The Bregagh River Ecological Assessment
Project Report

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Project Report for: Kilkenny City and County Councils and Keep Kilkenny Beautiful

By: Flynn, Furney Environmental Consultants

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1. INTRODUCTION

Scope of this Report

The following report is an ecological assessment of a section of the Bregagh River carried out by Flynn, Furney Environmental Consultants on behalf of Kilkenny County Council and Keep Kilkenny Beautiful (KKB). The purpose of this study was to gather baseline ecological and hydromorphological data to assess the overall quality of this section of the river and to contribute to the planning of actions for its maintenance and improvement.

The report details the following:

- A walkover survey of the river corridor within the urban areas of Kilkenny City.
- A detailed assessment of river corridor habitats over 4km stretch.
- Assessment of fisheries and habitat quality.

Project Objectives

The main project objectives may be described thus:

- To carry out a thorough study on the ecological and hydromorphological conditions of the Bregagh River within the area under study.
- To record and rank appropriately actions that could be undertaken to improve the overall habitat and fisheries quality of the river.
- To make recommendations on long-term measures such as monitoring or sampling.

This study is intended to supply information for Kilkenny County Council and KKB in order to allow these bodies to undertake measures in the medium to long-term. As such the report also address the responsibility of the local authority and region in terms of the EU Water Framework Directive. This directive sets out a framework for action in the management of water resources for all member states. The Water Framework Directive's fundamental objective is the maintenance of 'high status' of waters where it exists, preventing any deterioration in the existing status of waters and achieving at least 'good' status in relation to all waters.

The Bregagh River: Brief Summary within the Survey Area

The Bregagh River is a tributary of the River Nore which it joins in the very centre of Kilkenny City. The Bregagh is located within the South-Eastern River Basin District (RBD)in Hydrometric Area No. 15). This RBD has seen some improvements in water quality over recent years with over 50% of the channel length reported as being of *Good* status. The Bregagh River is directly connected to a Special Area of Conservation - the River Barrow and River Nore (Site Code 002162) cSAC as well as the River Nore Special Protection Area (SPA, Site Code 004233), an area designated specifically for bird conservation. Kilkenny City and its environs are located over a regionally-important

diffuse karst aquifer. This aquifer and some in the wider environs are rated as being of *high vulnerability* (Geological Survey of Ireland). Aquifer vulnerability refers to the ease with which pollutants of various kinds can enter underground water. The South-eastern River Basin District Risk Assessment for Groundwater in and around Kilkenny City shows that most of the aquifers are assessed as being *probably at significant risk of failing to achieve good status*. The river is predominantly a limestone fed river from both aquifer and surface water sources. The river does not have a high base flow and this would indicate that it is predominantly fed from surface runoff.

2. METHODOLOGY

Methodologies employed

Walkover Study of River Corridor

The authors have followed the methodology given by the Joint Nature Conservancy Council (JNCC, 2010) for habitat assessment. The guidelines by the Environment Agency (2003) were also used. Habitat classification followed Fossitt (2000) and the floral nomenclature used follows Parnell and Curtis (2012) and Scannell and Synnott (1987). Mammal names and status information were taken from Hayden and Harrington (2000) and Marnell et al. (2009).

Habitat Assessment of key Stretches

Habitat assessment was carried out, where possible, on the entire stretch following the River Habitat Assessment Guidelines given by the Environment Agency (2003). Information on river habitat study given by the RSPB (1994) was also used. It should be noted that this methodology guides that left hand side (lhs) and right hand side (rhs) banks are dictated by the surveyor's position looking downstream. All banks referred to in this report are described as such.

Fisheries Assessment

Assessment of the fisheries status was carried out using direct visual assessment and sampling of river substrate.

Fieldwork Description

Fieldwork was carried out in January, February and March 2017. The principal protocol followed was that of the Environment Agency (2003). Fieldwork was carried out in daylight hours with 2 no. workers at any given time. A total of 6 no. person days was taken to complete the fieldwork, not including mapping or other desktop work.

Constraints

The main constraining factor for the practical element of this project was the season in which the study was carried out. The implications of this constraint are:

- Many of the plant species which might normally be found within the river corridor were not in evidence. These included some macrophyte species. Some invasive species may also be impossible to detect at this time.
- Fewer bird species were recorded as fieldwork was prior to breeding season and summer migrants had yet to return.
- Macroinvertebrate sampling was not possible.

- Algal growth may have been much reduced given the cooler water temperatures when compared with summer months.

However, the season chosen was optimal for mammal survey - e.g. signs of otter activity such as paths, slides, protect sand holts are all more easily found in winter. The lower vegetation levels allow for better assessment of hydromorphological character and features. Kingfisher tunnels are also easier to find, as are nesting sites and of other characteristic river species such as dipper and grey wagtail.

3. RESULTS

Desk Study

Aerial Photography

Aerial photography of the section under study was obtained from Apple Maps and www.bing.com. The overall river corridor was reviewed as well as land use , flood plain and physical characters (e.g. obvious man-made features such as barriers, realignments etc.).

Water Quality Statistics Review

The EPA carries out water quality monitoring at 2 no. locations on the Bregagh River within the survey area (a third is upstream). These are at the Blackfriars Bridge (Ref No. RS15B0201300) and Irishtown Bridge (Ref No. RS15B020350). Q -values are only determined at the latter. Here this is recorded by the EPA as being Q2-3 or *Poor Status*[1]. Whereas the River Nore at the monitoring points upstream and downstream of its confluence with the Bregagh River is Q4 or *Good* status.

The Bregagh River is not a 'high status' monitored water body and is therefore not monitored and reported within this cohort. The EPA *Report on River Water Quality in County Kilkenny* (2013) describes some trends in water quality within the Bregagh. At the above Irishtown Bridge monitoring location, the pressures on the watercourse from storm water overflows and 'restoration/enhancement' works in 2013 while the Blackfriars Bridge monitoring point recorded the 4th highest average organophosphate concentration in County Kilkenny in this year although this concentration has fallen year on year since 2009-2011 sampling period. Mean Nitrate (mg/l N) concentrations have also fallen steadily over the last decade. A high BOD of 7.8 mg/l was recorded at Blackfriars Bridge in 2013.

All of the above indicate that there is pressure on the river from agricultural sources - principally nutrient enriching - in its upper reaches and significant pressure from urban overflows within the lower (urban) reaches, several pollutants being at play here, including untreated wastewater.

[1] The Biotic Index Values, or Q values, are assigned to rivers in accordance with biological monitoring of surface waters - low Q ratings, as low as Q1, are indicative of low biodiversity and polluted waters, and high Q ratings, as high as Q5, are indicative of high biodiversity and unpolluted waters. Good status as defined by the Water Framework Directive equates to approximately Q4 in the national scheme of biological classification of rivers as set out by the EPA.

Slightly polluted waters (Q3-4) support reduced or much reduced biological community diversity, have water quality which is fair or doubtful, and, may be of a satisfactory or unsatisfactory condition, referring to the likelihood of interference with beneficial or potential beneficial uses. Moderately polluted waters (Q2-3 or Q3) support much reduced or low biological community diversity, have water quality which is doubtful or poor, and, are of unsatisfactory condition.

Walkover Study - Description of sections under survey

For the purposes of the reporting of this survey, the river was divided into 3 no. reaches. The extent of these is shown in Appendix A. These are:

Reach 1. Clongowen to Kilcreene Reach
2. Kilcreene to Butt's Green
Reach 3. Butt's Green to Nore

Reach 1. Clongowen to Kilcreene 2.1 km

This first reach crosses under the R697 (Kells Road) and then culverted under the N76. The stream then flows (roughly parallel to the N76) in a north-westerly direction for around 800m. Artificial realignment (straightening) is a feature of this reach. During this time, the river passes through agricultural lands which are grazed by horses, sheep or cattle. There is evidence of erosion that has been caused by the realignment of the river during road construction. This is exacerbated in places by poaching from grazing animals. Vegetation tends to be simple on riverbank areas and bramble scrub is one of the more common types of woody vegetation. Some areas have garden waste disposed on the banktop. The river passes for the first time through significant built areas. A weir is crossed and a former viaduct, a structure of heritage value, is among the built assets of this stretch. The river passes through a small parkland area before passing under the R909. A significant area of built environment is either side of the channel for c. 200m before the river again passes through agricultural lands. Within the built area there are numerous outfalls to the river as well as dumping and overflow from a car-wash facility. Within the agricultural lands downstream, poaching is once more a significant feature on the riverbank and realignment has produced an artificially straight watercourse in this part of the reach. The Bregagh River is joined by 2 no. unnamed streams within a relatively short area. Fly-tipping is a significant pressure now and poaching by horses continues to be a factor in riverbank quality. The river passes through agricultural lands at Robertshill - grassland believed to be in County Council ownership - grazed informally by horses at time of survey, before reaching the stone 2-arched bridge which takes the R695 over the river at KIlcreene. Slightly upstream of this there is a 'jerry-built' footbridge.

Reach 2. Kilcreene to Butt's Green 1.2 km

Shortly after Kilcreene Bridge, the lands surrounding the channel become much more extensively managed and tree cover increases significantly. The confluence with the Kilcreene Stream is within the first 100m of this reach. However, it should be noted that the above tributary has been realigned - most likely originally to feed a millrace for the 17th century house here but laterally for aesthetic purposes and that the depleted reach is much reduced on account of this. There is a significant change in the habitat type now and mature trees appear for the first time in the section under study. These are both within broadleaved woodland (LHB) and scattered parkland

trees (RHB). Evidence of activity of specialist bird species was found here including droppings and caddises. Kingfisher and Dipper were both recorded within this section of the reach. Within the channel, habitat diversity is also hugely increased. A range of habitat types for salmonid species was noted although no Brown Trout or Atlantic Salmon were seen. Freshwater macrophytes (e.g. *Ranunculus* spp.) were recorded here in significant numbers for the first time on the survey. A water abstraction point was noted but it was not known whether this is in active use. The river meets a section of old wall - believed to be a remaining section of Kilkenny City wall - before it

widens, pooling before running alongside Butt's Green. A bitmac path runs along a section of the northern banktop here.

Reach 3. Butt's Green to Nore 0.64 km

A significant change occurs here as the river is now channelled through a straightened section alongside the park edge and an area of built environment (housing). However, There is still some good coverage of *Ranunculus* in places. Japanese knotweed (*Fallopia japonica*). Within an artificial (stone) channel, the watercourse reaches the modern box culvert bridge that carries the R695 over the Bregagh River. The *Buildings of Ireland* database records a mill as having been present here but no evidence of this was found. The wetted area of the channel here contracts as a vegetated spit and bar develop to the south of the bridge. The parkland continues just downstream of the bridge (LHB) where there is a landscaped area. Dace, Brown Trout and Grey Wagtail are distinctive river species that were recorded here.

The remainder of the reach is all within significantly built areas and very little by way of natural bank exists. However, where the channel is wider, sidebars have developed and have become colonised with native grass, reed and tree species. Some habitat value for native birds was noted here. The channel was seen to split here around a vegetated 'island'. Both stone walls and modern construction - mass concrete and gabions - form the channel sides as the river approaches Blackfriars Bridge. This 3-arched rubble stone bridge is of archaeological, architectural and scientific value and as such is an important aspect of Kilkenny City Heritage. The parapet has been reworked. There are many crevices, making this potential bat habitat although no evidence of bat activity was seen. It is considered unlikely that this is a hibernaculum but the bridge may well be used as a summer roost.

Downstream of Blackfriars Bridge the river is again significantly realigned within the built environment. A large boulder retaining wall is on the left hand bank and an older stone wall on the right hand bank has had a stone and concrete toe added. There are vegetated areas, however, with willow - some mature developing along both banks. A large mature crack willow (*Salix fragilis)* has been poorly managed here. Vegetated sidebars are a feature here. So too, unfortunately is litter with some domestic waste being noted here. A small copse of willow forms a rare piece of riparian woodland on the left hand bank as Irishtown Bridge is approached. This bridge is a 2-arch rubble stone road bridge that dates from the 1500's and is of considerable archaeological and architectural interest, despite being somewhat overlooked. The uneven stone structure allows for a pleasing assembly of wall flora here that includes Ivy-leaved Toad Flax, Pellitory of the Wall and White Valerian. A single Evening Primrose was an unusual find here.

Downstream of Irishtown Bridge, there is no natural or semi-natural habitat with the exception of the cobbled substrate of the river itself. The steep walls at sheer angles allow little habitat with the exception of some silt deposits where there is some Reed Canary-grass and Ivy on the channel walls. Flow rates increase here as the stream passes through a narrower channel. No evidence of any freshwater macrophytes were noted. Access was difficult beyond Irishtown Bridge and access to the adjacent brewery here was not possible. The stream was therefore only walked within sight of the pedestrian access point (on the southern channel wall adjacent the bridge) and

there is no entirely safe access from any other point. Aerial photography shows another (modern) bridge within the brewery grounds closer to the confluence with the Nore.

RHS Survey Results

Survey data was collected and analysed by the consultants and a summary of the key findings from the data is given below. Additional information on aspects of the RHS methodology can be found in the Field Survey Guidance Manual (EA, 2003).

Bank Profiles: Extensive areas of the Bregagh River have bank sections that have been reinforced. This was the predominant modification over the entire site under study that was artificially profiled. Some significant lengths have been entirely resectioned, resulting in some canalised sections with little or no natural features. However, Reach 2 contained several stretches with no modifications. Toe reinforcement was limited to Reach 3. There was one weir, within Reach 1 just upstream of Hotel Kilkenny.

Bank Materials: Earth banks made up the greater majority of the bank materials. However, Some significant stretches (e.g. in Reach 3) had entirely artificial materials such as concrete, gabions and stone walls. Some existing earth banks were seen to be built up with construction and demolition waste material.

Landuse (5m): This was varied - as may be expected following the course of a river from rural through suburban and urban areas. Improved agricultural grassland for grazing was the most commonly occurring landuse but suburban / urban development was narrowly the second most common. Tillage was also recorded. However, within Reach 2, parks and gardens formed a significant fraction. Reach 3 was dominated by urban habitat although there was some parkland at the start of this.

Flow Features: *Rippled flow* i.e. no waves but with a disturbed rippled surface was the predominant flow feature. Also significant was *Smooth flow* - i.e. perceptible downstream movement smooth with no eddies. There were no *freefalls* or *chutes*.

Bank Features: The greater majority of the site under study contained no notable bank features. Natural berms formed much of the upper reach banks. Some stable cliffs were noted. Vegetated point and side bars were a feature of the Reach 2.

Channel Feature: Trash (Urban debris) was unfortunately a common feature. Vegetated midchannel bars and were occasional. The greater majority of the section under study had no channel features.

Channel Substrate: The substrate of the channel was readily assessed almost throughout with the exception of the lower parts of Reach 1 and Reach 3. Cobble was the predominant substrate but there were also areas of sands, gravels as well as significant silt areas.

Trees and Associated Features: Tree coverage (within 5m of the riverbank) was most dense and consistent within Reach 2. It was understandably least so in Reach 3 although some riparian woodland has sparsely developed within the urban area.

Channel Vegetation: Channel vegetation was not visible in c. 25% of the survey area. Where it was, filamentous algae was the most common. Emergent reeds (e.g. reed canary-grass) was common throughout.

River Water Quality

No physicochemical water quality monitoring was included in the survey work carried out. However, simple field observations were carried out during the ongoing survey (e.g. examining the underside of cobbles for macroinvertebrate species and numbers). It was noted that this methodology revealed an invertebrate population structure that signified a biotic index in the region of Q2 for Reach 1, Q3-4 for Reach 2 and Q3 for Reach 3. These however would need to be confirmed by kick sampling and accurate identification over a range of sites within the Bregagh and will be recommended as a course of future action. The section below outlines the nomenclature for the Biotic Indexing of Water Quality.

The Biotic Index of Water Quality (BIWQ) was developed in Ireland by the Environmental Protection Agency (EPA). Q-values and water quality classes are assigned using a combination of habitat characteristics and structure of the macroinvertebrate community within the waterbody. Individual macroinvertebrate species are ranked for their sensitivity to organic pollution and the Q-value is assessed based, primarily, on their relative abundance within a biological sample. EPA indices, EPA water quality status and WFD status are interpreted in Table 2.

Table 2 *EPA water quality status summary*

Biotic Index	EQR	EPA Quality Status	Water Quality	WFD Status
Q5	1.0	Unpolluted	*Good*	High
Q4-5	0.9	Unpolluted	*Fair-to-Good*	High
Q4	0.8	Unpolluted	*Fair*	Good
Q3-4	0.7	Slightly Polluted	*Doubtful-to-Fair*	Moderate
Q3	0.6	Moderately Polluted	*Doubtful*	Poor
Q2-3	0.5	Moderately Polluted	*Poor-to-Doubtful*	Poor
Q2	0.4	Seriously Polluted	*Poor*	Bad
Q1-2	0.3	Seriously Polluted	*Bad-to-Poor*	Bad
Q1	0.2	Seriously Polluted	*Bad*	Bad

The EQR represents the relationship between the values of the biological parameters observed for a given body of surface water and the values for these parameters in the reference conditions applicable to that body. The ratio is expressed as a numerical value between zero and one, with high ecological status represented by values close to one and bad ecological status by values close to zero (EPA, 2006) In Ireland it is calculated as Observed Q-value/Reference Q-value (i.e., Q5). The EQR allows comparison of water quality status across the European Union as each member

state has an EQR value for 'High'; 'Good' etc., based on an anticollaboration of boundaries between water quality categories e.g., 'High-Good'; 'Good–Moderate'

Outline Fisheries Assessment

Reach 1

As fisheries consultants the authors' first experience with the Bregagh River was at Hotel Kilkenny (around halfway within Reach 1 of this present survey) where in 2009 the river overtopped the banks and flooded the leisure centre and pump house, causing a large degree of damage. We designed and constructed a bioengineered willow revetment retaining and flood protection wall and whilst working in the river it was apparent that it had a very healthy biodiversity at that juncture. Brown trout of over 1.5kg (3lbs) were routinely seen in the holding pool above the weir and a trip through the pool with a snorkle revealed a large population of trout of various age classes. The weir at the bottom of the pool adjacent to the petrol station could be classed as a total barrier to fish migration with the exception of very large scale flooding events that may or may not happen in any calendar year, therefore it is unlikely that many Atlantic salmon juveniles would be present above this impoundment. Personal correspondence with local angling representatives of the Kilkenny Angling Association had routinely witnessed Atlantic salmon spawning in the lower reaches of the Bregagh.

In 2012 the river was surveyed as part of the Keep Kilkenny Beautiful group's biodiversity work. In the course of this survey, many of the sections of the river included in this report were included in the 2012 survey. Again, the river had a relative abundance of different age classes of trout, and other species such as European eel, minnow, 3 spined stickleback and stone loach were seen during the course of the study. Instream plants such as *Ranunculus*, water cress, epiphytic algae, mosses and lichens were present where appropriate environmental conditions existed. However, the larger trout witnessed in 2009 seemed to be missing but this can neither be confirmed or denied as no electrofishing or other invasive technique of fisheries survey was undertaken.

This present (2017) survey revealed a quite different scenario. Despite walking every meter of the river channel (mostly instream) for the 4 kilometres surveyed, the authors did not see a single fish in Reaches 1 and 2. The top section of the survey area from the ring-road (Reach 1 Clongowen to Kilcreene) had deteriorated hugely from 2009/2012 relative to instream and riparian flora and fauna. Large scale poaching of the banks due to horses being kept in certain fields with no riparian fencing was largely responsible for a decrease in riparian vegetation and deposition of silt within the slower moving sections of the river above Hotel Kilkenny. Again it should be mentioned that no electrofishing was undertaken but water flow was low and we walked large sections of the bank slowly with polaroid glasses looking for fish, (prior to entering the water) and still saw no fish. In the section of river upstream of Hotel Kilkenny despite heavy shade from riparian tree growth, there were trout, minnows and stickleback throughout this stretch in both 2009 and 2012, in 2017, the substrate that had been predominantly cobble and gravel in the earlier surveys was smothered in silt deposits. As noted earlier in the report, poaching of ground by leaving livestock out all winter without riparian fencing and a vegetated buffer zone would have contributed to the siltation levels, but it also should be mentioned that tillage farming and other sources of high

siltation could be contributing factors from further on up the catchment. It is noteworthy that no kingfishers, dippers or otter activity was recorded within Reach 1.

Below the weir at Hotel Kilkenny, a number of illegal discharge points from car valeting services and other businesses were observed directly discharging their effluent into the river. A number of other potential illegal discharge points were observed but not actively discharging during the survey.

It is also of note that the river channel in Reach 1 has undergone many historical and recent human induced modifications of resectioning, separation of flood plain from river corridor by bunding and walls, and rudimentary bank stabilisation with builders fill, and concrete blocks. All these actions have reduced natural channel functioning, removing sinuosity and ultimately negatively impacting the natural physical and chemical functioning of the river. This has restricted or prevented the river from naturally healing itself in certain sections and has undoubtedly had impacts on the fisheries value of the river.

Lastly, the level of fly tipping and general urban trash throughout this entire Reach 1 was somewhat shocking. This added to an overall impression of neglect and environmental decay that was palpable throughout the survey conducted on this reach.

The results of the survey of Reach 1 were very disappointing in the context of the biodiversity of the River Bregagh. Basic sampling for invertebrates (looking under stones) revealed an invertebrate population structure that signified a biotic index in the region of Q2. This however would need to be confirmed by kick sampling and accurate identification over a range of sites within the Bregagh and will be recommended as a course of future action. The previous section outlined the nomenclature for the Biotic Indexing of Water Quality.

Reach 2

The physical components of a relatively healthy riverine ecosystem were apparent in Reach 2, positive signs such a good riparian vegetative structure and good physical configuration of the instream riffle-pool-glide was evident. Self cleaning gravels beds were apparent and during the survey in this section the surveyors noted dippers and a kingfisher, reflecting the positive change in land use within the river corridor and the manner in which local properties on the whole were protecting the environment. Both the Dipper and the Kingfisher are indicator species and would infer that there were both reasonable populations of invertebrates and fish within the vicinity. However, it is worth noting that both these species were seen near or at the juncture of a tributary joining the Bregagh and ultimately this may have been the greater attraction as it appeared considerably less impacted by anthropogenic actions than the Bregagh though it is also noted that one or two properties in the area have diverted said tributary stream through their properties as water features.

In the course of walking Reach 2 the authors still failed to see any fish species despite being certain that fish are present within the water course but certainly not in abundance. Urban trash was still ubiquitous throughout the reach but not in the same volumes as Reach 1.

The natural channel configuration has assisted the river in buffering some of the impacts described in Reach 1 but unfortunately the level of pollution entering the river from various sources upstream is, and will continue to have a negative impact on this reach despite its positive points. This section of the Bregagh requires strong protection from any interference by development or works within the riverine corridor and the active flood plain.

Reach 3

Despite being in the most urbanised section of the Bregagh's course, this section of river has an interesting morphology. Despite being walled in for most of the 600-700m, the river channel had good gradient breaks with clean gravels in sections and depositing sections with small sections of alluvial woodland. Deep small pools have formed in sections and at least expressed diversity of habitats.

Urban trash was everywhere throughout the reach and many discharge pipes lined the walls of which nothing is known of what may or may not be discharged through them. Despite the interesting features few fish were present within the reach. Dace and Brown Trout were the only species noted, these close to the bridge at Butt's Green.

Overall Ecological Assessment

Reach 1. Clongowen to Kilcreene 2.1 km

This is the longest of the three reaches. Its ecological character is quite strongly negatively influenced by the landuse of the adjacent lands. This is predominantly grazing but apparently informal grazing of horses is the primary impact. The realignment of the river has lead to long stretches of this reach being artificially straightened and without the features that may be expected in a river of this size and stage.

There is an ongoing erosion issue at the very start of this reach which must be addressed as bank just is being lost on a continual basis. The removal of woody vegetation, either through grazing pressure or tree-cutting has seriously diminished the value of the watercourse throughout much of this reach, in particular on the western bank (left hand bank).

Grazing pressure has resulted in loss of riparian vegetation and the ensuing poaching has led to loss of physical bank. Again, this is especially so on the left hand bank. Dumping, fly-tipping and casual littering occurs nearly throughout this reach and this mars its appearance as well as adding potential pollutants to the watercourse. Some trash (vegetation) has built up within the channel and this is will lead to localised flooding as well as being a 'litter-catcher'.

Overall freshwater macrophyte populations were lower than might be expected. This may be partly be because of realigned channel lengths within the reach. Some in-stream habitat variation occurred toward the end of the reach and it is here that offers best habitat for invertebrate species including the White-clawed Crayfish. Some habitat for Kingfisher tunnels exists but there was no evidence of activity of this species. Similarly, no Dipper activity was noted. A paucity in freshwater macroinvertebrates - not assessed as part of this current work - is likely to be responsible for this.

The recently-created embankments have resulted in artificially high banks in some areas and the absence of naturally vegetated areas. These are in part made up of construction and demolition waste materials and look poor, as well as being a potential source of contamination.

Reach 2. Kilcreene to Butt's Green 1.2 km

This was the most varied of the three reaches in terms of habitat types and overall ecological value. This reach contained the greatest amount of semi-natural habitat types although anthropogenic influences were visible throughout.

This reach is readily separable from the other 2 no. reaches by the amount of tree cover, in particular on the northern bank of the river. Mature trees with a developing understorey are a feature of the parkland and garden areas here. The riparian tree cover provides variable shading which benefits diversity of macroinvertebrate fauna, macrophyte flora and fishery habitat. There was no evidence of over-grazing or poaching of the banks within this reach.

Within the channel itself, there was a good diversity of riffle, glide and pool habitats. Variable deposition on bends was noted. The above would indicate good conditions for spawning habitat.

During wading, it was noted that there were some significantly deeper channel lengths. Some limited area of vegetated mid-channel bar was seen. Toward the end of the section - adjoining some of the deepest areas - the river widens to include a limited area of reed swamp with Reed canary-grass and Reedmace.

Reach 3. Butt's Green to Nore 0.64 km

The upper section of this Reach passes between parkland and urban area and here it is highly modified, diminishing the natural character and ecological value of the stream here. However, there was good variety of flow-type and some variety of channel habitat visible. Also visible were mature stands of the invasive species Japanese knotweed. This was seen to be mature and spreading. Both upstream and downstream of the modern road (R910) bridge at Butt's Green there was good variety of channel habitat which included vegetated bars which are of significant width on the right hand bank for c. 30m.

Downstream of this, the banks are of artificial structure and materials although accumulated materials have allowed some development of semi-natural habitats including grassed areas and riparian (willow-dominated) woodland. Old stone channel walls provide some habitat also, as do the older structures of Blackfriars and Irishtown Bridge. Here significant growth of plants such as Valerian and Pellitory of the Wall has become well-established.

Flow-rates were generally fast and some variety of river habitat types persisted until Irishtown Bridge. Following this, the canalised nature of the stream and the high level of shading of the watercourse by tall buildings adjacent greatly reduced the habitat diversity here.

4. DISCUSSION

River Habitat Quality Assessment

The 3 no. stretches that were examined for this study were examined under two assessment criteria that have been derived for the RHS system. These are described below with results.

Habitat Quality Assessment (HQA) is one of two key indices derived from River Habitat Surveys. It is a broad measure of the diversity and "naturalness of the physical (habitat) structure of the river channel and corridor. Its site value is determined by the presence and extent of features of known wildlife interest recorded by the standard survey procedure. A limitation of the system is the subjective nature of the scoring system, based, as it is, on a consensus of informed professional judgement.

As a rough guide, sections with a HQA of 40+% are good (average and above) for the river type considered during this survey. The scores were calculated by summing all component scores for each category (HQA = Flow types, Channel substrate, Channel features, Bank features, Bank vegetation structure, Channel vegetation, Land use within 50 m, Trees and associated features, and Special features, HMS = Modifications at spot-checks, Modifications present but not recorded in spot-checks, and Modified features within the whole site)

Habitat Modification Score (HMS) is a measure of the extent that the natural characteristics of the survey section have been modified by man. An HMS value of zero indicates no significant modification and represents natural (good) conditions. HMS values increase with increasing levels of modification. Like the HQA, the HMS can be described as an objective application of a set of subjective rules that provide a consistent form of comparison between sites. Arising from this, a Habitat Modification Index (HMI) may be assigned to sites that have been subject to RHS methodology. Factors that contribute to high HMS values include resectioned, reinforced, poached, bermed and embanked banks and culverted, resectioned, reinforced, dammed, weired and forded channels.

RHS Methodology for Assessing HMI and HQA

This is illustrated in the tables below.

Derivation of HMI **Derivation of HQA**

HMS	Descriptive category of channel	HMI Class
0	Pristine	1
0-2	Semi-natural	1
3-8	Predominantly unmodified	2
9-20	Obviously modified	3
21-44	Significantly modified	4
45+	Severely modified	5

HQA score category	HQA Class	Description
0 – 20%	5	Very Poor
20-40%	4	Poor
40-60%	3	Fair
60-80%	2	High
80-100%	1	Very High

Habitat Assessment Results

Habitat Modification Index

Overall, the catchment is *significantly modified* with only Reach 2 being *predominantly unmodified*. Reach 1 is *significantly modified* - intensive landuse (grazing) and removal of riparian vegetation - and Reach 3 is *severely modified* - artificial banks, resectioning and canalisation.

Habitat Quality Assessment

The upper reach of the section under study, Reach 1 was of *Poor* habitat quality. Reach 2 may possibly be described as being of *High* quality in places but some areas (where bank has been resectioned) would only be of *Fair* quality. Reach 3 was seen to be of *Poor* to *Very Poor* habitat quality.

The results are summarised below:

Reach No.	HQA	Habitat Quality Description	HMI	Modification Category
1	4	Poor	4	Significantly Modified
2	2	High	2	Predominantly Unmodified
3	4	Poor/Very Poor	5	Severely Modified

Ecological Assessment

Despite an overall acceptable diversity of habitat areas over the entire section under study, overall species diversity appeared to be lower than might be expected for a river of this size and stage. Bankside areas were typically low in semi-natural habitat areas and very few truly natural bankside areas exist here. Reach 1 shows this most starkly with realigned, resectioned areas devoid of woody vegetation. Reach 2 showed by far the highest diversity in habitat types and therefore a higher species diversity would be expected here. This was borne out by the only sightings of characteristic river species Kingfisher and Dipper being recorded here. Reach 3 is severely modified and although some riparian woody vegetation was noted, bankside and overall watercourse habitat diversity was low.

In-stream habitat types were most diverse and numerous in Reach 2 although a surprisingly good diversity of stream habitat types was recorded in the upper section of Reach 3. Reach 1 had the lowest overall diversity of in-stream habitat on a per metre basis. The intensive landuse along much of the section under study and no doubt upstream of the survey area accounts for much of the low habitat assessment scores. However, water quality is another key factor here (see below).

Water Quality

No physicochemical water quality analysis was carried out as part of this present survey. However, field observations (e.g. macroinvertebrate counts) concurred with historical water quality data reviewed. The survey would suggest that the most recent EPA Q-value of Q 2-3 indicating *poor* status is likely to be justified.

Numerous outfalls to the Bregagh River were noted. It is not known whether any of these are permitted. A clear instance of ongoing pollution at a carwash facility were recorded. Littering, fly-tipping/dumping would also have potential to impact on water quality. The present report does not include a survey of the river above Reach 1, all of which lies outside the urban area of Kilkenny City. While the rural environment will not have the potential for some of the chemical pollution arising from city storm-water overflows or unregulated commercial outfalls, the rural environment also has potential pollution sources. A broad examination of recent aerial photography shows that tillage now comprises around 25% of landuse of agricultural lands within the Bregagh River catchment. Elevated suspended solids as a result of surface runoff may be expected as a result of this use.

Fisheries

Of all of the results of this present survey, it is perhaps the paucity of fish observations that is the most remarkable. Only 2 no. species - Dace and Brown Trout were noted and these only once at 1 no. location. Reach 1 showed poor quality fishery habitat. The landuse of adjacent lands being likely to be the chief reason for this. However, Reach 2 showed a good variety of habitats including spawning gravels. Indicator species Dipper and Kingfisher were seen so fish species are almost certainly present but in numbers well below what has been recorded in previous work and what might be expected from a Reach of this quality. While passing through a heavily urbanised environment, Reach 3 still contained valuable fisheries habitat. These included sections of gravels and depositing sections Deep small pools have formed in sections and at least expressed diversity of habitats. . Some small areas of riparian woodland also occurred. Emergent (broadleaved) macrophytes were noted as were some sedges and reed canary-grass. It may thus be inferred that physicochemical water quality is an issue for the Bregagh River as despite the presence of favourable habitat, the abundance of fish species that may be expected was not present. This was further borne out by the relatively poor freshwater macroinvertebrate numbers observed.

5. Recommendations

A **dedicated electrofishing survey** of the Bregagh catchment is recommended. This is required to assess both species presence and abundance levels of fish and identify if any key protected species such as lamprey spp and Atlantic salmon are present and formulate distribution maps. These distribution maps could be highly valuable when assessing planning applications or formulation

of City and County Development plans. Such accurate assessment would also indicate the problem areas and influence catchment management proposals.

Regular physicochemical **water quality monitoring** should be commenced and maintained to understand and indeed react to the pressures that have been facing the Bregagh. Eutrophication may be a contributing factor from agricultural and sewage runoff, but there are other factors influencing the Bregagh that appear more sinister and it would appear from the paucity of fish and invertebrates that chemical toxins are present within the Bregagh river corridor.

All **areas used by livestock should be fenced permanently** to prevent further poaching of the riparian zone and allow a vegetative buffer zone to develop. It may be feasible to accelerate this by planting of native willow slips and alder to accelerate colonisation. Trees - if planted - should be sufficiently spaced so as not to create a tunnelling effect on the river and block out light.

A **large scale clean-up** of all the urban trash within the river corridor is urgently needed. A key rationale being that if an area is seen to be littered it will continue to be treated as such (and this is apparent throughout the surveyed reaches). Tighter surveillance in tipping hotspots is required as much of the material observed during the survey had been there for extended (3-5 years) without being removed or (as far as known) reported.

It may be recommended in the long term to have **sections of the river adopted** by local organisations in conjunction with KKB that could maintain and clean the sections on an annual basis.

A full **investigation into all the discharge points** within the urban/suburban environs is essential in reducing the input of contaminants that was witnessed being discharged with apparent impunity into the river.

Physical instream works relative to the creation of holding pools, gravel shoals and revetment of banks using bioengineering should be considered within the identified areas of poor resectioning, and areas where builders rubble and concrete has been tipped onto the banks and graded as bank protection.

The Bregagh could be a **highly valuable wildlife corridor if managed appropriately** throughout the urban/suburban environment and the fact that it meets the Nore in the very centre of Kilkenny City is important. The Bregagh could, if managed sympathetically, create a corridor for many aquatic and terrestrial animals and plants within the City limits to connect with rural sources and maintain or elevate biodiversity within the City.

It is recommended that a concerted **environmental awareness campaign** be carried out, utilising KKB's considerable experience in this area. It was noted that the Bregagh River was somewhat obscured from the public attention and that further oversight and thus protection could be gained through awareness of the river's importance and indeed presence. Signage, such as that previously used by KKB be revived and reused. Iconic and familiar river species such as the Kingfisher and Dragonfly could be used as has been done in other successful Tidy Towns.

References

Print

Environment Agency (2003) The River Habitat Survey Manual. Environment Agency, UK.

Environmental Protection Agency (2010) *Water Quality in Ireland, 2007-2009*. EPA, Dublin.

Environmental Protection Agency (2012) *Management Strategies for the Protection of High Status Water Bodies - STRIVE* Report Series No. 99. EPA, Dublin.

Environmental Protection Agency (2013) *Water Quality in Ireland 2010-2012 - Rivers and Canals*. EPA, Dublin.

Environmental Protection Agency (2014) *River Water Quality Report: Kilkenny 2013* - EPA, Dublin.

Online Resources

Environmental Protection Agency *Envision* Mapping and Database.

Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs. Historic Environment Viewers: http://webgis.buildingsofireland.net and http://webgisarchaeology.ie

Apple Maps

www.bing.com/maps

Appendix A. Mapping & Aerial Photography

Fig 1. Aerial showing three reaches under study.

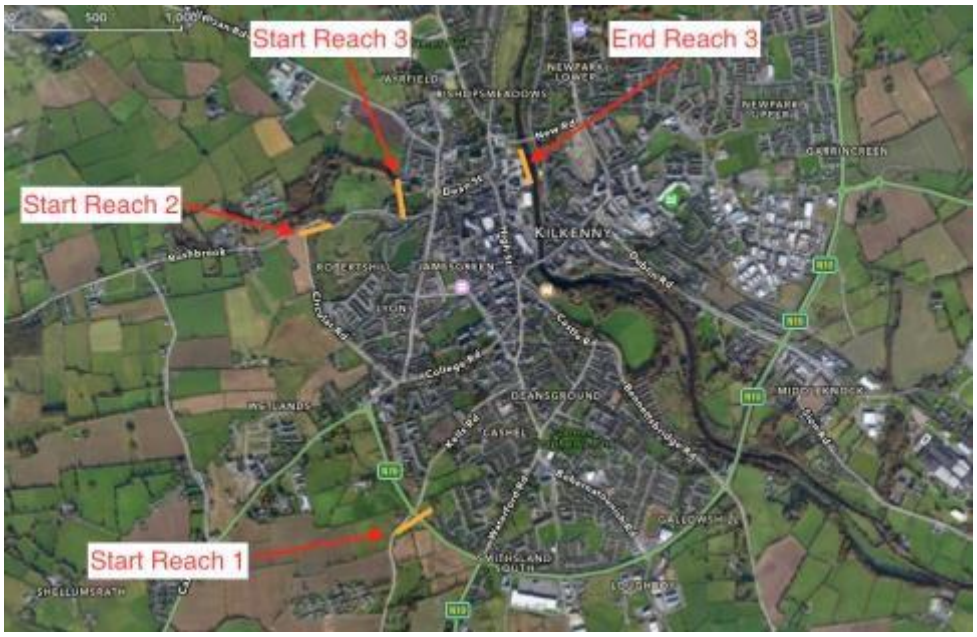

Fig 2. EPA 'Envision' database of rivers within c.5km of survey area.

Fig 3. The lowest reach of the Bregagh and the Special Area of Conservation.

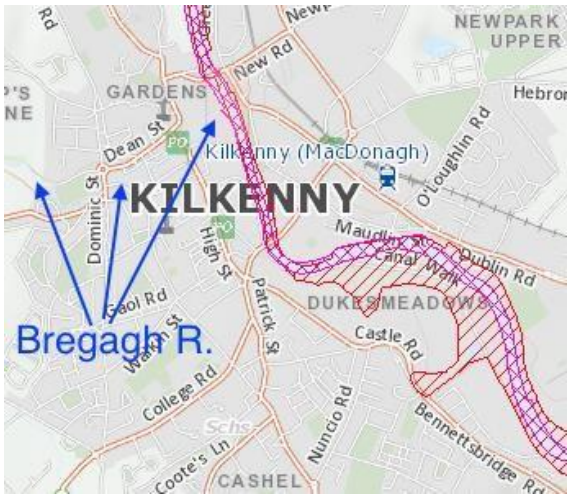

Fig 4. The extent of Reach 1

Fig 5. The extent of Reach 2

Fig 6. The extent of Reach 3

Appendix B: Some Photographs of Section under Study

Fig 1. Reach 1: Badly eroded right hand bank after culvert

Fig 2. Reach 1: First downstream section of river - note straight channel and lack of riparian vegetation.

Fig 3. Reach 1: Artificial surface- gabion wall on right hand bank with a well-cut grass bank.

Fig 4. Reach 1: Perhaps the best habitat in this reach is this slower and deeper section upstream of Hotel Kilkenny.

Fig 5. Reach 2: Parkland habitat and mature trees on left hand bank.

Fig 6. Reach 2The confluence of the Bregagh and Kilcreene Streams.

Fig 7. Reach 2: Note the woody vegetation and vegetated point bar.

Fig 8. Reach 2: a significant built structure at end of reach - part of the Kilkenny City wall.

Fig 9. Reach 3: Japanese knotweed over mass concrete artificial bank.

Fig 10. Reach 3: Upstream of road bridge at park. Some habitat has established here in the form of vegetated bars and banks.

Fig 11. Reach 3: In-stream habitat diversity apparent here despite obviously urban setting.

Fig 12. Reach 3: Final section of reach before confluence of Bregagh with River Nore. Note canalised channel and shading.