Chapter 5:

Flora and Fauna

5. FLORA AND FAUNA

5.1 INTRODUCTION

This section of the Environmental Impact Statement (EIS) describes the potential impacts of the proposed Lower Lee (Cork City) Drainage Scheme on flora and fauna and has been completed in accordance with the following guidance documents:

- Environmental Protection Agency (2000). Guidelines on Information to be contained in Environmental Impact Statements.
- Chartered Institute of Ecology and Environmental Management (CIEEM) (2006). Guidelines for Ecological Impact Assessment.
- Chartered Institute of Ecological and Environmental Management (CIEEM) (2012). Preliminary Ecological Appraisal.
- Fossitt JA (2000). A Guide to Habitats in Ireland.
- The Heritage Council (2011) Habitat Survey Guidelines: A Standard Methodology for Habitat Survey and Mapping in Ireland.

The chapter discusses the existing ecological environment, the potential impacts of the scheme and avoidance and mitigation measures in relation to habitats, flora and fauna in the zone of influence of the Lower lee (Cork City) Drainage Scheme.

5.2 METHODOLOGY AND LIMITATIONS

5.2.1 Desk Study

The study area for this chapter encompasses the channel, floodplain and immediate surrounding areas of the River Lee from the Innishcarra Dam extending along the main channel (including both north and south banks within the city) of the river to the Lee Estuary. The River Lee is joined by a number of small tributaries within the study area including the Bride West, Shournagh, Curragheen and Glasheen Rivers (see Figure 5.1). This area encompassed approximately 15 kilometres of the River Lee and its tributaries.

A desk study was undertaken to determine the proximity of the project to designated areas of conservation utilising the National Parks and Wildlife Service (NPWS) website database. Site synopses, conservation objectives, conservation management plans, site reports etc. were reviewed to identify qualifying interests of relevant sites. The NPWS database and Biodiversity Ireland database were also consulted regarding the occurrence of protected species of flora and fauna in the vicinity of the proposed scheme. Consultations were carried out with the NPWS and Inland Fisheries Ireland (IFI) requesting information on protected species and habitats within the study area as well as comments on the proposed project in relation to survey, assessment and specific mitigation requirements. A review of aerial photography over the entire study was undertaken to prepare a preliminary habitat map and to identify potential ecologically important habitats. The review also aimed to determine the proximity of the proposed drainage scheme to ecologically important sites in the general vicinity that may be subject to indirect impacts through severance of connecting corridors, pollution run-off during construction, etc. Existing sources of information and records on ecological interests were sourced and reviewed.

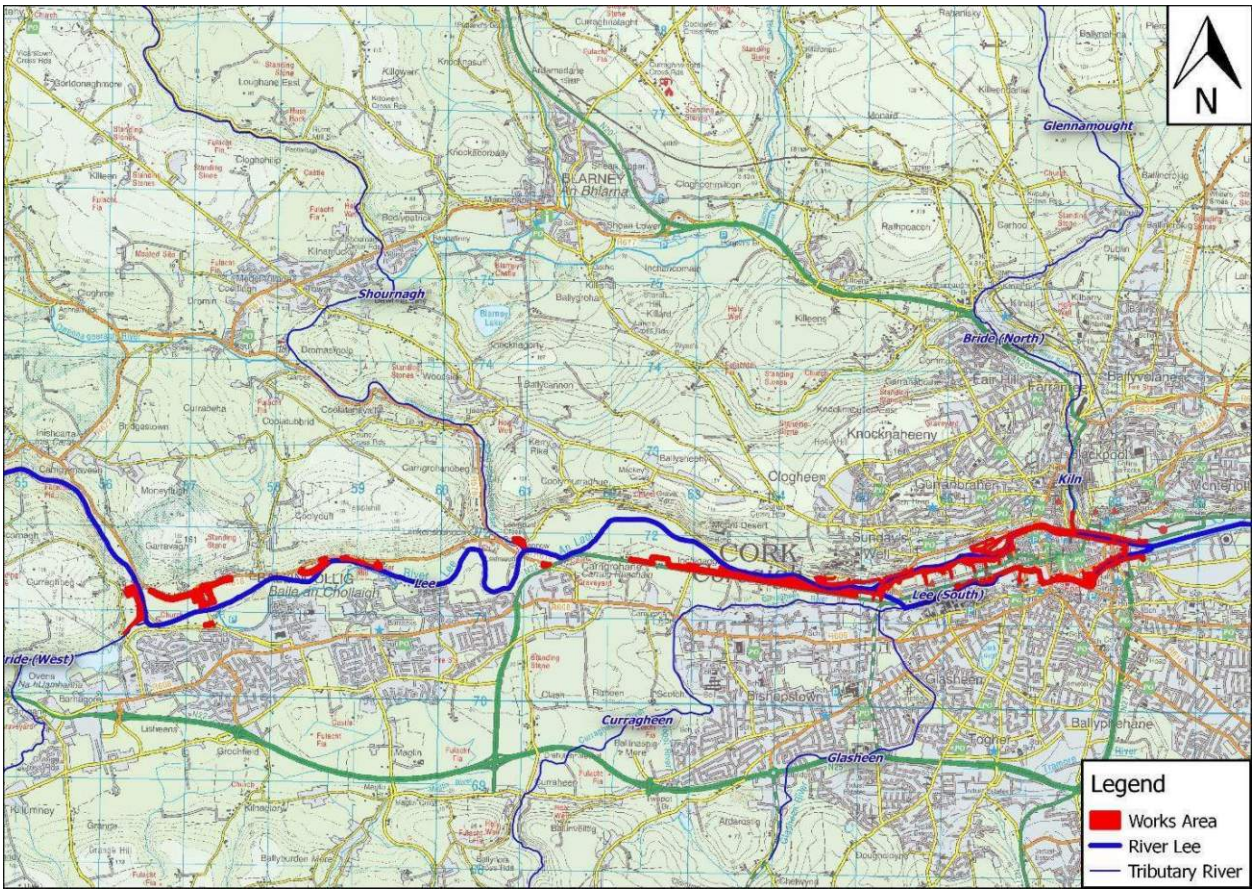

Figure 5.1 Study area (red) for the Lower Lee (Cork City) Drainage Scheme

5.2.2 Field Survey

Following on from the desk study, a series of site surveys were undertaken of the study area, encompassing the River Lee main channel from Inishcarra to the city centre as well as on the Rivers Curraheen, Glasheen, Bride (North) and the Glenamought. During the survey, habitat mapping was undertaken and the suitability of the works area to support plants, animals or habitats of note was considered. All watercourses within the proposed works areas were examined with a view to determining presence of species of note and potential ecological risks associated with the proposed drainage scheme. The flora was surveyed through direct observation on-site and the habitats were classified initially from aerial photographs and subsequently ground-truthed at the site. Fauna were surveyed through direct observation of bird and mammal species or of their signs and calls.

A number of site specific targeted surveys were carried out following consultation with NPWS and IFI for the following: bats, Otter (*Lutra lutra*), kingfisher (*Alcedo atthis*), floating river vegetation, fish species and Japanese knotweed (*Fallopia japonica*) and other invasive plant species. A summary of the field surveys completed to date is presented in Table 5.1 below.

Table 5.1: Targeted surveys undertaken along the River Lee, Curraheen, Glasheen, Bride (North) and Glenamought

Survey Type	Dates of Survey
Windshield habitat survey	18th June 2013
Walkover Survey /Habitat mapping	April/May 2014, April 2015, July 2016
Bat assessment	October 2014
Invasive species survey	August-September 2014
Otter Survey	October/November 2014, April-October 2015, July 2016
Kingfisher Survey	August – October (end) 2014, May-June 2015, July 2016
Electrofishing Survey	September 2014
Floating River Vegetation Survey	August and September 2014, June 2015
Sea Lamprey Redd Survey	July 2015

5.2.3 Designated Areas in the Vicinity of the Study Area

The NPWS publish synopses of the information regarding areas designated for conservation.

5.2.3.1 Natura 2000 Sites

Screening for Appropriate Assessment (AA) under Article 6(3) of the EU Habitats Directive has been completed and is included in Appendix 5A. The following summarises the information from the AA Screening Document. The nearest Natura 2000 sites (cSAC's or SPA's) are:

- Great Island Channel SAC (Site Code:004219)
- Cork Harbour SPA (Site Code 004030)
- The Gearagh SAC (Site Code 000108)
- The Gearagh SPA (Site Code 004109)

Great Island Channel SAC and Cork Harbour SPA are located within 15km of the proposed Lower Lee (Cork City) Drainage Scheme and therefore require screening for Appropriate Assessment (AA). The Gearagh SAC and The Gearagh SPA are located > 15km upstream of the proposed Scheme, however they are included within the screening for AA as they are considered to be within the zone of influence of the proposed Scheme during its operational stage (potential for impacts on water levels as a result of changes to the hydrological regime at Inishcarra and Carrigadrohid Dams).

Cork Harbour SPA is a large, sheltered bay system, with several river estuaries - principally those of the Rivers Lee, Douglas, Owenboy and Owennacurra. The SPA site comprises most of the main intertidal areas of Cork Harbour with the following designated as conservation interests: Little Grebe (*Tachybaptus ruficollis*), Great Crested Grebe (*Podiceps cristatus*), Cormorant (*Phalacrocorax carbo*), Grey Heron (*Andea cinerea*), Shelduck (*Tadorna tadorna*), Wigeon (*Anas Penelope*), Teal (*Anas crecca*), Pintail (*Anas acuta*), Shoveler (*Anas clypeata*), Red-breasted Merganser (*Mergus serrator*), Oystercatcher (*Haematopus ostralegus*), Golden Plover (*Pluvialis apricaria*), Grey Plover (*Pluvialis squatorola*), Lapwing (*Vanellus vanellus*), Dunlin (*Calidris alpine*),

Blacktailed Godwit (*Limosa limosa*), Bar-tailed Godwit (*Limosa lapponica*), Curlew (*Numenius arquata*), Redshank (*Tringa tetanus*), Black-headed Gull (*Chricocephalus ridibundus*), Common Gull (*Larus canus*), Lesser Black-backed Gull (*Larus fuscus*) and Common Tern (*Sterna hirundo*). Cork Harbour is an internationally important wetland site, regularly supporting in excess of 20,000 wintering waterfowl.

The Great Island Channel SAC is located >8 km downstream of the works area. It stretches from Little Island to Middleton, with its southern boundary being formed by Great Island. The site is a Special Area of Conservation (SAC) selected for the following habitats:

- [1140] Tidal Mudflats and Sandflats
- [1330] Atlantic Salt Meadows

The Gearagh SAC is located > 20km upstream of the proposed Scheme. The Gearagh has formed where the River Lee breaks into a complex network of channels (2 to 6 m wide) weaving through a series of wooded islands. The Gearagh SAC supports the Annex I priority habitat Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (Alno-Padion, Alnion incanae, Salicion albae) which comprises woods dominated by Alder (*Alnus glutinosa*) and Willow (*Salix* spp) on flood plains in a range of situations from islands in river channels to low-lying wetlands alongside the channels. The habitat typically occurs on moderately base-rich, eutrophic soils subject to periodic inundation. The alluvial woodland is of unique scientific interest. The area has probably been wooded throughout the post-glacial era (i.e. since the end of the last Ice Age, around 10,000 years ago and frequent flooding enhances its character. Originally, this area of alluvial woodland extended as far as the Lee Bridge. In 1954/55 extensive tree-felling and flooding in the eastern part of the Gearagh, carried out to facilitate the operation of the hydro-electric scheme, resulted in the loss of approximately 60% of the former woodland. Today, the reservoir covers the area from Lee Bridge to Annahala Bridge, and westwards of Illaunmore Island.

The Gearagh currently represents the only extensive alluvial woodland in Ireland or west of the Rhine in Europe. For this reason, it has also been designated as a Statutory Nature Reserve. The international importance of the site is recognised by its designation both as a Ramsar site and as a Biogenetic Reserve. The reservoir is also a Wildfowl Sanctuary (NPWS, 2013). The Gearagh SAC is designated for the following habitats and species:

- [3260] Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation
- [3270] Rivers with muddy banks with Chenopodion rubri p.p. and Bidention p.p. vegetation
- [91A0] Old sessile oak woods with Ilex and Blechnum in the British Isles
- [91E0] Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae)
- [1355] Lutra lutra (Otter)

The Gearagh SPA extends from Annahala Bridge westwards to Toon Bridge and the following are designated as conservation interests: wigeon (*Anas Penelope*), teal (*Anas crecca*), mallard (*Anas platyrhnchos*) and coot (*Fulica atra*). The site supports nationally important populations of these species. Other species that occur include Mute Swan (*Cygnus olor*), Whooper Swan (*Cygnus cygnus*), Gadwall (*Anas Strepera*), Shoveler (*Anas clypeata*), Pochard (*Aythya farina*), Tufted Duck (*Aythya fuligula*), Goldeneye (*Bucephala clanguia*),

Cormorant (*Phalacroxorax carbo*), Lapwing (*Vanelluls vanellus*), Golden Plover (*Pluvalis apricaria*) and Curlew (*Numenius arquata*).

The Appropriate Assessment screening report concluded that impacts on the above listed European Sites could be precluded on the basis of their distance from the proposed Lower Lee (Cork City) Drainage Scheme and the nature and scale of the proposed works.

5.2.3.2 Other Designated Sites

The proposed works are located in proximity to the Lee Valley pNHA (located adjacent to the works area) and Shournagh Valley pNHA (directly upstream of the works).

The Lee Valley pNHA occupies five different sections of the River Lee valley and is of regional conservation importance for the diverse range of semi-natural habitats that occur. The site supports wet broadleaved woodland, wet grassland, dry broadleaved woodland, unimproved dry grassland, freshwater marsh. A number of wetland bird species are known to breed in the site including Mallard, Heron, Sedge and Grasshopper warblers and Reed bunting. Small blue and White wood butterfly, both locally distributed species also occur. Proposed works adjacent to the pNHA are located in scattered trees and parkland as well as at the rear of private residential dwellings and not within habitats for which the pNHA is considered important.

Shournagh Valley pNHA includes two sections of the Shournagh River and comprises areas of wet woodland, scrub, scrub woodland and old estate mixed woodland. Dippers (*Cinclus hibernicus*) and Grey wagtail (*Motacilla cinerea*) are known to feed along and around the river channel. The pNHA is located approximately 300m upstream of proposed works.

The following pNHAs are also located within 5km of the study area. They are located either upstream at a distance of > 5km, downstream at a distance of>3km or are not connected by surface water:

- Cork Lough pNHA (Site Code: 001081) – Located to the South of the River Lee.
- Douglas River Estuary pNHA (Site Code: 001046) – Located to the East of the River Lee.
- Dunkettle Shore pNHA (Site Code: 001082) – Located to the East and North of the River Lee.
- Ballincollig Cave pNHA (Site Code: 001249) – Located to the South of the River Lee.
- Ardamadane Wood pNHA (Site Code: 001799) – Located to the North of the River Lee.
- Blarney Bog pNHA (Site Code: 001857) – Located to the North of the River Lee.
- Blarney Castle Woodland pNHA (Site Code: 001515) – Located to the North of the River Lee.
- Blarney Lake pNHA (Site Code: 001798) – Located to the North of the River Lee.
- Glanmire Wood pNHA (Site Code: 001054) – Located to the North of the River Lee.

Given the distance of these pNHAs from the works area and considering the nature and scale of the works, there is no potential pathway for negative impacts on these pNHAs.

The designated sites within the study area are shown in Figure 5.2.

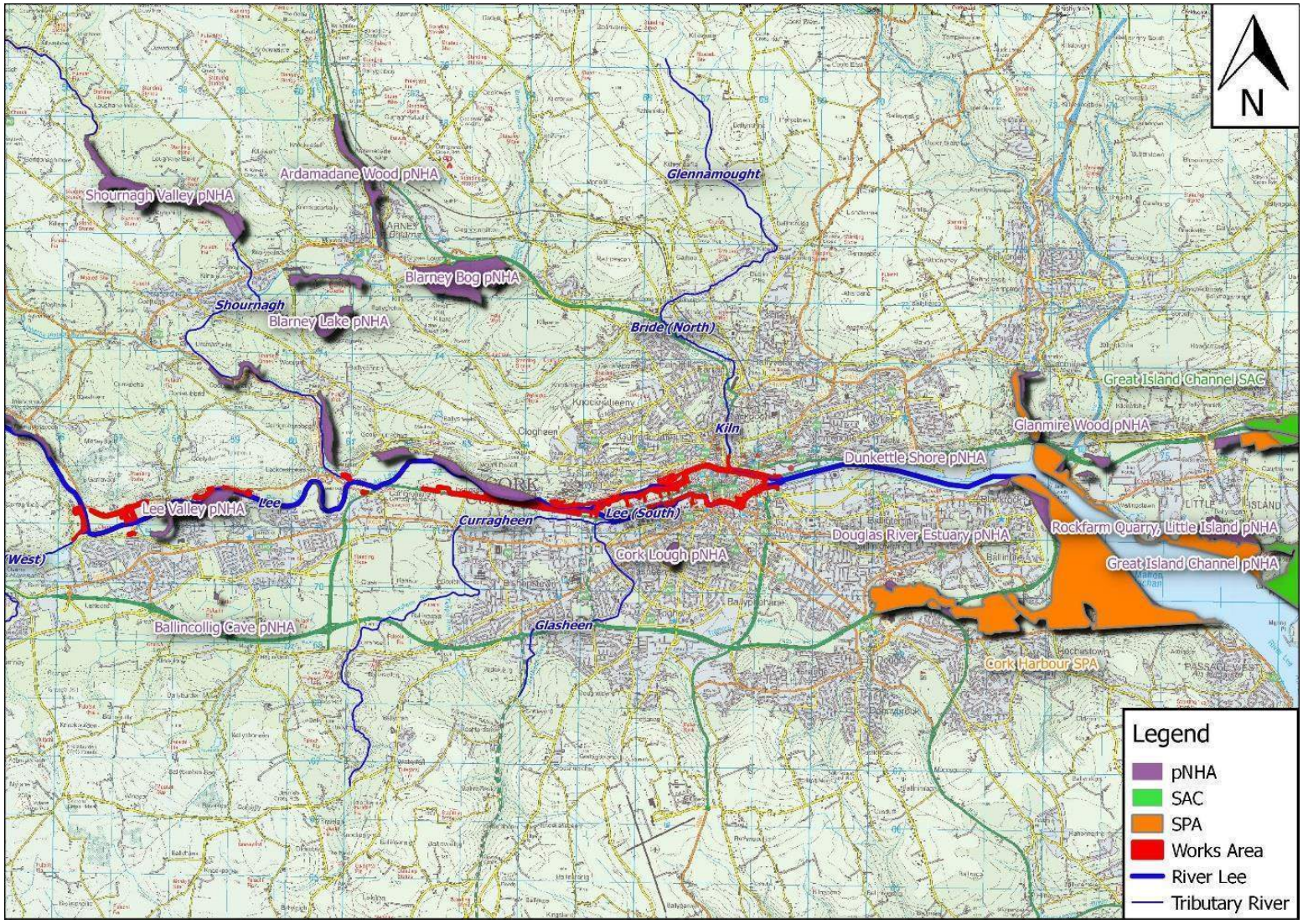

Figure 5.2 Designated Sites within the Study Area

5.2.4 Non Designated Features of Ecological Interest

5.2.4.1 River Lee and Tributaries

The River Lee with a catchment area of approximately 2000 km^2, rises in the Shehy Mountains on the western border of County Cork and flows eastwards through Cork City and flows into the sea at Cork Harbour.

Outside of the Gearagh to the west and the coastal transitional habitats of Great Island SAC and Cork Harbour SPA to the east, the aquatic habitats of the River Lee within the Study Area are not designated for nature conservation purposes.

The River Lee main channel from source to Cork City waterworks at Lee Road is a designated salmonid fishery under the EC (Quality of Salmonid Waters) Regulations of 1988 (SI 84 of 1988), implementing the Freshwater Fish Directive (78/659/EEC). The Lee is also known to contain populations of Brown trout (*Salmo trutta*), Lamprey (*Lampetra* sp. And Petromyzon sp.) and European eel (*Anguilla anguilla*).

In addition to the above, the river and its larger 1st order tributaries, support a number of other Annex I habitats and Annex II species listed under the European Habitats Directive (Council Directive 92/43/EEC) and a number of Annex I bird species listed under the EU Birds Directive (Directive 2009/147/EC).

The entire length of the River Lee and its tributaries provide suitable foraging/commuting corridors for Otter. Otter holts are known from the River Lee within the environs of the city and its 1st order tributaries. A survey by IWT et al (2012) to evaluate the Otter population in the inner city and the adjacent suburban areas identified a minimum population of 11 No. otters in the city area.

Ranunculus vegetation which corresponds to the Annex I habitat 'Watercourses of Plain to Montane Levels with the *Ranunculion fluitantis* and Callitricho-Batrachion vegetation [3260]' also occurs within the River Lee. The largest intact populations of *Ranunculus* vegetation are present on the River Lee main channel with smaller more localised populations recorded in the smaller 1st order tributaries e.g. the Bride River North, the Glen River, the Glenamought River and the Ballincolly Stream.

The River Lee upstream of the Study Area supports the Annex II species Freshwater Pearl Mussel (*Margaritifera margaritifera*) at Inchigeelagh. The following tributaries of the River Lee are also known to support Freshwater Pearl Mussel (John Lucey; EPA river monitoring, post 2003 cited in OPW, 2007):

- Lough Lua;
- Foherish (River Code 19/F/02);
- Laney (River Code 19/L/01);
- Sullane (River Code 19/S/02);
- Toon (River Code 19/T/02); and
- Bealaphadeen.

In terms of terrestrial sites of ecological importance along the River Lee, O'Mahony (2009) describes one of the most important habitats on the River Lee as "*the contiguous series of inundation meadows bordering the Lee Road in the flood plain of the River between Mount Dysert Road and Hollymount Road Junction within the Lee Fields*". The habitat is located on the northern banks of the River Lee at this location and within the River Lee pNHA. O'Mahony (2009) also describes an area of swampy scrub wood at the western boundary of

the Lee Fields on the northern banks as being of ecological interest and refers to a series of small ponds in the eastern extremity of the Lee Fields containing Tubular Water Dropwort (*Oenanthe fistulosa*).

Many of the stone walls in Cork City support a diverse array of species including two listed under the Flora (Protection) Order, 1999, i.e. Roundleaved cranesbill (*Geranium rotundifolium*) and Little robin (*Geranium purpureum*). These are listed as nationally 'Vulnerable' in the Irish Red Data Book. Little Robin is only known from walls and waste ground in Cork City and in Dungarvan Co Waterford. It is absent however, from Cork City's quay walls. Roundleaved cranesbill is found in very few sites in Ireland, one of which is waste ground areas around the city, where it has been recorded in greater numbers than at any of its other sites in Dublin and Wexford (Cork City Council, 2009). O'Mahony (2009) in Wildflowers of Cork City and County, also makes note of the presence of a locally diverse assemblage of wall plants adjacent to St. Vincent's River Bridge on the North Mall where small populations of Common Whitlowgrass (*Draba verna*), Thale cress (*Ardbidopsis thaliana*), Lemon-Headed Hop trefoil (*Trifolium campestre*) and naturalised Mind your-own-business (*Soleirolia soleirolii*) have been recorded by the author.

According to (Cork City Council, 2009) the River Lee running west from the City to the Lee Fields is an excellent area for bats. Natterers (*Myotis nattereri*) and Whiskered bat (*Myotis mystacinus*) have also been recorded in the environs the City (e.g. around Glanmire and may also occur in the more wooded areas along the Lee Road, Leemount and along the River Shournagh.

The Annex I bird species Kingfisher (*Alcedo atthis*) is known to occur on the River Lee along with Irish Dipper (*Cinclus hibernicus*). The River Lee supports a number of bird species of Special Conservation Interest listed for the coastal marine habitats of Cork Harbour SPA e.g. Cormorant (*Phalacrocorax carbo*) and Grey Heron (*Ardea cinerea*).

5.2.4.2 Innishcarra and Carrigadrohid Reservoirs

Following the construction of the River Lee hydroelectric scheme, a large part of the Lee Valley was flooded to form the Innishcarra and Carrigadrohid. Upstream of Carrigadrohid Reservoir, is an extensive wetland site that is of high importance to waders and wildfowl. It is monitored annually by IWeBS (Irish Winter Bird Survey) and part of the site overlaps with the Gearagh (designated as both an SAC and SPA). The reservoir upstream of Carrigadrohid Dam is recognised by Birdlife International as an Important Bird Area (IBA). The IBA covers The Gearagh and the upper part of the Carrigadrohid reservoirs, as far downstream as the Carrigadrohid Dam (identified by IWeBs as 'Innishcarra Reservoirs'). The site is divided into three main sub-sites, each of which have been shown to regularly hold significant number of water birds:

- The Gearagh (designated as an SPA)
- Sullane Delta (undesignated) – Supports significant numbers of regularly occurring wigeon, teal, shoveler, tufted duck, golden plover, lapwing and curlew (IWeBS data). The whooper swan population that occur at the Gearagh are also known to utilise this area for feeding and roosting (Crushell, 2010).
- Dunisky Culvert (undesignated) – Supports significant numbers of regularly occurring teal, mallard, tufted duck and curlew (IWeBs data).

Duck Mussel (*Anodonta anatine*) which is listed as Vulnerable on the Irish Red Data Book, also occurs in the Innishcarra reservoir.

5.2.5 Flora

2.2.5.1 New Flora Atlas

A search was made in the *New Atlas of the British & Irish Flora* (Preston *et al*., 2002) to find which rare or unusual plant species had been recorded in the 10 km squares in which the Lowerr Lee (Cork City) Drainage Scheme is located, i.e. W46, W47, W56, W57, W66, W67, W76, W77, W86 and W87. In addition, the NPWS records of protected species in the area of the proposed development were obtained for the relevant 10 km squares. 8 No. species protected under the Flora Protection Order, were recorded in the Study Area. These species are listed below together with their record period data and habitat requirements.

- Meadow Barley (*Hordeum secalinum*). Records from pre 1970 and 1987-1999. Upper parts of brackish marshes.
- Small Cudweed *(Logfia minima*). Records from pre 1970 and 1987-1999. Sandy and gravelly places.
- Mudwort (*Limosella aquatica*). Records from pre 1970. Small pools, especially on limestone, or on wet mud on the margins of lakes.
- Rough Poppy (*Papaver hybridum*). Records from pre 1970. Sandy fields.
- Pennyroyal (*Mentha pulegium*). Records from pre 1970 and 1987-1999. Damp, sandy places.
- Lesser Snapdragon (*Misopates orontium*). Records from pre 1970 and 1987-1999. Arable fields.
- Meadow Saxifrage (*Saxifraga granulata*). Records from pre 1970. Sandhills and pastures.
- Annual Knawel (*Scleranthus annuus*). Records from pre 1970. Waste places and roadsides on dry, sandy soils.

5.2.5.2 NPWS Records of Protected Species

The NPWS records of protected species in the area of the proposed development were obtained for the relevant 10 km squares. There were records for an additional 2 No. species listed under the Flora Protection Order. These species are listed below together with their record period (as listed on the NPWS database) and habitat requirements.

- Wood small-reed (*Calamagrostis epigejos*). Record from 2012. Damp rocky places.
- Red Hemp Nettle (*Galeopsis angustifolia*). Record from 1856. Calcareous gravels, especially on eskers.

The NPWS database also contained records for a number of rare plant species not protected under the Flora Protection Order. The species together with their status on the Irish Red Data List of Vascular Plants (Curtis and McGough 1988) are listed below:

- Musk Thistle (*Carduus nutans*), Data Deficient (dd). Pastures, heaths and roadsides.
- Little Robin (*Geranium purpureum*) Endangered (E). Formerly protected under 1980 FPO. Rocks and walls.
- Round-leaved Cranesbill (*Geranium rotundifolium*) Endangered (E). Walls and roadsides.
- Henbane (*Hyoscyamus niger*). Vulnerable (V). Sandy or stony shores.

- Sharp-leaved Fluellen (*Kickxia elatine*). Endangered (E). Formerly protected under 1987 FPO. Arable fields and open waste ground.
- Greater Broomrape (*Orobanche rapum-genistae*). Vulnerable (V) Rare (R). Formerly protected under 1980 FPO.
- Heath Cudweed (*Gnaphalium sylvaticum*). Records from 1844 and 1897.Vulnerable (V) Upland pastures and damp, sandy places.
- Nettle-leaved Bellflower (*Campanula trachelium*). Vulnerable (V). Woods, hedgebanks and shady roadsides. The records for Cork city are from the River Shournach, upstream of Healy's Bridge near Cork city and the date of the records is unknown. In is thought that in Ireland this species is now virtually confined to the river valleys of the Nore and the Barrow in the south of the country, where it is found alongside the edges of these rivers and in swamp woodland.
- Shepherd's needle (*Scandix pecten-veneris*). Extinct (Ex). Tilled fields. No longer extant.
- Corn chamomile (*Anthemis arvensis*). Extinct (Ex). Annual of light calcareous or sandy soils, growing in arable fields, especially cereals; also in leys, field and waste places, and on roadsides and disturbed ground near the sea. No longer extant.
- Cornflower (*Centaurea cyanus*). Records 1987-1999. Formerly occurred as an annual weed of arable habitats but more recently frequently found in waste places, on roadsides and on rubbish tips.
- Darnel (*Lolium temulentum*). Records Pre 1970. Annual, formerly a persistent weed of arable land. Now a rare casual of waste places.

5.2.5.3 Quay Walls Cork City Local BSBI recorder information

The flora of Cork's quay-walls is very diversified in places. The quay walls at Wandesford Quay adjacent to the South Gate are known to support a diverse colourful flora as identified by O'Mahony (2009) in Flora of Cork City and County. O'Mahony (2009) also makes note of the presence of a locally diverse assemblage of wall plants adjacent to St. Vincent's River Bridge on the North Mall where small populations of Common Whitlowgrass (*Draba verna*), Thale cress (*Ardbidopsis thaliana*), Lemon-Headed Hop trefoil (*Trifolium campestre*) and naturalised Mind your-own-business (Soleirolia soleirolii) have been recorded. The species here although not containing any protected plants are considered to be of high local importance for their assemblage. There are no known nationally-protected plant species present on the Cork City quay walls. Pennyroyal was recorded at Tivoli Docks, however was most likely adventive in origin and was not refound during a 2013 survey. Little Robin is not known to occur on the quay walls and is unlikely that it is present in this type of habitat (Tony O'Mahony pers. comm.).

5.2.5.4 Bryophytes

According to the NPWS Rare and Protected Species Records there are 2 No. records for Hasselquist's Hyssop (*Entosthodon fascicularis*), listed as Near Threatened (NT) in the Ireland Red List No. 8: Bryophytes, 2 No. records for *Schistidium elegantulum* subsp. *Elegantulum*, listed as Data Deficient (dd) in the Irish Red List of Bryophytes, 3 No. records for Tufted Feather-moss (*Scleropodium cespitans*), listed as Near Threatened (NT) in the Irish Red List of Bryophytes, 2 No. records for Rib-leaf Moss (*Tortula atrovirens*), listed as Near Threatened (NT) in the Irish Red List of Bryophytes, 1 No. record for Dog Screw-moss (*Tortula canescens*), listed as Data Deficient (dd), 2 No. records for *Weissia brachycarpa* var. oblique and 1 No. record for

Green-tufted Stubble-moss (*Weissia controversa*), both are listed as data deficient (dd) Irish Red List of Bryophytes from the Study Area.

5.2.6 Fish and Shellfish

5.2.6.1 Freshwater Pearl Mussel

According to the NPWS rare and protected species database there are historical (1903) records for Freshwater Pearl Mussel (*Margaritifera margaritifera*) from the 10km Grid Squares W67. Post 1987 records are for dead shells only. Freshwater Pearl Mussel is listed on Annex II of the EU Habitats Directive. The River Lee upstream of the Study Area supports Freshwater Pearl Mussel at Inchigeelagh. There are 10 No. records for Freshwater Pearl Mussel from the 10km Grid Squares W36 and W37.

The following tributaries of the River Lee are also known to support Freshwater Pearl Mussel:

- Lough Lua;
- Foherish (River Code 19/F/02);
- Laney (River Code 19/L/01);
- Sullane (River Code 19/S/02);
- Toon (River Code 19/T/02); and
- Bealaphadeen.

The works along the River Lee are not located in a Margaritifera Sensitive Area.

5.2.6.2 Lamprey

According to the NPWS Rare and Protected Species Records and the National Biodiversity Data Centre there are records for brook lamprey (*Lampetra planeri*) and sea lamprey (*Petromyzon marinus*) from the River Lee in the Study Area. Fish stock surveys carried out in the River Lee in 2013 in the Lee Fields area as part of the Water Framework Directive recorded Lamprey sp. present in the River Lee. All three Lamprey species are listed on Annex II of the EU Habitats Directive.

5.2.6.3 Atlantic Salmon

The River Lee is a designated salmonid watercourse under S.I. No. 293/1988 - European Communities (Quality of Salmonid Waters) Regulations, 1988. The River Lee contains 1.01% of the fluvial accessible habitat to Atlantic salmon (*Salmo salar*), ranking it 22nd nationally according to the Quantification of the Freshwater Salmon Habitat Asset in Ireland (McGinnity et al., 2003). Innishcarra dam is also a renowned Atlantic salmon fishery Atlantic salmon was recorded from the River Lee in 2013 during fish stock surveys undertaken as part of the Water Framework Directive. Atlantic salmon is listed on Annex II of the EU Habitats Directive.

5.2.6.4 European Eel

According to the National Biodiversity Data Centre (2014) there are records for European eel (*Anguilla anguilla*) from the Study Area. European eel was recorded from the River Lee in 2013 during fish stock surveys undertaken as part of the Water Framework Directive. European eel also occur on the south channel of the River Lee, downstream of the campus of University College Cork in 'the Gillabey Rock' area especially during the autumnal migration of silver eel (despite known declines in eel populations).

5.2.6.5 Brown Trout

Brown trout was recorded from the River Lee in 2013 during fish stock surveys undertaken as part of the Water Framework Directive.

5.2.6.6 Twaite Shad

According to the NPWS Rare and Protected Species Records there is 1 No. record for Twaite Shad (*Alosa fallax*) from the Study Area.

5.2.6.7 Other species

Numerous estuarine species are known from the lower reaches of the Lee from where the main channel splits into the north and south channels as far as Tivoli Docks, including flounder, thick-lipped grey mullet (*Chelon labrosus*), plaice (*Pleuronectes platessa*), juvenile pollock (*Pollachius pollachius*), juvenile cod (*Gadus morhua*), common goby (*Pomatoschistus microps*), sand goby (*Pomatoschistus minutus*), five-bearded rockling (*Ciliata mustela*), fifteen-spined stickleback (*Spinachia spinachia*), Nilsson's pipefish (*Syngnathus rostellatus*), scad (*Trachurus trachurus*) and sea trout (*Salmo trutta trutta*).

5.2.7 Birds

The Atlas of Breeding Birds in Britain and Ireland' (Sharrock, 1976), 'The New Atlas of Breeding Birds in Britain and Ireland: 1988-1991' (Gibbons et al., 1993), 'The Atlas of Wintering Birds in Britain and Ireland' (Lack, 1986) and The Bird Atlas 2007-2011 online Mapstore (http://app.bto.org/mapstore/StoreServlet) were consulted for information regarding the distribution of birds in Ireland. These atlases show data for breeding and wintering birds respectively in individual 10 km by 10 km squares.

Table 5.2 lists those species that are recorded in the Bird Atlases for the Study Area and are also protected under the EU Birds Directive or mentioned on the Birds of Conservation Concern in Ireland (BoCCI) red list. Birds listed under Annex I are offered special protection by the EU Birds Directive.

Table 5.2 Bird Atlas Data

Common Name	Scientific Name	Annex I	BoCCI red list
Hen Harrier	*Circus cyaneus*	Yes	No
Peregrine	*Falco peregrinus*	Yes	No
Corncrake	*Crex crex*	Yes	Yes
Kingfisher	*Alcedo atthis*	Yes	No
Merlin	*Falco columbarius*	Yes	No
Dunlin	*Caladris alpina*	Yes	No
Common Tern	*Sterna hirundo*	Yes	Yes
Whooper Swan	*Cygnus cygnus*	Yes	No
Lapwing	*Vanellus vanellus*	No	Yes
Curlew	*Numenius arquata*	No	Yes
Herring Gull	*Larus argentatus*	No	Yes
Blackheaded Gull	*Larus ridibundus*	No	Yes
Yellowhammer	*Emberiza citrinella*	No	Yes
Shoveler	*Anas clypeata*	No	Yes
Pintail	*Anas acuta*	No	Yes
Knot	*Caladris canutus*	No	Yes
Little Egret	*Egretta garzetta*	Yes	No
Golden Plover	*Pluvialis apricaria*	Yes	Yes
Barn owl	*Tyto alba*	No	Yes
Grey Wagtail	*Motacilla cinerea*	No	Yes
Roseate Tern	*Sterna dougallii*	Yes	No
Common tern	*Sterna hirundo*	Yes	No

A number of birds listed on Annex I of the EU Birds Directive have been recorded as breeding and wintering within the Study Area. In particular, the River Lee itself is known to support kingfisher throughout its length.

Barn owl, which is listed on the Red list of Birds of Conservation Concern has been known to nest in the Leemount area.

Many wintering bird species winter on farmland and flat coastal areas, tidal mudflats and estuaries, coastal lagoons, inland lakes and scrub. All of the species listed in Table 5.2 are potentially found at the locations of the proposed works. In particular, wintering bird species are likely to use areas of agricultural grassland and amenity grassland in the Study Area as feeding grounds.

In addition to the above atlas data, there is a cormorant (*Phalacrocorax carbo)* roost to the east of Mardyke Bridge along the tidal section of the River Lee north channel in Cork City. Up to 30 No. birds have been recorded during summer months roosting in mature Willow and Alder trees. Cormorants breed predominantly in colonies around the coast of Ireland on cliffs, however some birds breed inland in trees. Cormorant is Amber listed on the BoCCI list due to its localised breeding population. The European population has been evaluated as secure.

Oystercatcher, Black-tailed Godwit, Golden Plover and Curlew are known to feed during the winter months on wet farm grassland, i.e. Oystercatcher are known to feed in the Lee fields on amenity grassland adjoining the roads and on roundabouts in the city. Oystercatcher is amber listed on the BoCCI list. Grey wagtail (*Motacilla cinerea*) nests in the Lee Road Bridge over the River Shournagh, upstream of its confluence with the Lee. Grey wagtail is red listed on the BoCCI list due to declines in breeding populations.

The River Lee itself supports a range of more common species including Moorhen, Mallard, Grey Heron and Cormorant. According to local residents in the Ballincollig Little Egret is also known to occur occasionally on the River Lee in the area.

5.2.7.1 Whooper Swan

A desktop survey was undertaken to identify the numbers and distribution of Whooper Swan (*Cygnus cygnus*) on the River Lee within the study area, in particular within the vicinity of Innishcarra Reservoirs. The desktop review highlighted the following important Whooper Swan sites on the River Lee in the study area:1) Innishcarra Reservoir which consists of three sub-sites; The Gearagh, Sullane Delta, Dunisky Culvert and 2) Toon Valley, which consists of two sub-sites; Toon River Callows, Parkanillane and River Lee (Annahala West) (see Table 5.3 for Locations). The majority of records for Whooper Swan are from Innishcarra Reservoirs with only a small number of records coming from Toon Valley. In particular, The Gearagh appears to be the most important sub-site at Innishcarra for Whooper Swan, supporting the greatest numbers of any of the three sub-sites which make up Innishcarra Reservoir. Peak winter counts for Whooper Swan in The Gearagh for the period 2008/09 to 2012/13 indicate a population size of 107.

A peak of 89 birds were recorded on the fields on the western shore of the Gearagh in 2014. In 2015 Whooper swan began to arrive at the Gearagh in late October and gradually increased in numbers to peak at 71 birds in early December. In October 2016, 9 birds arrived back but (likely to be due to disturbance caused by shooting), these birds abandoned the area and to date have not yet returned (Aidan Duggan pers. comm.).

The Gearagh is located >30 km upstream of the proposed works, however changes to the hydrological regime at Innishcarra Dam have the potential to impact on water levels in the Gearagh.

According to the National Biodiversity Data Centre there are also records for Whooper Swan on the River Lee further downstream of the Innishcarra Reservoirs in the 10km Grid Squares W47, W57, W67 and W77. Whooper swan is also known to occur in Cork Harbour.

Table 5.3 Important sites for Whooper Swan on the River Lee

Site Name (Main Site)	Sub-sites	National Grid Reference
Innishcarra Reservoir	Innishcarra Reservoirs (whole site)	W330 700
	The Gearagh	W330 700
	Sullane Delta	W360 710
	Dunisky Culvert	W383 685
Toon Valley	Toon River Callows, Parkanillane	W290 702
	River Lee (Annahala West)	W305 700

5.2.7.2 NBDC records

In addition to the above bird species, there are also records for Annex I bird species Red-billed Chough (*Pyrrhocorax pyrrhocorax*) and Short-eared Owl (*Asio flammeus*) from the 10km Grid Squares which overlap with the footprint of the proposed works.

5.2.8 Mammals

5.2.8.1 Otter

The River Lee is known as an important habitat for Otter (*Lutra lutra*) and the species are found from the upper reaches of the River Lee as far downstream as Cork Harbour. Otter are protected under Annex II & IV of the EU Habitats Directive (92/43/EEC).

The Cork Urban Otter Survey was conducted between 2011 and 2012 identified a minimum population of 11 otters in the city area. Otter records are abundant from the County Hall Salmon Weir on the River Lee (Carrigrohane) downstream on both the north and south channels as far as the port of Cork. The majority of the records available are of Otter scats recorded during the Cork City Urban Otter Survey while a small number of visual records have also been submitted (NBDC, 2014).

5.2.8.2 Bats

According to the National Biodiversity Data Centre there are records for Common Pipistrelle (*Pipistrellus pipistrellus*), Soprano Pipistrelle (*Pipistrellus pygmaeus*), Daubenton's Bat (*Myotis daubentoni*), Leisler's Bat (*Nyctalus leisleri*), Natterer's Bat (*Myotis nattereri*), Brown Long-eared Bat (*Plecotus auritus*) and Lesser Horseshoe Bat (*Rhinolophus hipposideros*) from the Study Area. Existing bat records within the study area (sourced from Bat Conservation Ireland's National Bat Records Database) also identify Whiskered Bat (*Myotis mystacinus*) records within the works area. All Irish bat species are protected under the Wildlife Act (1976) and Wildlife Amendment Acts (2000 & 2010). Bats are also protected under Annex IV of the EU Habitats Directive. Across Europe, they are further protected under the Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention 1982), which, in relation to bats, exists to conserve all species and their habitats. The Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention 1979, enacted 1983) was instigated to protect migrant species across all European boundaries. The Irish government has ratified both these conventions.

5.2.8.3 Harbour Seal and Grey Seal

There are records for harbour seal (*Phoca vitulina*) and grey seal (*Halichoerus grypus*) from the 10km Grid Square W67. The species are listed on Annex II and V of the EU Habitats Directive.

5.2.8.4 Other Mammals

There are also records for Badger (*Meles meles*), Irish stoat (*Mustela erminea*), Red squirrel (*Sciurus vulgaris*), Eurasian pygmy shrew (*Sorex minutus*) and Irish Hare (*Lepus timidus*) from the Study Area.

5.2.9 Other Aquatic Species

According to the National Biodiversity Data Centre (2016) and the NPWS Rare and Protected Species database there are records for both Smooth newt and Common frog (*Rana temporaria*)from the Study Area. Although the fast flowing waters of the main channel are unlikely to support these species, drains and ditches throughout the works area are likely to provide suitable habitat.

5.2.10 Invertebrates

According to the National Biodiversity Data Centre (2016) there are records for Marsh fritillary (*Euphydryas aurinia*) from the 10km Grid Squares W66. Marsh fritillary is dependent upon the presence of its larval host plant, Devil's Bit Scabious (*Succisa pratensis*). The species is listed on Annex II of the EU Habitats Directive.

5.2.11 Water Quality

The EPA website, http://gis.epa.ie/Envision, contains information regarding water quality in selected Irish rivers based on surveys carried out by the EPA as part of the Water Framework Directive (WFD) Monitoring Programme. Biological information is provided in the form of Q values.

Information was gained on the River Lee as a whole, including monitoring within or very close to the study area and upstream. The Q status of the River Lee at Leemount Bridge, within the study area, is Q4 – Good status. The water quality of the River Lee at Innishcarra Bridge, in proximity upstream of the works is, is Q3-4 – Moderate status.
The lower reaches of the River Lee, has "moderate" status under the Transitional Waterbody Water Framework Directive Status (2010-2012 monitoring results).

5.3 Field Surveys

The wider study area was first visited on the 18th June 2013. During this visit, the general habitat types within the Study Area were observed and photographed. The purpose of this was to observe the habitats in the area first hand and to ground truth the findings of the desk study. No detailed floral or faunal surveys were carried out during this visit.

A further and more detailed survey of the River Lee and its tributaries was carried out in April and May 2014 and in April 2015. The survey extended from the channel floodplain and immediate surrounding areas of the river Lee as far as Innishcarra. A number of smaller tributary rivers were also surveyed including the Curragheen, Glasheen and Bride North. The river was systematically walked and each feature (e.g. riffle, pool or glide) was defined visually and mapped using gps technology. These features were then

described in terms of substrate conditions, flow path aquatic macrophytes, invertebrate communities and habitat variation and quality. Substrates were classified by particle size and named in accordance with the EPA, Rivers and Streams Ecological Assessment Field Sheet. Surveys of the terrestrial bankside habitats and mammalian and avifaunal activity were also undertaken. Suitability of habitats for Freshwater Pearl Mussel (*Margaritifera margaritifera*), Lamprey species (*Lampetra* sp and *Petromyzon* sp.) and salmonids was also assessed during this survey.

A number of targeted specialist surveys were carried out between August and November 2014, following consultation with NPWS and again in 2015 (refer to Table 5.1 for details of these surveys). These surveys were undertaken on small sections of the River Lee in July 2016 following the addition of new works locations.

5.3.1 Habitats and Flora

The study area for this chapter encompasses the channel, floodplain and immediate surrounding areas of the River Lee from the Innishcarra Dam extending along the main channel of the river to the Lee Estuary. The River Lee is joined by a number of small tributaries within the study area including the Bride West, Shournagh, Curragheen and Glasheen Rivers (Figure 5.1). The ecological character of the study is described below in terms the habitats (as per Fossitt, 2000. A Guide to Habitats in Ireland) present within and adjacent to the footprint of the proposed works. Where habitats are found to have links to or correspond to Annex I habitat the habitats are described in accordance with EC (2007). The habitats within the study area along the works corridor are described below.

5.3.1.1 Depositing Lowland Rivers (FW2)

The River Lee between Innishcarra Dam and Cork City has a meandering profile dominated by deeper glide habitat and pool with lesser amounts of riffle. The faster flowing areas of river are characteristically shallower and support large stands of stream water crowfoot as a result. The invasive plant Nuttall's pondweed invaded slower moving backwaters and bays off the main river channel. The areas of river supporting lush growth of *Ranunculus* are representative of the Annex I Habitat, Floating River Vegetation i.e. Water courses of plain to montane and Callitricho-Batrachion vegetation [3260]. The River Lee has a well intact and continuous mature riparian tree line along both banks for the majority of its course between Innishcarra Dam and Cork City. Areas of bank grade locally from drier meadow habitat with Reed canary grass (*Phalaris arundinacae*), Meadowsweet (*Filipendula ulmaria*), Purple loosestrife (*Lythrum salicaria*), Great willowherb (*Epilobium hirsutum*) and Alexanders (*Smymium olusatrum*) into inundation vegetation communities of Water pepper (*Persicaria hydropiper*), Marsh ragwort (*Senecio aquaticus*), Hemlock water dropwort (*Oenanthe crocata*), Wild angelica (*Angelica sylvestris*), Water mint (*Mentha aquatica*) and Water Figwort (*Scrophularia auriculata*), along with rarer examples of Water parsnip (*Berula erecta*) and Fool's watercress (*Apium nodiflorum*).

5.3.1.2 Drainage Channel (FW4)

A short, narrow (1m) drainage channel was recorded in the Ballincollig area (Coolyduff), adjacent to (and flowing into) an area of wet willow woodland (WN5) (works area LL205). The channel is heavily vegetated (>95% cover) with Fool's watercress and some marginal Reed canary grass, and held little water at the time of survey. Although the small section of channel may hold more water during periods of flooding, it offers little to no fisheries value although it may be suitable for amphibians.

5.3.1.3 Amenity Grassland (GA2)

Amenity grassland is present mostly as small, maintained patches throughout the works area. A relatively large lawn, with frequent ornamental beds (BC4), is located adjacent to the proposed flood defence levee in the works area in Ballincollig, separated from the works area by a linear strip of ornamental cotoneaster-dominated hedgerow (WL1). The garden contains a small ornamental garden pond (FL8) – see below. Amenity grassland is also present in the Lee Fields, to the south of the river, and Fitzgerald's Park (where it is described under the habitat classification Scattered trees and parkland).

5.3.1.4 Artificial Pond (FL8)

A small ornamental garden pond, with typical assemblage of ornamental plant species, is located adjacent to proposed flood defence levee works (works area LL205) in the Ballincollig area (Coolyduff), within a residential garden. The pond has no connectivity with the River Lee or its floodplain and is not considered to be of ecological value. A small artificial pond is also present in Fitzgerald's park (works area LL216) and supports White water lily (*Nymphaea alba*), Nuttals Pondweed (*Elodea nuttallii*) and Flowering Rush (*Butomus umbellatus*).

5.3.1.5 Old Sea Walls (CC1) & Tidal Channel (CW2)

The Lower reaches of the River Lee can be considered a tidal channel between Wellington Bridge on the North Channel and the Gillabey Rock on the South Channel to the Port of Cork where the channels converge. The brackish water permits the presence of Channel Wrack and abundant *Ulva* sp. that attach to the tidal walls along the water line. The walls themselves above the high water line support Ivy (*Hedera Hibernica*), Ivy Leaved toadflax (*Cymbalaria muralis*) and Maiden Hair spleenwort (*Asplenium trichomanes*). Pellitory-of-the-Wall (*Parietara Judaica*) was more common in the city centre. Two large perennial species Water figwort (*Scrophularia auriculata*) and Butterfly bush (*buddleja davidii*) are locally frequent between Wellington Bridge and the Port of Cork while Hemlock Water dropwort (*Oenanthe crocata*) was common where it found a rooting opportunity near the water. A small tidal channel (Distillery Channel) also runs close to the U.C.C. North Mall Campus and is surrounded by mixed broadleaved woodland (works areas LL217-LL208).

5.3.1.6 Scattered Trees and Parkland (WD5)

Scattered trees and parkland habitat is present at a number of locations in the vicinity of the flood relief works areas. The two most notable areas are the Lee Fields (works area LL209-LL211) on the south bank of the river, and Fitzgerald's Park (works area LL214-215). Fitzgerald's Park has a very diverse assemblage of ornamental trees including Field maple (*Acer campestre*), Weeping ash (*Fraxinus excelsior pendula*), Giant sequoia (*Sequoiadendron giganteum*), Whitebeam (*Sorbus Hibernica*), Hornbeam (*Carpinus betulus*), Basswood (*Tilia Americana*) and Yew (*Taxus baccata*). The park also contains flower beds and borders with ornamental species including the Hostas: Giant Blue hosta and Plantain lily, Green carpet (*Pachysandra terminalis*), Feather Reed grass (*Calamagrostis x acutiflora*) and Lady fern (*Athyrium filix-femina*). The border of the Park with the River Lee supports a host of invasive plants including the most alien Giant rhubarb (*Gunnera tinctoria*), with prominent stands of both Japanese knotweed (*Fallopia japonica*) and Himalayan balsam (*Impatiens glandulifera*) at its eastern boundary.

The Lee Fields which are one of the last natural flood plains in close proximity to the city support an abundance of mature trees including Sessile oak (*Qurcus petraea*), Field maple (*Acer campestre*), Sycamore (*Acer pseudoplatanus*) and Black poplar (*Populus nigra*) on the south bank of the river in the public park. A treeline of Alder (*Alnus glutinosa*), Grey willow (*Salix cinerea*) and Crack willow (*Salix fragilis*) is present on

the riparian margin of the Lee Fields. Throughout the park, trees are widely scattered with the exception of a more recent densely planted stand of Silver birch. The grassland is regularly maintained and contains species such as Perennial rye grass (*Lolium perenne*), White clover (*Trifolium repens*) and Ribwort plantain (*Plantago lanceolata*). Along the fringes of the Carrigrohane Road, Groundsel (*Senecio vulgaris*), Red dead nettle (*Lamium purpureum*), Redshank (*Persicaria maculosa*), Wavy bittercress (*Cardamine flexuosa*) and Curled dock (*Rumex crispus*) are locally frequent.

5.3.1.7 Old Stone Walls (BL1)

Adjoining Innishcarra Bridge to the south of the river (works area LL203) an old stone wall extends for some distance and supports abundant Navelwort (*Umbilicus rupestris*), Ivy, Ivy Leaved toadflax and Maiden Hair spleenwort (*Aspelnium trichomanes*). Other species include Mouse Ear chickweed (*Cerastium fontanum*) and Intermediate polypody (*Polypodium interjectum*).

5.3.1.8 Riparian Woodland (WN5)

A small but valuable patch of willow-dominated riparian woodland exists immediately adjacent to proposed works areas on the middle reaches of the Lee, downstream of Ballincollig weir at Coolyduff (works area LL205). Both Grey and Sally willow (*Salix cinerea* sub species *oleifolia* and *cinerea*) are the predominant species (invariably >5-6m in height), along with infrequent Osier (*Salix viminalis*), Reed Canary Grass (*Phalaris arundinacae*) and Nettle (*Urtica dioica*) on the fringes. The block is adjoined to the east by a typical riparian treeline (along the River Lee) composed of Ash, Alder and Grey willow. This area of woodland represents a drier form of the habitat, with inundation occurring only during winter floods or particularly high water levels.

A small area of riparian woodland that historically formed part of an active floodplain (ref: historic OSI mapping), but now is in the form of a drier type willow-dominated woodland is also present at the Coolyduff site (works area LL205). This woodland block currently covers <1000m^2 due to previous residential building and agricultural clearance and would have stood historically as a more pristine example of riparian woodland on the edge of the River Lee floodplain. Species composition is poor, with mature Grey and Sally willow dominating with a scrub-like understorey of bramble, nettle and rank grass species adjacent to open GS2 habitat. Due to drainage, this block currently corresponds poorly to WN5 woodland (as per Fossitt). Perrin et al. (2008a), in the National Survey of Native Woodlands 2003-2008 state that 'many riverside woodlands would not match the vegetation of the WN5 category well but are nevertheless technically riparian'. The riparian woodland encountered does not fall into a specific category under the newer classification of Perrin et al. (2008b), as it is subject only to highly infrequent inundation under extreme winter flood conditions with drier conditions prevailing, as reflected by a drier understory species assemblage.

A semi-mature riparian woodland block of 0.65 acres with a composition of semi-mature, thickly planted trees between 10 and 15 years in age (approx. 6-8m high) is present on the back Lee Road (works area LL212). The tree composition comprises Sally willow and Alder. The woodland is a drier form of riparian woodland with only very seasonal inundation occurring during winter floods. The ground flora is limited given the thickset nature of the stand and evident heavy shading limits species to small pockets of Creeping bent grass (*Agrostis stolonifera*) and Common striated feather-moss (*Eurhynchium striatum*). Bramble (*Rubus fruticosus*), Nettle and Reed canary grass are common in the more open margins of the woodland stand.

A second wetter form of riparian woodland occurs where seasonal inundation of water is present near the split of the River Lee into its north and south channels (works area LL214). It contains mature Crack willow, Grey willow and localised Sally willow with more localised alder. Himalayan balsam and to a lesser degree Japanese knotweed are present on higher ground. In the understory muddy exposed patches of nutrient-rich sediment support Wild angelica, Hemlock Water dropwort, Water mint and Water figwort.

5.3.1.9 Mixed Broadleaved Woodland

A section of woodland with occasional Oak, Ash, Willow, Sycamore and Downy Birch (*Betula pubescens*) (12m height), Bracken, Bramble, with occasional Lords and Ladies, gorse and holly in the understory is present to the north of the bend in the river at Curraghbeg (works area LL201).

A large area of mixed broadleaved woodland is present adjoining the Distillery channel (CW2) at the U.C.C. North Mall Campus (works area LL217). The woodland is dominated by mature Alder adjacent to the Distillery channel, with frequent Sycamore and localised Ash. Buddleia is common in the understory with a small number of Grey willow. Ground herbs included abundant Hogweed (*Heracleum sphondylium*), Cleavers (*Galium aparine*) and Nettle. Ivy carpets any areas where light and leaf litter permit its dominance alongside Bracken (Pteridium aquilinum). Wetter patches of shaded organic rich soil support ramsons (*Allium ursinum*), Three Cornered garlic (*Allium triquetrum*) and, closer to the water, Pendulate sedge (*Carex pendula*) and Hemlock Water dropwort. Winter heliotrope (*Petasites fragrans*) bramble and rank grasses are common in the open margins. The invasive plant Himalayan balsam is locally frequent in the understory in shaded areas and the woodland as a whole grades into one of the largest stands of Japanese knotweed in Cork City to the south.

5.3.1.10 Treelines

Treelines are frequent throughout the works area. They include natural treelines on the margins of the river and planted treelines in Cork City centre and elsewhere. The River Lee downstream from Innishcarra is characterised by dense, often continuous riparian treelines. The treelines bordering the river consist predominantly of Grey willow and Crack willow, with Alder and Sycamore also prominent, and to a lesser extent Sally willow. The composition varies widely between these species depending on the section of river. Ash is more localised on riparian treelines (especially near Ballincollig) with Elder and Buddleia being locally frequent in the understory. Trees in the riparian areas are mature and large, up to 16m. Treelines in areas subject to seasonal inundation of water have mud banks underneath with paludal flora including Water mint, Hemlock Water dropwort, Water horsetail (*Equisetum fluviatile*) and Marsh ragwort. Small stands of invasive Himalayan balsam were increasingly frequent from the lower Lee Fields as far as the North Mall. Downy birch is common in the treelines of the lower Curaheen River. Invasive Japanese knotweed encroachment is common on the Curaheen River. The treeline under stories support abundant Sweet briar, often entangled with the semi-invasive plant Traveller's Joy (*Clematis vitalba*).

Good natural linear riparian treeline habitat is present within (along) and adjacent to the proposed flood defence works areas in the following locations:

- **LL206 (Chainage C012705-C0112892 & C0112550)**: Riparian treeline of Alder and Willow species on the north bank that occasionally grades into scrub containing invasive species such as Japanese knotweed.
- **LL210-LL213 (Chainage C015450-C016766)**: Riparian treelines of Alder, Weeping willow, Grey willow, Black poplar and Downy birch on the south bank in Lee Fields adjacent to works and riparian

treeline of Ash, Crack willow and Sally willow and Alder both within and adjacent to works areas on the north bank of the river. On the south bank of the river, the public park between Carrigrohane Road and the Kingsley Hotel, which forms part of the Lee Fields, also supports a number of mature trees within the works area.

- **LL215 (Chainage C014667-C014785, C014591-C014642 & C014540):** Riparian treeline of Alder and occasional Willow, Black poplar and Ash on the north bank of the north channel. Sycamore and Alder treeline on the south bank of the north channel, adjacent to Mardyke Sports Ground.
- **LL216 (Chainage C014100-C014550 approx.):** Riparian treeline in Fitzgerald's Park (majority to be retained). Mature riparian Willow and Ash treeline along the north channel to the east of Fitzgerald's Park and the tennis grounds.
- **LL217 (C013537-C013688, C013700-C01-3750 approx., C013725 & C013950)):** 14m high mature Alder and Willow treeline further downstream on the north channel south bank between the tennis grounds and the UCC Lee Maltings Campus.

Treelines in the city centre have been planted within the concrete structure of the pathways in small enclosed beds adjoining the River Lee and as such are discontinuous. The majority of the treelines comprise Small Leaved Lime, with more localised ornamental species including Sergeant's cherry (*Prunus sargentii)*, Bird cherry (*Prunus padus*), Whitebeam and Hornbeam. A mature specimen of the atmospheric pollution tolerant hybrid tree species London plane (*Platanus × acerifolia*) is also found on O' Sullivans Quay. On the Mardyke walkway mature Poplar, Willow, Horse chestnut (*Aesculus hippocastanum)*, Beech (*Fagus sylvatica*) and Sycamore to 16m in height are present, grading into a double treeline on the north bank on approach to the North Mall.

5.3.1.11 Hedgerows

Hedgerows are present throughout the works area, typically on property boundaries and often grading into treelines. They include ornamental species such as Griselinea, Privet (*Ligustrum sp.*), Laurel (*Prunus laurocerasus*), Cotoneaster and coppiced Leylandi cypress. Native hedgerows are dominated by Hawthorn, with smaller amounts of Elder. Other rarer species included Wych elm (*Ulmus glabra*), Hazel (*Coryllus avellana*) and Poplar species. Hedgerows are coppiced and cut back in many places and often invaded by Travellers joy and to a lesser extent Buddleia (*Buddleja davidii*).

Invasive Japanese knotweed, and to a lesser extent Giant rhubarb, was also present in hedgerow near some residential properties (works area LL206), all within proposed works area boundaries, but were not present in sufficiently large areas to be classified as invasive scrub (WS3).

5.3.1.12 Dry Meadows and Grassy Verges (GS2)

Very good examples of this habitat exist in the lands bordering the old John A. Woods concrete works site near the confluence of the River Bride at Curraghbeg (works area LL201). Here locally diverse stands of GS2 exist fronting the river and in patches of shallow stony soil that adjoin the large expanses of the abandoned concrete works site. Grass does not dominate the meadow and because of the stonier and thinner soil, flowering species have more opportunity to share the habitat. In addition, the gradation from drier areas to damper areas adjoining the river to the east further enhances botanical diversity. Grasses include Rough meadow grass, Cocksfoot (*Dactylis glomerata*), False oat grass (*Arrhenatherum elatius*) and Yorkshire fog (*Holcus lanatus*). Flowering species such as Common bird's foot trefoil (*Lotus corniculatus*) is frequent alongside Bush vetch (*Vicia sepium*). In the drier less grassy margins flowering species such as Common field

speedwell (*Veronica agrestis*), Herb robert (*Geranium robertianum*) and Common fumitory (*Fumaria officinalis*) are present. Forb species include Rosebay willowherb (*Chamerion angustifolium*), Charlock (*Sinapsis arvensis*), Ragwort (*Senecio jacobaea*), Alexanders (*Smyrnium olusatrum*), Wild carrot (*Daucus carota*), Hogweed, Purple loosetrife (*Lythrum salicaria*) and Hemp agrimony (*Eupatorium cannabinum*). On damper ground meadowsweet (*Filipendula ulmaria*), Ragged robin (*Lychnis flos-cuculi*), Purple loosestrife and Marsh ragwort are present, while the umbellifer species Hemlock water dropwort is common on the edges of the wetter margins towards the river. Small patches of Hairy bittercress (*Cardamine hirsute*) were recorded locally in stoney sandy areas.

Other poorer examples of GS2 habitat throughout the works area contain Rough meadow grass (*Poa trivialis*), Cocksfoot, Nettle, Hogweed, Lanceolate plantain, Common knapweed (*Centaurea nigra*) and False brome (*Brachypodium sylvaticum*). Some of these are occasionally mowed and treated with herbicide for weed species.

5.3.1.13 Reed and Large Sedge Swamp (FS1)

A small and rare area (<250m^2) of sparse reedswamp (FS1) habitat is present within the works area at the "Riverside" residential property, opposite Ballincollig Regional Park (works area LL206). A linear strip of Reed canary grass is present along the river margin, with some limited examples of Purple loosestrife, Hemp agrimony and Great willowherb (*Epilobium hirsutum*). This area is subject to frequent inundation at high water levels. Adjoining areas of gravel substrate support Water pepper (*Persicaria hydropiper*), Water parsnip (*Berula erecta*) and Fool's watercress (*Apium nodiflorum*).

Whilst the area of gravel beds on which the FS1 is located do not grade into a specific Fossitt category, the habitat should be noted as littoral riverine gravel shoals capable of supporting many species of plant in addition to those mentioned (e.g. Redshank, Monkeyflower (*Mimulus guttatus*), Bittercress, Water Mint etc.).

5.3.1.14 Coniferous Plantation (WD4)

Only one area of new growth coniferous plantation was recorded at Curraghbeg, downstream of Innishcarra Dam (works area LL201). Three-four year old Sitka spruce (<1.5m in height) has been planted at this location. The open patches between the conifers support Great willowherb, Perennial sowthistle (*Sonchus arvensis*), Field horsetail (*Equisetum arvense*), Birdsfoot trefoil, creeping thistle (*Cirsium arvense*) and Charlock.

5.3.1.15 Scrub (WS1)

Areas of scrub occur throughout the works area. They are often adjoined treelines bordering the River Lee and comprise typical species such as Buddleia, Sally willow, Elder (*Sambucus nigra*) and Bramble. American willowherb (*Epilobium ciliatum*), Charlock, Winter heliotrope (*Petasites fragrans*) and Travellers Joy are also common in addition to Bindweed species with Bramble dominating some areas.

5.3.1.16 Buildings and Artificial Surfaces (BL3)

Concreted and man-made structures are present throughout the works area adjoining many of the habitats. They include the concreted surface expanses of the abandoned John A. Woods concrete works at Curraghbeg to the heavily urbanised reaches of Cork City. On occasion the periphery of these habitats are colonised by ruderals such as willowherb species, Nettle, Marsh woundwort (damp areas), Meadow grass, Sow thistle species, Scentless mayweed (*Tripleurspernum inodorum*), Fat hen (*Chenopodium album*), buddleia, Couch grass (*Elymus repens*), thistles, Knotgrass (*Polygonum aviculare* rare) and Greater plantain (*Plantago major*).

5.3.1.17 Improved agricultural grassland (GA1)

Improved grassland is present along the length of the River Lee upstream of Cork city. Agricultural pastureland for sheep grazing is present in the lands upstream of Innishcarra Bridge and intensive dairy farming in the Wood's Farm area adjoined the treelines and meadows of the River Lee. Improved grassland had characteristic species such as Perennial rye grass, Clovers (red & white), Ribwort plantain, Broadleaved dock, Dandelion and Creeping thistle.

5.3.1.18 Other notable habitats

O'Mahony (2009) refers to a swampy scrub wood at the western boundary of the Lee fields, on the north bank of the river which contains ditch horsetail, hybrid lesser marshwort, bladder sedge (*Carex vesicaria*), red currant (*Ribes rubrum*), summer snowflake (*Leucojum aestivum*), and black currant (*Ribes nigrum*). Dry calcareous embankments adjoining the scrub wood contain common twayblade (*Listera ovata*), goldilocks buttercup (*Ranunculus auricomus*), early purple orchid (*Orchis mascula*), and gooseberry. O'Mahony also refers to the margins of small ponds in the eastern extremity of the Lee Fields contains tubular water-dropwort (*Oenanthe fistulosa*), extremely rare in Cork (O'Mahony 2009). The works in this area (LL209-LL210) are confined to the south of the river.

Plate 5.1: River Lee Innishcarra Graveyard (FW2)

Plate 5.2: Tidal River Lee (CW2) in Cork City with old stone walls (CC1)

Plate 5.3: Scattered Trees & Parkland (WD5) with ornamental pond at Fitzgerald's Park

Plate 5.4: Old Stone Wall (BL1) – Adjoining Innishcarra Bridge

Plate 5.5: Riparian Woodland (WN5), back Lee Road

Plate 5.6: Mixed Broad Leaved Woodland (WD1) – North Mall U.C.C.

Plate 5.7: Mature Treeline (WL2) Mardyke Walkway

Plate 5.8: Coppiced hedgerow (WL1) alongside N22 at Carrigrohane

Plate 5.9: Dry Meadows & Grassy Verges (GS2)

Plate 5.10: Young Coniferous Plantation foreground (WD4)

Plate 5.11: Scrub (WS1)

Plate 5.12: Buildings & Artificial Surfaces (BL3)

Plate 5.13: Improved Grassland (GA1)

Plate 5.14: Invasive scrub (WS3) – Himalayan balsam alongside River Lee

Plate 5.15: Reed and large sedge swamps (FS1) – Reed canary grass alongside River Lee

Plate 5.16: Japanese knotweed growing alongside River Lee at "Riverside" Coolyduff

5.3.1.19 Floating River Vegetation

A floating river vegetation (FRV) survey was undertaken on the Lower River Lee catchment between Innishcarra Dam and Cork City in order to assess its distribution along the lower reaches of the Lee. Floating River Vegetation (FRV) habitat is widely distributed throughout the River Lee from Innishcarra Dam to Cork City (see Appendix 5B for details of the targeted survey). The habitat was dominated by *Ranunculus* vegetation which broadly defined its extent. Typically *Ranunculus* vegetation formed stands which covered large areas of channel in the shallower and faster flowing sections of river. While the habitat was present in water depths in excess of 1.5m its highest percentage cover was in shallower areas <1m deep. The *Ranunculus* zones were typically dominated by cobbles and/or gravel substrata. In these Ranunculus dominated zones macrophyte diversity was typically low, with *Fontanalis antipyertica* being the only other prominent submerged plant species within the FRV community present.

The high cover Ranunculus zones contained between 31-61%+ cover of Ranunculus vegetation and are marked as red or purple on Figures 5.3 & 5.4. These areas included but were not limited to the following areas; downstream of Iniscarra Dam, 'Poulavone', the 'Anglers Rest', the 'Doctors Stretch', 'Woods Farm' (Carrigrohane) and in the city suburbs at the 'Kingsley Hotel' (south Channel). Areas with high cover of FRV overlap with or lie in close proximity to the proposed works in works areas LL201 (no instream works), LL203 (no instream works), LL210 and LL211 (no instream works) and LL214 (instream works proposed at this location).

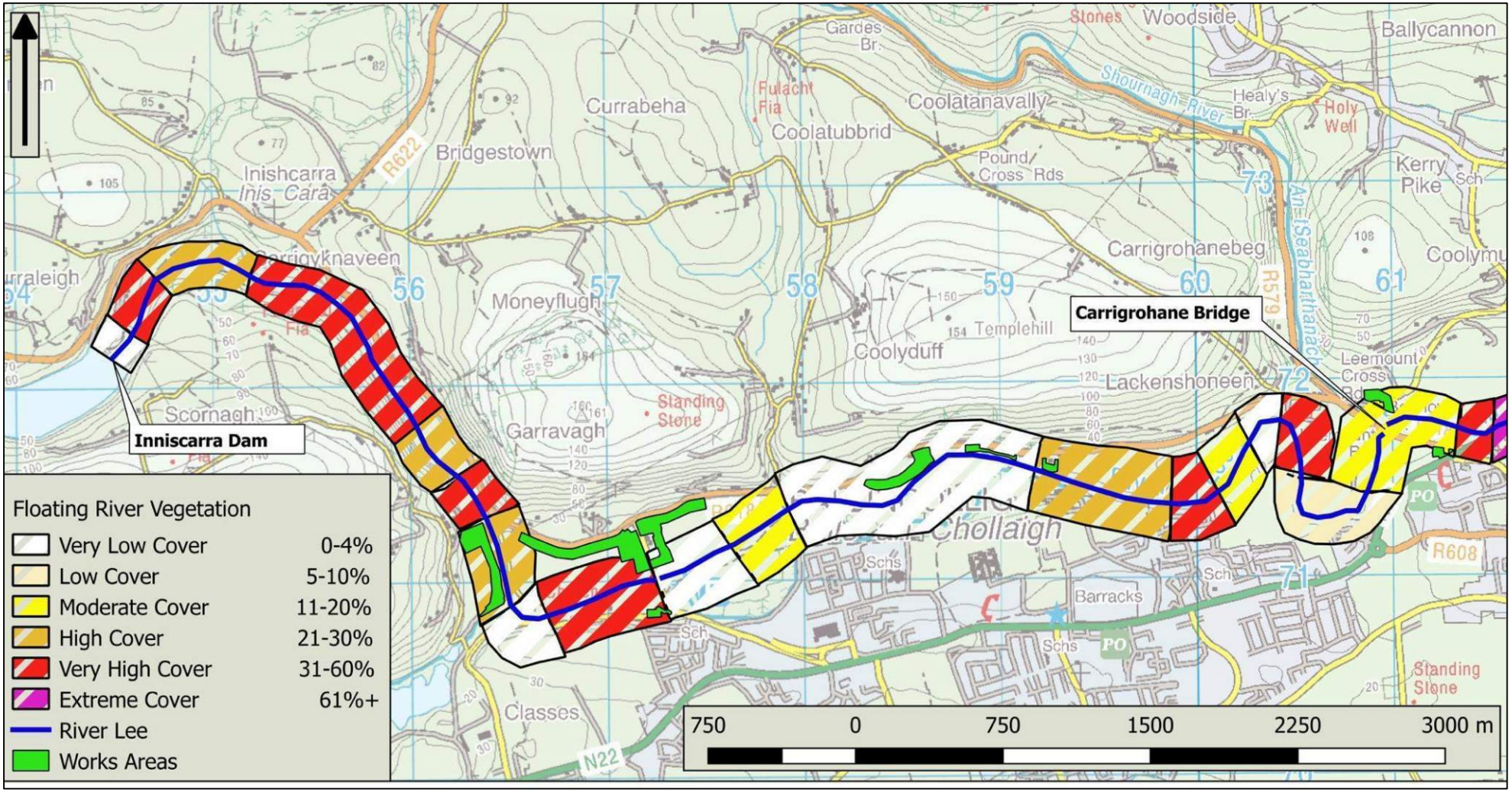

Figure 5.3 Percentage cover of Floating River Vegetation (FRV) along the River Lee

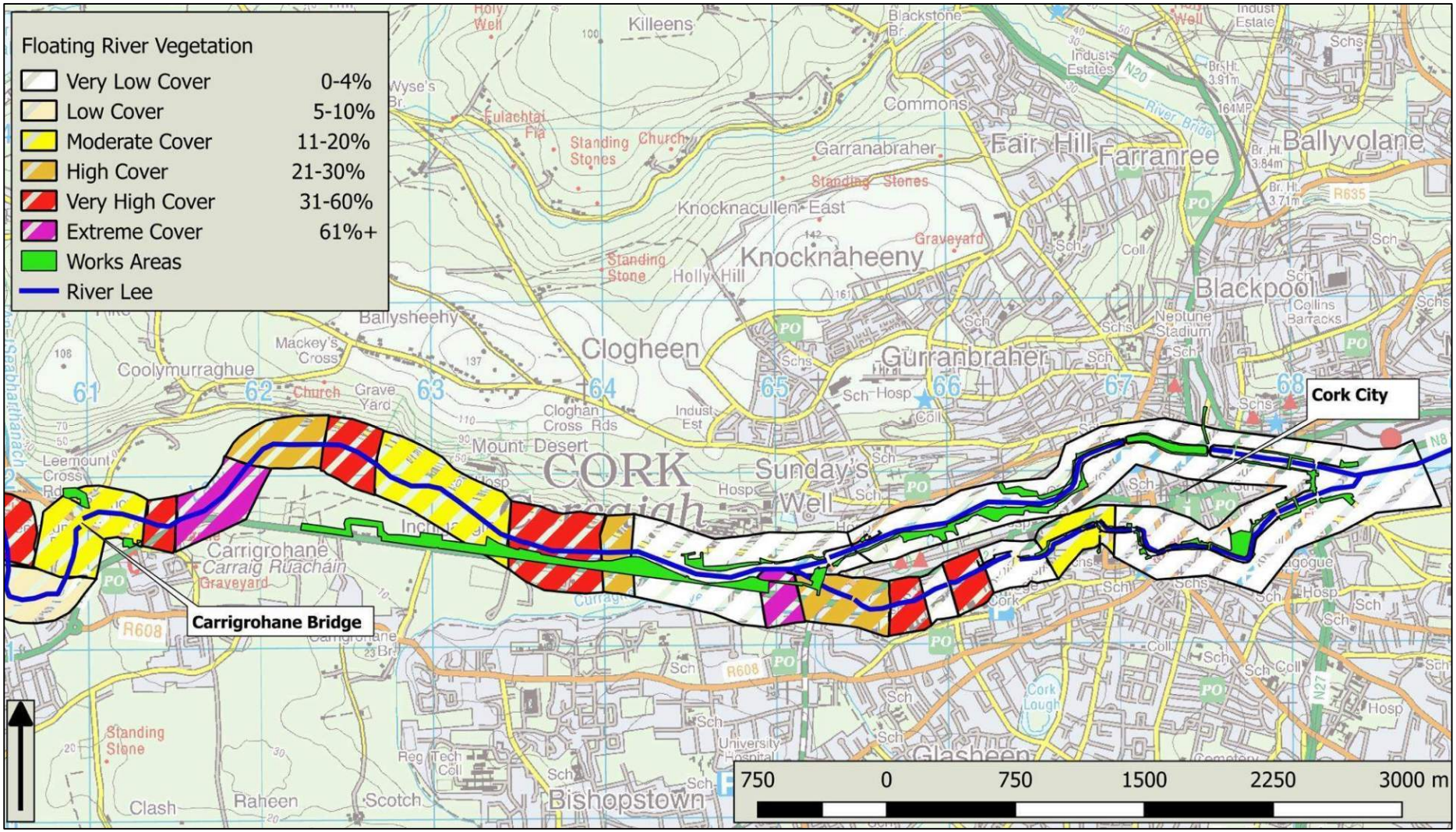

Figure 5.4 Percentage cover of Floating River Vegetation (FRV) along the River Lee

5.3.1.20 Invasive Plant Species

A targeted invasive plant species survey was carried out in 2014 to establish the distribution of invasive plants within the footprint of the proposed works. The survey targeted the invasive species Japanese Knotweed (*Fallopia japonica*), Giant Hogweed (*Heracleum mantegazzianum*), Giant Rhubarb (*Gunnera tinctoria*) and Himalayan Balsam (*Impatiens glandulifera*).

Invasive species were widespread throughout the works area. 5 No. invasive species (3 No. terrestrial, 2 No. aquatic) were recorded within the works area along the River Lee in the Study Area. 75 No. individual records of invasive species were documented during the survey of the Lower Lee, the Curragheen and the Glasheen rivers. The most commonly recorded species was Japanese Knotweed, which was especially frequent within Cork City boundaries, on the Lee and Curragheen rivers and was observed at 31 No. locations along the River Lee and 5 No. locations along the Curragheen river (refer to Appendix 5C for full details of the results of the survey including maps of invasive species locations). The next most common species recorded was Himalayan Balsam followed by Giant Rhubarb. Himalayan Balsam was recorded at 21 locations along the River Lee works areas. Giant rhubarb was locally frequent in Fitzgerald's Park and on the north bank of the River Lee opposite the park.

Nutall's Pondweed and the water fern *Azolla filiculoides* were also recorded. Nuttall's Pondweed, a submerged aquatic macrophyte previously unrecorded downstream of Innishcarra Reservoir, was recorded at 8 locations. It was widespread on the north bank on the River Lee in the Lee Fields in slack areas of water. The latter was recorded at a single small, wetland location at Hollymount, on the north bank of the Lee Fields.

A re-survey of the area was undertaken by Cork City Council in 2016 during which 12 invasive species, 7 of which are listed on the Third Schedule of The European Communities (Birds and Natural Habitats) Regulations 2011 Article 49 (2) of the regulations makes it an offence to disperse or cause to disperse or escape from confinement any non – native alien species as listed under the Third Schedule of the Regulations. Furthermore Section 50 of the Regulations prohibits the dealing in and keeping of certain species as listed in the Third Schedule. The implications of this results in the requirement of a license for disposal of non-native alien species at an offsite facility. Part 50 of the 2011 Regulation has not yet come into effect. Invasive species were again found to be widespread throughout the works area (Figure 5.5-5.10), in particular from Inchigaggin as far downstream as the location where the main channel splits into its north and south channels. Invasive species were also present in the works areas at Leemount Bridge and Ballincollig.

5.3.1.21 Rare and Protected Flora

No Annex II listed plant species or Flora Protection Order (FPO) species were recorded during the field surveys.

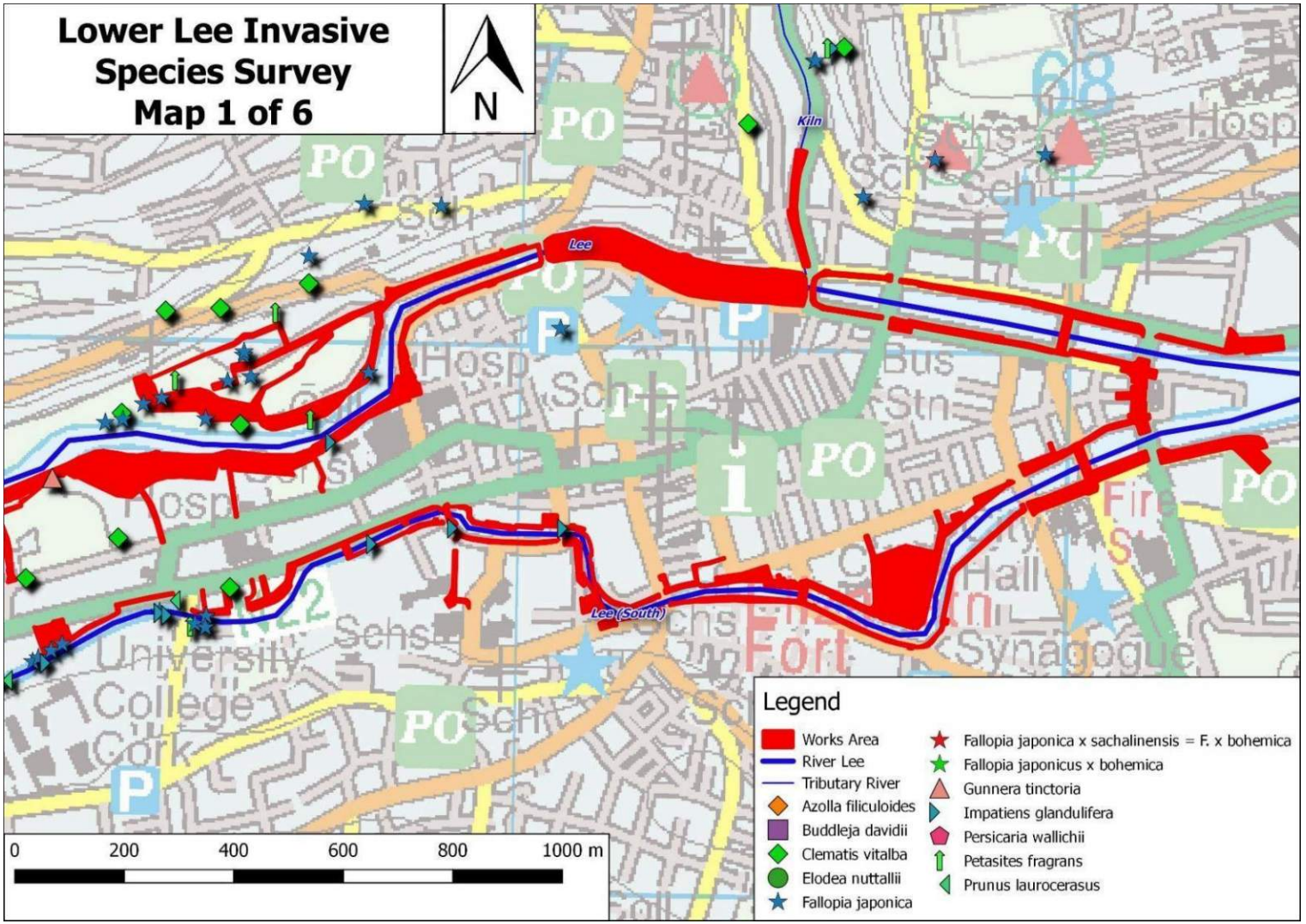

Fig 5.5: Map showing invasive species recorded within the proposed works areas along the River Lee

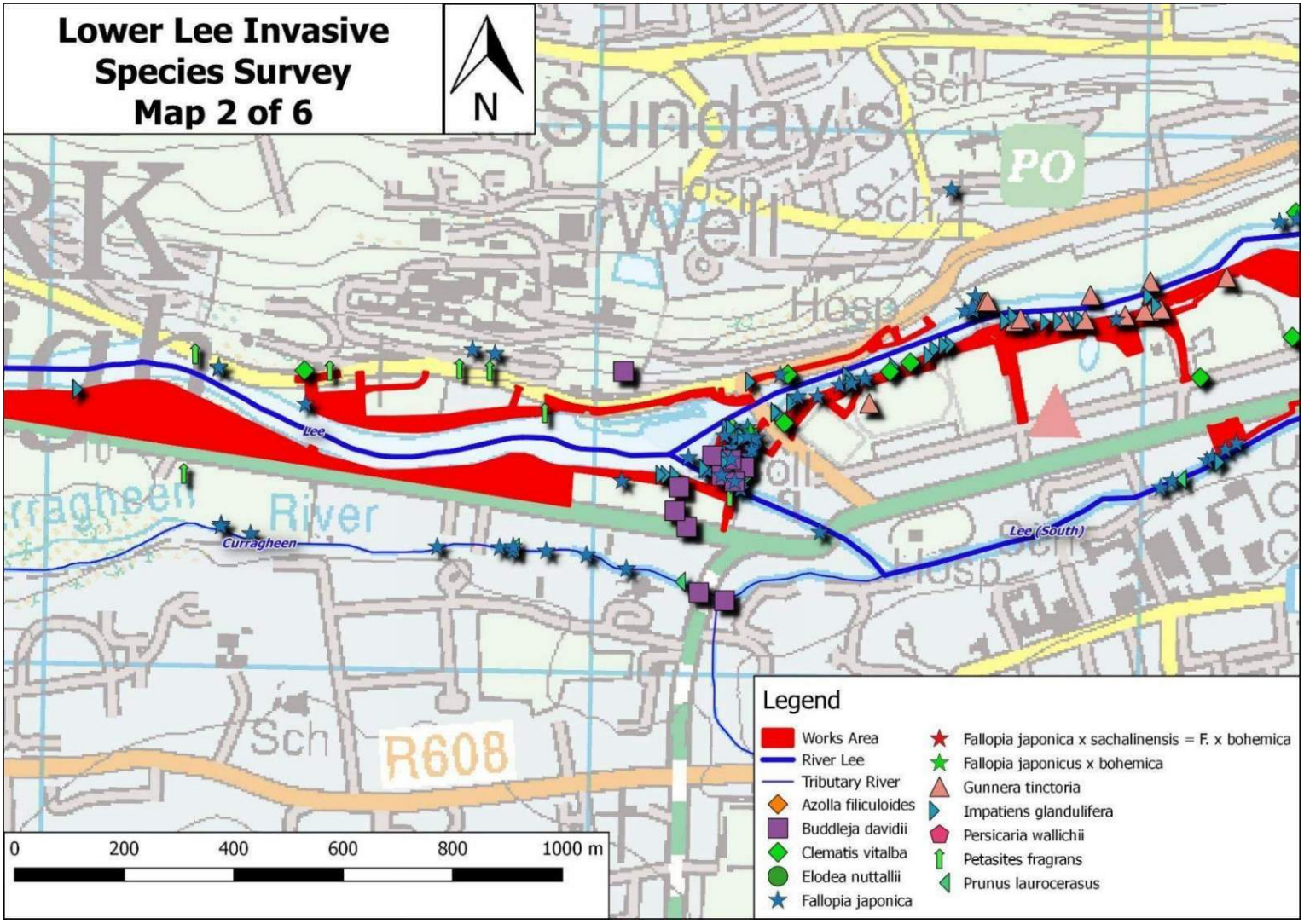

Fig 5.6: Map showing invasive species recorded within the proposed works areas along the River Lee

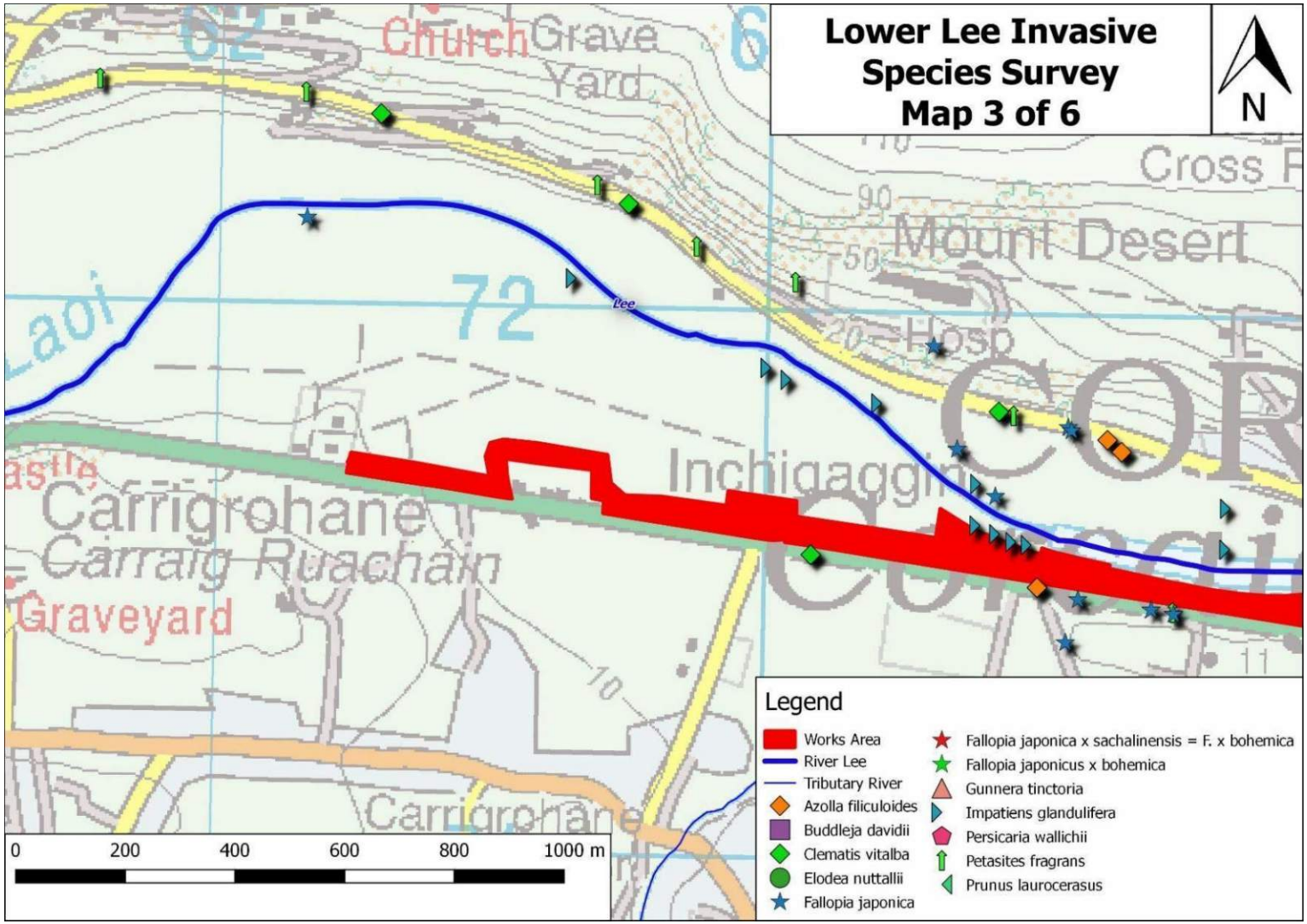

Fig 5.7: Map showing invasive species recorded within the proposed works areas along the River Lee

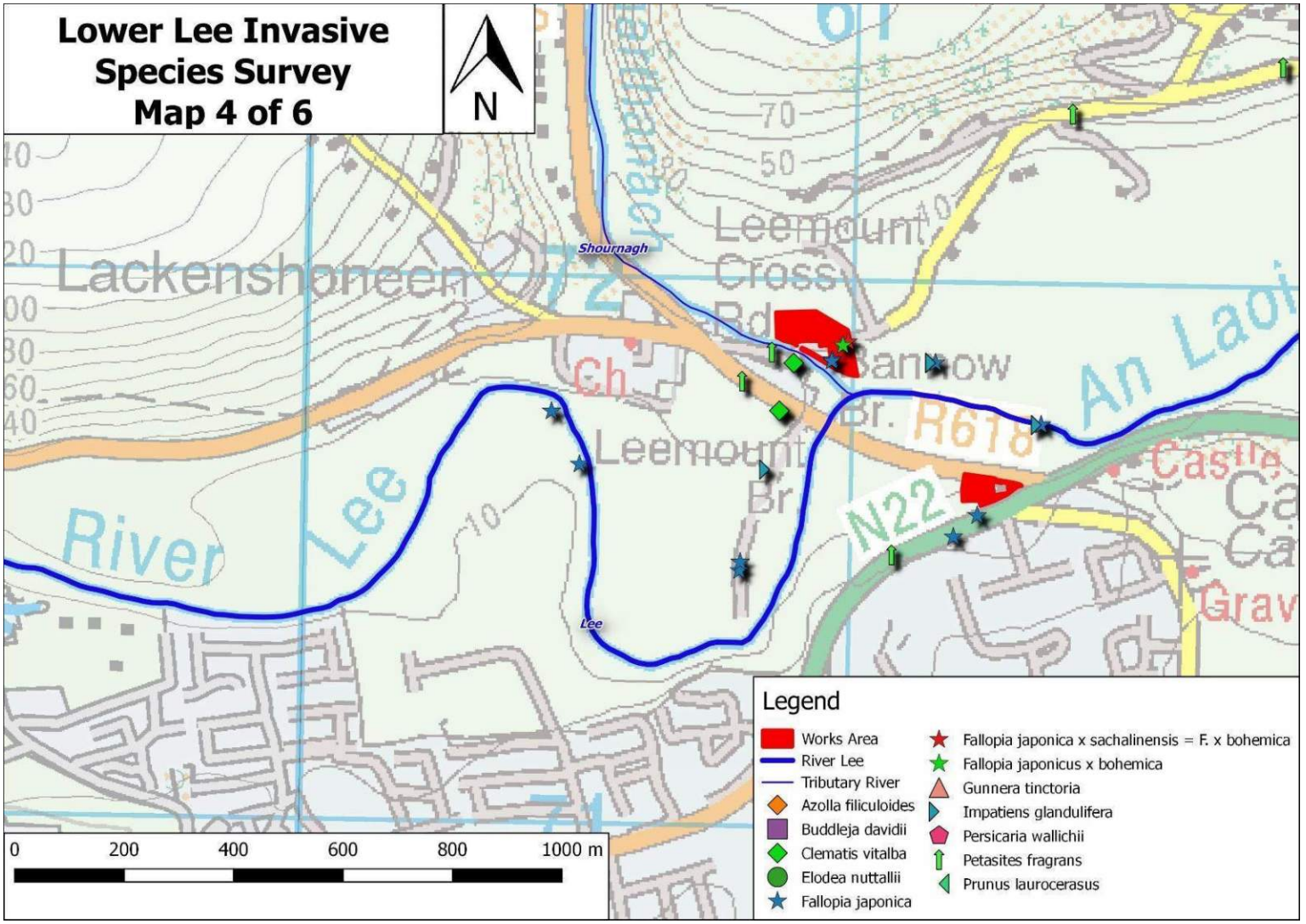

Fig 5.8: Map showing invasive species recorded within the proposed works areas along the River Lee

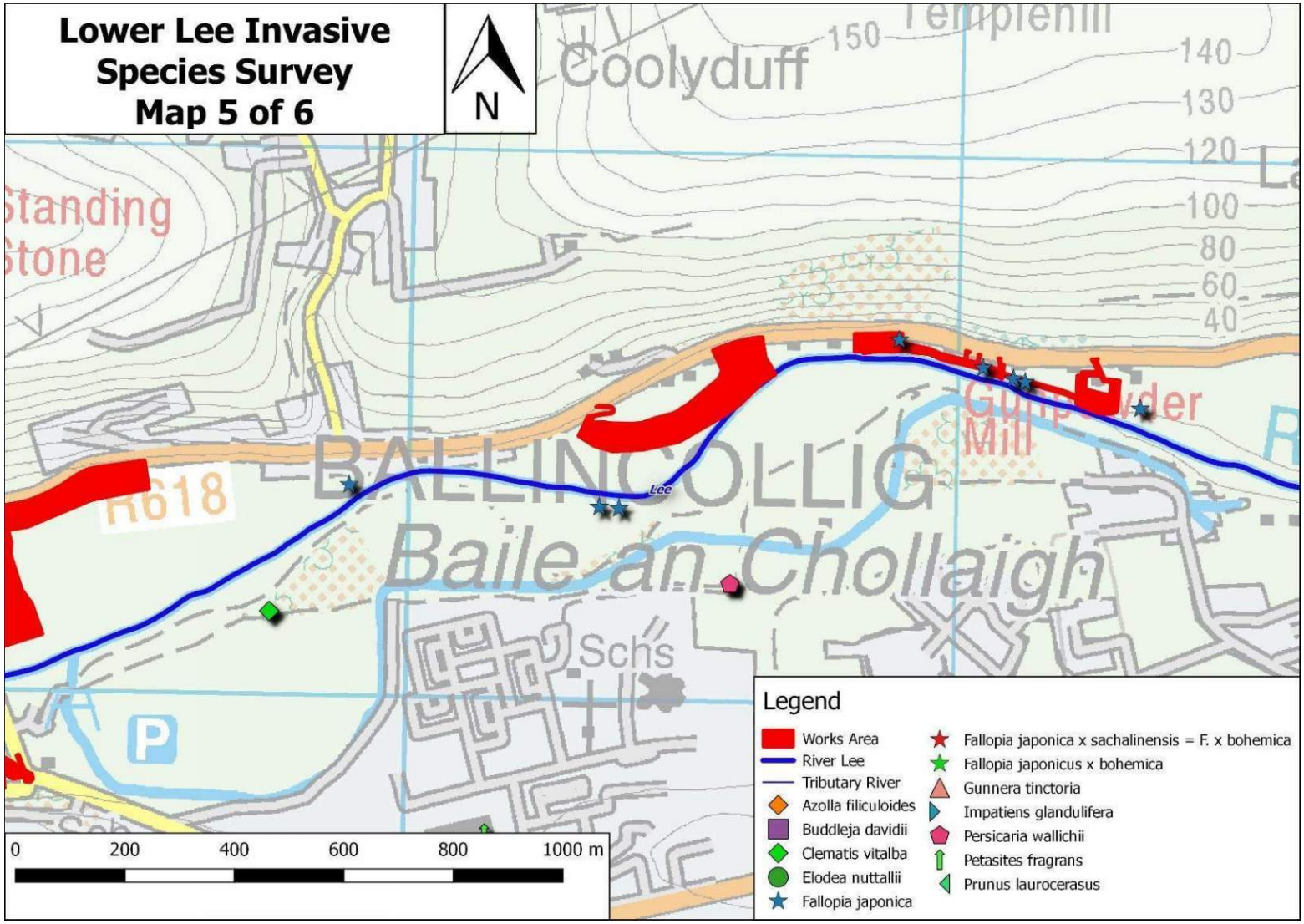

Fig 5.9: Map showing invasive species recorded within the proposed works areas along the River Lee

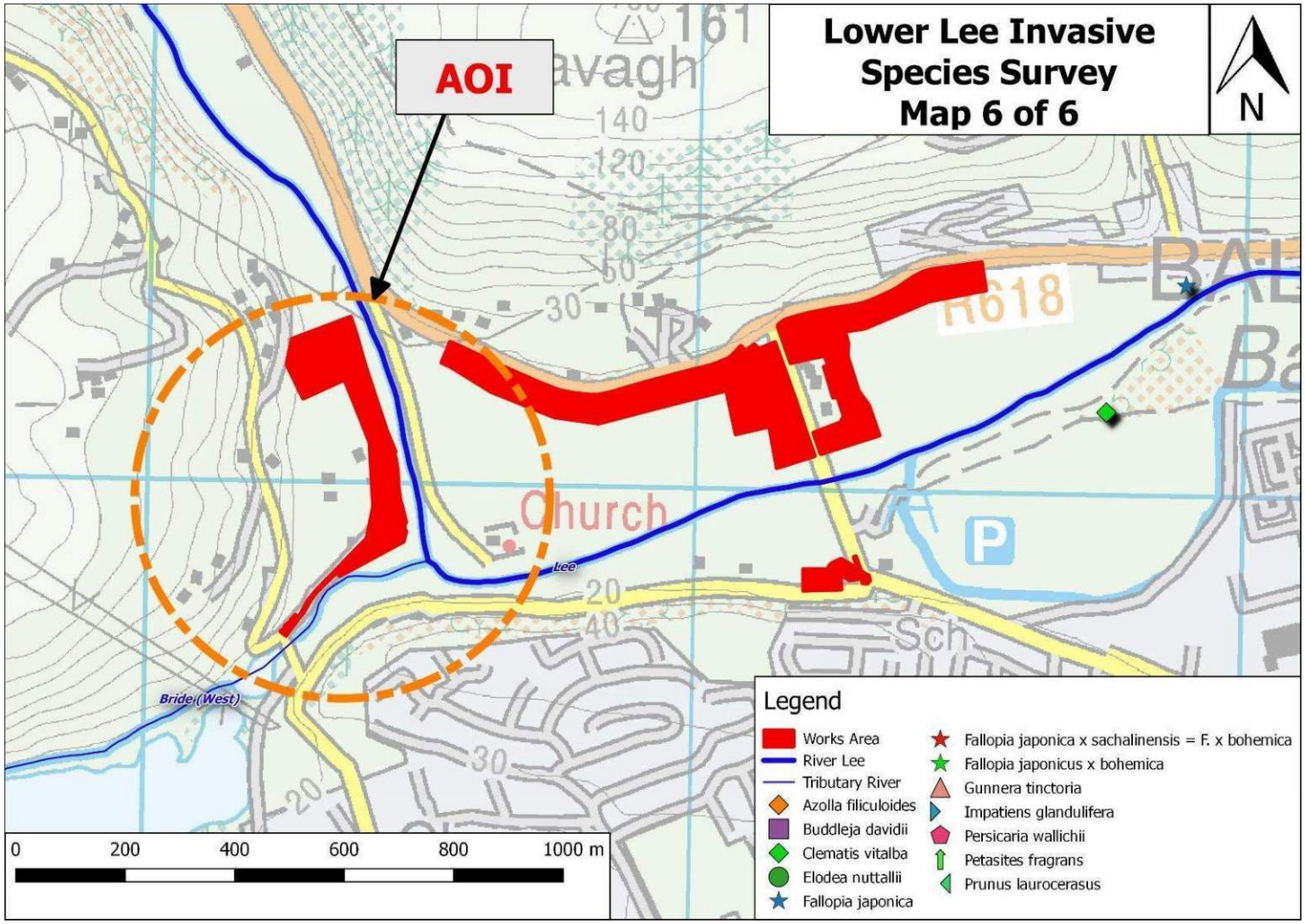

Fig 5.10: Map showing invasive species recorded within the proposed works areas along the River Lee

5.3.2 Significance of the Flora

Of the habitats recorded within the study area, the sections of the river that correspond to the Annex I Habitat '*Watercourses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation (3260)*' are of the greatest significance from a botanical perspective as they correspond to those protected under the EU Habitats Directive. The largest intact population of *Ranunculus* vegetation was recorded along the River Lee main channel with smaller more localised populations being recorded in the smaller watercourses, i.e. the Bride River North, the Glen River, the Glenamought River and the Ballincolly Stream. The importance of this habitat within the works area lies predominantly in its association with salmonid fish and invertebrates as it acts as both a food source and a resting habitat. This habitat can be considered to be of **High Local Importance.**

Some of the proposed works lie in or adjacent to areas of Riparian Woodland (WN5) comprising Willow (*Salix* sp.) and Silver Birch (*Betula pendula*), Ash (*Fraxinus excelsior*) and Hazel (*Corylus avellana*). One area of riparian woodland (WN5) was recorded behind the Environmental Research Institute (ERI), adjacent to the River Lee. Given this area may have been planted it is not considered a true representation of the corresponding I Annex I habitat, and thus is considered of Low to Moderate local importance in addition to the drier form of the habitat found near Coolyduff. Small, more natural areas of this habitat were located upstream of Wellington Bridge and may be considered of **High Local Importance.**

An area of mixed broadleaved woodland habitat (WD1) was encountered on the U.C.C North Mall campus bordering tidal sections of the River Lee channel. Given that this habitat is within the confines of Cork City and not a widespread habitat in suburban areas it is considered of **High Local Importance**, despite the evident encroachment of invasive Himalayan balsam and Japanese knotweed scrub (WS3).

Treelines (WL2) and hedgerows (WL1) throughout the works area are considered to be of **Moderate to High Local Importance** for nature conservation as they provide viable routes of transit and connectivity for fauna such as bat species as well as nesting sites for bird species. The mature deciduous trees along the river within the UCC Distillery Campus grounds and also along the opposite riverbank which comprise of alder *Alnus glutinosa*, beech *Fagus sylvatica*, lime *Tilia* spp., sycamore *Acer pseudoplatanus*, ash *Fraxinus excelsior* and horse chestnut *Aesculus hippocastanum*, are potential bat roosts and as such are considered to be of high local importance.

The GS2 grasslands bordering the River Lee channel in the vicinity of the old John A. Woods concrete works at Curraghbeg can be considered of **High Local Importance** due to a high diversity of flowering plants given the presence of shallow stony soils, infrequent grazing, and irregular cutting and herbicide treatment.

Sea walls (CC1) and tidal channels (CW2) may be considered of Low Local Importance within the study area, with the exception of a tidal river wall located at St. Vincents pedestrian bridge, North Mall, Cork City (River Lee, North channel) which supported Common whitlowgrass, Thale cress, Lemon-headed Hop trefoil and naturalised Mind-your-own-business (O'Mahony, 2009). As such given its particularly high diversity of wall plants it may be considered of **High Local Importance**.

Old stone walls (BL1) are considered of Low Local importance. However, where they support nationally rare Round-leaved Cranesbill (*Geranium rotundiflorum*), i.e. near the Wood's Farm area on the Carrigrohane road, they may be considered of **High Local Importance**.

Scattered trees and parkland (WD5) habitat is considered to be of **Moderate Local Importance**, due to a good diversity of tree species (native and ornamental) present in areas such as the Lower Lee Fields and

Fitzgerald's Park. Particularly in Fitzgerald's Park, mature trees along the river bank provide potential roosting habitat for bat species and can be considered to be of **High Local Importance.**

The habitats most common and with low botanical significance are those which are either highly modified through agriculture, amenity or urbanization. These habitats include Built land (BL3) improved agricultural grassland (GA1) and Amenity grassland (GA2) located throughout the study area at various locations. Where amenity grassland provides a valuable winter foraging resource to bird species such as Oystercatcher, i.e. at the Lee Fields, it can be considered to be of **Moderate to High Local Importance**.

5.3.3 Fauna

5.3.3.1 Birds

Bird species seen or heard during the field surveys were mostly typical of farmland and garden habitats with notable exceptions described below.

Kingfisher

A series of targeted Kingfisher (*Alcedo atthis*) surveys were carried out on the Lower River Lee in 2014 (breeding, feeding and sight survey), 2015 (breeding Kingfisher survey) and 2016 (in the Ballincollig area) in order to identify the distribution of kingfishers in the catchment of the flood relief works and also to highlight any nesting areas if visible. The survey areas included sections of river channel overlapping the proposed works areas. Bank walkover surveys were conducted to target areas where suitable nesting bank was located, along with areas containing appropriate riparian resting perches and good prey availability, and which overlapped with proposed works areas along the relevant river channels. Boat surveys were also conducted to enable access to otherwise inaccessible stretches of the River Lee between Innishcarra Graveyard and Poulavone.

Kingfishers were widespread along the River Lee, with ample high-quality foraging and perching areas recorded. In both 2014 and 2015 sightings of birds were widespread, ranging from near Innishcarra Dam as far downstream as Mardyke Bridge. No birds were recorded in Cork City centre or downstream of this point. Actively feeding kingfishers were observed at Innishcarra Graveyard and the County Hall weir. Numerous feeding Kingfisher were also recorded over the two survey periods.

Nesting sites identified over the two years are listed in Table 5.4. Three nesting sites were identified during the survey of the Lower River Lee inn 2014, two of which were located in close proximity at Poulavone in a small section of steep, open bank and one at the Lee Fields in the hollow of a mature willow tree. Overall, optimum nesting site potential was low along the Lower River Lee, with its typically low lying banks. Perching opportunities were frequent however, in the form of riparian/fallen trees or branches.

Nesting sites identified during 2014 were not utilised again during 2015. The birds at Poulavone may have moved into the Shournach River less than 1.5km downstream where activity between a pair of bird was observed several times on the lower Shournach (i.e. no activity seen upstream of Healy's Bridge during 2014/ 2015). Similarly, the nest site identified in the Lee Fields in 2014 was no longer in use and an alternative site was in use near the water intake at the Irish Water Treatment Plant of the Back Lee Road. At both sites Kingfisher with prey (minnow & juvenile perch) were observed entering the nest areas. A recently active nest site was also located in close proximity to the nest site recorded during 2014, however it is unknown whether the young had fledged and survived as only one adult was seen on the river during 2015.

Sightings were numerous in 2015 and included sightings at the Lee Fields, Kingsley hotel, Doctor's Stretch off the Lee Road, Castle Hole, Shournagh Bridge, Innishcarra Dam and Innishcarra Graveyard.

No nesting sites were identified in the Ballincollig area in 2016. Kingfisher activity was concentrated in two areas including an inlet adjoining the properties in the Ballincollig area (works area LL205) and the Gunpowder Mills Stream located within Ballincollig Regional Park. During July, Kingfisher were regularly seen feeding along the Gunpowder Mills Stream and occasionally in flight on the main river. Later in the season (September) Kingfisher were observed feeding in the inlet adjoining a riverside property on the north bank of the River Lee (i.e. adjoining the Innishcarra Road, works area LL206). Two Kingfisher were observed feeding from nearby riparian trees in the wider bay and this area is likely of some importance to the local population for feeding. No active nesting sites were observed and given the time of year (i.e. July) the optimal part of the breeding season had passed. It must be noted however, that the Poulavone Nest area to the east was active during the spring of 2016.

Table 5.4 Kingfisher nest records obtained from the River Lee during the survey August-October 2014 and 2015 *denotes an overlap with proposed works area.

River	Survey Type	Date	Kingfisher record	Area
Lee	Boat	25/8/14	Nest	Poulavone
Lee	Boat	25/8/14	Nest	Poulavone
Lee	Bank walkover	22/8/14	Nest*	Lee Fields
Lee	Bank walkover/ Vantage	16/7/15	Sighting (flying & carrying fish) Nest area	Lee Fields, Downstream towards Irish Water WTP

Other bird species

During field surveys potential habitat for Dipper (*Cinclus* hibernicus) was identified in the River Lee main channel at Ballincollig and Inchigaggin and in the South channel of the River Lee tidal zone in Cork city centre. Dipper are also know to occur in the Lee Road Bridge on the River Shournagh, upstream of its confluence with the Lee. The Irish Dipper (*Cinclus* hibernicus) a distinct subspecies from British and continental Dippers is and is green listed on the Birds of Conservation Concern Ireland (BoCCI). The Dipper is associated with fast-flowing, shallow upland streams but also found at lower altitudes in similar conditions. Nest sites are often found beneath bridges in crevices or in rocks or trees.

Grey wagtail is also known to occur on the River Lee, however the species was not recorded during field surveys. No other species listed on the Birds of Conservation Concern in Ireland (BoCCI) Red List were recorded during the field surveys.

Feeding Grey heron (*Ardea cinerea*) was recorded on the River Lee south channel upstream of the sharp ben in the river at the western end of Sullivans Quay. Heron was also recorded feeding in the River Lee at the weir at the Kingsley Hotel. A single Jay (*Garrulus glandarius*) was recorded in the garden of a residential dwelling in the Ballincollig area. Both heron and jay are green-listed on the BoCCI list.

No Annex I bird species (with the exception of Kingfisher) were recorded during field surveys.

5.3.3.2 Mammals

The study area was searched for signs of mammal activity with dedicated surveys undertaken for Otter (*Lutra lutra*) and Bats. Other species that are likely to occur in the area but were not recorded include Fox (*Vulpes vulpes*), Rat (*Rattus norvegicus*), Stoat (*Mustela ermina*), European Hedgehog (*Erinaceus europaeus*), Pygmy Shrew (*Sorex minutus*), and Brown Hare (*Lepus europaeus*). No badger or signs of badger were recorded within the works area.

Otter

A series of targeted Otter (*Lutra lutra*) surveys were carried out on the Lower River Lee and its tributaries the Curraheen, Glasheen, Bride (North) and Glenamought rivers in 2014 and again in 2015 in order identify the distribution pattern of otters in the catchment of the flood relief works and to identify active and/or breeding holts. The survey areas included sections of river channel overlapping the proposed works areas.

The entire length of the River Lee and its first order tributaries offers suitable habitat for Otter (*Lutra lutra*) with ample vegetation for cover along the river banks and likely good fishing within the river. The River Lee and its 1st order tributaries within the city environs are also known to support a population of foraging/commuting Otters. Numerous signs of Otter activity were recorded in the form of spraints and prints throughout the study area. In addition to this, a number of holt sites (both active and inactive) were recorded and an adult dog Otter was captured on camera adjacent to one of these holting sites downstream of Leemount Bridge. The River Lee banks and tributaries offer good habitat for holts with good vegetative cover in many areas. Overall Otter records were widespread in the Lower River Lee. Otter signs were recorded as far upstream as Innishcarra Dam and as far downstream as the Port of Cork. There are hotspots of Otter activity which are likely as a result of concentrations of available food resources, better breeding habitat opportunities and cover. Records of Otter from the targeted surveys are detailed below.

Innishcarra Dam to Innishcarra Bridge

Innishcarra Dam has a resident dog Otter that feeds on the rich fish assemblage present. A regular sprainting site was identified near the rocks at the pumphouse downstream of the dam. The dam area is a renowned Atlantic salmon fishery and thus is an important feeding area for Otter. In addition, Otter often avail of the fish mortality which occurs as a result of the hydroelectric turbines.

Innishcarra Bridge to Poulavone

A holting site and regular sprainting site was observed at the outfall of the Gunpowder Mills. In nearby flood culverts shoals of sand had accumulated and there was evidence of Otter dig patches and prints. The area appears to be utilised by an adult male with no evidence of natal holting at the time of the survey. An otter couch was also detected in the Gunpowder Mills stream in 2016. The Gunpowder Mills Stream now has a much reduced size following the breach of the Ballincollig Weir during the December 2015 floods. The couch and holt sites were both situated on the opposite side of the River Lee to the flood relief works. The area of the River Lee north of the old Barracks area in Ballincollig is considered the most important area between Innishcarra Bridge and Poulavone (i.e. the upper section of the Lower River Lee), given abundant fish for otter, good riparian cover and limited development.

Plate 5.17 Otter 'dig' patch and prints at culvert entrance

Plate 5.18 Ballincollig Weir is visited frequently by the public so the area is not a regular sprainting site

	
Plate 5.19 Otter holt	**Plate 5.20 Otter Scat with abundant greater pond snail & fish scales (roach) present (Gunpowder Mills Stream)**

Leemount Bridge to County Hall

A holting site was found downstream of Leemount Bridge in 2014. Otter spraint was common at the rocky outcrops adjoining Castle Hole and an adult dog Otter was captured on camera close to a known holting site. The holt appeared to be inactive in 2015 and a nearby excavated holt was identified downstream of the Anglers Rest. The excavated holt appeared to be utilised by two animals and is likely to be a natal holt as, historically, this area of the River Lee has had female Otter with cubs feeding in the adjoining fast water. The Leemount Bridge area is well known for Otter activity, likely because of its food resources. It is an important area for migratory salmon and resident brown trout which provide good feeding for Otter. Otters often feed downstream at night in the fast water in the Doctor's stretch where high abundances of Brown trout are found among the beds of Ranunculus vegetation.

Further downstream (near the Grotto) Otter are known to utilise a second 'Ranunculus zone' where they feed on Brown trout, minnow and stoneloach.

An active holt-site was identified upstream of the small wetland at Hollymount in summer 2014, however no Otter signs were observed at this location during the targeted survey in autumn 2014. Given the fluctuations of the River Lee due to its connection to an upstream hydro-electric dam the rise and fall of the river can often wash Otter scat and other signs away.

An active holt was identified on the north bank of the Lee, near Lee Water Treatment Plant in 2015. The holt was excavated under a mature alder tree. The holt appeared to be utilised by two animals in early 2015 and in late summer. Later in 2015 young were seen emerging from the area and were observed feeding regularly in beds of floating river vegetation near the weir downstream.

Otters are often seen at night feeding near the River Lee near the Lee Road. The area downstream of Hollymount wetland in the vicinity of the turbines is also known to be used by feeding otters.

County Hall to Cork City Centre

Otter scat was identified downstream of County Hall weir near the Duck's Pond, an important salmon holding pool. Thick riparian cover in this area of the river, with the bank sides being difficult to access provides seclusion for Otter. Otter spraint was also identified on the exposed gravels on the right hand side of the

weir downstream of the campus of University College Cork (UCC), i.e. 'the Gillabey Rock' area on the south channel of the River. This is a well-known Otter foraging area which has an abundance of sea and brown trout that shoal below the weir. At night otters feed under the beds of Ranunculus and overhanging trees adjoining the weir and are rarely seen during the day.

In 2015 two animals feeding along the North Mall were observed repeatedly entering the Distillery channel network adjoining the Distillery Fields UCC campus on the North Mall. It was not possible to determine the location of the holting area given the inaccessible nature of this area and no night time access to the pedestrian walk, however given the levels of activity there is a high probability a natal holt is located in the Distillery channel..

Further downstream an Otter was observed entering the large tunnel opposite the Beamish & Crawford brewery at O'Sullivan's Quay. Otter are known to use old storm culverts in the quay walls and it is unknown whether Otter have holted in these structures. The mouth of the tunnel often has shoals of slob trout feeding on passing invertebrates and also brown rat (*Rattus norveigicus*) that offer foraging for Otter.

Bats

A bat survey was carried out on the 19th and 20th of October 2014. The results are presented in full in Appendix 5D. A review of the habitats and structures with potential favourability for use by bats and directly impacted by the proposed development identified three specific areas with high suitability:

1) The derelict and disused structures of the Royal Gunpowder Mills within Ballincollig Regional Park.

2) The mature deciduous trees along the northern bank of the river within the University College Cork Distillery Campus and on the opposite, southern bank at the same location.

3) The quay walls within the city centre.

Signs of bats or actual bat presence were noted in three buildings within Ballincollig Regional Park with droppings of brown long-eared bat identified in a storage building and a magazine. A roosting Daubenton's bat was identified in a second magazine.

Though used by bats, the animals present within these buildings will not be at risk from the proposed scheme as all structures are above ground level and bat roosting sites within the buildings are several metres higher than predicted flood levels. Although many of the city quays have crevices and holes of various sizes suitable for use as roosting features, all are subject to inundation during flood events so are unlikely to be used by these animals due to the risk of drowning.

Although no roosts were identified in any mature trees in the study area, the presence of cracks and hollows within branches increases the likelihood that some may harbour bats.

5.3.3.3 Fish

A number of fisheries surveys were undertaken on the River Lee and several of its tributaries, to assess the overall fisheries habitat value in the lower River Lee and selected tributaries, particularly in relation to Annex II lamprey and salmonid species.

Electro-fishing surveys of the existing fish stocks at selected sites on the Rivers Lee (n=2), Curraheen (n=3), Glasheen (n=1), Co. Cork, were conducted over the 27-30th September 2014, the results of the surveys outlined below. A dive survey of the River Lee was undertaken in the deep areas of channel between the Lee Fields and the Kingsley Hotel downstream of the weir, where it was unfeasible to safely or effectively

electro-fish. A Sea lamprey (*Petromyzon marinus*) redd survey on the main channel of the River Lee between O' Donovan's Bridge (Anglers Rest) and Wellington Bridge on the Lower River Lee was undertaken during July 2015 to assess the importance of the Lower River Lee for spawning sea lamprey. The full results of the surveys are presented in Appendices 5E and 5F.

River Lee – Lee Road (Electro - fish survey)

A total of eight fish species were recorded in the surveyed section along the Lee Road, west of Cork City. Minnow (*Phoxinus phoxinus*), followed by Roach (*Rutilus rutilus*), Atlantic salmon and Brown trout, were the most frequently recorded species at the time of surveying. Gudgeon (*Gobio gobio*), Perch (*Perca fluviatilis*) and Stone loach (*Barbatula barbatula*) were also captured, along with a single example of European eel (*Anguilla anguilla*). A length-frequency plot for each species recorded is presented in Figure 5.11.

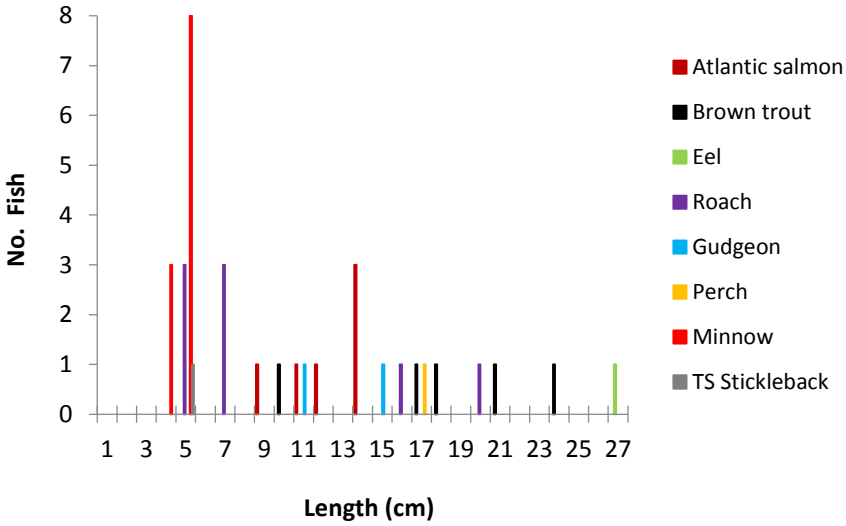

Fig 5.11: Length-frequency distribution plot for all fish species recorded at the River Lee – Lee Road September 2014

River Lee – d/s Kingsley Hotel (Electro - fish survey)

The River Lee downstream of the County Hall Weir (at the Kingsley Hotel) has an increased flow regime even during periods of low rainfall given the drop in channel gradient from the nearby weir upstream. As such, the habitat is more suitable for salmonid species and was considered an excellent nursery for salmon. Very clean river gravels, in clear water adjoined beds of *Ranunculus* sp. vegetation providing excellent cover. Atlantic salmon parr were the most abundant species recorded at this site (n=15). Low numbers of Brown trout, Eel, Perch and Stone loach were also present. As this site is located within the upper tidal reaches of the River Lee, several Flounder (*Platichthys flesus*) were recorded. A length-frequency plot for each species recorded is presented in Figure 5.12 below.

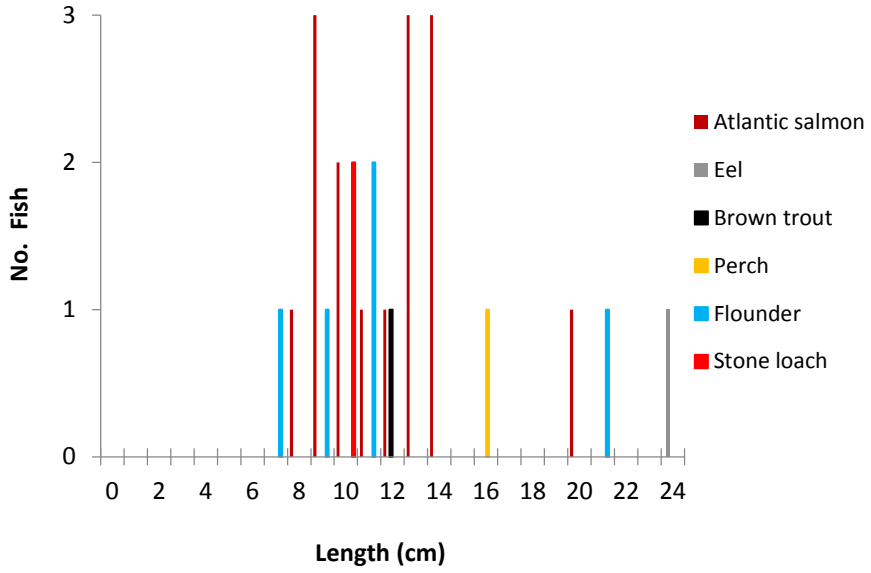

Fig. 5.12: Length-frequency distribution plot for all fish species recorded at the River Lee – d/s Kingsley Hotel

River Lee – u/s County Hall Weir (Dive survey)

The River Lee upstream of the Weir was artificially deep following the construction of the weir. The slower water has resulted in exuberant *Cladophora* spp. (green algae) growth, which covered up to 80% of the channel bed. Very high densities of Greater Pond snails (*Lymnaea stagnalis*) grazed on the large mats of vegetation. Fish were largely restricted to the margins of the river where cover existed. The centre of the channel held small densities of brown trout holding in the current. On the north bank, downstream of the water intake for the water treatment plant, large patches of Nuttall's Pondweed (*Elodea nuttali*) adjoined beds of broad leaved pondweed (*Potamogeton natans*) which supported good numbers of very large adult roach (circa 0.5-0.75kgs). Two small 'jack pike' (2-3kg) were also observed. Underneath the beds of Nuttall's Pondweed small shoals of Three-spined stickleback were present along with juvenile roach. The south bank of the River Lee had small densities of minnow shoaling on the boulder revetments underneath the water adjoining the Lee Fields walkway. One adult eel was also seen resting in a crevice.

River Lee – d/s County Hall Weir (Dive survey)

The River Lee downstream of the County Hall Weir was deep and fast-flowing with good quality spawning gravels and adult salmonid holding habitat. The north bank had slower flowing water with beds of silt and sand colonised by Nuttall's Pondweed. The bed profile slopes in gradient from the shallower water of the north bank to the deeper water of the south bank. The south bank of the channel downstream of the weir had fast flowing very deep water (circa. 4m) that extended as far downstream as the Kingsley hotel where the water shallowed into glide habitat. The fast water adjoining the south bank retaining wall held two shoals of large adult Atlantic salmon (4-8kgs), resting prior to their migration upstream. Each shoal had between 10-15 salmon that moved in circles between the island and the weir shoots. No brown trout or other species were observed in this area.

No lamprey species were recorded from the three electro-fishing sites or during the dive survey. The furthest downstream site was located at the Kingsley Hotel, no dive or electrofishing surveys were undertaken in the downstream reaches of the River Lee. However, numerous estuarine species are known to occur from this

point downstream to the Tivoli Docks (see Section 5.2.5.6) are a relatively recent introduction to the Lee system (c. 2008; Brazier & Macklin, unpublished data) and Juvenile Roach (*Rutilus rutilus*) were recorded at the Lee Fields site. Roach are considered an invasive fish species under articles 49 & 50 of the EU habitats Directive and the spread of this non-native species in the River Lee is cause for concern with regards to inter-specific competition with brown trout and Atlantic salmon. Pike (*Esox lucius*) were not recorded during the surveys but are present in the river downstream of Innishcarra Dam in low densities.

Sea lamprey red survey

The results of the Sea lamprey survey are outlined in Table 5.5 below.

Table 5.5 Results of Sea lamprey survey

Location	Redd Count	Notes	Depth & current velocity in parenthesis	IG coordinates (x, y)
North Channel (Fisheries Conservation Area)	2	2 Lamprey Redds in fast water at head of broken water in weir	1.7m (1.5ms^{-1})	164990, 071450; 165070, 071430
North Channel (Turbines)	3	Redds located between deeper water at outfall and *Ranunculus* beds downstream of steel bridge	1.4m (0.7ms^{-1})	164900, 071400; 162470, 072170; 165010, 071450
County Hall Weir	1	Redd located between shoot no.1 and shoot no. 2 on weir structure	2.2m (1.4ms^{-1})	165800, 071430
Lee Fields (West of Grotto)	1	Two adult lamprey excavating redds in deep glide habitat adjoining Ranunculus beds	1.5m (0.7ms^{-1})	165020, 071450
Total Number of Redds	7			

Overall the number of sea lamprey redds recorded in the River Lee were very low, indicating a small population size. The most important area for adult sea lamprey was found to be the area downstream of County Hall, most notably between the fisheries conservation area and the turbine channel to the north, where the River Lee splits into the north and south channels.

River Lee Tributaries

Overall species diversity was high in the Curraheen River sites surveyed. Atlantic salmon parr were recorded, albeit in low numbers. Good spawning potential for salmonids was observed although siltation has degraded the river habitat overall in these terms. High numbers of brown trout were also recorded owing to the often excellent holding habitat of the sites (i.e. plenty of deeper pools).

The Curraheen also offers good nursery habitat for Annex II lamprey species. River lamprey (*Lampetra fluviatilis*) transformers were present in the Curraheen although densities were low. Lamprey ammocoetes, regardless of species, require soft sediment (>5-10cm) in which to burrow, be it mud, sand, silt, clay or a

matrix of all types. This site was heavily silted and offered excellent larval lamprey habitat, with a high number of brook / river lamprey (*Lampetra spp.*) present.

The single site surveyed on the Glasheen River offered poor fisheries habitat and potential, featuring a low flow rate with heavy siltation and excessive macrophyte growth. The river is highly modified and urbanised and it is accepted locally that water quality is poor, largely due to urban run-off. These characteristics were reflected in the low diversity and abundance of fish recorded, i.e. 4 No. European eel. The siltation of gravel beds clearly inhibits the spawning of salmonid and lamprey species at this site, and the river in general.

5.3.4 Significance of Fauna

The River Lee within the study area is of considerable significance for a number of faunal species.

Two fish species listed on Annex II of the EU habitats directive were recorded in the River Lee and its tributaries and the River Lee was found to support an overall high diversity of fish species. The River Lee was found to support good stocks of Atlantic Salmon parr and migrating adults. Atlantic salmon was also recorded in the Curragheen River and the river was found to have good spawning potential for the species at a number of locations.

Although Lamprey were not recorded in the River Lee itself, good lamprey habitat is present in the lower Lee, downstream of Innishcarra Dam. Brook and River lamprey were recorded on the Curragheen River, however, which also contained excellent larval lamprey habitat as it was heavily silted. Although no works are proposed for the Curragheen (or Glasheen Rivers), the presence of the above species in these tributaries indicate potential for the species to occur in the main in the main River Lee.

Brown Trout was the most frequently recorded species in the Rivers Lee. Although Brown Trout has no legal protection, it is an important indicator of the ecological status of stream health and remains important in an overall biodiversity, conservation and management context. Removal of Brown trout has consequences for a stream meeting 'good status' under the Water Framework Directive (2000/60/EC).

European eel was recorded in the Rivers Lee (and its tributaries the Curragheen and the Glasheen). European eel is critically endangered and is considered to be the most threatened fish species in Ireland. The European eel has protective status under the European Eel Regulation EC No. 1100/2007 to facilitate the recovery of the eel stocks since the large decline in the 1980's.

Roach are considered an invasive fish species under articles 49 & 50 of the EU habitats Directive and the spread of this non-native species in the River Lee is cause for concern with regards to inter-specific competition with brown trout and Atlantic salmon. Roach are a relatively recent introduction to the Lee system. Pike (*Esox lucius*) were not recorded during the surveys but are known to be present in the river downstream of Innishcarra Dam in low densities.

In addition, the river and surrounding vegetation provide habitat for two further species that are protected under European legislation. These are Otter (Annex II, Habitats Directive) and Kingfisher (Annex I, Birds Directive).

Kingfisher were widespread in the River Lee but more localised in its tributaries. The River Lee is also important for breeding Kingfisher and Kingfisher nest sites were observed on the River Lee and the Curraheen rivers. Out of a total of 16 No. Kingfisher records recorded during the survey, 5 No. of these overlapped with the proposed works area. Kingfisher are protected under Annex I of the EU Birds Directive.

Otter records were widespread in the Lower River Lee but more localised or absent in its tributaries the Bride, Curragheen and Glasheen Rivers. The River Lee is a very good habitat for otters, given it has healthy fish stocks, good riparian cover and good water quality in the main channel. Otter are protected under Annex II of the EU Habitats Directive.

No evidence of Freshwater Pearl Mussel (Annex II, Habitats Directive) being present in the study area was recorded.

All bat species are protected under Annex IV of the EU Habitats Directive and are likely to use the area for foraging as well as mature trees and buildings for roosting.

The River Lee is important for a number of wintering bird species, in particular the area around the Inniscara Reservoir and The Gearagh SPA. Two species of wintering bird, known to use the reservoirs and The Gearagh: Whooper Swan and Golden Plover, are listed on Annex I of the EU Birds Directive. There is anecdotal evidence of little egret utilising the river in the Ballincollig area. Little egret is listed on Annex I of the EU Birds Directive. Grey wagtail, listed on the Birds of Conservation Concern Ireland (BoCCI) redlist are known to nest on the River Lee as well as the Irish Dipper, a subspecies unique to Ireland.

In addition to the above species, most of which are protected under European Legislation, the study area includes a wide diversity of aquatic and terrestrial habitats. The river itself has a varied morphology and a relatively undisturbed bed. This provides suitable habitat for a wide range of aquatic species. The woodlands, tree lines and bank side vegetation provide cover and feeding areas for a wide range of mammal and birds. The River Lee is considered to be of **High County/Regional Importance**, given that it is a designated salmonid watercourse and for the fauna it supports.

5.4 IMPACTS AND MITIGATION MEASURES

The classification of impacts in this EIS will follow the definitions provided in the Glossary of Impacts contained in the following guidance documents produced by the Environmental Protection Agency (EPA):

- 'Advice Notes on Current Practice in the Preparation of Environmental Impact Statements' (EPA, 2003)
- Guidelines on the Information to be contained in Environmental Impact Statements' (EPA, 2002)

Refer to Chapter 1 of the EIS for an explanation of impact classification terminology used in this EIS.

5.4.1 Do nothing Scenario

In a do-nothing scenario it is likely that the current regime of management and maintenance on the river would continue with the nature of the river being maintained essentially as it is. It is likely that maintenance works would include the removal of debris and build-up of sediments in the town and around the bridges, along with bank protection works where necessary. It is likely that these works would be undertaken in consultation with the IFI to minimise impacts on fisheries.

5.4.2 Impact on Loss of Habitat

5.4.2.1 Instream Habitats

Permanent Moderate Negative

The construction phase will involve works in channel and along the banks of the River Lee and the River Shournagh. The majority of the instream works occur in the lower reaches of the River Lee, however there are instream works at locations along the upper reaches of the Study Area. Instream works include the construction of in-channel sheet pile flood-defence walls and in-channel concrete walls close to the banks of the river, construction of a flow-control structure and vehicular bridge downstream of the Kingsley Hotel, construction of two penstocks in the Distillery channel network which runs in close proximity to the UCC Distillery Campus, construction of culverts on small streams, repairs to existing culverts, reclamation of a small inlet in the Ballincollig area, and grouting of existing quay wall and foundation zones in some city centre locations. There will be permanent and temporary loss of instream habitat during the construction and operation of the works at these locations, outlined in Table 5.6.

Table 5.6 Instream works areas

Townland/Area	Works Area	Chainage	Description
Coolyduff, Ballincollig	LL205	C0113100-C0113250	Proposed concrete pipe culvert to be constructed under proposed embankment. Existing culvert to be pressurised.
Coolyduff, Ballincollig	LL206	C0112700-C0112892	Proposed sheet pile flood defence wall in Lee channel. Existing nearby stream to be culverted. Culvert will be pressurised during a flood event.
Coolyduff, Ballincollig	LL206	C0112485-C0112550	Proposed sheet pile flood defence wall in Lee channel. Land to reclaimed from small inlet.
Leemount Cross	LL207	C019789-C019805	Proposed sheet pile flood defence wall in Lee Channel
Lee Fields	LL213	C015793	Existing stream to be culverted in a 2m wide by 1.2m high rectangular culvert. Culvert and existing adjacent culvert will be pressurised during a flood event.
South channel d/s of Kingsley Hotel	LL214	C023450	Proposed flow control structure. Width of channel to be reduced to 15m. Concrete sill to be placed along width of river bed. Existing footbridge to be removed and replaced with a vehicular bridge.
North channel between Lee Road and western Road	LL214	C015030-C015092	Proposed sheet pile flood defence wall in Lee channel
East of Fitzgerald's Park	LL216	C014094-C014315	Proposed sheet pile flood defence wall in Lee channel
South of UCC Distillery Campus	LL217	No chainage. Located in Distillery Channel	Proposed headwall and penstock on Distillery channel to prevent flow entering the channel during flood events. Penstock will normally be in open position and closed to prevent flooding due to high levels in River Lee. Proposed reinforced concrete footbridge. Bridge will tie into proposed embankments on either side.
West of North Mall	LL218	C013320	Proposed penstock to be placed on upstream face of existing bridge. Remedial works to existing

			bridge to ensure masonary arches have capacity for potential uplift.
South of UCC Distillery Campus	LL217 and LL218	C013425-C013688 & C013537-C013688	Proposed sheet pile flood defence wall in Lee channel
Carroll's Quay	LL221	C06250-C0610	Existing culvert to be pressurised during flood event. Existing bridge joints to be sealed to ensure capacity for upward seepage.
Albert Quay	LL224	C02150-C02240	Existing wharf to be demolished and reconstruction works to be undertaken along entire quay length. Proposed sheet pile wall to be constructed on riverside of existing quay.
South Mall	LL226 a & b	C02953-C021010	Proposed sheet pile wall to be constructed in channel. Pedestrian access ramp to be incorporated on dry side of wall and steel plates fitted along wet side of ramp.
South Mall	LL226 a &b	C021098-C021134	Proposed local raising of stone wall and waterproofing of existing wall.
French's Quay	LL226 a &b	C021210-C021457	Proposed sheet pile wall in Lee channel
Crosses Quay	LL226 a &b	C021457-C021468	Proposed reinforced concrete flood defence parapet. Existing quay wall and foundation zones to be grouted. New mass concrete backing wall to be provided and the face of existing wall is to be cleaned and repointed.
Crosses Quay	LL226 a &b	C021468-C021476	Existing quay wall and foundation zones to be grouted New mass concrete backing wall to be provided and the face of existing wall is to be cleaned and repointed
Proby's Quay	LL226 a &b	C021300	Existing culvert to be pressurised during a flood event. Repairs to the existing culvert work to internal joints. All drainage outlets to be fitted with non-return valves.
Wandesford Quay	LL227	C021583-C021638	Proposed sheet pile wall to be constructed in channel.
Wandesford Quay	LL227	C021638-C021725	Local raising of flood defence line along balcony's and restaurant's boardwalk. Existing quay wall and foundation zones to be grouted. Face to existing wall to be cleaned and repointed and stonework repaired where necessary. Parts of quay wall to undergo reconstruction.
Wandesford Quay	LL227	C030-C03135	Existing culvert to be pressurised during flood event. Repairs to existing culvert and works to internal joints where necessary. All drainage outfalls to be fitted with non-return valves.
Western Road	LL228	C022400-C022500	Proposed sheet pile flood defence wall to be constructed in channel.

Of particular significance, there will be permanent loss of instream habitat in the south channel of the River Lee at the location of the proposed flow control structure and pedestrian bridge (works area LL214). Works at this location require the narrowing of the channel to 15m in width and the works will result in the permanent loss of river bed habitat across the entire width of the south channel as identified in Drawing LL313. There will be some permanent loss of instream habitat in the River Lee Distillery Channel during construction of

proposed penstocks at the upstream and downstream ends of the channel (works areas LL217 and LL218). There will also be permanent loss of instream habitat in Ballincollig where a large proportion of a small inlet is to be reclaimed as part of the flood defence works (works area LL206). There will be permanent loss of instream habitat in a number of small streams, i.e. Ballincollig (two streams in works areas LL205 and LL206), and Lee Fields north bank (stream in works area LL213).

During the operational stage of the scheme there is potential for indirect loss of habitat at the location of the proposed flow control structure as well as downstream of the structure as a result of scouring of the river bed. The sill will be designed so as to be flush with the existing river bed and scour protection measures will be put in place as required, therefore no impacts as a result of long term scouring are anticipated. Scouring could also occur following a flood event, due to release of flood waters downstream once the flow control structure is reopened. It is proposed to release flood water gradually over a number of hours which should reduce the likelihood of scour.

Design and operation ensures that the water levels in the River Lee south channel and in the River Lee Distillery channel during closure of the flow control structure and penstocks structures (River Lee Distillery channel) will be maintained and the risk of significant reduction of water levels is considered unlikely. The design of the choke structure on the flow control will ensure that partial opening is possible during a flood event.

The sluice openings will be controlled by electric actuators on the valves which will be linked to a control system which will use gauge data from the waterworks weir upstream of the flow control structure, upstream on the Curragheen and the tide gauge. During an extreme Curragheen event, the amount of opening possible will be determined by the control system and based on predetermined look-up tables. The structure will be opened or closed partially or fully as required. Generally the sluice will be partially open unless it would otherwise cause flooding. In a situation where it ever needs to be closed fully this will be during a high tide or extreme Curragheen flow or both. In such a scenario the control structure will be significantly backwatered and there will therefore be no situation where the channel can dry out.

The penstock on the Distillery channel will be closed in sequence to ensure water is retained along the full length of the channel. The pump at the downstream end of the channel will be designed to ensure that no flooding occurs due to ingress of water into the channel while at the same time maintaining water levels. The proposed works at the distillery channel will have a **slight negative impact** while the flow control structure will have a **permanent moderate negative impact** on instream habitat in the works area.

The proposed works are located adjacent to and in close proximity to the River Lee at many locations throughout the works area. They are located instream at the location of the proposed stream culverts (LL205, LL206, LL213), penstocks (LL217 and LL218) and the proposed flow control structure and new vehicular bridge (LL214) (see also Table 5.6 in Section 5.4.2.1). There is potential for water quality related impacts on instream habitats silt release and pollution incidents during construction which could adversely impact on the river and its habitats, this could result in temporary decline in water quality, increased turbidity, fine sediment redistribution and nutrient enrichment. Given the pollution control measures in place as part of the design of the scheme it is expected that the impact will be slight temporary negative.

Floating River Vegetation

Floating River Vegetation (FRV) habitat is widely distributed throughout the River Lee from Innishcarra Dam to Cork City and there is potential for loss of this habitat as a result of above listed instream works.

During construction, there will be direct loss of FRV cover at the location of the proposed flow control structure on the south channel of the river downstream of the Kingsley Hotel, where there is cover of 61% + of this

habitat. There will be loss of the habitat in particular during construction of the 5m wide flap which will be anchored to a sill in the bed of the channel. Despite the high cover , the FRV in the River Lee at this location, is not considered to be an example of high quality Annex I habitat given the high percentage cover of *Ranunculus penicillatus* and lack of diversity of other species indicative of high quality habitat (including *Myriophyllum spp., Callitriche spp., Sium erectum, Zannichellia palustris, Potamogeton spp.* and *Fontinalis antipyretica)* (the interpretation manual of European Habitats (EU Commission, 2007). Despite this, the FRV community on the River Lee does have some links to the Annex I habitat "Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation [3260]"

There is potential for direct loss of FRV in the north channel where works are proposed instream on the south bank adjacent to the tennis courts to the east of Fitzgerald's Park and adjacent to the UCC campus grounds, however FRV cover in the entire north channel is low and therefore direct loss is unlikely to be significant. There is also potential for direct loss of FRV in the south channel where instream works are proposed adjacent to Albert's Quay, in the bend in the river between Union Quay and Georges Quay, and on O'Sullivan's Quay, Frenches Quay close to the Brewery and Wandesford Quay, however with the exception of Wandesford Quay, where FRV cover is moderate, FRV cover is low in these stretches of the channel. There will be limited loss of FRV at these locations with the most significant loss occurring at the location of the flow control structure downstream of the Kingsley Hotel.

During the operational stage of the scheme there is potential for loss of FRV habitat downstream of the flow control structure as a result of temporary changes in flow velocity, scouring of the river bed and up-rooting of the vegetation. As discussed above, the structure will be designed so that the sill will be flush with the existing channel bed with scour protection in place so reducing the extent of scour.

There is potential for impacts on FRV throughout the River Lee due to changes in the hydrography (i.e. natural flow pattern) which can reduce retention times and increase levels of scouring, suspended solids loadings and even change channel profile (Haslam, 1997). Proposals on the Lower River Lee to alleviate flooding may increase flow rates during peak rainfall events. Should the rates of flow increase during intense rainfall events coupled with structural modifications to the channel (i.e. retaining walls etc.), erosional patterns may shift the bed structure and thus impact on the ability of *Ranunculus* to gain footing in the channel (worse case scenario). Deposition of the transported material downstream can mobilise sediment bound nutrients to slower flowing areas of channel and may encourage the proliferation of non-native and invasive plants such as Nuttall's Pondweed.

In the River Lee, the floating river vegetation community is largely represented by *Ranunculus penicillatus* species, a species that does require strong water flows for growth. *Ranunculus penicillatus* is a streamlined, many leaved species and as such offers low resistance to flow and thus is one of the most tolerant riverine species to river spate (resistance of 40g). The species also only fragments at high force and as such has a very high anchoring strength (>750g). *Ranunculus penicillatus* is very tolerant to battering placing it in the most tolerant class (refer to FRV survey Appendix 5B). The projected flow increases of the flow rates in terms of a 5 year return period are considered small at 0.345ms-1 approximating to a 20% increase during spate events from the baseline. These events would typically occur during the winter after Ranunculus stands have broken down. It is considered unlikely that the cover of *Ranunculus penicillatus* would be reduced given its extremely high tolerance to flow rates. At the location of the flow control structure where differences in flow rates may be anticipated following a flood event and opening of the control structure, it is anticipated that water will be released gradually over a number of hours, thus reducing the potential for uprooting. Additionally, given that the quantities and rate of flow of water released downstream following a flood will

be comparable to quantities and flow rates during an existing flood event, and the low frequency with which the structure will in operation (i.e. 100-year flood), it is not anticipated that there will be a significant impact on FRV at this location.

In summary the proposed changes in flow rates are unlikely to significantly change the structure of the FRV community in the Lower River Lee which is largely is represented by *Ranunculus penicillatus* and a lower diversity of other associated species.

The floating river vegetation is considered important for its links to the Annexed I Habitat namely 'water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation' as well providing a habitat for resting and feeding salmonids. The impact on FRV is considered to be **permanent moderate negative** at the location of the flow control structure and **permanent slight – moderate negative** elsewhere. The overall area of permanent instream channel loss, and therefore FRV loss, will be low. Where instream habitat is temporarily affected due to construction footprint aquatic flora affected by the construction phase impacts will recolonise from upstream sources. Likewise in the unlikely event of a sedimentation or pollution event as a result of construction works, recolonization from upstream sources in likely. Changes in flow rates arising from the operational stage of the scheme are anticipated to be small and are not expected to have a significant impact on FRV habitat within the River Lee.

5.4.2.2 Terrestrial Habitat

Permanent Moderate Negative

Terrestrial construction works are largely confined to the River Lee banks and adjoining areas as well as temporary construction compounds and access routes. At the western extent of the Scheme, between Innishcarra and County Hall, the proposed works impact largely on agricultural land and built land, amenity grassland and parks and scattered trees. However there will be some loss of treeline and hedgerow as well as localised loss of semi-natural grassland and reed and large sedge swamp habitat within the works area. To the east of County Hall the works area becomes more heavily urbanised, however riparian treelines still remain an important feature of the River Lee channel between County Hall and the city centre and parks such as Fitzgerald's Park support a number of mature and ornamental trees. The terrestrial habitat impacted is rated as high value local importance.

It is proposed to designate floodplains (washlands) upstream of Cork City. This along with the Flood Forecasting system for the Scheme will facilitate the use of revised dam operation procedures resulting in a more aggressive lowering of reservoir levels in advance of a predicted flood event to maximise available reservoir storage and thus provide increased attenuation to reduce the peak flow during major flood events. In creating washlands by pre-emptive advance spilling of water from the reservoirs at higher rates, 'artificial' or 'early' flooding of existing floodplains will occur. This will predominantly affect agricultural land to the west of the city. These lands will benefit from the scheme in terms of a reduction in the peak flows and thus magnitude of flooding from extreme events. However, as a result of the pre-emptive spilling of higher flows from the dams, these lands will be subject to a greater frequency of lower or medium flooding events. In addition, the proposed scheme will result in peak flows extending for a longer duration during a given flood event. See Appendix 3A of the EIS for map of designated wash lands. Agricultural land designated as washlands is rated as low value local importance.

Treelines (**Moderate – High local importance**)

The River Lee banks downstream from Innishcarra are characterised by dense, often continuous riparian treelines. The treelines bordering the river consist predominantly of Grey willow and Crack willow, with Alder and Sycamore also prominent, and to a lesser extent Sally willow. The composition varies widely between these species depending on the section of river. Non-riparian treelines are also present throughout the scheme, notably in Fitzgerald's Park, the Lee Fields and in Cork City Centre.

There will be loss of treelines, some of which contain mature trees in the following works areas:

- **LL203 (Chainage C014650-C014800):** Some loss of treeline close to Innishcarra Bridge, where a proposed embankment ties into high ground adjacent to the north bank of Innishcarra Bridge.
- **LL206 (Chainage C012705-C0112892 & C0112550)**: Loss of riparian treeline further downstream in the Ballincollig area during the construction of proposed flood defence walls to the rear of private dwellings. The riparian treeline is composed mostly of mature Alder and Willow species. It occasionally grades into scrub containing invasive species such as Japanese knotweed, approximately halfway along the proposed works area.
- **LL207 (Chainage C019789-C019805 & C019450-C019500):** Loss of riparian treeline along the Shournagh during construction of proposed sheet pile flood defence wall and loss of treelines to the east of Leemount Bridge during construction of flood defence embankment and reinforced concrete flood defence wall.
- **LL210-LL212 (Chainage C015875-C016766)**: Loss of trees in the scattered parks and woodland habitat in the Lee Fields area to the south of the River Lee during construction of a flood defence embankment. Trees present include Sessile oak, Black poplar, Field maple and Willow species, some of which are mature. It is proposed to **retain** the riparian treeline on the south bank adjacent to the River Lee channel.
- **LL213 (Chainage C015403-C015418)**: Loss of small section of riparian treeline to the west of the Kingsley Hotel during construction of a pedestrian access ramp to provide access to proposed pedestrian walkway, existing riverside walkway and car park.
- **LL213 & LL214 (Chainage C015350-5300, C023537-C023693, C023682-C023692, C023692-C023750, C015102-C015425 & C015030-C01509):** Loss of treeline on the south bank of the River Lee adjacent to the Kingsley Hotel during construction of the proposed flood defence wall and loss of riparian treeline on the north bank of the river across from the Kinsley Hotel during construction of the proposed concrete and steel flood defence wall. It is proposed to **replace /reinstate** much of the treeline on the north bank as well as a section of the treeline on the south bank to the east of the Kingsley Hotel.
- **LL215 (Chainage C014667-C014785, C014591-C014642 & C014540):** Loss of 14-16m riparian treeline of Alder and occasional Willow, Black poplar and Ash on the north bank of the north channel during construction of the proposed sheet pile flood defence wall It may be possible to retain these trees pending landowner permission. Some loss of Sycamore and Alder treeline on the south bank of the north channel, adjacent to Mardyke Sports Ground. The section lost is to the south of the pedestrian path and not immediately adjacent to the river. Loss of Wych Elm treeline to the east of Fitzgerald's Park along Ferry Walk. It is proposed to **replant or reinstate** this treeline.
- **LL216 (Chainage C014100-C014550 approx.):** It is proposed to retain the majority of the riparian treeline in Fitzgerald's Park, however there will be loss of some trees, mostly to the south of the pedestrian path along the river during construction of the proposed flood defence embankment.

There will be some loss of newly planted trees to the east of Fitzgerald's park during construction of the proposed access stairs and ramping to the existing and proposed footpaths. There will be some loss of mature riparian Willow and Ash treeline along the north channel to the north-east of the tennis grounds during construction of the proposed sheet pile wall.

- **LL217 (C013537-C013688, C013700-C01-3750 approx., C013725 & C013950):** Loss of 14m high mature Alder and Willow treeline further downstream on the north channel south bank between the tennis grounds and the UCC Lee Maltings Campus during construction of the proposed sheet pile wall. There will also be some small loss of non-riparian treeline on both the north and south banks.
- **LL218-LL228**: In the city centre there will be loss of riverside treelines throughout the Scheme footprint. Treelines within the city centre are mostly non-native and consist of Small leaved lime, Bird cherry, Seargent's cherry, Whitebeam and Hornbeam. Generally where trees are lost in the city centre it is proposed to replace trees lost by replanting with tree species that suit the cityscape.

Works are also located in proximity to riparian treelines in works areas LL205 and LL213. Although it is proposed to retain the existing treelines at these locations, care should be taken to avoid damage to or accidental loss of the trees.

Riparian Woodland (**High local importance**)

There will be some loss of riparian woodland on the north bank of the River Lee in the lee Fields area where refurbishment of an existing embankment is proposed (works area LL212, **Chainage C015800-C015900**). The woodland is located to the South of Lee Road adjacent to the Environmental Research Institute building and is dominated by Sally willow, Weeping willow (rare) with occasional Alder and an understory of Nettle, Reed canary grass & Bramble. A known Otter holt is also present in the vicinity. This area of woodland may have been planted (Ross Macklin pers. comm.) and is not considered a true representation of the Annex I habitat and is of low to moderate local importance.

There will be some loss of riparian woodland to the east of the Kinsley Hotel where the River Lee splits into its north and south channels (works area LL214, **Chainage C015050-C015102**) during construction of the proposed flood defence embankment. Himalayan Balsam and Japanese knotweed are also present at this location.

Small sections of riparian woodland are present immediately adjacent to the proposed flood defence embankment in the Ballincollig area (works area LL205), downstream of the Ballincollig Weir. Although the embankment is located in agricultural grassland and it is not proposed to remove any woodland, care should be taken during construction to avoid damage to or accidental loss of any sections of woodland.

Mixed Broadleaved Woodland (**High Local Importance**)

There will be some loss of Mixed broadleaved woodland along the north channel (works area LL217, **Chainage C013742-C013925**) due to construction of proposed flood defence embankments. Japanese knotweed is also abundant in this area.

*Hedgerow & WS1 (***Moderate Local Importance***)*

There will be some loss of hedgerow and scrub at various locations throughout the works area.

Dry meadow and grassy verge (**High local importance**)

There will be some loss of high value local importance grassland habitat in works area LL201 (**Chainage C0115571-C0115968**) as a result of the proposed flood defence embankment. Areas of this habitat, elsewhere along the scheme are less species diverse and are considered to be of lower importance.

*Reed and Large Sedge Swamp (***Low Local Importance**)

There will be localised loss of reed and large sedge swamp to the rear of private properties ('Riverside') residential property in the Ballincollig are (works area LL206) due to the construction of a proposed flood defence wall in the Ballincollig area (LL206). Species composition consists of Reed canary grass, Purple loosestrife, Hemp agrimony and Great willowherb. It is located adjacent to an area of gravel substrate which supports Water pepper, Water parsnip and Fool's Watercress. Although this area does not grade into a specific category, it should be noted as littoral riverine gravel shoals capable of supporting many plant species such as Redshank, Monkeyflower, Bittercrass, Water mint etc.

*Wet grassland (***Moderate Local Importance***)*

Some loss of wet grassland/willow scrub during access to the LL205 works area.

*Scattered trees and parkland (***Moderate Local Importance**)

There will be some loss of trees in this habitat in the Lee Fields area as a result of the construction of a pedestrian and vehicle access ramp and flood defence embankment on the south bank of the river (works area LL210-LL213, **Chainage C015400-C016875 &C014300-C014500**). The embankment runs the length of the parkland habitat which supports non-mature sessile oak, Black poplar, Field maple and Willow species with an understorey of amenity grassland, and will result in a significant number of trees being removed. There will also be loss of tree in this habitat in Fitzgerald's Park (see description in 'Treelines' above).

Amenity grassland and Improved agricultural grassland (**Low Local Importance**)

There will be loss of both amenity and agricultural grassland throughout the scheme footprint, including within the Scattered trees and parkland habitat in the Lee Fields and Fitzgerald's Park. Impacts will be mostly temporary as this habitat will be reseeded to match its original state where possible.

Sea walls (**Low local importance**)

All sea walls are considered to be of low local importance with the exception of a tidal river wall located at St. Vincents pedestrian bridge, North Mall (River Lee, North channel) which supports Common whitlowgrass, Thale cress, Lemon-headed Hop trefoil and naturalised Mind-your-own-business (O'Mahony, 2009). As such given its particularly high diversity of wall plants it may be considered of **High Local Importance**. There is potential for loss of quay wall flora due to grouting and the construction of parapet flood defence walls built upon refurbished existing quay walls throughout the city area. Although no rare or protected species are known from the quay walls, the walls do support a diverse flora. Bat species are unlikely to roost in the Quay Walls due to the potential for flooding (see Appendix 5D)

It is anticipated that the impact on habitats of high local importance, as well as the impact on trees in scattered parks and woodland habitat in the works area will be **permanent and temporary moderate negative.**

5.4.2.3 Mitigation Measures

General

- A Project Ecologist will be appointed for the duration of the works.
- The footprint of works will be identified at the onset and will be demarcated to avoid unnecessary disturbance to habitats outside the works area. Method Statements detailing the construction footprint and access routes to the proposed works will be approved prior to construction.
- A minimum of one week's notice will be sent to NPWS and IFI of the commencement of the works.
- The Contractor will provide Toolbox talks for all construction staff regarding the importance of best practice and the protection and sensitive nature of the River Lee and its riparian habitats.

Aquatic habitats

- Inland Fisheries Ireland (IFI) shall be consulted with on the method statement for proposed instream works.
- Upon completion of the works channel vegetation will be allowed to recolonise naturally.
- In channel working will be minimised, where possible, method statements will identify access routes and works areas prior to commencement in consultation with the Project Ecologist.
- At locations where there will be temporary loss of river bed habitat as a result of instream construction works, gravel beds, cobble and boulder refugia will be removed prior to the commencement of works and retained for habitat re-establishment post-completion of the works.
- Appropriate mitigation measures will be implemented prior to the construction phase to ensure that water quality is not adversely affected through pollution incidents and silt mobilisation. This mitigation will include:
    - At all locations, works within 10m of a watercourse or wetland area will employ silt fences to prevent run-off containing suspended solids entering the watercourse.
    - Siltation traps (e.g. SedimatsTM) will be installed in any drains in the vicinity of excavations.
    - Instream works will employ silt curtains to trap silts/sediments and prevent them from being washed downstream.
    - Works on quay walls and bridges will employ netting to trap any falling debris and silts and prevent them from entering the watercourse.
    - All works undertaken on the banks will be fully consolidated to prevent scour and run off of silt. Consolidation may include use of protective and biodegradable matting (coirmesh) on the banks and also the sowing of grass seed on bare soil.
    - Ingress of river water into excavations by lateral intrusion or precipitation will require the deployment of pumps. The pumps shall be integrated pump or shall sit on an appropriately sized drip tray which is monitored and emptied regularly. Where required submersible pumps shall be deployed. The maintenance and refuelling of pumps shall be undertaken in accordance with standard best practice.

- Measures shall be deployed for silt removal from pumped water. The discharge of suspended solids should not exceed 25mg/l. A baseline threshold for suspended solids and turbidity levels shall be identified by the site ecologist (and approved by the employers representative).
- Where possible vehicles will be refuelled away from watercourses (at a minimum of 50m) in a designated bunded refuelling area away from surface water gullies, drains and water bodies. A drip tray will be used for all refuelling. In the event of refuelling outside of this area, any storage of oils and diesel on site will be in steel or plastic tanks of good integrity and bunded to 110% of tank capacity.
- It is important to prevent any escapement of chemicals such as hydrocarbons, hydraulic fluids and concrete. This will be dealt with specifically in a construction method statement that will be signed off on by the contractor.
- Spill kits and hydrocarbon absorbent packs will be available and drip trays will be used during refuelling.
- All relevant personnel will be fully trained in the use of this equipment.
- There will be no tracking of machinery in the stream/river beds. Where possible works will be carried out from the bank. Where this is not possible, method statements will be provided and submitted for approval prior to commencement of works.
- Where soil/made ground and subsoil stripping occurs, the resulting excavated soil fractions will be segregated into inert, non-hazardous and /or hazardous fractions (in accordance with Council Decision 2003/33/EC, the EPA water classification criteria at certain licensed landfills in Ireland).
- The excavation and handling of inert material will be carefully managed in such a way as to prevent any potential negative impact on the receiving water environment.
- Where possible the excavated spoil would not be stored beyond the working day, however in the event that this is not practical appropriate precautions in relation to the material will be taken. These precautions will include appropriate storage and covering.
- All associated hazardous construction waste will be stored within temporary bunded storage areas prior to removal by an appropriate EPA or Local Authority approved waste management contractor.
- The guidelines provided by the Department of the Marine and Natural Resources, with respect to concrete wash waters, CIRIA, the UK Environment Agency and Environment and Heritage Service, the UK Department of the Environment and Inland Fisheries Ireland will be adhered to in order to ensure that there is a neutral impact on the water environment during the construction phase of the proposed development.
- All cofferdams, or other structure installed within the river channel, to allow working in dry conditions must be designed by a competent person, be constructed of appropriate materials and take account of site conditions (i.e. depth of water, available space, bed substrate, flow velocities, flow patterns, duration of works, accessibility and potential ingress of water). During any working with cofferdams the following will be adhered to:

- The cofferdam will be inspected daily for any movement, leakage and general deterioration; any defects found will be remedied immediately.
- The working area will not be de-watered directly into the river; the removed water must receive silt treatment before discharge.
- Before removal of the cofferdam at completion of the works all materials, debris, tools, plant and equipment will be removed from the work area and any potential sources of pollution/contamination within the cofferdam will be cleaned up.
- The de-watered area will be re-watered before the cofferdam is removed to avoid the sudden ingress of water which may cause erosion of the replaced substrate.
- When re-watering is undertaken, the pump inlets will be screened appropriately to prevent the intake of fish or other aquatic animals.

- During all works the weather forecast will be monitored and a contingency plan developed to prevent damage or pollution during extreme weather and high flow events.
- All machinery and plant used will be regularly maintained and serviced and will comply with appropriate standards to ensure that leakage of diesel, oil and lubricants is prevented.
- At the location of the flow control structure (works area LL214), the sill which will be attached to the river bed will be designed in such a way as to prevent scour downstream,
- The design of the scheme will ensure that flow/water will be maintained in the south channel of the River Lee at all times when the flow control structure is closed.
- The design of the scheme will ensure that water can be maintained in the Distillery channel running in proximity to the UCC Distillery Campus at all times when the proposed penstocks at both the upstream and downstream ends of the channel are closed.
- After the implementation of the flood relief scheme a survey should be commissioned to examine whether any changes in the distribution of the FRV community have occurred.

Terrestrial habitats

- Working hours will generally be restricted to normal working hours (8:00am – 6:00pm). However these hours may be extended to take advantage of favourable tides, works at busy junctions etc.
- All works including locations of access roads, machinery set up etc. will be clearly marked out prior to the commencement of works.
- Outside of the lands proposed for construction ingress of machinery should be avoided and prevented using appropriate site fencing.
- Trees will be retained where practicable.
- Hedgerow/tree line planting will be undertaken to replace the length of hedgerow/treeline lost to accommodate the new flood defence walls and embankments. Hedgerows and treelines will be replanted as close to the existing alignment and location as possible, will use native, locally sourced species.
- In relation to replanting of riparian treeline, species used will be as close as possible in species composition to the existing treeline.

- Upon completion of the works, any new embankments in grassland areas will be re-sown with an appropriate species rich grass and wildflower seed mix.
- Excavated subsoils will be reused as fill, or for the construction of flood defence embankments where possible.
- Any areas of bare soil remaining after the landscaping phase will be revegetated as soon as possible by spreading a grass seed mix in order to minimise sediment run-off potential.

5.4.2.4 Residual Impact

Permanent Moderate Negative Impact

The proposed mitigation will ensure that habitat diversity is maintained as much as possible within the channel and adjoining terrestrial habitat, however there is unavoidable loss of habitats of conservation interest namely floating river vegetation (with links to Annex I habitat) riparian woodland, broadleaved woodland and some riparian treeline as well as river bed habitat. For all habitats listed above, while a permanent loss of habitat is anticipated, the quantity is generally low. In addition, the floating river vegetation is not considered to be a good example of Annex I habitat in the works area. The residual impact on floating river vegetation is therefore considered to be a permanent moderate negative, as there is little or no opportunity for reestablishment of lost habitat. Although the quantity of riparian woodland and broadleaved woodland to be lost is low, these habitats are of high local importance. The importance of the riparian treelines and other mature trees, given their importance as access and foraging corridors and potential as roosts is also considered to be high local importance. There will be some replacement of treeline, however the residual impact on riparian woodland, treelines and broadleaved woodland remains permanent moderate negative. Permanent loss of instream habitat will be low in the context of the river as a whole. Where temporary loss of instream habitat occurs, gravel, boulder and cobble refugia will be salvaged prior to commencement of instream works and retained for habitat re-creation post completion of the works. The residual impact is considered permanent slight to moderate negative.

5.4.3 Impact on Floral Species

Permanent Significant Negative

No protected flora or rare flora of conservation interest have been identified within the study area. Little robin (*Gernaium purpureum*) is known to occur on stone walls in Cork City although it is not known to occur on the quay walls within the works area. Round-leaved cranesbill (*Geranium rotundifolium*) is also known to occur in waste ground areas around the city but was not encountered during field surveys. Both are listed as nationally 'Vulnerable' in the Irish Red Data Book.

The Quay Walls are not known to support any nationally protected plant species; however, they are florally diverse, and given the city centre location are of high local value. There will be loss of this diversity as a result of grouting and refurbishment works to the quay walls/ other structures. It is preferable to minimise removal of existing flora and to retain a residual pool of plants representing the full variety present, particularly in species rich areas. However, the proposed work will require complete removal of vegetation from the quay walls in order to provide a robust flood relief scheme. Complete vegetation removal from the quay walls is considered necessary to allow for repointing of the walls as, if the walls are not thoroughly

cleaned and regrouted, repointed grout can leak through open joints and into the river during the grouting process. Cementitious grout is the preferred technical solution as opposed to a lime mortar alternative.

Cement is not normally colonised by plants and this work will result is a significate reduction in plant colonisation in comparison to lime mortar. Given that there will be significant loss of flora along the entire length of the quay walls, including the florally diverse areas adjacent to St. Vincent's pedestrian bridge and Wandesford Quay, and given the use of cement rather than lime mortar, the impact on flora is considered to be long-term significant negative.

5.4.3.1 Mitigation

- As for General Habitats (See 5.4.2.3)
- Vegetation to be retained will be identified at the outset of the works and cordoned off to allow for protection.

5.4.3.2 Residual Impact

It is considered that, given the complete clearance of vegetation from the quay walls and the limited opportunity to mitigate impact of loss, the impact on flora remains Permanent Significant Negative.

5.4.3.3 Invasive Species

Long Term Significant Negative

Construction activities in areas infested with non-native invasive species have the potential result in their spread to locations previously un-infested. The Japanese Knotweed stands along the River Lee within the footprint of the works are extensive in areas. In addition Himalayan balsam and Giant rhubarb is also present in some works area. Consequently this species could be spread should appropriate measures not be followed; this could have a negative impact, if the plant is transferred to a habitat of high ecological value.

5.4.3.4 Mitigation

- A invasive species survey will be carried out during the tender period and / or an advance works contract will be put in place where an invasive species survey will be carried out to map their extent. An Invasive Species Management Plan will be put in place prior to commencement of construction.
- The contractor will be responsible for the proper management and treatment of Invasive Species (as per the management plan and works requirements) during the construction works. This responsibility will be explicitly stated in the works requirements.
- As there is potential for invasive species to spread prior to the commencement of construction and the survey is essentially a snapshot of a particular time, the contractor will be responsible for the proper management and treatment of invasive species within any works area where invasive species were not identified during the surveys.
- Treatment / monitoring will be carried out as part of the ongoing maintenance for the scheme.
- Treatment will be carried out by a suitably qualified person and will involve the use of herbicides approved for working in proximity to an aquatic environment.
- A bio-security protocol will be put in place during the construction phase of the development. This will ensure that all plant machinery and equipment will be thoroughly cleaned and inspected for any fragments of knotweed prior to leaving site.

- All construction staff will receive training in the identification and management of the invasive species, including identification of knotweed rhizomes, to verify the clearance of any area.

5.4.3.5 Residual Impact

Permanent Neutral/Positive Impact

With proper mitigation in place for the control and eradication of Japanese knotweed in place, there is a significantly reduced risk of spread of the plant to sensitive environments and there will be eradication of Japanese Knotweed locally. The impact on flora is therefore reclassified as **Permanent Neutral/Positive Impact.**

5.4.4 Impact on Fauna

Terrestrial Animals

Permanent Significant Negative Impact

There will be a potential impact on mammals and birds as a result of the proposal and during the construction phase in particular Otter, bats and kingfisher.

5.4.4.1 Otter

Otter were widespread on the River Lee with numerous spraints and prints recorded as far upstream as Innishcarra Dam and as far downstream as the Port of Cork. In addition to this a number of holt sites (both active and inactive) were recorded and overall the river Lee banks and tributaries offer good habitat for holts with good vegetative cover in many areas. The River Lee and its 1st order tributaries within the city environs are also known to support a population of foraging/commuting Otters. Impacts relating to the Otter from the proposed scheme include disturbance, the removal of habitat and reduction of forage resource.

In the Leemount area, neither the inactive Otter holt in a manmade culvert or the new excavated holt further downstream on the river bank will be directly impacted by the proposed works, being at least 500m from the proposed sheet pile wall and embankment works. However, works should be cognizant of the fact that this area is utilised by otters and provides excellent Otter feeding habitat.

The proposed works occur in close proximity, approximately 80m, to an existing holt in Inchigaggin opposite the football pitch. The holt was found to be inactive during 2015 and partially covered by river water. It is believed that the holt was only used during dry summers of 2013 to 2014 during extended low water periods. However there remains potential for disturbance related impacts as a result of the proposed flood defence embankment and pedestrian and vehicle access ramp construction works at this location should the holt be occupied during the proposed works.

There is potential for direct impacts on an active holt identified on the north bank of the Lee, adjoining the Lee Water treatment Plant as a result of proposed embankment refurbishment works (works area LL213). The holt was excavated under a mature alder tree. The holt appeared to be utilised by two animals in early 2015 and in late summer 2015 young were seen emerging from the area and were observed feeding regularly in beds of floating river vegetation near the weir downstream.

There is potential for the proposed penstock construction works on the Distillery channel (works areas LL217 and LL218) to effect Otter which are known to utilise the area, or impact on an Otter holt if present. Surveys

undertaken during 2015 could not identify a holt location given the thick vegetation cover and lack of easy access, however otters were observed frequently entering the channel from the main River Lee along the North Mall and given the levels of activity there is a high probability a natal holt is located in the Distillery channel network. During flood conditions access to the Distillery channel will be blocked by closure of the proposed penstocks at both the upstream and downstream ends of the channel, which may impacts on Otter passage and could reduce the water level in the channel.

Otter have been known to historically holt in old storm culverts in the quay walls and otter were observed entering the large tunnel opposite the Beamish and Crawford Brewery in 2014. It is unknown whether otters have holted in this manmade structure. Although no evidence of otters holting in any storm culverts in the quay walls was identified during the surveys, otter are transient in nature and may move from year to year, utilising different locations for breeding and/or resting. Given their transient nature, the possibility of otter using suitable old storm culverts in the quay walls for breeding and/or resting in any given year cannot be ruled out. There is therefore potential for impacts on otter where storm culverts in the city (both north and south channels) are to be sealed off as part of the works.

Otter are known to forage along the entire length of the River Lee, which offers very good Otter foraging resource. Otter are generally nocturnal foragers and as construction works will be undertaken during daylight hours it is unlikely that there will be significant disturbance related impacts to foraging Otter. Impacts are likely restricted to disturbance of breeding and/or resting Otter.

In the absence of mitigation, impacts on Otter are **Permanent Significant Negative.**

5.4.4.2 Otter Mitigation

- See also mitigation measures for protection of habitats (Section 5.4.2)
- Pre-construction Otter surveys will be undertaken for the scheme with particular regard to all identified active and inactive Otter holts in in proximity to the works to determine whether presence and/or activity has changed and to determine whether identified holts are breeding holts.
- In particular, the channel network adjoining the U.C.C. Distillery Campus will be surveyed in addition to the identified active holt area adjoining the Lee Water Treatment Works, given that the proposed works may overlap with breeding areas.

  Otters have historically been known to holt in manmade culverts adjoining the quayside sea walls. A preconstruction assessment will identify potential holting locations and provide a survey of these sites to determine usage. This will allow for proper measures to be put in place so that no breeding otters are impacted by piling and vibration disturbance during the construction phase should breeding overlap with the timing of works. The survey will further mitigate against impact from sealing of culverts as proposed as part of the works.
- No works should be undertaken within 150m of any holts at which breeding females or cubs are present, except following consultation with and agreement from NPWS and provided appropriate mitigation measures are in place.
- No wheeled or tracked vehicles (of any kind) should be used within 20m of active, but non-breeding, Otter holts. Light work, such as digging by hand or scrub clearance should also not take place within 15m of such holts, except under licence.

- The prohibited works area associate with any Otter holt will be fenced off with temporary fencing prior to any potentially invasive works in order to restrict access and ensure that no works are undertaken in proximity to a holt. Appropriate awareness of the purpose of the enclosure should be conveyed through notification to site staff and sufficient signage should be placed on each exclusion fence.
- All contractors or operators on site should be made fully aware of the procedures pertaining to each affected holt.
- Where the works will require the destruction of a non-breeding holt, this will only be done in agreement with and under licence from NPWS. An application for a licence under section 54 of S.I. No. 477 of 2011 (Birds and Natural Habitats Regulations) will be made to NPWS.
- The affected holt will be excluded in line with NRA Guidelines for the Treatment of Otters Prior to Construction.
- Under no circumstances will a breeding holt be evacuated until the otters have vacated the holt (established by a suitably qualified specialist).
- An alternative holt site will be constructed/provided wherever there will be destruction of an existing holt.
- The design of the scheme will ensure that water can be maintained in the Distillery channel network, where a potential otter holt is located, at all times when the penstocks at both the upstream and downstream ends of the channel are closed during flood conditions.
- Otter passage will be maintained at the location of both penstocks on the Distillery channel in accordance with NRA Guidelines for Treatment of Otters Prior to Construction.
- To minimise the potential for Otters becoming trapped, all excavations will be left open for the minimum possible time, and not over-night. If excavations have to be left open over-night they will either be covered securely or fitted with an escape ramp (no more than 45°) to allow accidentally trapped animals to escape. Materials to cover excavations or create escape ramps will be on site at all times so that all excavation areas can be made safe before leaving site.
- In relation to mitigation for otter foraging resources see mitigation for habitats in Section 5.4.2 above.

Residual Impacts on Otter

With appropriate mitigation in place it is anticipated that there will be a **Permanent Slight/ Moderate Impact** on Otter in the River Lee as a result of habitat loss. Mitigation to protect Otter and Otter enhancement works will minimise the impact.

5.4.4.3 Kingfisher

Only one Kingfisher nesting site was identified overlapping with the proposed works, i.e. in the Lee Fields in 2014. Works at this location consist of flood defence embankment construction, are set back from the river bank in habitat classified as Scattered trees and parkland and will not directly impact Kingfisher at this location. The nest had moved to the north bank in 2015 given the nature and specific location of the proposed works in this area, i.e. no in bank works, an adverse impact is not anticipated with appropriate mitigation and avoidance. Sightings of birds were widespread, ranging from near Inishcarra Dam as far downstream as Mardyke Bridge, however these birds are unlikely to be significantly disturbed during construction. No

birds were recorded in Cork City centre or downstream of Mardyke Bridge. There will be some loss of Kingfisher feeding habitat in the Ballincollig area where a small inlet to the rear of residential properties (works area LL206) in which Kingfisher have been observed feeding on minnow, will be reclaimed. However, Kingfisher were observed feeding in the nearby channel of the Gunpowder Mills Stream (i.e. Ballincollig Regional Park) during the July 2016 survey period meaning that nearby alternative feeding sites are available.

In the absence of mitigation impacts on Kingfisher are considered **Slight Negative Impact.**

5.4.4.4 Other Birds

The impact of the proposed works on the overwintering water bird population which Cork Harbour supports is discussed as part of the Screening for Appropriate Assessment. This section considers impacts on the wider bird population within the study area, including breeding bird populations and non-waterbird populations in winter. By the nature of the construction works involved in this scheme, a degree of disturbance to birds present in the vicinity of the works areas is inevitable. The magnitude of this impact, however, depends on a number of characteristics of the works, including:

- The timing of the construction activities
- The level of disturbance, both spatially and temporally
- The availability of equivalent habitats outside of the influence of disturbance to accommodate displaced birds.

The works proposed in this scheme will be conducted in relatively localised areas. In many of these areas, levels of disturbance are already relatively high as result of its urban location. This, in combination with the substantial amounts of similar habitats outside the likely zone of influence, should minimise the potential for long-term population impacts from disturbance throughout the construction phases.

The potential for impacts on Whooper Swan, particularly in the Gearagh, due to changes in water levels arising from proposed changes to the hydrological regime at Innishcarra Dam were investigated in a desktop study.

It is proposed that the ESB will continue to operate the dams at Carrigadrohid and Innishcarra as is at present for the majority of the time. However continuous monitoring and simulation of predicted rainfall will allow potentially significant flood events to be detected in advance. When a potentially significant event is detected by the forecasting system, the 'flood protocol' will be triggered and the reservoir levels can be safely drawn down to create storage in advance of the event. This will be achieved by allowing for greater discharges in advance of a forecasted event. This greater discharge will not result in the flooding of properties other than those washlands designated by the scheme, due to creation of downstream defences. The following considerations have been included in the proposed flood forecasting system and dam operations:

- The normal range of operating levels in the dams are not amended.
- Minimum and maximum reservoir levels and/or seasonal variations in same, have not been amended so as to avoid impacting existing environmental receptors/constraints such as levels in the Gearagh, water supply requirements, fish life etc.
- The maximum draw down rate limit at Carrigadrohid remains for road embankment safety reasons.

It is anticipated that any changes in the hydrological regime are unlikely to significantly affect sustained water levels in The Gearagh and that there is unlikely to be any loss of Whooper Swan foraging habitat as a result of the operational stage of the Scheme.

The construction of flood defence embankments in amenity grassland will result in a temporary reduction of foraging habitat for bird species such as Oystercatcher, which utilise this habitat, i.e. the Lee Fields. Habitat reduction will be short term as any embankments in such habitats will be reinstated to their previous state through re-seeding.

There is potential for impacts on Grey wagtail and dipper breeding sites. Any in-bank works or works in proximity to a bridge

The removal of vegetation, hedgerows, treelines and woodland required prior to construction has the potential to impact on nesting birds. Impact on nesting birds in the absence of mitigation is **Slight Negative Impact.**

5.4.4.5 Birds Mitigation

- See also mitigation measures for protection of habitats (Section 5.4.2)
- All vegetation clearance works and site preparatory works will be conducted outside of the bird nesting season (March to September inclusive). If this is not possible, a breeding bird survey will be undertaken in advance of the works to ensure that there will be no impacts on nesting birds. If nests are found, they will be safeguarded, with an appropriate buffer, until the chicks have successfully fledged.
- Works at the locations of known Kingfisher nests will be undertaken outside of the Kingfisher breeding season, i.e. outside of the period April to the end of August.
- Best practice guidelines for riparian birds (RSPB et al., 1994; OPW, 2007) should be adhered to during any proposed works to minimise potential impacts to kingfishers possibly utilising the Rivers Lee.
- Hedgerow /treeline planting will be undertaken to replace the length of hedgerow/treeline lost. Hedgerows/treeline will be replanted as close to the existing alignment and location as possible and will use native, locally sourced species appropriate to the locality.
- Works in improved agricultural grassland and/or amenity grassland known to be important foraging habitat for wintering bird species will be undertaken during the summer months.
- There will be no works permitted during winter (October to March) in the Lee Fields in order to avoid disturbance to Oyster catcher.
- Embankments built on any of these habitats will be re-seeded to match the surrounding grassland habitat.
- Proposed works in proximity to roosting cormorants will be surveyed prior to the commencement of works and works will not commence without prior approval from the site ecologist.
- Timber hoarding will be used on all works where there is likely visual and noise related disturbance.
- If/where encountered, any Grey wagtail or dipper nests will be safe-guarded with an appropriate buffer until the chicks have successfully fledged.

5.4.4.6 Residual Impact

With mitigation in place it is anticipated that impacts on bird species will be **Slight Temporary Negative.**

5.4.4.7 Bats

Permanent Moderate Negative

The River Lee is an important habitat for bats. The watercourse acts as a vegetated corridor along which bats can commute from the wider countryside into the urban environment. The riparian habitat also provides a sheltered foraging area, a breeding site for invertebrate prey and, at night, screening from the surrounding artificial lighting of the urban area. Bridges, buildings and trees along and over the river also offer potential roosting sites for bats.

Bat species within the area of the proposed development will be affected by both the construction phase and subsequent existence of new structures such as embankments and walls which will require the removal of mature trees.

There is potential for loss of roosting bat habitat in the mature deciduous trees along the river within the UCC Distillery Campus grounds. In addition mature trees along the opposite riverbank are potential bat roosts. The mature trees in Fitzgerald's Park, of which there will be some removal, also provide potential roosting habitat for bat species. There is no bat roosting potential along the quay walls.

There is potential impact for loss of bats roosting in mature trees as a result of the scheme. In addition all treelines, woodland and scrub is likely to provide commuting or forging habitat for bats. The potential impact of site clearance on bats is considered **Permanent Moderate Negative**.

5.4.4.8 Bats Mitigation

- See also mitigation measures for protection of habitats (Section 5.4.2)
- Any new lighting required as part of the project will be of as low a wattage as possible and will cowled and directed away from the surface of the water.
- Prior to the commencement of site clearance, tree surveys will be carried out on trees identified as potential for bat roosts. If roosts are found or their potential cannot be ruled out, an appropriate mitigation strategy will need to be devised and an application to NPWS for a derogation licence under section 55 of S.I. No. 477 of 2011 (Birds and Natural Habitats Regulations) will be required.
- Removal of trees with bat roost potential will be carried out in September/ October and under the supervision of a bat ecologist.
- Trees with ivy-cover, once felled, should be left intact onsite for 24 hours prior to disposal to allow any bats beneath foliage to escape overnight.
- A Bat box scheme will be put in place to mitigate for loss of trees and suitable foraging habitat for bats. Approximately 4 bat boxes will be provided for on stone walls faces or mature trees (as deemed appropriate). Bat boxes will be woodcrete bat boxes such as those manufactured by Schwelger and will be put in place as per the recommendations identified in NPWS Irish Wildlife Manual (2006) Bat Mitigation Guidelines for Ireland.

5.4.4.9 Residual Impacts

Permanent Slight Negative Impact

With mitigation measures in place there is no significant risk to bats within the study area. Loss of foraging habitat and prey species will result in some loss of species using the area, while some minor temporary tree roost will be lost, a bat box scheme will largely mitigate this.

5.4.5 Impact on Fisheries

The impact of the works on fisheries overall is a **Permanent Moderate Negative Impact**.

In general the study area to the west of the city contains good fisheries habitat with eleven species recorded in total through electro-fishing. Notably, good stocks of Atlantic salmon parr (electro-fishing) and migrating adults (dive survey) were recorded. The River Lee is an important salmon fishery and the presence of good numbers of juvenile salmon and adults is indicative of a healthy fish population. The entire River Lee channel supports Atlantic salmon and the most important fishery exists at Innishcarra Dam.

The majority of the proposed works for the River Lee (Cork City) Main Drainage Programme are not instream, however during construction phase some works will be required within the channel including the construction of the flow control structure and proposed vehicular bridge downstream of the Kingsley Hotel (works area LL214), construction of the penstock in the Distillery channel running adjacent to the UCC Distillery Campus (works area LL217-LL208), construction of sheet pile walls at various locations, reclamation of small inlet in Ballincollig (works area LL206) and the construction of a number of culverts on small streams (works areas LL205, LL206, LL.213).

These works can potentially result in disturbance including noise, visual and vibrations which would displace fish from the works area and result in a temporary impediment to fish passage on the River Lee, particularly at the location of the flow control structure.

There is also potential for direct fish mortalities as a result of in-channel works, though entrapment over pumping etc. for stream diversions during works. Should in channel works be carried out during spawning then the impact may be particularly severe and while any disturbance impact will be temporary it can potentially result in reduction in spawning success and result in loss of a year class.

There will be permanent loss of fisheries habitat at the location of the proposed flow control structure (approx. 5m in width and 17m in length) as a result of instream river bed works during construction of a sill and installation of associated scour protection if required. There will also be some permanent loss of fisheries habitat at the location of the adjacent proposed vehicular bridge and narrowing of the channel to 15m in width. The River Lee, directly upstream of these works i.e. the Lee Road area as well as downstream of Salmon Weir and downstream of the Kingsley Hotel, contains good salmonid spawning gravel habitat. The River Lee downstream of the Kingsley Hotel also contains excellent nursery habitat. An excellent salmonid holding pool is also present downstream of Salmon Weir. The south channel of the Lee also supports some very good fisheries habitat. An important Atlantic salmon holding pool is present in the Duck's Pond downstream of O'Neill Crowley Bridge. European eel are known to occur in the River Lee in the Gillabey Rock area, i.e. the weir downstream of Donovan's Bridge and area also supports an abundance of brown trout and sea trout that shoal below the weir. Shoals of fish are also known to occur at the hot water outfall from the power station at the marina.

There is potential for loss of good juvenile lamprey habitat in the Ballincollig area (works area LL206) in a small, shallow slack/back bay or inlet composed of soft sediment ≥10-15cm in depth, which is to be reclaimed as part of the works. It is recommended that, if present, juvenile lamprey should be removed prior

to any works activities. There are no instream works proposed at any of the locations where sea lamprey redds were identified. Furthermore the low numbers of sea lamprey identified during the surveys indicate a small adult population size.

The Leemount area is an important area for migratory salmon and resident brown trout which provide good feeding for Otter. Instream works are proposed within the Shournagh and this location and there is potential for loss of salmon pool habitat, however works in this location are adjacent to the river bank. It is expected that works at this location will take approximately four weeks.

Loss of floating river vegetation, particularly at the location of the flow control structure (works area LL213) could also have potential impacts for fish. FRV provides shelter for invertebrates and fish. In particular, the larvae of the blackfly *Simulium* spp. can occur in extremely high densities on the *Ranunculus* fronds and provide an important food resource for young salmonids. Equally, when non-compacted, the sand tailing at the end of *Ranunculus* beds provides burrowing for lamprey ammocoetes. Fish shelter under the *Ranunculus* beds, which are especially important in large rivers such as the Lee where shading in open stretches may be unavailable, meaning FRV provides the only instream structure for fish to rest under.

The impact on fisheries habitat is considered **Permanent Moderate Negative** due to both permanent and temporary loss of river bed. Gravel beds will be reinstated insofar as possible at the locations where construction related disturbance occurs, however, there will be a small amount of permanent fisheries habitat loss due to the permanent placement of flood defence structures instream. The most significant loss of fisheries habitat is anticipated at the flow control structure with most other in-channel flood defences located at the edge of the channel.

5.4.5.1 Fisheries Mitigation

- See also mitigation measures for protection of habitats (Section 5.4.2).
- All instream works will be carried out in consultation with Inland Fisheries Ireland, in particular the design of the flow control structure, downstream of the Kingsley Hotel will be designed in consultation with IFI.
- In channel working will be minimised, where possible, method statements will identify access routes and works areas prior to commencement in consultation with the Project Ecologist.
- In-channel working during the salmonid spawning season will not be permitted (October to June inclusive) except under exceptional circumstances and with agreement from IFI.
- During the construction phase, fish passage will be maintained in areas of in-channel working.
- Any pumps used for over-pumping must be 'fish-friendly' and fitted with appropriate screens.
- Avoid working in areas identified as being suitable for fish spawning, where practicable.
- Any clean gravels removed as part of the works will be retained and used for habitat reinstatement on completion of the works.
- Prior to the reclamation of the small inlet in Ballincollig (work are LL206), all juvenile lamprey will be removed and transferred to suitable upstream habitat under licence from IFI.

5.4.5.2 Residual Impact

Permanent Slight to Moderate Negative Impact

Mitigation measures will minimise the impact on fisheries from the construction phase. Permanent loss of habitat will be small scale and temporary loss will be mitigated in the context of this assessment by the salvage of gravel, boulder and cobble refugia for use in habitat re-creation following completion of the works. The residual impact on Fisheries within the main channel is considered to be a Permanent Slight to Moderate Negative Impact.

5.4.6 Impact on Amphibians

There is potential for loss of amphibian habitat in the small streams to be culverted and/or for which a pressurisation of the existing culvert is proposed. The drainage channels are of low fisheries value. **Permanent slight negative.**

5.4.6.1 Amphibian Mitigation

- The streams will be surveyed prior to the commencement of works and any eggs/tadpoles will be removed and translocated under licence from NPWS to a suitable nearby habitat/upstream of the culvert prior to the commencement of the works.

5.4.6.2 Residual Impacts

Permanent negligible to slight negative.