



Plate 8-8: Marsh under flood conditions (March 2019)



Plate 8-9: Wet grassland near north west ditch



Plate 8-10: Willow treeline between north west ditch and embankment



Plate 8-11: Poached grassland to east of St Mary's estate.



Plate 8-12: Amenity grassland



Plate 8-13: Sheet piling and earthen pathway



Plate 8-14: Opposite-leaved pondweed (Denyer, 2017)¹



Plate 8-15: Mammal hole

¹ Denyer, J. (2017) King's Island *Groenlandia densa* Survey, June 2017. Unpublished report



Plate 8-16: Mammal hole- adjacent to flood water



Plate 8-17: Badger recorded on camera beside mammal holes (2019)



Plate 8-18: Entrance holes to mining bee nests in sandbags



Plate 8-19: Early growth of Giant Hogweed beside path



Plate 8-20: Area A9 to be electro-fished (bank beside walkway)

Appendix C2 Supporting Bird Species Desktop and Survey Data

National Biodiversity Data Centre Bird Data

Table C-1: Protected and Notable Bird Species within grid square R55Y, R55Z, R55T and 55U. (Data from National Biodiversity Data Centre, 2019)

Grid square	Scientific name	Common name	Record	Designation
R55Y	<i>Anas platyrhynchos</i>	Mallard	2013	Wildlife Acts, EU Birds Directive
R55Y	<i>Asio flammeus</i>	Short-eared Owl	2011	Wildlife Acts, EU Birds Directive, Birds of Conservation Concern - Amber List
R55Y	<i>Cygnus olor</i>	Mute Swan	2014	Wildlife Acts, Birds of Conservation Concern - Amber List
R55Y	<i>Delichon urbicum</i>	House Martin	2014	Wildlife Acts, Birds of Conservation Concern - Amber List
R55Y	<i>Fulica atra</i>	Common Coot	2013	Wildlife Acts, EU Birds Directive, Birds of Conservation Concern - Amber List
R55Y	<i>Hirundo rustica</i>	Barn Swallow	2014	Wildlife Acts, Birds of Conservation Concern - Amber List
R55Y	<i>Larus canus</i>	Mew Gull	2013	Wildlife Acts, Birds of Conservation Concern - Amber List
R55Y	<i>Larus ridibundus</i>	Black-headed Gull	2013	Wildlife Acts, Birds of Conservation Concern - Red List
R55Y	<i>Phalacrocorax carbo</i>	Great Cormorant	2014	Wildlife Acts, Birds of Conservation Concern - Amber List
R55Y	<i>Riparia riparia</i>	Sand Martin	2014	Wildlife Acts, Birds of Conservation Concern - Amber List
R55Y	<i>Sturnus vulgaris</i>	Common Starling	2014	Wildlife Acts, Birds of Conservation Concern - Amber List
R55Y	<i>Tachybaptus ruficollis</i>	Little Grebe	2013	Wildlife Acts, Birds of Conservation Concern - Amber List
R55Y	<i>Tyto alba</i>	Barn Owl	2013	Wildlife Acts, Birds of Conservation Concern - Red List
R55Z	<i>Larus fuscus</i>	Lesser Black-backed Gull	2011	Wildlife Acts, Birds of Conservation Concern - Amber List
R55Z	<i>Larus ridibundus</i>	Black-headed Gull	2015	Wildlife Acts, Birds of Conservation Concern - Red List
R55Z	<i>Mergus merganser</i>	Goosander	2011	Wildlife Acts, EU Birds Directive, Birds of Conservation Concern - Amber List
R55Z	<i>Phalacrocorax carbo</i>	Great Cormorant	2011	Wildlife Acts, Birds of Conservation Concern - Amber List
R55Z	<i>Sturnus vulgaris</i>	Common Starling	2015	Wildlife Acts, Birds of Conservation Concern - Amber List
R55Z	<i>Alcedo atthis</i>	Common Kingfisher	2011	Wildlife Acts, EU Birds Directive, Birds of Conservation Concern - Amber List
R55Z	<i>Tachybaptus ruficollis</i>	Little Grebe	2011	Wildlife Acts, Birds of Conservation Concern - Amber List
R55T	<i>Anas crecca</i>	Teal	2017	Wildlife Acts, EU Birds Directive, Birds of Conservation Concern - Amber List
R55T	<i>Mergus merganser</i>	Goosander	2011	Wildlife Acts, EU Birds Directive, Birds of Conservation Concern - Amber List
R55T	<i>Anas clypeata</i>	Northern Shoveler	2011	Wildlife Acts, EU Birds Directive, Birds of Conservation Concern - Red List
R55T	<i>Passer domesticus</i>	House Sparrow	2011	Wildlife Acts, Birds of Conservation Concern - Amber List
R55T	<i>Phalacrocorax carbo</i>	Great Cormorant	2013	Wildlife Acts, Birds of Conservation Concern - Amber List
R55T	<i>Rallus aquaticus</i>	Water Rail	2011	Wildlife Acts, Birds of Conservation Concern - Amber List
R55T	<i>Riparia riparia</i>	Sand Martin	2014	Wildlife Acts, Birds of Conservation Concern - Amber List

R55T	<i>Sturnus vulgaris</i>	Common Starling	2012	Wildlife Acts, Birds of Conservation Concern - Amber List
R55T	<i>Tachybaptus ruficollis</i>	Little Grebe	2012	Wildlife Acts, Birds of Conservation Concern - Amber List
R55T	<i>Tringa totanus</i>	Common Redshank	2011	Wildlife Acts, Birds of Conservation Concern - Red List
R55U	<i>Alcedo atthis</i>	Common Kingfisher	31/12/2011	Wildlife Acts Birds of Conservation Concern - Amber List
R55U	<i>Columba livia</i>	Rock Pigeon	23/08/2013	Wildlife Acts, EU Birds Directive
R55U	<i>Anas platyrhynchos</i>	Mallard	31/12/2011	Wildlife Acts, EU Birds Directive
R55U	<i>Anas crecca</i>	Eurasian Teal	31/12/2011	Wildlife Acts Birds of Conservation Concern - Amber List, EU Birds Directive
R55U	<i>Anser anser</i>	Greylag Goose	31/12/2011	Wildlife Acts Birds of Conservation Concern - Amber List, EU Birds Directive
R55U	<i>Aythya fuligula</i>	Tufted Duck	31/12/2011	Wildlife Acts Birds of Conservation Concern - Amber List, EU Birds Directive
R55U	<i>Mergus merganser</i>	Goosander	31/12/2011	Wildlife Acts Birds of Conservation Concern - Amber List, EU Birds Directive
R55U	<i>Cygnus olor</i>	Mute Swan	31/12/2011	Wildlife Acts Birds of Conservation Concern - Amber List
R55U	<i>Haematopus ostralegus</i>	Eurasian Oystercatcher	26/02/2013	Wildlife Acts Birds of Conservation Concern - Amber List
R55U	<i>Larus fuscus</i>	Lesser Black-backed Gull	23/08/2013	Wildlife Acts Birds of Conservation Concern - Amber List
R55U	<i>Phalacrocorax carbo</i>	Great Cormorant	09/04/2016	Wildlife Acts Birds of Conservation Concern - Amber List
R55U	<i>Sturnus vulgaris</i>	Common Starling	23/08/2013	Wildlife Acts Birds of Conservation Concern - Amber List
R55U	<i>Tachybaptus ruficollis</i>	Little Grebe	31/12/2011	Wildlife Acts Birds of Conservation Concern - Amber List
R55U	<i>Larus ridibundus</i>	Black-headed Gull	23/08/2013	Wildlife Acts Birds of Conservation Concern - Red List
R55U	<i>Alcedo atthis</i>	Common Kingfisher	31/12/2011	Wildlife Acts Birds of Conservation Concern - Amber List

Full Breeding Bird Survey Data

Table C-2: Bird species recorded within the survey area.

Common Name	Latin name	Conservation Status			Breeding status	Comments	Habitat
		EU Annex Species	Conservation Listed Species	Riparian Action Plan Species			
Kingfisher	<i>Alcedo atthis</i>	Annex I	Amber	✓	Possible	Kingfisher observed flying along Shannon further north of Kings Island. No nesting banks found on within FRS	Likely to nest on opposite bank of Shannon and Abbey Rivers. Historically noted on Shannon further north
Little Egret	<i>Egretta garzetta</i>	Annex I	Green	✓	Possible	Observed foraging south of Kings Island at Clancy's Strand. No nesting within FRS	No evidence of nesting in marsh or woodland of Kings Island. Urbanised location may make it unsuitable.
Grey Wagtail	<i>Motacilla cinerea</i>	-	Red	✓	Confirmed	Observed in suitable habitat, nest in wall at Thomond Weir at Brown's Quay. No nesting found within FRS	Foraging for food and nest in between crevices in wall.
Mute Swan	<i>Cygnus olor</i>	-	Amber	✓	Confirmed	Female on nest on river marsh on north edge of Kings Island beyond embankment	Marsh Habitat
Cormorant	<i>Phalacrocorax carbo</i>	-	Amber	✓	Unlikely	Group of 5 No nesting within FRS they may be part of the nesting colonies at Bunlicky further south.	5 Observed on gravelly area below Parteen Railway
Coot	<i>Fulica atra</i>		Amber	✓	Possible	One male calling from river edge reeds on Abbey River No nesting within FRS	Alluvial Woodland
Swift	<i>Apus apus</i>		Amber		Not breeding	Flyover only	
Black-headed Gull	<i>Chroicocephalus ridibundus</i>	-	Red		Not breeding	Roosting on playing pitches	
Blackbird	<i>Turdus merula</i>	-	Green		Probable	At least 5 pairs observed in suitable habitat feeding young and alarm calling on Kings Island	Riparian woodland and vegetation along the ditches
Blackcap	<i>Sylvia atricapilla</i>	-	Green		Probable	1 male and female Observed in suitable habitat on Kings Island	Riparian woodland
Blue Tit	<i>Cyanistes caeruleus</i>	-	Green		Possible	At least 4 pairs observed in suitable habitat	Riparian woodland and scrub

						on Kings Island; males singing	along ditches
Bullfinch	<i>Pyrrhula pyrrhula</i>	-	Green		Possible	One male observed in suitable habitat on Kings Island	Scrub along ditch
Carrion Crow	<i>Corvus corone</i>	-	Green		Possible	2 pairs Observed in suitable habitat on Kings Island	Alluvial Woodland and individual trees along ditches
Chaffinch	<i>Fringilla coelebs</i>	-	Green		Probable	Female and males observed alarm calling. Observed carrying food material for young on Kings Island	Alluvial Woodland and scrub habitat of ditches
Chiffchaff	<i>Phylloscopus collybita</i>	-	Green		Possible	Observed carrying food material for young on Kings Island	Alluvial Woodland and scrub habitat of ditches
Coal Tit	<i>Parus ater</i>	-	Green		Confirmed	Group of 9 observed moving along woodland on Kings Island	Riparian woodland
Dunnock	<i>Prunella modularis</i>	-	Green		Possible	At least 2 pairs observed in suitable habitat; males singing on Kings Island	Alluvial Woodland and scrub habitat of ditches
Goldfinch	<i>Carduelis carduelis</i>	-	Green		Probable	At least 3 pairs observed in suitable habitat on Kings Island	Scrub habitat of ditches
Great Tit	<i>Parus major</i>	-	Green		Possible	One male singing observed in suitable habitat on Kings Island	Scrub habitat of ditches
Grey Heron	<i>Ardea cinerea</i>	-	Green		Possible	No nesting on Kings Island. Observed hunting along river at Verdant Plc	May be nesting beyond Kings Island
Hooded Crow	<i>Corvus cornix</i>	-	Green		Possible	Nesting in one tree along path of Kings Island	Trees
Mallard	<i>Anas platyrhynchos</i>	-	Green		Possible	1 female with young observed in suitable habitat Riparian Woodland on Kings Island along Abbey River	Alluvial Woodland and River
Magpie	<i>Pica pica</i>	-	Green		Confirmed	Observed alarm calling and carrying food material for young on Kings Island	Alluvial woodland
Pied Wagtail	<i>Motacilla alba</i>	-	Green		Confirmed	Observed flying into nest under house gutter at St. Marys Park on Kings Island	Amenity grassland and houses
Robin	<i>Erithacus</i>	-	Green		Confirmed	2 pairs - one pair	Alluvial

	<i>rubecula</i>					in Alluvial Woodland Alarm calling and young fledglings in bush along ditch on Kings Island	Woodland and scrub habitat of ditches
Rook	<i>Corvus frugilegus</i>	-	Green		Possible	Colony Observed in suitable habitat on Kings Island	Beyond Kings Island at Parteen
Song Thrush	<i>Turdus philomelos</i>	-	Green		Possible	One pair observed on foraging football pitch on Kings Island	Amenity grassland and scrub along ditches
Swallow	<i>Hirundo rustica</i>	-	Amber		Possible	Observed feeding over wet grassland of SAC on Kings Island	Near sheds and buildings
Woodpigeon	<i>Columba palumbus</i>	-	Green		Possible	1 Observed in suitable habitat; male singing	Alluvial Woodland
Wren	<i>Troglodytes troglodytes</i>	-	Green		Confirmed	3 pairs observed along ditches of Kings Island.	Scrub along ditches

Appendix C3 Summary of Opposite-leaved pondweed *Groenlandia densa* Data for NPWS

This section contains all references to Opposite-leaved Pondweed *G. densa* in the EIAR as requested by NPWS. This is for the purpose of ease of access to the information for this and future translocation projects for this species.

Chapter 4 Description of Proposed Development

Area A3 - North West Embankment (Ch 0+365 to 1+250)

A3 Existing Condition

There is currently an existing embankment encircling the north of the island and an associated footpath. Approximately 520m of the existing embankment is located within the SAC. The crest of the embankment is formed by large sandbags which were installed as temporary flood defence measures during previous high flood events, however many of these sandbags are damaged and no longer provide adequate defence. There is an open drain on the eastern side of the existing embankment which currently contains a protected species, pondweed (*Groenlandia densa*).

A3 Design Proposal

A new embankment is proposed along 920m of the northwest perimeter of the island, set back on the inside of the existing embankments. The top of the embankments will be at the FDL height of 5.3m, constructed of impermeable clay, with a top width of 3m. The clay will slope down at a 1 to 3 slope on both sides. They will be graded and surfaced with landscape fill and topsoil respectively, at a 30-degree slope on the side of St. Mary's Park, and sloped downward so that the end meets the top of the existing embankment. Overall, with the total width will range from 60 to 70m but will vary at different locations and is designed to blend into St. Mary's Park. The surface would be seeded with meadow grassland. A new bitmac footpath (3m wide) is proposed along the top of the embankment, with breakout areas to allow street furniture in the future. Additional connecting paths are proposed to connect the embankment to the St. Mary's Park housing estate to the east and south. Street lighting (columns 6m high) is proposed along the outside of the walkway, which would be directed inward and away from the SAC.

The proposed embankment would envelop the existing drainage ditch to the west and the open drain to the east which currently contains the protected pondweed, and as such filter drains are proposed on the inside of the embankments. A new swale is also proposed along the northwest corner of the island on the inside of the proposed embankment. The swale would allow pondweed (*Groenlandia densa*) to be translocated under licence from the existing ditch.

A3 Drainage Design

There is an existing outfall to the River Shannon from an existing open drain on the inside of the existing flood embankment, outfall location towards the north-west corner of the island. As part of the Kings Island Flood Scheme works, this outfall will be decommissioned, and a new outfall will be constructed. The new outfall location will be at the southern end of a new open drain on the inside of the new flood embankment which is required to translocate the opposite leaved pondweed in the existing open drain. A filter drain at the toe of the new flood embankment will run from the filter drain to the north of St. Mary's Crèche towards the new open drain. A second open drain to the north of the island will capture runoff from the embankment from the west of the handball alley to the proposed open drain. Refer drawing no. 2015s3218-003 to 2015s3218-004.

Chapter 5 Consultation

Consultation Responses

Table 5-1 Summary of statutory consultation responses

Consultee	Response	Response Date
Department of Culture, Heritage and the Gaeltacht (DAU) including National Parks and Wildlife Services (NPWS)	Email ref. G Pre00001/ 2019 requesting that the archaeological assessment be completed under certain guidelines as outlined Letter dated 22 March 2019 included points regarding ecological impacts for works proposed in Areas A3, A7 and A9. Letter dated 12 June 2019 included recommendations for the treatment of underwater archaeology and the proposed translocation of Opposite-leaved pondweed and juvenile lamprey.	06/02/2019 22/03/2019 12/06/2019

Responses are further summarized and addressed in the following table according to their relevance to the appropriate section of the EIAR.

Summary of Issues Raised through Statutory Consultation

Consultee	Summary of Additional Issues Raised	How the issue is addressed in this EIAR
4. Description of Scheme		
DAU (NPWS)	It would be the Department's preference that the existing drain, where opposite-leaved pondweed is found, is retained. The reason for this preference is the low success of translocation projects for this species in the past.	A response was submitted to NPWS at the design stage, which was followed by a meeting which took place between NPWS, LCCC, Arup, and JBA, on the 2nd of July to discuss these matters. This is summarized below.
	Three pieces of information are required for the Department to advise fully on the question of marshland at the cSAC boundary: 1. It needs to be calculated how much marsh habitat within the cSAC will be lost to the embankment. 2. The type of marsh vegetation proposed to be lost within the cSAC needs to be described. 3. The extent to which the marsh vegetation is dependent on poor drainage (perched water), as opposed to water due to groundwater backup due to river flooding, needs to be established.	
8. Biodiversity		
LCCC	Thomas O'Neill (Heritage Officer) requested that the EIAR should cross reference, where necessary, with the NIS. This could include topics such as treatment of Annex Habitats, treatment of the Triangular Club Rush and Opposite Leaved Pond Weed and associated mitigation measures such as relocation	Chapter 8 -Biodiversity addresses the impact of the scheme on protected species and habitats and will cross reference the contents of the NIS and associated mitigation measures.
DAU (NPWS)	Area A3 (Northwest Embankment): A Section 21 (Wildlife Act) licence will be necessary for the translocation of the opposite-leaved pondweed, and should be applied for to the Licensing Unit, National Parks & Wildlife Service (NPWS).	This point is discussed further below in Section 5.3.3

Consultation with NPWS

A letter dated 12 June 2019 (ref G Pre00001/2019, Appendix C4) was sent to JBA regarding the pre-planning consultation, following the application for a derogation license to translocate the protected plant *Groenlandia densa*. The letter raised the following points:

Translocation of Opposite-leaved Pondweed

- It would be the Department's preference that the existing drain, where Opposite-leaved Pondweed is found, is retained. The reason for this preference is the low success of translocation projects for this species in the past.
- A response was submitted by JBA, which was followed by a meeting to discuss the points raised. The response made the following points:

Translocation of opposite-leaved pondweed

- Retaining the open drain will create engineering, public health and associated risks which together with Project Supervisor Design Process (PSDP) review we are required to design out such risk where possible, namely:
 1. Relocating the new embankment on the inside of the existing open drain will cut off the flow path for overland flows, which currently recharge the open drain
 2. A new embankment on the inside of the existing open drain will create a dumping ground within the existing open drain, as it will be hidden between the existing and new embankments
 3. Should any person(s) get into trouble within the open drain, they will not be visible from St Marys, therefore, an increased risk of drowning
 4. Locating the proposed embankment inside of the existing open drain will be such that the said drain will be exposed to the tidal element of the River Shannon more regularly and will eventually be lost as the existing embankment is eroded and/or fails in due course.

A meeting which took place on 2nd July 2019 between LCCC, NPWS, JBA and Arup discussed the following points:

- Construction methodology of embankment regarding translocation of Opposite-leaved pondweed *Groenlandia densa*
- Methodology will include sequencing of construction allowing the excavation of new ditch and drainage connection to the Shannon River prior to that of the embankment.
- Pondweed must stay in original ditch as long as possible but may go into suitable storage for a period prior to translocation. It must not be moved to new ditch before suitable hydrological and water chemistry conditions are in place.
- The Section 21 licence for the translocation of the pondweed will be contingent on final method statement approved by NPWS.

Enhancement plan for Opposite-leaved Pondweed in environs of Limerick.

- The enhancement of other sites where pondweed occurs in Limerick was a preferred option by NPWS.
- Further liaising with NPWS is required to proceed with this type of project.

Chapter 8 Biodiversity

Habitat and Protected Flora Surveys

Ecological Survey methods were in general accordance with those outlined in the following documents:

Ecological Survey methods were in general accordance with those outlined in the following documents:

- Heritage Council (2011) 2. Best Practice Guidance for Habitat Survey and Mapping.
- Phase 1 Habitat Survey methodology (Joint Nature Conservation Committee (JNCC), 1990, revised 2003) 3
- Ecological Surveying Techniques for Protected Flora and Fauna during the Planning of National Road Schemes (NRA, 2009)4

Plant names follow Stace (2010)5. Flora of particular ecological interest, including non-native invasive species such as Japanese Knotweed (*Reynoutria japonica*), Giant Hogweed (*Heracleum mantegazzianum*), and Himalayan Balsam (*Impatiens glandulifera*), and/or protected species such as Opposite-leaved Pondweed (*Groenlandia densa*) were recorded and mapped when observed during all surveys.

Desktop Study

A desk-based assessment was carried out to collate information regarding protected/notable species and statutorily designated nature conservation sites in, or within close proximity to, the study area. A data search for protected and notable species was conducted using the National Biodiversity Data Centre Mapping System (National Biodiversity Data Centre, 2019).

Protected Flora

Kings Island spans across four 2km national grids on the National Biodiversity Data Centre's map viewer, R55U, R55T, R55Y and R55Z. The following protected plant species have been noted in the 2km Squares:

- Opposite-leaved Pondweed (*Groenlandia densa*) in the Limerick Canal to the south east of the site and in a small area to the south by O'Callaghans Strand;

1.1 Methodology

An ecological walkover survey of the area was conducted by JBA Consulting ecologists on 09/09/2015 (resurveyed 2019) to record the habitats and flora of the scheme as part of the EIAR Constraints Study. The purpose of this survey was also to detect the presence or likely presence of protected species that may be impacted by the scheme and identify the need for further surveys, if necessary. The survey was chiefly concerned with recording habitats suitable for protected habitats and species; and notes were also made on other flora and fauna. The more detailed ecological surveys and species-specific surveys were carried out during 2016, 2017, 2018 and 2019 (re-surveying) for the proposed scheme, by a team of specialist ecologists and other technical specialists as seen in Table 8-1.

Habitat and Protected Flora Surveys

Summary of Ecological Surveys

Table 8-1 Details of specialised ecological surveys conducted in 2015 - 2019

Name	Company	Role	Ecological Receptor	Dates
Dr. Joanne Denyer & Tanya Slattery	Denyer Ecology and JBA Consulting	Aquatic plant specialist and Botanist	Opposite-leaved Pondweed <i>Groenlandia densa</i>	April 2017

² Heritage Council (2011). *Best Practice Guidance for Habitat Survey and Mapping*. The Heritage Council

³ JNCC (Joint Nature Conservation Committee) (2010). *Handbook for Phase 1 habitat survey: A Technique for Environmental Audit*. Peterborough: JNCC

⁴ NRA (2009). *Ecological Surveying Techniques for Protected Flora and Fauna during the Planning of National Road Schemes*. National Roads Authority. Available at: <https://www.tii.ie/technical-services/environment/planning/Ecological-Surveying-Techniques-for-Protected-Flora-and-Fauna-during-the-Planning-of-National-Road-Schemes.pdf> [Accessed 29 May 2019]

⁵ Stace C. (2010). *New Flora of the British Isles*. 3rd Ed. Cambridge University Press, Cambridge.

Name	Company	Role	Ecological Receptor	Dates
Tanya Slattery	JBA Consulting	Ecologist and Botanist	Detailed habitat survey of Sir Harry's Mall Habitat	8 March 2018

Habitat and Flora Field Survey Results

(FW4) Drainage ditches

There are a number of ditches on the island. The main drainage ditches run along the inside of the embankment on King's Island and are mainly for land drainage purposes. The drainage ditch on the west (Plate 1-4) has two outflows into the Shannon River, though one is blocked at present. The drainage ditch on the east of the island has one outflow to the Abbey River.

Vegetation within and on the banks of the drainage ditch on the west included Reed Sweet-grass (*Glyceria maxima*), Yellow Iris (*Iris pseudacorus*), Water Horsetail (*Equisetum fluviatile*) and Bulrush (*Typha latifolia*). A section of this drainage ditch contains the protected species Opposite-leaved pondweed (*Groenlandia densa*) and so was surveyed and characterised further by an aquatic specialist.

Nearby borehole and trial pit investigations have shown that the ditch is located in an area of relatively impermeable clay, underlain by sands and gravels. The existing ditch is fed both by surface water run-off from surrounding lands and groundwater through the lower sand/ gravels layer (Denyer, 2019)⁶.

The ditch section with *Groenlandia densa* had relatively clearwater with low overall algal cover at the time of survey. Aquatic macrophytes were abundant in the channel and the ditch had shallow eastern bank, grading into wet grassland to the east. There was no shading by scrub or tall vegetation and the ditch was in mid-successional stage with small amounts of open water and a mixture of submerged, floating and emergent vegetation. Water sampling shows that the ditch has a pH between 7.5 and 8 (highly calcareous) and is neither brackish nor highly polluted (Denyer, 2017)⁷.

Six shallow drainage channels run across marsh habitat to the east of the site (Plate 1-5). The drainage ditch at the south east of the site flow north into the flood plain (Plate 1-6).

Protected Flora

Opposite-leaved Pondweed

Opposite-leaved Pondweed was observed in the ditch to the north west of the site during the walkover survey on the 17/01/2017 by botanist Tanya Slattery (JBA) (Plate 1-14, Appendix C1). As this plant is protected under the Flora Protection Order, confirmation of the species identification, based on photographs taken during the survey, was obtained by Aquatic Macrophyte specialist Joanne Denyer. Joanne Denyer proceeded to obtain a derogation license from the NPWS, in order to confirm the extent of its range within this area and develop possible translocation or alternative habitat development plans in consultation with the NPWS.

Opposite-leaved Pondweed is normally found in calcareous waters of rivers, streams, canals, ditches and ponds. In Ireland, this species is typically associated with areas that are periodically disturbed, including canals, drains and tidal stretches of rivers. It is one of the subtypes of one of the qualifying features of the Lower River Shannon SAC (NPWS 2012a)⁸ and can tolerate a

⁶ Denyer J. (2019) Section 21 Application *Groenlandia densa* Methods Statement.

⁷ Denyer, J. (2017) King's Island *Groenlandia densa* Survey, June 2017. Unpublished report

⁸ NPWS (2012a). Lower River Shannon SAC (site code 2165). 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 18 April 2019]

certain level of disturbance. It had not previously been identified on King's Island or within the said drainage ditch.

Figure 8-6 in EIAR Volume 3 shows the main areas of Opposite-leaved Pondweed plants observed in a section of the ditch approximately 200m in length (mapped using GPS). In the southern section of the ditch (where the transect was located), Opposite-leaved Pondweed was present throughout the channel and only particularly dense populations have been mapped. The plants appeared healthy at the time of survey and had been present in the ditch during January, suggesting they had overwintered in the ditch.

To the north and south of the section with Opposite-leaved Pondweed the ditch is infilling and overgrown suggesting that no ditch clearance had been undertaken recently. To the north the channel is shaded by scrub and dense patches of Duckweed (*Lemna* spp.) and litter dominate the water surface. To the south, the ditch channel is dominated by Bulrush (*Typha latifolia*), Reed Sweet-grass (*Glyceria maxima*) and Bur-reed (*Sparganium* spp.) Opposite-leaved Pondweed was not recorded from these overgrown ditch sections.

Macrophytes growing with Opposite-leaved Pondweed at the time of surveys included Common Stonewort (*Chara vulgaris*), Thread-leaved Water-crowfoot (*Ranunculus cf. trichophyllus*) (not flowering), Blue-fruited Water-starwort (*Callitriche cf. obtusangula*) (not flowering or fruiting), Reed Sweet-grass (*Glyceria maxima*), Bur-reed (*Sparganium* spp.) (not flowering), Least Duckweed (*Lemna minuta*) Common Duckweed (*Lemna minor*), Water Horsetail (*Equisetum fluviatile*), filamentous algae, Brooklime (*Veronica beccabunga*), Pink Water-speedwell (*Veronica catenata*) and Yellow Flag (*Iris pseudacorus*).

The area to the north-west of the Island was examined for the presence of the protected species, Triangular Club-rush, however none were identified during the ecological surveys. Access was restricted to certain areas of the site and due to the time of year that the survey was conducted, this species may not have been observable and may still be present. However potential Triangular Club-rush was recorded during the fisheries surveys between Thomond Bridge and Curragower falls on the west of King's Island.

Opposite-leaved Pondweed is protected by Section 21 of the Wildlife Act (1976) and is listed on the Flora (Protection) Order (2015)⁹. It is listed as 'Near Threatened' on the Irish Vascular Plant Red List (Wyse Jackson et al., 2016)¹⁰; and is identified as one of the three high conservation elements (sub-types) of the Feature of Interest of the Annex I habitat Water courses of plain to montane levels with the *Ranunculion fluitans* and *Callitriche-Batrachion* vegetation [3260] within the Lower River Shannon Special Area of Conservation (SAC) (NPWS, 2012b)¹¹.

Opposite-leaved Pondweed was not visibly apparent in the ditch or recorded by JBA ecologists during the re-surveying of habitats on King's Island in spring/summer of 2019. This is not to say that the pondweed does not still exist there. Surveyors did not enter the close environs of the ditch in 2019 as this would require a licence by an aquatic botanical specialist.

Fisheries

Riparian habitat

Opposite-leaved Pondweed was not observed between Thomond Bridge and Sarsfield Bridge but is highly likely to occur in the slack water areas of the Abbey River. It is however known to thrive in the adjoining Park Canal, east of Baal's Bridge (Reynolds et al., 2006). Littoral

⁹ S.I. No. 356/2015 - Flora (Protection) Order, 2015.[Available at:

<http://www.irishstatutebook.ie/eli/2015/si/356/made/en/print>] [Accessed 28 May 2019]

¹⁰ Wyse Jackson, M., FitzPatrick, Ú., Cole, E., Jebb, M., McFerran, D., Sheehy Skeffington, M. & Wright, M. (2016) Ireland Red List No. 10: Vascular Plants. National Parks and Wildlife Service, Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs, Dublin, Ireland [Available at:

<https://www.npws.ie/sites/default/files/publications/pdf/RL10%20VascularPlants.pdf>] [accessed 28 May 2019]

¹¹ NPWS (2012b) Lower River Shannon SAC 002165 Conservation Objectives [online]

https://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO002165.pdf . [Accessed 5 April 2019]

macrophytes included brooklime, Water mint, Cuckoo flower (*Cardamine pratensis*) and Fool's watercress (*Apium nodiflorum*) which were locally common upstream of Curragower Falls.

Invasive Non-native Species

The location 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, on the embankment itself and in the ditch that contains Opposite-leaved Pondweed.

Construction Impacts 2: Species loss (Protected flora)

Opposite-leaved Pondweed *Groenlandia densa*

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

The permanent infilling of the ditch at the base of the western embankment to enable the construction of the new embankment inside the old one, will result in the loss of the only population of the protected species Opposite-leaved Pondweed on King's Island. The species requires particular conditions in which to survive which are not available in the other ditches and watercourses on King's Island (Denyer, 2017)¹².

Characterisation of unmitigated impact on the feature

Infilling of the ditch will result in the complete loss of the population of Opposite-leaved pondweed on King's Island.

Rationale for prediction of effect

Opposite-leaved Pondweed is a protected species and only occurs in one section of ditch on King's Island. It is known to occur in Limerick Canal to the south east of the site and in a small area to the south of the King's Island by O'Callaghan's Strand (NBDC). As this is the only population of Opposite-leaved Pondweed on the island, the infilling of the ditch will result in the loss of this species in the area.

Effects without mitigation

The permanent infilling of the ditch and subsequent loss of this species on King's island will result in a significance impact at local and national level.

Operation impacts 2: Species loss (Protected flora)

Opposite-leaved Pondweed

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

Opposite-leaved Pondweed *Groenlandia densa*

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

The permanent infilling of the ditch at the base of the western embankment to enable the construction of the new embankment inside the old one, will result in the loss of the only population of the protected species Opposite-leaved Pondweed on King's Island. The species requires particular conditions in which to survive which are not available in the other ditches and watercourses on King's Island (Denyer, 2017)¹³

Characterisation of unmitigated impact on the feature

¹² Denyer (n 36)

¹³ Denyer, J. (2017) King's Island *Groenlandia densa* Survey, June 2017. Unpublished report

Infilling of the ditch will result in the complete loss of the population of Opposite-leaved Pondweed on King's Island.

Rationale for prediction of effect

Opposite-leaved Pondweed is a protected species and only occurs in one section of ditch on King's Island. It was known to occur in Limerick's Park Canal to the south east of the site, though it has not been recorded there since 2006, in a small area to the south of the King's Island by O'Callaghan's Strand (NBDC) and in other areas of Limerick (Reynolds, 2013)¹⁴. As this is the only population of Opposite-leaved Pondweed on the island, the infilling of the ditch will result in the loss of this species in the area.

Effects without mitigation

The permanent infilling of the ditch and subsequent loss of this species on King's island will result in a significance impact at local and national level.

Operation impacts 4: Water quality

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

Periodic maintenance of embankments or drainage scheme (i.e. clearing of build-up of silt) will contribute additional particulate matter to sensitive water courses.

Characterisation of unmitigated impact on the feature

Once embankments and open areas are revegetated there is less opportunity for silt runoff. However, over time, vegetation debris or silt may block drains and outflows. Maintenance work may result in silt being released to the Shannon or Abbey Rivers.

Rationale for prediction of effect

Drainage and maintenance requirements for the new embankments connect these areas to sensitive water courses within the SAC. Any silt/polluted runoff will end up in the local drains or channels within King's Island and will eventually reach the rivers via the filter drains and outfalls.

Effects without mitigation

Without mitigation there could be long term impact from runoff to sensitive water courses within King's Island (channel with Opposite-leaved Pondweed) and within the SAC (Shannon and Abbey rivers). These are assessed as a significant impact at local and national level and at International level respectively.

Specific design mitigation

Opposite-leaved Pondweed

Conservation of Opposite-leaved Pondweed *Groenlandia densa* on King's Island has been discussed with NPWS (see Appendix C3-2). A licence for the translocation of the pondweed has been applied for (Appendix C3-3) and approved (Appendix C3-4) and the following mitigation applies:

- To conserve the population of Opposite-leaved Pondweed *G. densa* design mitigation includes the relocation of plant specimens to suitable watercourse habitats. This involves removal of pondweed plants from ditch habitat to a holding area and then translocation into a newly excavated channel and two other locations. Mitigation will follow the Methods statement in the Section 21 Licence Application (Floral Protection Order) for *G. densa* (Denyer, 2019)¹⁵ (Appendix C3-3) and any additional agreements with NPWS. A licence has been granted by NPWS (see Appendix C4).

¹⁴ Reynolds, S. (2013) *Flora of County Limerick*. National Botanic Gardens

¹⁵ Denyer J. (2019) Section 21 Application *Groenlandia densa* Methods Statement.

- All conservation work connected with *G. densa* and its habitat to follow and implement the strategies, methods and actions described in the report “Section 21 Application. *G. densa* Methods Statement. March 2019. Unpublished report to NPWS, in support of Section 21 Licence application prepared by Denyer Ecology”⁸¹, its two appendices A&B and the finalised detailed translocation plan (see below) and any subsequent modifications to these as may be proposed and agreed with the NPWS.
- The detailed translocation plan noted in sections 2.3.1 and 2.3.3 of the above report to be finalised in agreement with NPWS and incorporated with a finalised Methods Statement report into a Conservation Management Plan for the species at the site, in advance of commencement of any of the works – this plan to include finalised details of actions to be undertaken and the order and timeline for these.
- Translocation of *G. densa* with storage should remain the prime method; although direct translocation should also be attempted if feasible.
- Translocation/enhancement of two other sites in or as near to King’s Island as possible, as per NPWS instructions under licence. The option of using the upper parts of the drains on the east side of Kings Island will be considered for habitat translocation of some plants, if suitable habitat can be created there, as a first choice in habitat enhancement, rather than sites distant from King’s Island. Sites outside of King’s Island will have to be owned by LC&CC. Sites where Opposite-leaved Pondweed occur in Limerick are outlined in Reynolds (2013), *Flora of Limerick*. Five potential sites have been chosen by licence holder Jo Denyer. These are described below in Table 8-14 with their ranking (1 being the highest) and are also seen in Figure 8-14. There are two sites with a ranking of 1, Rossbrien ditch/ Ballynaclogh River and Ballynaclogh River, east of Dooradoyle, which are the most likely sites for enhancement. If, after surveying, none of the five sites listed in Table 8-14 are feasible NPWS will be contacted for further advice on other suitable sites.

The enhancement of two chosen 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.

Table 8-14: Potential *G. densa* enhancement sites and ranking (1 being highest)

Site name	Limerick CC ownership	Grid reference	Date last recorded*	Notes	Rank
Rossbrien ditch/ Ballynaclogh River	Part of site	R571546	2010	In situ populations recovered after dredging (under licence) in 2009, but subsequently declined due to lack of ditch management. Current condition unknown.	1
Ballynaclogh River, east of Dooradoyle	Part of site	R566546	2009	In situ populations recovered after dredging (under licence) in 2009, but subsequently declined due to lack of ditch management. Current condition unknown.	1
Abbey River	Possibly, depending on exact location	R581574	1998	Unknown if <i>Groenlandia densa</i> has been recorded recently or if suitable habitat still present within LCC owned lands.	2
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 more recent 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

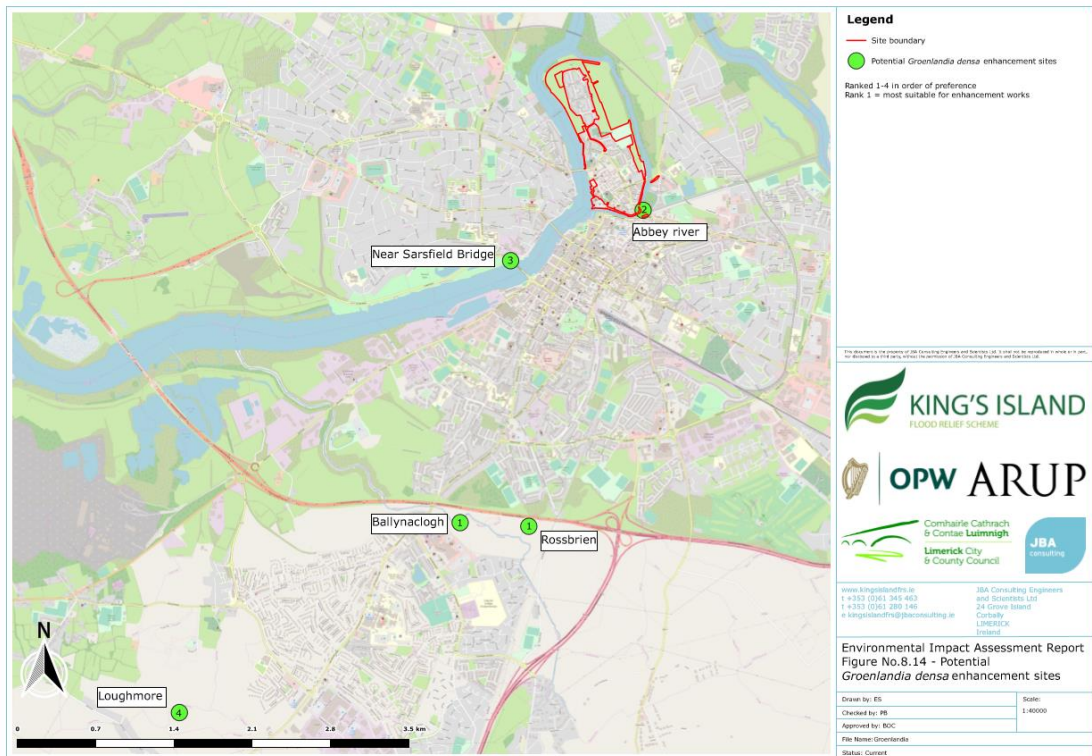


Figure 8-14: Potential *G. densa* enhancement sites

Construction Phase Mitigation

Construction Mitigation 3: Management measures for Surface Water

- No excavation shall take place below the water-table on the Application Site except for excavation of channel for Opposite-leaved Pondweed

Operation Phase Mitigation

Protected flora

To ensure the successful translocation of Opposite-leaved Pondweed to the new channel monitoring of Opposite-leaved Pondweed in the new channel on King's Island will take place according to Section 21 Licence application for *Groenlandia densa* (Denyer, 2019)¹⁶, 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, and advice from NPWS.

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.

Residual Impact

Table 8-15 summarises in tabular form the conclusions and identifies what the residual impact of the proposed King's Island FRS will be on ecological receptors.

Table 8-15: Summary of impacts of proposed King's Island FRS on ecological receptors (relevant rows re *G. densa* extracted)

Impacts	Characterisation of unmitigated impact on the feature	Effect without mitigation	Mitigation	Significance of effects of residual impacts after mitigation
Construction impacts				
Habitat loss/disturbance	Ditch and wet grassland Construction of embankments will result in direct loss of ditches and wet grassland	The loss of north west ditch is assessed as significant at a national level due to presence of protected species Opposite-leaved Pondweed.	Relocation of ditch and reinstate with similar hydrology and sediment features to original; adequate sloping of ground to allow revegetation and succession of wet grassland	Not significant
(Protected Flora) Species loss	Infilling of ditch will result in loss of population of Opposite-leaved Pondweed	Without mitigation population of Opposite-Leaved Pondweed will be lost to King's Island, leading to significant impact at a National and local level.	Removal of pondweed plants from ditch habitat to a holding area and then translocation into a newly excavated channel. Mitigation will follow the Methods statement in the Section 21 Licence Application (Floral Protection Order) for <i>Groenlandia densa</i> (Denyer, 2019) and any subsequent modifications to these as may be proposed and agreed with the NPWS. NPWS have requested enhancement of two further sites where Opposite-Leaved Pondweed is located in the environs of Limerick city. These are seen in Figure 8.14.	Not significant
Operational Impacts				
(Protected) Species loss	Opposite-leaved Pondweed A new channel with translocated population of Opposite-leaved Pondweed may not lead to successful reestablishment of this species.	Without monitoring and a management plan population may not succeed, leading to significant impact at a National and local level.	Management of channel vegetation, Monitoring of Opposite-leaved Pondweed according to Section 21 Licence application for <i>Groenlandia densa</i> (Denyer, 2019) and any subsequent modifications to these as may be proposed and agreed with the NPWS. Monitoring of two further enhancement sites as agreed with NPWS.	Not significant
Reduction in	Periodic maintenance	Silt runoff into ditch with	Regular review of	Not

water quality	works such as clearing filter drains and outfalls will contribute silt or pollutants to water courses	Opposite-leaved Pondweed, and Shannon and Abbey Rivers will lead to significant impact at local and national level and at an International level respectively.	maintenance requirements	significant
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Monitoring

Opposite-leaved pondweed

Post-construction Monitoring for Opposite-leaved Pondweed within King's Island and at two other sites will take place under the licensing agreement for relocation of this species.

Consultant Surveys, Licence Applications and Licences for *G. densa*

King's Island *Groelandia densa* Survey June 2017 by Denyer Ecology is seen in Appendix C3-1. Licence application for translocation of *G. densa* is seen in Appendix C3-3 and NPWS licence approval in Appendix C4.



KING'S ISLAND *GROENLANDIA DENSA* SURVEY

June 2017

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

Report information

Report title:	King's Island <i>Groenlandia densa</i> survey	
Client:	JBA Consulting	
Document reference:	DE2041 R01b	
Project number:	DE2041	
Author(s):	Dr Joanne Denyer	Date: Jun 2017
Checked and authorised:	Dr Joanne Denyer	Date: Jun 2017

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1 INTRODUCTION

Denyer Ecology was commissioned to undertake an initial survey and assessment of translocation options for a population of *Groenlandia densa* present in a drainage ditch at King's Island, Limerick City. *Groenlandia densa* is protected under the Flora (Protection) Order, 2015; is listed as 'Near Threatened' on the Irish Vascular Plant Red List (Wyse Jackson et al., 2016); and is identified as one of the three high conservation elements (sub-types) of the Feature of Interest of the Annex I habitat Water courses of plain to montane levels with the *Ranunculion fluitanis* and *Callitricho-Batrachion* vegetation [3260] within the Lower River Shannon Special Area of Conservation (SAC).

The aims of the survey and assessment were to:

- Consult with relevant organisations and individuals in relation to *Groenlandia densa* records in the local area and translocation methods for this species.
- Review relevant *Groenlandia densa* ecology and distribution data in Ireland.
- Undertake an Initial survey and assessment of the drainage ditch on King's Island where over-wintering *Groenlandia densa* was recently recorded by JBA (January, 2017). Included application for a National Parks and Wildlife Service (NPWS) Section 21 licence application to survey *Groenlandia densa* at the site.
- Review *Groenlandia densa* translocation options at the site.
- Advise on potential impacts to the Conservation Objectives for the Lower River Shannon SAC from translocation of *Groenlandia densa*.

1.1 Project

Flora surveys are being undertaken as part of the Ecological Impact Assessment (EclIA) of the King's Island Flood Relief Scheme, Limerick City. JBA Consulting are undertaking the EclIA and Denyer Ecology has been sub-contracted to undertake an aquatic plant survey, focussing on *Groenlandia densa*.

King's Island is susceptible to both coastal and fluvial flood risk and very significant flooding occurred in spring 2014 when existing defences failed locally, both overtopping the through breaching. An element of the proposed flood relief scheme at King's Island proposes to construct an embankment on the western side of King's Island. The proposed embankment will be constructed on the landward side of the existing sandbags/hedgerow that separates the riparian habitat of the River Shannon and the amenity grassland area adjacent to St. Oliver Plunkett Street. An existing ditch, where *Groenlandia densa* has recently been recorded, falls within the footprint of the proposed embankment. The construction of the embankment will result in the ditch being filled in and permanently lost. The project design team are currently conducting the multi-criteria assessment for the selection of the preferred option of the flood relief scheme. All options under consideration involve the construction of an embankment along the western side of King's Island and thus the resultant loss of the existing ditch.

1.2 Survey area

The ditch where *Groenlandia densa* has been recorded is located on the north-eastern side of King's Island (Figure 1, Appendix A. In addition, the remaining length of ditch on the east and western side of King's Island was surveyed (Figure 1.1).

2 METHODOLOGY

2.1 Survey area

2.2 Desktop data

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 (supplied by Limerick County Council).
- 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).
- *New Atlas of Britain and Ireland* Preston et al., 2002)
- Botanical Society of Britain and Ireland (BSBI) online mapping.
- Geological Survey of Ireland (GSI) 1:100,000 Bedrock data (downloaded shapefiles)
- Reports on *Groenlandia densa* translocation projects, as cited in text.
- 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
- BSBI Vice-County recorder for H8 (Limerick)
- Dr Simon Barron, Director of Ecology, Botanical, Environmental & Conservation (BEC) Consultants Ltd
- Stephen Heery, Ecologist
- Eamonn Horgan, Environment and Heritage Officer, Waterways Ireland

2.4 Field Survey

The survey method was based on the following standard methodologies for surveying macrophytes in ditches: UK Common Standards Monitoring (CSM) Guidance for Ditches (JNCC, 2005)

2.4.1 Walk-over and mapping of *Groenlandia densa*

The entire length of the drainage ditch was 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 necessary. A grapnel was only used where no plants of *Groenlandia densa* were visible from the bank, to assess whether any plants are actually present. This ensured the full extent of the plant within the ditch is recorded.

2.4.2 Detailed transect survey

The length of ditch where *Groenlandia densa* had been recently recorded is quite short (c200m) and has relatively homogenous vegetation. Therefore one continuous 100m transect was recorded rather than the recommended minimum 5 x 20m transect lengths (which would have been very close together). This is not considered to affect the detail of the information obtained, as the recorded parameters (e.g. water depth, species composition etc.) did not show much diversity in this section of ditch. The transect was located in the area where *Groenlandia densa* was most consistently abundant.

The transect was surveyed from one ditch bank using a grapnel. In addition the entire length of the ditch section with *Groenlandia densa* and most of the remaining ditch length on King's Island was walked to look for *Groenlandia densa*. The survey focused on aquatic macrophytes (submerged and floating) and the DOMIN value (Table 2.1) for each species was recorded. Brief notes were made on the ditch physical characteristics and bank vegetation. The transect location (start and end point) was recorded with a GPS in the field.

Table 2.1. DOMIN scale of abundance

DOMIN value	Percentage cover range
10	91-100%
9	76-90%
8	51-75%
7	34-50%
6	26-33%
5	11-25%
4	4-10%
3	<4%, many individuals
2	<4%, several individuals
1	<4%, few individuals

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

- Ditch length
- Water depth
- Water clarity
- Algal dominance
- Rare/ quality species
- Channel form
- In-channel vegetation (successional stage of ditch)
- Bankside vegetation cover
- Native macrophyte species richness
- Non-native macrophyte species
- Salinity
- pH: measured during survey using handheld device and subsequent water sampling by Limerick County Council.

The ditch survey was undertaken in March 2017. This is outside of the optimal season (May to September) for surveying aquatic plants. However, *Groenlandia densa* was producing winter shoots in this location in January 2017, which enabled an assessment of the population to be made in early spring. If it is considered that it is not possible to fully assess the *Groenlandia densa* population and associated aquatic macrophyte flora, further survey work will be recommended.

Where possible, all taxa (excluding macroalgae) will be identified to species level. For some species, identification to species level required particular features, such as fruits or flowers, to be present. If these are absent then it may not be possible to identify to species level, or a repeat survey visit may be required.

2.5 Voucher specimens

A small voucher specimen from the site was collected and will be subsequently lodged at the herbarium in the National Botanic Gardens, Glasnevin (DBN). *Groenlandia densa* is locally abundant at this site (and in the general area e.g. Reynolds, 2013), therefore a small disturbance of a healthy population will not lead to an overall negative impact on the survival of the *Groenlandia densa* population at the survey site.

2.6 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 before any in-channel aquatic macrophyte surveys were undertaken in this ditch. A detailed methods statement was submitted to NPWS and these methods were followed during the surveys (as described in this report).

2.7 Microscope identification, voucher specimens and referees

A small voucher specimen of *Groenlandia densa* was collected and will be subsequently lodged at the herbarium in the National Botanic Gardens, Glasnevin (DBN). *Groenlandia densa* is locally abundant at this site (and in the general area e.g. Reynolds, 2013), therefore a small disturbance of a healthy population will not lead to an overall negative impact on the survival of the *Groenlandia densa* population at the survey site.

In addition, small samples of species requiring microscope identification (e.g. charophytes) were collected as necessary.

2.8 Plant species nomenclature

Plant nomenclature follows that of the New Flora of the British Isles. 3rd Edition. (Stace, 2010). Specialist publications for species groups were referred to as relevant.

2.9 Limitations

Where possible, all taxa (excluding macroalgae) were identified to species level. For some species, identification to species level required particular features, such as fruits or flowers, to be present. Where these were absent, it was not always possible to identify to species level. The surveys were undertaken in March 2017, which is outside the optimal survey season for ditches: mid June to late August (JNCC, 2005). However, *Groenlandia densa* is producing winter shoots in this location, which enabled an assessment of the population to be made at this time, which was the primary aim of the survey.

3 RESULTS

3.1 Desktop survey results

3.1.1 Distribution in Ireland

Groenlandia densa is rare in Ireland. It is currently known from the north-east (Co. Antrim) and the Grand and Royal Canals in Co. Dublin (e.g. Downey, 1991); but is more frequent in the southern half of the country (Parnell and Curtis, 2012; Preston et al., 2002). *G. densa* is listed as 'Near Threatened' on the Irish Vascular Plant Red List (Wyse Jackson et al., 2016) and is protected under the Flora (Protection) Order, 2015.

G. densa has been recorded from 18 hectads in Ireland since 1987 (Preston et al., 2002). This is a decrease from earlier records (23 hectads pre-1970). *G. densa* is considered to have declined in Britain and Ireland due to the effects of eutrophication and habitat loss (e.g. urbanisation and the loss of spring-fed streams and ditches because of falling water tables) (Preston et al., 2002; Preston & Crofts, 1997 & Preston, 1995). It is now extinct as a native species in Scotland (Preston et al., 2002).

Groenlandia densa is listed in the Conservation Objectives for Annex I 3260 Floating River Vegetation for a number of SACs in Ireland including: Slaney River Valley SAC [000781]; Lower River Suir SAC [002137]; Lower River Shannon SAC [002165]; and, Blackwater River (Cork/Waterford) SAC [002170].

3.1.2 Distribution in Co. Limerick

Groenlandia densa is locally abundant around Limerick City and near the lower River Maigue (Reynolds, 2013; Figures 3.1 & 3.2). It has been recorded from 6 hectads in Co. Limerick (Vice-county H8) pre-2000: R24, R34, R44, R45, R55 and R65 (BSBI Maps, 2017; Figure 3.1). It has not been recorded from R24 since 2000 (1904 record from Ahacronane River) and so is currently known from five hectads (Reynolds, 2013; Figure 3.1). It has been recorded from 13 tetrads in Co. Limerick post-2000 (BSBI Maps, 2017).

Groenlandia densa is present within the Lower River Shannon SAC (NPWS 2013, NPWS 2102). Figure 3.2 shows the distribution of *G. densa* in Limerick (from NPWS records) in relation to the SAC boundary. The main areas for *G. densa* within the SAC are: River Maigue (although some records are

in drainage ditches adjacent to the river and outside of the SAC), the Limerick Canal and a few records from the River Shannon. The ditches adjacent to Ballynaclough River (SW of Limerick City) are not within the SAC, but have abundant *G. densa* in an approximately 1km long stretch (see Table 3.1). Another key site outside of the SAC boundary is the ditch associated with Loughmore Common (see Table 3.1).

In 2006, a number of sites in Co. Limerick were surveyed for *Groenlandia densa* as part of a survey of rare and scarce vascular plants in the county (Reynolds et al., 2006). This states that *G. densa* is quite common around Limerick City in ditches, rivers and canals. However, *G. densa* is noted as having declined in the Abbey River and tidal River Shannon, where there have been extensive drainage works. A summary of the key features of nine sites that were surveyed in 2006 is shown in Table 3.1. These include drainage ditches, a canal and tidal mud. Some have been surveyed post 2006 and *Groenlandia densa* is still present (e.g. Adare, 2009; Ballynaclough River, 2007 and Ferry Bridge, 2012) (Reynolds, 2013). However, a survey of the Limerick Canal in 2009 failed to re-find *G. densa*, despite it having been recorded from a 1.5km stretch in 2006 (Reynolds, 2013). A survey for the OPW in 2007 found *G. densa* to be the dominant species in large sections of back drains of the Ballynaclough River (Ní Bhroin, 2007).

There is one record from the Abbey River on the west side of King's Island (from 1998 but not re-found post-2000). However there are no current or historic records from the eastern side of King's Island, where the project site ditch is located. The closest recent records are from the Limerick Canal, to the south-east of King's Island (2006).