Walkover Assessment

Badsey Brook (Warwickshire Avon) catchment

14-15/06/2017

Undertaken by Gareth Pedley

Key findings

- The lack of connectivity and habitat fragmentation created by numerous weirs is one of the major impacts in the Badsey Brook catchment, with more than 29 individual structures observed. These obstructions range from small, raised areas of the bed to complete (>3m) barriers.
- The channel and course of the brook has been significantly altered by straightening and dredging in many areas. This leaves an impacted geomorphology that is less capable of maintaining and developing natural high quality habitats.
- Several point-source pollution issues were identified during the walkover, ranging from suspected illegal discharges to underperforming infrastructure, all of which require action.
- Given the extent of habitat degradation that has occurred through past channel modifications, and the now limited areas of higher quality habitat, it is not surprising that the waterbody is underperforming. With the fragmentation of remaining habitats through numerous weirs, it is hard to see potential for significant improvement without a major programme of weir removals. This again highlights the need for river restoration and weir removals as part of any Environment Agent capital works and the vital opportunity that the Broadway scheme once presented.

1.0 Introduction

This report is the output of a site visit to the Badsey Brook sub-catchment, a tributary of the Warwickshire Avon, near Evesham. The purpose of the visit was to provide a general habitat assessment and barrier appraisal of the brook, and to offer recommendations of potential work that could be undertaken in mitigation for a large Environment Agency (EA) Flood Risk and Coastal Management (FCRM) scheme in the village of Broadway on the Bunches Brook (the major tributary of the Badsey Brook).

Normal convention is applied throughout this report with respect to bank identification, i.e. the banks are designated left bank (LB) or right bank (RB) whilst looking downstream. The Ordnance Survey National Grid Reference system is used for identifying specific locations and references to upstream and downstream are often abbreviated to u/s and d/s, respectively, for convenience.

2.0 Catchment and fishery overview

Table 1. Overview of the waterbody details

	Waterbody details
River	Badsey Brook
Waterbody Name	**Broadway - Badsey Brook** - source to confluence with River Avon
Waterbody ID	GB109054039350
River Basin District	River Severn
Current Ecological Quality 2015	**Poor** – 'poor' for 'macrophytes and phytobenthos' and 'phosphate'
U/S Grid Ref of reach inspected	SP 09230 37223
D/S Grid Ref of reach inspected	SP 04971 45446
Length of river inspected (km)	>13km

Water body classification

Select year: 2009 Cycle 1 ▾ Select year: 2016 Cycle 2 ▾

	2009 Cycle 1	2016 Cycle 2	Objectives
Overall Water Body	Bad	Poor	Good by 2027
Ecological	Bad	Poor	Good by 2027
Biological quality elements	Bad	Poor	Good by 2027
Fish	Moderate	Good	Good by 2015
Invertebrates	Moderate	Good	Good by 2027
Macrophytes and Phytobenthos Combined	-	Poor	Good by 2027
Phytobenthos	Bad	-	-
Hydromorphological Supporting Elements	Supports Good	Supports Good	Supports Good by 2015
Physico-chemical quality elements	Moderate	Moderate	Good by 2027
Ammonia (Phys-Chem)	High	High	Good by 2015
Biochemical Oxygen Demand (BOD)	-	High	-
Dissolved oxygen	High	Good	Good by 2015
pH	High	High	Good by 2015
Phosphate	Poor	Poor	Good by 2027
Temperature	Good	High	Good by 2015
Specific pollutants	High	High	High by 2015
Supporting elements (Surface Water)	-	-	Not assessed
Chemical	Does not require assessment	Good	Good by 2015

(http://environment.data.gov.uk/catchment-planning/WaterBody/GB109054039350)

The river was assessed during two days of walkovers on the 14th and 15th June 2017. The first day was primarily to look at the FCRM site for which the mitigation was required and to assess the major known barriers on the catchment. The second day was to cover the long sections of brook between the previously visited locations.

For the purpose of this report, the river will be assessed from the u/s extent visited on the Bunches Brook, working downstream to the confluence with Badsey Brook, and downstream to the River Avon. The Badsey Brook was not inspected upstream of its confluence with the Bunches Brook, which is actually a much larger component than the Badsey Brook within this sub-catchment.

3.0 Habitat Assessment

3.1 Bunches Brook

Although rain had fallen much earlier in the previous week, flow within the brook was around summer level. It was therefore surprising to see elevated turbidity/fine sediment loading from the farthest u/s point assessed. This suggests an input further u/s than the walkover reach that should be identified and addressed as the impact was noted throughout the watercourse d/s.

Figure 1. Around the u/s limit inspected on Bunches Brook, potential salmonid spawning and juvenile habitat was observed, despite channel realignment. Areas of the brook and tributaries u/s become more naturally sinuous and appear to provide improved habitat.

Figure 2. Moving d/s, some deeper water is present on the bends but the section immediately u/s of Broadway Weir is particularly straight, providing poorer quality, more uniform habitat.

Figure 3. Some potential spawning and juvenile habitat is available in the straight section u/s of Broadway Weir (u/s of the impounded reach). However, the channel is uniform, straightened and of an artificially low gradient (owing to the weir) and would clearly benefit restoration to a more natural gradient and more sinuous planform, with pool and riffle habitat variation. Note the tree and bank clearance work that has already been undertaken, creating just part of the requirement for environmental mitigation associated with the flood alleviation scheme; it is not clear why all these trees were removed.

With such limited opportunities for weir removals and river restoration in the current financial climate, any opportunities must be seized when they arise, to achieve vital environmental improvements on watercourses such as this. Undertaking restoration work as part of a large community scheme also provides the multi-party benefits and often vital leverage in negotiations. The alternative, which has happened here, is that the river restoration and habitat improvement mitigation is lost from the scheme and, to compound the issues, the flood attenuation scheme will be built around the existing impacts (weir and artificially straightened and elevated channel) preventing weir removal or river restoration at a later date. The missed opportunity for weir removal and river restoration is not something that can ever be fully mitigated in the lifespan of the weir.

Figure 4. Broadway Weir (SP 09048 37477). The >1.5m high structure is impassable (u/s) to all species in almost all flows, as a result of the shallow water cascade over a steep, stepped face, with an additional vertical lip at the top of the structure.

Weirs like this fragment a catchment, isolating fish populations u/s and disconnecting d/s fish populations from vital habitat u/s (including vital spawning and juvenile areas), making them even more susceptible to impacts from habitat degradation and pollution. They reduce flow and sediment conveyance, artificially elevating the bed and water levels u/s and undoubtedly contributing to out of bank flows. Opportunities to remove these redundant weirs must be seized if habitats and fish populations are to be significantly improved. No fish pass can mitigate the wider ecological and geomorphological impacts of a weir and any attempts to improve fish passage are invariably more complex and expensive than weir removal, with a greater long-term liability. From this point d/s to the road bridge (Fig. 5) the brook flows through private gardens and so was not assessed.

Figure 5. At SP 09014 37599, an undersized bridge d/s of Broadway Weir is suspected to cause much of the flooding around Broadway, precipitating the flood alleviation scheme (also begging the question why the weir u/s and flow-throttle are being addressed to reduce flooding). The brook d/s of this point flows through a narrow buffer of deciduous trees, with gardens on the RB and predominantly arable agriculture on the LB.

Figure 6. At SP 08750 37749, a stone culvert has been dammed with boards at the u/s end to facilitate an abstraction. This blockage should be removed to assist fish passage and sediment transport. Here the brook flows through a deciduous treed buffer.

Figure 7. At SP 08610 37850, suspected unconsented (EA staff on the visit were unaware) drainage work appeared to be underway which should be investigated. Strangely, this work also appears on aerial photography, so may be ongoing.

Figure 8. At SP 08560 37878, a weir comprising large stone blocks creates a small impoundment. This almost certainly unconsented structure appears unnecessary and interrupts sediment transport. Man-made obstructions like this should ideally be removed.

Figure 9. At SP 08545 37973, the culvert under a disused railway creates an extended shallow water section and degrades habitat but poses no major barrier to fish movement or sediment transport. Elevated algal growth was observed.

Figure 10. Just d/s of the railway line, another small track crossing poses no issue for fish or sediment movement. Note the irrigation pipe in the background. From this point down, irrigation pipes are a regular occurrence; some appearing disused but others active.

Figure 11. The physical habitat quality between Broadway and Leedon's Holiday Park is generally as good as can be expected within an often straightened channel which limits the development of geomorphological features (discrete pools and riffles).

Figure 12. Continued occasional signs of excess nutrient input are apparent through excess algal growth. Not all potential sources could be identified and field drainage/diffuse pollution is likely to be a contributor, along with septic tank discharges.

Figure 13. At SP 08200 38202 a clear-span crossing of the brook within a large private garden poses no issue for fish or sediment transport but localised reinforcement of the banks degrades bankside habitats.

Figure 14. Just u/s of Leedon's Holiday Park a small crossing poses no issue for fish or sediment movement. These deeper-water areas highlight the fine sediment loading.

Figure 15. The culvert at the main entrance to Leedon's Holiday Park (SP 08175 38345) is sufficiently sunken to pose no issue to fish or sediment movement; however, the water here is currently impounded by a weir a short distance d/s.

Figure 16. The 1m high, vertical faced structure of Leedon's Holiday Park weir (SP 08155 38380) and lack of depth d/s creates an impassable barrier to fish passage and sediment movement at most flows. Erosion of the bed and banks around the structure has led to undermining and destabilisation of the structure. Rather than repairing the inappropriate obstruction, the area should be re-landscaped to facilitate free fish passage and sediment transport while retaining an aesthetically pleasing appearance.

Figure 17. Visible areas of the gardens within Leedon's Holiday Park revealed significant revetment of the banks.

Figure 18. Elevated pipe culvert at the d/s entrance to Leedon's Holiday Park (SP 07880 38497) creates a small barrier to fish passage through a vertical step, shallow water within and fluming through the pipes. Adult salmonids are likely to ascend in most flows but it poses an obstacle to eels, lamprey and smaller individuals/species. The solution: short-term, a small rock ramp easement; but ideally, replacement with a larger, clear span bridge or sunken culvert which would address potential flow throttle/flood issues.

Figure 19. An outfall at SP 07834 38490 appeared to pose no major issues, although a slight increase in algae was observed on the apron. It was initially suspected to be fed by surface water from the park but tufa within the pipe suggests a groundwater component.

Figure 20. Immediately d/s of the Holiday Park the LB habitat is good but maintenance of the RB degrades marginal habitat. The substrate quality is also good but the straightened channel offers limited habitat diversity or fish holding capacity. Possible restoration site.

Figure 21. At SP 07709 38490 a low-level weir within a private garden creates an impoundment, interrupts sediment transport and a small obstruction to fish passage. Much of the channel in this area is straightened and shallow. The garden to the RB and rough ground to the LB may offer potential for river restoration.

Figure 22. A short section of more natural planform/recovering channel and improved, mobile substrate d/s of the garden offers better habitat and potential salmonid spawning; however, clear signs of relatively recent dredging were apparent from spoil heaps on the bank. The possibility for restoration extends through this section u/s of Childswickham.

Figure 23. A straightened but naturally improving tributary joins the brook at SP 07583 38469, providing better invertebrate habitat and potential for salmonid spawning.

Figure 24. Signs of elevated nutrient input/eutrophication were evident on the tributary in the form of excess algal growth but it was crystal-clear, unlike the main brook which becomes gradually clearer d/s but remains turbid (previous and subsequent Figs). Further investigation suggests the local STW (SP 08146 37755) discharges to this watercourse u/s and could be contributing excess nutrients, as could the adjacent land use.

Figure 25. The brook flows through private gardens as it enters the southern edge of Childswhickam, where a previously unknown, complete barrier to fish and sediment movement was identified at SP 07456 38486. This is an ornamental feature within the gardens but may also increase flood risk locally which could assist a case for removal. Note the turbidity, which is more obvious in the occasional deeper areas.

Figure 26. At SP 07387 38557 a road crossing of the brook poses no major issue for fish or sediment movement, although sediment is accumulating on the d/s side, possibly due to dredging/widening of that area in the past.

Figure 27. A pipe observed at SP 07383 38571 poses no obvious impact upon the brook.

Figure 28. A small outfall just d/s was flowing at the time of the visit; the volume and clarity of water, and substrate supplied, suggest that this may actually be a small tributary that has been piped beneath the village.

Figure 29. Greater width and depth variation around the mid-point of the village and a good buffer of diverse marginal and emergent vegetation improve habitat quality. Note the bright, algae-free substrate suggesting that inputs/algae observed u/s are localised issues, and also the further improved water clarity.

Figure 30. The clear-span/sunken culvert road crossing at SP 07148 38726 poses no major issues.

Figure 31. At the western, d/s side of the village, the brook regains some sinuosity and, correspondingly, habitat quality improves, with deeper pool habitat available where bends allow areas of bed scouring and deposition elsewhere.

Figure 32. The more sinuous tree-lined section d/s of the garden (SP 06912 38751 - SP 06463 39034) provides habitat variation, with trailing vegetation and branches further assisting natural enhancement. However, maintenance and removal of overhanging and trailing vegetation was being undertaken which will negatively impact upon habitat quality.

Figure 33. The confluence of the much smaller Badsey Brook and the larger Bunches Brook (foreground). Badsey Brook upstream of the confluence appears little more than a straightened field drain.

3.2 Badsey Brook

Owing to time constraints, Badsey Brook was not inspected upstream of the confluence with Bunches Brook as Badsey Brook is a much smaller component of the overall sub-catchment and flow. Inspection of maps and aerial photography confirm the much smaller catchment and major straightening of the channel on the Badsey Brook u/s. Correspondingly, the Bunches Brook u/s of the confluence offers the greatest habitat potential and its headwaters form the majority of the natural (and potential) salmonid spawning and juvenile areas within this sub-catchment.

Figure 34. Badsey Brook d/s of the confluence is again subject to straightening and dredging, with obvious signs of paleo-channels in the fields on the RB (Fig. 35).

Figure 35. Paleo-channels of the brook were clearly evident within the adjacent horse field (SP 06551 38960 - SP 06456 39114). It is likely that the use of this land for grazing has helped preserve the contours of the channel better than occurs in the more heavily cultivated, adjacent arable fields.

Figure 36. On the opposite bank to the horse field, a manure midden was located within 10m of the watercourse.

Figure 37. At SP 06454 39104, the putrid smelling outfall of what appeared to be a poorly maintained septic tank was observed.

Figure 38. The Horton Road crossing at SP 06451 39119 poses no particular issues.

Figure 39. From d/s of Horton Road, and just a short distance d/s of the midden and suspected sceptic tank discharge, significantly elevated algal growth was noted on the river bed, for some distance d/s.

Figure 40. The channel d/s of Horton Road is notably straightened and incised, with only a minimal buffer strip (potentially contributing to eutrophication of the brook). Consequently, as the channel naturally adjusts, it is encroaching on the cultivated land; indeed, the buffer has been lost in at least one location (SP 06460 39192).

Figure 41. At SP 06457 39218 a large pipe culvert poses a minor obstruction but it is large and sunken enough to be passable by most fish.

Figure 42. At SP 06477 39508, unsympathetic armouring of the bed at a gas pipe crossing creates an impoundment, obstruction to sediment transport and small obstacle to fish.

Figure 43. The impact of eutrophication on algal growth can be observed for over 1km d/s of Horton Road. Nutrients are also likely to be entering the watercourse from the poorly buffered arable fields adjacent throughout this section. Note the lack of natural substrate resulting from past straightening/dredging.

Figure 44. The brook is impounded and habitat is significantly degraded for >100m u/s of Murcot Mill weir (Fig. 45).

Figure 45. Murcot Mill Weir (SP 06329 40028) - a completely impassable >2m high weir. This weir further fragments the catchment, preventing fish passage into the section u/s, which are both similarly isolated as a result of Broadway and Leedon's Park Weirs.

Figure 46a-f. Six small weirs d/s of Murcot Mill (at, SP 06334 40098, SP 06327 40126, SP 06305 40161, SP 06292 40208, SP 06286 40223 and SP 06274 40246, respectively) create minor, passable obstructions, but greatly degrade the habitat quality in the area and, although small, interrupt sediment transport/natural geomorphological processes.

Figure 47. At SP 06289 40213, between the weir depicted in 46d and 46e, another suspected poorly maintained septic tank discharge was observed.

Figure 48. None of the house access crossings pose an issue to the free movement of fish or sediment and, without the weirs, areas in which the vegetation has not been overly maintained could otherwise provide reasonable quality habitat if the channel were allowed to develop.

Figure 49. The channel does appear to be naturally adjusting here, but is being artificially maintained, as evident by a side channel that has been dug through an area of slumped bank/deposition that that was pushing the channel towards the road, which has now created a small island.

Figure 50. A small ditch joins the brook via a large pipe culvert at SP 06238 40395, but was almost dry on the day of inspection.

Figure 51. Evidence of ongoing channel maintenance was observed around SP 06241 40407; an over-capacity channel that has led to uniform deposition and encroachment of marginal/emergent plants, and has become weed-choked (actually now greatly reducing conveyance in comparison to a more natural channel, capable of maintaining its capacity).

Figure 52. At SP 06253 40460, a clear-span crossing poses no issues to fish or sediment movement.

Figure 53. Further examples of emergent and aquatic vegetation taking advantage of inappropriately maintained channel sections and encroaching in to the excess capacity channel.

Figure 54. More recent channel maintenance and suspected herbicide spraying along the banks (SP 06266 40622).

Figure 55. Moving d/s, the river regains a small deciduous tree buffer but the impact of previous dredging activity creates very poor quality habitat.

Figure 56. The section u/s of Mill House Farm remains straightened and poor quality habitat, becoming impounded towards the mill weir. Livestock also have access on the RB.

Figure 57. Mill House Farm weir (SP 06381 41089) is a renovated structure with a sluice (and overspill) that currently takes most of the flow (Fig. 58), but is designed to control water to the mill, which can then either flow through a second sluice/spillway (Fig. 59) or through the mill (Fig. 60).

Figure 58. On the day of the visit, almost all of the brook's flow was bypassing the overspill weir, via a sluice. While the sluice is at an accessible height for fish, the head of water above the pipe (>3m) and associated high velocities within the pipe will render it impassable to fish. Even with flow over-spilling the weir it would be completely impassable.

Figure 59. A second spillway, just u/s of the mill, is also completely impassable to fish and was receiving no flow at the time of the visit.

Figure 60. The channel beneath the mill was dry. The weir and infrastructure associated with Mill House Farm creates another complete obstruction to fish and sediment movement and again, disconnects habitats u/s and d/s.

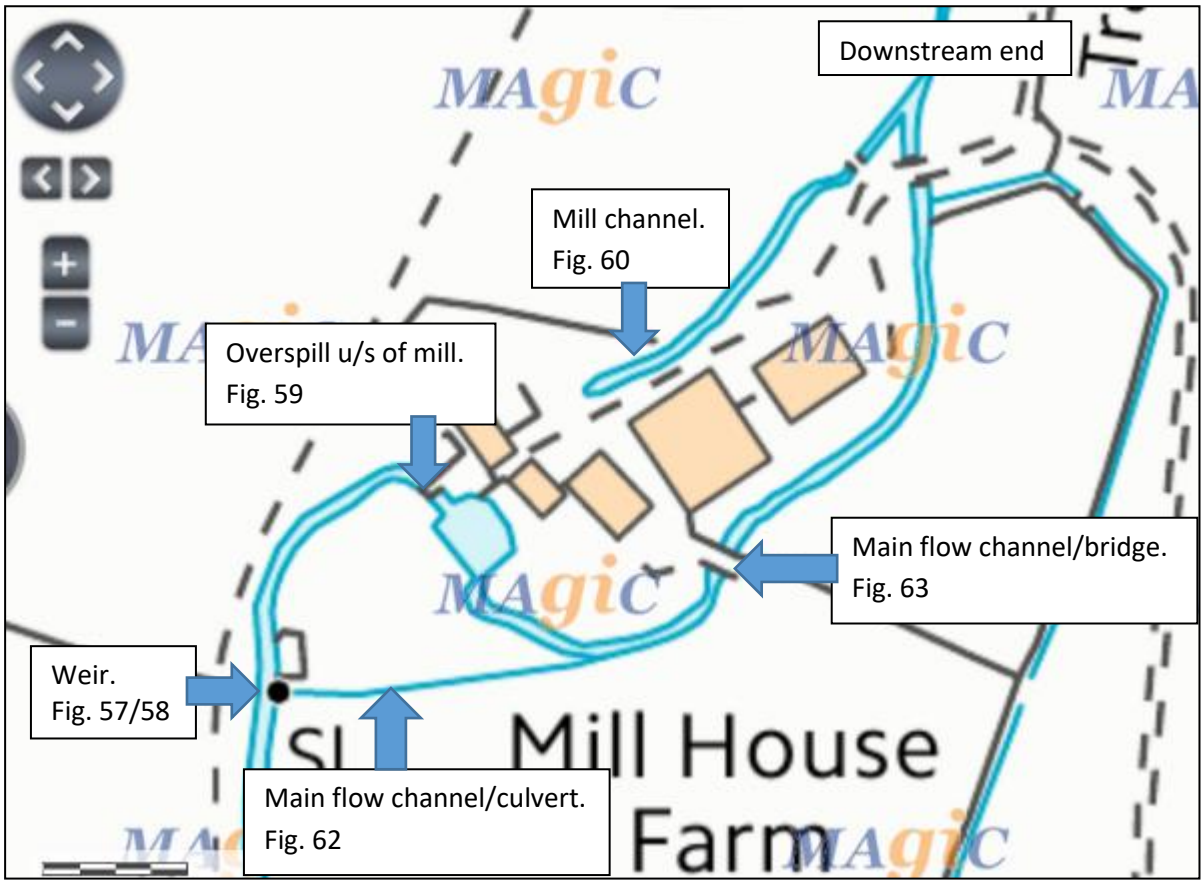

Figure 61. The basic layout of Mill House Farm with the brook flowing south to north (map taken from www.natureonthemap.naturalengland.org.uk/magicmap.aspx).

Figure 62. At SP 06399 41085, a crossing of the main channel d/s of the weir poses no issues for fish or sediment movement.

Figure 63. Crossing at SP 06472 41113 poses no issues for fish or sediment movement.

Figure 64. The Mill access track crossing at SP 06513 41193 currently poses no issues but did appear to be degrading.

Figure 65. Although buffered, habitat within the over-capacity channel d/s of the mill provides poor quality habitat.

Figure 66. The A44 road bridge culvert (SP 06550 41356) has been built greatly over-capacity to double as an access ford. This creates a shallow-water channel and has encouraged fine sediment deposition across the bed but the structure poses no significant issues or fish or sediment movement.

Figure 67. At SP 06529 41468, Longdon Hill road crossing is also of ample capacity and supports natural substrate throughout, posing no issues for fish passage.

Figure 68. Past channel realignment/dredging has clearly been conducted d/s of Longdon Hill road, as evident by exposed boulder clay in the bed and a lack of coarse substrate.

Figure 69. The canal-like, straightened channel d/s, provides poor quality trout habitat, better suited to coarse fish. The excess capacity of the channel is clearly unable to self-maintain its dimensions and is becoming choked with vegetation and fine sediment. Suspected paleo-channels were evident in the floodplain around this location (red ellipse).

Figure 70. At Whickham Farm, an armoured bed section/possible pipe crossing at SP 06587 41687 poses a small obstacle to fish and sediment movement.

Figure 71. Another structure a few metres d/s (SP 06584 41695) also creates a small obstruction and appeared to be associated with a pipe (centre of shot).

Figure 72. The deck of the farm access track (SP 06587 41708) poses no issues but the inappropriately installed structure with armoured bed and associated step create a small and unnecessary issue for fish and sediment movement.

Figure 73. At SP 06584 41768, dredging and widening of the channel combined with a weir creates a small boating pool, greatly degrading the channel. This destruction of habitat should be addressed; it is likely to be unconsented work.

Figure 74. Immediately d/s of the boating area, some improved substrate habitat has been allowed to develop, and provides an example of the kind of features that should be expected in the absence of dredging and straightening.

Figure 75. The improved section is, however, very limited, with the channel being dredged, straightened and uniformly over-capacity a short distance d/s. Note the emergent vegetation is more characteristic of canals and stillwaters.

Figure 76. The pasture land at either side of the channel in this area could offer potential for a river restoration scheme if the funding were available e.g. if grazing land would be less impacted by a reinstated meandering channel than arable land use (particularly if the land ownership/tenancy is the same on both banks).

Figure 77. The dredged channel becomes increasingly poor quality habitat as the impoundment of the weir structure around Manor House begins to influence the flow. Tree pruning/maintenance undertaken in this area reduces the availability of low and trailing branch cover and further degrades habitat.

Figure 78. The impoundment u/s of Manor House weir creates an obstruction to d/s fish movement and a sediment sink, preventing substrate movement though the section.

Figure 79. The impoundment is created with sluices on two channels at the d/s end of the pond (red and blue circles, figures 81 & 82, respectively).

Figure 80. The purpose of the impoundment now appears to be primarily the supply of water to ornamental features within Manor House garden, via a small sluice (red circle).

Figure 81. The RB side overspill (SP 06788 42159) – the steep, c. 45° slope, steepening towards the crest, is effectively impassable by fish or sediment.

Figure 82. The LB side sluice (SP 06782 42158) – a vertical board sluice, impassable to fish or sediment when shut.

Figure 83. A small board weir in the channel d/s of the sluice (SP 06775 42171) creates an obstruction even if the sluice were open/raised.

Figure 84. Just d/s of the board weir, a crudely constructed stone weir (SP 06761 42189) also creates yet another obstacle.

Figure 85. The overspill channel and the sluice channels join c. 35m d/s of the pond, before flowing through a double culvert that supports the access track/road to the houses. While the RB culvert is perched, free passage is afforded through the main, LB channel.

Figure 86. A small weir/armoured bed was observed at SP 06774 42287, possibly associated with services. It poses a minor obstacle and should be set well below bed level.

Figure 87. At SP 06891 42411 a tributary joins the brook. The water clarity appeared good and there were no obvious signs of quality issues.

Figure 88. The adjacent land use remains as grazing, with a buffer fence on the LB and livestock access on the RB (although access appeared minimal).

Figure 89. Clear signs of past channel modification but active sediment transport and potential salmonid spawning habitat was apparent.

Figure 90. A small tributary joining at SP 06847 42807 appeared little more than a ditch and created no visible impact upon the brook.

Figure 91. A small weir at SP 06818 42875 creates an impoundment and inhibits fish and sediment movement. The scour pool d/s has also increased erosion of the LB.

Figure 92. Where bends and depth variation are present, coupled with overhanging and trailing cover, areas of higher quality habitat were observed. Moving d/s, land use on the RB becomes private gardens and market gardening increases on the LB.

Figure 93. The Badsey Lane crossing (SP 06788 43018) poses no issues for fish or sediment movement.

Figure 94. Where sufficient buffer is allowed between the channel and adjacent land use, the riparian habitat is relatively good but past realignment/dredging remains the issue.

Figure 95. At SP 06856 43229, the bank is covered with geotextile, presumably as ill-advised bank protection, which is having the opposite effect by preventing vegetation growth, leaving it unconsolidated and actually more susceptible to erosion.

Figure 96. Straightened, featureless channel, typical in much of the section from Badsey Lane down to the B4035, between the gardens and market gardens.

Figure 97. A weir at SP 06788 43374 poses a barrier to fish movement at low flows, impounding the brook u/s and interrupting sediment transport. Large numbers of fish were observed congregating in the riffle below. This suggests that the uniform channel and impounded water u/s, and from a short distance d/s of the weir, do not provide suitable habitat for rheophilic species in low flow, high temperature conditions.

Figure 98. With no access to natural riffle sections u/s or d/s owing to the presence of barriers, chub (red circle) and trout (blue circle) were observed in higher densities immediately d/s of the weir.

Figure 99. Shade and structure are available in the channel between the weir and the B4035, particularly the wooded section immediately u/s of the road, but in warm conditions this habitat is likely to be unsuitable for many fish species, particularly salmonids. Note the impounding influence of the weir >500m further d/s.

Figure 100. The B4035 road bridge poses no issues for fish or sediment movement but from the bridge, the increasing influence of the weir, and diversion of the channel away from the valley bottom, can be observed.

Figure 101. Immediately u/s of the weir, the channel opens out into a large ponded area.

Figure 102. The >1.5m weir (SP 06543 43998) creates a complete barrier to fish and sediment and may increase flood risk locally through artificial elevation of the bed level. The majority of flow passes down the weir on the RB side – there is a sluice on the LB.

Figure 102. To the LB side of the weir is a set of decrepit sluices which, by the emergent plants choking the channel d/s, do not appear to be in regular use or taking much flow but may offer potential for a bypass route if agreement were gained to lower the river level.

Figure 103. The channel around the weir is clearly perched to the side of the valley bottom (left of shot), offering an opportunity to bypass the weir and restore the brook to a more natural channel in the valley bottom (centre of shot), potentially reducing flood risk to properties on the LB and restoring habitat quality and passage fish – providing tenant and / or landowner agreement can be gained. This may be a difficult sale on a hay/silage field.

Figure 104. At SP 06586 44069 (c. 100m d/s of the main weir), an old ford further disconnects habitat and artificially elevates the bed. This too could be bypassed with a river restoration scheme, but the associated footpath would require a bridge.

Figure 105. Emanating from an arch under the footings of the ford was a foul smelling high nutrient discharge (possibly septic tank or misconnection). This undoubtedly pollutes and enriches the watercourse.

Figure 106. Recent dredging and tree maintenance had been undertaken on the channel d/s of the ford (SP 06626 44157). Removal of/bypassing the ford and weir would reduce the inundation and waterlogging of adjacent land more effectively than channel dredging.

Figure 107. A reasonable sized tributary joins the brook at SP 06687 44326; however, the extent of channel modification and fine sediment loading greatly reduce habitat quality in the section observed. Further investigation of fine sediment inputs would be beneficial.

Figure 108. A small bridge at SP 06700 44383 poses no issues for fish or sediment movement. Around this point, the adjacent land use is a mix of arable and pasture with a reasonable buffer afforded in most places.

Figure 109. Although supporting a healthy treed buffer, the extent of dredging and channel modification degrades long sections and renders it of little use to salmonids.

Figure 110. A large STW flap-valve at SP 06664 44612 was not discharging during the visit and no increased signs of enrichment were observed in the immediate vicinity.

Figure 111. A second large flap-valve at SP 06603 44648 was discharging at the time of the visit and, again, no signs of additional enrichment were observed, other than algal growth on trailing vegetation which was also observed u/s. However, it should be noted that the overcapacity channel and deep water in the vicinity make it hard to identify the usual, obvious signs of enrichment like sewage fungus and excess algal growth on the bed.

Figure 112. Just d/s of the STW outfalls, recent channel and tree maintenance appeared to have been undertaken, perhaps associated with the overhead powerlines.

Figure 113. Immediately d/s of the railway culvert (SP 06453 44836), a series of large, piped-discharges that appear to be associated with the market gardening operation, along with suspected abstractions from the brook. Although hard to ascertain, the bed of the brook still appears relatively clear of algae immediately u/s of the pipes.

Figure 114. The area around the discharges is screened from the adjacent market gardening/greenhouses area with a series of wooden fence panels. Himalayan Balsam was also observed here, which would form a good starting point for further investigation as to its extent on the catchment.

Figure 115. At the next outfall pipe (SP 06435 44857) a distinct chemical odour and water discolouration was observed, along with excess suds.

Figure 116. Within a short time, the discharge increased, became much more turbid and the associated chemical odour increased.

Figure 117. The bed around the discharge/pipes becomes smothered with algae and appears highly eutrophic. This provides poor invertebrate habitat. Detailed investigation of the discharges d/s of the railway line and from the STW would be beneficial.

Figure 119. Another pipe was observed at SP 06329 44900.

Figure 120. The steep, sheer face of the EA flow gauging weir (SP 06277 44922) and shallow water depth poses a major obstacle for all fish species, particularly eel and lamprey. Excessive growth of weed u/s and d/s of the gauging station are almost certainly a result of the elevated nutrient inputs a short distance u/s.

Figure 121. The general habitat d/s of the gauging station is naturalising with cover and structure available although, as with other sections, past channel maintenance has left a greatly over-capacity channel.

Figure 122. Adjacent to two ponds, seepage was observed through the banks into the brook via what may have been signal crayfish burrows (at SP 06027 45092). Further inspection was not possible as the holes were at the opposite side of a deep channel.

Figure 123. For the remainder of the brook d/s to the Avon, the channel is tree-lined, punctuated by small open areas, but is buffered in most areas. The predominance of nettles among the buffer may suggest nutrient seepage from the adjacent fields.

Figure 124. Small abstraction points were noted right along the brook with several in the lower section, like this one at SP 05731 45253. Also note the suspect herbicide usage on the bank/dead vegetation (right of shot).

Figure 125. Although the channel is clearly over-capacity, lacking natural coarse substrate and resembling a canal, the occasional trout was observed in areas where vegetation pinches the channel, accelerating flow velocities and providing cover.

Figure 125. Eutrophication and algal smothering can be observed in shallower, unshaded sections throughout the lower brook, like the remains of an old weir (SP 05587 45344), presumably associated with Faulk Mill. The remains pose no issues now.

Figure 126. A larger area of bank appears to have been sprayed with herbicide at SP 05569 45328. A small buffer has been left/re-established at the bank toe that should help consolidate the area. Usage of herbicide this close to a watercourse requires written agreement from the EA.

Figure 127. Past dredging has left much of the lower channel featureless and lacking flow diversity (as with many sections u/s) and the lack of discernible bed features/riffles has allowed slower flow species to colonise the area, such as pike (red circle), roach and perch.

Figure 128. Another apparently active abstraction was observed at SP 05489 45377.

Figure 129. The bridge on Mill Lane poses no issues.

Figure 130. At SP 05313 45452, a recent pond and wetland development has been undertaken, apparently in consultation with the EA (according to the tenant/landowner).

Figure 131. The development includes a small online loop, just u/s of an abstraction point that was being used to irrigate a small tree plantation further up the bank. Note the almost static flow of the brook, as evident by stillwater emergent and floating-leaved vegetation.

Figure 132. A small, clear-span stone bridge within the vegetation (left of shot) at SP 05068 45429 poses no issues.

Figure 133. There are no obstructions to fish accessing the brook from the River Avon.

4.0 Recommendations

4.1 Fish passage

To reconnect habitat and allow fish population optimal use of Badsey / Bunches brooks, the following issues with fish passage need to be addressed. Complete removal of the offending structures must always be the first and No. 1 option considered as no alternative can restore watercourses to a natural state or provide anywhere near the same ecological benefit. Weir removal also delivers massive improvements to sediment and flow conveyance, lowering both bed and water levels u/s and lowering flood risk by reducing the occurrence of out of bank flows.

Fig	Location	Issue	Proposed action	Priority (1-3)
4	SP 09048 37477	Broadway Weir	This weir should be removed. No other option provides the reduced flood risk, reinstatement of natural geomorphology and fish passage. Other options have the potential to reduce conveyance and increase potential flood risk at the site. They would also require detailed flow modelling (further expense). Installing any kind of easement or fish pass at the site would be also be a far greater expense.	1
6	SP 08750 37749	Partially Dammed culvert	Removal of the wooden board obstruction is a small job that could be undertaken by the EA Operations Delivery Team by hand. N.B. High priority owing to ease of completion.	1
8	SP 08560 37878	Block stone weir	Total removal or removal of the central blocks of weir.	2
16	SP 08155 38380	Leedon's Park weir	Removal of the (presumably unconsented) weir and re-landscaping of the area/channel to prevent a deterioration to the site aesthetics.	1
18	SP 07880 38497	Leedon's Park pipe culvert	A small, informal rock ramp type easement could be installed on the d/s side to alleviate the step, raising the d/s bed slightly above the invert the culvert pipes. Long-term, the structure should be replaced with a single, much larger, partially sunken culvert.	2
21	SP 07709 38490	Small garden weir	This is a low priority but should be removed.	3

25	SP 07456 38486	Weir	Agreement should be sought to remove the weir, citing the reduction to flood risk and habitat benefits that could be achieved. This is likely to be difficult as the weir now forms an ornamental feature of the garden.	1
41	SP 06457 39218	Pipe culvert	Minor obstruction – possibly no action.	3
42	SP 06477 39508	Armoured pipe crossing	This is bad practice and should be prevented from occurring again, or being reinstated if maintenance is undertaken but may not be cost-effective to rectify as a discrete job.	3
45	SP 06329 40028	Murcot Mill weir	Agreement should be sought to remove the weir, citing reduction to flood risk and habitat benefits that could be achieved. This is likely to be difficult as the weir now forms an ornamental feature of the garden.	1
46a-f	SP 06334 40098, SP 06327 40126, SP 06305 40161, SP 06292 40208, SP 06286 40223 and SP 06274 40246	Six small weirs	Discussion with the landowners, who have almost certainly installed the weirs as ornamental features, is required to explain the impact upon sediment and flow conveyance and therefore increased flood risk, in addition to the impact upon habitat.	3
57, 58 & 59	SP 06381 41089	Mill House Farm Weir	Agreement should be sought to remove the weir, citing reduction to flood risk and habitat benefits that could be achieved. This is likely to be difficult as the weir now appears to form an ornamental feature of the site. Another option may be to undertake further inspection of the site to identify whether a more permanent, passable channel could be reinstated under	1

			the mill; however, this route is currently dry and was not inspected for obstructions or feasibility.	
70	SP 06587 41687	Armoured bed	Ascertain purpose of the structure and remove if possible.	2
71	SP 06584 41695	Armoured bed	Ascertain purpose of the structure and remove if possible.	2
	SP 06587 41708	Concrete bridge footings	Ascertain purpose of the structure and remove if possible. Possible notching of structure.	
81	SP 06788 42159	Manor House overspill	Ideally the structure should be removed but the associated water supply may prove problematic. A technical fish pass or rock ramp type easement could be installed in either channel; however, opening of the sluice is likely to be part of the management of flooding caused by the structure.	1
82	SP 06782 42158	Manor House sluice		1
82	SP 06775 42171	Small weir d/s of sluice	The main benefit of removing this structure can only be realised if the sluice were made passable to fish (or left open). Removal would, however, reduce the potential for fish to be trapped within the channel d/s of the sluice.	3
84	SP 06761 42189	Small weir d/s of sluice and overspill	This weir should be removed as it impacts upon both channels but is, currently, d/s of two worse obstructions (sluice and overspill)	2
86	SP 06774 42287	Armoured bed	Remove if not protecting services.	3
91	SP 06818 42875	Small weir	Remove if not protecting services.	1
97	SP 06788 43374	Small weir	Remove if not protecting services.	1

104	SP 06586 44069	Raised ford	Removal of this ford would be a priority if the major weir upstream were removed or bypassed, unless the bypass also bypassed this ford.	1
107	SP 06543 43998	Large weir	Ideally the river should be reinstated to its original channel, which would bypass the weir. If this is not possible, the weir should be removed, but the use of the pond for amenity may make this problematic. If removal is not possible a technical fish pass or rock ramp type easement could be installed in either channel.	1

4.2 Loss of habitat / potential restoration

Potential sites in which channel realignment/restoration could be undertaken are highlighted in the following table. Full channel restoration will always be the No.1 option to reinstate habitat but where absolutely infeasible there may be merit in further investigation of options like 'dig and dump' type restoration. 'Dig and dump' restoration is nowhere near as effective in restoring habitat as full restoration but can be employed to good effect in sections where the available land at either side of the channel is limited or where budgets is a major constraint.

Fig	**Location**	**Issue**	**Proposed action**	**Priority (1-3)**
20, 21, 22 & 23	SP 07880 38497 - SP 07583 38469	Straightened channel	The adjacent land use may offer the potential for river restoration	2

34 & 35	SP 06551 38960 – SP 06456 39114	Straightened channel	Possible river restoration	2
40	SP 06460 39192	Lack of buffer strip	Seek larger buffer along watercourse.	3
51	SP 06241 40407	Over-dredged channel	Investigate channel maintenance regime d/s of and seek to prevent over-dredging/creation of an over-capacity channel that is leading to excess sediment deposition and choking with emergent vegetation.	2
68, 69, 75 & 76	SP 06529 41468 – SP 06752 42205	D/s of the	Possible options for river restoration in pasture either side of the brook. This could, potentially include the removal/alleviation of three small weirs and the dredged pond (Fig. 73); it could even include the area of the larger Mill Pond around Manor House, although the requirement of a water supply to ornamental features within Manor House grounds may be prohibitive.	2
73	SP 06584 41768	Dredged channel and weir	Remove weir and educate landowners that such work is not permitted on a watercourse.	1
95	SP 06856 43229	Geotextile	Remove geotextile that is preventing vegetation growth on bank.	2
106	SP 06626 44157	Dredged channel	This work would not be required if the river were restored to its natural course.	3
120	SP 06277 44922	Gauging weir	Ideally this structure should be replaced with more modern, less intrusive flow gauging technology but in the short-term, a fish pass/easements should be installed. Eel passes should already be installed on EA weirs.	1

4.3 **Potential pollution** (require further investigation/sampling)

Fig	Location	Issue	Proposed action	Priority (1-3)
19	SP 07834 38490	Outfall	Elevated algal growth was noted around the pipe so monitoring/observation of the outfall may be beneficial.	3
23 & 24	SP 07583 38469	Elevated algal growth	Investigate STW discharge to the watercourse further u/s.	2
37, 36 & 39	SP 06454 39104	Discharge	Investigate suspected septic tank issues. Also manure midden adjacent to watercourse. (Fig 39 – suspected impact)	1
47	SP 06289 40213	Discharge	Investigate suspected septic tank issues.	1
54	SP 06266 40622	Herbicide	Investigate herbicide use next to watercourse	2
105	SP 06586 44069	Discharge	Investigate suspected septic tank/misconnection issues	1
113	SP 06453 44836	Discharge	Investigate pipe discharge for excess nutrients and chemicals.	1
115, 116 & 117	SP 06435 44857	Discharge	Investigate pipe discharge for excess nutrients and chemicals.	1
119	SP 06329 44900	Discharge	Investigate pipe discharge for excess nutrients and chemicals.	1
124	SP 05731 45253	Herbicide	Investigate herbicide use next to watercourse	2
126	SP 05569 45328	Herbicide	Investigate herbicide use next to watercourse	2

The extent of balsam on the catchment should also be investigated from the railway crossing near Blackminster (SP 06453 44836), where it was first recorded. Railway tracks often form a distribution route for Invasive Non-Native Species and this could be its u/s limit on the watercourse, from which any eradication programme should begin.

5.0 Making it Happen

WTT may be able to offer further assistance such as:

- WTT Project Proposal
    - WTT can devise a more detailed project proposal (PP) report for basic aspects of the work identified (e.g. not requiring detailed engineering or geomorphological designs). This would detail the next steps to take in initiating improvements, highlighting specific areas for work and how it can be undertaken. The PP report could then form part of any required consent applications.

6.0 Disclaimer

This report is produced for guidance; no liability or responsibility for any loss or damage can be accepted by the Wild Trout Trust as a result of any other person, company or organisation acting, or refraining from acting upon guidance made in this report.