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KING'S ISLAND
FLOOD RELIEF SCHEME

EIAR Addendum Report Volume 1

King's Island Flood Relief Scheme

October 2020



Comhairle Cathrach
& Contae **Luimnigh**

Limerick City
& County Council



OPW

Oifig na
nOibreacha Poiblí
Office of Public Works

JBA Project Manager

Declan White
 24 Grove Island
 Corbally
 Limerick
 Ireland

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This report is on behalf of Limerick City and County Council. This report provides an Addendum to the EIAR for the King's Island Flood Relief Scheme.

Prepared byEmily Rick BSc(Env) MSc
 Environmental Scientist (JBA)

.....Sarah McCutcheon
 Executive Archaeologist (LCCC)

.....Patricia Byrne BSc (Hons), PhD, MCIEEM
 Ecologist (JBA)

.....Daniel Garvey BA (Hons) MSc CEnv MIEEnvSc
 Environmental Scientist (Arup)

Reviewed byBernadette O'Connell BA MSc CMLI
 Associate Director (JBA)

.....Sheila O'Sullivan CEng MIEI
 Civil & Environmental Engineer (Arup)

.....Declan White BE CEng MIEI
 Principal Engineer (JBA)

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1 Introduction

Limerick City & County Council (LCCC) submitted a planning application to An Bord Pleanála in December of 2019 for a flood relief Scheme (FRS) for King's Island, Limerick City accompanied by an Environmental Impact Assessment Report referred to here as "the EIAR". An Bord Pleanála issued a Further Information (FI) request in relation to the proposed scheme. The FI requested additional details to be amended in the EIAR as provided within this report, referred here within as "the Addendum EIAR".

1.1 Response to ABP comments

In response to the request from An Bord Pleanála, additional information and/or clarification has been provided as relevant to several chapters of the EIAR, as shown in Table 1-1.

Table 1-1. Additional information provided in this report, as relevant to chapters of the EIAR

Chapter in EIAR		Additional information or clarification required	Location in Addendum Report
1	Introduction		
2	Legislation and Planning Policy	Y	Section 2
3	Constraints, Alternatives Considered, Options, and Scoping		
4	Description of the Proposed Development	Y	Section 3
5	Consultation	Y	
6	Population and Human Health		
7	Materials Assets (incl. Traffic, Waste, and Utilities)		
8	Biodiversity	Y	Section 4
9	Surface and ground water		
10	Soils and Geology	Y	Section 5
11	Noise and Vibration	Y	Section 6
12	Air Quality, Dust and Climate Change		
13	Landscape and Visual	Y	Section 7
14	Cultural Heritage	Y	Section 8
15	Interaction between environmental aspects		
16	Cumulative Impacts and Major Accidents and/or Disasters		

The Addendum EIAR and the appendices are in 3 Volumes as follows:

Volume 1 (this volume)

- Appendix A: Schedule of Environmental Commitments
- Appendix B: Supplemental information to Section 4: Biodiversity
 - Appendix B1: Invasive Species Management Plan (JBA, 2019)
 - Appendix B2: Bryophyte Assessment Report (Denyer Ecology, 2020)
 - Appendix B3: Report on the Assessment of Potential *Groenlandia densa* Enhancement Sites (Denyer Ecology, 2020)
- Appendix C: Revised Photomontage for VVM11

Volume 2

- Appendix D: Supplemental information to Section 8: Cultural Heritage
 - Appendix D1a: King's Island Flood Relief Scheme Preliminary Stratigraphic Report on Archaeological Testing (Volume 1)

Volume 3

- Appendix D1b: King's Island Flood Relief Scheme Preliminary Stratigraphic Report on Archaeological Testing (Volume 2)
- Appendix D2: King's Island Flood Relief Scheme Underwater Archaeological Impact Assessment (UAIA)
- Appendix D3: Drawings of design mitigation as a response to the results of the test excavations in Area B3

2 Legislation and Planning Policy

This section contains further information about the legislation and planning policy, which is relevant to the proposed development, in response to the following comments:

With regard to comment No. 1:

1. Directive 2014/52/EU

The constraints study detailed in Section 3.1 of the EIAR states that same was undertaken by reference to the EPA's Guidelines 'Advice Notes on the current practice in the preparation of Environmental Impact Statements, 2003. Following the changes provided by Directive 2014/52/EU and in advance of its transposition by the European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2018, the Environmental Protection Agency published Guidelines on the Information to be contained in Environmental Impact Assessment Reports (Draft August 2017).

While still in draft the Guidelines reflect the revisions in the Directive including the changes within the environmental factors to be addressed and are used as best practice. Whilst it is noted that the Guidelines are referenced at Section 1.3.1 of the EIAR, you are requested to review the EIAR in light of the changes provided for in Directive 2014/52/EU as transposed by the European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2018 and reflected within the EPA's most recent guidance.

This point has been addressed in Section 2.1 below, and clarification is made about the reference guidelines used to complete the EIAR.

With regard to comment No. 5:

5. EIAR – Policy Consideration

The policy section of the EIAR (section 2.5) does not reference the National Climate Action Plan 2019 which was published in August 2019 prior to the submission of the application. You are requested to revise this section of the EIAR to address all current policy provisions at National, Regional and Local level which relate to the proposed development.

This point has been addressed in Section 2.2 below, and makes reference to the National Climate Action Plan (2019) as well as the Limerick City and County Council Draft Climate Adaptation Strategy 2019-2024. This information is to be read as supplemental information to Section 2.5.2 and Section 2.5.4 of the EIAR, respectively.

2.1 Directive 2014/52/EU

Despite the initial phases of this study being undertaken prior to the publication of the above (Constraints Study and Options Study, which are detailed in Chapter 3 of Volume 2 of the EIAR), the EIAR and its associated Scoping Report were completed in reference to the most recent guidelines.

The EIA Directive is transposed into Irish law through the European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2018 (S.I. No. 296 of 2018). The new Regulations transpose the requirements of Directive 2014/52/EU, amending previous Directive 2011/52/EU, on the assessment of the effects of certain public and private projects on the environment (the EIA Directive) into planning law with effect from 1st September 2018.

The new Directive adapts a new title for environmental impact assessment as Environmental Impact Assessment Report. For the purposes of this assessment the term Environmental Impact Assessment Report (EIAR) is used to describe the final report for this assessment.

The new Directive is designed to “strengthen the quality of the environmental impact assessment procedure” and it notes that environmental issues, including natural resources, sustainability, biodiversity and climate change have become more important in policy making and must, therefore, be at the forefront of the environmental assessment and decision-making processes.

The EIAR was undertaken in accordance with the requirements of Directive 2014/52/EU on the assessment of the effects of a development on the environment. The EIAR was also undertaken in accordance with:

- EPA's Draft Guidance Note on the Preparation of Environmental Impact Statements (2015);
- EPA's Draft Guidelines on the Information to be Contained in Environmental Impact Assessment Reports (May 2017); and
- Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment (August 2018).

No further changes have therefore been made to the EIAR in response to this comment, as it was prepared following the requirements of Directive 2014/52/EU.

2.2 Climate Legislation and Policy

In addition to the Legislation and Policy described in Chapter 2 of the EIAR Volume 2, the following additional policies, plans, and strategies have been described below, as relevant to the proposed development:

- National Climate Action Plan 2019; and
- Limerick City and County Council Draft Climate Adaptation Strategy 2019-2024.

2.2.1 National Climate Action Plan 2019

The National Climate Action Plan 2019 was published by the Government of Ireland in 2019 in light of the report of the Joint Oireachtas Committee on Climate Action, Climate Change: A Cross-Party Consensus for Action, which builds on the work of the Citizens Assembly on climate change, Agenda 2030 and the Paris Agreement. The plan calls for a transformational shift in society toward climate resilience and sustainable development, particularly toward:

- Vast reduction and mitigation of carbon emissions by 2030;
- Meeting the EU target of net zero emissions by 2050;
- Sectoral targets and actions for climate change mitigation and adaptation

Certain sectors are highlighted as contributing unfavourably to carbon emissions. Certain sectors, notably Enterprise, Transport, and Waste, will contribute to emissions identified in the National Climate Action Plan 2019 by the proposed development:

- Enterprise, through cement production during the construction phase;
- Transport, via emissions through delivery of construction materials and site access, however with an overall improvement to the cycling and walking network within Limerick City once the development is operational;
- Waste, through the production of construction waste materials.

The proposed development will contribute to meeting the following actions identified within the Plan once operational:

Action 95: Develop and implement cycle network plans for all major cities

Action 121: Work with other public bodies and community groups exploring opportunities to increase public access in forests on publicly owned lands.

The proposed development will provide a significant public amenity through the provision of a mixed cycle and walkway around King's Island. The new development will improve accessibility on King's Island through provision of the new path, new lighting plan, improved public realm through landscaping and amenity features, as well as giving access for pedestrians and cyclists to enjoy views of the River Shannon and Abbey River and the Limerick cityscape.

Action 148: Mandate the inclusion of green criteria in procurements using public funds, introducing requirements on a phased basis and provide support to procurers as required.

The procurement process for the proposed development will take into account the EPA's Green Public Procurement (GPP) Guidelines for the Public Sector (2014)¹.

Action 176: Engage with all utility providers to improve the resilience of services in the face of severe weather events.

All relevant service providers were contacted as part of the non-statutory consultation, as described in Chapter 5 of the EIAR. In addition, Chapter 7 Material Assets (including Utilities) of the EIAR, covers impacts on services including telecom, electric, gas, and other networks. Overall, the need for the proposed development is for the protection of King's Island and its associated services from the effects of severe storms and so contributes to meeting this action.

2.2.2 Limerick City and County Council Draft Climate Adaptation Strategy 2019-2024

The LCCC Draft Climate Adaptation Strategy 2019-2024 identifies future climate change risks for County Limerick. Coastal flooding, for which this proposed development is intended, was given a score of 4 on the prioritisation scale - i.e. Major climate risk.

The proposed development contributes to meeting the following actions under this strategy:

7.2 Support and assist OPW in delivery of flood relief schemes and defences

9.9 Promote adequate invasive species control protocols on all Local Authority projects and works

In addition, the scheme has been designed to be adaptable to climate change under the OPW's Mid-Range Future Scenario (MRFS), which considers sea level rise of 0.5m in 100 years. This means it will be structurally viable, in the future, to raise walls and embankments by up to 0.5m to account for sea level rise. This is further examined in Chapter 12 of the EIAR, under Climate Change Adaptability.

2.3 Implications for the EIAR

With the addition of the above legislative and policy context, there have been no changes made which would fundamentally alter the assessment made in the EIAR, or its conclusions.

¹ Environmental Protection Agency (2014) Green Procurement: Guidance for the Public Sector. Dublin, Ireland. Available: <http://www.epa.ie/pubs/reports/other/corporate/olg/GreenPublicProcurementfinalwebv2.pdf>

3 Description of the Proposed Development

This section includes clarifications regarding the description of the proposed development, described in Chapter 4 of the EIA, based on the following comments received.

With regard to comment No. 6(i):

6. Japanese Knotweed Bund and Illegal Landfill

Reference is made in Chapter 10 (Soils and Geology) to excavation within Flood Cell A4 of contaminated soils on the site of the illegal landfill and to the excavation and movement of part of the Japanese Knotweed bund.

(i) In relation to the Japanese knotweed bund, it is noted that the development description provided in the planning report refers to replacing the excavated material on top of the existing bund (not within the SAC) and reprofiling same. However, section 2.4.7 of the NIS refers to the north-western section of the bund being relocated to the south-east of the bund to allow space for embankment construction. Furthermore, Section 11.4.2 of the EIA relates to the potential construction phase Noise and Vibration Impacts and refers in the description of Area A4 to the 'possible retaining wall construction at bund encapsulating Japanese Knotweed'. Please clarify and provide details of the proposed works including plans, elevations and sections of same

This point has been addressed in Section 3.1 below, which clarifies the details of the proposed works at the Japanese knotweed bund. Further clarification is provided in the Addendum NIS, and in Section 6 of this Addendum EIA which provides revisions of the Noise and Vibration chapter of the EIA.

With regard to comment No. 11:

11. Noise and Vibration

Reference is made at Section 11.4.2 of the EIA to a boardwalk over the SAC within Area A5 – Star Rovers to Athlunkard Boat Club – please clarify what is meant by boardwalk and if it is intended to provide same please provide comprehensive details of the proposal.

This reference to a boardwalk over the SAC was made in error. Section 3.2 below provides clarification of the proposed works at the Star Rovers to Athlunkard Boat Club section of the scheme. The assessment made is amended in Section 6 of this Addendum EIA which provides revisions of the Noise and Vibration chapter of the EIA.

3.1 Area A4 - Japanese Knotweed Bund

The description provided in Section 4.3.4 of the EIA is correct in describing the proposed works required at the existing Japanese Knotweed Bund (extracted from the EIA Volume 2 and copied below). These works are illustrated overleaf in Figure 3-1, extracted from planning drawing KIFRS-C-108-PL1. Further drawings of the proposed works at this area are provided in planning drawing KIFRS-A-006-PL2.

EIA Volume 2, Chapter 4 - Description of the Proposed Development, 4.3.4 Area A4 - Area A4 - North East Embankment (Ch 1+250 to 1+920)

The proposed flood defence embankment is to run along the rear of the houses on St. Munchin's Street. Where the embankment passes by the existing Japanese Knotweed bund, a small part at the northern end of the bund will need to be excavated locally to provide sufficient space for the embankment corridor. The excavated material will be replaced on top of the existing bund (not within the SAC) which will be reprofiled. This work will be undertaken in accordance with current best practice with regard to invasive species. The bund will subsequently be treated on site as part of a multi-year eradication programme.

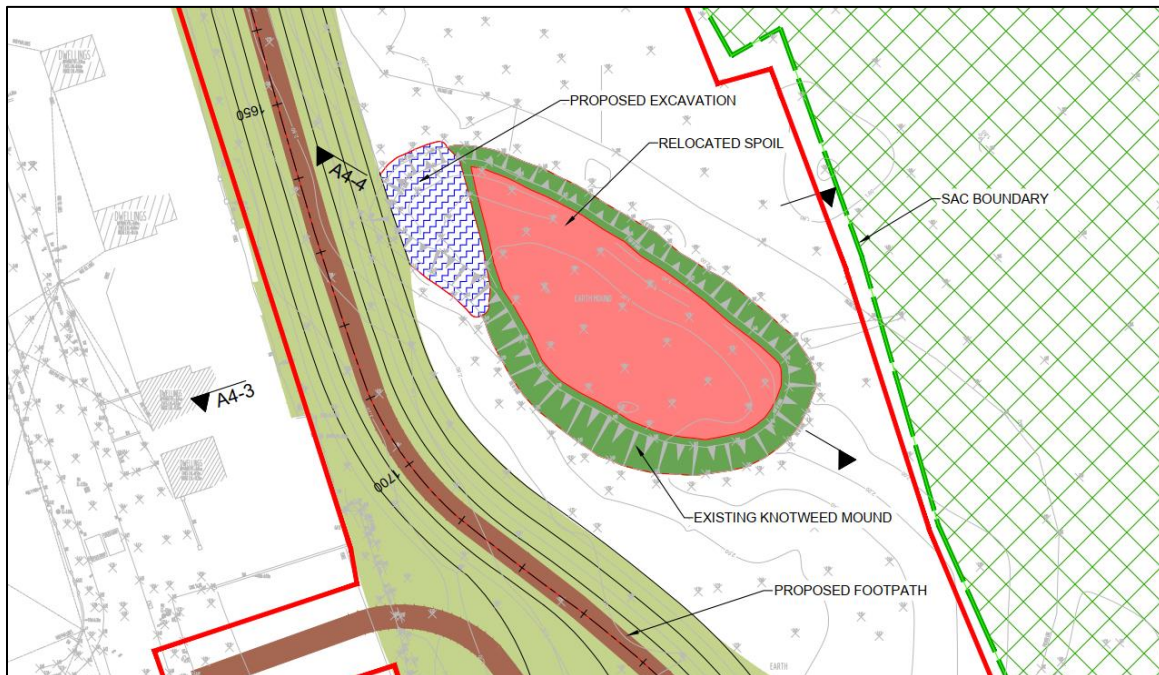


Figure 3-1. Proposed works at Japanese Knotweed Bund (extracted from planning drawing no. KIFRS-C-108-PL1).

3.2 Area A5 - Athlunkard Boat club and Star Rovers Pitches

The description provided in Section 4.3.5 of the EIAR is correct (extracted from the EIAR Volume 2 and copied below). No boardwalk is proposed at this location; the reference provided in Section 11.4.2 of the EIAR was made in error.

EIAR Volume 2, Chapter 4 - Description of the Proposed Development, Section 4.3.5 Area A5 - Star Rovers to Athlunkard Boat Club (Ch 1+920 to 2+500)

A5 Existing Condition

The existing embankment and sandbags are in a state of disrepair and continue along the perimeter of the island until the boundary of the Athlunkard Boat Club. An existing open drain runs along the perimeter of the Star Rovers pitches.

A5 Design Proposal

The proposed flood defence embankment will extend approximately 400m around the northern and eastern sides of the sports fields until it reaches the northern boundary of Athlunkard Boat Club.

The SAC is very closely aligned to the northern and eastern sides of the Star Rovers FC pitches. The embankment side slopes will therefore be reduced to minimise encroachment onto the area of the pitches whilst avoiding the need for any alterations to the east-west open drain defining the boundary of the SAC. The existing north-south open drain will be infilled.

In order to provide sufficient space for the proposed embankment along the northern side of the Star Rovers pitches, the AstroTurf pitch will be partially relocated further south by approximately 17m. This will result in temporary disruption to the playing area during construction and the loss of 6 parking spaces and storage area on the western side, accessed from Assumpta Park. A row of semi mature trees will be planted along the western edge of the sports area to screen the training pitches from residents in Assumpta Park.

A 2m high paladin boundary security fence will be erected, offset 3m from the base of the embankment. as it wraps around the grass pitches. High ball-stop netting will also be erected behind the goals of both the Star Rover FC and Athlunkard FC pitches. The proposals in this area are illustrated in Photomontages 4 and 5, in Volume 4.

Drainage from the inside of the proposed new embankment both to the north and east of the Star Rovers pitch will discharge to the existing open drain at the south-east corner of the SAC. This drainage will also pick up any existing drainage from the playing pitches. A non-return valve will be provided to the proposed outfall. Refer to Drainage drawing nr KIFRS-C-205

3.3 Area B3 - Potato Market to King John's Castle (Ch 3+275 to 3+705)

Minor changes have been made to the design of the proposed development in Area B3 following uncovering of archaeological remains, described further in Section 8 of this Addendum EIA and in Appendix D. The amended project description for the area is provided below, with updates to the original scheme design in bolded text.

Section 3.3.1 is intended to replace the EIA Section **4.3.12 Area B3 - Potato Market to King John's Castle (Ch 3+275 to 3+705) - Design Proposal**

Section 3.3.2 is intended to replace the EIA Section **4.5.13 B3 Construction Requirements - Between the Courthouse and King John's Castle**

3.3.1 Design Proposal

The cantilevered viewing opening in the Potato Market will be replaced with a glazed flood defence panel, supported by the existing quay wall strengthened locally by the construction of a mass concrete backing wall.

A stone clad ramped access structure will provide the flood defence to the existing access opening to the pedestrian bridge. The proposed flood defence ramp will be offset from the existing buildings allowing access to the existing doorway and windows. The walls along the Potato Market will be repaired where necessary, by pointing and grouting, to achieve the required flood levels. A new approximately 2.5m high independent flood defence wall will be constructed on the Potato Market side of the existing Curraghbour Boat Club boundary wall. Once it meets the Potato Market railing it will reduce in height to the 5.3mOD. The wall will be faced with rough-hewn stone in a sneaked pattern laid to courses with a stone coping. The wall will extend through the Potato Market railings after approx. 4m length to form a pier on the other side.

An automatic flood gate will be constructed at the entrance to Curraghbour Boat Club. Its deployment will be triggered by an ultrasonic level gauge sited at the adjoining quay side. This will be a hinged automatic flood gate with a manual override option. For further redundancy, a secondary manual barrier will also be installed parallel to the automatic barrier, but on its dry side. An RC flood wall clad with masonry is proposed to extend northwards from the flood barrier to the next change in direction of the quay wall. It will be founded on the existing quay wall which will be pointed and grouted, and further strengthened through the construction of a mass concrete backing wall. A raised table top will be located in the area framed by this wall, the automatic barrier and the Potato Market railings, with ground levels of 4.15m AOD providing passive protection for events up to the 1 in 5 year event.

Glass flood defence panels will extend westwards at the viewing platform atop of an RC stub wall clad in masonry. This will be founded on the historic quay wall which will be pointed and grouted and further strengthened by the construction of a mass concrete backing wall. The ground level at this location will be raised by approximately 300mm to reduce the relative difference between dry side ground level and flood defence height to 1.2m thus ensuring clear views of the river are not restricted along the public walkway.

Along the cantilevered boardwalk by the Court House, glass flood defence panelling is also proposed. This will sit atop of a new shorter RC cantilever element which will replace the existing cantilevered walkway. Even though the overall width is reduced, the existing railing will be set back to provide a 2.4m wide public walkway whilst still retaining a separate security pathway around the courthouse for maintenance purposes. This glass flood defence panelling will extend to the northern boundary of the Court House. The new RC cantilever will sit atop of the historic quay wall which will be pointed and grouted. New mini-piles at circa 4m centres will be required to support the new RC cantilever slab. These mini-piles will be installed alternating with the existing ground anchors which are also at circa 4m centres.

Beyond the Court House, further glazed flood defence panelling is proposed as far as the location of the existing fountain to the west of the Civil Offices. These panels will sit atop of the historic

quay wall which will be pointed and grouted and further strengthened, by the construction of a mass concrete backing wall. The proposals in this area is illustrated in Photomontages 10 and 11 in Volume 4.

To the northwest of the Civil offices, an historic Bridge links the old city wall (which is a National monument) to an historic Mill structure, the remains of which can just be seen protruding from the historic quay wall. An historic tunnel structure is also located in this area. A comprehensive desk study assessment, **followed by archaeological test trenching in 2020**, was undertaken to define in so far as is possible the location of all of these below ground features. A flexible flood defence and associated foundation design has been adopted which can respond to any slight deviation in alignment without compromising the structural stability of the solution or altering the above ground aesthetics. The flood defences in this area will consist of stone clad RC parapets, founded on a grillage of bored concrete piles. The layout of the piles has been developed to avoid any damage to the archaeological features **with a 2000mm horizontal buffer and 150mm vertical buffer to the medieval bridge leading to the mill structure and to the arches at the northern end of the historic vaults. The finished ground level is slightly raised to facilitate the buffer.** This approach will ensure that the features are preserved in situ and recorded. It is also proposed to incorporate some interpretation boards at this location to tell the story of these historic features. At this location, six early mature Lime trees will be removed to ensure no further root damage is caused to any archaeological features in the area.

The final section of flood defences in this area, located to the north of any archaeological features will consist of further glazed flood defence panelling. These panels will sit atop of the historic quay wall which will be pointed and grouted and further strengthened, by the construction of a mass concrete backing wall. This solution will tie into high ground just south of St. John's Castle but without any direct connection to the Castle structure itself, thus avoiding any direct impact on the National Monument.

There are a number of existing outfalls which discharge to the River Shannon from the Potato Market, Courthouse and the rear of City Hall.

2 No. outfalls from the Potato Market carpark are to be made redundant as part of the scheme works. A new storm outfall will be provided to accommodate storm drainage from the Potato Market carpark and the access road in/out of Merchants Quay. A by-pass petrol interceptor will be constructed to enhance the water quality prior to discharge. An inter-tidal storage tank will be constructed to prevent flooding on the surface during extreme tide conditions in the Shannon. **This inter-tidal storage tank will be located between the court house and the potato market and to avoid the 18th century harbour and historic city walls, the inter-tidal storage tank will replace the existing soakpit tank within the potato market car park.**

The existing outfall to the south-west of the civic building will be increased in size with a non-return valve installed. An overflow within the final manhole will convey flows to the proposed inter-tidal storage tank to the north while the outfall is surcharged.

The existing outfall to the rear of the City Hall will be increased in size with a non-return valve installed. Inter-tidal storage for existing paved areas behind the new glass panel and the wider contributing area will be provided adjacent to the outfall such that flooding on the surface does not occur during high tide conditions in the Shannon.

The existing outfall to the south-west corner of King Johns Castle will be increased in size with a non-return valve installed. As this outfall drains existing car-parking predominantly to the west of City Hall, a by-pass petrol interceptor will be constructed to enhance the water quality prior to discharge. Refer to drawings nr KIFRS-C-209 to C-216.

3.3.2 Construction Requirements

In the EIAR Section 4 **Description of Proposed FRS** the following wording from Section **4.5.13 B3 Construction Requirements from the original EIAR** will be replaced:

'Between the Courthouse and King John's Castle

Past the courthouse, 6no. early mature Lime trees between the Council offices and the glass panelling will be removed for construction and replaced with appropriate species on completion of the construction works.'

Replacement text is as follows:

'Between the Courthouse and King John's Castle

Past the courthouse, 6no. early mature Lime trees between the Council offices and the glass panelling will be removed for construction.'

3.4 Implications for the EIAR

Minor revisions are provided in the following Sections of this report based on the clarifications and updates provided above:

- Section 6 - Noise and Vibration
- Section 7 - Landscape and Visual Impact Assessment
- Section 8 - Cultural Heritage

4 Biodiversity

This section outlines the response to the submissions on the presence of bryophyte communities (mosses and lichens) associated with the qualifying interest 'watercourses of plain to montane levels' associated with the Lower River Shannon SAC on Quay walls within the application boundary.

With regard to comment No. 8:

8. Bryophyte communities

A number of submissions refer to the presence of bryophyte communities (mosses and lichens) associated with the qualifying interest 'watercourses of plain to montane levels' associated with the Lower River Shannon SAC on Quay walls within the application boundary. You are requested to respond to this matter.

The following Section 4.1 and 4.2 address bryophyte communities within the study area of the proposed development.

In addition to further information provided on the Bryophyte communities, additional details have been provided about the status of the research project being undertaken by LCCC on Opposite-leaved pondweed (*Groenlandia densa*). These details are provided in Section 4.3 of this Addendum and Appendix B3.

4.1 Bryophytes

In response to submissions received referring to the presence of bryophyte communities on quay walls, further study was undertaken to assess the potential occurrence of Annex I bryophyte communities within the development boundary. Surveys were conducted by Denyer Ecology in July of 2020 to assess the species and habitats present on the site. In addition to ecological walkover surveys, a desktop assessment was undertaken, as was consultation with National Parks and Wildlife Service (NPWS). The results of this assessment are summarised below in Section 4.1, and the full report by Denyer Ecology provided in Appendix B2. In light of the findings of this assessment, the predicted impacts of the proposed development are assessed in Section 4.2 below. The implications for the below findings with regards to the Natura 2000 network are further assessed in the Addendum NIS which accompanies the response to Further Information.

4.1.1 Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation

The Annex 1 habitat Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation is known to occur in the Lower River Shannon SAC, and includes three sub-types of the habitat;

1. *Groenlandia densa* (L.) Fourn., Opposite-leaved Pondweed
2. *Schoenoplectus triqueter* (L.) Palla, Triangular Club-rush
3. Bryophyte-rich streams and rivers

The first two sub-types are associated with tidal reaches of rivers, while the latter sub-type is found in fast-flowing stretches of unmodified streams and rivers (NPWS, 2012).

The third sub-type Bryophyte-rich streams and rivers habitat is recorded in fast flowing rivers and streams (NPWS, 2012) within Shannon estuary SAC. However, the river section adjacent to King's Island is a lowland depositing river, and does not have the high, variable, flow or structure (in-channel and marginal boulders) of bryophyte dominant upland eroding rivers. Although the quay walls along the southern boundary of the King's Island do support a vascular plant and bryophyte flora, a survey carried out in 2020 (Denyer Ecology 2020 and Appendix C) recorded no rare or protected bryophyte species. Although full access to the wall was not possible for the survey, the rare/protected bryophyte species recorded from within the Lower River Shannon SAC (and which indicate the 'bryophyte-rich sub-type) are not highly likely to occur in this habitat. Bryophytes are of low cover in the overall channel as they are restricted to the quay walls. Therefore, the aquatic bryophyte zone is not considered to be an example of the Annex I habitat 3260. This was discussed and confirmed with NPWS. However, aquatic bryophyte zone does have affinity with

the Annex 1 sub-type Bryophyte-rich streams and rivers habitat, is part of an SAC river system (for which 3260 is a Qualifying Interest) and functions as an ecological link/ corridor through the city in this part of the SAC and has County ecological value.

It is therefore assessed that as the Annex I habitat 3260 sub-type Bryophyte-rich streams and rivers habitat does not occur within the zone of influence of the King's Island FRS, there will be no significant impacts on this Annex 1 habitat within the Lower Shannon SAC from the proposed works (see also King's Island FRS NIS Addendum report where this habitat is screened out).

The full report on Bryophyte-rich streams and rivers habitat on the Limerick city quay walls (Denyer Ecology 2020a) is seen in Appendix B.2 of this report.

4.2 Protection of Quay Wall Aquatic and Vascular Vegetation in Relation to Biodiversity Loss.

A full survey, ecological evaluation, and recommendations on quay wall vegetation communities (including bryophytes and vascular plants) was carried out by Denyer Ecology (2020a). Several vegetated zones were noted on the quay walls:

- Algal zone
- Aquatic bryophyte zone
- Dry wall bryophytes
- Tall-herb swamp vascular plant zone

These ecological features and their evaluation are summarised below (from Denyer Ecology 2020a):

Table 4-1. Importance of ecological features found on quay walls (from Denyer Ecology, 2020a)

Ecological Feature	Importance	Rationale
Algal zone	Local (low) ecological value	Not considered further in this assessment
Aquatic bryophyte zone	County ecological value	Of ecological value - carried forward
Dry wall bryophytes	Local (high) ecological value.	Of ecological value - carried forward
Tall-herb swamp vascular plant zone	Local (high) ecological value.	Of ecological value - carried forward

The section below evaluates the impact of King's Island FRS on the various vegetation zones of the quay walls.

4.3 Predicted Impact of the Proposed Development

4.3.1 Construction Phase Impacts 1: Habitat Loss/Disturbance

Bryophytes

Proposed activity and its duration, biophysical change and relevance to the feature in terms of ecosystem structure and function

Works are proposed to the quay walls which would involve clearance of vegetation on the walls. The upgrading of the flood defence walls along the southern part of King's Island involves cleaning vegetation from the face of the existing wall, removing loose mortar and pointing the existing wall with mortar.

Characterisation of unmitigated impact on the feature

The physical damage from clearing vegetation and repointing the walls will result in removal/reduction of aquatic and dry bryophyte communities on the quay walls. Without mitigation quay wall vegetation may take some time to re-establish. However, bryophytes do not have roots

and attach to stonework/ mortar by rhizoids (small root-like structures). This means that they can quickly recolonise surfaces where the surface is suitable (e.g. not too smooth).

Rationale for prediction of effect

Vegetation clearance of walls could reduce the area of bryophytes on the quay walls causing a significant impact for aquatic bryophytes at a county level, and for dry bryophytes at a local (high) level.

Vascular plants

Proposed activity and its duration, biophysical change and relevance to the feature in terms of ecosystem structure and function

Works are proposed to the quay walls which would involve clearance of vegetation on the walls. The upgrading of the flood defence walls along the southern part of King's Island involves cleaning vegetation from the face of the existing wall, removing loose mortar and pointing the existing wall with mortar.

Characterisation of unmitigated impact on the feature

The physical damage from clearing vegetation and repointing the walls will result in removal/reduction of Tall-herb swamp at the river edge and vascular plant on the stonework of the quay walls. Without mitigation this vegetation may take some time to re-establish.

Rationale for prediction of effect

Vegetation clearance of walls could reduce the area of vascular plants below and on the quay walls causing a significant impact for vascular plants at a local (high) level.

4.3.2 Operation Phase

During operation there will be no impact from the King's Island FRS on the bryophytes and vascular plants on the quay walls. These plants will revegetate naturally, aided by the flow of water of the Abbey and Shannon Rivers.

4.3.3 Recommendations

This section outlines the recommendations made by Denyer Ecology (2020a) (see Appendix B.2) to retain the bryophyte and vascular vegetation on the quay walls.

Works are proposed to the quay walls associated with the King's Island Flood Relief Scheme. The works should be designed to maintain the distribution of habitats of ecological value, maintain urban biodiversity and to maintain species diversity and distribution throughout this area of the SAC. A number of recommendations for each zone are summarised below:

Algal zone

- No recommendations. Vegetation likely to quickly recolonise any disturbed/ replaced sections of quay wall.

Aquatic bryophyte zone

- Retain where possible and maintain distribution and species diversity throughout area.
- If not possible to preserve all current areas of aquatic bryophyte vegetation, then the aim should be to retain some areas of bryophytes (of all species) throughout the survey area and to ensure that any replaced stonework is suitable for bryophyte recolonisation.
- Bryophytes do not have roots and attach to stonework/ mortar by rhizoids (small root-like structures). This means that they can quickly recolonise surfaces where the surface is suitable (e.g. not too smooth). Any replaced stonework should be of a similar texture to the existing stone to promote re-establishment of the aquatic bryophyte flora.
- If some stonework needs to be removed, then the species are likely to survive temporary removal and replacement.
- The bryophytes are present both on the stonework and on the mortar between the stones. If the mortar is being replaced, then retain the bryophytes on the stonework. If the stonework is being cleaned, then maintain some bryophytes on the mortar.

Dry wall bryophyte zone

- Retain where possible and maintain distribution and species diversity throughout area.
- Ensure that any new stonework has a similar texture to the present stonework to ensure rapid re-colonisation of bryophytes on any new surfaces.
- Stonework with bryophytes present can be removed and replaced if required.

Tall-herb swamp vascular plant zone

- Retain where possible and maintain distribution and species diversity throughout area.
- Retain suitable niches at the river edge (raised, shallow areas exposed at low tide) and areas within the stonework which are suitable for vascular plant growth. This will enable rapid recolonisation of any disturbed/ repaired/ replaced stonework and other substrates.

4.4 Mitigation Measures

Including the recommendations of Denyer Ecology (2020a), the mitigation measures for quay wall bryophytes and vascular plants are thus outlined below:

- Prior to the commencement of works on the quay wall, the Contractor's ecologist shall undertake a survey to identify the locations where bryophytes are present.
- ECoW to give a toolbox talk to the appointed contractor before starting work at the quay walls to explain methodology and areas containing bryophytes and/or tall herb swamp.
- While pointing and repair work is taking place on quay walls, retain 40-50% of aquatic bryophytes (below the high spring tide) and dry bryophytes (above the spring tide), maintaining a distribution of species across the walls.
- Any replaced stonework should be of a similar texture to the existing stone to promote re-establishment of the aquatic bryophyte flora.
- The bryophytes are present both on the stonework and on the mortar between the stones. If the mortar is being replaced, then retain the bryophytes on the stonework. If the stonework is being cleaned, then maintain some bryophytes on the mortar.
- For dry bryophytes ensure that any new stonework has a similar texture to the present stonework to ensure rapid re-colonisation of bryophytes on any new surfaces.
- Stonework with bryophytes present can be removed and replaced if required.
- Leave silted/muddy areas found at the base of the quay walls containing aquatic plants in order to retain the seedbank of tall-herb swamp vegetation. Silts should only be cleaned where it is required structurally.

4.5 Residual impact

4.5.1 Construction Phase

With retention of 50% of quay wall vegetation during the construction phase, residual impacts will be temporarily negative, but not significant. Bryophytes can rapidly recolonise the quay walls where the surface is suitable. Tall-herb swamp vascular plants will likewise re-establish from silt/muddy areas left undisturbed, and vascular plants will re-establish from intact areas of plants left undisturbed on the stonework.

4.5.2 Operation Phase

During operation there will be no impact from the proposed development on the bryophytes and vascular plants on the quay walls. These plants will revegetate naturally, with the aquatic bryophytes aided by the flow of water of the Abbey and Shannon Rivers.

4.6 Additional requirements from NPWS (Translocation of Opposite-leaved pondweed *Groenlandia densa*)

In fulfilment of the mitigation requirements of NPWS regarding the translocation of Opposite-leaved pondweed *Groenlandia densa* on King's Island, translocation/habitat enhancement works of two other sites in or as near to King's Island as possible, were outlined in the EIA and Denyer (2019). This research project, developed by LCCC and in consultation with Denyer Ecology

aquatic plant specialists, investigates colonisation, requirements of pondweed and vegetation management of other species.

Since the original submission, four potential sites were surveyed by Denyer Ecology in 2020, and three sites were identified as having potential for pondweed enhancement: Rossbrien (main channel and two drainage ditches), Ballynaclogh River (main river channel and adjacent drainage ditch) and the Limerick Canal. These three sites will be discussed with NPWS and of these, two sites will be selected. A habitat conservation and management plan in relation to *Groenlandia densa* will then be created for these two sites and a Section 21 licence application submitted for the proposed works.

The latest report incorporating surveys of the four sites is provided in Appendix B.3 (Denyer Ecology, 2020b).

4.7 Description of Proposed FRS - Area B3

As described in Section 3.3.2 above, the following wording from Section **4.5.13 B3 Construction Requirements** from the original EIAR will be replaced:

'Between the Courthouse and King John's Castle

Past the courthouse, 6no. early mature Lime trees between the Council offices and the glass panelling will be removed for construction and replaced with appropriate species on completion of the construction works.'

Replacement text is as follows:

'Between the Courthouse and King John's Castle

Past the courthouse, 6no. early mature Lime trees between the Council offices and the glass panelling will be removed for construction.'

The removal and non-replacement of these trees will have no impact on the outcome of the EIAR.

4.8 Implications for the EIAR

With the addition of the above, there have been no changes made which would fundamentally alter the assessment made in the EIAR, or its conclusions.

5 Soils, Geology and Land

The following section provides additional information regarding soil condition and remediation works at the landfill site in St. Mary's Park, as well as further information on the impacts on Land, as required under Annex IV(4) of Directive 2014/52/EU. This information is supplied in response to the following comments:

With regard to comment No. 6(iii):

6. Japanese Knotweed Bund and Illegal Landfill

Reference is made in Chapter 10 (Soils and Geology) to excavation within Flood Cell A4 of contaminated soils on the site of the illegal landfill and to the excavation and movement of part of the Japanese Knotweed bund.

(iii) No detail is provided as to the removal of contaminated soils on the site of the illegal landfill. You are therefore requested to provide more detail on the current proposals for or remediation already carried out of same.

The following text was provided in the original EIAR, under Section 10.4.3 Soils:

Landfills

There is an area that once contained an unlicensed landfill to the east of St Mary's Park on the Site as detailed in Figure 10-2 Volume 3, which is currently being remediated. JBA understand that municipal waste and mixed construction and demolition waste had been removed off site for disposal. Contaminated soils are likely to be present in this landfill, but the level and extent of contamination is not known.

The above paragraph is to be removed from the EIAR, and replaced with the further information provided in Section 5.1 of this Addendum. The following Section of the EIAR, "10.5 Predicted Impacts of the Development on Soils and Geology" describes where excavations will be required at the site as part of the works during construction of the proposed development, and where soils are to be re-used on site.

With regard to comment No. 2:

2. Environmental Factors – Land

The European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2018 transpose the requirements of Directive 2014/52/EU into Irish planning law and by so doing amend Section 171A of the Planning and Development Act 2000, as amended. Section 171A(b)(i) requires "an examination, analysis and evaluation, carried out by the planning authority or the Board, as the case may be, in accordance with this Part and regulations made thereunder, that identifies, describes and assesses, in an appropriate manner, in the light of each individual case, the direct and indirect significant effects of the proposed development on the following:

- (I) population and human health;
- (II) biodiversity with particular attention to species and habitats protected under the Habitats and the Birds Directive;
- (III) land, soil, water, air and climate;
- (IV) material assets, cultural heritage and the landscape;
- (V) the interaction between the factors mentioned in clauses (I) to (V)"

You are requested to submit a revised Environmental Impact Assessment Report which includes an additional chapter which specifically address the matter of 'land' as it is included in Clause (III) above.

An additional section has been provided which contains an assessment on the matter of "Land" as required under Directive 2014/52/EU and Section 171A of the Planning and Development Act 2000. This section, provided in Section 5.2 below, provides supplemental information to Chapter 10 of the EIAR, therefore amending the title of the chapter to

"Chapter 10: Soils, Geology and Land". The information provided in Section 5.2 is to be read in conjunction with Chapter 10 of the EIAR.

5.1 Illegal landfill site

There is an area that once contained an unlicensed landfill to the east of St Mary's Park on the Site as detailed in Figure 10-2 Volume 3 of the EIAR.

A Tier 2 Risk Assessment was undertaken for the illegal landfill site in St Mary's Park by Verde Consultants in 2010, under the EPA Code of Practice (Environmental Risk Assessment for Unregulated Waste Disposal Sites). This assessment classified the landfill site as a Class B based on the SPR linkage score summary. The key risks were due to the mixed waste type and due to direct surface water linkages between the waste body, the river and Special Area of Conservation. The assessment concluded that there was a moderate risk of transfer of contamination to these receptors, and that potential impacts would increase should the volume of waste increase and also during times of flooding. It was recommended that remedial works take place to reduce the risk rating of the site.

Priority Construction were commissioned to undertake remedial works at the site between July and October of 2015. Approximately 23,024m³ of waste material was excavated, processed and segregated. Waste was disposed off-site at a licenced Waste Management facility. All of the areas excavated were backfilled and regraded using inert material recovered on-site.

Illegal dumping is no longer taking place at this site. Results of the soil analysis, undertaken after site remediation, are described below.

5.1.1 Soil Analysis

As part of a site investigation completed by PGL in 2016², soil samples were taken from various locations around King's Island and analysed for a full range of analytes. The location of the boreholes and summary of the results of the soil investigation have been included in Appendix E1 of Volume 2 of the EIAR, with accompanying figure provided in Figure 9-6 of Volume 3.

Discrete soil samples were taken from the boreholes and submitted to an analytical laboratory for a full suite of heavy metal, polyaromatic hydrocarbon (speciated), polychlorinated biphenyl analysis (7 congeners), Total Petroleum hydrocarbon (speciated aliphatic and aromatic), BTEX (benzene, toluene, ethyl benzene and xylene) analysis. No asbestos analysis was conducted on the samples. Waste Acceptance Criteria (WAC) analysis was also determined on the samples, and a summary of the results are provided in Appendix E2 of Volume 2 of the EIAR, with accompanying figure provided in Figure 9-6 of Volume 3.

In the site where the illegal landfill previously existed, in Area A4 where the North East Embankment is proposed, the following contaminants were found:

- Zinc (TP116) (0.5 m) at levels of 300 mg/kg and in TP117 (0.5 m) at levels of 270 mg/kg;
- Elevated levels of Barium
 - BH113 (460 mg/kg at 1.0 m and 410 mg/kg at 1.5 m)
 - BH116 (240 mg/kg at 0.5 m and 210 mg/kg at 1.2 m)
 - BH109 (190 mg/kg in BH109 at 0.5 m to 310 mg/kg in BH109a)
- Total petroleum hydrocarbons (TPHs) contamination at TP116 (300 mg/kg), and TP117 (0.5 m) (270 mg/kg)
- Mineral oil an indicator of anthropogenic sources of contamination was detected in TP116 (210 mg/kg)

The Waste Acceptance Criteria analysis carried out on the samples found that total organic carbon (TOC) was the main reason for exceedances with the inert landfill site criteria of 3%. TOC levels of 11% was detected in a sample taken from BH109 (1.0 m) and 5.1% from the same trial pit at 1.5 m). TOC levels in TP117 (0.5 m) was 5 % and in TP116 (0.5 m) was 4.0 %.

The review of the soil analysis results demonstrates that a number of sources of anthropogenic activities have contributed to the quality of the soil around the site. There is evidence of

² PGL. (2016). King's Island Flood Relief Scheme - Site investigation Contract, Phase 2 Factual Report

petrol/diesel contamination of the soil, metals or scrap metals has contributed to some of the elevated heavy metal results found in the soil analysis.

5.2 Land

The following section describes the baseline conditions of the land to be impacted by the proposed development, with regard to land use, land take, land ownership, and topography.

5.2.1 Existing Land Use

The existing land use where the proposed development is to take place in the north of the island, shown in Figure 10-3 in Volume 3 of the EIAR, is primarily Public Open Space, which is used for recreation and as a public walkway on top of the existing embankments. The open space inland of the embankments are also used for horse grazing, and horse and cart "sulky" racing in some areas including an informal track to the west of St Mary's Park, though this is not an approved land use in the area. The eastern part of the island contains the Star Rovers FC and Athlunkard Villa FC, which are owned by LCCC and will be repositioned as part of the proposed development as agreed between LCCC and the football club (further described in Section 5.2.4).

The land of the proposed defences in the south of the island is the edge of existing roads, quays, and/or pedestrian routes, as shown in Figure 10-1, in Volume 3 of the EIAR. Significant public buildings include the Court House, Limerick City and County Council Offices, Barrington's Hospital, and King John's Castle. Public and commercial spaces are further described in Chapter 7 of the EIAR, Population and Human Health.

5.2.2 Historic Land Use

In the past, the lands in the North of the island were considered liable to flood and were used for military exercising grounds and agriculture/grazing. St. Mary's Park estate was constructed in the 1930s as was an associated Sewage Works facility shown in the historic Cassini Maps³. Flood embankments in the north of the island are a feature in the Historic Map 6-inch Black & White maps (1837-1842)⁴, and remain in the same location today.

The south of the island remains in a similar configuration to its historic land use. The major riverside features include George's Quay, Merchant's Quay, Sir Harry's Mall, and the Potato Market and are included in historic maps from 1837-1842.

5.2.3 Land take

The proposed development can be divided into two separate structures: embankments, and flood walls. The greatest land take will be in areas where embankments are to be constructed, in Areas A3 (North West Embankments), A4 (North East Embankments), A5 (Star Rovers Pitches), and a section of Area A6 (Athlunkard Boat Club), which will have both embankment and flood wall features. The remaining areas will be constructed of new reinforced concrete flood wall, repairs and reinforcement of existing flood wall, and refurbishment of public access areas including walkways.

The total above-ground land take for the proposed development will be approximately 50,200m². Of this, approximately 49,000m² will be embankment, while 855m² will be flood wall, with an additional 395m² of ramp being raised at the Absolute Hotel. The total land take of the embankments is significant for the reason that they will gently sloping down to connect with the existing ground level for public safety and visual/landscaping purposes (slopes ranging from 1:10 to 1:30 in Area A3, and 1:6 in Area A4) using imported topsoil, and will be re-seeded with meadow grass to resemble same.

Land ownership

The majority of lands within the scheme area are in the ownership of LCCC. Land ownership agreements and/or permissions have been sought for areas of private ownership which form part of the proposed development. Additionally consultation with the relevant stakeholders has progressed to allow construction works to take place when planning permission has been granted.

³ Ordnance Survey Ireland (2020) 'Historic Map 6 Inch Cassini', available: <http://map.geohive.ie/>

⁴ Ordnance Survey Ireland (2020) 'Historic Map 6-inch Black & White maps (1837-1842)', available: <http://map.geohive.ie/>

All stakeholders were consulted at each stage of the process and amendments were made to the design, taking their considerations into account where appropriate.

In one area at Sir Harry's Mall (8.43m² within Area A7), lands must be acquired by LCCC to progress the works.

Additional areas where lease agreements were altered for the works include the following:

- Star Rovers Football Club (occupying an area of approximately 17,000 m²)
- The Athlunkard Villa Football Club (occupying an area of approximately 24,000 m²)
- The Athlunkard Boat Club (occupying an area of approximately 3400 m²)
- The Potato Market Car Park (occupying an area of approximately 3000 m²)
- Courts service (occupying an area of approximately 1850 m²)
- Absolute Hotel (Works to wall within the land holding, approximately 50 m²)

Further detail about these agreements are provided below.

Sir Harry's Mall (King's Island Development)

One small area of King's Island (8.43m² at Sir Harry's Mall) was required as part of accommodation works to facilitate the construction and operation of the realigned footpath, bus parking and turning of buses for the Absolute Hotel. A letter of consent to undertake the works was submitted with the planning application to An Bord Pleanála and LCCC is progressing the purchase of the land.

Star Rovers Football Club

Star Rovers Football Club has a long-term lease from LCCC for the lands. A letter of consent to undertake the works was submitted with the planning application to An Bord Pleanála. LCCC is preparing a legal agreement with Star Rovers Football Club to undertake the flood relief works, including accommodation works.

Athlunkard Villa Football Club

Athlunkard Villa Football Club has a long term lease from LCCC for the lands. A letter of consent to undertake the works was submitted with the planning application to An Bord Pleanála. The Council is preparing a legal agreement with Athlunkard Villa Football Club to undertake the flood relief works, including accommodation works.

Athlunkard Boat Club

The property within the boundary wall around Athlunkard Boat Club is owned by Athlunkard Boat Club. The flood scheme is constructing a new flood defence wall along their southern boundary and relocating their vehicular entrance to the west side of the site with a new internal access road to the clubhouse. A letter of consent to undertake the works was submitted with the planning application to An Bord Pleanála. LCCC is preparing a legal agreement with Athlunkard Boat Club to undertake the works, including accommodation works.

Courthouse, Merchant's Quay

The area inside the railings around the courthouse is unregistered and the Courts Service are looking to have these lands vested in their ownership. Courts Service have agreed to relocation of the railing on the north and west side of courthouse being relocated closer to the building to facilitate the walkway around the courthouse. The new flood defence wall would be slightly cantilevered beyond the quay wall to maintain a 2.4 metre walkway between the glass panels and the realigned courthouse railing. A letter of consent to undertake the works was submitted with the planning application to An Bord Pleanála. The new line of the railings is as shown outlined in red on the drawing 'KIFRS-CS-03', attached to the Letter of Consent from The Courts Service submitted as part of the Further Information Response Report to An Bord Pleanála.

As a result of the archaeological excavations the underground surface water storage tank between the Potato Market and the courthouse has been relocated closer to the courthouse building. The construction of the tank requires the temporary removal of the railings on the south side of the courthouse and excavation between the railings and the courthouse for working space. The Courts Service has provided a Letter of Consent for these works as included in the Further Information Response Report to An Bord Pleanála.

LCCC are preparing a legal agreement with Courts Service for the works around the courthouse, including accommodation works.

5.3 Predicted Impact of the Proposed Development

Do-Nothing Scenario

Many of the existing flood defences on King's Island, including all of the embankments in the north of the island are in a state of disrepair. In the do-nothing scenario, the public lands in these areas will continue to degrade, eventually becoming inaccessible to the public. There is also a possibility that future flood events will occur, having a significant negative impact on the lands in King's Island through saltwater intrusion, and contamination of lands by flood waters. This would have cascading effects on population and human health, soils and geology, surface and groundwater, and material assets.

Construction Phase

As described in the original EIAR (Section 10.5.2), during the construction phase, earthworks will be undertaken at the site of the historic landfill as part of works proposed in Area A4. This will include minor excavations (stripping of soil and surficial soil layers) in order to build the foundations of the embankments in this location. Soil remediation was previously completed within this site with only residual petrol/diesel contamination of the soil and heavy metals being observed during site investigations. No significant impact to the environment as the soils will be retained onsite and reused locally in the proposed earthworks.

Any excavated soils will be re-used on site and will not be exported off-site. Any waste material will be processed in accordance with mitigation measures set out in Chapter 7 of the original EIAR which covers Material Assets, Utilities, and Waste.

The construction footprint of the proposed development will be 197,010m²; this includes all construction areas on the island, the site compound and access areas where jack-up barges will be deployed on the opposite side of the Abbey River due to space and access constraints on King's Island. For the duration of the construction of the embankments and flood walls, the public walkway and public open area will be inaccessible, and strict access restrictions will apply in and around the site compound. Road closures will be necessary during certain phases of construction, such as at George's Quay and Sir Harry's Mall.

The lands will be inaccessible in phases over the duration of the construction phase (approximately 18 months), however the construction of each area and flood reinforcement will occur in phases, subject to the scheduling of the contractor and according to various construction timing windows as specified in the Schedule of Environmental Commitments.

The lands will undergo a moderate change during the construction phase through stripping of vegetation and soils, and import of fill material, particularly in the north of the island.

Operation Phase

The total above-ground land take for the proposed development will be approximately 50,200m²; the majority of which is in ownership of LCCC, some of which is under lease agreement with various stakeholders. The proposed scheme will provide an improvement to the public realm, public amenity areas, and improve public safety around the River Shannon and Abbey Rivers. There will be a change in the topography of the land in Areas A3 (North West) and A4 (North East) due to the construction of the embankments, however the area will remain accessible to the public and remain part of the public realm. There will be no significant change to the land in the south of the island, rather an upgrade will be provided for the various walls, and public walkways and roadways. No change in land use zoning will take place.

Some change in land configuration will take place, particularly in the re-positioning of the Star Rovers FC pitch. The design of the new field has been agreed with the football club, and further details of this and associated mitigation measures are provided in Chapter 6 of the EIAR - Population and Human Health.

Once the development is operational, there will be no further impact to the soils, geology and land environment in the vicinity of the historic landfill site.

5.4 Mitigation Measures

Construction Phase

Mitigation measures have been recommended to maintain public access to land and public safety during the construction phase, as detailed in Chapter 6 of the EIAR - Population and Human Health, and will be provided in the CEMP for the construction site. The construction site has been planned to take up as little space as possible, with the site compound being located in the north east corner of St. Mary's Park in an area of Public Open Space, so as to have minimal impact on transport, commercial, or other activities.

No further mitigation measures are proposed beyond those listed in Section 10.6 of the original EIAR, as these will be sufficient to protect the soils, geology, and land environment within and surrounding the site of the historic illegal landfill.

Operation Phase

The proposed development has included a number of measures in the design to ensure that the landscape character is improved (detailed in Chapter 14 of the EIAR- Landscape and Visual), and that accessibility for the public onto the lands are maintained or improved when the proposed development is operational. Legal agreements have been sought with relevant landowners.

No additional mitigation measures are required during the operation phase.

5.5 Residual Impact

Construction Phase

The public will have minimal access to the land for the duration of the construction phase. There will be a moderate to significant disruption to the land particularly in the north of the island through stripping of soils, import of materials onto the site, and presence of the site compound. This impact will be temporary, and lasting only the duration of the construction phase (approximately 18 months total), after which the landscaping design including vegetation seeding and planting will reduce the impact.

There will be a slight temporary negative impact with regard to disruption to access of the lands in the south of the island where flood walls are to be constructed, however this will last only the duration of the construction phase.

There are no changes to the residual impacts during the construction phase listed in Section 10.7 of the original EIAR in light of the information provided on the historic illegal landfill site.

Operation

When operational, the proposed development will result in effects that are long-term to permanent in duration. These include a moderate change in the topography in the north of the island through the creation of sloping flood embankments in Areas A3, A4, A5, and A6. The land use will be maintained, with improvements to the public realm. The majority of lands are in ownership of LCCC, with only a small area permanent land acquisition required. Where lease agreements exist within the land boundary, stakeholder agreements have been prepared. The nature of the proposed development is to protect the lands of King's Island from the effects of flooding, providing a benefit to the lands compared to the do-nothing scenario. The overall impact of the proposed development to the land in terms of land use is slight positive.

There are no changes to the residual impacts during the operation phase listed in Section 10.7 of the original EIAR in light of the information provided on the historic illegal landfill site.

5.6 Implications for the EIAR

With the addition of the above information and assessment of both the historic illegal landfill site, and further information on the "Land", there have been no assessment made

which would fundamentally alter the conclusions made in the EIAR regarding the significance of impacts

6 Noise and Vibration

The following section provides a minor amendment to the Noise and Vibration chapter of the EIAR, in response to the following comments.

With regard to comment No. 6(i):

6. Japanese Knotweed Bund and Illegal Landfill

Reference is made in Chapter 10 (Soils and Geology) to excavation within Flood Cell A4 of contaminated soils on the site of the illegal landfill and to the excavation and movement of part of the Japanese Knotweed bund.

(i) In relation to the Japanese knotweed bund, it is noted that the development description provided in the planning report refers to replacing the excavated material on top of the existing bund (not within the SAC) and reprofiling same. However, section 2.4.7 of the NIS refers to the north-western section of the bund being relocated to the south-east of the bund to allow space for embankment construction. Furthermore, Section 11.4.2 of the EIAR relates to the potential construction phase Noise and Vibration Impacts and refers in the description of Area A4 to the 'possible retaining wall construction at bund encapsulating Japanese Knotweed'. Please clarify and provide details of the proposed works including plans, elevations and sections of same.

The reference describing a retaining wall, referred to in Section 11.4.2 of the original EIAR, was made in error. The project description is clarified in Section 3.1 of this addendum report above. No changes to the impact assessment are required for this part of the proposed development.

With regard to comment No. 11:

11. Noise and Vibration

Reference is made at Section 11.4.2 of the EIAR to a boardwalk over the SAC within Area A5 – Star Rovers to Athlunkard Boat Club – please clarify what is meant by boardwalk and if it is intended to provide same please provide comprehensive details of the proposal.

The wall noted in Section 11.4.2 of the EIAR is no longer the proposed design for this area. The impact assessment provided in Section 11.4.2 of the EIAR under the subheading "Area A5 - Star Rovers to Athlunkard Boat Club" has been revised to include the up-to-date scheme description in Area A5, which was clarified previously in Section 3.3 of this Addendum report. This reflects impacts likely to arise during the construction phase of the proposed development.

The text provided in Section 11.4.2 of the EIAR under the subheading "Area A5 - Star Rovers to Athlunkard Boat Club" is to be removed from the EIAR, and replaced with the text in Section 6.1 of this Addendum.

6.1 Revised impact assessment for Area A5

Area A5 - Star Rovers to Athlunkard Boat Club

Works proposed: Engineered embankment proposed to run along the north side of the Star Rovers FC ground before re-joining along the inside edge of existing footpath until Athlunkard Boat Club. Proposed pedestrian access paths to the embankment walkway and vehicular access to boat house.

Table 11-12 Predicted sound pressure levels at the nearest sensitive receptor for construction works in Area A5.

Plant in operation (EIAR Table 11-8)	Predicted Noise Level (LAeq, 1 hr) dB(A)	Limit Value (LAeq, 1 hr) dB(A)	Impact Rating (refer to Error! Reference source not found.)	Change in noise level over baseline dB(A)
Embankment construction Tracked Excavator, Articulated Dump Truck, Dozer	63	65	Not significant	14

The results of the assessment indicate that for construction phase in Area A5, the daytime noise limit of 65 dB LAeq is likely to be complied with during the construction works adjacent to the nearest receptor. The predicted effects associated with these works are temporary and negative. The impact is not significant.

6.2 Implications for the EIAR

With the revision of the above Noise and Vibration impact assessment, there have been no changes made which would fundamentally alter the assessment made in the original EIAR, or its conclusions.

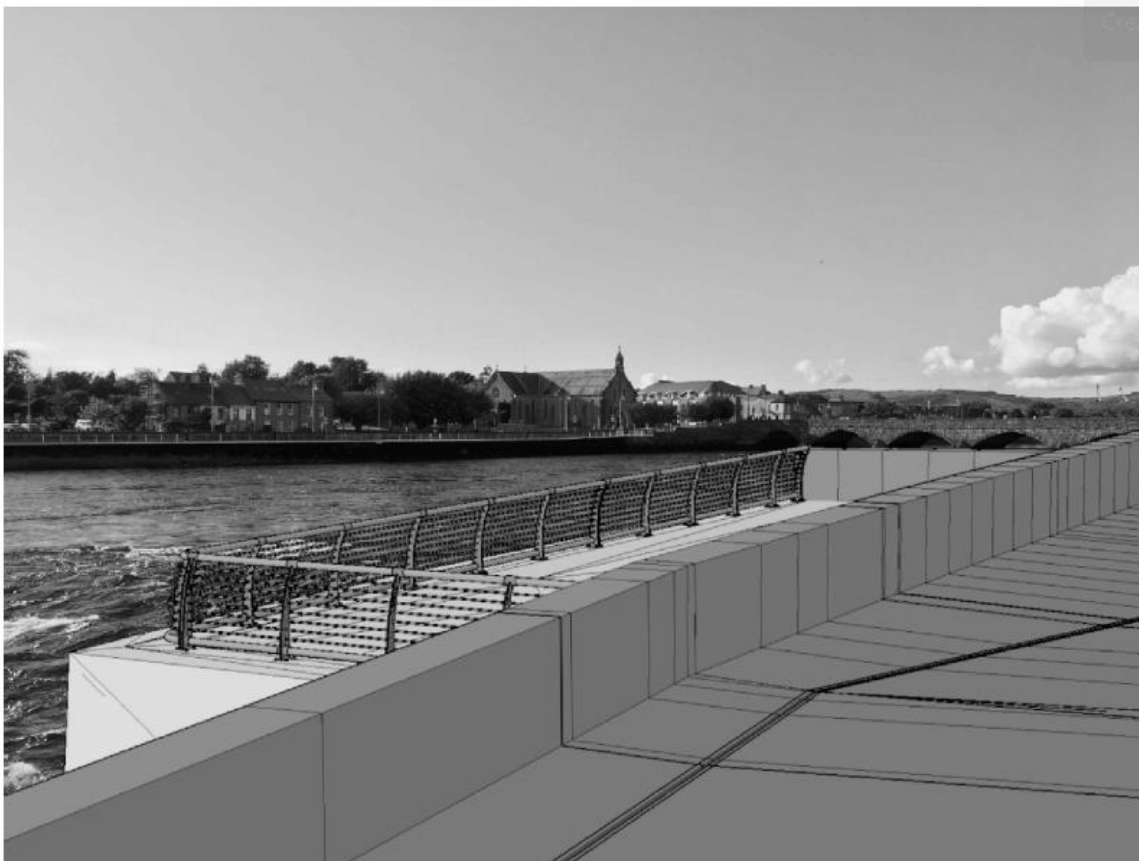
7 Landscape and Visual

7.1 Revised impact assessment for Area B3

Due to the findings of the archaeological testing in area B3, changes have been to the proposed development which affect the visual amenity and landscape character. The updated project description is provided in Section 3.3 and details of the archaeological testing and resolution are described in Section 8.

Changes which affect visual amenity involve removal of six early mature lime trees close to the civic buildings, the trees are not replaced to ensure no root damage is caused to any archaeological features in the area.

The flood defences in this area around the archaeological testing and resolution are also being altered, previously it was proposed to use glazed flood defence panelling, this has been changed and will consist of stone clad RC parapets, founded on a grillage of bored concrete piles. The stone wall will separate the pedestrian footpath along the Civic Building from the archaeological remnants which will have a high quality curved metal railing (1.17m high) along the alignment of the quay wall edge (western and southern sides) to maintain a connection with the river and a section of the existing wall to be reconstructed to a height of 1.1m on the northern side, as shown in the artistic impression in Figure 7-1 below extracted from Drawing KIFRS-MQ-101-Area B3 Railing Detail.



ARTISTIC VIEW ONLY - FOR INFORMATION ONLY

Figure 7-1. Artistic view of proposed Area B3 Railing Detail (extracted from planning drawing no. KIFRS-MQ-101)

The final section of flood defences in this area, located to the north of any archaeological features will consist of further glazed flood defence panelling. These panels will sit on top of the historic quay wall which will be pointed and grouted and further strengthened, by the construction of a mass concrete backing wall. This solution will tie into high ground just south of St. John's Castle but without any direct connection to the Castle structure itself, thus avoiding any direct impact on the National Monument.

The photomontage showing this area, "Proposed VVM 11" in Volume 4 of the original EIAR, was upgraded to reflect this change and to assist in updating the LVIA. The updated photomontage is provided in Appendix C of this report, and is to replace "Proposed VVM 11" in Volume 4 of the original EIAR.

The revised photomontage illustrates the proposed flood wall from Clancy's Street on the western side of the River Shannon 150m from the County Hall and Court House. The change along this view point will be perceived as general improvements to the riverside wall, cleaning and repair of stone, removal of the former metal railings, and replacement with a new stone wall. Removal and non-replacement of the lime trees will allow visibility of the stone wall and tall hedge and mature trees to the rear and greater visibility of the side elevation of the Civic Buildings. The proposed railing around the archaeological remnants will not be perceptible from this viewpoint, they will merge into the elevation of the proposed stone wall to the rear. The glass panels which replace the former railing along the path to south of St. John's Castle will also not be perceptible from this viewpoint.

The visual impact from this view point will remain unchanged as a result of the proposed archaeological testing, resolution and the changes to the flood defences. The sensitivity of the residential properties is very high, the magnitude of the change is negligible, therefore the overall visual impact from this view point is assessed as Imperceptible and Not Significant.

In terms of impact on landscape character the valued landscape elements in area B3 are the river edge of the Shannon River, the river edge walkway, the river corridor views of historic features and landmark buildings plus distant views in a northern direction of the hills and ridgelines of County Clare. The presence of valued landscape features gives the area a 'High' landscape character sensitivity rating. The changes as a result of the archaeological testing, resolution and the altering of the flood defences remain medium in scale within the context of the urban environment, they involve the introduction of new features including interpretive panels for the archaeological features that lead to a slight altering of the landscape character. Overall the magnitude of the proposed flood defence and drainage upgrade in this location remains as 'Medium'. The significance of the landscape impact will be the combination of the sensitivity of the landscape 'High' against the magnitude of the change 'Medium'. The resulting impact before mitigation is Permanent, Moderate, Negative and unchanged from the EIAR as previously submitted.

The residual impact on the landscape character and visual amenity resulting from the archaeological testing, resolution and the altering of the flood defences in area B3 will remain as Short term, Slight, Negative Impact.

7.2 Implications for the EIAR

With the revision of the above Landscape and Visual Impact assessment, there have been no changes made which would fundamentally alter the assessment made in the original EIAR.

8 Cultural Heritage

With regard to comment no. 4:

4. Cultural Heritage

You are referred to the comments received from the Department of Culture, Heritage and the Gaeltacht relating to underwater archaeology. You are requested to address the concerns raised and in particular the following:

(i) Underwater AIA was recommended by NMS as part of consultation process for EIAR which has not been carried out but a recommendation for same included in the EIAR. It is stated that the full nature and extent of impacts arising on intertidal zones of the Abbey River and Shannon River for storage tanks, outfalls and spud leg barges are not fully detailed but potential for underwater cultural heritage to be present in areas not previously excavated are extremely high and it is again recommended that an UAIA be carried out as soon as possible to inform final design phase of works with part of Project Archaeologist role to advise on UAIA strategy.

Ms Sarah McCutcheon, Local Authority Archaeologist, has been appointed as Project Archaeologist for the duration of the project. Further details on the Underwater Archaeological environment is provided in Section 8.1, with a fully detailed UAIA provided in Appendix D2.

(ii) In relation to Flood Cell Areas A5 & A6 it is stated that these areas are of high archaeological potential with Athlunkard directly linked with the Viking origins of Limerick with potential that sites or material relating to maritime activity including Athlunkard as a longphort with potential for remains of wrecks, nausts etc. to be present and original Viking settlement could be located within footprint of proposed works with similar potential for features of the walled city and its history. Recommendations proposed relate to the strategy for archaeology testing in areas that can be tested in advance of construction works. They also request that further information is required on outfalls proposed into Abbey River in terms of potential impacts on intertidal zone/Abbey River – the nature and extent of works. You are requested to address this matter.

Further details on the Viking and Anglo-Norman remains around King's Island are provided clarifications made in Section 8.2 with a fully detailed Archaeological testing Report in Appendix D1.

(iii) Reference is also made to the works within Flood Cell Areas A9, A10, B1, B2 and B3 and in particular the potential for negative impacts on underwater cultural heritage from outfall works that may run into the intertidal zone or into the river within these areas and proposed intertidal works for the storage tanks and other works in the foreshore including use of spud leg barges and outfalls including one near King John's Castle with area to be impacted in foreshore and subtidal areas in Area B3.

Further details on the Underwater Archaeological environment is provided in Section 8.1, with a fully detailed UAIA provided in Appendix D2.

(iv) It is stated that the proposed excavations for support walls behind historical quays will be deep with high potential to impact previously unrecorded archaeology.

- You are therefore requested to address the concerns expressed and to provide the further information requested and to outline the strategy proposed for the UAIA including scope and extent of the proposed assessment.
- You are also requested to review and revise the 'Proposed Testing Regime' outlined in Appendix G of Volume 2 of the EIAR which currently refers only to Flood Cell B3 to reflect the matters outlined within this request.

Further details on the Underground Archaeological environment is provided in Section 8.3, with a fully detailed Archaeological Testing Report provided in Appendix D1.

8.1 Project Archaeologist

Ms Sarah McCutcheon, Local Authority Archaeologist, has been appointed as Project Archaeologist for the duration of the project.

8.2 Underwater archaeology

The extent of the underwater and intertidal impact was interrogated. There was consultation with the Underwater Unit of The Department to agree the scope of the Underwater Archaeological Impact Assessment (UAIA). The impacts were shown to be limited to an outfall at the NW of the island and the spud-leg barges used for the repointing of the quay walls. All other works are terrestrial, including the storage tanks. The nomenclature employed for the tanks was misleading, inter-tidal was not a spatial designation, rather it referred to the time between high and low tide as these tanks are designed to act when high rainfall coincides with a high tide. The outfalls at Star Rovers and Athlunkard Boat Club are into an existing drainage ditch; other outfalls are actually outlets, which are incorporated in the quay walls. Some of these outlets in the quay walls are new (x2), most are upgrades of existing (x5).

Mizen Archaeology Ltd. were engaged to carry out a UAIA which included a dive survey for the full width of the Abbey River from Baal's Bridge to the northern end of the board walk at the Absolute Hotel upstream from the Abbey Bridge and at the outfall at the NW of the island. A wade survey was carried out on the foreshore between King John's Castle and the Curraghgour Boat Club. The stretch in the Abbey River from Baal's Bridge to the Potato Market was not included as it was subject to archaeological investigation during the Limerick Main Drainage Scheme 1999. At that time, the bed of the Abbey River was converted to a terrestrial state and, following archaeological investigation, the river bed was graded mechanically. This was confirmed by the Licence Holder, Mr. Edmund O'Donovan. The UAIA surveys, including metal detection were conducted under licence in August 2020. The full report is attached in Appendix D2 and the recommendations are included in the Schedule of Environment Commitments.

8.3 Viking and Anglo-Norman remains

The entire island has the potential to yield Viking and Anglo-Norman remains though the use of the toponym of Athlunkard in this area (a street, a bridge & the Boat Club) is noteworthy. The townland of Athlunkard, however, is located in Co. Clare on the east bank of the River Shannon following its bend southwards to Reboge. The site of a potential longphort has been identified in the adjoining townland to the north, Fairyhill. Elements of the site are included as a ringwork castle, an earthwork and a mound in the list of Recorded Monuments for Co. Clare, CL063-025001/002/003. According to O'Kelly⁵ the longphort would probably have extended to St. Thomas' Island. Finds of iron weapons and implements are recorded from the site and 2 silver ingots were found in the vicinity. This decreases the potential for finding the longphort within the footprint of King's Island. Archaeological test trenches were excavated in Areas A5 & A6 as part of the recent campaign of archaeological investigations. The results were negative; however, these areas will be archaeologically monitored during construction works. It has been established that the outfalls in this area debouch into an existing drainage ditch and will not impact on the Abbey River.

8.4 Archaeological Test Trenching

A significant programme of archaeological test trenching was conducted from May – August 2020 (start delayed to after May 18th 2020 by Covid-19) by Billy Quinn, Licence Holder of Moore Group. The works were conducted under Ministerial Consent (C000980; E005120; R000528) as they were situated on or close to the City Defences (deemed a National Monument) in the public domain. The test trenching focussed mainly on:

- a. profiling at intervals the stratigraphy behind the quay walls up to a depth of 4m;

⁵ Kelly, E.P. (2015) 'The longphort in Viking-Age Ireland: the archaeological evidence', *The Vikings in Ireland and Beyond: before and after the battle of Clontarf*, H.B. Clarke & R. Johnson eds., Four Courts Press for the Royal Society of Antiquaries of Ireland, Dublin, 2015, 55-92 (accessed 09 October 2020)

- b. testing the area of the storage tank between the Court House and the Potato Market;
- c. testing the route of the proposed sewer across Merchants Quay, traversing Bridge St and joining the existing network on George's Quay;

In general, the results have shown that the existing quay walls along the Abbey River and from the Potato Market to King John's Castle date to the 18th and 19th centuries and the area behind them consists of contemporary infill. Therefore, the dig-out is unlikely to impact on accumulated medieval layers.

South of King John's Castle a significant length of the city wall had previously been exposed in archaeological testing in advance of the construction of Corporate Buildings (1987-88). The City Wall lies between 11m and 20m inland from the present quay walls. These earlier investigations had also exposed a bridge extending out from a gate in the city wall which gave access to two medieval mills. The deep dig out for the proposed defences was of particular concern in the area of the medieval mill (Area 1 in the test trenching report). The impact had already been mitigated in the SW corner of this area by converting from the glass panels (which require a deep dig out) to a wall supported on a concrete beam that is, in turn, constructed on pile foundations. The foundation beam proposes to span the medieval bridge leading to the mill with a buffer of 150mm provided between the soffit of the beam and the top of the bridge. The finished ground level was slightly raised to facilitate the buffer. Test excavations in the remainder of the area revealed the well-preserved remains of 2 vaults constructed upstream from the bridge beneath the 18th century brewery. These vaults were only enclosed by the existing quay wall in the 19th century. To conserve these, the design has been altered across the full width of the area to a wall on pile foundations. The test excavations have revealed sufficient space for pile caps throughout the area and the revised design still spans the medieval bridge (refer to Appendix D3 CH Drawings 1-4). To facilitate the test excavations, six small lime trees were removed in advance. They were not appropriate for the location as their roots would ultimately have invaded the sub-surface masonry structures. They will be replaced elsewhere.

The area between the Court House and the Potato Market (Area 5 in the test trenching report) revealed lengths of wall associated with the harbour, particularly of the late 18th century re-design, but also, potentially, a short section of the medieval city wall/dock (TT5-5; C5-5-13). The storage tank has been designed to provide a 2.4m buffer with this early wall and a 2m buffer from the 18th century quay wall. The outlet from the tank will go through the foundation level of the late 18th century dock wall (refer to Appendix D3 CH Drawing 7), interpreted as the south facing wall of the northern pier of the 'Long Dock' of the New Quay.

The proposed sewer line is to cross Merchants Quay and join the Limerick Main Drainage Sewerage Network on George's Quay. This means it will have to cross the line of the city wall where it provided access to the medieval harbour from Quay Lane through a gate, known as Quay Lane Gate. Test trenching (Area 6, TT6-1, in the test trenching report) revealed the location of the Gate, the line of the city wall and the possible foundations of the bastion on the medieval quay. These elements were deliberately reduced in 1760. To mitigate any impact on these significant findings the sewer has been designed to cross beneath the base of the foundation of the wall with a significant buffer of 1m provided (refer to Appendix D3 Drawings 5-7). The line of the sewer crossing Bridge Street is designed to be outside the outer face of the City Wall as established in a test trench on George's Quay (Area 7 TT7-1). The remainder of the line of the sewer across Merchants Quay is through 18th and 19th century layers deposited in the infilled harbour.

Testing was also carried out at Star Rovers and the Athlunkard Boat Club, as well as at the NW of the island. Additional trenches were investigated at Creagh Lane due to proposed additional pipe work. None of these trenches produced archaeological material.

8.5 Predicted Impact of the Proposed Development

8.5.1 Construction Phase

Underwater Archaeology

Areas A8, A9, and A10: Absolute Hotel boardwalk to Baal's Bridge (UAIA Area 2)

The impact of the proposed scheme in this area will arise from the spud legs of a barge being placed on the riverbed during the repointing of the quay wall. No other damage expected on the riverbed. Since it has a small footprint, the impact is perceived as minimal.

Area A3: Northwest King's Island Outfall and Fishermen's Access (UAIA Area 3)

The dive assessment did not identify any archaeological remains on the riverbank or to a distance of c. 10m out into the river. However, the alluvial silt bed of the river retains the potential for preserving archaeological remains.

The proposed works in this area involve the installation of an outfall pipe, which necessitates groundworks to the bank, intertidal zone and into the riverbed. There is potential therefore that the works could impact previously unknown archaeological remains.

Area B3: Curraghour Boat Club to King John's Castle (UAIA Area 1)

The impact of the proposed scheme in this area will arise from the spud legs of a barge being placed on the riverbed during the repointing of the quay wall. No other impact is expected on the riverbed. As a portion of the features from the mill lays on the riverbed, there is the chance that the legs will negatively impact the features. In addition, there is the potential for further subsurface material associated with the mill and its weir or other artefactual material to remain in the riverbed, which the works, i.e. placement and movement of the spud-legs, may negatively impact.

Archaeological Remains

The impact of the scheme has been successfully mitigated by redesign in Areas B3 & B2. Buffer areas have been provided for masonry structures. There is potential in greenfield sites to uncover previously unknown archaeological remains.

8.5.2 Operation Phase

There are no predicted impacts in the Operational Phase other than those identified in the original EIAR.

Operation Phase impacts associated with the proposed development will predominantly consist of impacts of the setting of archaeological and architectural features as a result of the proposed flood defences. These impacts will be predominantly visual, such as the glass panel near King John's Castle. The remainder of the visual impacts are described in the EIAR under Chapter 14 - Landscape and Visual Impact Assessment, and Chapter 15 - Cultural Heritage.

8.6 Mitigation Measures

Further mitigation measures in addition to those provided in the EIAR have been provided, which are specifically relevant to the monitoring of Archaeological Heritage during the construction phase. The following sections are to be read in conjunction with the mitigation measures already set out in the EIAR under Section 14.5. All mitigation measures are summarised in this report under Appendix A - Schedule of Environmental Commitments.

8.6.1 Construction Phase

The best form of mitigation, preservation in situ, is achieved by designing to avoid direct physical impacts upon archaeological, architectural and cultural heritage site, structures, monuments and features. All designated archaeological, architectural and cultural heritage sites, structures, monuments or features have been avoided by the design team as far as was practicably possible, taking into account all the environmental constraints and requirement of the project brief.

Archaeological Heritage Mitigation

The National Monuments Act, as amended requires that, in the event of the discovery of archaeological finds or remains that the relevant authorities, the National Monuments Service of the DoH/LGH and the National Museum of Ireland, should be notified immediately. Allowance will be made for full archaeological excavation, in consultation with the National Monuments Service of the DoH/LGH, in the event that archaeological remains are found during the construction phase.

In areas where there is the potential that archaeological, architectural or cultural heritage site, structures, monuments or features could be impacted on during the construction phase, one or both of the following mitigations measures have been recommended:

Archaeological monitoring — in areas of archaeological potential, excavations associated with construction works will be monitored by a suitably qualified archaeologist. In the event that archaeological deposits are discovered, work in the area will cease immediately and the archaeologist will liaise with the National Monuments Service of the DoH/LGH and the National Museum of Ireland.

Archaeological testing – best practice in areas of high archaeological potential demands caution, to ensure that archaeological deposits are identified as early as possible, thereby ensuring that any loss from the archaeological record is minimised. Under a monitoring remit, an archaeologist will observe normal construction works, usually undertaken with a toothed excavator bucket. During archaeological testing a licensed eligible archaeologist supervises excavations undertaken with a toothless grading bucket, under licence to the National Monuments Service of the DoH/LGH, thereby ensuring the early identification of archaeological deposits and minimal loss to the archaeological record. Undertaking this confirmatory surveying will ensure that sufficient time can be allowed within the construction schedule for the excavation of any archaeological deposits discovered.

Dive/Wade Survey – in areas of archaeological potential associated marine/aquatic environments archaeological surveys are overseen by the Underwater Archaeological Unit of the National Monuments Service. The only area this relates to for the proposed KIFRS is tidal and exposed during low tides and low river flow. Best practice requires that such area be subject of a visual dive/wade survey with metal detection under licence to the Underwater Archaeological Unit of the National Monuments Service and the National Museum of Ireland. Such work should be conducted well in advance of potential impacts to allow for sufficient time for resolution of any archaeology that may be found.

Addressing concerns raised by the Development Applications Unit, Ms Sarah McCutcheon, Local Authority Archaeologist, has been appointed as Project Archaeologist for the duration of the project.

The following mitigation measures are recommended in addition to measures set out in the original EIAR:

1. Archaeological monitoring by a suitably qualified underwater archaeologist shall be undertaken for all groundworks for the outfall and the fishermen's access from the terrestrial/banks, along the intertidal zone and into the river at the NW of King's Island (Area 3).
2. The repair, pointing and grouting of the features associated with the medieval mill should be undertaken by those with a proven track record in historic building works. The repairs should include efforts to protect the features from further scour damage. A detailed methodology for the works concerning these features should be submitted to the National Monuments Service for approval prior to commencement.
3. Suitable precautions for all construction machinery and equipment used in the areas, a) between King John's Castle and the Court House and b) at the junction with Bridge Street, to be built-in to the construction design to avoid any damage to underground masonry features.
4. Where masonry structures are exposed in the course of the works a suitable membrane in conjunction with 50mm polystyrene or other suitable buffer material shall be used to protect the structure from construction matter.
5. Archaeological monitoring of all aspects of the scheme that involve ground disturbance. Specifically, archaeological monitoring of the following:

Area A2

- Archaeological monitoring of dig-out for foundations of new flood defence wall.

Areas A3, A4, A5, A6

- Topsoil stripping of areas where it is proposed to construction the embankment;
- Archaeological monitoring of topsoil stripping of proposed construction site compound;
- Archaeological Monitoring of dig-out associated with the construction of proposed drainage, including the inter-tidal storage tank in Area A6; and
- Archaeological monitoring of topsoil stripping and dig-out associated with the construction of the new access ramp and flood defence wall at Athlunkard Boat Club.

Area A7

- Archaeological monitoring of dig-out for foundations to reinforce the existing flood defence defences.

Area A9

- Archaeological monitoring of demolition of existing river wall and dig out for foundations for new flood defence defences

Area A10

- Archaeological monitoring of demolition of existing river wall and dig out for foundations for new flood defence wall; and
- Archaeological monitoring of dig-out associated with proposed new surface water drainage.

Area B1

- Archaeological monitoring of hand dig-out for foundations for new concrete flood defence wall;
- Archaeological monitoring of dig-out for mass concrete backing wall to support glass panel flood defences; and
- Archaeological monitoring of dig-out associated with proposed new surface water drainage.

Area B2

- Archaeological monitoring of dig-out for foundations for new concrete flood defence walls;
- Archaeological monitoring of dig-out for mass concrete backing wall to support glass panel flood defences;
- Archaeological monitoring of dig-out associated with proposed new surface water drainage;

Area B3

- Archaeological monitoring of all dig-out for mass concrete backing wall to support glass panel flood defences;
- Archaeological monitoring of all dig-out for proposed surface water drainage, including two flood cells/ storage tanks and associated outfalls;
- Archaeological monitoring of all dig-out associated with the decommissioning of the existing pumping stations to the north of the Council's Offices and to the north of the Court House;
- Archaeological monitoring of all dig-out associated with the construction of the proposed gravity sewer from north of the Council's Offices to its point of connection to the Limerick Main Drainage on George's Quay;

6. Should archaeological material be found during the course of monitoring, the archaeologist may have work on the site stopped, pending a decision as to how best to deal with the archaeology. The Development Applications Unit, National Monuments Service, Department of Housing, Local Government & Heritage and the Project Archaeologist shall be informed immediately. Should an archaeological excavation be required then the following shall apply: satisfactory arrangements for the recording and excavation of any archaeological material that may be considered appropriate to excavate shall be provided and all post excavation analysis up to final report stage shall be

completed. Within twelve months of the completion of the excavation a final report (in the format recommended in the Guidelines for Authors of Reports on Archaeological Excavations 2006 National Monuments Service) shall be submitted.

7. All recommendations are subject to the approval of the National Monuments Service, Department of Housing, Local Government & Heritage.
8. Should design detailing or any subsequent factor necessitate design modification in areas of archaeological importance this will require approval by the Project Archaeologist in consultation with the National Monuments Service.

8.6.2 Operation Phase

The design has been completed in recognition of significant cultural and archaeological artefacts, in consultation with the Project Archaeologist. No further mitigation measures will be required when the proposed development is operational.

8.7 Residual Impact

8.7.1 Construction Phase

Following the archaeological test trenching in areas of high archaeological potential the scheme has been designed to avoid all subsurface medieval masonry structures. In other areas archaeological monitoring (including an experienced underwater archaeologist where appropriate) will be in place for the duration of the ground disturbance.

8.7.2 Operation Phase

As previously stated, there is no physical impact during the operational phase. There are some minor, visual impacts which may improve the setting of the areas, which are further addressed in Chapter 14 of the EIAR.

8.8 Implications for the EIAR

The findings of the additional studies outlined above confirm the original assessment provided in the EIAR Chapter 15 - Cultural Heritage. In light of the new findings, the scheme has undergone minor design revision to mitigate these findings. **With the revision of the above assessment, there have been no changes made which would fundamentally alter the assessment made in the original EIAR.**

References

Denyer J. (2019) Section 21 Application *Groenlandia densa* Methods Statement. Unpublished report.

Denyer Ecology (2020a) King's Island quay wall bryophyte Assessment. Unpublished report.

Denyer Ecology (2020b) King's Island Flood Relief Scheme: Assessment of potential *Groenlandia densa* enhancement sites. Unpublished report.

NPWS, (2012) Conservation Objectives supporting document Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitriche-Batrachion* vegetation (habitat code 3260). Available at:
https://www.npws.ie/sites/default/files/publications/pdf/002165_Lower%20River%20Shannon%20SAC%20Water%20Courses%20Supporting%20Doc_V1.pdf [Accessed 15 September 2020]

Appendices

Appendix A Schedule of Environmental Commitments

Appendix B Supplemental information to Section 4: Biodiversity

Appendix B1

Invasive Species Management Plan (JBA, 2019)

Appendix B2

Bryophyte Assessment Report (Denyer Ecology, 2020)

Appendix B3

Report on the Assessment of Potential *Groenlandia densa* Enhancement Sites (Denyer Ecology, 2020)

Appendix C Revised Photomontage for VVM11

Appendix D Supplemental information to Section 8: Cultural Heritage

See Volumes 2 and 3

A Schedule of Environmental Commitments

The following summarises the environmental commitments proposed in the EIAR for the proposed King's Island FRS. The purpose of these environmental commitments is to mitigate against adverse environmental impacts identified in previous chapters of the EIAR. The following is divided into measures to be implemented during the construction phase, to be incorporated into a site-specific CEMP to be developed by the appointed contractor prior to works commencing, and the operation phase, which are monitoring and maintenance commitments intended to mitigate against future impacts when the proposed development is operational.

A.1 Construction mitigation

A.1.1 Human Beings

1. A Construction Environmental Management Plan (CEMP) will be prepared by the contractor prior to construction commencing. This will include provisions for managing access around construction sites, maintenance of residential amenity, working hours, and noise and dust limits, etc., to reduce impacts to residents in the area.
2. A Health and Safety Programme will be put in place on the site prior to commencement of construction.
3. The requirements of the Safety, Health and Welfare at Work (Construction) Regulations 2013 (S.I. No. 291 of 2013) will be complied with at all times.
4. The site will also be operated under a Construction Transportation Management Plan (CTMP) which will alleviate potential impacts from the construction on the local community.
5. During pre-construction and construction phases safety will be managed in accordance with the Safety, Health and Welfare at Work (Construction) Regulations 2013 (S.I. No. 291 of 2013). A Project Supervisor Construction Stage (PSCS) will be appointed as part of the proposed project;
6. Safety will be a primary concern during the construction phase of the proposed FRS. A contractor safety management program will be implemented identifying potential hazards associated with the proposed work including a permit to work system;
7. The design of the final proposal will be subject to safety design reviews to ensure that all requirements of the project are safe. A Project Supervisor for the Design Process (PSDS) will be appointed as part of this process;
8. Temporary contractor facilities and areas under construction will be enclosed and fenced off from the public with adequate warning signs of the risks associated with entry to these facilities. Entry to these areas will be restricted and will be kept secure when construction is not taking place.
9. Construction on the sports pitches will take place during the off-season for the club (July-August) to minimise disruption to the clubs.
10. Measures to ensure public safety, with respect to construction traffic, are detailed under the Traffic section.

A.1.2 Traffic

1. The appointed contractor will follow a Construction Traffic Management Plan (CTMP).
2. To reduce the impact on the surrounding road network, HGV movements will be encouraged to avoid the peak hours due to traffic through the city.
3. The appointed contractor will provide a competent person with responsibility for traffic management coordination for the duration of the project.
4. All workers will receive a comprehensive site induction which shall include, as appropriate, a section on traffic management and clear guidance on the routes which should and should not be used.
5. A system of clear signage relating to the project, both temporary and permanent, will be agreed with the planning authority. These signs will also identify those roads to be used (and not to be used) for accessing the site in line with the objectives of the CTMP.

6. Construction Staff Mobility Management will take place. Vehicle sharing will be actively encouraged in an effort to minimise the number of vehicles travelling to site daily. It is also possible and indeed likely that construction staff will arrive on site prior to or early in the AM peak hour, and leave after the PM peak hour.
7. Vibration measurements shall be taken at the base of buildings, on the side facing the source of vibration in high traffic areas of the site. A pre-condition survey will also be undertaken of all properties potentially affected by the works (likely within a 10m radius of works areas). Crack monitoring will be installed on such affected properties and monitored throughout the works.

A.1.3 Utilities

1. The site-specific CEMP will ensure that the natural material assets will be protected during construction. The CEMP will cover natural material assets such as groundwater protection, surface water protection, work practices close to the SAC, protection of habitats and species, waste management, noise and traffic management
2. The contractor will take all actions to avoid unplanned disruptions to any services during the construction phase of the project.
3. The contractor will be responsible for identifying the location of all utility infrastructure within the work areas.
4. They will be responsible for ensuring that all works undertaken in and around known utility services will be carried out using strict and robust Method Statements.
5. The major services suppliers will be contacted in advance of ground works proceeding in an area to ensure that all protocols and procedures are correct and are complying with the service providers requirements.
6. Services disruptions impacting on residents or commercial outlets will only happen where unavoidable. In this scenario, residents and commercial outlets will be given advanced warning of the date, time and expected

A.1.4 Waste Management

1. A Waste Management Plan will be developed by the appointed contractor in advance of the works.
2. Concrete and stone materials will be minimized in terms of materials taken offsite. This will be achieved through crushing and screening of the materials, and re-use for alternative purposes such as site access tracks. Any material that is not re-used will be brought offsite and disposed of at a licensed waste facility, as agreed with Limerick County Council and as written in the Contractor's Waste Management Plan.
3. To reduce the quantity of waste, soil will be retained and re-used on site where possible.
4. The contractor will be required to carry out a waste characterisation of any material (including soils) that will be taken off site for disposal. A waste acceptance criteria (WAC) analysis and asbestos levels will be determined on any material that will be taken off site for disposal. See measures listed under Soils and Geology for further measures regarding soil removal.
 - a. Uncontaminated soil materials can be brought to a soil recovery facility.
 - b. Any materials exceeding soil trigger levels determined by Table 3.3 -Summary of Soil Trigger Levels for Soil recovery Facilities of the EPA Guidelines ⁶ or invasive species will be disposed at a hazardous landfill site.
5. All waste materials will be disposed at an appropriately licensed facility.
6. All wastes generated within the canteen will be segregated and handled separately (further addressed in Chapter 7 of the original EIAR- Material Assets including Waste).

6 EPA. (2017). *Waste acceptance criteria and development of soil trigger values for EPA-licensed soil recovery facilities.*

A.1.5 Biodiversity

1. All Site construction will be undertaken in accordance with the CIRIA (2015) Environmental Good Practice on Site (Charles and Edwards 2015);
2. All of the works and mitigation measures will be monitored by an Ecological Clerk of Works (ECoW) suitably qualified ecologist during the construction period, with findings reported to the competent authority. The ecologist should have at least 5 years' experience in riverine infrastructural works and should have a high-level knowledge of fisheries and fish conservation. Ecologist to advise on location and be present during positioning.
3. Access to riparian/alluvial woodland will be prevented by sensitively located fencing and signage.
4. Surface water controls including appropriate erosion and silt controls (e.g. trenches, settling ponds/tanks, silt fence) will be employed to prevent any flow of surface water from the site into the SAC marsh, water courses within the site, or the Shannon or Abbey Rivers. Contents of any sediment tanks will be removed off site by a licenced waste contractor. The details of the control of site drainage will be shown in the developed CEMP.
5. At no point should there be storage of material or vehicles/machinery at east of the site near the flood plain area within the SAC or near newly excavated channel at north of site;
6. The excavation through embankments with open trench for connection of filter drain to Shannon River and to drains across flood plain need to be carried out during a period of dry weather. Rainfall needs to be monitored and works carried out during consecutive dry days;
7. Works on excavation and removal of existing sandbags, footpath, and concrete along the length (approx. 1km) of the western embankment Place to include appropriate erosion and silt controls to prevent surface water flow and accidental spillages onto riverbank and into Shannon River. Discussion at detailed design/construction phase on benefits of retention of concrete plinth;
8. Reseeding of embankments will take place immediately after construction;
9. No excavation shall take place below the water-table on the Application Site except for excavation of channel for Opposite-leaved Pondweed;
10. The site compound shall be located within the site boundary and sited as far from any water course (>50m) as possible.

Works in proximity to the Lower River Shannon SAC

11. The boundary of the SAC on the flood plain will be fenced off throughout the period of works.
12. The delineation of trench works by a fence, outside of which no access shall be permitted;
13. The footprint of the construction works on the eastern embankment (Area A4) will be minimised to limit encroachment into Lower River Shannon SAC.
14. Works on cutting sheet piling will take place from the embankment only and will not take place from the marsh side of the SAC.
15. Extension of drains in marsh to connect with filter drains from the proposed eastern embankment will be carried out prior to construction of embankment. Excavations will be minimised by marking out allowed tracking route of machinery. The ECoW to advise on location and be present during positioning.
16. Any disturbed marsh habitat at the SAC boundary and where drains were widened and deepened will be allowed to revegetate naturally.

Badger

17. The outlier Badger sett at the southern end of Area A4 will be permanently closed. A letter of permission has been sought (Appendix C5 of Volume 2 of the EIAR) and granted (see Appendix C6 of Volume 2 of the EIAR) by NPWS, the conditions of which should be followed.

18. On completion of construction the proposed embankment will be revegetated with native hedgerow species to enhance habitat suitable for Badger.

Otter

19. A survey for Otter will be carried out within 10 months prior to construction. This should be supplemented by inspection of development area immediately prior to site clearance, to ensure no holts have been created in the intervening period.
20. If any holts are found appropriate steps will be taken and a derogation licence will be applied for from NPWS.
21. Trenching works shall not create confined areas where Otter may get trapped. If such areas are created, the area will be fitted with an escape ramp (no more than 1:2 slope) to allow trapped animals to escape when the area is not in operation.

Bats

22. Lighting will be minimised during hours of darkness and will not illuminate peripheral mature trees and vegetation to ensure no adverse effects on bats and other nocturnal animals.
23. New lighting required adjacent to the proposed footpath along the embankment will be of as low a wattage as possible and will be directed away from the surface of the water.
24. The specification and colour temperature of light treatments will be chosen based on their tolerability by bats. LED luminaires are ideal due to their sharp cut-off, lower intensity, and dimming capability. A warm white spectrum (ideally less than 2700K) will be used to reduce the blue light component.
25. Where lighting along the public pathway is required, dimmable lights will be installed so that during peak dusk activity, the lowest light level is apparent, and the light levels are increased slowly to full output as the natural light decreases. The light fittings will be mounted at 6m or less.

Birds

26. All works on the eastern embankment (Area A4) will be conducted between April and September inclusive for the duration of the project to prevent disturbance impacts to important overwintering waterbird populations within the flood plain.
27. No vegetation clearance works and site preparatory works will be permitted within the bird nesting season (31 March to 31 August inclusive). If this is not possible, a breeding bird survey will be undertaken by a suitably qualified ecologist in advance of the works to ensure that there will be no impacts on nesting birds.

Trees

28. Planting of trees/scrub lost to the project should take place as soon as possible after the clearance works to ensure continuity and availability of habitat on the site. Tree planting, using native, locally sourced species appropriate to the locality, will replace the length of treeline lost to accommodate the new flood embankment.
29. Landscape plans and long-term management will encourage planting of native tree and plant species to expand and further enhance wildlife corridors on King's Island.
30. Additional planting of treelines will benefit bats foraging in the area and act as dark buffer zones to illuminated areas.
31. Trees will be planted to compensate for loss of willow treelines along ditches during construction of western and eastern embankment. Additional trees will be planted as screening for houses from raised embankment paths (see Section 4.3.4).

Bryophytes and aquatic plants

32. Prior to the commencement of works on the quay wall, the Contractor's ecologist shall undertake a survey to identify the locations where bryophytes are present
33. ECoW to give a toolbox talk to the appointed contractor before starting work at the quay walls to explain methodology and areas containing bryophytes and/or tall herb swamp.

34. While pointing and repair work is taking place on quay walls, retain 40-50% of aquatic bryophytes (below the high spring tide) and dry bryophytes (above the spring tide), maintaining a distribution of species across the walls.
35. Any replaced stonework should be of a similar texture to the existing stone to promote re-establishment of the aquatic bryophyte flora
36. The bryophytes are present both on the stonework and on the mortar between the stones. If the mortar is being replaced, then retain the bryophytes on the stonework. If the stonework is being cleaned, then maintain some bryophytes on the mortar
37. For dry bryophytes ensure that any new stonework has a similar texture to the present stonework to ensure rapid re-colonisation of bryophytes on any new surfaces.
38. Stonework with bryophytes present can be removed and replaced if required.
39. Leave silted/muddy areas found at the base of the quay walls containing aquatic plants in order to retain the seedbank of tall-herb swamp vegetation. Silts should only be cleaned where it is required structurally.

Pollinators

40. On-site Ecologist must agree timing and supervision for removal of sandbags. Sandbags on the western embankment will be moved only after solitary bees emerge from hibernation in the spring and before new nests have been excavated. Provision of a suitable replacement bank with sandy substrate suitable for aggregations of solitary bees will be made.

Fisheries

41. No in-channel working is permitted during the salmonid spawning season (November to March inclusive).
42. Pre-construction targeted removal for translocation of juvenile lamprey will take place at Areas A9 and B3. Electro-fishing is possible between July 1st and September 30th. An electro-fishing licence has been applied for and granted from IFI (see Appendix C7 of Volume 2 of the EIAR).
43. Ecologist to oversee deployment and movements of jack-up rigs.
44. The area (27 m²) beneath proposed jack-up rig locations in Area B3 will be electro-fished.
45. IFI Biosecurity Protocol for Field Survey Work (see Appendix C8 of Volume 2 of the EIAR) to be adhered to for any instream works: i.e. jack-up rigs and electro-fishing.
46. Lamprey ammocoetes from the Abbey River would be translocated
47. Ensure launch of jack-up rig will not entail disturbance to riverbank or riverbed substrate.
48. Jack-up rig and plant are clean and are in good working order (no leaks) before entering the estuarine environment for work on defence walls in Area A9 and B3.
49. All working platforms within or adjoining watercourses should have spill kits available to prevent egress of chemicals include concrete, lubricants, fuels, setting compounds or other from entering the River Shannon
50. Launch of jack-up rig will be carried out by crane and will not disturb bank habitats or bottom sediment at launch sites
51. Emergency repair tools and/or towing equipment is to be made available in case of damage to jack-up rig

Non-Native and Invasive Species (NNIS)

52. In order to mitigate the potential spread of non-native invasive species listed in the Third Schedule (Part 1) of the European Communities (Birds and Natural Habitats) Regulations 2011, the mitigation measures listed in Section 4 of the King's Island Invasives Species Management Plan (JBA, 2019) will be implemented during construction.

A.1.6 Surface water and groundwater

The following Guidelines will be used, as a minimum, by the contractor to prepare their Method Statements and Environmental Management Plan:

- Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters. Inland Fisheries Ireland, 2016;
- Fishery guidelines for Local Authority works. Department of Marine and Natural Resources 1998;
- CIRCA – Guideline Document C532 – Control of Water Pollution from Construction Sites; and
- CIRIA – Guideline Document C642 – Development and Flood Risk – Guidance for the Construction Industry.

In addition, the following measures should be followed:

1. A site-specific CEMP will be prepared by the contractor prior to the commencement of any works in order to ensure all works are carried out in a manner designed to avoid and minimise any adverse impacts on the receiving environment.
2. The Project Manager will take full ownership of the CEMP and will be responsible for storing all site records, including but not limited to, training records, incidents and emergencies, environmental quality monitoring records and updates to Method Statements. Sub-contractors will be made aware of the site-specific Construction and Environmental Management Plan for the work;
3. An Emergency Plan for the site will be established by the Main Contractor prior to work commencing at the site. As a minimum the Emergency Plan should contain contact details for statutory bodies such as the NPWS and IFI. All site workers should be made aware of the plan and its location in the site offices;
4. Regular inspections and maintenance of plant and machinery checking for leaks, damage or vandalism will be made on all plant and equipment.
5. There will be no refuelling of machinery within or near the river channel. Refuelling will take place at designated locations at distances of greater than 30 metres from the watercourse. No vehicles will be left unattended when refuelling. Mobile plant will refuel over a drip tray with an absorbent mat.
6. In the event of a spill the Contractor will ensure that the appropriate procedures are in place. If a spillage does occur, it will be contained with adsorbent pig bags. These will be placed in a hazardous waste bin for ultimate disposal. The contractor will replenish the adsorbent pig bags immediately.
7. Contractors will ensure that spill kits will be accessible to construction personnel at all times and all spills will be reported to the Main Contractor.
8. If a spillage of a hazardous material to groundwater does occur, the groundwater will be contained and pumped to a tank or holding vessel prior to shipment off site for disposal. The contractor will maintain disposal records. The contractor will identify the cause of the spillage and mitigation measures and controls will be put in place to prevent a repeat. The CEMP for the site will be updated and contractors and sub-contractors will be made aware of the amendments.
9. Do not attempt to hose the spillage down or clean up with detergents or emulsifiers, as these will increase the risk of harming the environment.
10. Fail-safe site drainage and bunding through drip trays on plant and machinery will be provided to prevent discharge of chemical spillage from the sites to surface water;
11. Any fuel that is stored on the site will be stored appropriately and at a location that is set back from the river. All other construction materials will be stored in this compound. The compound will also house the site offices and portable toilets. This compound will either be located on ground that is not prone to flooding or will be surrounded by a protective earth bund to prevent inundation.
12. All liquids, solids and powder containers will be clearly labelled and stored appropriately in sealable containers. Storage of fuels and oils will be in the main contractor's compound only.
13. Where a contractor is responsible for materials stored in a bunded area, that contractor shall implement measures for the regular inspection of bunds and emptying of rainwater

- (when uncontaminated). Bunding must have a minimum capacity of 110% of the volume of the largest tank or 25% of the total storage capacity, whichever is the greater. Bunding shall be impermeable to the substance that is being stored in the tank.
14. If surface water or groundwater ingress into excavations is encountered, then the Main Contractor should ensure that the groundwater is not exposed to hazardous materials. If removal of the groundwater is required then this should be stored, treated if necessary and disposed of appropriately. If disposal of groundwater to the public sewer is required, then the necessary approval and license should be sought from Irish Water.
 15. All works undertaken near the banks will be fully consolidated to prevent scour and run-off of silt. Consolidation may include use of protective and biodegradable matting or geotextiles on the banks and the sowing of grass seed on bare soil. A silt fence should be included around the site perimeter in the vicinity of earth works, where possible, to retain silts onsite.
 16. If ponding occurs onsite during periods of heavy rainfall, water will be pumped into a pond or sedimentation tank to allow settling of fine sediments prior to pumping to the local stormwater system. The use of settling lagoons, settling tanks, or equivalent, with outflow control measures may be used for the interception of surface water or groundwater pumped from an active working area.
 17. All concrete works will be carried out in dry conditions. Concrete and mortar washout will take place in an impermeable bunded/lined area. The concrete will be allowed to go off and broken up and used as blinding for site roads/haul roads etc.
 18. All earthworks will aim to be carried out in periods of dry weather (generally from April to September inclusive) to avoid potential for suspended sediment runoff.
 19. All works undertaken near the banks will be fully consolidated to prevent scour and run-off of silt. Consolidation may include use of protective and biodegradable matting or geotextiles on the banks and the sowing of grass seed on bare soil.
 20. This is especially necessary when undertaking works on cutting of sheet piling and excavation and laying of new Bitmac path to north of sheet piling (Area A4). Rainfall needs to be monitored and works carried out during consecutive dry days.
 21. Where possible, excavated soils should be re-used on site. Stockpiles of material should be located away from waterbodies.
 22. In the event of contaminated ground or hazardous waste been uncovered e.g. asbestos, work will stop and an investigation into the extent and characteristics of the material will be undertaken. The waste material will be removed by a licenced haulier and disposed of at a licenced/permitted facility. Waste disposal records will be kept by the Project Manager. Sandbags/ silt fences should be placed on the surface water drainages channels in this event;
 23. A water quality monitoring regime will be established and agreed with the NPWS and IFI in advance of works commencing.
 24. With regards to instream works and the use of the moveable working platforms/jack up rigs, the following mitigation is proposed:
 - a. The platform will be impermeable with raised sides to ensure that any spillages or debris caught by the barge is trapped before entering the surface water.
 - b. Netting or similar should be used in the space between the jack up rig and the walls to trap any falling debris which would otherwise fall into the River Shannon or Abbey Rivers.
 - c. Construction should be phased appropriately to avoid multiple movements of the jack-up rig, therefore limiting disturbance to the riverbed.
 25. In the event of flooding during the construction phase:
 - a. The old flood embankments around the north of the island will be left in situ until the new embankments are finished.
 - b. In areas A9 south of the Absolute Hotel, Area 10 Abbey Bridge to Baal's Bridge, and Area B2 at the pontoon access, the contractor will be required to monitor storm and high tide conditions that may cause inundation. In the event of a high tide or storm event, temporary concrete flood barriers can be erected at the exposed locations.

26. Works on pilings and new concrete wall at Verdant Place to include appropriate erosion and silt controls to prevent surface water flow and accidental spillages onto riverbank and into Shannon River.

A.1.7 Soils and Geology

During the construction phase, there will be consideration for the standard best international practice including but not limited to:

- CIRIA, (2001), Control of Water Pollution from Construction Sites, Guidance for Consultants and Contractors, (C532) Construction Industry Research and Information Association;
- CIRIA (2005), Environmental Good Practice on Site (C650); Construction Industry Research and Information Association;
- BPGCS005, Oil Storage Guidelines;
- CIRIA 697 (2007), The SUDS Manual; and
- UK Pollution Prevention Guidelines, (PPG) UK Environment Agency, 2004.

In addition, the following measures should be followed:

1. Temporary storage of soil will be carefully managed in such a way as to prevent any potential negative impact on the receiving environment and the material will be stored away from any surface water drains. Movement of material will be minimised in order to reduce degradation of soil structure and generation of dust.
2. The contractor will be required to import clean fill material to the site. The contractor will request a waste characterisation report from the supplier of the waste soil. The material will need to meet the inert criteria to be accepted onto the site.
3. The Contractor will be required to install a Soil Management Programme for the operations at the site. The construction programme will contain as a minimum, ways to minimise truck movements across the site to avoid soil compaction, re-use of suitable material on-site to minimise the quantities that need to be imported.
4. The contractor will be required to carry out a waste characterisation of the material that will be taken off site for disposal. Soil materials will be required to undergo waste characterisation prior to removal of materials offsite. A waste acceptance criteria (WAC) analysis and asbestos levels will be determined on any material that will be taken off site for disposal.
5. To minimise any impact on the underlying subsurface strata from material spillages, all oils, solvents and paints used during construction will be stored within temporary bunded areas.
6. Re-fuelling of construction vehicles and the addition of hydraulic oils or lubricants to vehicles, will take place in a designated area (or where possible off the site) which will be away from any existing surface water gulleys or drains.
7. All ready-mixed concrete will be brought to site by truck. A suitable risk assessment for wet concreting will be completed prior to works being carried out which will include measures to prevent discharge of alkaline wastewaters or contaminated storm water to the underlying subsoil.
8. In the case of drummed fuel or other chemical which may be used during construction containers should be stored in a dedicated internally bunded chemical storage cabinet and labelled clearly to allow appropriate remedial action in the event of a spillage.

A.1.8 Noise and Vibration

1. Construction noise will be kept to a minimum. The contract documents will specify that the contractor, undertaking the construction of the works, will be obliged to take specific noise abatement measures and will comply with the best practice outlined in BS 5228 – 1136.

2. Selection of plant machinery with low inherent potential for generation of noise and/or vibration. All construction plant and equipment to be used at the site will be modern equipment and will comply with the relevant legislation and regulations;
3. Regular maintenance of plant will be carried out in order to minimise noise produced by on-site operations. The regular and effective maintenance of plant can play an important role in reducing noise emissions. In particular, attention will be paid to the lubrication of bearings and the integrity of silencers. Silencers and engine covers will be maintained in good and effective working order;
4. All vehicles and mechanical plant will be fitted with effective exhaust silencers and maintained in good working order for the duration of the construction phase;
5. Any compressors used on-site will be of the 'sound reduced' models fitted with properly lined and sealed acoustic covers which will be kept closed whenever the machines are in use and all ancillary pneumatic tools shall be fitted with suitable silencers;
6. Machines, which are used intermittently, will be shut down or throttled back to a minimum during those periods when they are not in use;
7. Any plant, such as generators or pumps, which are required to work outside of normal working hours, will be surrounded by an acoustic enclosure;
8. Training of drivers to ensure smooth machinery operation/driving, and to minimise unnecessary noise generation;
9. A c.2.4m hoarding of density of at least 7kg/m² shall be provided around construction works for concrete walls/barriers outlined in Section **Error! Reference source not found.**; and
10. A maximum speed limit of 30 km/hr will be imposed for HGVs and drivers will be instructed to maintain as far as possible the distances between vehicles.

Monitoring during construction

1. Prior to the commencement of construction works, baseline noise monitoring will be carried out by the Contractor to determine the existing noise environment. During the works, noise monitoring will take place at the nearest sensitive receptors to the works. Eight noise sensitive locations will be monitored during construction, these are shown in Figure 11-1, Volume 3 of the EIAR.
2. Monitoring will be carried out at worst-case receptors at these locations, at a minimum. Measured levels will be compared to the limits outlined in Table 11 4.
3. If and when the noise limits are likely to be exceeded as a result of the proposed works, the Contractor will contact the affected residents/businesses through the Community Liaison Officer (CLO) as well as Limerick City and County Council.
4. Vibration measurements shall be taken at the base of buildings, on the side facing the source of vibration. Where feasible, the measurement should be taken on a hard surface on the ground outside the building. A pre-condition survey will also be undertaken of all properties potentially affected by the works (likely within a 10m radius of works areas). Crack monitoring will be installed on such affected properties and monitored throughout the works.

A.1.9 Air Quality

1. A Dust Management Plan (DMP) will be developed and implemented which will include the mitigation measures outlined below to control dust emissions. The DMP will include monitoring of dust deposition, and possibly real-time PM10 continuous monitoring as well as visual inspections.
2. Plan site layout so that machinery and dust causing activities are located away from receptors (human, surface water), as far as is possible.
3. Erect solid screens or barriers around dusty activities or the site boundary that are at least as high as any stockpiles on site.
4. Fully enclose site or specific operations where there is a high potential for dust production and the site is active for an extensive period.
5. Avoid site runoff of water or mud.
6. Keep site fencing, barriers and scaffolding clean using wet methods.

7. Remove materials that have a potential to produce dust from site as soon as possible, unless being re-used on site. If they are being re-used on-site cover seed or fence stockpiles to prevent wind whipping.
8. Ensure all vehicles switch off engines when stationary - no idling vehicles.
9. Avoid the use of diesel or petrol-powered generators and use mains electricity or battery powered equipment where practicable.
10. Impose and signpost a maximum-speed-limit of 15 mph on surfaced and 10 mph on unsurfaced haul roads and work areas.
11. Produce a Construction Logistics Plan to manage the sustainable delivery of goods and materials.
12. Only use cutting, grinding or sawing equipment fitted or in conjunction with suitable dust suppression techniques such as water sprays or local extraction, e.g. suitable local exhaust ventilation systems.
13. Ensure an adequate water supply on the site for effective dust/particulate matter suppression/mitigation, using non-potable water where possible and appropriate.
14. Use enclosed chutes and conveyors and covered skips.
15. Minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use fine water sprays on such equipment wherever appropriate.
16. Ensure equipment is readily available on site to clean any dry spillages, and clean up spillages as soon as reasonably practicable after the event using wet cleaning methods.
17. Avoid bonfires and burning of waste materials.
18. Avoid scabbling (roughening of concrete surfaces) if possible.
19. Ensure sand and other aggregates are stored in bunded areas and are not allowed to dry out, unless this is required for a particular process, in which case ensure that appropriate additional control measures are in place.
20. Ensure bulk cement and other fine powder materials are delivered in enclosed tankers and stored in silos with suitable emission control systems to prevent escape of material and overfilling during delivery.
21. For smaller supplies of fine powder materials ensure bags are sealed after use and stored appropriately to prevent dust.
22. Use water-assisted dust sweeper(s) on the access and local roads, to remove, as necessary, any material tracked out of the site. This may require the sweeper being continuously in use.
23. Avoid dry sweeping of large areas.
24. Ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport.
25. Inspect on-site haul routes for integrity and instigate necessary repairs to the surface as soon as reasonably practicable.
26. Install hard surfaced haul routes, which are regularly damped down with fixed or mobile sprinkler systems, or mobile water bowsers and regularly cleaned.
27. Implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site where reasonably practicable).
28. Ensure there is an adequate area of hard surfaced road between the wheel wash facility and the site exit, wherever site size and layout permits.
29. Access gates to be located at least 10m from receptors where possible.

A.1.10 Climate change

During the construction phase, best environmental practices will be followed in order to mitigate for greenhouse gas emissions as a result of the proposed FRS:

1. Ensure all vehicles switch off engines when stationary - no idling vehicles.
2. Avoid the use of diesel- or petrol-powered generators and use mains electricity or battery powered equipment where practicable.

3. Impose and signpost a maximum-speed-limit of 15 mph on surfaced and 10 mph on unsurfaced haul roads and work areas.
4. Produce a Construction Logistics Plan to manage the sustainable delivery of goods and materials.

A.1.11 Landscape

1. Minimise disruption to the existing river edge walkway during construction.
2. Within the southern part of Kings Island pedestrian access will be disrupted but not prevented as the work to construct the raised wall proceeds.
3. Tree surgery to the existing mature trees including raising of the tree crown and removal of lower branches and basal shoots will prevent damage by construction work.
4. Prevention of machinery and storage of building supplies within the tree root protection areas will minimise any damage to these valuable resources and maintain the sylvan charm of George's Quay during construction.
5. Soft landscape proposals to be implemented as soon as plant beds have been formed.

A.1.12 Cultural Heritage

Archaeological Heritage

Addressing concerns raised by the Development Applications Unit, Ms Sarah McCutcheon, Local Authority Archaeologist, has been appointed as Project Archaeologist for the duration of the project.

The following mitigation measures are recommended in addition to measures set out in the original EIAR:

1. Archaeological monitoring by a suitably qualified underwater archaeologist shall be undertaken for all groundworks for the outfall and the fishermen's access from the terrestrial/banks, along the intertidal zone and into the river at the NW of King's Island (Area 3).
2. The repair, pointing and grouting of the features associated with the medieval mill should be undertaken by those with a proven track record in historic building works. The repairs should include efforts to protect the features from further scour damage. A detailed methodology for the works concerning these features should be submitted to the National Monuments Service for approval prior to commencement.
3. Suitable precautions for all construction machinery and equipment used in the areas, a) between King John's Castle and the Court House and b) at the junction with Bridge Street, to be built-in to the construction design to avoid any damage to underground masonry features.
4. Where masonry structures are exposed in the course of the works a suitable membrane in conjunction with 50mm polystyrene or other suitable buffer material shall be used to protect the structure from construction matter.
5. Archaeological monitoring of all aspects of the scheme that involve ground disturbance. Specifically, archaeological monitoring of the following:

Area A2

- Archaeological monitoring of dig-out for foundations of new flood defence wall.

Areas A3, A4, A5, A6

- Topsoil stripping of areas where it is proposed to construction the embankment;
- Archaeological monitoring of topsoil stripping of proposed construction site compound;
- Archaeological Monitoring of dig-out associated with the construction of proposed drainage, including the inter-tidal storage tank in Area A6; and
- Archaeological monitoring of topsoil stripping and dig-out associated with the construction of the new access ramp and flood defence wall at Athlunkard Boat Club.

Area A7

- Archaeological monitoring of dig-out for foundations to reinforce the existing flood defence defences.

Area A9

- Archaeological monitoring of demolition of existing river wall and dig out for foundations for new flood defence defences

Area A10

- Archaeological monitoring of demolition of existing river wall and dig out for foundations for new flood defence wall; and
- Archaeological monitoring of dig-out associated with proposed new surface water drainage.

Area B1

- Archaeological monitoring of hand dig-out for foundations for new concrete flood defence wall;
- Archaeological monitoring of dig-out for mass concrete backing wall to support glass panel flood defences; and
- Archaeological monitoring of dig-out associated with proposed new surface water drainage.

Area B2

- Archaeological monitoring of dig-out for foundations for new concrete flood defence walls;
- Archaeological monitoring of dig-out for mass concrete backing wall to support glass panel flood defences ; and
- Archaeological monitoring of dig-out associated with proposed new surface water drainage.

Area B3

- Archaeological monitoring of all dig-out for mass concrete backing wall to support glass panel flood defences;
- Archaeological monitoring of all dig-out for proposed surface water drainage, including two flood cells/ storage tanks and associated outfalls;
- Archaeological monitoring of all dig-out associated with the decommissioning of the existing pumping stations to the north of the Council's Offices and to the north of the Court House;
- Archaeological monitoring of all dig-out associated with the construction of the proposed gravity sewer from north of the Council's Offices to its point of connection to the Limerick Main Drainage on George's Quay;

6. Should archaeological material be found during the course of monitoring, the archaeologist may have work on the site stopped, pending a decision as to how best to deal with the archaeology. The Development Applications Unit, National Monuments Service, Department of Housing, Local Government & Heritage and the Project Archaeologist shall be informed immediately. Should an archaeological excavation be required then the following shall apply: satisfactory arrangements for the recording and excavation of any archaeological material that may be considered appropriate to excavate shall be provided and all post excavation analysis up to final report stage shall be completed. Within twelve months of the completion of the excavation a final report (in the format recommended in the Guidelines for Authors of Reports on Archaeological Excavations 2006 National Monuments Service) shall be submitted.
7. All recommendations are subject to the approval of the National Monuments Service, Department of Housing, Local Government & Heritage.
8. Should design detailing or any subsequent factor necessitate design modification in areas of archaeological importance this will require approval by the Project Archaeologist in consultation with the National Monuments Service.

Architectural Heritage

It is recommended that a suitably qualified built heritage specialist be appointed to oversee the effective implementation of the architectural mitigation measures recommended for the construction phase of the proposed development. The specialist should maintain continuing liaison with Limerick City and County Council's Conservation Architect throughout the construction phase of the development.

Area A1

- **Thomond Bridge (RPS 428)**

The installation of new coping will abut the north-eastern wall of the bridge. Liaison and potential monitoring of works by a built heritage specialist.

Area A10

- **Baal's Bridge (RPS 433)**

Existing wall along the northern side of the Abbey River between Abbey Bridge and Baal's Bridge will be rebuilt to achieve the required height. The existing walls to be recorded prior to commencement of works. Method of recording to be agreed with Limerick City and County Council's Conservation Architect.

Area B3

- **King John's Castle (RPS 004)**

Although there are no predicted impacts, given the proximity of the Castle which is of National importance, Liaison and potential monitoring of works by a suitably qualified built heritage specialist is recommended.

- **Undercroft cellars, Medieval Mill and Bridge (RPS 050)**

The KIFRS has been designed to prevent impacts on structures associated with this Protected Structure. However, given the extensive nature of the works in and around the bridge and mill care is required.

Liaison and potential monitoring of works by a suitably qualified built heritage specialist is recommended.

- **County Court House (RPS 012)**

The existing modern railings and original stone plinth will be moved to within 1m along north-western and south-western sections of the courthouse. Removal of the boardwalk is positive as it will expose the original quay wall.

Liaison and potential monitoring of works by a suitably qualified built heritage specialist is recommended.

- **Potato Market (RPS 320)**

Detailed design of glass panel in open and flood walls associated with the ramp and how they interface with the historic fabric of the Potato Market to be agreed architectural heritage specialist and Limerick City and County Council Conservation Architect prior to construction.

Liaison and potential monitoring of works by a suitably qualified built heritage specialist is recommended.

- **Quay Walls: Merchants Quay**

Potential slight to significant impacts. 1) Existing railings along the quay edge will be replaced by glass panels. 2) Existing walls will be raised to achieve the required height. The walls will be raised by removing the coping and by the introduction of new masonry walling to match existing. The coping will be replaced on the raised section. 3) Removal of existing poorly preserved wall to south of steps adjacent to civic space. This wall will be replaced with a concrete wall clad in stone with stone coping. The stone wall currently blocking the steps will be replaced with a glass panel.

Liaison and monitoring of works by a suitably qualified built heritage specialist is recommended.

A.2 Monitoring and maintenance

A.2.13 Human beings

A maintenance and monitoring schedule to be implemented to ensure defences are operating safely.

A.2.14 Utilities

The operators of the scheme (LCCC) will ensure that the conditions attached to the foreshore licence will be complied with.

A.2.15 Biodiversity

1. To ensure the successful translocation of Opposite-leaved Pondweed to the new channel monitoring in the new channel on King's Island will take place according to Section 21 Licence application for *Groenlandia densa* (Denyer, 2019), conditions outlined in Licence No. FL08/2019 (Licence to take Protected Flora, alter or otherwise interfere with the habitat or environment of a species of Protected Flora) seen in Appendices C3 and C4 of Volume 2 of the original EIAR, and advice from NPWS.
2. Management of vegetation growth in new channel will follow guidance in final Conservation Management Plan for Opposite-leaved Pondweed as agreed with NPWS.
3. After completion of excavations for relocated channel, in-channel sediment and hydrology features will be reinstated as per the Methods statement in the Section 21 Licence Application (Floral Protection Order) for *Groenlandia densa*. Slope angle of new channel to be agreed with NPWS.
4. The enhancement of two additional sites for *G. densa* will be developed and monitored over three years. This will be carried out as a research project for scientific and educational purposes, and a report will be published after completion.
5. The steepness (1:3) of the embankment in the northern third of the proposed eastern embankment and the southern embankment area north of Star Rovers should discourage public access to the floodplain in these areas. Planting a natural barrier using whips of low-growing native species such as Hawthorn/Blackthorn on or near base of eastern embankment where it is less steep and where there is space between SAC boundary and base of embankment should also discourage access to the flood plain. Allow minimal meadow grassland management (e.g. one cut / year) on the embankment, with unmanaged areas where scrub and natural succession are allowed. Public access of the paths and use of marsh is likely to be less during the winter months when flooding occurs.
6. A local awareness campaign could highlight the biodiversity of King's Island. Bird counts by local Limerick nature groups (e.g. Irish Wildlife Trust, Birdwatch Ireland) could potentially monitor wintering bird numbers and rates of disturbance from public use of new paths.
7. Regular maintenance of drainage network will ensure good water quality. This will include regular operation and review of drainage maintenance requirements. Maintenance procedures will follow those recommended in CIRIA SUDS Manual (2015), Part E C753, Chapter 32 Operation and Maintenance.

A.2.16 Climate change

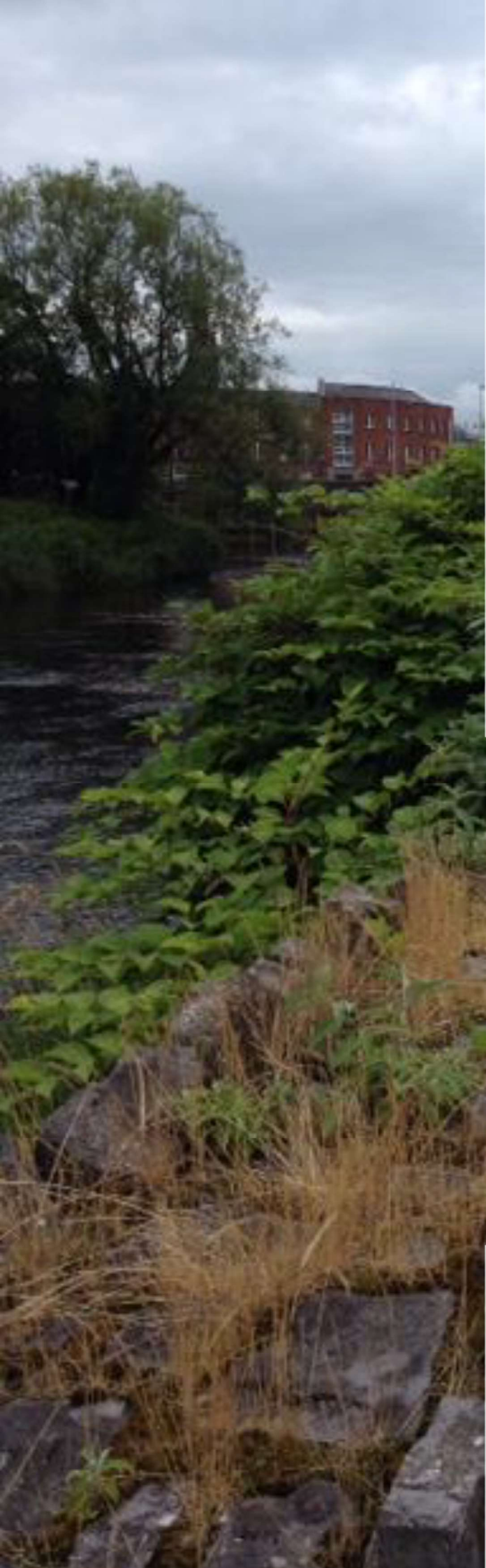
The scheme should be monitored over the next decades to determine the appropriateness of implementing adaptation measures as a result of climate change.

A.2.17 Landscape and visual

Monitoring of the growth of the planted material around the site boundary and within the staff parking will be carried out during the 18-month Defects Liability Period and the subsequent establishment period to ensure any screen planting which has failed to establish is replaced in the next planting season.

B Supplemental information to Section 4: Biodiversity

- B.1 Invasive Species Management Plan (JBA, 2019)**
- B.2 Bryophyte Assessment Report (Denyer Ecology, 2020a)**
- B.3 Report on the Assessment of Potential *Groenlandia densa* Enhancement Sites (Denyer Ecology, 2020b)**



Invasive Species Management Plan

August 2019



JBA Project Manager

Bernadette O'Connell
24 Grove Island
Corbally
Limerick
Ireland

Revision History

Revision Ref / Date Issued	Amendments	Issued to
v1.0 / 27th July 2016		Robert Gallagher, LCCC
v2.0 / 17th August 2016		Robert Gallagher, LCCC
v3.0 / 2nd August 2019	updated from 2017 document	ARUP, LCCC

Contract

This report describes work commissioned by Limerick City and County Council in relation to the management of Invasives at King's Island and as part of the King's Island Flood Relief Scheme (FRS). Niamh Sweeney and Anne Murray of JBA Consulting carried out this work in 2016. Hannah Mulcahy updated this document in 2019.

Prepared by Hannah Mulcahy BSc. MSc.
Assistant Ecologist

Reviewed by Jean Hamilton BSc., MSc. MCIEEM
Senior Ecologist

..... Patricia Byrne BSc, PhD, Dip
Ecologist

..... Niamh Burke BSc PhD CEnv MCIEEM
Principal Ecologist

..... Declan White BE CEng MIEI
Principal Engineer

Purpose

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1 Introduction

1.1 Background

Limerick City & County Council (LCCC) have commissioned a project to develop a flood relief Scheme (FRS) for King's Island, Limerick City. JBA Consulting has been appointed by Limerick City and County Council, to undertake Environmental Consultancy services in relation to the FRS. This includes an Invasive Species Management plan to remove non-native invasive species (INNS) within works areas in order to prevent the spread of INNS while the works are carried out. This plan mainly considers Giant Hogweed (*Heracleum mantegazzianum*), Butterfly Bush/ Buddleja (*Buddleja davidii*) and Japanese knotweed (*Reynoutria japonica*), but other invasive species, such as Himalayan Balsam (*Impatiens glandulifera*) are considered where necessary.

Control of NNIS on King's Island to date includes treatment of Japanese Knotweed by Limerick City and County Council in 2016, when a stand of Japanese Knotweed was excavated and banded on site for follow-up chemical treatment. An Invasive Species Management Plan was prepared in 2016 in preparation for planned works on the King's Island FRS, and treatment of Japanese Knotweed, Giant Hogweed and Himalayan Balsam was carried out in 2017. The scheme was postponed, and therefore there was no treatment carried out in 2018. This plan will update the work already carried out and outline the treatment that will be carried out in preparation for the main FRS works (programmed to begin in Spring 2020).

1.2 Purpose of this report

The purpose of this report is to outline the control measures to be implemented to prevent the spread of invasive species during advance works and main works for the FRS. The report is separated into two parts: advance works and main works. As part of advance works, a contractor has been appointed to treat invasive species within works areas, to clear them for the contractor carrying out the main works; the first part of this plan outlines the measures to be implemented during this phase. However, it will not be possible to make works areas completely free of invasive species prior to the commencement of works in 2020, so the second part of this plan outlines the control measures to be implemented by the contractor carrying out the main works.

1.3 Invasive non-native species

Non-native plants and animals are those originating from outside Ireland. Invasive plants and animals are those that spread rapidly, often becoming dominant, and have a negative effect on the environment (both built and natural). Invasive species are often non-native; however, some native species can become invasive, especially when outside their normal range e.g. Gorse or Bracken.

Examples of the negative effects caused by invasive species include structural damage, environmental degradation, aesthetic degradation, biodiversity loss, loss of land function, access restrictions and increased risk to human and animal health and safety. Costs incurred because of invasive species can include repairs to damaged structures and environment, delays to works, loss in value of a landholding or other asset, potential for prosecution because of damage caused by invasive species or infringement of legislation and loss of reputation through mismanagement of invasive species. The economic cost of IAS within the EU has been estimated at €12.7 billion/year (Kettunen et al. 2009).

Management of invasive species can be very expensive, often ranging into millions of pounds nationwide. A well informed and structured approach can help to reduce the costs and increase the effectiveness of management.

The importance of the threat of invasive species is reflected in a suite of international, European and national policy and legislation. The European Communities (Birds and Natural Habitats) Regulations 2011 (EC 2011) contain provisions to address the problem of invasive species; Schedule 3 of the Regulations contains a list of non-native species subject to restrictions under Regulations 49 and 50.

Additionally, one of targets of the National Biodiversity Action Plan 2017-2021 (NBDC 2017), Ireland's 3rd National Biodiversity Plan, is to control harmful invasive alien species and to reduce the risk of introduction and/or spread of new species.

1.4 Description of the Site

1.4.1 Existing Site

King's Island is located on the north side of Limerick city centre and measures circa 1,500m north-south and circa 490m east-west and as outlined red in Figure 1-1.

The north and west of the Island is bounded by the River Shannon while the east and south of the Island is bounded by the Abbey River. The northern and central area of King's Island is primarily residential with undeveloped land and riparian woodland dominating the outer area of the island where it adjoins the Rivers Shannon and Abbey.

The southern region of the Island is more commercial, incorporating multiple commercial, medical and government services.

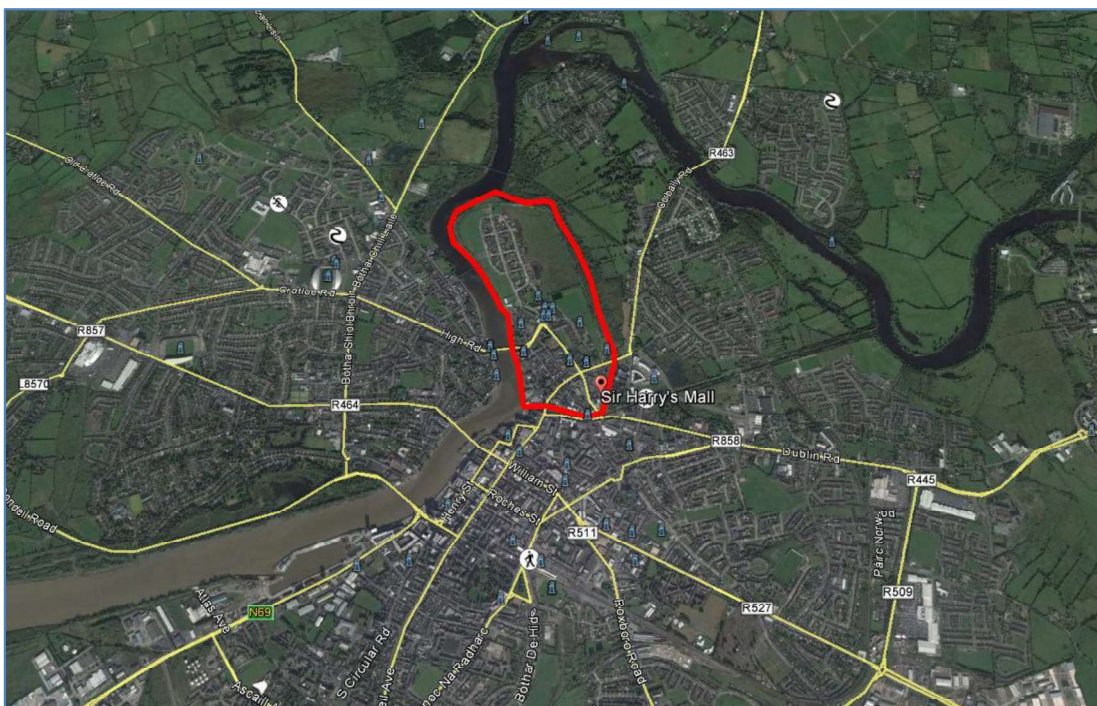


Figure 1-1:- Site Location Map within Limerick City

1.4.2 Proposed Development

The flood relief scheme (FRS) is likely to incorporate a combination of hard and soft defences around the Island perimeter which can be summarised as follows:

- New flood embankment along the western, northern and eastern boundaries of the Island from St Mary's Community Centre at Verdant Place to the Athlunkard Boat Club north of O'Dwyer Bridge;
- A new defence wall to the front/rear of Athlunkard Boat Club to O'Dwyer Bridge;
- Raising of existing defence wall from O'Dwyer Bridge to Absolute Hotel
- New defence wall from Absolute Hotel to Baal's Bridge;
- New defence wall along Georges Quay;
- Road raising at junction of Bridge Street and Georges Quay
- New defence wall to the rear of the Courthouse and Merchants Quay to tie in with King Johns Castle.

1.4.3 Verdant Place

It should be noted that the management of invasive species along Verdant Place has already been addressed under a separate commission and will not form part of the overall management plan as outlined within this document. However, consideration is given to the treatment methods and outcome of Verdant Place in the context of the overall management plan.

1.4.4 Existing Japanese Knotweed Bund

Japanese Knotweed was treated by Limerick City Council in 2015 and placed in surface bund located in St. Mary's Park. This was treated by LCCC by spraying for many years. It is understood that the bund is no longer sprayed by Limerick County Council. During a survey in June 2019, it was found that a small amount of Japanese Knotweed was growing through the bund.

1.4.5 Timeline of works

It is envisaged that a planning application will be ready for submission to An Bórd Pleanála (ABP) by August 2019. Construction is expected to commence by Q2 2020, with a 2-year construction programme.

A tender for the management of Invasive species on Kings Island was issued in June 2019. The treatment of the specified invasive species will begin by the end of August 2019, with a follow up treatment in September 2019. Two more years of treatment will be carried out, ending in 2021.

1.4.6 Existing Environment

The Lower River Shannon Special Area of Conservation (SAC) encompasses the River Shannon, River Abbey and the north-east section of King's Island (Figure 1-2 and Figure 1-3). The presence of non-native invasive species is identified as a threat to this SAC (NPWS 2015).

The conservation objectives of the SAC note the presence of the endangered species Triangular Club-rush (*Scirpus triqueter*) and Opposite-leaved pondweed (*Groenlandia densa*). Triangular Club-rush has been recorded to the north west of the island and Opposite-leaved pondweed is present in the Limerick Canal (NPWS 2012). Surveys for the FRS found that Opposite-leaved pondweed was also present in a drainage ditch to the north-west of Kings Island. Both species are protected under the Flora Protection Order 1999.

A Screening for Appropriate Assessment was carried out and delivered to Limerick CCC in August 2017 (JBA Consulting 2017). It was found that there will be no significant effects from the Invasive species treatment on the Natura 2000 sites. However, this screening stipulated that should further treatment of invasive plant species be required in the future, with the procurement of a new contract/contractor, a revised site-specific method statement and a new Screening for AA will be required.

A new contract will be drawn up for this treatment, therefore this plan will require a new Screening for Appropriate Assessment and should include the final methodologies proposed by the contractors, once the contractor has been commissioned.

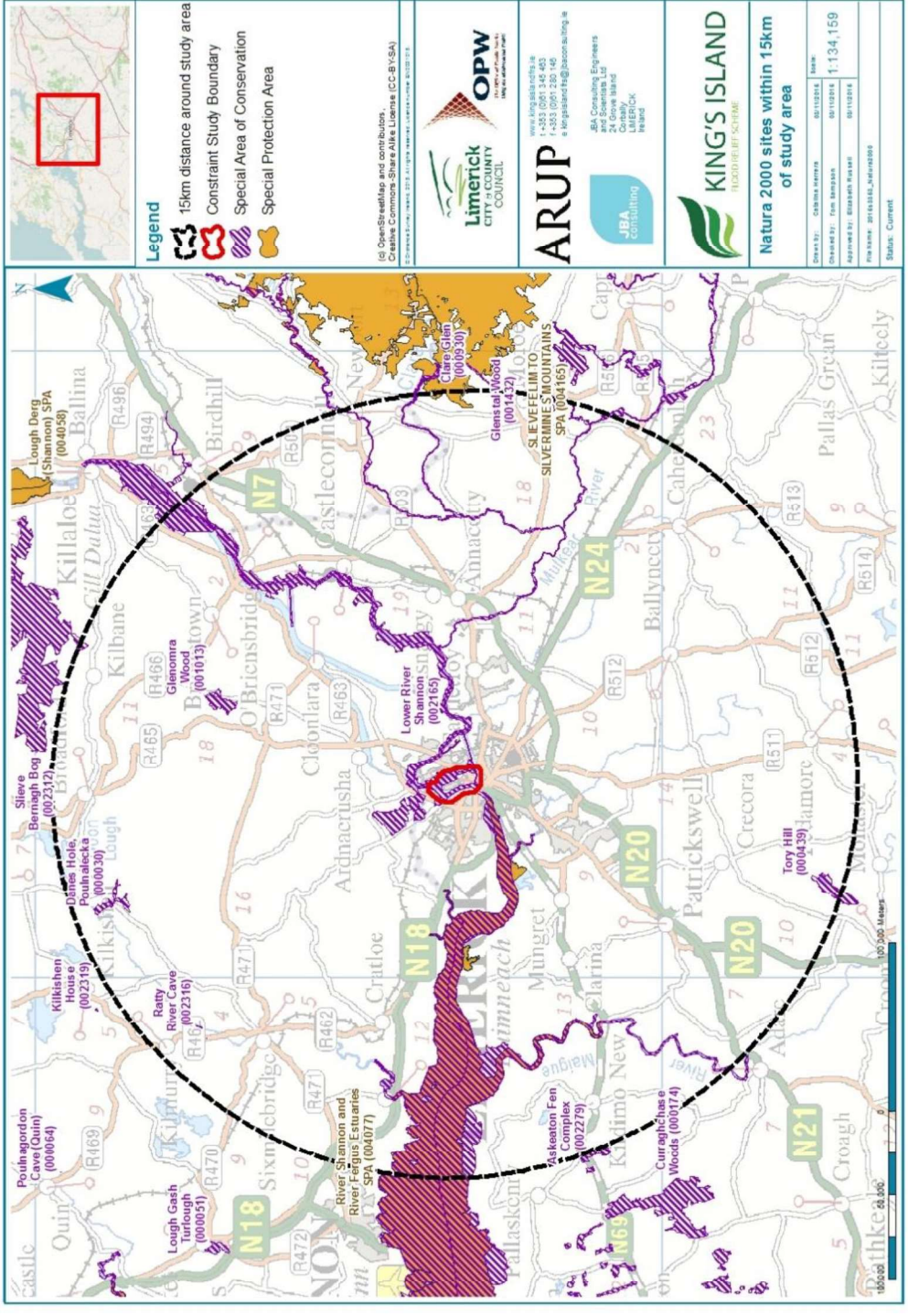


Figure 1-2 Lower River Shannon SAC (002165) Boundary Overview

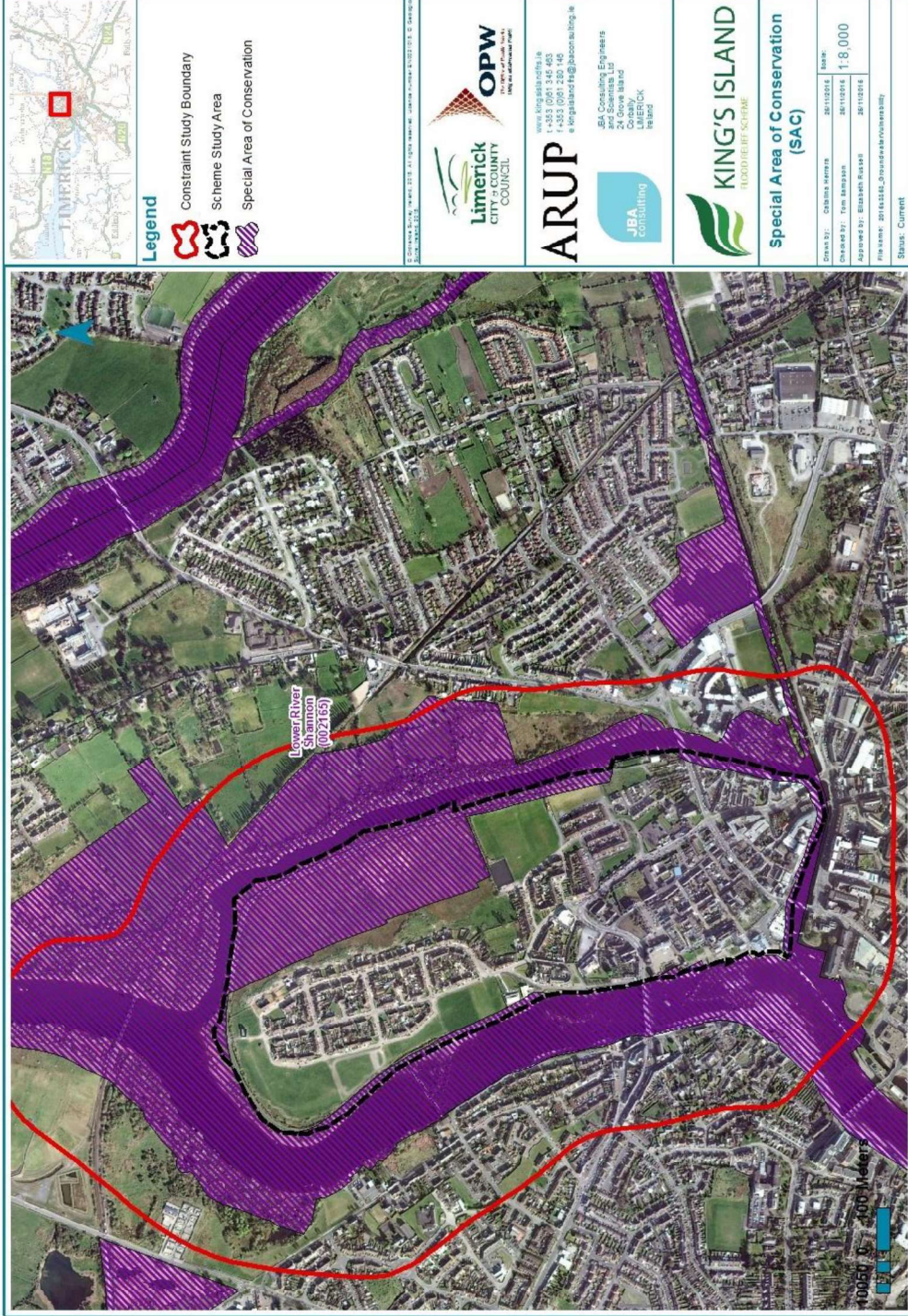


Figure 1-3 King's Island and the Lower River Shannon SAC (002165)

2 King's Island Invasive Species Surveys and Treatment to Date

2.1 Overview

Since 2013, there have been many invasive species surveys at King's Island, and Limerick CCC have engaged contractors to carry out control of invasive species as part of enabling works for the FRS. This section summarises work on invasive species at King's Island to date.

The main locations that invasive non-native species have been recorded are along the river walls, existing embankment, riparian habitats and in the undeveloped land of King's Island, both within and outside of the designated areas.

Invasive non-native species noted on King's Island (from all surveys) include:

- Japanese Knotweed (*Reynoutria japonica*);
- Giant Hogweed (*Heracleum mantegazzianum*);
- Himalayan Balsam (*Impatiens glandulifera*);
- Buddleja (Butterfly Bush) (*Buddleja davidii*);
- Winter Heliotrope (*Petasites fragrans*);
- Red Valerian (*Centranthus ruber*)
- Montbretia (*Crocasmia x crocosmiiflora*)
- Sycamore (*Acer pseudoplatanus*)

Japanese Knotweed, Giant Hogweed and Himalayan Balsam are listed in the Third Schedule (Part 1) of the European Communities (Birds and Natural Habitats) Regulations 2011. Japanese Knotweed and Giant Hogweed are being treated on King's Island under an invasive species management plan (JBA 2016) updated 2019), as they are a risk in preventing the conservation objectives of the designated sites from being reached. The European Communities (Birds and Natural Habitats) Regulations 2011 (Regulation 49 and 50) restrict the dispersal, spread and transportation of these invasive species.

Japanese Knotweed and Giant Hogweed were recorded at various locations on King's Island. The bund of buried Japanese Knotweed created in 2015 by LCCC is present beside the marsh habitat, and some regrowth was noted in July 2019. Numerous stands of Japanese Knotweed are located along the boundary line of the SAC and adjoining housing estate. The distribution of Giant Hogweed was contained to the outer fringe of the island, among the riparian woodland and wet grassland areas in 2017. However, by 2019 it was recorded on either side of the pathway on the western embankment (Figure 2-3), on the embankment itself and in the ditch that contains the protected plant Opposite-leaved pondweed.

Himalayan Balsam is abundant along the edges of the island within the riparian woodland and wet grassland habitats.

Buddleja, Red Valerian, Sycamore, Montbretia and Winter Heliotrope are amber listed by Invasive Species Ireland (2017), meaning that they are species that could pose a threat to native species or habitats by causing decline or loss, or species that could impact either/both Natura 2000 sites and the goals of the Water Framework Directive. Winter Heliotrope and a small patch of Montbretia were observed along grassy verges and embankments to the south-east of the site where Himalayan Balsam was previously observed. Sycamore is established all over the island, particularly in the north half. Buddleja and Red Valerian were found mostly in stonework such as bridges and walls; these species are known to cause structural damage to buildings and walls.

Details of all surveys and treatment of invasive species on King's island are described below.

2.1.1 Initial Surveys 2013

A habitat survey was carried out at King's Island in 2013, to inform the preparation of a Natura Impact Statement (Openfield Ecological Services, 2013). This report noted the presence of Japanese Knotweed and Giant Hogweed on King's Island.

During the 2013 surveys, invasive species (including Himalayan Balsam, Japanese Knotweed and Giant Hogweed) were recorded along the river walls, existing embankment, riparian habitats and in the undeveloped land of King's Island. Butterfly-bush (*Buddleja davidii*) was also recorded throughout the island.

2.1.2 Treatment of Invasive Species 2015

Limerick City Council began treatment of the Japanese Knotweed located in St. Mary's Park in 2015. The Japanese Knotweed was placed in a surface bund, measuring c.60m long x 28m wide and is approximately 2m above ground level. The bund which is covered in a thin layer of topsoil was sprayed with chemical treatment at regular intervals, which is no longer carried out by LCCC.

2.1.3 Invasive Species Surveys and Treatment 2016

JBA Consulting carried out a preliminary invasive species survey on King's Island during a Phase 1 habitat survey in September 2015 and updated the mapping during the appropriate Flora season in July 2016.

Japanese Knotweed over the whole of King's Island was initially mapped in July 2016 and was subsequently treated by foliar spray and/or wipe as follows:

- Initial Treatment: End of August 2016
- Follow Up Treatment: End of September 2016

There was no treatment of Giant Hogweed or Buddleja in 2016.

2.1.4 Invasive Species Surveys and Treatment 2017

King's Island was mapped again by JBA Consulting in July 2017 for invasive species, as shown on Figure 2-1 below. It was found that Japanese Knotweed, Giant Hogweed and Buddleja remained extensive around the Island. The treatment was carried out on all three species by foliar spray and/or wipe as follows:

- Initial Treatment: 14th / 15th September 2017
- Follow Up Treatment: Mid October 2017

Invasive species treatment locations are shown in Figure 2-1 and Figure 2-2 below.

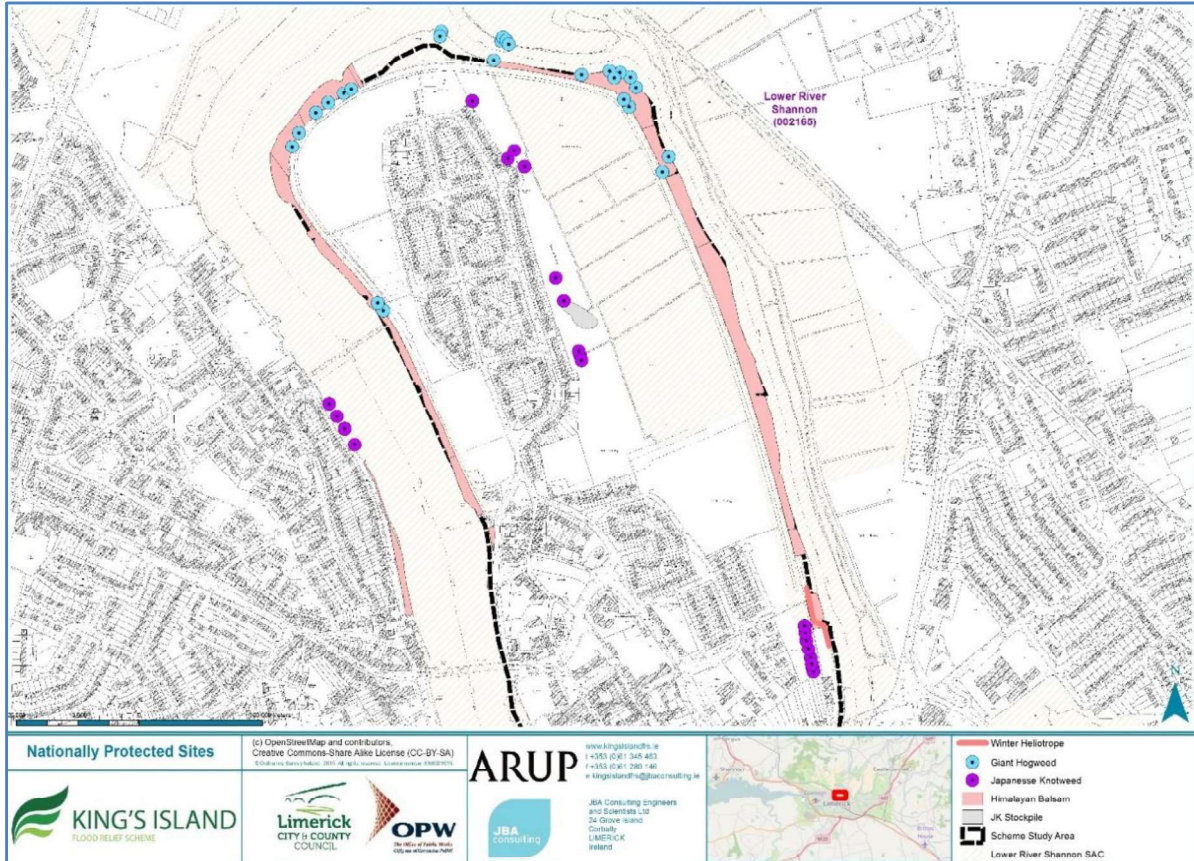


Figure 2-1 NNIS survey in 2017 shows location of Giant Hogweed (blue) and Japanese Knotweed (purple).

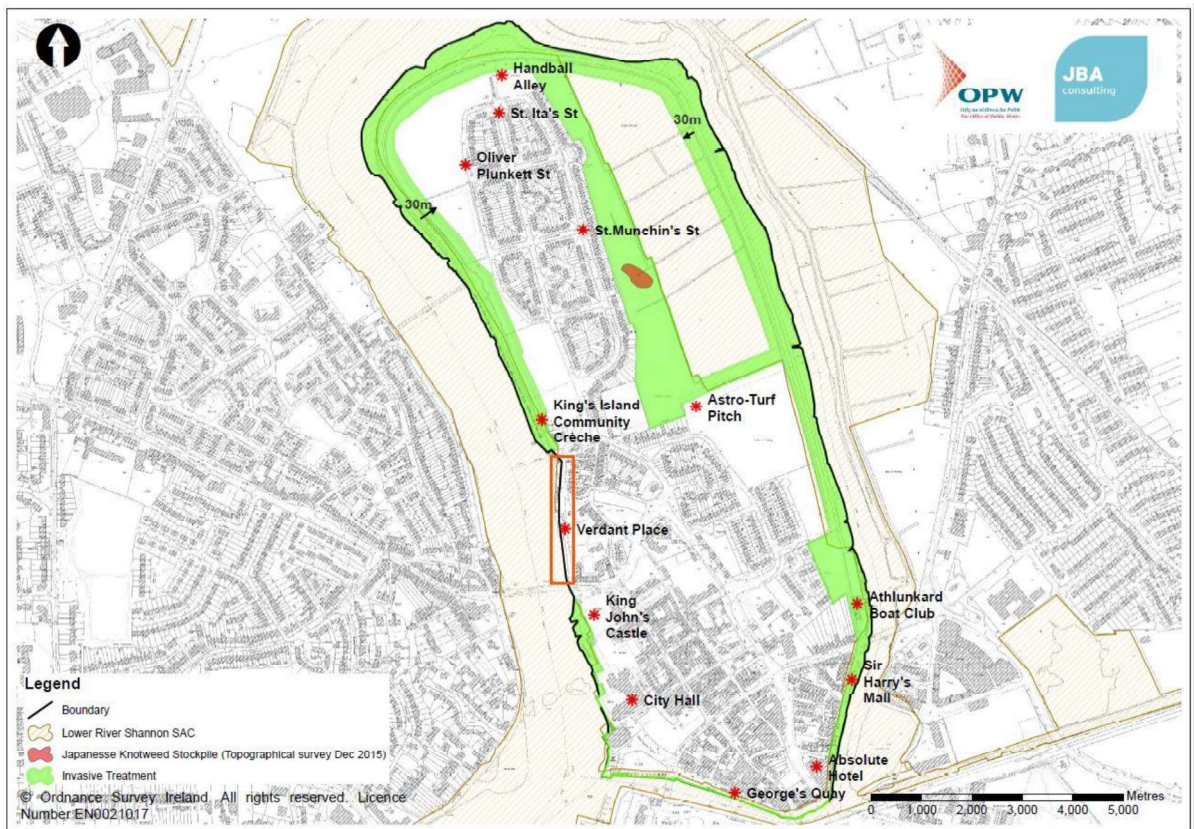


Figure 2-2 Invasive Species Distribution and Treatment Locations at the Kings Island FRS scheme, 2017

2.1.5 Invasive Species Surveys and Treatment 2019

In 2019, King's Island was resurveyed by JBA Consulting ecologists for the extent of invasive species; Figure 2-3 below shows the distribution of invasive species as mapped during this survey.

It was found that overall there was less Japanese Knotweed after treatment in 2017, but the plant was still prevalent in some areas, and without control will likely re-establish itself. Two notable areas include near the handball alley to the north of the site, and at the back of a demolished residential site on St Senan's Street. Both areas contain a large sward of Knotweed, and both are fenced off with metal fencing, so will require access by the council.

Giant Hogweed was most extensive to the west of the island, and was recorded establishing itself along the path and in the drainage ditches.

Himalayan Balsam was recorded indicatively only due to the survey being carried out early in the growth season for this plant. The cover of Himalayan Balsam from 2017 survey has been applied to Figure 2-3 as an indication of extent.

Buddleja is occasional throughout, particularly on stone walls, buildings and bridges.

A tender for management of Japanese Knotweed, Giant Hogweed and Buddleja was issued in June 2019. An amendment was issued to the tender to include the management of Himalayan Balsam in the areas that will be affected by the works. The tender states that the treatment will be carried out for three years on all three species by foliar spray and/or wipe as follows:

- Initial Chemical Treatment by End of August 2019
- Follow-Up Treatment 2019 by September end 2019
- 2020 Initial Chemical Treatment by 3rd of August 2020
- Follow-Up Treatment 2020 by September end 2020
- 2021 Initial Chemical Treatment 2021 by end of August 2021
- Follow-Up Treatment 2021 by September end 2021

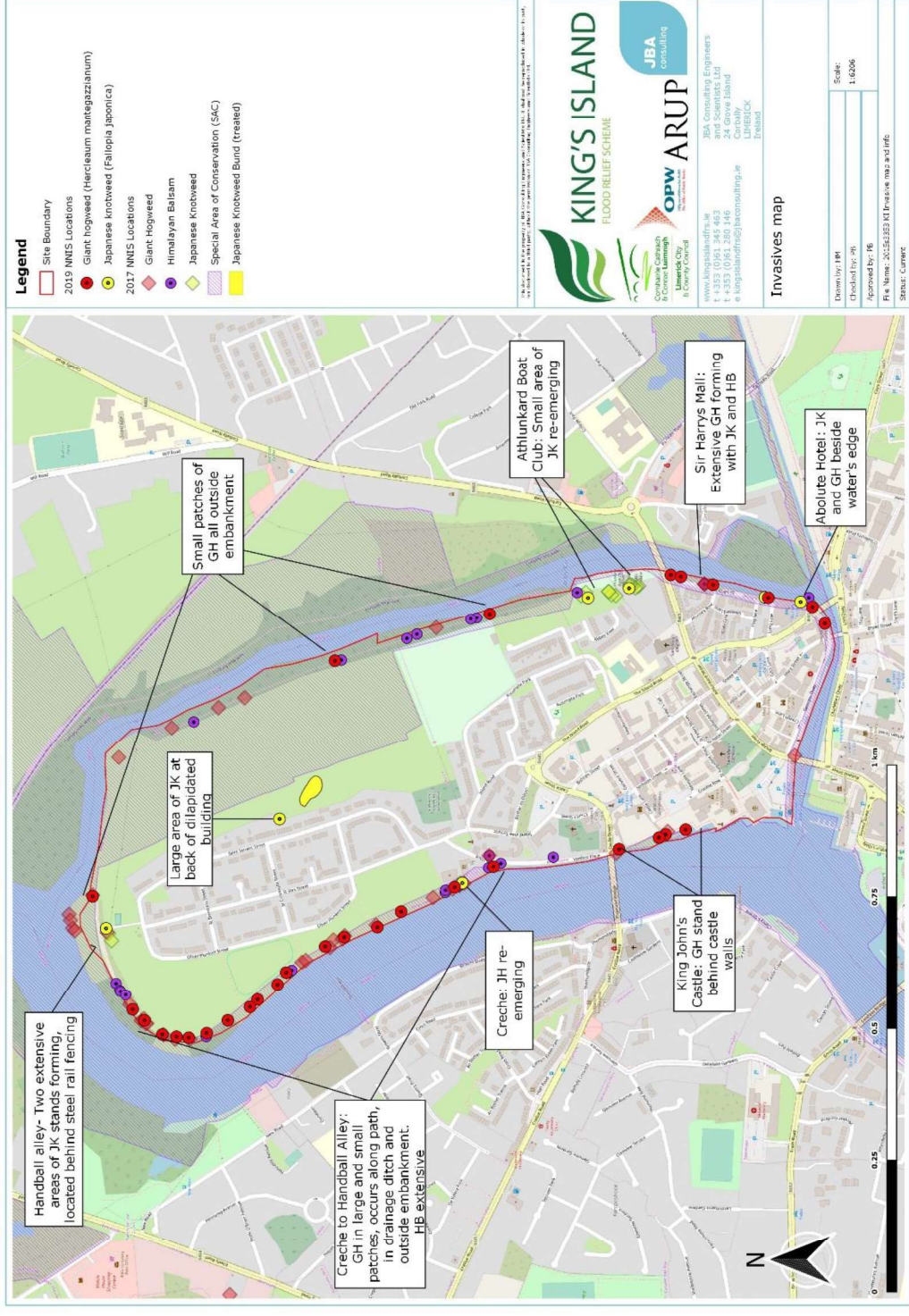


Figure 2-3 Extent of Japanese Knotweed (yellow) and Giant Hogweed (red) and approximate locations of Himalayan Balsam (purple) on King's island in 2019.

3 Invasive Species Description

3.1 Japanese knotweed

Japanese Knotweed (*Reynoutria japonica*) is listed in the Third Schedule (Part 1) of the European Communities (Birds and Natural Habitats) Regulations 2011. It is an herbaceous plant that can grow in large stands up to 3m in height and is prevalent along roads and riverbanks. It has red/purple shoots in early spring and produces lime-green heart-shaped leaves. The plant produces small creamy white flowers from July to August. The rhizomes (root-like underground stems) form dense mats that can be 3 metres in depth and up to 7 metres laterally from the parent plant. As only female plants occur in Ireland, it is spread entirely vegetatively, via the transport of soil material contaminated with the rhizome or plant material (Early et al. 2009)

The aggressive growth pattern means it is capable of exposing weaknesses in hard engineered structures such as concrete, tarmac, brick walls and foundations.

Specific problems caused by Japanese Knotweed are:

- Damage to paving and tarmac areas;
- Damage to retaining wall structures;
- Damage to building foundations;
- Damage to flood defence structures;
- Damage to archaeological sites;
- Reduction in land values;
- Aesthetic issues;
- Reduction in biodiversity throughout, shading native vegetation;
- In winter, the plant dies back, and leaves banks bare and vulnerable to erosion.
- Many insects/wildlife that are dependent on our native plants are lost or in danger;
- Restriction of access to riverbanks for anglers, bank inspection and amenity use.

3.2 Giant Hogweed

Giant hogweed is listed in the Third Schedule (Part 1) of the European Communities (Birds and Natural Habitats) Regulations 2011. It is noted for its huge size as it can grow 3-5 metres tall and its leaves can be up to 1.5m in diameter. It flowers from June to September, producing thousands of seeds. It invades river and stream banks, railway lines, disused waste land and other damp places. It has spread rapidly, despite being the subject of on-going control measures in some areas.

The plant's large leaves block sunlight to less vigorous native plants in its immediate vicinity, which results in a decrease in biodiversity. As a result, it can out-compete native riverside plants leaving riverbanks bare in the winter and susceptible to erosion during spates and floods.

Giant Hogweed sap contains a chemical which, in the presence of sunlight, causes a skin reaction resulting in burning, itching and blistering which can persist for 6 years. The reaction can occur by individuals accidentally brushing past leaves and can be especially acute in children. For this reason, it is a serious and significant danger to public health.

The following provides a summary of the key impacts of the species:

- Harmful to humans due to toxic sap making the skin sensitive to UV light.
- Can lead to the closure of public amenity areas.
- Excludes native species.
- Dies back in winter leaving riverbanks vulnerable to erosion.
- Has subsequent potential sedimentation impacts on fish spawning areas.
- Reports suggest that its leaves can be harmful to young wildfowl.

3.3 Buddleja

This species is listed as Amber and Uncertain Risk on the Invasive Species Ireland list. The plant can cause damage to buildings, particularly on old brickwork. Therefore, it may compromise the walls along King's Island including the walls at Verdant Place, Harrys Mall and Georges Quay. It is not considered an issue for the northern part of the island.

Buddleja is a deciduous shrub that typically grows around 1.5 to 2m tall. It commonly planted in gardens due to its robust growth, fragrance and range of bloom colours, and often recommended for its ability to grow in poor soil, in particular, to attract butterflies. The flowers grow in triangular spikes, in a range of purple to light purple shades, with egg-shaped to lance-shaped leaves that grow to 25cm long.

Like many of the invasive plants, Buddleja has escaped cultivation and spread rapidly by windborne seed. Buddleja displaces native vegetation on disturbed ground, roadsides, railways and riverbanks.

Buddleja is a prolific seed producer; a single flower spike can produce over 40,000 seeds. Seeds are dispersed by wind and water, and may remain dormant in the soil for many years. These shrubs also alter the nitrogen and phosphorous amounts in the soil, giving it an advantage that displaces native species, particularly in riparian areas.

The following provides a summary of the key impacts of the species:

- Attracts pollinating insects away from native species.
- Damage to buildings, particularly old stonework

3.4 Himalayan Balsam

Invasive Species Ireland identified Himalayan balsam (*Impatiens glandulifera*) as one of the highest risk non-native invasive species in Ireland. This is largely due to its impact on native waterside vegetation within designated sites. It was first introduced in 1839 as an ornamental garden plant. Since, it has spread to most parts of Ireland. In its home range, the Himalayas, it has adapted to develop thousands of seeds due to the nutrient poor soil and cold temperatures. Due to the warmer climate in Europe and nutrient rich soils it has thrived and has become highly invasive.

It is the tallest annual plant (completes its life cycle in one year) in Ireland and due to its rapid growth, it shades out most of our native species, leaving banks bare in the wintertime. The species is particularly frequent in damp soil areas such as along the banks of watercourses, where it often forms continuous stands. It can also establish in damp woodland, flushes and mires. In the autumn, the plants die back, leaving the banks bare of vegetation and vulnerable to erosion, leading to knock on effects such as the increased siltation of fish spawning grounds as well as bank instability and therefore increased flood risk. Recent research suggests it competes for pollinators such as bumblebees with the native riverbank species, and so reduces pollination of other plants.

It is possible to successfully control or eradicate Himalayan Balsam from infested sites. However, while removal of Himalayan Balsam increases plant diversity, the species that respond most dramatically are commonly other non-native plants. It is recommended that efforts are made to enhance native species, as part of a control programme.

The following provides a summary of the key impacts of the species:

- Excludes native species.
- Leaves riverbanks exposed to erosion in winter.
- Subsequent potential sedimentation impact on fish spawning areas.
- Attracts pollinating insects away from native species.
- Increased risk of flooding due to siltation of water courses and bank instability.
- Main transmission route via water courses.

3.5 Potential Impacts of Invasive Species on King's Island

Invasive species have been recorded along the river walls, existing embankment, riparian habitats and in the undeveloped land of King's Island; these include the non-native invasive species

Japanese Knotweed, Giant Hogweed and Himalayan Balsam. These species are listed in the Third Schedule (Part 1) of the European Communities (Birds and Natural Habitats) Regulations 2011 and their presence therefore needs to be addressed given the impending flood relief scheme works for King's Island. Regulation 49 and 50 restrict the dispersal, spread and transportation of these invasive species. Buddleja is also present throughout the island; this species is not listed under Schedule 3 but is a non-native plant which has the potential to cause damage to structures during this scheme.

Therefore, the future management of invasive species on King's Island is pertinent. This document sets out the control and/or eradication measures to be implemented at King's Island during the Flood Relief works.

The main potential impacts of the invasive species vary for the proposed Flood Relief Scheme, but Japanese Knotweed has the greatest potential to damage flood defence structures directly as it can grow through hard engineered structures causing weaknesses and damage. Japanese Knotweed, Giant Hogweed, Buddleja and Himalayan Balsam may compromise riverbanks by exposing them to erosion when the plants dieback and cause an increased risk of flooding through erosion and bank instability.

During construction of the Flood Relief Scheme, it is possible that the movement of soils, disturbance of areas, tracking of machines etc. may result in the transport of seeds or plant fragments of invasive species and the spread of invasive species across the site.

These species will require control due to the potential impacts on the site during construction, in particular the risk of spreading the invasives in King's Island and also within the Natura 2000 Site - Lower River Shannon SAC.

4 Proposed Measures for Control of Invasive Species at King's Island, 2019-2021

4.1 Consideration of Options for Eradication and/or Control

It is important to note that on river systems, control should be undertaken on a catchment wide basis, working from the upstream end to prevent seed re-colonisation. King's Island is located towards the downstream confluence of the River Shannon which has a large river catchment and there are invasive species known to occur upstream in the catchment which have been surveyed on other projects by JBA ecologists. These will provide a continuous source of seeds and plant fragments (notably of Japanese Knotweed) unless a catchment wide approach is taken in the long term.

However, it is not within the scope of these works eliminate all NNIS within a catchment wide approach. The purpose of the 2019 management plan is to control and prevent the spread of the above NNIS during the construction of the Flood Relief Scheme.

This plan as such relates directly to the eradication of existing invasive species along the likely routes of the flood relief scheme as described in Section 1.4.2.

Given the above scheme options in addition to time constraints, the type of treatment and methods are somewhat confined.

For example, the excavation and/or chemical treatment of Himalayan Balsam has not been considered which would result in disturbance within the SAC. Similarly, stem injection of Japanese Knotweed has not been recommended on this project, primarily because it is a relatively slow process, whereby, 12m²/day/man would be typical at best.

The fate of any invasive species across King's Island is a function of several competing probabilities:

- Probability of detecting all infestations (a function of the number of patches, the size of patches, location of patches and the rigor of the search effort);
- Probability of an undetected infestation causing a new outbreak (function of patch size and location, frequency of dispersal events);
- Probability of killing an individual patch (function of patch size, treatment strategy, treatment efficacy, local community cooperation);

Given the reasons outlined above, it has been concluded that it will not be feasible to eradicate invasive species in King's Island within the timeframe allowed. The main aim of this strategy is therefore to prevent the spread of invasive species during the FRS works.

The measures outlined below are recommended for the control of invasive species within King's Island FRS works areas. For ease of interpretation, responsibilities have been allocated to the Invasive Species Contractor (Section 4.2) and to the main contractor (Section 4.3).

Below is a description of a suggested method of treatment and removal for each target NNIS on Kings Island.

4.2 Measures to be Employed by Invasive Species Contractor

The treatment of these species must take place in August 2019, with a follow up treatment in September 2019 if required. The next two years of treatment (2020 and 2021) will occur while the FRS works are on-going.

4.2.1 Invasive Species Management Plan

Prior to the commencement of treatment, the successful invasive species contractor must outline their treatment methods in a method statement, for approval by JBA Consulting and Limerick CCC.

4.2.2 Site Walk-through

The contractor will walk through the site with JBA ecologists to determine the extents of invasive species and measures to be implemented at each location, as well as highlighting habitat and

species sensitivities. Particular care must be taken close to watercourses, especially close to the ditch containing protected species Opposite-leaved pondweed (*Groenlandia densa*).

4.2.3 Species-specific plans

4.2.3.1 Japanese Knotweed (JKW)

At King's Island, this invasive plant has taken hold of a few areas and poses a serious threat to the integrity of any hard-engineered structures that may be proposed as part of the Flood Relief Scheme. The locations of JKW include the quay walls at Verdant Place (which has already undergone treatment), near the Kings Island Community Crèche, along the wall at Harrys Mall, and boardwalk at the Absolute Hotel. It also occurs in large stands near the handball alley, at the back of St. Marys Park and at the back of Abbey View near the boat club. There may be other areas that arise over the course of treatment and the re-exposure of soils during site investigations or construction works. The JKW bund in St Mary's Park has also begun to regrow.

Chemical treatment is likely to fast-track and eradicate the Japanese Knotweed, although the works carried out at Verdant Place has shown that there is a need to ensure that the contractor understands the constraints of working near/within an SAC. In this regard, the contractor shall agree the treatment methods with an on-site ecologist. The spraying of other species that are not of concern and native/protected species that may occur near the invasives needs to be restricted and managed.

This also has implications for soil exposure and increased erosion along riverbanks along with opening areas that may allow other invasives to take hold. Some seeding of grasses may be required as part of the management of particular areas under the advice of an ecologist in terms of appropriate seeding, appropriate grass species and how this can be achieved within or adjacent to the SAC.

4.2.3.2 Giant Hogweed

Given the location of individual plants close to the riverside the following is suggested where feasible on King's Island. The most effective chemical for the control of giant hogweed is glyphosate. Foliar sprays of glyphosate are suitable for large infestations, but as the chemical is broad-spectrum, it will kill all sprayed plants. Injection into the stem of the plant approximately 30cm above the ground with 5ml of a 5% v/v solution can be used where spot treatment is required.

Herbicides such as Glyphosate based products can be applied as a spot treatment to individual plants, using hand-held equipment or as a foliar spray campaign. In the latter instance, total eradication of all vegetation will occur and necessitate reseeding of the treated area with grass and other native plants. Establishing a good sward of grasses soon after treatment of the weed will help to reduce the rate of re-colonisation of the area by seeds. This would be carried out under the advice of the onsite ecologist to establish the appropriate grass species and subject to consultation with NPWS. In locations containing sensitive vegetation, giant hogweed is best controlled by injecting herbicide into the stem. Foliar spray application should be undertaken before the flowering stem has fully elongated in mid-spring during periods of mild, dry weather. Where control is being undertaken later in the year after stem elongation, the stems should be cut back to ground level and the re-growth sprayed.

It is important to note that the seeds of this plant can remain viable for many years (possibly up to 15) although most will become unviable after just 2 years. The seed bank is typically found in the top 5cm of soil (Booy, O. et al. 2007). Once a plant has produced seed, it should be assumed that the seeds will be present in the surrounding area for at least this length of time. Control measures will only affect those plants that have already germinated, and viable seed may continue to germinate each year until the seed bank is exhausted. Eradication will require regular annual monthly checks during the growing season to ensure that any late germinating plants are controlled before they can set seed. Follow-up removal will be required for a period of at least 5 years to ensure complete control. Subsequent soil disturbance in the area, however, may give rise to a new flush of seedlings. Mowers, strimmers or weed whackers should not be used as they tend only to stimulate additional budding on the root crown; do not reduce the plants rigour; and, can flail sap onto operators and through clothing. Consultation with the on-site ecologist will help refine the specific methodology for each discrete patch of vegetation, as required.

4.2.3.3 Buddleja

The treatment of Buddleja may be different depending upon its growth stage and location. Only the Buddleja on walls or hardstanding areas will be treated on King's Island with chemicals, if it cannot be removed by manual means (hand pulling/ cutting etc.).

Although not as urgent as the removal of the Buddleja from walls and hard structures, an option of manual removal may be examined at a later stage within habitats of the SAC. However, this will require careful assessment and planning subject to its location and its extent. It is not considered good practice to remove all species in the one season as it may cause a significant amount of disturbance to the habitats and to the SAC, and create areas that will be susceptible to erosion along with other invasive species removal. Therefore, the manual removal of Buddleja can be done over a number of years over the long term with a specific plan for this species. This can be carried out as follows:

Removal of Buddleja is best when it first comes into flower but has not yet produced seeds. Small plants can be easily hand-pulled when the soil is moist. Remove larger bushes by cutting the plant at the base. Dig up the stump and cover it with a thick plastic bag, or mulch to prevent regeneration. Remove new shoots until the rootstock dies, and do not leave stems on the ground, or they may root.

4.2.3.4 Himalayan Balsam

Given the location of Himalayan Balsam within protected/important river and wetland habitats and the extent of the plant interspersed with protected species, and next to the protected area of the Lower Shannon SAC, this plant requires specific management and restricted treatment methods.

Himalayan Balsam is an annual plant and, therefore, the key objective for control of Himalayan Balsam is to exhaust the plants seed bank. This can be done by repeatedly removing adult plants before they set seed. Seed bank longevity is about two years and control programmes should be undertaken for the whole of this period followed by a 5-year monitoring programme, pending the contractor methodology proposed.

Hand pulling is an effective way of removing adult plants in small areas and is more environmentally friendly than chemical control. Care should be taken to remove the whole plant as plants can regrow within the same season if cut and not fully removed. Hand pulling must be carried out before the plant flowers.

The removal of Himalayan Balsam requires a special method statement as all the plants are located in the wetland areas of the SAC and also within the Priority Habitat - Alluvial Woodland. Therefore, given the soft nature of the ground underfoot, the manual removal of this species will require that only one or two persons access the area on foot and target the species without trampling across the areas of wetland causing more damage to the SAC. No chemical control will be used for this species. Collateral damage occurs as all plants in vicinity are affected where glyphosate is used thus damaging protected species and habitat and also compounding problems of soil erosion during high river flows. This also exposes areas for recolonisation by this and other invasives in the following years.

In terms of treatment, the aim of treatment is to try to eradicate/reduce this species without inadvertently damaging the area within which it occurs. It is also important to note that this species is not a threat to the proposed new Flood Scheme from a structural basis but rather the objective is to control it in order to reduce the transport or movement of this species during the construction phase of the Flood Scheme. Hand pulling can be carried out next year and the subsequent years whilst construction is ongoing.

4.3 Management of Invasive Species during Construction of the Flood Relief Scheme

Though treatment of invasive species is to be carried out by a specialist contractor prior to the commencement of the FRS, it will not be possible to ensure that all works areas are entirely free of invasive species prior to the commencement of works. It may be possible to kill off above-ground vegetation, but the rhizomes (of Japanese Knotweed) and seeds (of Giant Hogweed and Himalayan Balsam) will remain in the soil. The measures below are proposed to prevent the spread of invasive species via transport of contaminated soil during the main works.

4.3.1 Species-specific plans

4.3.1.1 Japanese Knotweed

According to the preferred plan for the embankment behind St Mary's Park, the Japanese Knotweed bund, created by LCCC in 2015, will have to partially moved to accommodate the embankment. It is suggested that 1/3 of bund be piled on top of the other 2/3 of the bund, and that a vertical root barrier (geotextile membrane) be installed between the Japanese Knotweed and the flood bund to prevent knotweed from growing into the flood bund and causing structural damage. This will require follow-up treatment as outlined in Section 2.1.5 above.

A key site where two extensive stands of Japanese Knotweed occurs is either side of the footbridge that crosses the ditch, close to the handball alley at the north end of Kings Island. This area will be beneath the planned embankment. After this site has been sprayed by the Invasives contractor, this soil will be considered contaminated. The area will be fenced off to prevent tracking and spread of the vegetative parts of the Japanese Knotweed, and a Geotextile membrane will be placed over the area before the embankment is emplaced.

A stand of Japanese Knotweed also occurs between Abbey View and the boat club. This is a small stand that has been sprayed in previous years. A similar approach as above should be implemented here. Refer to Figure 2-3 for locations.

4.3.1.2 Giant Hogweed

Key areas where Giant Hogweed occurs is at Sir Harry's Mall and Absolute Hotel, and from the Community Centre to the Handball alley (north west of Kings Island). Much of it occurs outside the area of the works, but some Hogweed has established along the existing path and in the drainage ditch where Opposite-leaved pondweed occurs, as well as on the water side of the existing embankment. On the western embankment, where existing sandbags, footpath, and concrete plinth along the edge of the River Shannon will be excavated and removed, any material with potential Giant Hogweed seeds (i.e. seed bank) will either be left in situ and subject to annual treatment as described in section 4.2.3.2 above or, if removal of soil material needed as part of the works, this material stored on site on top of a membrane for surveillance and treatment. The on-site ecologist can provide guidance on the best course of action for any discrete area(s) affected.

4.3.1.3 Himalayan Balsam

Key areas of Himalayan Balsam are at Sir Harry's Mall and Absolute Hotel. The north half of Kings island has extensive cover, but this is contained by the perimeter wall, outside of the immediate works area. Where works will entail entering areas of the SAC where Himalayan Balsam occurs, i.e. new wall near creche, new storm outfall and fisherman's path at north west of site, Himalayan Balsam should be hand pulled in these locations as the plant appears. Biosecurity measures will need to be followed closely.

4.3.1.4 Buddleja

Any Buddleja growing in the way of the works can be removed by hand if it does not cause damage to any structures, otherwise it can be sprayed.

4.3.2 The following methods should be employed to prevent further spread of invasive species

- Identification of designated haul routes throughout the site to avoid contamination;
- A Method Statement produced by the contractor in advance of works outlining the exact invasive plant eradication methodology and timeline.

- Training to be given to site operators and contractors prior to commencing any works via toolbox talks by a suitably qualified person/ ecologist which will detail the identification of the plant and provide an education on site practices to prevent further spread.

Best practice guidance should be referred to during invasive management works, which would include the following:

- Best Practice Management Guidelines Japanese knotweed *Fallopia japonica*, Invasive Species Ireland (2015).
- Guidelines on the Management of Noxious Weeds and Non-Native Invasive Plant Species on National Roads (Revision 1, National Roads Authority, December 2010)

4.3.3 General Biosecurity Considerations On-Site

It is important to have biosecurity measures in place to ensure that invasive species are not transported to or from the site. It is also important to consider potential pathways of introductions onto your site from elsewhere and for mitigation procedures to be put in place to prevent this.

All contractors should be fully briefed, and ensure all staff are aware of what the species looks like and the issues associated with it. This could be done through 'tool-box' talks or within site introductions. All persons working on site must understand the role and authority of the Ecology Clerk of works managing the issue of the non-native species. All contractors should provide the biosecurity protocols that they will implement when on site.

Any areas that are contaminated/infested with non-native species should be recorded within the site invasive species management plan for construction phase, isolate them with fencing and put up restricted access signs where relevant.

4.4 Cleaning equipment and machinery

It is important to maintain a good site hygiene when dealing with any non-native species:

- A fence that can be clearly seen should mark out the area of issue. Signs should be erected to warn people working there that the area is infested / contaminated.
- Where contaminated soil, materials or water are located, signage should be erected to indicate them.
- Personnel working on or between sites should ensure their clothing and footwear are cleaned where appropriate to prevent spread
- Tracked vehicles should not be used within the area of infestation.
- All vehicles leaving the infested area and / or transporting infested soil/materials must be thoroughly pressure-washed in a designated wash-down area before being used for other work.
- Where cross-contamination is possible (i.e. from one site to another), consider designating vehicles or machinery to specific sites where possible to prevent spread.
- Material / water left after vehicles have been pressure-washed must be contained, collected and disposed of appropriately.
- All chemicals used for the control of non-native species should be stored and used in a responsible manner.
- All wash facilities including wastewater from washing vehicles, equipment or personnel should be managed and disposed of at a licenced facility so as not to not cause harm to the environment.

5 Conclusions

Management is necessary to prepare the site in advance of construction works which are expected to commence from Q2 2020 following the granting of planning permission from An Bórd Pleanála.

A contractor has been appointed for the treatment of invasive species from 2019 to 2021. The Contractor must begin works by August 2019, to ready the site for works to begin in 2020. The Invasive Species Contractor has been procured to manage Japanese Knotweed, Giant Hogweed, Himalayan Balsam and Buddleja.

Prior to the commencement of treatment works, the contractor will walk through the site with JBA ecologists, to fully assess the extent of invasive species and to discuss treatment methods to be used at each location and sensitivities of relevant habitats and species. The contractor will then prepare a management plan outlining the treatment methods to be used, and this is to be agreed with JBA Consulting and Limerick CCC. On receipt of methodology from the Invasive Species contractor, an Appropriate Assessment Screening Report will be required.

As it will not be possible to ensure that all areas are free of invasive species prior to the commencement of the FRS, the contractor for the main works will also have to take measures to prevent the spread of invasive species, particularly when moving soil or machinery. Instructions for the main contractor have also been provided in this report.

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Appendices

A 2019 Invasive species survey

No.	Species	Longitude	Latitude	Comments
KS-IS1	Giant hogweed (<i>Hercleauum mantegazzianum</i>)	Lon:-8.6186228692611841	Lat:52.6691250270723046	1mx1m
KS-IS2	Giant hogweed (<i>Hercleauum mantegazzianum</i>)	Lon:-8.6186290718695311	Lat:52.6690590195848287	1mx1m+HB
KS-IS3	Himalayan balsam (<i>Impatiens glandulifera</i>)	Lon:-8.61891011170828746	Lat:52.6685649063928665	3-4plants
KS-IS4	Giant hogweed (<i>Hercleauum mantegazzianum</i>)	Lon:-8.6189195048144267	Lat:52.6684139902262629	1 plant
KS-IS5	Japanese knotweed (<i>Fallopia japonica</i>)	Lon:-8.6190978717139171	Lat:52.6675173361344875	Several plants
KS-IS6	Giant hogweed (<i>Hercleauum mantegazzianum</i>)	Lon:-8.6191429663529799	Lat:52.6675044699131192	Two plants
KS-IS7	Japanese knotweed (<i>Fallopia japonica</i>)	Lon:-8.6191430501720117	Lat:52.6669209218143166	Several plants. Few giant hogweed as well.
KS-IS8	Giant hogweed (<i>Hercleauum mantegazzianum</i>)	Lon:-8.6193312238982127	Lat:52.6667658566056431	One plant.
KS-IS9	Giant hogweed (<i>Hercleauum mantegazzianum</i>)	Lon:-8.6198075674554513	Lat:52.6665521180747689	1 plant
KS-IS10	Giant hogweed (<i>Hercleauum mantegazzianum</i>)	Lon:-8.6268811990013905	Lat:52.6684211142052376	1 plant
KS-IS11	Giant hogweed (<i>Hercleauum mantegazzianum</i>)	Lon:-8.6257562879553298	Lat:52.669338241754712	4x35m stretch along castle wall
KS-IS10	Giant hogweed (<i>Hercleauum mantegazzianum</i>)	Lon:-8.6268811990013905	Lat:52.6684211142052376	1 plant
KS-IS12	Giant hogweed (<i>Hercleauum mantegazzianum</i>)	Lon:-8.6261794902464608	Lat:52.6700260397537292	1 plant
KS-IS13	Giant hogweed (<i>Hercleauum mantegazzianum</i>)	Lon:-8.6267160158684728	Lat:52.672227689369333	Several plants
KS-IS14	Japanese knotweed (<i>Fallopia japonica</i>)	Lon:-8.6271687224587676	Lat:52.6726914849622858	Giant hog and jap
KS-IS15	Giant hogweed (<i>Hercleauum mantegazzianum</i>)	Lon:-8.6272187624207017	Lat:52.67294516326217724	Several plants. Plus HB
KS-IS16	Giant hogweed (<i>Hercleauum mantegazzianum</i>)	Lon:-8.6279831081709144	Lat:52.6737305475889457	Few plants
KS-IS17	Giant hogweed (<i>Hercleauum mantegazzianum</i>)	Lon:-8.6284231580874220	Lat:52.6741328370316637	1 plant
KS-IS18	Giant hogweed (<i>Hercleauum mantegazzianum</i>)	Lon:-8.6287108250042692	Lat:52.6744857989742172	4-5 plants
KS-IS19	Giant hogweed (<i>Hercleauum mantegazzianum</i>)	Lon:-8.6288318531082755	Lat:52.674713909278659	Several batches on current old embankment, drainage ditch and by the river.
KS-IS20	Giant hogweed (<i>Hercleauum mantegazzianum</i>)	Lon:-8.6297199223270908	Lat:52.6756792981668127	2 plants
KS-IS21	Giant hogweed (<i>Hercleauum mantegazzianum</i>)	Lon:-8.6301815462090055	Lat:52.6759060058368362	1 plant
KS-IS22	Giant hogweed (<i>Hercleauum mantegazzianum</i>)	Lon:-8.6304972600272212	Lat:52.6761636045320643	1 plant
KS-IS23	Giant hogweed (<i>Hercleauum mantegazzianum</i>)	Lon:-8.6179150083839051	Lat:52.6834655168762964	River side of old embankment
KS-IS24	Giant hogweed (<i>Hercleauum mantegazzianum</i>)	Lon:-8.6310621164819512	Lat:52.6766044507293714	1 plant
KS-IS25	Giant hogweed (<i>Hercleauum mantegazzianum</i>)	Lon:-8.6291976173560450	Lat:52.6761802591993913	Several in woodland
KS-IS26	Giant hogweed (<i>Hercleauum mantegazzianum</i>)	Lon:-8.6315919365814242	Lat:52.677314131914390	-
KS-IS27	Giant hogweed (<i>Hercleauum mantegazzianum</i>)	Lon:-8.6315664555957827	Lat:52.6775396615757359	2 plants near ditch plus several on river side of embankment
KS-IS28	Giant hogweed (<i>Hercleauum mantegazzianum</i>)	Lon:-8.6315047674894402	Lat:52.6777800964682115	Couple on the embankment several river side
KS-IS29	Giant hogweed (<i>Hercleauum mantegazzianum</i>)	Lon:-8.6312171816906247	Lat:52.6779165119423283	2 plants
KS-IS30	Giant hogweed (<i>Hercleauum mantegazzianum</i>)	Lon:-8.6307719349941525	Lat:52.6782553084685219	Several. Large patch on riverside.
KS-IS31	Japanese knotweed (<i>Fallopia japonica</i>)	Lon:-8.6285570170810715	Lat:52.6787907444431198	3mx 3m stand north. 1x 2m south.
KS-IS32	Japanese knotweed (<i>Fallopia japonica</i>)	Lon:-8.6254170723339776	Lat:52.6758160908265722	By abandon house. Large stand.
KS-IS33	Japanese knotweed (<i>Fallopia japonica</i>)	Lon:-8.6170718439764951	Lat:52.6701690590657350	1 plant
KS-IS34	Japanese knotweed (<i>Fallopia japonica</i>)	Lon:-8.6195039860448248	Lat:52.6703299834718806	1 young plant
KS-IS35	Giant hogweed (<i>Hercleauum mantegazzianum</i>)	Lon:-8.6170964211286396	Lat:52.6701713137058007	Several plants
KS-IS36	Giant hogweed (<i>Hercleauum mantegazzianum</i>)	Lon:-8.6216012109151308	Lat:52.6758919051407588	Several plants on abbey side
KS-IS37	Giant hogweed (<i>Hercleauum mantegazzianum</i>)	Lon:-8.6394383223248008	Lat:52.6804807715673320	Several well established plants on river confluence side

B 2017 Invasive species survey

B.1 Invasive Species Survey Description 2017

No	Species	Width (cm)	Height (cm)	Longitude	Latitude	Comments
East of the Island. NW of Athlunkard Boat Club						
1	Japanese Knotweed.			-8.618782	52.669728	Dead Stands, previously treated.
2	Japanese Knotweed.			-8.618782	52.669728	At Athlunkard boat club where Japanese Knotweed was treated by Limerick City and County Council (LCCC).
3	Japanese Knotweed.	14	13	-8.618803	52.669757	All new growth in this area.
4	Japanese Knotweed.	10	22	-8.618838	52.669785	
5	Japanese Knotweed.	10	13	-8.618772	52.669837	
6	Japanese Knotweed.	57	20	-8.61874	52.669878	
7	Japanese Knotweed.	14	10	-8.618772	52.669888	
8	Japanese Knotweed.	13	13	-8.61906	52.670118	
9	Japanese Knotweed.	500	17	-8.619038	52.670192	Roots excavated LCCC
10	Japanese Knotweed.	20	12	-8.618947	52.670243	
11	Japanese Knotweed.	30	10	-8.61895	52.670238	
12	Japanese Knotweed.	600	150	-8.618977	52.670632	
13	Japanese Knotweed.	500	300	-8.619073	52.670708	Approximately 3 new stands
14	Himalayan Balsam.			-8.618987	52.670777	HB Not treated in this contract.
15	Buddleia			-8.618987	52.670783	
16	Himalayan Balsam.	370	200	-8.619727	52.672485	West of path. HB Not treated in this contract.
17	Himalayan Balsam.	50	200	-8.619762	52.672587	East of path. HB Not treated in this contract.
East of Island, East of Astro turf pitch						
18	Giant Hogweed	0	0	-8.620012	52.673173	Dead Stand.
19	Himalayan Balsam.	270		-8.620205	52.673503	4804 Himalayan Balsam. growing in sandbag . HB Not treated in this contract.
20	Himalayan Balsam.	40	20	-8.620325	52.673672	Include alignment, West of path on sandbag. HB Not treated in this contract.
21	Himalayan Balsam.	300	150	-8.620948	52.674787	Include alignment, West of path on sandbag. HB Not treated in this contract.
22	Non native?	150	170	-8.621043	52.674942	Non native, blue flowers. 2 plants on

No	Species	Width (cm)	Height (cm)	Longitude	Latitude	Comments
						same side. HB Not treated in this contract.
East of Island, East of St Munchin's Street						
23	Buddleia	40	80	-8.621222	52.675247	East of path, adjacent to sandbag
24	Buddleia	90	120	-8.621182	52.675237	East of path, adjacent to sandbag
25	Buddleia	140	180	-8.621245	52.675285	West of path
26	Buddleia	400	150	-8.621262	52.675352	East of path, adjacent to sandbag
27	Buddleia	150	120	-8.621478	52.675667	
28	Buddleia	40	150	-8.621663	52.675912	
29	Buddleia	150	250	-8.621783	52.676128	
30	Buddleia	70	170	-8.62179	52.67616	
31	Buddleia	470	320	-8.621845	52.676275	Right side of path
32	Giant Hogweed	180	260	-8.622018	52.676428	
33	Giant Hogweed	260	180	-8.622303	52.676873	Left side of path
34	Himalayan Balsam.	650		-8.622705	52.677292	Himalayan Balsam growing on. 3+ plants. HB Not treated in this contract.
35	Giant Hogweed	70	30	-8.622878	52.677665	
36	Giant Hogweed	300	300	-8.623727	52.678565	
North of the Island						
37	Giant Hogweed	500	500	-8.627597	52.678992	Approx 2 plants
38	Giant Hogweed	150	200	-8.62814	52.67939	
39	Giant Hogweed	150	100	-8.628305	52.679365	No flower head.
40	Giant Hogweed	150	100	-8.628527	52.679328	
41	Giant Hogweed		200	-8.6286	52.679288	
42	Buddleia	500	300	-8.628605	52.679293	Bank adjacent to path and on opposite bank
North of the Island, Along drainage ditch, opposite bank to path , cross small bridge, near handball court						
43	Japanese Knotweed.	500	200	-8.628663	52.678713	
44	Giant Hogweed	150	150	-8.628638	52.678737	
45	Japanese Knotweed.	350	300	-8.628867	52.67866	
46	Buddleia	200	250	-8.628477	52.678717	
NW of the Island, along path						
47	Himalayan Honeysuckle	250	250	-8.629642	52.678642	
48	Buddleia	200	250	-8.629705	52.67866	on embankment sand bags
49	Himalayan Balsam.	30	80	-8.630067	52.678578	On embankment sand bags. HB Not treated in this contract.
50	Himalayan Balsam.	30	80	-8.630267	52.678512	As above, growing on sandbags. HB Not

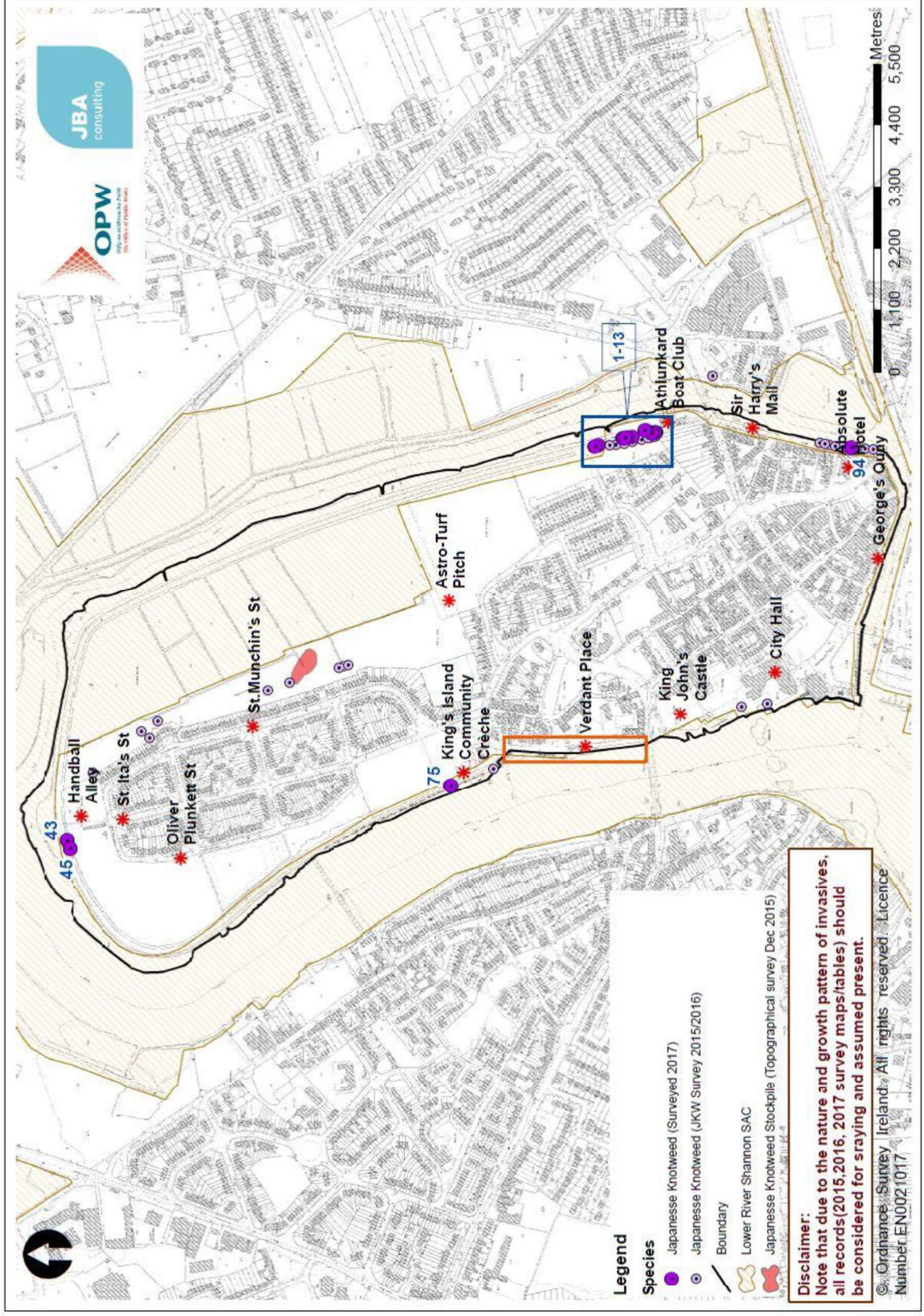
No	Species	Width (cm)	Height (cm)	Longitude	Latitude	Comments
						treated in this contract.
51	Himalayan Balsam.	30	80	-8.6303	52.678498	As above, growing on sandbags. HB Not treated in this contract.
52	Himalayan Balsam.	30	80	-8.630398	52.678412	As above, growing on sandbags. HB Not treated in this contract.
53	Giant Hogweed	100	80	-8.630667	52.678338	
54	Giant Hogweed	500	500	-8.631068	52.678098	
55	Giant Hogweed	50	50	-8.631127	52.678143	2 small new plants, growing on path, Inside of alignment
56	Giant Hogweed	50	20	-8.631185	52.678063	New, small growth on path
57	Giant Hogweed	500	500	-8.631207	52.67805	
58	Giant Hogweed	500	500	-8.631513	52.677763	Approximately 2 plants, large leaves ~70cm.
59	Giant Hogweed	350	550	-8.631635	52.677563	Approximately 3 plants, including one dead stem.
60	Giant Hogweed	50	80	-8.631625	52.677308	Growing on path.
61	Himalayan Balsam.			-8.631552	52.677033	Growing on sandbags. HB Not treated in this contract.
62	Himalayan Balsam.			-8.629725	52.67563	In drainage ditch. HB Not treated in this contract.
63	Himalayan Balsam.			-8.629657	52.675585	On embankment. HB Not treated in this contract.
West of Island, West of Oliver Plunkett St						
64	Giant Hogweed	150	200	-8.629427	52.675412	Estimated basal leaf width. Located on river bank. 3m from path.
65	Giant Hogweed	150	200	-8.629375	52.675348	Estimated basal leaf width. Located on river bank. 3m from path.
66	Giant Hogweed	150	100	-8.629007	52.674938	Broken GH (fallen over), but still alive. Leave length approximate.
67	Giant Hogweed	500	60	-8.628792	52.67488	This is a stand of several low lying young GH. A few plants within 5m stretch.
68	Giant Hogweed	50	50	-8.628763	52.674727	
69	Giant Hogweed	100	100	-8.62867	52.67469	
70	Giant Hogweed	200	300	-8.628365	52.674157	
71	Giant Hogweed	200	300	-8.627582	52.673187	
72	Himalayan Balsam.			-8.627435	52.67298	Growing on sandbank. HB Not treated in this contract.

No	Species	Width (cm)	Height (cm)	Longitude	Latitude	Comments
West of Island, near (NW) Creche						
73	Himalayan Balsam.			-8.627375	52.672977	Inside alignment (path). HB Not treated in this contract.
74	Giant Hogweed	100	250	-8.627337	52.672855	
75	Japanese Knotweed.	300	500	-8.627167	52.672727	
76	Giant Hogweed	250	150	-8.627238	52.672742	
77	Giant Hogweed	30	30	-8.627178	52.672662	
78	Himalayan Balsam.			-8.627252	52.672755	HB Not treated in this contract.
79	Himalayan Balsam.			-8.626733	52.672247	HB Not treated in this contract.
80	Himalayan Balsam.			-8.626389	52.672237	HB Not treated in this contract.
81	Himalayan Balsam.			-8.626607	52.672038	HB Not treated in this contract.
82	Himalayan Balsam.			-8.626389	52.672237	HB Not treated in this contract.
83	Himalayan Balsam.			-8.62642	52.671145	On wall, difficult to see, looks like one plant. HB Not treated in this contract.
<i>End at Thomond Bridge</i>						
West of the Island. Bank adjacent to drainage ditch						
85	Buddleia	n/a	n/a	-8.6245279	52.675273	Embankment with trimmed sides.
King John's Castle and riverwalk way towards City Hall						
84	Giant Hogweed	100-200	100-400	-8.626295	52.670073	In front of King Johns Castle along the bank. Approximately 10 or more GH plants within a 50m stretch. Use GPS point as reference.
86	Giant Hogweed			-8.638782	52.676593	
87	Giant Hogweed			-8.638782	52.676593	
88	Giant Hogweed			-8.62567	52.6692	
89	Buddleia	500	300	-8.625792	52.6687011	
				-8.625384	52.6686439	
Potato Market Carpark (from small bridge)						
90	Buddleia	2000	500	-8.6242208	52.6670494	Along the carpark wall facing the canal. Starting point. Multiple Plants.
91	Buddleia	2000	500	-8.62350841533691	52.66704559	Along the carpark wall facing the canal. Ending point. Multiple Plants.
Along George's Quay						
92	Giant Hogweed	300	300	-8.623508453	52.66704559	Along Quay Wall.
93	Buddleia	300	300	-8.62015152	52.66656113	Approximately 100m stretch. Multiple Stands.
				-8.619925499	52.66649628	
Along Absolute Hotel river walk						
94	Japanese Knotweed.	Variable	Variable	-8.619144063	52.66684344	New stand growing underneath dead stand. Approx. 75m stretch.
				-8.619190216	52.66738129	
95	Himalayan Balsam.			-8.619072914	52.66682816	HB Not treated in this

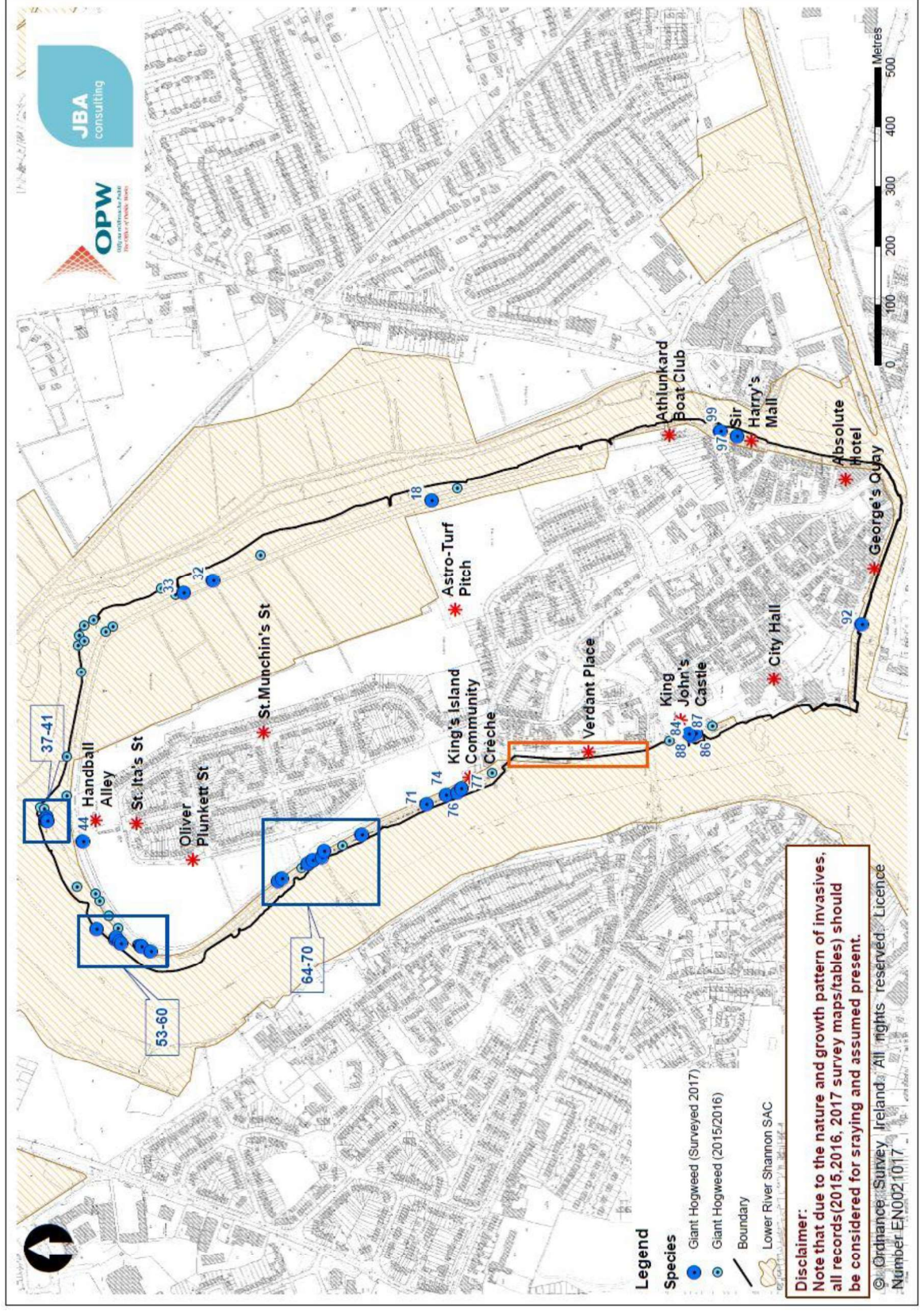
No	Species	Width (cm)	Height (cm)	Longitude	Latitude	Comments
				-8.619190216	52.66738129	contract.
Along Sir Harry's Mall						
96	Himalayan Balsam.			-8.618715286	52.66860962	Along most of the stretch . HB Not treated in this contract.
97	Giant Hogweed	250	250	-8.618715286	52.66860962	Approximately 1 stand
98	Buddleia	Variable	Variable	-8.618715286	52.66860962	Approximately 100m stretch. Multiple Stands. Along wall facing canal.
99	Giant Hogweed	250	250	-8.618715286	52.66860962	Approximately 3 stands

Disclaimer: Note that due to the nature and growth pattern of invasives, all records (2015,2016, 2017 survey maps/tables) should be considered for spraying and assumed present.

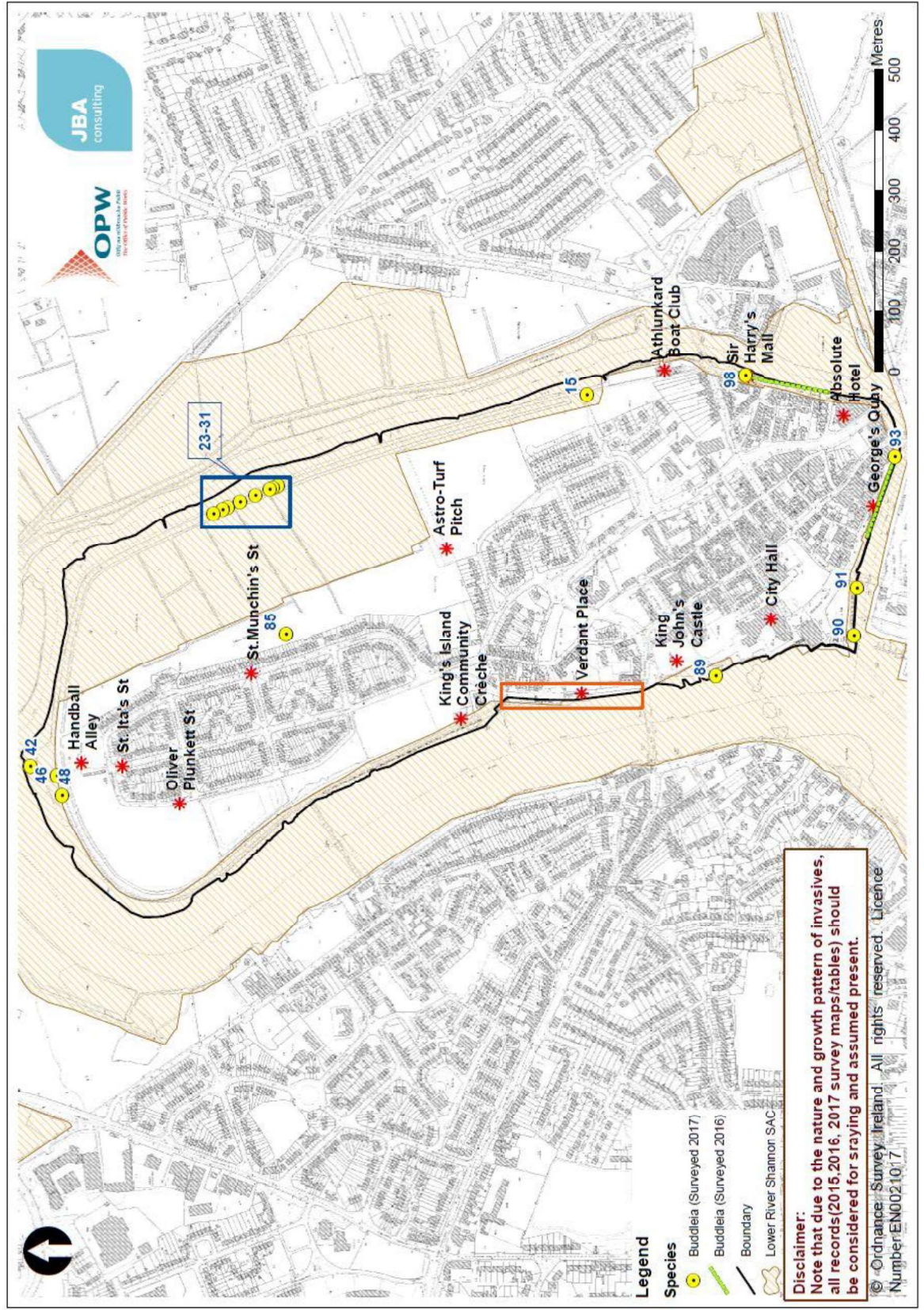
B.2 Invasive Species Survey Map 2017: Japanese Knotweed



B.3 Invasive Species Survey Map 2017: Giant Hogweed



B.4 Invasive Species Survey Map 2017: Buddleia



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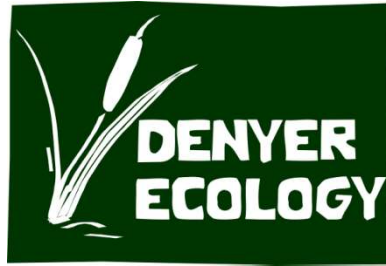
Dublin
Limerick

Registered Office
24 Grove Island
Corbally
Limerick
Ireland

t: +353 (0) 61 345463
e: info@jbaconsulting.ie

**JBA Consulting Engineers
and Scientists Limited**
Registration number 444752





KING'S ISLAND QUAY WALL BRYOPHYTE ASSESSMENT

July 2020

**Report produced by Denyer Ecology for:
JBA Consulting**

11 Dargle View, Rathfarnham, Dublin, D16 XY51, Ireland T +353 86 2379153 joanne@denyerecology.com
www.denyerecology.com

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1 INTRODUCTION

1.1 Background and aims

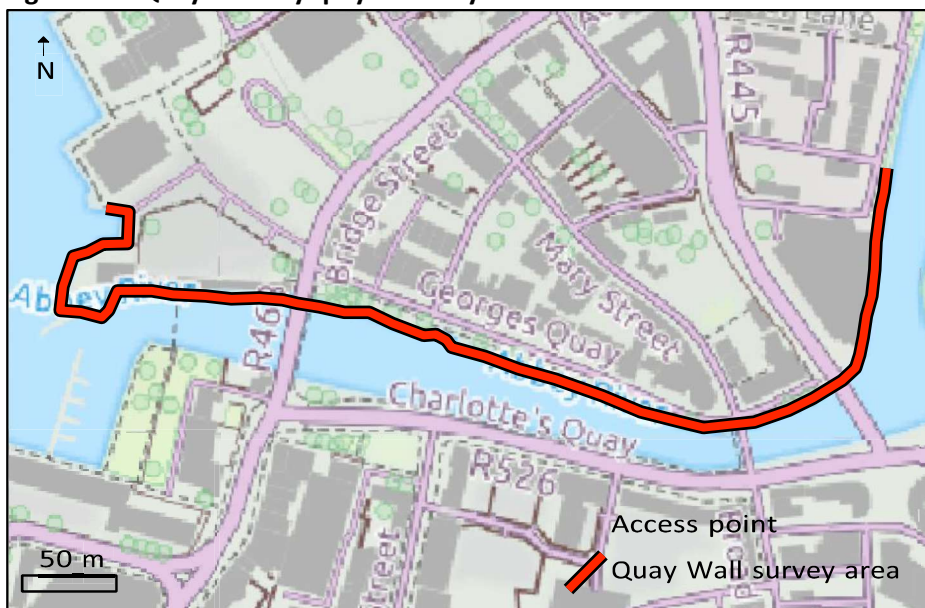
A bryophyte-rich sub-type of the Annex I habitat 'Water courses of plain to montane levels with the *Ranunculus fluitans* and *Callitriche-Batrachion* vegetation' [3260] occurs within the Lower River Shannon Special Area of Conservation (SAC). Some of the bryophyte species that indicate this habitat type have been recorded growing on sections of quay wall on King's Island, as the river is largely freshwater in this location. The proposed King's Island Flood Relief Scheme includes works to the quay walls which could potentially impact on vegetation on the walls. The aim of this assessment was to:

- Consult with relevant organisations (e.g. NPWS) and review relevant literature to clarify the identification of the 'bryophyte-rich sub-type' of the Annex I habitat 3260.
- Describe the bryophyte communities present on the quay walls.
- Use the above information to evaluate the ecological value of the quay wall bryophyte (and vascular plant) communities.
- Assess any potential impacts to the quay wall bryophyte (and vascular plant) communities
- Identify potential avoidance/ mitigation measures to protect any identified quay wall habitats of high ecological value.

1.2 Site

The survey area includes the quay wall along the southern boundary of King's Island and part of the eastern and western boundaries (Figure 1.1).

Figure 1.1. Quay wall bryophyte survey area



Maps © Thunderforest, Data © OpenStreetMap contributors

2 METHODOLOGY

2.1 Desktop information

The following resources were consulted:

- GIS boundaries of designated site data (data accessed via NPWS website).
- Aerial photography (Bing Maps).
- British Bryological Society Atlas of British and Irish bryophytes (Blockeel et al., 2014a & 2014b).
- British Bryological Society Atlas dataset
- Lower River Shannon SAC: Conservation objectives supporting document - Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitriche-Batrachion* vegetation (Habitat code 3260).

2.2 Consultation

The following organisations and individuals were consulted for this project:

- National Parks and Wildlife Service (bryophyte specialist and river specialist)

2.3 Quay wall survey

The quay wall survey was undertaken from vantage points along the quay wall due to access limitations. In one location the lower river wall was accessed via steps (Figure 1.1). Bryophyte and vascular plant species were identified to species level where possible. The focus was on species within the tidal flood zone, but some species from higher up the wall (above the high water line) were also recorded. Where relevant, habitats are referred to using the Guide to Habitats in Ireland (Fossitt, 2000), these are underlined in the text.

2.4 Ecological evaluation

The ecological importance of the survey area was assessed using the criteria listed in the *Guidelines for Assessment of Ecological Impacts of National Roads Schemes* (NRA, 2009) and the *Guidelines for Ecological Impact Assessment in the UK and Ireland* (CIEEM, 2016). The assessment was based on the presence and quality of the springs and associated species and does not taken into account fauna species.

Ecological evaluation scheme:

- International ecological importance
- National ecological importance
- County ecological importance
- Local (higher value) ecological importance
- Local (lower value) ecological importance

2.5 Plant species nomenclature

Vascular plant nomenclature will follow that of the *New Flora of the British Isles*. 4th Edition (Stace, 2019). The bryophyte nomenclature adopted by Blockeel et al. (2014a & b) is used; this is based on the *Checklist of British and Irish bryophytes* (Hill et al., 2008) with minor modifications to reflect recent taxonomic changes.

2.6 Limitations

Most of the river and walls are inaccessible. However, the main bryophyte species could be recorded from a distance by an experienced recorder as diversity is not high. The river edge and wall were accessed in one location and this verified the species present. The rare species listed for the 'bryophyte-rich sub-type' of 3260 in the Lower Shannon River SAC (NPWS, 2012) would not be expected to occur in the habitats recorded within the survey area.

3 REVIEW OF BRYOPHYTES AND ANNEX I 3260 HABITAT

Relevant information (from national and European reports and guidance documents) on the identification of 3260 Floating River Vegetation and references to bryophytes is summarised below. Key bryophyte species and information are highlighted in bold where relevant.

3.1 Interpretation manual of European Union habitats (EC, 2007)

- Water courses of plain to montane levels, with submerged or floating vegetation of the *Ranunculion fluitantis* and *Callitricho-Batrachion* (low water level during summer) or aquatic mosses.
- Plants: *R. trichophyllum*, *R. fluitans*, *R. peltatus*, *R. penicillatus* ssp. *penicillatus*, *Ranunculus penicillatus* subsp. *pseudofluitans*, *R. aquatilis*, *Myriophyllum* spp., *Callitriche* spp., *Sium erectum* (*Berula erecta*), *Zannichellia palustris*, *Potamogeton* spp., ***Fontinalis antipyretica***.
- This habitat is sometimes associated with *Butomus umbellatus* bank communities.

3.2 Article 17 report 2019 (NPWS, 2019)

- Broad definition of Annex I habitat, including **upland**, flashy, **oligotrophic**, **bryophyte** and algal-dominated rivers, to tidal reaches dominated by higher plants.
- **Low-nutrient, high-velocity river types** are associated with **high bryophyte diversity**, cascades, riffles and riparian woodland.
- Weekes et al. (2018) described four main categories of river macrophyte communities and found that **diversity** was **highest in bryophyte communities**.
- In Ireland, many river communities represent an altered state caused by anthropogenic impacts on habitats, particularly changes in hydrology and morphology. Site-specific conservation objectives for the habitat identify site-specific vegetation and other communities of high conservation value where possible (sub-types).
- High conservation value sub-types are associated with natural hydrological regimes, including functioning floodplains.
- **Typical species have not been fully defined** but may include higher plants, **bryophytes**, algae and invertebrates. The list of typical species for habitat 3260 was based on the interpretation manual of EU habitats (CEC, 2013) and is the same as that reported for the 2007-2012 cycle: *Berula erecta*, *Callitriche* spp., ***Fontinalis antipyretica***, *Myriophyllum* spp., *Potamogeton* spp., *Ranunculus aquatilis*, *Ranunculus peltatus*, *Ranunculus penicillatus*, *Ranunculus trichophyllum*, *Zannichellia palustris*.

3.3 Article 17 report 2013 (NPWS, 2013)

- Species – *Ranunculus trichophyllum*, *Ranunculus penicillatus*, *Ranunculus peltatus*, *Ranunculus aquatilis*, *Myriophyllum* spp., *Callitriche* spp., *Sium erectum* (*Berula erecta*), *Zannichellia palustris*, *Potamogeton* spp., and ***Fontinalis antipyretica***.
- The plants that are characteristic of the habitat are listed in the Interpretation Manual (EC, 2003) and include a number of *Ranunculus* species and all *Callitriche* species, including other submerged aquatic plants.
- The community *Callitricho-Batrachion* is described in White and Doyle (White and Doyle, 1982) and includes species of the *Ranunculus* subgenus *Batrachium* and two species of *Callitriche*, *C. hamulata* and *C. platycarpa* as diagnostic species.
- There are few published records for descriptions of this habitat in Ireland and no comprehensive island-wide descriptions. No specific assessments of typical species have been undertaken to date.
- **The EU (2003) definition of this habitat is very broad, especially when the presence of aquatic mosses is taken into account.** Using this broad definition, the habitat will be found in most watercourses in Ireland. Despite work by Kelleher (2011), there is to date no accepted definition of this habitat, its sub-types and their distribution in Ireland.

- The description of habitat 3260 is broad, covering rivers from **upland bryophyte** and macroalgal **dominated stretches**, to lowland depositing rivers with pondweeds and starworts (EC, 2007; Hatton-Ellis and Grieve, 2003). Selection of Special Areas of Conservation for the habitat in Ireland has used this broad interpretation. Thus, it must be recognised that a number of sub- types of this habitat exist in Ireland. As in the UK, it is considered that the habitat as defined is too broad for a single set of conservation guidelines to cover it (Hatton-Ellis and Grieve, 2003).

3.4 Irish National Vegetation Classification scheme for aquatic river macrophytes (Weekes et al., 2018)

- This describes four main river vegetation categories: 1) Bryophyte-dominated aquatic vegetation; 2) bryophyte-dominated marginal vegetation; 3) vascular plant-dominated aquatic vegetation; and, 4) vascular plant-dominated marginal/ emergent vegetation.
- 46% of plots were bryophyte-dominated communities.
- There is no discussion of the affinity of the vegetation categories or communities with Annex I 3260 vegetation.

3.5 Irish Vegetation Classification – FW2 *Ranunculus penicillatus-Fontinalis antipyretica* group The aquatic vegetation communities within the *Ranunculus penicillatus-Fontinalis antipyretica* group of the Irish Vegetation Classification are summarised in Table 3.1 below. This uses information in the full synopsis for each aquatic community (available to download from <https://www.biodiversityireland.ie/projects/national-vegetation-database/irish-vegetationclassification/explore/>).

Table 3.1. Summary of key characteristics of Irish Vegetation Classification FW2 communities

Community name and code	Vegetation and key species*	Annex I correspondence	Conservation value
FW2a: <i>Fontinalis antipyretica</i> – <i>Myriophyllum alterniflorum</i> aquatic community	Species-poor, bryophyte-dominated aquatic community. <i>Fontinalis antipyretica</i> is the only constant species and can form extensive submerged or floating patches. The most likely other bryophytes to be seen here are <i>Rhynchostegium riparioides</i> , <i>Leptodictyum riparium</i> and <i>Chiloscyphus polyanthos</i> . In the more nutrient-poor acidic streams of the uplands, <i>Fontinalis squamosa</i> may be found.	No significant correspondence	This is a species-poor community of relatively low intrinsic conservation value
FW2b: <i>Rhynchostegium riparioides</i> – <i>Chiloscyphus polyanthos</i> aquatic community	Bryophytes dominate this aquatic community and vascular plants seldom occur. <i>Rhynchostegium riparioides</i> is the only constant species. The liverwort <i>Chiloscyphus polyanthos</i> and the moss <i>Fontinalis antipyretica</i> are also frequent components. <i>Conocephalum conicum</i> , <i>Pellia endiviifolia</i> and <i>Marchantia polymorpha</i> are occasionally found. Nutrient-poor, acidic streams in the uplands favour <i>Scapania undulata</i> and <i>Fontinalis squamosa</i> , the latter of which can grow abundantly in those waters. Conversely, in more base-rich situations, <i>Cratoneuron filicinum</i> can dominate.	No significant correspondence	This is a fairly bryophyte-rich community but typically of relatively low conservation value.

Community name and code	Vegetation and key species*	Annex I correspondence	Conservation value
FW2c: <i>Ranunculus penicillatus</i> – <i>Fontinalis antipyretica</i> aquatic community	Mid-channel expanses of the floating leaves of <i>Ranunculus penicillatus</i> (subsp. <i>penicillatus</i>) are the key feature of this aquatic community. <i>Fontinalis antipyretica</i> is also a constant species in the channel but is never abundant <u>Constant species</u> <i>Ranunculus penicillatus</i> (V) <i>Fontinalis antipyretica</i> (V) <u>Additional bryophytes</u> <i>Leptodictyum riparium</i> (I) <i>Rhynchostegium riparioides</i> (I) <i>Chiloscyphus polyanthos</i> (I) <i>Fontinalis squamosa</i> (I) <i>Marchantia polymorpha</i> (I) <i>Scapania undulata</i> (I)	3260 Floating river vegetation	‘Due to the relative abundance of crowfoots (<i>Ranunculus</i> spp. subgenus <i>Batrachion</i>) almost all examples of this community correspond with the EU HD Annex I habitat 3260 Floating river vegetation’
FW2D: <i>Apium nodiflorum</i> – <i>Ranunculus penicillatus</i> aquatic community	This aquatic community has a notable floating-leaf component, with <i>Ranunculus penicillatus</i> (subsp. <i>penicillatus</i>) a constant species, as is <i>Fontinalis antipyretica</i> . <u>Constant species</u> <i>Apium nodiflorum</i> (V) <i>Ranunculus penicillatus</i> (V) <i>Fontinalis antipyretica</i> (IV) <i>Callitriche stagnalis</i> (IV) <u>Additional bryophytes</u> <i>Leptodictyum riparium</i> (III) <i>Rhynchostegium riparioides</i> (III)	3260 Floating river vegetation	‘Almost all examples of this community with a relative abundance of crowfoots (<i>Ranunculus</i> spp. subgenus <i>Batrachion</i>) correspond with the EU HD Annex I habitat 3260 Floating river vegetation.’
FW2E: <i>Apium nodiflorum</i> – <i>Rorippa nasturtium-aquaticum</i> agg. aquatic community	Variable community of watercourses in which a variety of species can dominate. <i>Apium nodiflorum</i> and <i>Rorippa nasturtium-aquaticum</i> agg. are constants and lend a strong forb element to the rather diverse marginal/emergent vegetation. Bryophyte element usually consists of <i>Leptodictyum riparium</i> , <i>Fontinalis antipyretica</i> and <i>Rhynchostegium riparioides</i> . <u>Constant species</u> <i>Apium nodiflorum</i> (IV) <i>Rorippa nasturtium-aquaticum</i> agg. (IV) <u>Additional bryophytes</u> <i>Leptodictyum riparium</i> (III) <i>Fontinalis antipyretica</i> (III) <i>Rhynchostegium riparioides</i> (II) <i>Pellia endiviifolia</i> (I) <i>Brachythecium rivulare</i> (I) <i>Brachythecium plumosum</i> (I) <i>Fissidens crassipes</i> (I) <i>Cinclidotus fontinaloides</i> (I) <i>Brachythecium rutabulum</i> (I)	3260 Floating river vegetation	‘Almost all examples of this community with a relative abundance of crowfoots (<i>Ranunculus</i> spp. subgenus <i>Batrachion</i>) correspond with the EU HD Annex I habitat 3260 Floating river vegetation.’

Community name and code	Vegetation and key species*	Annex I correspondence	Conservation value
FW2F: <i>Potamogeton pectinatus</i> – <i>Myriophyllum spicatum</i> aquatic community	<i>Potamogeton pectinatus</i> dominant and the only constant species	1150 Lagoons* / 3150 Eutrophic lakes (not 3260)	'Many examples of this community occur in water bodies that qualify as EU HD Annex I priority habitat 1150 Lagoons.'

*Nomenclature as per IVC classification where some older names are used

3.6 Review of Floating River Vegetation in Ireland (Kelleher, 2011)

- This review states that the data from current work and from previous studies does not aid habitat definition in the traditional phytosociological and objective sense and so a more subjective approach is necessary.
- Floating River Vegetation definition can be restricted to that given by White and Doyle (1982) as the *Callitricho–Batrachion* community which includes species of the *Ranunculus* subgenus *Batrachium* and two species of *Callitriche*, *C. hamulata* and *C. platycarpa* as diagnostic species.
- There are two dominant species of *Ranunculus* in FRV in the Republic of Ireland, these are *R. penicillatus* and *R. peltatus*.
- This review states that a more accurate definition of FRV habitat is required as current habitat descriptions could be interpreted as including '*almost all watercourses as Fontinalis antipyretica is found in flowing water aquatic habitats*'. '*For conservation purposes it is necessary to be able to define more accurately the habitat so that optimal conditions can be determined.*' '*If the definition of the Callitricho- Batrachion from White and Doyle (1982) is used for FRV in an Irish context, the number of watercourses can be narrowed and a more meaningful and manageable definition of the habitat is possible.*' Therefore this review takes an approach that FRV definition should be based on vascular plants and the *RanunculusBatrachium* distribution.

3.7 White and Doyle (1982)

- Briefly describe a range of aquatic plant communities, including the *Callitricho-Batrachion* community. The diagnostic species are listed as *Ranunculus* sub-genus *Batrachium*, *Callitriche hamulata* and *C. platycarpa*. *Potamogeton perfoliatus* and *Myriophyllum* sp. are listed as associate species. In addition, some alliances within the Pondweed class (*Potametea*) would fit the broad approach to classification of this habitat. Any bryophyte component is not listed.

3.8 JNCC (UK) Background to 3260 SAC Site selection

- This habitat type is characterised by the abundance of water-crowfoots *Ranunculus* spp., subgenus *Batrachium* (*Ranunculus fluitans*, *R. penicillatus* ssp. *penicillatus*, *R. penicillatus* ssp. *pseudofluitans*, and *R. peltatus* and its hybrids).
- There are several variants of this habitat in the UK. In each, *Ranunculus* species are associated with a different assemblage of other aquatic plants, such as *Rorippa nasturtiumaquaticum*, *Callitriche* spp., *Sium latifolium* and *Berula erecta*, *Myriophyllum* spp. and *Myosotis scorpioides*. In some rivers, the cover of these species may exceed that of *Ranunculus* species.
- Sub-type 1 is found on rivers on chalk substrates. The community is characterised by *Ranunculus peltatus* (spring-fed headwater streams), *R. penicillatus* ssp. *pseudofluitans* (middle reaches), and *R. fluitans* (downstream sections). *Ranunculus* is typically associated in the upper and middle reaches with *Callitriche obtusangula* and *C. platycarpa*.

- Sub-type 2 is found on other substrates, ranging from lime-rich substrates, through soft sandstone and clay to more mesotrophic and oligotrophic rocks. Faster-flowing western rivers on harder rocks support *Ranunculus penicillatus* ssp. *penicillatus*, while western and northern rivers on sandstone or alluvial substrates often support both *R. penicillatus* ssp. *penicillatus* and *R. fluitans*. Elsewhere in the UK they contain a mixture of species, and hybrids, but rarely support *R. penicillatus* ssp. *penicillatus* or *R. fluitans*. Associated species include *Berula erecta*, *Callitriche obtusangula*, *Potamogeton crispus*, *P. pectinatus* and *Zannichellia palustris*. *Butomus umbellatus* is an occasional bank-side associate.
- Sub-type 3 is a mesotrophic to oligotrophic community found on **hard rocks in the north and west**. Rivers in Wales, Northern Ireland and south-west England are significant for the occurrence of *Ranunculus penicillatus* ssp. *penicillatus*. Other typical species include the ***Fontinalis squamosa***, *Myriophyllum alterniflorum* and *Callitriche hamulata*. More oligotrophic examples of this community lack *Ranunculus* spp. and are dominated by *M. alterniflorum*, *C. hamulata* and *Potamogeton polygonifolius*.
- 3260 is widespread in Europe, though examples on chalk (sub-type 1) are rare
- 3260 is widespread in rivers in the UK, especially on softer and more mineral-rich substrates.

3.9 Classification of 3260 vegetation communities in the United Kingdom

The 'Ecology of Watercourses Characterised by Ranunculion fluitantis and Callitriche-Batrachion Vegetation' (Hatton-Ellis & Grieve, 2003) is an account of the ecological requirements of watercourses characterised by Floating River Vegetation that was produced as part of Life in UK Rivers project. This work was carried out using only British data, but the authors aim is that the classification can provide a broad framework within Europe, until more detailed analysis is available from other member states. There are differences between the UK and Ireland, for instance some species have different habitat preferences in the two geographic areas. An example is *Ranunculus penicillatus* subsp. *penicillatus*, which occurs only in base-poor water in Britain, whereas in Ireland it has a much broader ecological tolerance and distribution. ^[L]_{SEP}

The publication classifies six Floating River Vegetation (*Callitriche-Batrachion*) communities:

CB1: Lowland, low-gradient *Potamogeton/Sagittaria* eutrophic river community

CB2: Base-rich *Ranunculus penicillatus* ssp. *pseudofluitans*-*Callitriche obtusangula* rivers, including chalk streams

CB3: Large *Ranunculus* rivers

CB4: Smaller meso-eutrophic rivers

CB5: **Atlantic bryophyte** *Callitriche hamulata*/*Ranunculus penicillatus* ssp. *penicillatus* rivers

CB6a: Slow-flowing, base-poor rivers

CB6b: **Fast-flowing, bryophyte-dominated rivers**

3.10 Irish SAC Conservation Objectives

Published Conservation Objectives are available for a number of SACs which have Floating River Vegetation 3260 as a Qualifying Interest (listed in NPWS, 2019). These have been summarised in Table 3.2 and any mention of bryophytes/ bryophyte species/ bryophyte rich 'sub-types' highlighted.

Table 3.2. 3260 bryophyte communities listed in SAC conservation objectives

SAC site and code	Conservation objectives document	Specific bryophyte reference in relation to 3260	Bryophyte species associated with 3260
Slaney River Valley SAC 000781	Version 1 (2011)	No	n/a
River Barrow and River Nore SAC 002162	Version 1 (2011)	Tufaceous sub-type of with bryophytes	None listed

SAC site and code	Conservation objectives document	Specific bryophyte reference in relation to 3260	Bryophyte species associated with 3260
Lower River Shannon SAC 002165	Version 1 (2012)	Bryophyte rich-sub-type identified. (See section 3.11 for more detail)	<i>Schistidium platyphyllum</i> , <i>Philonotis caespitosa</i> , <i>Cinclidotus riparius</i> , <i>Ephemerum crassinervium</i> subsp. <i>rutheanum</i> . <i>Ephemerum cohaerens</i> , <i>Fissidens monguillonii</i> , <i>Fontinalis antipyretica</i> , <i>Platyhypnidium riparioides</i> , <i>Sciuro-hypnum plumosum</i> , <i>Cinclidotus fontinaloides</i> , <i>Hygroamblystegium tenax</i> , <i>Aneura pinguis</i> , <i>Fissidens crassipes</i> , <i>Racomitrium affine</i> , <i>Chiloscyphus polyanthos</i> , <i>Fissidens viridulus</i> , <i>Leptodictyum riparium</i> , <i>Trichostomum brachydontium</i> and <i>Scapania undulata</i> .
Blackwater River (Cork/Waterford) SAC 002170	Version 1 (2012)	No	n/a
Black Head-Poulsallagh Complex SAC 000020	Version 1 (2014)	Caher River (groundwater fed) on limestone and with tufa deposits.	Upper sections of river with <i>Fontinalis antipyretica</i> . Lower sections with tufa spring species. Fringing bryophyte communities are an integral part of the structure and functioning of river systems.
Connemara Bog Complex SAC 002034	Version 1 (2015)	No	n/a
The Gearagh SAC 000108	Version 1 (2016)	'It is likely that the river and stream channels, which are almost entirely within the woodland, have limited vascular plants and are dominated by bryophytes.'	<i>Fontinalis antipyretica</i> , <i>Leskea polycarpa</i> , <i>Brachythecium rivulare</i> , <i>Calliergon cordifolium</i> , <i>Climacium dendroides</i> , <i>Conocephalum conicum</i> , <i>Hygroamblystegium tenax</i> , <i>Leskea polycarpa</i> , <i>Pellia epiphylla</i> , <i>Rhizomnium punctatum</i> and <i>Sciuro-hypnum plumosum</i> , <i>Riccia cavernosa</i>
Lough Corrib SAC 000297	Version 1 (2017)	'Any high conservation value sub-types in the SAC will be associated with natural, fast and highly variable flows.' Mentions 'Bryophyte-rich and tufaceous streams and rivers' but these also correspond to Annex I 7220 habitat.	n/a

SAC site and code	Conservation objectives document	Specific bryophyte reference in relation to 3260	Bryophyte species associated with 3260
Killarney National Park, Macgillycuddy's Reeks and Caragh River Catchment SAC 000365	Version 1 (2017)	High conservation value rivers include those associated with waterfalls/cascades and important bryophyte and fern communities.	n/a
Owenduff/Nepin Complex SAC 000534	Version 1 (2017)	The SAC was selected for a species-poor sub-type dominated by bryophytes and algae and with limited vascular plants.	<i>Bryum riparium</i>
Glanmore Bog SAC 001879	Version 1 (2017)	The rivers and streams are generally fast-flowing, with cascades and waterfalls, and are likely to be dominated by macroalgae and bryophytes, with limited submerged or emergent higher plant	A number of Near Threatened bryophytes of damp rock near streams and waterfalls are known to occur in the SAC [however these are not 3260 species]
Mweelrea/Sheeffry/Erriff Complex SAC 001932	Version 1 (2017)	No	<i>Fissidens viridulus</i> , <i>Fontinalis squamosa</i> , <i>Hygrohypnum duriusculum</i> , <i>Bryum riparium</i> and <i>Fissidens serrulatus</i>
Cloghernagore Bog and Glenveagh National Park SAC 002047	Version 1 (2017)	Yes. The rivers and streams are generally fast-flowing, with cascades and waterfalls, and are likely to be dominated by macroalgae and bryophytes.	<i>Schistidium agassizii</i>
Lower River Suir SAC 002137	Version 1 (2017)	Some fast-flowing rivers occur that should, naturally, be dominated by macroalgae and bryophytes	No known records for rare or threatened bryophytes from the rivers in the SAC
Moyree River System SAC 000057	Version 1 (2017)	No	n/a

3.11 Lower River Shannon SAC

Three high conservation elements (sub-types) have been identified for this the site:

1. *Groenlandia densa*
2. *Schoenoplectus triqueter*
3. **Bryophyte-rich streams and rivers**

The first two sub-types are associated with tidal reaches of rivers, while the **latter sub-type** (3) is found in **fast-flowing stretches of unmodified streams and rivers**. In addition to these three subtypes, it is likely that other high-conservation value sub-types exist within the site. Further investigation of all sub-types is required.

- The bryophyte sub-type is associated with natural, fast and highly variable flows. Groundwater discharges may be important in some areas of the bryophyte-rich sub-type.
- A rich bryophyte flora has been recorded from the Bilboa River, Mulkear catchment, particularly the steeply graded section above the confluence of the Gortnageragh River. Two

RDB species recorded are *Schistidium platyphyllum* Vulnerable (VU) and *Philonotis caespitosa* Near Threatened (NT) (Lockhart et al., 2012). The bryophyte-rich habitat was found in mature, relatively undisturbed, river stretches of 10-12 m, occasionally up to 20 m, wide. The mapped sub-type extends of c 13km. The bryophyte flora of the Bilboa River requires conservation of riparian woodland in order to maintain humid conditions.

- A bryophyte-dominated community was also recorded in the narrower (1-4 m wide) channels in the Mulkear system.
- *Cinclidotus riparius* was recorded in the River Fergus near Ennis in 1884 by S.A. Stewart, but on all recent field visits, the water level has been too high to allow comprehensive searches (Lockhart et al., 2012). This species, in particular, requires further investigation in the Fergus and in other nearby rivers, lakes and turloughs.
- There are likely to be other stretches with bryophyte-rich sub-types. *Ephemerum crassinervium* subsp. *rutheanum* (NT) and *Ephemerum cohaerens* (VU) are two mud-dwelling mosses associated with the draw-down zones of lowland rivers and lakes. These are both known from the River Shannon upstream of the SAC. *Fissidens monguillonii* (NT) is also associated with marginal fine substrata of rivers and lakes, that is known from two locations on the River Shannon: near Carrick-on-Shannon and the Shannon Callows.
- *Fontinalis antipyretica* (characteristic species of 3260) is an aquatic generalist that can be found from some metres depth in lakes to periodically inundated areas (Lockhart et al., 2012).
- *Schistidium platyphyllum* and *Philonotis caespitosa* are found on in-stream boulders in the Bilboa river.
- Common aquatic bryophytes species in the bryophyte rich sub-type include: *Cinclidotus fontinaloides*, *Fontinalis antipyretica*, *Platyhypnidium riparioides*, *Racomitrium affine*, *Sciurohypnum plumosum* and occasionally *Aneura pinguis*, *Chiloscyphus polyanthos*, *Fissidens crassipes*, *F. viridulus*, *Hygroamblystegium tenax*, *Leptodictyum riparium*, *Scapania undulata* and *Trichostomum brachydontium*. *Ranunculus penicillatus* is the most widespread associated vascular plant.

3.12 Key points from review

- Typical species for 3260 in Ireland have not been fully defined. The current species list (NPWS, 2019) only includes one bryophyte. *Fontinalis antipyretica*, which is typical of mesotrophic to eutrophic waters, often in lowland watercourses. Species of upland bryophyte dominated watercourses are not defined in the latest Article 17 report (NPWS, 2019).
- The typical species lists (NPWS, 2019; EC, 2007) do not mean that one of these species on its own (e.g. *Fontinalis antipyretica*) would constitute 3260.
- Bryophyte dominated aquatic communities are frequent in Ireland, particularly in upland eroding watercourses. The aquatic moss dominant type of 3260 usually refers to upland eroding rivers with oligotrophic water, high flow and high cover and diversity of bryophytes.
- Where lowland, depositing, watercourses have been listed as a 'bryophyte rich sub-type' of 3260 in Ireland, this is because of the presence of one or more rare or protected species.
- Some reviews and data sources do not include bryophyte dominated watercourses as having affinity with 3260 and require vegetation with vascular plants within *Ranunculus* (subgenus *Batrachium*) to be present. However, the Irish national approach (Article 17 report definitions) does include bryophyte dominated upland eroding watercourses and those which are considered a 'bryophyte rich sub-type'. The classification system developed in the UK (Hatton-Ellis & Grieve, 2003) for 3260 does include one bryophyte dominant community: 'Fast-flowing, bryophyte-dominated rivers' (CB6b).

4 QUAY WALL VEGETATION COMMUNITIES

The quay walls Stone walls and other stonework (BL1) within the survey area support a vascular plant and bryophyte flora. The river is tidal in this location, but largely freshwater Depositing/lowland rivers (FW2). The plant communities are zoned according to their location on the wall and hence tidal influence. Additional example photographs of each of the zones are shown in Appendix A.

4.1 Algal zone

The zone lowest on the wall, which has the greatest submergence period, is dominated by algae (Photograph 4.1). In many areas this also grades into the aquatic bryophyte zone (shown as red and orange arrows in Appendix A).

Photograph 4.1. Example of algal zone on quay wall (orange arrow)



4.2 Aquatic bryophyte zone

The aquatic bryophyte zone is usually above the algal zone, but sometimes the algal zone is absent/sparse, or the aquatic bryophytes grow within the algal zone (see photographs in Appendix A and Photograph 4.2). The aquatic bryophyte species recorded within this zone are:

Cinclidotus fontinaloides (locally abundant)

Fontinaloides antipyretica (locally abundant)

Platyhypnidium plumosum

Sciuro-hypnum plumosum

In addition, some non-aquatic bryophyte species occurred at the top of this zone and are probably intermittently inundated (Photograph 4.2):

Bryum capillare

Didymodon rigidulus

Orthotrichum cupulatum

Schistidium apocarpum

Photograph 4.2. Example of aquatic bryophyte zone on quay wall (red arrows) and non-aquatic bryophytes at the top of the high water line (green arrow)



4.3 Dry wall bryophytes

Above the high-water line, particularly on the tops of the walls, there is a community of 'dry wall' bryophytes. Species present include:

Brachythecium rutabulum

Orthotrichum anomalum

Bryum capillare

Orthotrichum cupulatum

Didymodon rigidulus

Schistidium crassipilum

Grimmia pulvinata

Schistidium apocarpum

Homalothecium sericeum

Tortula muralis

Photograph 4.3. Example of 'dry wall' bryophyte zone (blue arrow)



4.4 Tall-herb swamp vascular plant zone

Plants typical of wetlands such as Tall-herb swamps (FS2) are locally frequent along the quay wall. These occur throughout the upper tidal range of the river, either growing in small flat areas which are inundated at high tide (Photograph 4.4) or directly from the wall itself (see additional photographs in Appendix A). Species typical of dry walls (usually non-native species) are frequent above the high water level.

Typical wetland species:

Alnus glutinosa (Alder)
Angelica sylvestris (Wild Angelica)
Caltha palustris (Marsh-marigold)
Filipendula ulmaria (Meadowsweet)
Jacobaea aquatica (Marsh Ragwort)
Lythrum salicaria (Purple-loosestrife)
Mentha aquatica (Water Mint)
Myosotis scorpioides (Water Forget-me-not)
Oenanthe crocata (Hemlock Water-dropwort)
Phragmites australis (Common Reed)
Rumex crispus subsp. *uliginosus* (Curled Dock)
Salix cinerea (Grey Willow)
Scrophularia auriculata (Water Figwort)

Invasive (non-native) vascular plants:

Impatiens glandulifera (Indian/ Himalayan Balsam)
Heracleum mantegazzianum (Giant Hogweed)

Dry wall species:

Asplenium scolopendrium (Hart's-tongue)
Buddleja davidii (Butterfly-bush)
Centranthus ruber (Red Valerian)
Cymbalaria muralis (Ivy-leaved Toadflax)
Erigeron karvinskianus (Mexican Fleabane)
Parietaria judaica (Pellitory-of-the-wall)

Photograph 4.4. Marsh/ tall-herb swamp plants by river (yellow arrows)



5 ECOLOGICAL EVALUATION OF QUAY WALL VEGETATION COMMUNITIES

5.1 Algal zone

No affinity with any Annex I habitat. Likely to be able to rapidly recolonise new/ disturbed substrates. Local (low) ecological value.

5.2 Aquatic bryophyte zone

The quay walls support an aquatic bryophyte flora with some species typical of Floating River Vegetation (3260) Annex I habitat: *Cinclidotus fontinaloides*, *Fontinalis antipyretica*, *Platyhypnidium riparioides* and *Sciuro-hypnum plumosum*. However, the presence of these species alone does not indicate 3260 habitat. The review in Section 3 shows that bryophyte dominated 3260 typically has one or more of the following characteristics:

- Upland eroding rivers with oligotrophic water and high flow.
- High cover and diversity of bryophytes.
- Boulders present in-channel.
- Presence of one or more rare or protected species.
- Presence of at least one species within *Ranunculus* (subgenus *Batrachium*).

The river section within the survey is a lowland depositing river. It does not have the high, variable, flow or structure (in-channel and marginal boulders) of bryophyte dominant upland eroding rivers. No rare or protected bryophyte species were recorded from the quay walls within the survey area. Although full access was not possible for the survey, the rare/ protected bryophyte species recorded from within the Lower River Shannon SAC (and which indicate the 'bryophyte-rich sub-type) are not highly likely to occur in this habitat. Bryophytes are of low cover in the overall channel as they are restricted to the quay walls. Therefore, the aquatic bryophyte zone is not considered to be an example of the Annex I habitat 3260. However, it does have affinity with this habitat, is part of an SAC river system (for which 3260 is a Qualifying Interest) and functions as an ecological link/ corridor through the city in this part of the SAC. County ecological value.

5.3 Dry wall bryophyte zone

The bryophytes present in the dry wall areas do not have affinity with any Annex I habitat and no rare or protected bryophyte species were recorded. They do however form an important part of the urban biodiversity in this area. Local (high) ecological value.

5.4 Tall-herb swamp vascular plant zone

The tall-herb swamp vegetation present on the walls and exposed mud in shallow areas by the walls has affinity with the Annex I habitat 6430 *Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels*. At least five indicator species from this habitat are present: *Angelica sylvestris*, *Filipendula ulmaria*, *Lythrum salicaria*, *Mentha aquatica* and *Myosotis scorpioides*. It is mostly a narrow strip or scattered plants and does not cover a significant area. However, it does have affinity to this habitat and is typical of river marginal habitat in less modified sections of the riverbank to the north and south of the city and elsewhere within the Lower River Shannon SAC. It forms an important part of the urban biodiversity in this area. The Annex I habitat 6430 is not a Qualifying Interest for the Lower River Shannon SAC. Local (high) ecological value.

6 RECOMMENDATIONS

Works are proposed to the quay walls associated with the King's Island Flood Relief Scheme. The works should be designed to maintain the distribution of habitats of ecological value, maintain urban biodiversity and to maintain species diversity and distribution throughout this area of the SAC. A number of recommendations for each zone are summarised below:

6.1 Algal zone

- No recommendations. Vegetation likely to quickly recolonise any disturbed/ replaced sections of quay wall.

6.2 Aquatic bryophyte zone

- Retain where possible and maintain distribution and species diversity throughout area.
- If not possible to preserve all current areas of aquatic bryophyte vegetation, then the aim should be to retain some areas of bryophytes (of all species) throughout the survey area and to ensure that any replaced stonework is suitable for bryophyte recolonisation.
- Bryophytes do not have roots and attach to stonework/ mortar by rhizoids (small root-like structures). This means that they can quickly recolonise surfaces where the surface is suitable (e.g. not too smooth). Any replaced stonework should be of a similar texture to the existing stone to promote re-establishment of the aquatic bryophyte flora.
- If some stonework needs to be removed, then the species are likely to survive temporary removal and replacement.
- The bryophytes are present both on the stonework and on the mortar between the stones. If the mortar is being replaced, then retain the bryophytes on the stonework. If the stonework is being cleaned, then maintain some bryophytes on the mortar.

6.3 Dry wall bryophyte zone

- Retain where possible and maintain distribution and species diversity throughout area.
- Ensure that any new stonework has a similar texture to the present stonework to ensure rapid re-colonisation of bryophytes on any new surfaces.
- Stonework with bryophytes present can be removed and replaced if required.

6.4 Tall-herb swamp vascular plant zone

- Retain where possible and maintain distribution and species diversity throughout area.
- Retain suitable niches at the river edge (raised, shallow areas exposed at low tide) and areas within the stonework which are suitable for vascular plant growth. This will enable rapid recolonisation of any disturbed/ repaired/ replaced stonework and other substrates.

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**KING'S ISLAND FLOOD RELIEF SCHEME:
ASSESSMENT OF POTENTIAL *GROENLANDIA DENSA*
ENHANCEMENT SITES**

September 2020

**Report produced by Denyer Ecology for:
JBA Consulting**

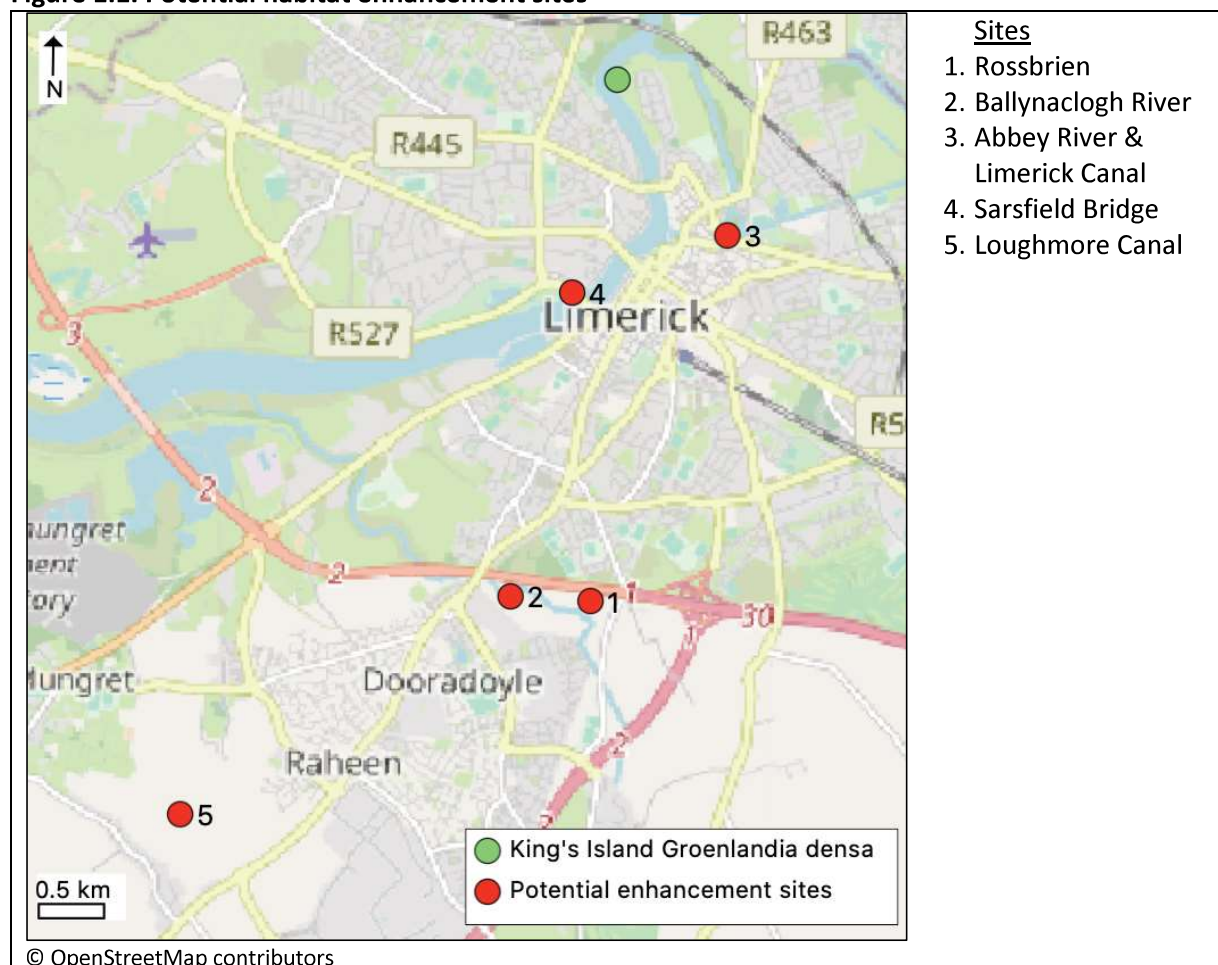
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Site name	Limerick CCC ownership	Grid reference	Date last recorded*	Notes	Rank
Near Sarsfield Bridge	Yes	R5757	1993	Unknown if <i>Groenlandia densa</i> has been recorded recently or if suitable habitat still present within LCC owned lands.	3
Loughmore Canal	Part of site	R5453	2006 (NPWS), possibly additional records	Translocation plan created for proposed dredging, but this may not have yet been undertaken. Not clear if <i>Groenlandia densa</i> is present in LCC owned part of the canal.	4

*from NPWS records for *Groenlandia densa* (supplied to Denyer Ecology in 2018)

Figure 1.1. Potential habitat enhancement sites



2 METHODOLOGY

2.1 Section 21 Licence

A 'Licence to Take or Interfere with Protected Plant Species' under Section 21 of the Wildlife Act in relation to the aquatic plants: Opposite-leaved Pondweed *Groenlandia densa* was obtained from NPWS [Licence No. FL01/2020] before any in-channel aquatic macrophyte surveys were undertaken. A detailed methods statement was submitted to NPWS.

2.2 Desktop information

The following resources were consulted:

- GIS boundaries of designated site data (data accessed via NPWS website).
- Site synopsis and Conservation Objectives for the Lower River Shannon SAC [site code 002165] (NPWS, 2013; 2012b)
- Aerial photography (Bing maps).
- Records of *Groenlandia densa* in County Limerick held by National Parks and Wildlife Service (NPWS).
- *A survey of rare and scarce vascular plants in County Limerick* (Reynolds et al., 2006).
- *Flora of County Limerick* (Reynolds, 2013).
- Additional publications and documents cited in text where relevant.

2.3 Consultation

The following organisations and individuals were consulted for this project:

- National Parks and Wildlife Service

2.4 Field survey

The entire length of the drainage ditch(es)/ river channels at each selected site were walked to determine the extent and abundance of the *Groenlandia densa* population.

The location of populations of *Groenlandia densa* were mapped using GPS. Where the plant was easily visible from the bank, grapnel sampling was not be necessary. A grapnel was only used where no plants of *Groenlandia densa* were visible from the bank, to assess whether any plants were actually present.

The survey focused on *Groenlandia densa*, but any other species of aquatic macrophytes (submerged and floating) present were recorded.

The following habitat information was recorded where possible (based on JNCC, 2005):

- Water depth
- Water clarity
- pH and Conductivity
- Record whether the channel is trapezoidal or non-trapezoidal
- Successional stage of ditch
- Shading of ditch
- Total macro-algal cover (filamentous species and Enteromorpha)
- Total cover of any non-native aquatic plant species

The surveys were undertaken in June 2020. Where possible, all taxa (excluding macroalage) was identified to species level. For some species, identification to species level requires particular features, such as fruits or flowers, to be present. Where these are absent then it may not be possible to identify to species level. Habitat types were identified and classified using the Guide to Habitats in Ireland (Fossitt, 2000).

2.5 Plant species nomenclature

Vascular plant nomenclature follows that of the *New Flora of the British Isles*. 4th Edition (Stace, 2019). The bryophyte nomenclature adopted by Blockeel et al. (2014a & b) is used; this is based on the *Checklist of British and Irish bryophytes* (Hill et al., 2008) with minor modifications to reflect recent taxonomic changes.

2.6 Limitations

At some sites the tidal mud within the channel and/ or water levels restricted the areas which could be surveyed. However, usually the channel could be clearly seen and it is not considered that this affected the *Groenlandia densa* distribution mapping.

3 SURVEY RESULTS

3.1 Potential enhancement sites survey results

The full survey results are included in Appendices A-D and summarised in Table 3.1. *Groenlandia densa* was only recorded from one site (Rossbrien), where it was present in the main river channel and an adjacent ditch. It was not re-found at any of the other sites. Loughmore Canal was not surveyed as a review of the data and land ownership showed that relevant areas of the site were not in LCC ownership. It would therefore not be a suitable enhancement site. In addition, there is proposed dredging and translocation at this site already, so enhancement works are better focussed at other sites.

3.2 King's Island survey results

The full survey results are included in Appendix E. *Groenlandia densa* was not recorded in the 2020 survey (or the 2019 survey). The ditch has become overgrown due to natural vegetation succession and there is also some localised dumping.

Table 1.1. Potential Groenlandia densa habitat enhancement sites

Site name	Groenlandia densa recorded in 2020	Site notes	Suitability as potential enhancement site
Rossbrien	Yes, locally abundant within northern section of tributary to Ballynaclogh River and present in a few locations in ditch in SE of site.	Groenlandia densa frequency at the site is reduced from the 2006 survey which is likely to be due to natural vegetation succession. Recent dredging/ disturbance in the northern channel section has opened up the vegetation and promoted growth of Groenlandia densa	Yes. The watercourses have become overgrown since the 2006 survey and sensitive management (under licence) would create the early succession conditions required by Groenlandia densa. It may also be possible to introduce Groenlandia densa to the channel to the NW which is overgrown and where Groenlandia densa has never been recorded.
Ballynaclogh River, east of Dooradoyle	No	The drainage ditch where Groenlandia densa was frequent in 2006 is overgrown due to natural vegetation succession. There is also dense vegetation on much of the exposed mud at the edges of Ballynaclogh River.	Yes. The watercourses have become overgrown since the 2006 survey and sensitive management (under licence) would create the early succession conditions required by Groenlandia densa.
Limerick Canal and Abbey River	No	The canal does not appear to have been managed recently (e.g. dredging). The vegetation is mid-successional and may not currently be suitable for Groenlandia densa growth.	Yes (Limerick Canal). Groenlandia densa was previously recorded from throughout the length of the canal within the survey area. Sensitive management (under licence) would create the early succession conditions required by Groenlandia densa.
Near Sarsfield Bridge	No	Limited potential habitat for Groenlandia densa	No. Limited potential for habitat enhancement in this location

4 CONCLUSIONS

4.1 Potential enhancement sites

Three sites are suitable for enhancement works: Rossbrien (main channel and two drainage ditches); Ballynaclogh River (main river channel and adjacent drainage ditch) and the Limerick Canal.

- At Rossbrien the main channel (tributary to the Ballynaclogh River) and ditch in the NW of the site are within LCC ownership. The ditch to the SE is not within LCC ownership.
- At Ballynaclogh, the river to the west of where the Rossbrien tributary joins the river and the part of the western section of the drainage ditch are within LCC ownership.
- The ownership of the Limerick Canal is to be confirmed.

The sites will be discussed with NPWS and two sites selected. A habitat conservation and management plan in relation to *Groenlandia densa* will be created for the sites and a Section 21 licence application submitted for the proposed works.

4.2 King's Island

As part of the proposed Flood Relief Scheme, the ditch where *Groenlandia densa* has been recorded on King's Island will be lost and a new ditch created to the east. To facilitate colonisation of the new ditch by *Groenlandia densa*, either plants or sediment (with seed and other propagules) can be translocated to the new ditch. A Section 21 licence for this translocation has been granted by NPWS (Licence No. FL08/ 2019). In order to maximise the success of the *Groenlandia densa* it is best to translocate living plants, but these have not been recorded within the ditch since 2017. This has been discussed with NPWS and it is recommended that sensitive management (ditch clearance) is undertaken within sections of the ditch to promote the open, early successional conditions required for *Groenlandia densa*. A Section 21 Licence application will be submitted for this work and is currently being prepared. The habitat management work (subject to licence) would be undertaken over the winter/ spring 2020-2021 to create suitable conditions for *Groenlandia densa*. This species is able to rapidly respond to habitat management and should regenerate (if propagules are still present in the ditch) in spring/ summer 2021.