Tullow, County Carlow Habitat Survey and Biodiversity Report

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Report to Tullow Tidy Towns Committee

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Acknowledgements

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Comhshaol, Pobal agus Rialtas Áitiúil
Environment, Community and Local Government

LOCAL AGENDA 21 ENRIRONMENTAL PARTNERSHIP FUND

The Local Agenda 21 Environmental Partnership Fund, which has operated since 1997, promotes sustainable development by assisting small-scale environmental projects at local level. These projects involve partnership arrangements between local authorities and various local groups including community groups, schools and environmental NGOs.

The Fund encourages involvement of local communities in local action and decision-making and assists them in working towards the goal of sustainable development. The value of the scheme is enhanced by the voluntary effort that it facilitates.

The Local Agenda 21 Environmental Partnership Fund assists sustainable development from the ground-up and facilitates, at local level, the achievement of the objectives of the Agenda 21 action plan on sustainable development which was agreed at the UN Conference on Environment and Development in Rio de Janeiro, in 1992 (the "Earth Summit"). Renewed political commitment for sustainable development was secured at the Rio +20 Conference in Brazil in June 2012, on the 20th anniversary of the "Earth Summit'.

The Local Agenda 21 Environmental Partnership Fund is administered by local authorities, while the Department maintains a co-ordinating role. Eligible projects are those which support and complement, at a local level, national environmental policies such as those on Waste, Biodiversity, Climate Change, Air, Water and Sustainable Development. Local authorities are required to provide an equivalent amount of funding to successful projects as the funding provided by the Department. Funding can also be supplemented by other sources, e.g. the private sector, in order to maximise the potential for partnership arrangements.

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About the Authors

Hazel Doyle – Hazel completed an MSc in Biodiversity and Conservation in Trinity College Dublin. Prior to this she obtained an honours degree in Zoology from University College Dublin. In conjunction with this habitat survey, Hazel's research project focused on the wetland habitats of Tullow town. Her thesis was entitled ***"Wetland floristic biodiversity within Tullow town, County Carlow – a vegetation survey".*** This involved a vegetation survey along the River Slaney - a designated special area of conservation (SAC) - and artificial lakes in the local golf course.

Ronan Corrigan – Ronan completed his honours Master's degree in Applied Environmental Science from University College Dublin with his Undergraduate degree also being in the same field, but from Trinity College Dublin. For the duration of this fieldwork, Ronan worked on his thesis project entitled ***"Foraging value of semi-natural woodlands and grasslands for pollinating insects".*** This study looked at which habitat type produced the most amount of forage for pollinating insects, as well as how dependable this forage was through the seasons.

From left to right: Dr. Daniel Kelly, Hazel Doyle, Ronan Corrigan and Dr. Tamara Hochstrasser. This photo was taken in the Tara Arms, Tullow on the 26th November 2014 after an oral presentation of the Habitat Survey.

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1. Introduction

1.1. Study Brief- Why was a Habitat Survey Carried Out?

Develop Tullow Association Limited and Tullow Tidy Towns Committee commissioned a Habitat Survey to be conducted in Tullow during June-July, 2014. This request follows recommendations from National Tidy Town Adjudicators in both 2012 and 2013 reports. Tidy Towns Competitions grade on many different categories such as Tidiness and Litter Control, Landscaping and Open Spaces, Sustainable Waste and Resource Management etc; however, more recently, emphasis has been placed on the category "Wildlife and Natural Amenities". This category includes raising awareness of the natural amenities in the local area, carrying out habitat surveys, conducting wildlife audits and/or producing biodiversity reports etc. Under this category the judges suggested a habitat survey be undertaken to identify important habitats and sites of biodiversity in the town, and to make recommendations for their management and conservation. The recommendation from the 2012 adjudicator's report states: "... as you are aware there are many other habitat types present in Tullow which a general survey would identify for you. This survey should be a basis for you to preserve the identified habitats in your area and investigate the possibility of developing new ones." The recommendation from the 2013 adjudicator's report encourages this idea and states: "As suggested by last year's adjudicator the creation of a habitat survey would be useful and interesting".

Habitat surveys are becoming increasingly used by Tidy Towns groups and city councils as an approach to understanding the biodiversity of various urban and sub-urban areas. This report focuses on the floristic biodiversity, or plant life in Tullow town. Animal groups, such as insects, birds, amphibians and mammals go beyond the scope of this report, yet certain interesting species are noted which may be worthy of protection.

1.2. Background Information

1.2.1. What is Biodiversity?

Biodiversity is the variety of genes, species and ecosystems which together provide us with vital ecosystem goods and services such as food, carbon sequestration, clean air and water.

Put simply, biodiversity (also called biological diversity) is the 'variety of life', such as the number of different plant and animal species. Biodiversity was formally defined as "the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems" in the Convention on Biological Diversity (CBD) at the United Nations Earth Summit in Rio de Janeiro in 1992. We all depend on biodiversity which provides us with Ecosystem Goods and Services, which according to the Millennium Ecosystem Assessment (2005) are "the benefits people obtain from ecosystems". These are categorised and include provisioning services (food, water, timber, fibre), regulating services (disease control, climate regulation, flood defence, water quality), cultural services (recreation, aesthetics and spiritual benefits) and supporting services (soil formation, photosynthesis, nutrient cycling) (Millennium Ecosystem Assessment, 2005). Ecosystem services in one sense are invaluable as, without them, the economies of the earth would cease (Constanza *et al.,* 1997). According to Constanza *et al.,* (1997) who looked at the economic valuation of these benefits, ecosystem services have an average value of US$33 trillion per year. Biodiversity has a major role to play in the delivery of these vital services.

Understanding, assessing and enhancing urban biodiversity is crucial both from conservation and social perspectives (Kowarik, 2011). The urban environment in the past was generally associated with low biodiversity and often neglected by ecologists; it lacked the attention

which natural and semi-natural habitats received. However, more recent research at city and county scales has found that urban and sub-urban areas contain relatively high levels of biodiversity (Godefroid & Koedam, 2003). They also include areas of wilderness that are readily accessible to large numbers of people, which is important as there is evidence available to suggest a positive relationship between green spaces in urban environments and better mental health and wellbeing (Lee & Maheswaran, 2011). Biodiversity in urban areas should therefore be promoted and conserved. In order to increase or maintain biodiversity, habitats need to be identified, preserved or managed, and monitored. This project aimed to gather the baseline information on Tullow's floristic diversity and habitats, which can then be conserved and possibly enhanced.

1.2.2. What is a Habitat?

According to Fossitt (2000), habitats are basic building blocks of the environment that are inhabited by plants and animals. They are environmental units which facilitate a certain suite of species adapted to the abiotic conditions such as the climate, topography and soil associated with each as well as the management and disturbance regime that a particular area undergoes over time. A critical step in biodiversity conservation and management is obtaining baseline ecological information of the area in question. This information can then be used for conservation management and monitoring, habitat restoration, identification of important natural areas for protection, public awareness and the provision of a baseline study for more detailed ecological research (Smith *et al.*, 2011). Local habitat surveys provide information on the plant and animal communities in an area and recommendations on how to enhance or restore habitats. Local people involved will be enabled to understand

Habitats can be artificial, semi-natural or natural areas. They are defined by biotic factors such as the species of plants and animals living there and by abiotic conditions such as climate, geology and soil.

more about the nature and ecology of their home town and feel empowered to protect it (Phillips & Wilson, 1995). Habitat surveys are an effective, replicable method of gathering the necessary information about the biodiversity of an area.

1.3. Project Aims

1. Identify and describe all habitat types in Tullow,
2. Highlight habitats of conservation value,
3. Produce a habitat map of Tullow town,
4. Produce a species list showing the floristic biodiversity in Tullow and
5. Make recommendations for enhancing biodiversity in Tullow and for further research.

1.4. Study Area

Carlow is the smallest inland county in Ireland and is surrounded by five other counties (Figure 1). County Carlow was previously part of Botanical District III (also called the Barrow District) which consisted of Counties Kilkenny, Carlow and Laois. According to More & Moore's *Cybele Hibernica* (1898), this district "appears to be the poorest in rare species of all the Irish botanical districts". By 1901, Robert Lloyd Praeger had recorded 578 species for the county (Booth, 1979). County Carlow is now biological vice county H13, with Tullow being part of Carlow's Botanical District 3, also called the "North Carlow Plain" (Booth, 1979).

Tullow *(An Tulach* in Irish, meaning "mound"), is a small but expanding market town in the north-east of County Carlow. It is located 16km from Carlow town and 98km from Dublin city. Tullow facilitates the ever-expanding Dublin commuter belt and has a growing population of 3,972 with a population density of 898 persons per square kilometre (Census, 2011). Tullow is located on the river Slaney where the N81 intersects the R725. It is also fifteen minutes from the Dublin to Waterford motorway - which is set to increase local population and residential and infrastructural development further.

a) **b)**

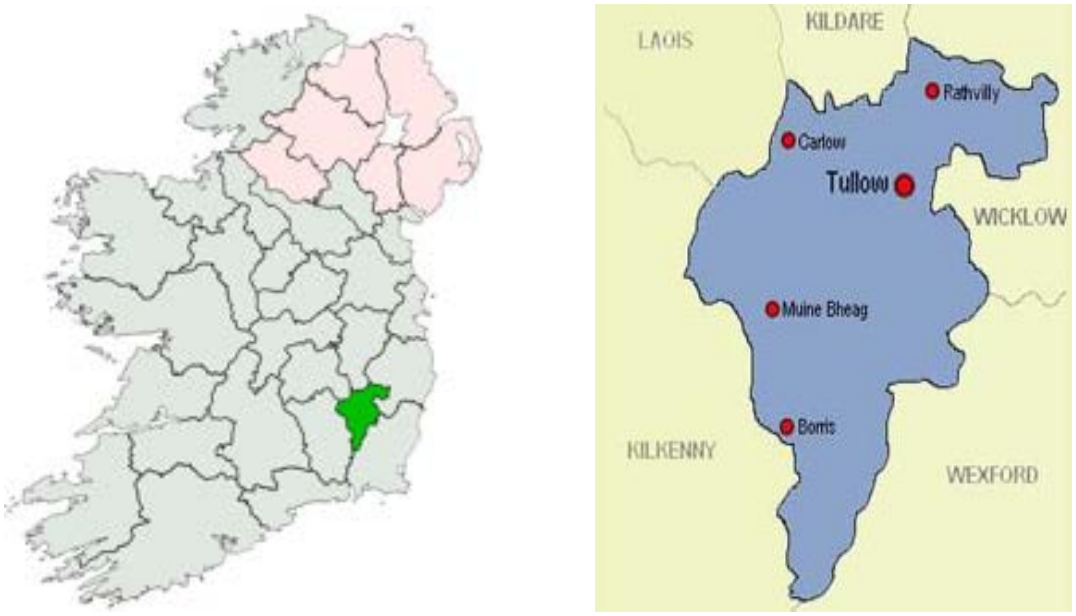

Figure 1. Maps showing a) location of County Carlow in Ireland and b) location of Tullow town in County Carlow.

The target area for assessment and survey work lies within the Tullow town Electoral Division, an area of approximately 4.42 square kilometres and roughly within the 50 kph (kilometre per hour) zone. For the purpose of this survey, however, we go beyond this boundary to take in significant habitats that are located close by. In particular Mount Wolseley Golf Resort is outside of the Electoral Division, however it contains artificial ponds, classified as FL8 (Other Artificial Lakes and Ponds) in *A Guide to Habitats in Ireland* (Fossitt, 2000). These wetland habitats have the potential to harbour unique aquatic plant species. This was confirmed by the thesis of H. Doyle (2014), which found the artificial ponds to be more species rich than the River Slaney. Recommendations on management practices are provided to enhance these artificial freshwater habitats. Tullow Hill is also included in this survey even though the entire feature does not lie within the boundary (see Figure 2 below for the site area map). These sites will be discussed further in the recommendations section of the report.

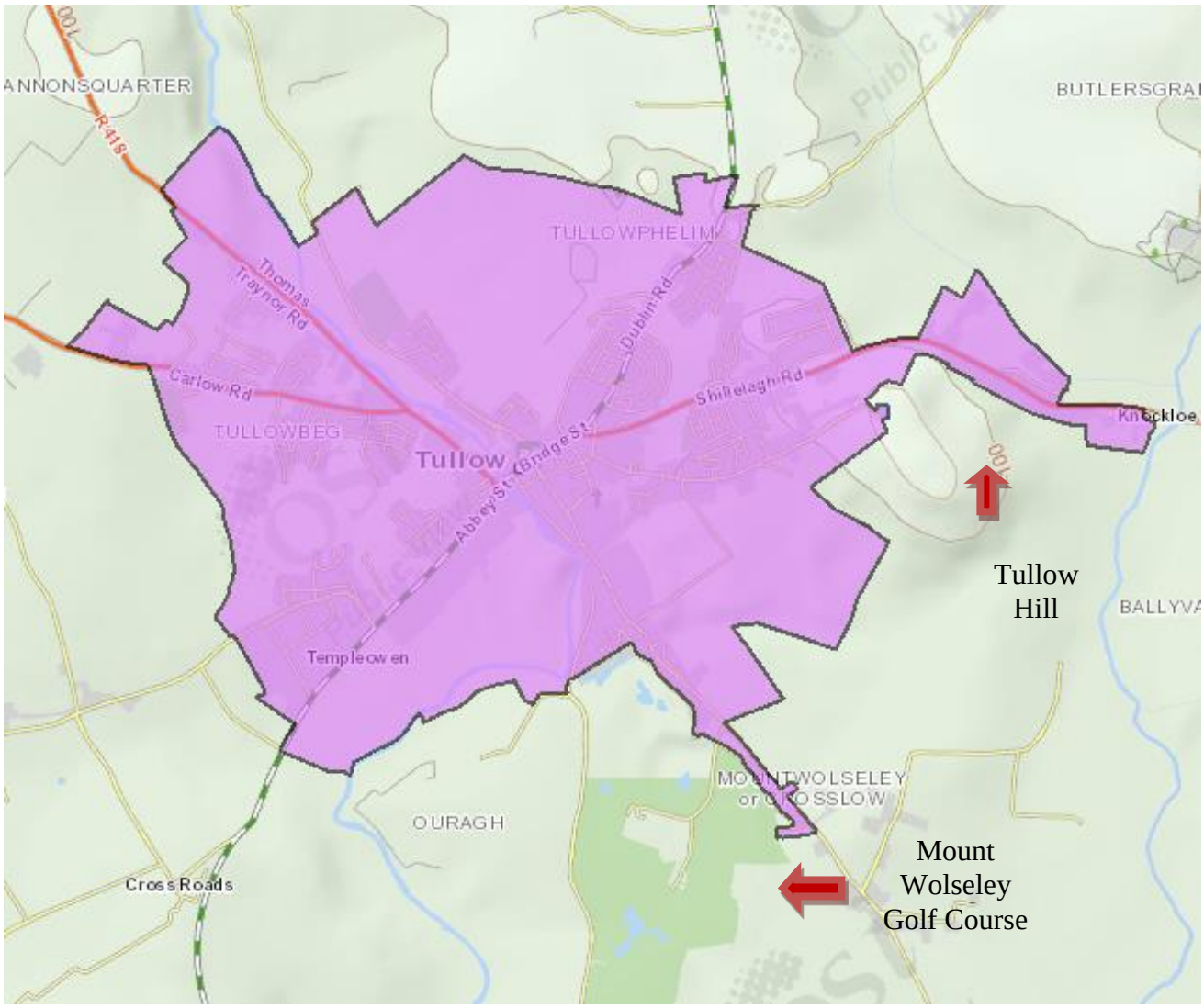

Figure 2. Study site of Tullow town showing the area and boundaries for the field work. The habitat survey was carried out within the area shaded in pink, with the additions of Tullow Hill and Mount Wolseley Golf Course. Source: http://census.cso.ie/sapmap/.

1.5. The River Slaney- a Special Area of Conservation in Tullow

The river Slaney is an SAC (Special Area of Conservation) site that is legally protected under the European Habitats Directive (Council Directive 92/43/EEC). The River Slaney was designated an SAC (site code 000781) for many habitats listed on Annex I of the Habitats Directive, including alluvial wet woodlands, a priority habitat on Annex I of this Directive (NPWS 2014). Other habitats include estuaries, tidal mudflats, floating river vegetation and old oak woodlands. The Slaney SAC comprises all the Slaney system from the headwaters in

Wicklow Mountains to the estuarine area of Wexford harbour. This habitat type is classified as Depositing Lowland River under the Fossitt habitat classification system and has high conservation value as a habitat in Tullow town.

The River Slaney is protected under EU legislation. It has been designated as an SAC (Special Area of Conservation) under the Habitats Directive due to the species and habitat types present.

The SAC is of high importance to many protected species such as freshwater pearl mussel (*Margaritifera margaritifera*), sea lamprey (*Petromyzon marinus*), brook lamprey (*Lampetra planeri*), river lamprey (*Lampetra fluviatilis*), twaite shad (*Alosa fallax*), Atlantic salmon (*Salmo salar*), otter (*Lutra lutra*) and common (harbour) seal (*Phoca vitulina*) (NPWS 2014). A significant population of freshwater pearl mussel (*Margaritifera margaritifera*) occurs on the Derreen River, a tributary running close to Tullow which joins the Slaney approximately 2 km downstream of Tullow town. This species is particularly sensitive to siltation of water, which can be caused by the erosion of river banks. A number of flora and fauna found along the SAC site are listed in the Red Data Book such as the yellow archangel (*Lamiastrum galeobdolon*) and the following mammals: pine martin (*Martes martes*), badger (*Meles meles*), Irish hare (*Lepus timidus hibernicus*) and Daubenton's bat (*Myotis daubentonii*). The common frog (*Rana temporaria*), another red-listed species also occurs along the site (NPWS 2014). These species may not be found in the Slaney in Tullow specifically; however, the impacts upstream will affect species downstream. The SAC is of great ornithological interest, with internationally important populations of species such as mute swan, light-bellied brent geese, bar-tailed godwit and black-tailed godwit. There are a further eighteen species of wintering water fowl such as curlew, lapwing and red shank occurring in numbers of national importance (NPWS 2014).

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2. Methodology and Approach

The various stages for the production of this report are listed and discussed below.

1. Desk study and Consultations
2. Field work and Mapping
3. Compiling Species Lists
4. Report writing and Recommendations

Approach

The Heritage Council Guidelines were referred to for this habitat survey so that methods used were standard and could be replicated by other surveyors. These guidelines include *Best Practice Guidance for Habitat Survey and Mapping* (Smith *et al.*, 2011) and *A Guide to Habitats in Ireland* (Fossitt, 2000). Previous habitat surveys which followed these publications and guidelines were also consulted (see section 2.1). Nomenclature of all plant species names follows the eighth edition of Webb's An Irish Flora (Parnell & Curtis, 2012).

2.1. Desk study and Consultations

Both authors, along with their supervisors Dr. Daniel Kelly and Dr. Tamara Hochstrasser, travelled to Tullow to meet with Cllr William Paton of the Tullow Tidy Towns committee. The project was discussed, boundaries and limitations defined and accommodation organised. Mount Wolseley Golf Resort was contacted and arrangements were made for access to the golf course during the two months of field work. Maps were consulted and obtained from the Map Library in Trinity College. Six inch: 1 mile and twenty five inch: 1 mile maps were used.

The *Best Practice Guidelines for Habitat Survey and Mapping* (Smith *et al.*, 2011), was obtained for use during the entire process of planning, field work, mapping and report writing. *A Guide to Habitats in Ireland* (Fossitt, 2000) was also obtained for consultation in the field. Other appropriate published and unpublished works were consulted, including

Evelyn Booth's *Flora of county Carlow* (1979). Previous habitat survey and biodiversity reports were studied, particularly ones which used the approach of the Heritage Council's Best Practice Guidelines to conduct their survey (in order to ensure that this work is replicable). These include Kilkenny City Habitat Survey Report (Smith *et al.*, 2010), Clonegal Habitat and Biodiversity Report (Hickey, 2013), Laois Habitats Survey (Hickey & Tubridy, 2010) and the Survey and Mapping of Habitats in mid Clare (Kearney, 2010).

2.2. Field work and Mapping

Preparatory work was necessary for the habitat survey such as gathering equipment, permissions for access onto land, preliminary maps etc. Scoping of the task was undertaken during the initial week of the survey by walking around the town up to the 50kph speed signs. Grasslands, woodlands, wetlands and artificial habitat types were noted on preliminary maps. Once the locations of these broad habitat types were known, we then re-visited the sites to assess each of them and identify the habitats to level 3 in Fossitt (2000). This was done by comparing the species lists in Fossitt with the species in each of the sites and comparing management practices etc. GIS (Geographic Information System) was employed to construct the habitat map of Tullow town. Habitat types were mapped as polygons and colour coded following Smith *et al*. (2011) for colour coding and map design.

2.3. Compiling species lists

Two tables are provided to show all the species of vascular plants recorded in Tullow during the seven weeks of the habitat survey period in June/July, 2014; (Appendix 2 and 3). The first table is sorted by plant family, the second by common name. Scientific names are given for all species. Nomenclature follows Parnell and Curtis (2012). Species were identified in the field using Streeter *et al.* (2009) or Parnell and Curtis (2012); if this was not possible, a sample was taken and pressed for later identification. This vascular plant inventory was confined to this 7 week period, and does not claim to be a comprehensive list of species for

Tullow. The Flora of County Carlow was used to ascertain whether new species were recorded for Tullow or even for County Carlow - see Table 2 for a list of all new species recorded.

2.4. Report writing and presentation

This joint report was written following field work. Habitat types identified in Tullow are listed in the Results section, described and visually supported with photographs. Recommendations were an important part of this report and advice was sought from supervisors and other academics.

3. Results

3.1. Habitats

16 habitats types were identified in Tullow. These are listed by Fossitt (2000) habitat code and habitat name in Table 1 below. All habitats listed are housing biodiversity, however, they vary in conservation value. Potential conservation value is an arbitrary judgement based on experience of the authors and dependent on appropriate management of the habitat (low = not usually housing species of high conservation value (note exceptions in habitat descriptions), medium = can house species of conservation value under appropriate management, high = efforts should be made to increase the conservation value of these habitats).

3.2. Habitat Descriptions

Habitat descriptions are based on Fossitt (2000). Notes taken in the field are incorporated into the description of each habitat. Dominant species are listed for each habitat type. The majority of habitat descriptions are accompanied by a photograph of a corresponding site from Tullow, taken by the authors (see Figures 3-18). If any other species were significantly abundant or conspicuous these are mentioned also. The habitat map, another significant component of this report is found in the appendices (Appendix 1.). This is a GIS map illustrating each habitat type found in Tullow town.

Table 1. All 16 habitats types identified in Tullow, based on Fossitt (2000). All habitats listed are housing biodiversity, however, they vary in conservation value (cf. text for explanation). Low = not usually housing species of high conservation value (note exceptions in habitat descriptions), medium = can house species of conservation value under appropriate management, high = efforts should be made to increase the conservation value of these habitats.

Habitat Code	Habitat Name	Potential conservation value
BC1	Arable crops	Low
BC4	Flower beds and borders	Low
BL1	Stone walls and other stonework	High
BL3	Buildings and artificial surfaces	Low (but note exceptions)
ED2	Spoil and bare ground	Low
ED3	Recolonising bare ground	Medium
FL8	Other artificial lakes and ponds	High
FW2	Depositing lowland rivers	High
GA1	Improved agricultural grassland	Low
GA2	Amenity grassland	Low
GS2	Dry meadows and grassy verges	High
WD5	Scattered trees and parkland	Medium
WL1	Hedgerows	High
WL2	Tree lines	High
WN5	Riparian woodland	High
WS1	Scrub	High

1. **BL3- Buildings and Artificial Surfaces**

This category is found under "Cultivated and Built Land". It includes all artificial surfaces constructed with materials such as tarmac, paving stones, bricks, blocks and astroturf. Examples of these surfaces include roads, car parks, pavements, yards, paths, driveways and sports grounds (Figure 3). Buildings, with the exception of derelict stone buildings and ruins (found under BL1 - Stone Walls and Other Stonework) are placed under this Fossitt category. Examples include domestic, community, agricultural and industrial buildings. In Tullow town this category includes shops, business premises, housing estates, local facilities such as the library, the N81 and other roads, car parks and out to agricultural and industrial buildings such as the grain factory south of the Slaney. Any built structures that are not constructed using natural stone should be placed under this category. This would include walls made of bricks, blocks, cement and concrete.

The Tullow Monastery National School is a nesting site for the declining migratory bird species swift (*Apus apus*). Bird Watch Ireland is currently undertaking a swift conservation project to halt the decline of this iconic species.

This habitat type is of little biodiversity value: if excessive artificial surfacing is used, for example in front gardens, it will not only decimate plant life but also exacerbate the risk of flooding (Perry & Nawaz, 2008). However, some buildings do serve as important roosting and nesting sites for many bird and bat species. The Tullow Monastery National School is one example which serves as a nesting site for the migratory swifts (*Apus apus*) that come to breed and raise their offspring over the summer months. Many swifts were observed flying into and out of nests from the eaves of Tullow Monastery National School, which supported a large colony of these birds. (Originally, swifts nested in crevices in cliffs and trees).

3a) 

Figure 3. Buildings and Artificial Surfaces.
a) Market Square on the N81 looking up at statue of Father John Murphy.

3b) 

3c) 

Figure 3b. Road in Tullow close to the 50km/hr speed boundary. **3c)** Red valerian photographed off Mill Street, looking down onto car park opposite library.

However they have adapted to buildings, nesting in crevices, under eaves or in nest boxes. Swifts are very faithful to their old nesting sites so it is imperative that there is minimal disturbance to these old buildings). Some plant species may also survive in small crevices and broken up surfaces (Figures. 3b and 3c).

2. **BC1- Arable Crops**

This category also belongs under 'Cultivated and Built Land' and includes all agricultural land cultivated and managed for the production of arable crops (Fossitt, 2000). These include cereals such wheat, barley, oats and maize and other root, leaf, energy or fibre crops such as potatoes, turnip and rape. BC1 is a common habitat type around Tullow (Figure 4). Traditionally many weed species would occur around arable crops that are now in decline and may find refuge in disturbed urban environments. A mosaic of arable with grassland is good for many bird species, including grey partridge which are currently being bred in Tullow.

At the landscape level, a mosaic of arable crops, grasslands and hedgerows is good for many bird species, including grey partridge.

Figure 4. Arable Crops. Cuanahowan

3. **BC4- Flower Beds and Borders**

Flower beds and borders is the category used for ornamental flower beds (Figure 5). This habitat type is dominated by herbaceous plants and dwarf shrubs (Fossitt, 2000). Part of the Cultivated and Built Land category, this habitat type is highly modified and most species are deliberately planted for decoration and landscaping. A high proportion of the species found in this habitat type are therefore non-native species. These habitats are constantly maintained and managed for aesthetic purposes. This habitat type may support nectar-feeding insects, however often exotic insect-pollinated plants are not as effective for maintaining the native species of insects as our native plants.

Figure 5. Flower Beds and Borders. Mill Street, opposite Tullow Community School.

4. **GA1- Improved agricultural grasslands**

Improved agricultural grasslands are intensively managed and modified habitats (Figure 6). These grassland habitats are regularly fertilised, heavily grazed and/or often used for silage making (Fossitt, 2000). Improved grasslands are significantly different from natural or semi-

natural grasslands. They are poorer in species richness and diversity. Improved agricultural swards are dominated by a few species such as rye-grasses (*Lolium perenne, L. multiflorum* and varieties thereof), Yorkshire fog *(Holcus lanatus),* crested dog's-tail *(Cynosurus cristatus),* Timothy-grass *(Phleum pratense)* and meadow-grass (*Poa spp.)* (Fossitt, 2000). Broad-leaved species or "agricultural herbs" typically include creeping buttercup (*Ranunculus repens),* plantain *(Plantago spp.),* common nettle *(Urtica dioica),* creeping thistle *(Cirisium arvense),* spear thistle *(Cirisium vulgare),* dock (*Rumex spp.*) and dandelion (*Taraxacum spp.*) (ibid). In Tullow, Improved agricultural grasslands are a frequent habitat type towards the town boundary limits. Within the survey boundaries, GA1 is highly concentrated in the Southeast of the town between Tullow hill and Mount Wolseley Golf Resort. The habitat type was generally confirmed from a distance as directly entering the fields was not required.

Figure 6. Improved agricultural grasslands. By road leading up to Tullow Hill.

5. **GA2- Amenity grassland**

Amenity grasslands are non-agricultural grasslands, generally on fertile soil (Figure 7). Amenity grasslands are characterised by swards of low species diversity, highly managed for recreational purposes. Included under this habitat type are garden lawns and public park areas. Management may include regular mowing throughout the year and applications of

fertilisers and herbicides. This maintains a dense, yet very short sward for constant public use. Grasses found in GA2 may include rye-grasses (*Lolium spp.*) (usually not with the same abundance as in GA1 – Improved agricultural grasslands), Yorkshire fog (*Holcus lanatus)* and meadow-grass (*Poa spp*.) (Fossitt, 2000). Broadleaved herbs common in this habitat type include daisy (*Bellis perennis),* dandelion *(Taraxacum spp.),* clover *(Trifolium spp.)* and plantain (*Plantago spp*.) (ibid). In Tullow, GA2 is a very common habitat type present in areas such as Mount Wolseley golf course, public parks along the Slaney, the nature reserve and sports pitches.

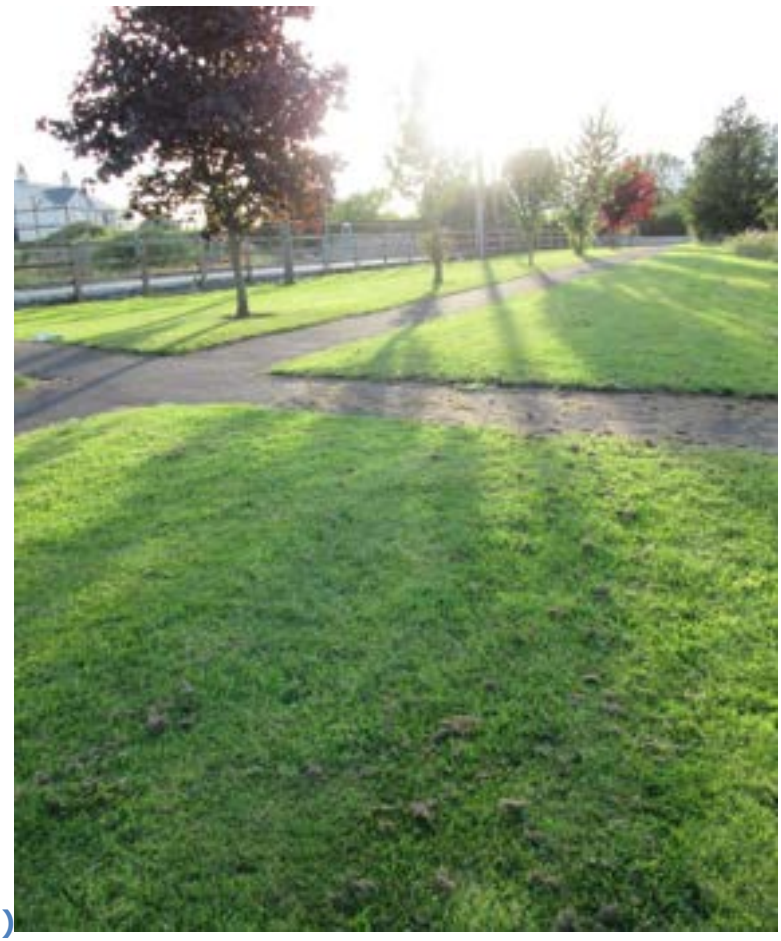
Figure 7. Amenity Grassland. Mount Wolseley Golf Course.

6. **WD5- Scattered Trees and Parkland**

This habitat type is classed within the broader woodland habitat category and incorporates areas that have less than 30% tree cover of the habitat in question. This habitat type is frequently found in amenity grassland areas such as parklands. In Tullow this category is found near the River Slaney, which is a nature reserve (Figure 8a). The use of herbicides

and pesticides in these areas should therefore be particularly tightly managed, and if possible avoided (for information on herbicide use cf. 6. Recommendations). Studies have

8a)



8b)

Figure 8. Scattered trees and parkland.
8a) In the park on the South bank of the River Slaney, on the Castledermot Road. 8b) Computer-generated landscape scenario for a residential neighbourhood in Switzerland, showing alternative management of parkland (less intensive cutting, no herbicide use around trees and planting of shrubs) (from Obrist *et al.*, 2012).

been completed to see how people would react to alternative management of these kinds of urban areas (e.g. Obrist *et al.*, 2012). In Switzerland, it has been found that people often prefer a slightly 'wilder' management regime, which is also beneficial for plant and insect diversity (Figure 8b, Obrist *et al.*, 2012).

7. **ED2- Spoil and bare ground**

This habitat type includes heaps of spoil (Figure 9) and rubble and areas of bare ground resulting from ongoing disturbance (Fossitt, 2000). Spoil and bare ground become quickly re-colonised by early successional plants. Once vegetation cover exceeds 50% the habitat should be classed as Recolonising bare ground (ED3) (Fossitt, 2000), discussed in the next section.

Figure 9. Spoil and bare ground.
Taken on the top of Tullow Hill (see trigonometric point in background; trigpoints were used by the Ordnance Survey for mapping).

8. **ED3- Recolonising bare ground**

This habitat type is used for areas such as abandoned sites, bare or disturbed ground and artificial surfaces like tarmac or concrete where plants have recolonised and vegetation cover exceeds 50% (Figure 10). According to Fossitt (2000), typical species of this category include colt's foot (*Tussilago farfara*), common nettle (*Urtica dioica*), dandelion (*Taraxacum agg.*), willowherb (*Epilobium spp.*), ragwort (*Senecio spp.*), and grasses (however, they generally do not dominate). Because of their heterogeneity these habitats can be particularly rich in biodiversity. However, they will naturally disappear over time, as colonization by more competitive plants continues. In any given town it is good for biodiversity if a steady rotation of these sites around the town could be assured, to give these early successional species a habitat. Spraying such habitats with herbicide is generally undesirable; in most cases the species in this habitat naturally disappear over time (unless there are invasive species present).

Figure 10. Recolonising bare ground. Near Ouragh Road, north of the Slaney.

9. **WS1- Scrub**

This habitat category takes account of areas that are dominated by at least 50% cover of shrubs, stunted trees and brambles (Fossitt, 2000). Trees may have stunted growth of less than 5m due to exposure, poor soils or waterlogging. Scrub land is usually found in inaccessible locations on abandoned or marginal farmland. In Tullow this habitat type was found on Tullow hill at the start of the habitat survey. It consisted of spinose plants such as hawthorn, blackthorn, gorse, and bramble, also broom (Figure 11).

Scrub is a transitional habitat type between grassland and woodland; if the area is not grazed or mown scrub replaces grassland. On Tullow hill, the scrub land has been removed and covered with materials from construction sites - an example of how easily habitats of biodiversity value can be destroyed.

Figure 11. Broom (*Cytisus scoparius*), a native shrub recorded on Tullow Hill. (Photo not taken in Tullow).

10. **WL2- Tree lines**

According to Fossitt (2000), treelines are single rows of trees, greater than 5m high. Tree lines are generally planted and therefore located along field and property boundaries (Figure 12). They have an important function of sheltering against wind, which can enhance crop growth and/or human comfort when walking through the landscape. In Ireland, a large proportion of species in treelines are non-native such as beech, sycamore, conifers and horse chestnuts. Tullow has a number of examples of this habitat type, largely along field boundaries.

Figure 12. Treeline. (Photograph not taken in Tullow).

11. **FL8- Artificial lakes and ponds**

This category comprises artificial, ornamental standing bodies of water found in parks, golf courses, gardens or demesnes (Fossitt 2000). Only the area of open water, with or without aquatic vegetation, is included under this category (Fossitt 2000). In Tullow, examples are located in Mount Wolseley Golf Resort (Figure 13). The course contains six main artificial lakes. Dominant species of this habitat type included branched bur-reed (*Sparganium erectum),* small pondweed (*Potamogeton berchtoldii),* broad-leaved pondweed

(Potamogeton natans) and water-starwort (*Callitriche spp.*) Common duckweed (*Lemna minor)* is also plentiful, with ivy-leaved duckweed (*Lemna trisulca)* only found in the largest of the ponds. Although this habitat type is artificial, many native species are found here. This shows the potential for creating habitats in Tullow. The vegetation survey conducted on the wetlands of Tullow by the first author found that this artificial habitat type was, in fact, richer in plant species than the river Slaney, a natural habitat (Doyle, 2014). Therefore the habitat Artificial lakes and ponds also merits being promoted and conserved. Excess nutrients from the golf course should be prevented from entering the ponds.

Figure 13. Artificial lakes and ponds**.** Mount Wolseley Golf Resort (hotel in background).

12. **WN5- Riparian woodland**

Riparian woodlands include wet woodlands along rivers and low lying islands that are susceptible to frequent flooding. Dominant species of this habitat type include willows (*Salix spp.*), meadowsweet (*Filipendula ulmaria*), hemlock water-dropwort (*Oenathe crocata*), reed canary-grass (*Phalaris arundinacea*) and hedge bindweed (*Calystegia sepium*). In Tullow these typical species are found along the river Slaney (Figure 14). Invasive alien species however - notably Himalayan balsam (*Impatiens glandulifera*) - can also be abundant, as is

the case in the Tullow area, where this plant seems to be spreading. This is discussed in more detail below (Section 6. Recommendations).

Figure 14. Riparian woodland. South side of the River Slaney in the public park.

13. **GS2- Dry meadows and grassy verges**

Dry meadows and grassy verges are classed under Semi-natural grasslands in Fossitt (2000). They are characterised by low intensity management (i.e. minimal mowing with little or no grazing or fertiliser application) and support a higher diversity of species than improved grasslands. Species that used to be more widespread when agricultural grasslands were more extensively managed can be found here. These grasslands offer great potential for restoration, even though the development of a species-rich sward depends on the proximity of populations of desirable species (Klaus, 2013).

Roadside verges and other patches of urban grassland provide a habitat for species of plants and insects that have declined with the increase in the intensity of management of agricultural grasslands (Klaus 2013).

Grass species in this habitat include meadow-grasses (*Poa* spp.), Meadow Foxtail (*Alopecurus pratensis*), fescues (*Festuca* spp.), cock's-foot (*Dactylis glomerata)* and false oat-grass (*Arrhenatherum elatius*) (Fossitt, 2000). Broadleaved herbs range from robust herbaceous plants such as cow parsley (*Anthriscus sylvestris*), hogweed (*Heracleum sphondylium*), nettles (*Urtica dioica*) to low-growing species such as bush vetch (*Vicia sepium*), creeping cinquefoil (*Potentilla reptans*) and clovers (*Trifolium spp.*). Sometimes decorative species such as Common Knapweed (*Centaurea nigra*), Cat's-ear (*Hypochoeris radicata*) and Ox-eye Daisy (*Leucanthemum vulgare*) can appear (Fossitt, 2000).

Figure 15. Dry meadows and grassy verges.
Field off the Rathoe Road – mid way between Gortnahowan and St. Patrick's Park.

In Tullow, this habitat type is found in graveyards and neglected fields (Figure 15). It is also found at the water treatment plant and on road verges. If grasslands and grassy verges are rich in broadleaved herbs, it is best to continue the current management, otherwise broadleaved herbs can be encouraged by removing cuttings from the site (to lower the nutrient content of the soil) and/or changing the cutting regime. A comparison of extensively

managed grassland with hedgerows in Tullow found that they currently are not harbouring as many broadleaved species that are important for pollinators as the hedgerows do (Corrigan, 2014). This may be because the extensive management of these grasslands has not gone on for long enough or because there is a lack of seed dispersal of broadleaved species to these grasslands (Klaus, 2013).

14. **BL1- Stone walls and other stonework**

This category includes stone walls and other stone structures such as stone bridges and ruins. Stone walls can harbour many species often found nowhere else in the area. Stone walls differ in terms of age, physical structure and geological make-up. Older walls with little to no maintenance or management are often very floristically diverse with an abundance of lichens, mosses and ferns. Walls are extensive, ubiquitous urban ecosystems that act as a habitat supporting mixed assemblages of species (Francis, 2010).

Figure 16. Stone walls and other stonework at Templeowen.

Tullow has many stone walls throughout the town (e.g. Figure 16). Some species found in this category included Ivy-leaved toad flax (*Cymbalaria muralis*), fern grass (*Catapodium rigidum*), common polypody (*Polypodium vulgare*), navelwort (*Umbilicus rupestris*), maidenhair spleenwort (*Asplenium trichomanes*), wall-rue (*Asplenium ruta-muraria*), white stonecrop (*Sedum album*), pellitory-of-the-wall (*Parietaria judaica*) (Figure 25) and field scabious (*Knautia arvensis*) (Fossitt, 2000). Stone walls should not be sprayed with herbicides as they contain unique and sometimes specialized plant life that can be encouraged with appropriate management (Francis, 2010). This will be discussed further in section 6 Recommendations.

15. **FW2- Depositing lowland rivers**

This watercourse habitat reflects a river which deposits fine sediment on the river bed, in particular along the bends of meanders. Deposition conditions are typical of areas with low gradient and where water flow is slow. Naturally, such rivers meander along their floodplain; however, many rivers which run through urban areas have been modified and walled to control and concentrate the river flow through the town, village etc.

In Tullow, the river Slaney (Figure 17) runs from north to south and has been canalised in the urban zone of the town around the bridge for the mill race. The most dominant aquatic species found in the Slaney include branched-bur reed (*Sparganium erectum),* stream water-crowfoot *(Ranunculus penicillatus),* and broad-leaved pondweed *(Potamogeton natans).* On the bank, dominant species included the invasive Himalayan balsam (*Impatiens glandulifera*), common nettle (*Urtica dioica)* and creeping buttercup (*Ranunculus repens)* and grass species, in particular reed canary-grass (*Phalaris arundinacea)*.

Figure 17. Depositing lowland rivers.
Taken on the north side of the river off the end of Mill Street before the Graveyard ("The Mullawn").

16. **WL1- Hedgerows**

Hedgerows are linear woodland habitat types consisting of shrubs and occasional trees (Figure 18). According to Fossitt (2000), they are defined as being under 5m high and under 4m wide. Various environmental factors influence the species of hedgerows, such as drainage, geology, soil type, management and age. Typical plants of hedgerows include spinose plants such as hawthorn, blackthorn, holly, brambles and gorse. Climbing plants are also frequently found in hedgerows. These species include goosegrass (*Galium aparine*) (or "cleavers"), hedge bindweed (*Calystegia sepium*) and ivy (*Hedera helix*). Other trees and shrubs include ash (*Fraxinus excelsior*), hazel (*Corylus avellana*), beech and willow species.

Figure 18. Hedgerows. Source: www.ecolandscapes.ie.

Hedgerows in Tullow were located most commonly as boundaries around fields or properties. They are a very important habitat for many animals, particularly nesting birds during the summer. For this reason, it is illegal to cut hedges during March to August under section 46 of the Wildlife (Amendment) Act, 2000. In urban areas, hedgerows are often remnants of semi-natural vegetation and as such significantly contribute to biodiversity (Kowarik, 2011). When developing land, it should be a priority to conserve these kinds of islands of biodiversity that were found to be rich in broad-leaved species important for pollinators in Tullow (Corrigan, 2014).

4. Evaluation of Tullow's Biodiversity

4.1 Habitat evaluation

Tullow town has 16 habitat types within the town boundaries that were classified based on the experience of the authors according to the general conservation value (Table 1). This shows that there is a wide range of habitats for such a small area in Tullow. A wide variety of habitats has the potential to host a wide range of plant and animal diversity with the appropriate management.

4.1.1. Highly modified habitats

Habitats which are intensively managed tend to have little conservation value and are low in biodiversity such as amenity grassland, arable crops, and artificial surfaces such as buildings (Table 1). However these can always be enhanced for our native flora and fauna. Wild patches can be left at the edges of cropland for wild flowers and pollinating insects. Old buildings which may hold nest sites for summer migrant species such as swifts and swallows can be renovated at an appropriate time causing minimal impact to the sites which these birds are highly loyal to. New buildings can be fitted with nest boxes to facilitate these important birds.

4.1.2. Habitats of high conservation value in Tullow

Habitats of significant conservation value in Tullow include: the river Slaney, lakes and ponds in Mount Wolseley Golf Course, old stone wall and stone works and the various dry meadows and grassy verges around the town which have been left wild with little maintenance.

4.2. Species evaluation

Booth's (1979) *Flora of Co. Carlow* was used to create a list of species found in botanical district 3 ("North Carlow Plain"), which includes Tullow, Hacketstown and Rathvilly. She listed 489 species for this district as a whole. Of the species recorded during this habitat survey of Tullow town, 161 species were already recorded for the district as a whole by Booth (1979) (see Appendices 2 and 3 for list of species).

The new species recorded included Branched bur-reed (*Sparganium erectum*), which is very common in Tullow in the two wetland habitats (FL8 and FW2). It is found growing in thick stands along the river Slaney and in particular the lakes in Mount Wolseley (Figure 19).

Figure 19. Branched bur-reed (*Sparganium erectum*) in ponds in Mount Wolseley Golf Course

Woodruff (*Galium odoratum*) was also found, however it was found near a garden and is most likely a garden escape. The alien species, Butterfly-bush (*Buddleja davidii*) is another new species for Tullow, it is found in derelict sites growing from walls and the wooden footbridge leading to the skate park. It has not become a problem yet, but it is potentially invasive. Another species new to Tullow is Lemon balm (*Melissa officinalis*) (Figure 20), an

alien species which spreads both by seed and vegetatively. It was recorded only on the bank of the Slaney, near the footbridge. Two species were new records for county Carlow (Table 2). These are both introduced species: cherry laurel **(***Prunus laurocerasus*) and American willowherb (*Epilobium ciliatum*).

Figure 20. Lemon balm (*Melissa officinalis*)
growing on bank of the River Slaney near the footbridge.

4.2.1. Invasive Species in Tullow

The flora of Tullow includes a small number of invasive non-native species. The control of invasive species is discussed in section 6.2.

Japanese knotweed (*Fallopia japonica*) was introduced as a garden plant in the nineteenth century and is now established and common throughout the British Isles. It is a tall, erect, thicket forming perennial and can reach up to 2 m high (Streeter *et al.*, 2009). It can be found along roadsides, buildings, walls, and riverbanks and on waste ground.

In Tullow, Japanese knotweed is not yet a major threat and is not found in great density or numbers; however ***it should be removed urgently to prevent this***.

Table 2. New species recorded for Tullow district and for Co. Carlow (i.e. additions to the records in Booth 1979)

	Common name	Scientific name	New record for:
1	American willowherb	*Epilobium ciliatum*	Co. Carlow
2	Cherry laurel	*Prunus laurocerasus*	Co. Carlow
3	Biting stonecrop	*Sedum acre*	Tullow
4	Bittersweet	*Solanum dulcamara*	Tullow
5	Branched bur-reed	*Sparganium erectum*	Tullow
6	Butterfly-bush	*Buddleja davidii*	Tullow
7	Ivy-leaved duckweed	*Lemna trisulca*	Tullow
8	Lemon balm	*Melissa officinalis*	Tullow
9	Pendulous sedge	*Carex pendula*	Tullow
10	Rosebay willowherb	*Chamerion angustifolium*	Tullow
11	Shining crane's-bill	*Geranium lucidum*	Tullow
12	Small pondweed	*Potamogeton berchtoldii*	Tullow
13	Spiked water-milfoil	*Myriophyllum spicatum*	Tullow
14	Woodruff	*Galium odoratum*	Tullow
15	Yellow water-lily	*Nuphar lutea*	Tullow

Figure 21. Japanese knotweed (*Fallopia japonica*).
By the steps at the bridge on the north side of the Slaney, next to the museum.

The only record of Japanese knotweed in Tullow town is north of the River Slaney growing out of the pavement beside the museum (Figure 21).

Himalayan balsam or Indian balsam, (*Impatiens glandulifera*) is a tall, erect annual with large, conspicuous pink or white flowers (Figure 22). It was introduced to Ireland at the end of the 19th century as a garden plant. Since then it has spread rapidly throughout the island. It seeds freely. At maturity, the seeds are shot out from the explosive capsules; they may be carried further by water. The plant grows remarkably tall for an annual plant - taller, in fact, than any annual species native to Ireland. It therefore shades out nearby plants, denying them sunlight.

a)  **b)** 

Figure 22. Himalayan balsam (*Impatiens glandulifera*).
a) large stand south of the River Slaney, opposite the Supervalue carpark.
b) close up of the plant south of River Slaney east of wooden bridge.

Cherry laurel (*Prunus laurocerasus*) is a glossy-leaved evergreen shrub which can grow up to 10m tall (Figure 23). First introduced in Ireland in about the 18th century, it has been widely planted in woodland habitats and spreads by layering. It grows to form dense, evergreen thickets that completely shade out all other plants. The plant is also highly toxic: its leaves release hydrogen cyanide when damaged. The poisonous nature of the plant means that grazing animals avoid it, giving cherry laurel a competitive advantage over many other plants.

Figure 23. Cherry laurel (*Prunus laurocerasus*)
(Photo not taken in Tullow).

In Tullow, cherry laurel is found on the artificial islands in the river Slaney. Although it does not yet pose a major threat to biodiversity there, it should still be removed to avoid future problems (and to promote native biodiversity). Cherry laurel was not recorded for county Carlow by Booth (1979) – presumably because it was not considered to be sufficiently well naturalized in the county.

5. Additional biodiversity

5.1. Bird Survey

Animals were outside the scope of this report. However, a two-hour bird survey was conducted during the field work period from 7-9am on the 8th July 2014. The methods follow survey protocols from Bird Watch Ireland. The results of the survey are not analysed here, but a list of the bird species seen and heard is presented in Appendix 4). There is clearly potential for research on the bird species of Tullow in the future.

5.2. Mammals: a note

Irish Hare (Figure 24) were seen at the base of Tullow hill. Around 8 individuals were observed, also on the 8th July 2014.

Figure 24. Irish hare
(Photo sourced from Conserve Ireland).

6. Recommendations

6.1. Management of Existing Habitats

The 16 habitat types found in Tullow in this habitat survey should be managed, enhanced, promoted and conserved where possible. This conservation management should follow best practice guidelines.

Hedgerows provide an important source of biodiversity in Ireland in terms of plants, birds and insects, such as butterflies (Baudry *et al.* 2000; Hinsley & Bellamy 2000; Dover & Sparks 2000). They provide shelter and nesting sites for birds and insects alike. The plants in the hedgerows, like bramble and ivy, can provide food sources for birds and mammals. They play an important role in linking up different habitats by acting as "corridors" through which insects and mammals can move. Tullow has a number of separate treelines, old hedgerows and woodland areas, which could potentially be linked up by new hedgerows. Hawthorn and blackthorn are commonly planted in new hedges as these plants make for good barriers between fields (Hedgelink 2015). But other native shrubs and trees can be considered to plant in the hedge – the greater the variety of woody plants, the more diverse the wildlife will likely be (Hedgelink 2015). After a while, other plant species will colonise the new hedgerow if left alone (Doogue & Kelly 2006). Whenever planting native species, the plants should be locally sourced in order to maintain the genetic make-up of native plants that is characteristic of the locality.

Correct management of hedgerows contributes to their value as a habitat for wildlife. People commonly cut back their hedgerows annually, but if they can be left, it is healthier for the hedges and more cost effective to cut them every two or three years (Hedgelink 2015). This way flowers and fruits can develop and provide food for wildlife. It is illegal to cut hedgerows from the 1st of March to the 31st of August in Ireland under section 46 of the Wildlife (Amendment) Act, 2000. This is to prevent birds' nests being damaged and other

young animals being disturbed. Hedges are often cut back using strimmers to give a neat appearance. While this clean cutting can maintain a dense hedge, it does not maximize the wildlife benefit of the hedge. More infrequent cutting with a flail head is therefore now recommended, even though this management method is rather unsightly as it breaks the stems of the hedge, but the hedge recovers readily from this cutting (Hedgelink 2015).

Riparian woodlands include wet woodlands along rivers and on low lying islands that are susceptible to frequent flooding. In Tullow, this is limited to various areas along the river Slaney and on the small artificial islands located where the mill used to be. The main species found along these areas are willow, reed canary grass, hedge bindweed and hemlock water-dropwort. Invasive species such as Himalayan balsam are found in great abundance here and can be considered a threat to the local ecosystem, thus should be removed (cf. Section 6.2. Invasive Species Control).

There is an array of benefits to a river from maintaining healthy riparian woodlands (Broadmeadow & Nisbet 2004; Little *et al.* 2008). Riparian forests can prevent excess nutrients from entering the river, can prevent river bank erosion and provide habitat for many species. Furthermore, if the canopy is allowing just the right amount of light onto the river, they can promote wildlife in the stream by regulating the temperature of the water (Broadmeadow & Nisbet 2004). Trees provide leaf litter and invertebrates to the stream, which provides food for the organisms found within the stream (Little *et al.* 2008). Riparian areas can also act as reservoirs for water, thus preventing flood events downstream during large bursts of precipitation. Such ecosystem benefits are important to maintain the conservation value of the designated river Slaney that runs through Tullow. It is therefore recommended to protect and possibly enhance the Riparian Forest along the river. National guidance on how to restore Riparian Forest was provided by Little *et al.* (2008).

The Old Stone Walls and Stone Work of Tullow town harbour many different species such as ferns, stonecrop, pellitory-of-the-wall (Figure 25), field scabious and fern grass which were only found on these structures and in no other habitat types. The species found on old stone walls around Tullow increase the diversity of plants in the town and should not be managed intensively. Walls should not be sprayed with herbicide.

Figure 25. Pellitory-of-the-wall (*Parietaria judaica*)

6.2. Invasive Species Control

Due to features such high competitive ability and efficient seed dispersal, invasive species can spread quickly and reduce the number of native species. They should be controlled and where possible removed. Removal of the three major invasive species recorded is of high importance. The task could be used to increase awareness of biodiversity in Tullow, through actively involving local residents in organised removal projects. Groups such as Conservation Volunteers may be consulted about the best methods to use. In addition, guidance on invasive species and their control can be found at the following website provided by the

National Parks and Wildlife Service and the Northern Ireland Environmental Protection Agency: http://invasivespeciesireland.com/toolkit/. The National Roads Authority also has published useful guidance on managing noxious weeds and invasive species along roadsides: http://www.nra.ie/environment/environmental-construction-guidelines/.

Japanese knotweed grows in dense thickets that can suppress native flora and block paths created by small animals by growing too densely for them to traverse. Japanese knotweed has more direct economic impacts than the other two invasive species in Tullow; its roots are able to burrow through tough materials and the plant is even known to grow through concrete and tarmac (ISI 2015). When established on riverbanks it can weaken flood defences, like the ones located on the riverbanks in Tullow. It also can grow densely enough to block small water channels (ISI 2015).

This plant should not be removed by lay people as it is very tenacious and regrows very easily from small remnants (ISI 2015). ***Plants that are pulled or dug up and dumped elsewhere very commonly colonise the area they are dumped in.*** There is a strong possibility of someone removing the plant but disposing of it incorrectly, thus unwittingly exacerbating the problem by promoting its spread. It is recommended to hire specialists to remove the plant using physical and chemical methods that will ensure it is not spread and does not re-grow. Ireland does have specialists in Japanese knotweed removal, e.g. the O'Donovan Agri Group: The sooner this plant is removed the less chance there is of its becoming a serious problem in the town.

Himalayan balsam is found along rivers, ditches and wet woodlands. Once established it spreads fast forming dense stands. As it continues to spread and grow, surrounding plant biodiversity is greatly reduced (ISI 2015). Tullow has large, dense stands of this invasive plant along the river Slaney. This overshadows other riparian vegetation along the bank, completely outcompeting smaller, native wetland species. Dominance by this species can

lead to bank erosion. ***It is highly recommended to remove this species where it is found.***

The recommended method for removal of this plant is by manual means (ISI 2015). Himalayan balsam can be cut with a scythe or dug up using a trowel or similar implement. The plant has to be removed from the lowest node to prevent resprouting. It is essential to establish native vegetation quickly after control to prevent river bank erosion. This is also why e.g. treatment with herbicides is not the most effective as it will kill other plant species as well and thus slow down recolonization of the area after treatment. It may be useful to organise community effort events to sweep through Tullow and remove the plant and to clear some distance upstream as well. With repeated efforts (because this species is a prolific seed producer), the balsam should disappear after a few years (ISI 2015). There are parts of Tullow with only a small gap separating the river banks from local properties that have an overabundance of Himalayan balsam, so in some locations it may be necessary to expand the control to private gardens and replace it with native species in order to avoid re-infestation.

Cherry laurel forms dense thickets in the understory of woodlands, and suppresses the native flora. It was recorded in Tullow in small quantity on the islands in the Slaney. These shrubs should be removed, and care must be taken to ensure that they don't grow back. The plant must be dug up where possible. If the plant has rooted too deeply then it should be heavily pruned back. Once a sufficient quantity has been removed, a small amount of herbicide should be applied to where the cuts for pruning were made, or where the remaining roots are. The herbicide may cause some damage to nearby native plants, but this is preferable to the alternative of allowing the cherry laurel to continue growing. The remnants should be burnt or disposed of in a safe manner as cut cherry laurel branches still have the potential to grow roots and colonise fresh areas. It should also be noted that cuttings from this plant are poisonous.

6.3 Pesticide and herbicide use

Pesticide and herbicide use are often needed in management of public greenspaces and agricultural land. However, when using such products it should be kept in mind that the substance used are toxic to some forms of life and thus can have negative effects on biodiversity. The Irish EPA has published guidelines on pesticide/herbicide use and the protection of drinking water at: http://www.epa.ie/water/dw/sourceprotection/#.VaJgRWZVgXu. Similar guidelines were also published by the UK government and are accessible here: http://www.pesticides.gov.uk/guidance/industries/pesticides/user-areas/amenity-users-home. According to the European Communities (Sustainable Use of Pesticides) Regulations 2012, which come into effect on 26 November 2015, personnel using herbicides and pesticides needs to be trained and registered http://www.irishstatutebook.ie/2012/en/si/0155.html. For more information about the Sustainable Use of Pesticide Regulations see also http://www.teagasc.ie/crops/sustainable_use_directive/.

6.4. Promoting Tullow's Biodiversity

Local authorities have been actively considering the local biodiversity in their local area and development plans. Since the new category of *Wildlife and Natural Amenities* was introduced, many habitat surveys have been undertaken and biodiversity plans created for urban areas around Ireland. Tullow's biodiversity could be promoted through community engagement and involvement. Professional planners, landscape architects, voluntary groups and particularly the local inhabitants of Tullow should work together in conserving and managing the habitats and biodiversity of the town (Emery 1986).

Mount Wolseley Golf course in particular, from the vegetation survey, was shown to support important wetland floristic biodiversity, with major differences in species composition from the flora of the river Slaney. This biodiversity should be promoted within the resort and conserved. The present vegetation survey focused on species of vascular plants; however, it was noted that green filamentous algal cover in many of the lakes was very high. The algal cover at the time of sampling was dominated by the genus *Cladophora;* the genus *Spirogyra* was also present (N. Allott, pers. comm.). The high density of green filamentous algae appears to indicate, in this case, high levels of phosphate fertiliser being applied to the grass, at close proximity to the water's edge. One lake in particular had a dense mat across most of the lake surface. This algal "bloom" has the potential to unbalance the ecology of the lake. Plant diversity and species richness was found to be lower in this lake, which could be due to the effects of the high density of filamentous green algae. It is recommended that phosphate application should be limited, and should not be applied within a certain distance away from the water's edge.

6.5. Tullow Hill

During the period of field work it was found that large-scale dumping and removal of hedgerows was occurring on the top of Tullow Hill, a site which had a unique flora compared to other habitat types of Tullow. The top of Tullow hill was classified as Spoil and Bare ground (ED2) for the habitat survey; prior to this dumping it would have been classed as Scrub habitat (WS1). Species recorded on the hill included spinose plants such as Gorse, Hawthorn and Blackthorn. Species found mainly or exclusively on Tullow hill included Sheep's bit (*Jasione montana*), Navelwort (*Umbilicus rupestris*) and Broom (*Cytisus scoparius*) (Figure 11) – a suite of species characteristic of acidic soils.

6.6 Further Research

This habitat survey should only be seen as a baseline study upon which knowledge can be built. An important and effective way to analyse and monitor any changes which Tullow undergoes is to carry out subsequent habitat surveys in the future. Habitat surveys conducted every five years are likely to be appropriate intervals for monitoring changes in habitats. Tullow as a town produces development strategies and plans on how the town is to develop over the next decade. Carrying out a survey every five years would allow progress to be monitored in tandem with the drafting and implementation of these plans.

Secondly, wildlife surveys are a good way to monitor species of animals which depend on the habitats of Tullow. These surveys provide more detailed information on animals living in the area, particularly if there are protected species, rare or endangered species. This information obtained can complement the habitat study and allow Tullow to factor in conservation more effectively into its development as a town. These studies can also be used to monitor the health of the river Slaney. As it is an SAC, it is awarded certain protection by the EU. Under other EU legislation, according to the WFD (Water Framework Directive), the quality of water in the river should not be allowed to deteriorate - this could result in fines. Monitoring the water independently and regularly can help the town take note of any significant changes, identify potential threats to the river, and make appropriate responses.

7. References

Baudry, J., R. G. H. Bunce, & Burel, F. (2000). Hedgerows: An international perspective on their origin, function and management. *Journal of Environmental Management* 60:7-22.

Booth, E. M. (1979). *The flora of county Carlow.* Dublin: Royal Dublin Society.

Broadmeadow, S., & Nisbet, T. R. (2004). The effects of riparian forest management on the freshwater environment: a literature review of best management practice. *Hydrology and Earth System Sciences Discussions* 8:286-305.

Corrigan, R. (2014). *Foraging value of semi-natural woodlands and grasslands for pollinating insects.* MSc thesis. MSc in Applied Environmental Science. University College Dublin.

Costanza, R., R. D'Arge, R. De Groot, S. Farber, M. Grasso, B. Hannon, K. Limburg, S. Naeem, R. V. O'Neill, J. Paruelo, R. G. Raskin, P. Sutton, & Van Den Belt, M. (1997). The value of the world's ecosystem services and natural capital. *Nature* 387:253-260.

Doogue, D. & Kelly, D. L. (2006). Woody plant assemblages in the hedges of eastern Ireland: products of history of ecology? *Biology & Environment: Proceeding of the Royal Irish Academy* 106B:355-370.

Dover, J., & Sparks, T. (2000). A review of the ecology of butterflies in British hedgerows. *Journal of Environmental Management* 60:51-63.

Doyle, H. (2014). *Wetland floristic biodiversity within Tullow town, County Carlow – a vegetation survey*. MSc thesis. MSc in Biodiversity and Conservation. Trinity College, the University of Dublin.

Emery, M. (1986). *Promoting nature in cities and towns, a practical guide*. Ecological Parks Trust/Croom Helm, London.

Fossitt, J. (2000). *A guide to habitats in Ireland*. The Heritage Council.

Francis, R. A. (2010). Wall ecology: A frontier for urban biodiversity and ecological engineering. *Progress in Physical Geography* 35:43-63.

Godefroid, S., & Koedam, N. (2003). Distribution pattern of the flora in a peri-urban forest: an effect of the city–forest ecotone. *Landscape and Urban Planning* 65: 169-185.

Hedgelink (2015). *Hedgerow management*. http://hedgelink.org.uk/ (Accessed: 10 August 2015).

Hickey, B. (2013). *Clonegal Habitat and Biodiversity Report*. Clonegal Tidy Village Association and Carlow County Council, Clonegal Kildavin Community Website.

Hickey, B., & Tubridy, M. (2010). *Laois Habitats Survey 2010*. Heritage Council.

Hinsley, S. A., & Bellamy, P. E. (2000). The influence of hedge structure, management and landscape context on the value of hedgerows to birds: A review. *Journal of Environmental Management* 60:33-49.

ISI (2015). *Invasive Species Ireland. Most unwanted*. Department of Arts, Heritage and the Gaeltacht and Northern Ireland Environment Agency. http://invasivespeciesireland.com/ (Accessed 10 August 2015).

Kearney, P. (2010). *Survey and mapping of habitats in mid Clare*. Survey findings report. Clare County Council. Galway.

Klaus, V. H. (2013). Urban grassland restoration: A neglected opportunity for biodiversity conservation. *Restoration Ecology* 21:665-669.

Kowarik, I. (2011). Novel urban ecosystems, biodiversity, and conservation. *Environmental Pollution* 159: 1974-1983.

Lee, A. C., & Maheswaran, R. (2011). The health benefits of urban green spaces: a review of the evidence. *Journal of Public Health* 33:212-222.

Little, D., K. Collins, J. Cross, D. Cooke, & McGinnity P. (2008). *Native riparian woodlands – a guide to identification, design, establishment and management*. Native Woodland Scheme Information Note No. 4. Woodlands of Ireland, Dublin.

Millennium Ecosystem Assessment (2005). *Ecosystems and human well-being: Synthesis*. Island Press, Washington, DC.

NPWS (2014). *Site synopsis. Slaney River Valley SAC*. Version of 10.02.2014. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht. Available at: http://www.npws.ie/protected-sites.

Obrist, M. K., T. Sattler, R. Home, S. Gloor, F. Bontadina, M. Nobis, S. Braaker, P. Duelli, N. Bauer, P. D. Bruna, M. Hunziker, & Moretti, M. (2012). *Biodiversität in der Stadt – für*

Mensch und Natur (in German). Merkblatt für die Praxis 48. ISSN 1422-2876, WSL Birmensdorf, Birmensdorf, Switzerland. http://www.wsl.ch/publikationen

Parnell, J. A., T. Curtis, & Cullen, E. (2012). *Webb's an Irish flora*. Cork University Press.

Perry, T., & Nawaz, R. (2008). An investigation into the extent and impacts of hard surfacing of domestic gardens in an area of Leeds, United Kingdom. *Landscape and Urban Planning* 86:1-13.

Phillips, M., & Wilson, S. (1995). *A guide to conducting a local habitat survey*. Sussex Wildlife Trust, Henfield

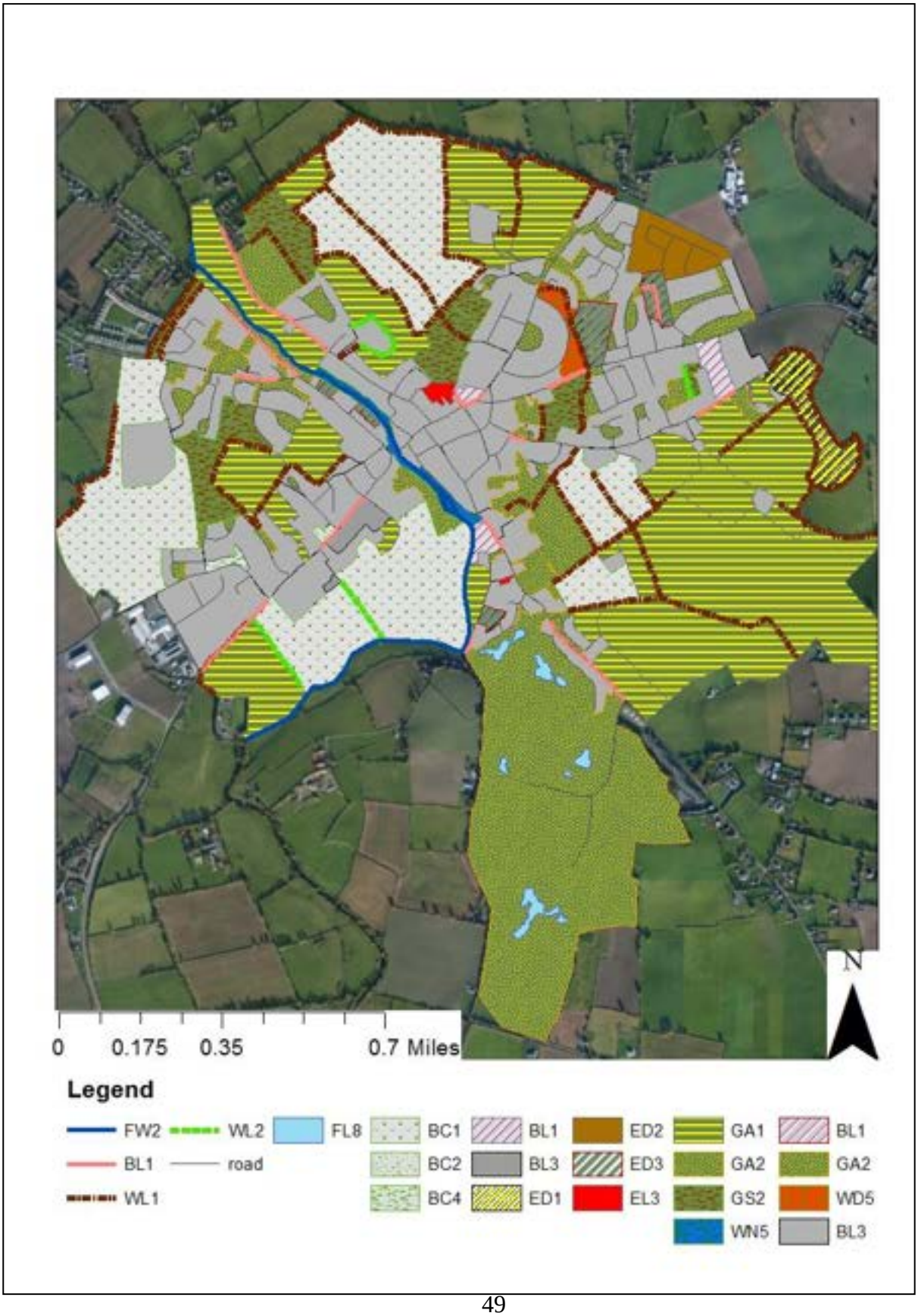
Smith F.G., P.O. Donoghue, K. O'Hora, & Delaney E. (2011*). Best practice guidelines for habitat survey and mapping*. The Heritage Council.

Smith, G.F., E. Delaney, K. O'Hora, & O'Donoghue, P. (2010). *Habitat Survey and Mapping of Kilkenny City: Habitat Survey Report*. Report prepared for the Councils of the City and County of Kilkenny. Atkins, Dublin.

Streeter, D., Hart-Davies, C., Hardcastle, A., Cole, F., & Harper, L. (2009).*Collins flower guide*. London: Collins.

Appendices

Appendix 1. Habitat Map of Tullow Town



Appendix 2. Plant species List sorted by Family Name

Family	**Common Name**	***Scientific Name***
Apiaceae	Water dropwort	*Oenanthe crocata*
	Hogweed	*Heracleum sphondylium*
	Cow parsley	*Anthriscus sylvestris*
	Fool's water-cress	*Apium nodiflorum*
Aquifoliaceae	Holly	*Ilex aquifolium*
Araliaceae	Ivy	*Hedera helix*
Aspleniaceae	Hart's tongue	*Phyllitis scolopendrium*
	Maidenhair spleenwort	*Asplenium trichomanes*
	Wall rue	*Asplenium ruta-muraria*
	Rusty back	*Ceterach officinarium*
Asteraceae	Welted thistle	*Carduus crispus*
	Spear thistle	*Cirisium vulgare*
	Creeping thistle	*Cirisium arvense*
	Common knapweed	*Centaurea nigra*
	Nipplewort	*Lapsana communis*
	Cat's ear	*Hypochaeris radicata*
	Lesser hawksbit	*Leontodon taraxacoides*
	Perennial sow-thistle	*Sonchus arvensis*
	Prickly sow-thistle	*Sonchus asper*
	Smooth sow-thistle	*Sonchus oleraceus*
	Dandelion	*Taraxacum sp.*
	Cudweed	*Gnaphalium sp.*
	Daisy	*Bellis perennis*
	Feverfew	*Tanacetum parthenium*
	Yarrow	*Achillea millefolium*
	Corn marigold	*Chrysanthemum segetum*
	Scentless mayweed	*Tripleurospermum inodorum*
Asteraceae	Pineapple-weed	*Matricaria discoidea*
	Common ragwort	*Senecio jacobaea*
	Colt's foot	*Tussilago farfara*
	Butterbur	*Petasites hybridus*
Balsaminaceae	Himalayan balsam	*Impatiens glandulifera*
Boraginaceae	Common comfrey	*Symphytum officinale*
	Forget-me-not	*Myosotis arvensis*
Brassicaceae	Garlic mustard	*Alliaria petiolata*
	Water-cress	*Rorippanasturtium-aquaticum*
	Hedge mustard	*Sisymbrium officinale*
	Lady's smock	*Cardamine pratensis*
	Shepherd's purse	*Capsella bursa-pastoris*

Family	**Common Name**	***Scientific Name***
Brassicaceae (cont.)	Wild turnip	*Brassica rapa*
Buddlejaceae	Butterfly-bush	*Buddleja davidii*
Callitrichaceae	Water-starwort sp. 1	*Callitriche sp.*
	Water-starwort sp. 2	*Callitriche sp.*
Campanulaceae	Sheep's-bit	*Jasione montana*
Caprifoliaceae	Elder	*Sambucus nigra*
	Guelder rose	*Viburnum opulus*
	Snowberry	*Symphoricarpus albus*
	Honeysuckle	*Lonicera periclymenum*
Caryophyllaceae	Greater stitchwort	*Stellaria holostea*
	Lesser stitchwort	*Stellaria palustris*
	Common mouse ear	*Cerastium fontanum*
	Pearlwort sp.	*Sagina sp.*
	Campion sp.	*Silene sp.*
Chenopodiaceae	Orache	*Atriplex sp.*
	Goosefoot	*Chenopodium sp.*
Convolvulaceae	Hedge bindweed	*Calystegia sepium*
Convolvulaceae	Large bindweed	*Calystegia silvatica*
Crassulaceae	Navelwort	*Umbilicus rupestris*
	White stonecrop	*Sedum album*
	Biting stonecrop	*Sedum acre*
Cyperaceae	Oval sedge	*Carex leporina*
	Hairy sedge	*Carex hirta*
	Pendulous sedge	*Carex pendula*
	Remote sedge	*Carex remota*
Dipsacaceae	Field scabious	*Knautia arvensis*
Euphorbiaceae	Sun spurge	*Euphorbia helioscopia*
	Petty spurge	*Euphorbia peplus*
	Cut-leaved crane's-bill	*Geranium dissectum*
	Herb robert	*Geranium robertiana*
	Shining crane's-bill	*Geranium lucidum*
	Hedgerow crane's bill	*Geranium pyrenaicum*
Equisetaceae	Field horsetail	*Equisetum arvensis*
Fabaceae	Bird's-foot trefoil	*Lotus corniculatus*
	Bush vetch	*Vicia sepium*
	Tufted vetch	*Vicia cracca*
	Meadow vetchling	*Lathyrus pratensis*
	Black medick	*Medicago lupulina*
	White clover	*Trifolium repens*
	Lesser trefoil	*Trifolium dubium*

Family	**Common Name**	***Scientific Name***
	Red clover	*Trifolium pratense*
	Gorse	*Ulex europaeus*
	Broom	*Cytisus scoparius*
	Spiked water-milfoil	*Myriophyllum spicatum*
Fumariaceae	Common fumitory	*Fumaria officinalis*
Gentianaceae	Common centaury	*Centaurium erythraea*
Hydrocharitaceae	Canadian pondweed	*Elodea canadensis*
Iridaceae	Yellow iris	*Iris pseudacorus*
Juncaceae	Toad rush	*Juncus bufonius*
	Soft rush	*Juncus effusus*
	Hard rush	*Juncus inflexus*
Lamiaceae	Hedge woundwort	*Stachys sylvatica*
	Red dead-nettle	*Lamium purpureum*
	Balm	*Melissa officinalis*
	Self-heal	*Prunella vulgaris*
	Water mint	*Mentha aquatica*
Lemnaceae	Common duckweed	*Lemna minor*
	Ivy-leaved duckweed	*Lemna trisulca*
Liliaceae	Bluebell	*Hyacinthoides non-scripta*
Oleaceae	Lilac	*Syringa vulgaris*
Onagraceae	American willowherb	*Epilobium ciliatum*
	Great willowherb	*Epilobium hirsutum*
	Broad-leaved willowherb	*Epilobium montanum*
	Hoary willowherb	*Epilobium parviflorum*
	Rosebay willowherb	*Chamerion angustifolium*
Nymphaeaceae	Yellow water-lily	*Nuphar lutea*
Papaveraceae	Common poppy	*Papaver rhoeas*
Plantaginaceae	Greater plantain	*Plantago major*
	Ribwort plantain	*Plantago lanceolata*
Poaceae	Red fescue	*Festuca rubra*
	Perennial rye grass	*Lolium perenne*
	Crested dog's tail	*Cynosurus cristatus*
	Annual meadow grass	*Poa annua*
	Rough meadow grass	*Poa trivialis*
	Cock's foot	*Dactylis glomerata*
	Fern grass	*Catapodium rigidum*
	Wild-oat	*Avena fatua*
	False oat-grass	*Arrhenatherum elatius*
	Yorkshire fog	*Holcus lanatus*
	Reed canary-grass	*Phalaris arundinacea*
	Creeping bent	*Agrostis stolonifera*

Family	**Common Name**	***Scientific Name***
	Common bent	*Agrostis capillaris*
Poaceae (cont.)	Meadow foxtail	*Alopecurus pratensis*
	Common couch	*Elytrigia repens*
Polygonaceae	Redshank	*Persicaria maculosa*
	Knotgrass	*Polygonum aviculare*
	Japanese knotweed	*Fallopia japonica*
	Common sorrel	*Rumex acetosa*
	Curled dock	*Rumex crispus*
	Clustered dock	*Rumex conglomeratus*
	Wood dock	*Rumex sanguineus*
	Broad-leaved dock	*Rumex obtusifolius*
Polypodiaceae	Polypody	*Polypodium vulgare* Agg.
Potamogetonaceae	Broad-leaved pondweed	*Potamogeton natans*
	Curled pondweed	*Potamogeton crispus*
	Small pondweed	*Potamogeton berchtoldii*
Primulaceae	Scarlet pimpernel	*Anagallis arvensis*
Ranunculaceae	Creeping buttercup	*Ranunculus repens*
	Field buttercup	*Ranunculus acris*
	Stream water-crowfoot	*Ranunculus penicillatus*
	Thread-leaved water-crowfoot	*Ranunculus trichophyllus*
Rosaceae	Meadowsweet	*Filipendula ulmaria*
	Silverweed	*Potentilla anserina*
	Creeping cinquefoil	*Potentilla reptans*
Rosaceae	Blackberry	*Rubus fruticosus Agg.*
	Raspberry	*Rubus idaeus*
	Cherry laurel	*Prunus laurocerasus*
Rubiaceae	Field madder	*Sherardia arvensis*
	Woodruff	*Galium odoratum*
	Marsh bedstraw	*Galium palustre*
	Lady's bedstraw	*Galium verum*
	Goosegrass	*Galium aparine*
Scrophulariaceae	Common figwort	*Scrophularia nodosa*
	Water figwort	*Scrophularia auriculata*
	Snapdragon	*Antirrhinum majus*
	Ivy-leaved toadflax	*Cymbalaria muralis*
	Germander speedwell	*Veronica chamaedrys*
	Common field-speedwell	*Veronica persica*
	Thyme leaved speedwell	*Veronica serpyllifolia*
	Brooklime	*Veronica beccabunga*
	Blue water-speedwell	*Veronica anagallis-aquatica*

Family	**Common Name**	***Scientific Name***
	Wall speedwell	*Veronica arvensis*
	Red bartsia	*Odontites vernus*
Solanaceae	Bittersweet	*Solanum dulcamara*
Sparganiaceae	Branched bur-reed	*Sparganium erectum*
Taxaceae	Yew	*Taxus baccata*
Urticaceae	Common nettle	*Urtica dioica*
	Small nettle	*Urtica urens*
	Pellitory-of-the-wall	*Parietaria judaica*
Valerianaceae	Common valerian	*Valeriana officinalis*
	Red valerian	*Centranthus ruber*
Violaceae	Wild pansy	*Viola tricolor*

Appendix 3. Species List sorted by Common Name

Common name	***Scientific name***	**Family**
American willowherb	*Epilobium ciliatum*	Onagraceae
Annual meadow grass	*Poa annua*	Poaceae
Balm	*Melissa officinalis*	Lamiaceae
Bird's-foot trefoil	*Lotus corniculatus*	Fabaceae
Biting stonecrop	*Sedum acre*	Crassulaceae
Bittersweet	*Solanum dulcamara*	Solanaceae
Black medick	*Medicago lupulina*	Fabaceae
Blackberry	*Rubus fruticosus Agg.*	Rosaceae
Blue water-speedwell	*Veronica anagallis-aquatica*	Scrophulariaceae
Bluebell	*Hyacinthoides non-scripta*	Liliaceae
Branched bur-reed	*Sparganium erectum*	Sparganiaceae
Broad-leaved dock	*Rumex obtusifolius*	Polygonaceae
Broad-leaved pondweed	*Potamogeton natans*	Potamogetonaceae
Broad-leaved willowherb	*Epilobium montanum*	Onagraceae
Brooklime	*Veronica beccabunga*	Scrophulariaceae
Broom	*Cytisus scoparius*	Fabaceae
Bush vetch	*Vicia sepium*	Fabaceae
Butterbur	*Petasites hybridus*	Asteraceae
Butterfly-bush	*Buddleja davidii*	Buddlejaceae
Campion sp.	*Silene sp.*	Caryophyllaceae
Canadian pondweed	*Elodea canadensis*	Hydrocharitaceae
Cat's ear	*Hypochaeris radicata*	Asteraceae
Cherry laurel	*Prunus laurocerasus*	Rosaceae
Clustered dock	*Rumex conglomeratus*	Polygonaceae
Cock's foot	*Dactylis glomerata*	Poaceae
Colt's foot	*Tussilago farfara*	Asteraceae
Common bent	*Agrostis capillaris*	Poaceae
Common centaury	*Centaurium erythraea*	Gentianaceae
Common comfrey	*Symphytum officinale*	Boraginaceae
Common couch	*Elytrigia repens*	Poaceae
Common duckweed	*Lemna minor*	Lemnaceae
Common field-speedwell	*Veronica persica*	Scrophulariaceae
Common figwort	*Scrophularia nodosa*	Scrophulariaceae
Common fumitory	*Fumaria officinalis*	Fumariaceae
Common knapweed	*Centaurea nigra*	Asteraceae
Common mouse ear	*Cerastium fontanum*	Caryophyllaceae
Common nettle	*Urtica dioica*	Urticaceae
Common poppy	*Papaver rhoeas*	Papaveraceae

Common name	***Scientific name***	**Family**
Common ragwort	*Senecio jacobaea*	Asteraceae
Common sorrel	*Rumex acetosa*	Polygonaceae
Common valerian	*Valeriana officinalis*	Valerianaceae
Corn marigold	*Chrysanthemum segetum*	Asteraceae
Cow parsley	*Anthriscus sylvestris*	Apiaceae
Creeping bent	*Agrostis stolonifera*	Poaceae
Creeping buttercup	*Ranunculus repens*	Ranunculaceae
Creeping cinquefoil	*Potentilla reptans*	Rosaceae
Creeping thistle	*Cirisium arvense*	Asteraceae
Crested dog's tail	*Cynosurus cristatus*	Poaceae
Cudweed	*Gnaphalium sp.*	Asteraceae
Curled dock	*Rumex crispus*	Polygonaceae
Curled pondweed	*Potamogeton crispus*	Potamogetonaceae
Cut-leaved crane's-bill	*Geranium dissectum*	Euphorbiaceae
Daisy	*Bellis perennis*	Asteraceae
Dandelion	*Taraxacum sp.*	Asteraceae
Elder	*Sambucus nigra*	Caprifoliaceae
False oat-grass	*Arrhenatherum elatius*	Poaceae
Fern grass	*Catapodium rigidum*	Poaceae
Feverfew	*Tanacetum parthenium*	Asteraceae
Field buttercup	*Ranunculus acris*	Ranunculaceae
Field horsetail	*Equisetum arvensis*	Equisetaceae
Field madder	*Sherardia arvensis*	Rubiaceae
Field scabious	*Knautia arvensis*	Dipsacaceae
Fool's water-cress	*Apium nodiflorum*	Apiaceae
Forget-me-not	*Myosotis arvensis*	Boraginaceae
Garlic mustard	*Alliaria petiolata*	Brassicaceae
Germander speedwell	*Veronica chamaedrys*	Scrophulariaceae
Goosefoot	*Chenopodium sp.*	Chenopodiaceae
Goosegrass	*Galium aparine*	Rubiaceae
Gorse	*Ulex europaeus*	Fabaceae
Great willowherb	*Epilobium hirsutum*	Onagraceae
Greater plantain	*Plantago major*	Plantaginaceae
Greater stitchwort	*Stellaria holostea*	Caryophyllaceae
Guelder rose	*Viburnum opulus*	Caprifoliaceae
Hairy sedge	*Carex hirta*	Cyperaceae
Hard rush	*Juncus inflexus*	Juncaceae
Hart's tongue	*Phyllitis scolopendrium*	Aspleniaceae
Hedge bindweed	*Calystegia sepium*	Convolvulaceae
Hedge mustard	*Sisymbrium officinale*	Brassicaceae

Common name	***Scientific name***	**Family**
Hedge woundwort	*Stachys sylvatica*	Lamiaceae
Hedgerow crane's bill	*Geranium pyrenaicum*	Euphorbiaceae
Herb robert	*Geranium robertiana*	Euphorbiaceae
Himalayan balsam	*Impatiens glandulifera*	Balsaminaceae
Hoary willowherb	*Epilobium parviflorum*	Onagraceae
Hogweed	*Heracleum sphondylium*	Apiaceae
Holly	*Ilex aquifolium*	Aquifoliaceae
Honeysuckle	*Lonicera periclymenum*	Caprifoliaceae
Ivy	*Hedera helix*	Araliaceae
Ivy-leaved duckweed	*Lemna trisulca*	Lemnaceae
Ivy-leaved toadflax	*Cymbalaria muralis*	Scrophulariaceae
Japanese knotweed	*Fallopia japonica*	Polygonaceae
Knotgrass	*Polygonum aviculare*	Polygonaceae
Lady's bedstraw	*Galium verum*	Rubiaceae
Lady's smock	*Cardamine pratensis*	Brassicaceae
Large bindweed	*Calystegia silvatica*	Convolvulaceae
Lesser hawksbit	*Leontodon taraxacoides*	Asteraceae
Lesser stitchwort	*Stellaria palustris*	Caryophyllaceae
Lesser trefoil	*Trifolium dubium*	Fabaceae
Lilac	*Syringa vulgaris*	Oleaceae
Maidenhair spleenwort	*Asplenium trichomanes*	Aspleniaceae
Marsh bedstraw	*Galium palustre*	Rubiaceae
Meadow foxtail	*Alopecurus pratensis*	Poaceae
Meadow vetchling	*Lathyrus pratensis*	Fabaceae
Meadowsweet	*Filipendula ulmaria*	Rosaceae
Navelwort	*Umbilicus rupestris*	Crassulaceae
Nipplewort	*Lapsana communis*	Asteraceae
Orache	*Atriplex sp.*	Chenopodiaceae
Oval sedge	*Carex leporina*	Cyperaceae
Pearlwort sp.	*Sagina sp.*	Caryophyllaceae
Pellitory-of-the-wall	*Parietaria judaica*	Urticaceae
Pendulous sedge	*Carex pendula*	Cyperaceae
Perennial rye grass	*Lolium perenne*	Poaceae
Perennial sow-thistle	*Sonchus arvensis*	Asteraceae
Petty spurge	*Euphorbia peplus*	Euphorbiaceae
Pineapple-weed	*Matricaria discoidea*	Asteraceae
Polypody	*Polypodium vulgare* Agg.	Polypodiaceae
Prickly sow-thistle	*Sonchus asper*	Asteraceae
Raspberry	*Rubus idaeus*	Rosaceae
Red bartsia	*Odontites vernus*	Scrophulariaceae

Common name	***Scientific name***	**Family**
Red clover	*Trifolium pratense*	Fabaceae
Red dead-nettle	*Lamium purpureum*	Lamiaceae
Red fescue	*Festuca rubra*	Poaceae
Red valerian	*Centranthus ruber*	Valerianaceae
Redshank	*Persicaria maculosa*	Polygonaceae
Reed canary-grass	*Phalaris arundinacea*	Poaceae
Remote sedge	*Carex remota*	Cyperaceae
Ribwort plantain	*Plantago lanceolata*	Plantaginaceae
Rosebay willowherb	*Chamerion angustifolium*	Onagraceae
Rough meadow grass	*Poa trivialis*	Poaceae
Rusty back	*Ceterach officinarium*	Aspleniaceae
Scarlet pimpernel	*Anagallis arvensis*	Primulaceae
Scentless mayweed	*Tripleurospermum inodorum*	Asteraceae
Self-heal	*Prunella vulgaris*	Lamiaceae
Sheep's-bit	*Jasione montana*	Campanulaceae
Shepherd's purse	*Capsella bursa-pastoris*	Brassicaceae
Shining crane's-bill	*Geranium lucidum*	Euphorbiaceae
Silverweed	*Potentilla anserina*	Rosaceae
Small nettle	*Urtica urens*	Urticaceae
Small pondweed	*Potamogeton berchtoldii*	Potamogetonaceae
Smooth sow-thistle	*Sonchus oleraceus*	Asteraceae
Snapdragon	*Antirrhinum majus*	Scrophulariaceae
Snowberry	*Symphoricarpus albus*	Caprifoliaceae
Soft rush	*Juncus effusus*	Juncaceae
Spear thistle	*Cirisium vulgare*	Asteraceae
Spiked water-milfoil	*Myriophyllum spicatum*	Fabaceae
Stream water-crowfoot	*Ranunculus penicillatus*	Ranunculaceae
Sun spurge	*Euphorbia helioscopia*	Euphorbiaceae
Thread-leaved water-crowfoot	*Ranunculus trichophyllus*	Ranunculaceae
Thyme leaved speedwell	*Veronica serpyllifolia*	Scrophulariaceae
Toad rush	*Juncus bufonius*	Juncaceae
Tufted vetch	*Vicia cracca*	Fabaceae
Wall rue	*Asplenium ruta-muraria*	Aspleniaceae
Wall speedwell	*Veronica arvensis*	Scrophulariaceae
Water dropwort	*Oenanthe crocata*	Apiaceae
Water figwort	*Scrophularia auriculata*	Scrophulariaceae
Water mint	*Mentha aquatica*	Lamiaceae
Water-cress	*Rorippanasturtium-aquaticum*	Brassicaceae
Water-starwort	*Callitriche sp.*	Callitrichaceae

Common name	***Scientific name***	**Family**
Water-starwort	*Callitriche sp.*	Callitrichaceae
Welted thistle	*Carduus crispus*	Asteraceae
White clover	*Trifolium repens*	Fabaceae
White stonecrop	*Sedum album*	Crassulaceae
Wild pansy	*Viola tricolor*	Violaceae
Wild turnip	*Brassica rapa*	Brassicaceae
Wild-oat	*Avena fatua*	Poaceae
Wood dock	*Rumex sanguineus*	Polygonaceae
Woodruff	*Galium odoratum*	Rubiaceae
Yarrow	*Achillea millefolium*	Asteraceae
Yellow iris	*Iris pseudacorus*	Iridaceae
Yellow water-lily	*Nuphar lutea*	Nymphaeaceae
Yew	*Taxus baccata*	Taxaceae
Yorkshire fog	*Holcus lanatus*	Poaceae

Appendix 4. Preliminary Bird Survey

Bird species observed and heard during bird survey in Tullow on the 8th of July 2014 during the dawn chorus.

Common name	**Species**
Swallow	*Hirundo rustica*
Jackdaw	*Corvus monedula*
Starling	*Sturnus vulgaris*
Wood pigeon	*Columba palumbus*
House sparrow	*Passer domesticus*
Grey wagtail	*Motacilla cinerea*
Pied wagtail	*Motacilla alba yarrellii*
Hooded crow	*Corvus cornix*
Blackbird	*Turdus merula*
Robin	*Erithacus rubecula*
Song thrush	*Turdus philomelos*
Wren	*Troglodytes troglodytes*
Magpie	*Pica pica*
Collared dove	*Streptopelia decaocto*
Great tit	*Parus major*
Goldfinch	*Carduelis carduelis*
Bullfinch	*Pyrrhula pyrrhula*
Dunnock	*Prunella modularis*
Chaffinch	*Fringilla coelebs*
Blue tit	*Parus caeruleus*
Green finch	*Carduelis chloris*
Pheasant	*Phasianus colchicus*