with improvements most apparent at Site 2 (see Figure 2). At Site 4 WHPT-ASPT O/E ratios remain the same, at just below the Good/Moderate threshold (Figure 2), however this site showed a decrease in WHPT-NTAXA to below the threshold values compared with 2017 results indicating water/habitat issues. Overall Site 4 still remains below the Good/moderate threshold for water/habitat quality after the enhancement works. This may be due in part to the recent weed cutting (see Plate 2) at Site 3 and 4 that would have reduced habitat quality and affected the WHPT-NTAXA and WHPT-ASPT scores. Additionally three recent pollution events in Werrington Brook may have affected the water quality and coincidentally, on the day of survey, pollution was noted flowing downstream of Site 2.

¹ N.B. The two WHPT indices are primarily designed to detect organic pollution. Habitat improvements and restoration works that increase macro-invertebrate diversity, however, will be reflected in increasing WHPT-NTAXA and WHPT-ASPT scores

¹ Walley, Hawkes, Paisley & Trigg (WHPT) index – an index originally derived to assess the response of certain freshwater invertebrate taxa to organic enrichment, used as an assessment of biological water quality and replaced Biological Monitoring Working Party (BMWP). Scores range from -1.6 to 13 with species tolerant of organic enrichment having low scores. Scores for individual taxa are added together to give an overall sample score and then divided by the number of scoring taxa to give an average score per taxon.

² WHPT-NTAXA (Number of taxa) – the number of WHPT-scoring taxa.

³ WHPT-ASPT (Average Score Per Taxon) – the overall WHPT score divided by the number of scoring taxa.

⁴ CCI (Community Conservation Index) – an index designed to assess the conservation value of macro-invertebrate communities by incorporating elements of both rarity and taxon richness. Rarity values for invertebrate species range from 1 (Very Common) to 10 (RDB1- Endangered).

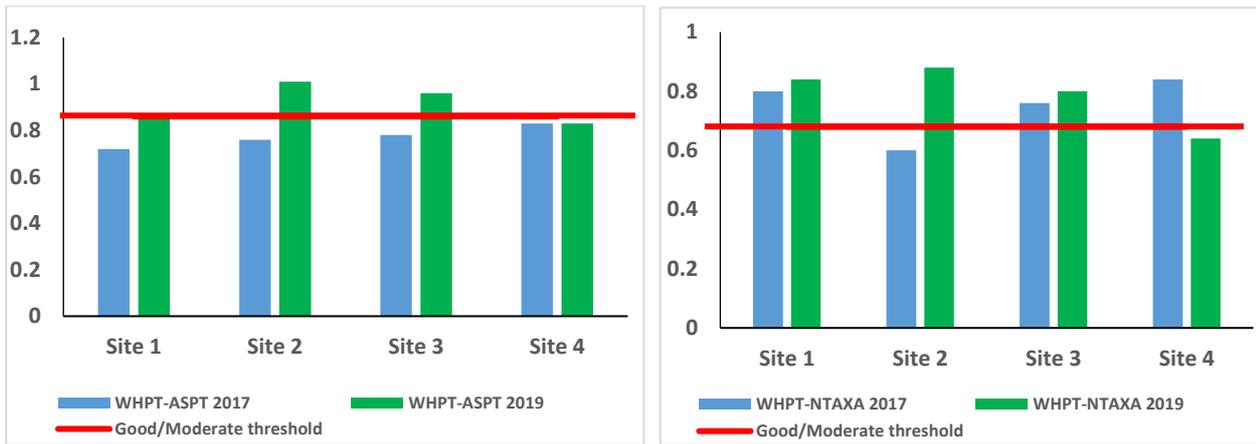


Figure 2: Comparison of Werrington Brook profiles for water quality (WHPT-ASPT O/E and WHPT-NTAXA O/E) before (2017) and after improvement works (2019).

The O/E LIFE ratios from Figure 3 below indicate low flow pressure was still impacting the control site (Site 1), however, the ratios are now above the guidance threshold for all other sites indicating general improvements in flow downstream of Site 1 after the enhancement works. PSI O/E ratios also improved since the enhancement works although they remained below the guidance threshold and indicated a continued fine sedimentation pressure at all sites.

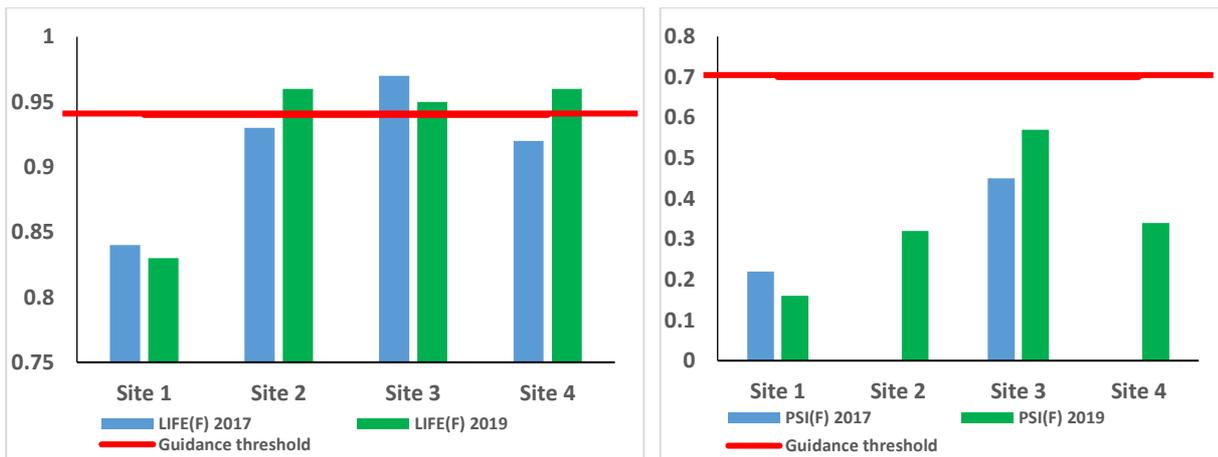


Figure 3: Comparison of Werrington Brook profiles for flow velocity (LIFE O/E) and fine sedimentation accumulation (PSI O/E) before (2017) and after improvement works (2019).

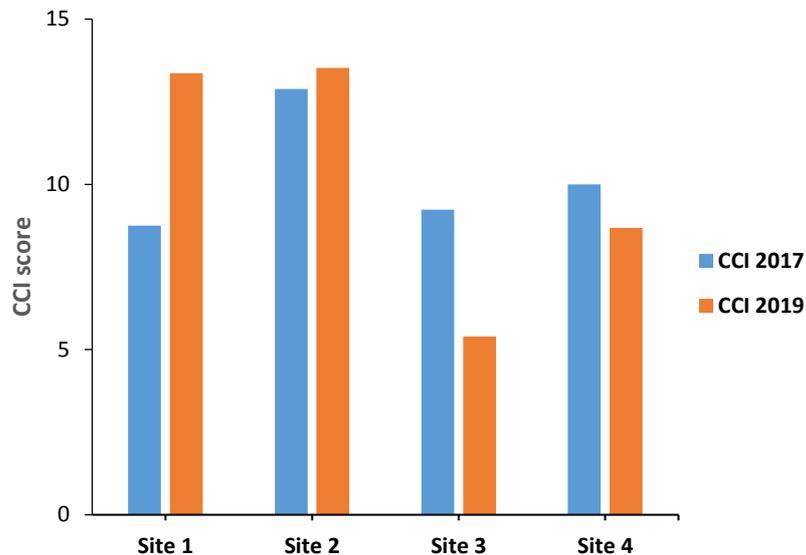


Figure 4: Comparison of Werrington Brook Community Conservation Index (CCI) profiles before (2017) and after restoration (2019).

The CCI increased at Site 1 and 2 (from 8.8 to 13.4 and 12.9 to 13.5 respectively; see Figure 4) and are both now classified as having “Fairly High” Conservation Value. The large increase at Site 1 may be due to ongoing habitat improvement after the completion of enhancement works in 2015 upstream of this site. The CCI values decreased at Site 3 and 4 after the enhancement works, which may be due to the weed cutting.

The macro-invertebrate data for the post enhancement survey can be found in Appendix Tables A1 and A2. No nationally rare or scarce species were found. *Haliplus laminatus* (Crawling water beetle) is an indicator of a good quality habitat and remains present at Site 1, 2 and 3. The local rarity *Pisidium pulchellum* (iridescent pea mussel) also remains present after enhancement works at Site 1, 2 and 3. *Hesperocorixa sahlbergi* (Lesser water boatman) and *Ilyocoris cimicoides* (Saucer bug) were both found at Site 3 and 4 respectively; these species are usually found in still water habitats (ponds and canals) and in areas with high organic matter and therefore indicative of the low flow habitat at these sites.

No *Haliplus* species were found at site 4 during the 2019 survey, whereas *Haliplus sibiricus* and *Haliplus linneatocollis* were found before in 2017. This could be an indication of the reduction in water and/or habitat quality at this site. There are six known rainwater drain outfalls into this stretch of Werrington Brook and on the day of survey (18 September 2019) a white ‘oily’ substance was observed on the surface flowing downstream of Site 2 (see Plate 1). Additionally, two pollution events along this stretch of Werrington Brook were recorded in 2019 before the survey was conducted the 3rd May 2019 (NIRS ref: 1699445) and 9th July 2019 (NIRS ref: 1717105). It is therefore possible that this could have affected the water quality.



Plate 1: Pollution event observed on day of survey (18th September 2019) flowing downstream of Site 2.



Plate 2: indicating weed cutting had taken place on one side of Werrington Brook just upstream of Site 4.

The apparent decrease in water/habitat quality at Site 4 is likely to be a combination of factors. Recent weed cutting at this site and multiple pollution events upstream may have affected the habitat quality and therefore the aquatic invertebrates at this site. It should be also noted that this is always going to be a marginal site as it's located just upstream of Cuckoo's Hollow lake so there is limited gradient and energy in this section so naturally would be the slowest to show improvement.

Macrophytes and algae

A previous macrophyte survey completed in 2018 along this stretch of Werrington Brook found the aquatic plant species diversity had doubled since the improvement works therefore increasing habitat quality and amenity value of the waterbody. The survey in 2019 confirms increases in aquatic plant diversity at all sites after the enhancement works (see Figure 7 below) with the exception of Site 4 which had been visibly affected by the recent weed cutting. Site 1 and 2 had the highest diversity with species such as starwort (*Callitriche*), water plantain (*Alisma Plantago-aquatica*) (Plate 3), Fool's watercress (*Apium nodiflorum*) (Plate 4) and Brooklime (*Veronica beccabunga*) and Softrush (*Juncus effusus*) (Plate 5).

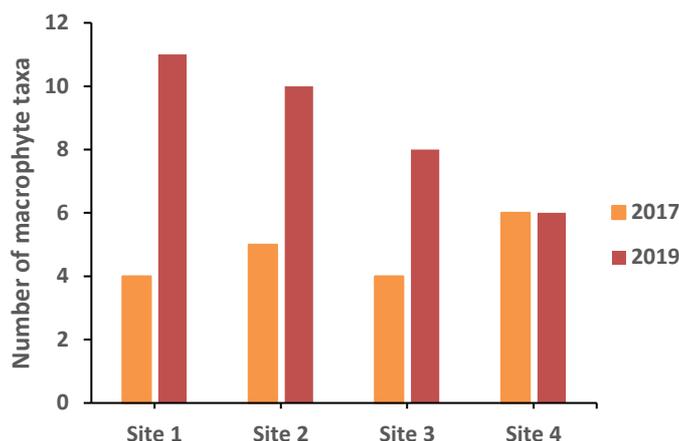


Figure 7: Comparison of the number of plant and algae species per site before (2017) and after (2019) improvement works.



Plate 3: Water starwort (*Callitriche*), Nuttall's pond weed, (*Elodea nuttallii*) water plantain (*Alisma plantago-aquatica*), reed sweet-grass (*Glyceria maxima*) along Werrington Brook between Site 1 and 2.



Plate 4: Large stands of fool's watercress (*Apium nodiflorum*).



Plate 5: Brooklime (*Veronica beccabunga*) and soft rush (*Juncus effusus*).

Fish (observed)

The highest numbers of small fish were found at Site 3 where *Phoxinus phoxinus* (Minnow) were found (Figure 5). An increase in small fish was observed at Site 1 (Figure 6) compared to 2017 but there were decreases in the number of fish found at Site 3 and 4 compared to the 2017 data (Figure 6); this could again be due to reductions in habitat quality after weed cutting and pollution events. However, on the day of survey several large very active schools of roach were observed along the reach between Site 3 and 4 and also in Cuckoo's Hollow Lake and a kingfisher was also observed between Site 3 and 4.

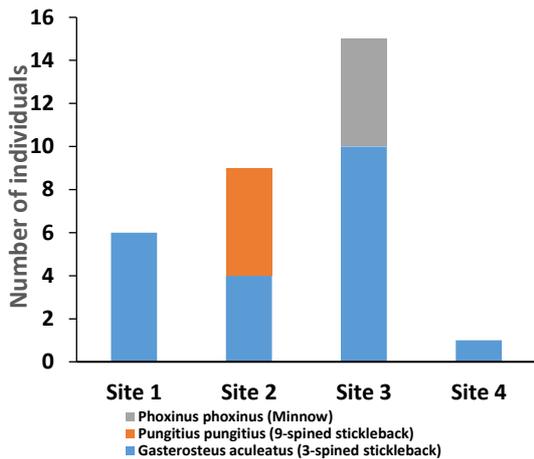


Figure 5: Number and species of fish at each site during the 2019 survey.

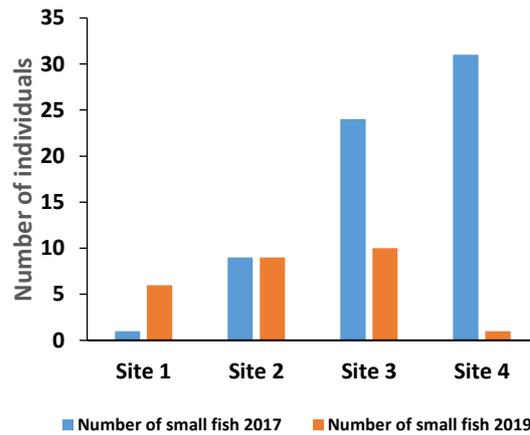


Figure 6: Comparison of fish numbers between 2017 and 2019.

Conclusions

The 2017 enhancement works at Werrington brook improved water and habitat quality to levels above the Good/Moderate WFD threshold resulting in a concomitant improvement in ecological communities at Werrington Brook. Aquatic plant biodiversity increased substantially at all sites (aside from Site 4) thereby increasing the complexity of the habitat for aquatic invertebrates, fish and other wildlife such as the kingfisher that was observed during the post-enhancement survey.

Only one site (Site 4) furthest downstream of the works was found to have decreased in water and/or habitat quality which could be due to multiple factors such as its location in close proximity to Cuckoo's Hollow Lake, recent weed cutting and pollution events compared with sites further upstream. It is therefore recommended that another survey is completed in September 2020 to allow for these compounding factors.

Appendix 1: Data

Table A1: Aquatic invertebrate taxa recorded during the post-enhancement survey (18 September 2019) of Werrington Brook, Aubretia Avenue Reach for Site 1 and 2 (Upstream Larkspur Bridge and Wysteria Way Green).

Site name:		Control Site 1 – Upstream of Larkspur bridge	Site 2 – Wysteria Way Green
Site location:		TF1790903185	TF1784503398
Scientific name	Common Name		
<i>Polycelis nigra/tenuis</i>	Flatworm	3	6
<i>Dugesia lugubris/polychroa</i>	Flatworm		2
<i>Valvata piscinalis</i>	Common valve snail	30	20
<i>Bithynia tentaculata</i>	Common bithynia snail	40	10
<i>Potamopyrgus antipodarum</i>	Jenkins' spire snail		
<i>Physa fontinalis</i>	Bladder snail	50	5
<i>Lymnaea stagnalis</i>	Great pond snail	30	8
<i>Radix balthica</i>	Wandering snail	100	2
<i>Planorbis carinatus</i>	Keeled ramshorn snail	1	3
<i>Planorbis planorbis</i>	Bladder snail	5	
<i>Anisus vortex</i>	Whirlpool ramshorn snail	300	20
<i>Hippeutis complanatus</i>	Flat ramshorn snail	1	2
<i>Gyraulus crista</i>	Nautilus ramshorn snail	3	
<i>Planorbarius corneus</i>	Great ramshorn snail	70	10
Succineidae	Amber snail		1
Succinea	Amber snail		
<i>Sphaerium corneum</i>	Horny orb mussel	3	6
Pisidium	Pea mussel		
<i>Pisidium milium</i>	Rosy pea mussel	2	
<i>Pisidium nitidum</i>	Shining pea mussel	10	10
<i>Pisidium pulchellum</i>	Iridescent pea mussel	10	10
Oligochaeta	Freshwater worm	20	30
<i>Glossiphonia complanata</i>	Leech	6	6
<i>Glossiphonia verrucata</i>	Leech		
<i>Helobdella stagnalis</i>	Leech	3	
Erpobdellidae	Leech	1	
<i>Erpobdella octoculata</i>	Leech	2	3
<i>Erpobdella testacea</i>	Leech	1	10
Hydracarina	Water mite	50	3

<i>Argyroneta aquatica</i>	Diving bell spider		4
Ostracoda	Seed shrimp		4
<i>Asellus aquaticus</i>	Water hoglouse	30	300
<i>Crangonyx pseudogracilis/floridanus</i>	Freshwater shrimp	2	30
<i>Gammarus pulex</i>	Freshwater shrimp	10	100
<i>Centroptilum luteolum</i>	Small spur wing mayfly		
Coenagrionidae	Damselfly	3	
<i>Ischnura elegans</i>	Blue-tailed Damselfly	3	9
<i>Nepa cinerea</i>	Water scorpion	1	
<i>Ilyocoris cimicoides</i>	Saucer bug		
Notonecta	Common backswimmer		
<i>Notonecta glauca</i>	Common backswimmer	2	
<i>Plea minutissima</i>	Pygmy backswimmer		2
Corixidae	Lesser water boatman		
<i>Hesperocorixa sahlbergi</i>	Lesser water boatman		
<i>Sigara dorsalis</i>	Lesser water boatman	1	
Haliplus	Crawling water beetle	7	
Haliplus ruficollis group	Crawling water beetle		
<i>Haliplus flavicollis</i>	Crawling water beetle		
<i>Haliplus immaculatus</i>	Crawling water beetle	7	
<i>Haliplus laminatus</i>	Crawling water beetle	4	6
<i>Haliplus lineatocollis</i>	Crawling water beetle	8	5
<i>Laccophilus hyalinus</i>	Alder fly		
<i>Hyphydrus ovatus</i>	Caddis fly		1
<i>Rhantus suturalis</i>	Caddis fly	1	
<i>Gyrinus substriatus</i>	Caddis fly	1	2
Laccobius	Scavenger beetle		
<i>Sialis lutaria</i>	Aderfly		2
<i>Phryganea bipunctata</i>	Cased caddis fly	1	1
<i>Athripsodes aterrimus</i>	Cased caddis fly	9	2
Tipula	Crane fly		
<i>Dixa nebulosa</i>	Crane fly	1	
Culicidae	Mosquito		
Ceratopogonidae	Biting midge	1	1
Tanypodinae	Non-biting midge	4	10
Orthoclaadiinae	Non-biting midge		
Chironomini	Non-biting midge	1	
Tanytarsini	Non-biting midge	1	
Chrysops	Horse fly		1
Sciomyzidae	Marsh fly	4	
MACROPHYTES			
<i>Cladophora glomerata/Rhizoclonium hieroglyphicum</i>	Blanket weed	present	present
<i>Ranunculus sceleratus</i>	Celery-leafed crowfoot	present	

<i>Rorippa nasturtium-aquaticum</i> agg.	Water cress	present	present
<i>Apium nodiflorum</i>	Fool's watercress		present
<i>Callitriche</i>	Water starwort	present	present
<i>Rorippa nasturtium-aquaticum</i>	Water cress		
<i>Persicaria amphibia</i>	Amphibious bistort	present	present
<i>Solanum dulcamara</i>	Bittersweet/Woody nightshade	present	
<i>Veronica beccabunga</i>	Brooklime	present	present
<i>Elodea nuttallii</i>	Nuttal's pondweed	present	present
<i>Glyceria maxima</i>	Reed canary-grass	present	present
<i>Juncus effusus</i>	Soft rush	present	present
<i>Sparganium erectum</i>	Branched bur-reed	present	present
FISH			
<i>Phoxinus phoxinus</i>	Minnow		
<i>Gasterosteus aculeatus</i>	Three-spined stickleback	6	4
<i>Pungitius pungitius</i>	Nine-spined stickleback		5

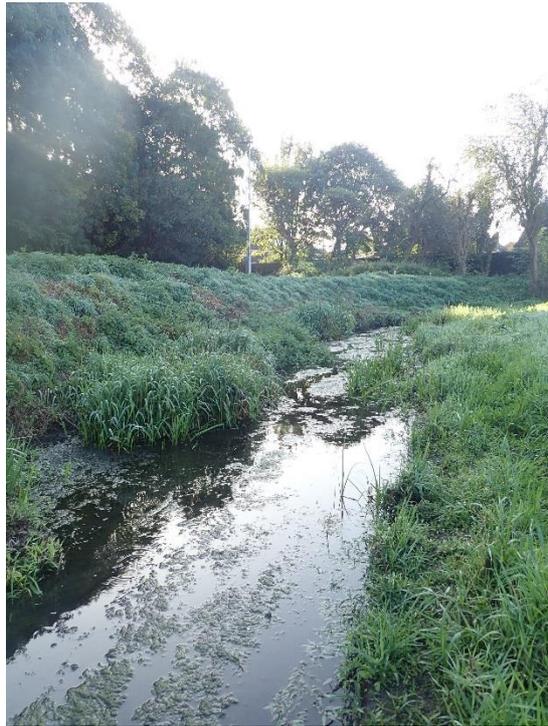
Table A2: Aquatic invertebrate taxa recorded during the post-enhancement survey (18 September 2019) of Werrington Brook, Aubretia Avenue Reach for sites 3 and 4 (Welbourne outflow and Cuckoo's Hollow Footbridge).

Site name:		Site 3 – Welbourne outflow	Site 4 – Upstream Cuckoo's Hollow Foot bridge
Site location:		TF1763503486	TF1757703726
Scientific name	Common Name		
<i>Polycelis nigra/tenuis</i>	Flatworm		
<i>Dugesia lugubris/polychroa</i>	Flatworm		
<i>Valvata piscinalis</i>	Common valve snail		
<i>Bithynia tentaculata</i>	Common bithynia snail	20	10
<i>Potamopyrgus antipodarum</i>	Jenkins' spire snail	1	2
<i>Physa fontinalis</i>	Bladder snail	7	40
<i>Lymnaea stagnalis</i>	Great pond snail	5	1
<i>Radix balthica</i>	Wandering snail	6	2
<i>Planorbis carinatus</i>	Keeled ramshorn snail		
<i>Planorbis planorbis</i>	Bladder snail	40	8
<i>Anisus vortex</i>	Whirlpool ramshorn snail	100	40
<i>Hippeutis complanatus</i>	Flat ramshorn snail		
<i>Gyraulus crista</i>	Nautilus ramshorn snail		
<i>Planorbarius corneus</i>	Great ramshorn snail	10	2
Succineidae	Amber snail		
Succinea	Amber snail		2
<i>Sphaerium corneum</i>	Horny orb mussel		10
Pisidium	Pea mussel	10	

<i>Pisidium milium</i>	Rosy pea mussel		
<i>Pisidium nitidum</i>	Shining pea mussel		40
<i>Pisidium pulchellum</i>	Iridescent pea mussel		
Oligochaeta	Freshwater worm	200	9
<i>Glossiphonia complanata</i>	Leech	8	2
<i>Glossiphonia verrucata</i>	Leech		1
<i>Helobdella stagnalis</i>	Leech	3	
Erpobdellidae	Leech		
<i>Erpobdella octoculata</i>	Leech		
<i>Erpobdella testacea</i>	Leech	40	6
Hydracarina	Water mite		10
<i>Argyroneta aquatica</i>	Diving bell spider	1	
Ostracoda	Seed shrimp	10	10
<i>Asellus aquaticus</i>	Water hoglouse	400	200
<i>Crangonyx pseudogracilis/floridanus</i>	Freshwater shrimp	40	200
<i>Gammarus pulex</i>	Freshwater shrimp	80	10
<i>Centroptilum luteolum</i>	Small spur wing mayfly	1	
Coenagrionidae	Damselfly		
<i>Ischnura elegans</i>	Blue-tailed Damselfly	20	20
<i>Nepa cinerea</i>	Water scorpion		
<i>Ilyocoris cimicoides</i>	Saucer bug		1
Notonecta	Common backswimmer	1	
<i>Notonecta glauca</i>	Common backswimmer		1
<i>Plea minutissima</i>	Pygmy backswimmer		
Corixidae	Lesser water boatman	1	2
<i>Hesperocorixa sahlbergi</i>	Lesser water boatman	1	
<i>Sigara dorsalis</i>	Lesser water boatman		4
Halipus	Crawling water beetle	1	
Halipus ruficollis group	Crawling water beetle	20	
<i>Halipus flavicollis</i>	Crawling water beetle	2	
<i>Halipus immaculatus</i>	Crawling water beetle		
<i>Halipus laminatus</i>	Crawling water beetle		
<i>Halipus lineatocollis</i>	Crawling water beetle	8	
<i>Laccophilus hyalinus</i>	Alder fly	2	
<i>Hyphydrus ovatus</i>	Caddis fly		
<i>Rhantus suturalis</i>	Caddis fly		
<i>Gyrinus substriatus</i>	Caddis fly		
Laccobius	Scavenger beetle	1	
<i>Sialis lutaria</i>	Aderfly		10
<i>Phryganea bipunctata</i>	Cased caddis fly		
<i>Athripsodes aterrimus</i>	Cased caddis fly	4	
Tipula	Cranefly	1	
<i>Dixa nebulosa</i>	Cranefly		
Culicidae	Mosquito	4	

Ceratopogonidae	Biting midge		
Tanypodinae	Non-biting midge	100	10
Orthoclaadiinae	Non-biting midge	8	20
Chironomini	Non-biting midge		
Tanytarsini	Non-biting midge		
Chrysops	Horse fly		
Sciomyzidae	Marsh fly		
MACROPHYTES			
Cladophora glomerata/Rhizoclonium hieroglyphicum	Blanket weed	present	present
Ranunculus sceleratus	Celery-leafed crowfoot		present
Rorippa nasturtium-aquaticum agg.	Water cress		
Apium nodiflorum	Fool's watercress	present	
Callitriche	Water starwort		present
Rorippa nasturtium-aquaticum	Water cress	present	present
Persicaria amphibia	Amphibious bistort	present	
Solanum dulcamara	Bittersweet/Woody nightshade		
Veronica beccabunga	Brooklime	present	
Elodea nuttallii	Nuttal's pondweed	present	present
Glyceria maxima	Reed canary-grass	present	present
Juncus effusus	Soft rush	present	
Sparganium erectum	Branched bur-reed		
FISH			
Phoxinus phoxinus	Minnow	5	
Gasterosteus aculeatus	Three-spined stickleback	10	1
Pungitius pungitius	Nine-spined stickleback		

Appendix 2: Site photos



Site 1: Upstream of larkspur bridge (Control Site).



Site 2: Wysteria Way Green.



Site 3: Welbourne outflow.



Site 4: Upstream of Cuckoo's hollow bridge.

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