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## APPENDIX A - ROSSBRIEN

### Site details

<b>Site name:</b> Rossbrien, Co. Limerick	<b>Grid Reference:</b> R571546
<b>Vice-county No.:</b> H8	<b>SAC:</b> n/a
<b>Surveyor(s):</b> Dr Joanne Denyer	<b>Survey date:</b> 16/06/20
<b>Elevation (m):</b> <5m	<b>Solid geology:</b> Limestone

### Site notes

#### Site location

The survey area includes a tributary of the Ballynaclogh River and adjacent drainage ditches (Figure 1.1) within Limerick City. Ballynaclogh River is a separate survey site (Appendix B).

**Figure 1.1. Rossbrien 2020 survey area**



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#### Site description

The Ballynaclogh tributary in this location is a channel of 20 to 25m in width. The channel has a series of shelves at different heights, which are exposed as low tide. At the lowest height there is a channel of 2-5m in width which has water at low tide. Although strongly tidal, the vegetation (and electrical conductivity measurement) suggests that the water is still largely freshwater in this tributary. The upper shelves of the river channel and riverbanks are dominated by reed and large sedge swamp (FS1) and tall-herb swamp (FS2). Higher, drier areas are dominated by dry meadow and grassy verge (GS2) and scrub (WS2). The N18 southern ring road crosses the channel (bridge) in the centre of the survey area (Figure 1.1).

There is a drainage ditch adjacent to the channel in the north-west of the survey area which is similarly dominated by reed and large sedge swamp and tall-herb swamp. However, this has little open water. The drainage ditch in the south-east of the site is more species-rich and in the northern area it has vegetation with affinity to rich fen and flush (PF1) and the banks support species-rich wet grassland (GS4) with frequent orchids (*Dactylorhiza fuchsii*). The southern end of the ditch is locally heavily shaded by willow scrub.

#### Protected site(s)

The survey area is not located within or adjacent to any protected sites. The Ballynaclogh River discharges into the Lower River Shannon Special Area of Conservation (SAC).

#### Watercourse habitat type

Fossitt: Drainage ditches (FW4) and tidal rivers (CW2)

#### Annex I habitat(s)

The aquatic vegetation in main channel is an example of the Annex I habitat **Floating River Vegetation** [3260]. No aquatic *Ranunculus* spp. were recorded, but *Potamogeton pectinatus* and *Myriophyllum alterniflorum* were present with other aquatic macrophyte species.

## APPENDIX A - ROSSBRIEN

### *Groenlandia densa*

1) *Groenlandia densa* was recorded at a number of locations in the main channel in the north of the area (Figure 1.2; Photographs 1.12-1.14). Here it was growing on recently disturbed/ dredged river mud with open vegetation. Some plants were slightly above the water level at low tide. Associate species include *Agrostis stolonifera*, *Alisma plantago-aquatica*, *Callitriche obtusangula*, *C. stagnalis*, *Elodea canadensis*, Filamentous algae, *Helioscadium nodiflorum*, *Ranunculus repens*, *Persicaria amphibia*, *P. hydropiper*, *Potamogeton pectinatus*, *Ranunculus repens*, *Rumex crispus* subsp. *uliginosus* and *Zannichellia palustris*.

2) *Groenlandia densa* was also recorded in the drainage ditch in the SE of the site, to the east of the Ballynacloagh River (Figure 1.3; Photographs 1.7-1.8). Here it was found in areas that still had some open water, cover of emergents was not dominant and there was no shading by bankside scrub. Associate species include *Agrostis stolonifera*, *Alisma plantago-aquatica*, *Berula erecta*, *Callitriche obtusangula*, Filamentous algae, *Galium palustre*, *Glyceria* sp. *Helioscadium nodiflorum*, *Mentha aquatica* and *Myosotis scorpioides*.

**Figure 1.2. *Groenlandia densa* in main channel of Ballynacloagh tributary**



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**Figure 1.3. *Groenlandia densa* in drainage ditch in SE, east of Ballynacloagh River**



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## APPENDIX A - ROSSBRIEN

### Additional notes (Drainage ditch in NW of site) (Photographs 1.1-1.2)

- Water depth: <0.5m deep (not obviously tidal)
- Water clarity: 100% slight turbidity
- Algal dominance: 0%
- Rare/ quality species: n/a
- Channel form: 100% trapezoidal (river channel with series of shelving banks)
- In-channel vegetation: 100% late successional (contains over 70% cover of emergent).
- Bankside vegetation cover: <5% heavily shaded (N18 road bridge crosses channel)
- Native macrophyte species (submerged, floating and emergent): *Helioscadium nodiflorum* (locally dominant), *Lemna minor* (locally dominant in southern area)
- Additional bank species: *Arrhenatherum elatius*, *Galium aparine*, *Filipendula ulmaria*, *Holcus lanatus*, *Iris pseudacorus*, *Phalaris arundinacea*, *Phragmites australis* and *Urtica dioica*.
- Non-native macrophyte species: n/a
- Non-native emergent species: n/a
- Salinity: not recorded
- pH: not recorded

### Additional notes (Drainage ditch in SE of site) (Photographs 1.3-1.8)

- Water depth: c0.30m (not obviously tidal)
- Water clarity: 100% clear
- Algal dominance: <5% (small areas with some filamentous algae but not dominant)
- Rare/ quality species: *Groenlandia densa*, *Hydrocharis morsus-ranae*, *Rumex crispus* subsp. *uliginosus*
- Channel form: 50% trapezoidal
- In-channel vegetation: 30% mid-successional (small amounts of open water and a mixture of submerged, floating and emergent vegetation); 70% late successional (contains over 70% cover of emergent)
- Bankside vegetation cover: 15% heavily shaded (shaded by bankside scrub in southern section)
- Native macrophyte species (submerged, floating and emergent): *Alisma plantago-aquatica*, *Berula erecta*, *Callitriche obtusangula*, *Caltha palustris*, *Carex riparia*, *Glyceria maxima*, *Hydrocharis morsus-ranae*, *Mentha aquatica*, *Myosotis scorpioides*, *Ranunculus flammula* and *Rumex crispus* subsp. *uliginosus*.
- 'Fen' species within ditch channel in N area: *Carex lepidocarpa*, *Eleocharis palustris*, *Galium palustre*, *Triglochin palustris*, *Calliergon giganteum* and *Calliergonella cuspidata*.
- Additional bank species: *Angelica sylvestris*, *Arrhenatherum elatius*, *Dactylorhiza fuchsii*, *Epilobium hirsutum*, *Iris pseudacorus*, *Juncus acutiflorus*, *J. inflexus*, *Filipendula ulmaria*, *Lotus pedunculatus* and *Plantago lanceolata*.
- Non-native macrophyte species: n/a
- Non-native emergent species: n/a
- Salinity: 1350  $\mu\text{S}/\text{cm}$  (slightly brackish)
- pH: 7.34

### Additional notes (Ballynaclogh tributary) (Photographs 1.9-1.18)

- Water depth: c0.25m at low tide
- Water clarity: 100% clear
- Algal dominance: <5% (mostly on exposed mud in northern section of channel)
- Rare/ quality species: *Groenlandia densa*, *Rumex crispus* subsp. *uliginosus*
- Channel form: 100% trapezoidal (river channel with series of shelving banks)
- In-channel vegetation: 100% mid-successional (small amounts of open water and a mixture of submerged, floating and emergent vegetation)
- Bankside vegetation cover: <5% heavily shaded (N18 road bridge crosses channel)
- Native macrophyte species (submerged, floating and emergent): *Alisma plantago-aquatica*, *Callitriche obtusangula*, *C. stagnalis*, *Carex riparia*, *Helioscadium nodiflorum*, *Mentha aquatica*, *Myriophyllum verticillatum*, *Oenanthe crocata*, *Potamogeton pectinatus*, *Rumex crispus* subsp. *uliginosus* and *Zannichellia palustris*.
- Additional bank species: *Angelica sylvestris*, *Epilobium hirsutum*, *Juncus effusus*, *Myosotis scorpioides*, *Phalaris arundinacea*, *Phragmites australis* and *Senecio aquatica*.
- Non-native macrophyte species: *Elodea canadensis* (locally dominant)
- Non-native emergent species: n/a
- Salinity: 920  $\mu\text{S}/\text{cm}$  (freshwater)
- pH: 7.49

### Current management

- Drainage ditch in NW of site: No obvious signs of management
- Drainage ditch in SE of site: No obvious signs of management

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- Main channel (Ballynaclogh tributary): The northern section appeared to have been recently dredged/ disturbed from the upper bridge south to just below the N18 bridge (Photographs 1.15-1.18). There was exposed mud around the bridge where it was shaded (Photographs 1.15-1.16), but the vegetation to the north was recolonising (Photographs 1.17-1.18) and *Groenlandia densa* was frequent on the exposed mud. Local residents stated that it had been dredged/ vegetation cleared c 6 weeks prior to the survey (e.g. late April-early May). The southern section did not appear to have been managed recently and the channel was filling with *Potamogeton pectinatus* and tall emergents (Photographs 1.10-1.11). No *Groenlandia densa* was recorded in this section as it favours the early successional vegetation stage.

### Threats

Infilling of the river channel and ditches with vegetation (emergent, submerged and floating) due to lack of management.

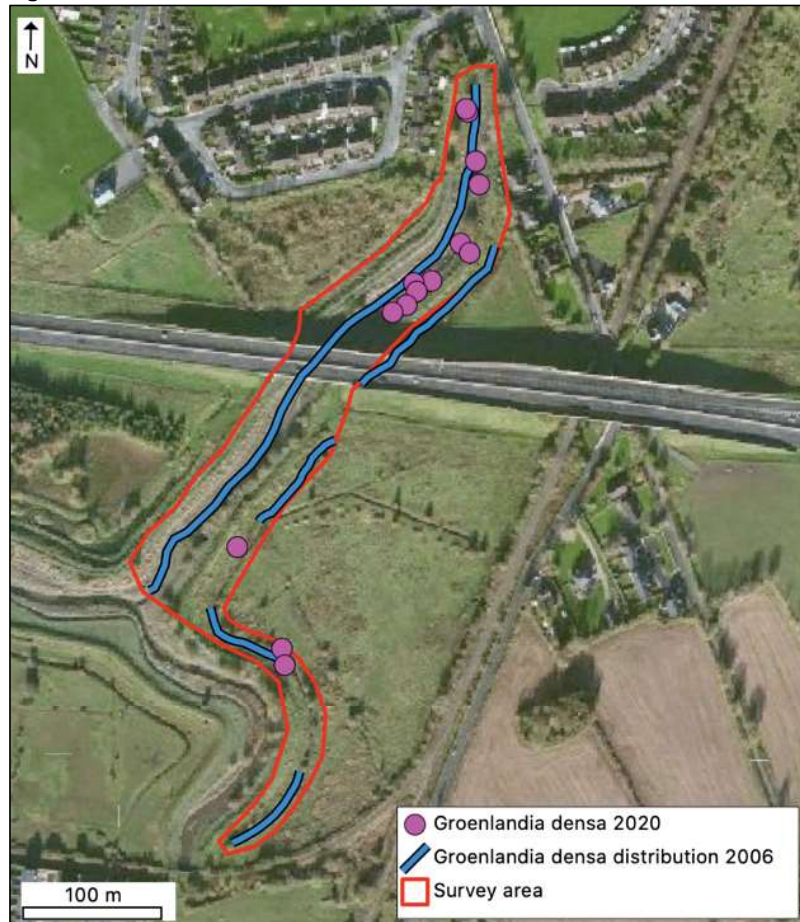
### Conservation measures

Regular (sensitive) vegetation clearance in selected sections (or one side of the ditch/ river at a time) to improve conditions for early successional macrophyte species such as *Groenlandia densa*

### Historic records

*Groenlandia densa* was last recorded from this area in 2006 (NPWS data provided March 2017) and *A survey of rare and scarce vascular plants in County Limerick* (Reynolds et al., 2006). The associate species recorded are similar to those listed in this 2020 survey and *Groenlandia densa* favoured early successional stages of vegetation (with open mud or water). It was recorded from throughout the main channel and SE drainage ditch. Whilst *Groenlandia densa* plants were re-found at both sites in 2020, the distribution was reduced. This is likely to be due to a lack of management in the main channel to the south of the N18 road bridge and throughout the remnant length of the SE drainage ditch (as clear from comparison of 2006 and 2020 photos of this ditch).

Figure 1.4. Distribution of *Groenlandia densa* at Rossbrien in 2006 vs 2020



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2006 data supplied by NPWS

## PHOTOGRAPHS

*Groenlandia densa* surveys 2020

## 1 INTRODUCTION

### 1.1 Background and aims

Denyer Ecology was commissioned to undertake an assessment of potential enhancement sites for *Groenlandia densa* in relation to the proposed King’s Island Flood Relief Scheme, Limerick City. This scheme would involve the translocation of a population of *Groenlandia densa* from an existing ditch on King’s Island into a newly created replacement ditch. A Section 21 licence for this translocation has been granted by NPWS (Licence No. FL08/ 2019). NPWS were consulted as part of this project and recommended that, in addition to the *Groenlandia densa* population translocation, habitat enhancement works be undertaken at an additional two sites within Limerick City environs. The aim of the 2020 surveys and assessment was to identify two potential enhancement sites.

Previous reports in relation to *Groenlandia densa* at King’s Island:

- Denyer Ecology (2017a). Section 21 Licence Application: *Groenlandia densa*: Methods Statement. Licence application (for survey work) submitted to NPWS.
- Denyer Ecology (2017b). King’s Island *Groenlandia densa* survey June 2017. Unpublished report.
- Denyer Ecology (2019). Section 21 Licence Application: *Groenlandia densa*: Methods Statement. Licence application (for translocation) submitted to NPWS.
- Denyer Ecology (2020). Section 21 Licence Application: *Groenlandia densa*: Methods Statement. Licence application (for survey work) submitted to NPWS.

### 1.2 *Groenlandia densa*

*Groenlandia densa* is an aquatic plant protected by Section 21 of the Wildlife Act (1976) and is listed on the Flora (Protection) Order (2015). *Groenlandia densa* 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 fluitantis* and *Callitriche-Batrachion* vegetation [3260] within the Lower River Shannon Special Area of Conservation (SAC) (NPWS, 2012).

### 1.3 Sites

The potential enhancement sites comprise a number of sites where *Groenlandia densa* has been recorded recently or historically (Table 1.1; Figure 1.1). In addition, a repeat survey of the King’s Island population was undertaken as this was not recorded as being present in 2019 (Figure 1.1).

The potential habitat enhancement sites were selected based on their proximity to King’s Island, possible site ownership by Limerick City and County Council, presence of *Groenlandia densa* (at least historically) and other information on current population and site condition. The potential sites were ranked (rank of 1 = site most likely to be suitable) as shown in Table 1.1.

**Table 1.1. Potential *Groenlandia densa* habitat enhancement sites**

Site name	Limerick CCC ownership	Grid reference	Date last recorded*	Notes	Rank
Rossbrien	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
Limerick Canal and Abbey River	Possibly, depending on exact location	R581574	2006	Unknown if <i>Groenlandia densa</i> has been recorded recently or if suitable habitat still present within LCC owned lands.	2

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DITCH IN NORTH WEST OF SITE (TO WEST OF MAIN CHANNEL)



Photograph 1.1. Late successional vegetation dominated by emergents (view to NW)



Photograph 1.2. Late successional vegetation with dense *Helioscadium nodiflorum* (view to SW)

DITCH IN SOUTH-EAST OF SITE (TO EAST OF BALLYNACLOGH RIVER)



Photograph 1.3. View of ditch to south (from E bank of Ballynaclogh River).



Photograph 1.4. Heavily shaded southern section (view to E).



Photograph 1.5. Middle section dominated by emergents (view to NE).



Photograph 1.6. Fen vegetation in northern section (view to N).

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Photograph 1.7. Mid-successional section with open water and *Groenlandia densa* (view from W bank).



Photograph 1.8. Mid-successional section with open water and *Groenlandia densa*.

MAIN CHANNEL (TRIBUTARY OF BALLYNACLOGH RIVER)



Photograph 1.9. Channel to the north of the N18 (view to S)



Photograph 1.10. Channel to the south of the N18 (view to N)



Photograph 1.11. Channel dominated by *Potamogeton pectinatus* to the south of the N18 bridge (view to S)



Photograph 1.12. Channel with open water and regenerating aquatic vegetation by upper bridge (view to NW). *Groenlandia densa* locally frequent.



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Photograph 1.13. *Groenlandia densa* locally abundant with *Callitriche* sp. and *Persicaria amphibia* and *P. amphibia*.



Photograph 1.14. *Groenlandia densa* locally abundant with *Callitriche* sp.



Photograph 1.15. Recent dredging/ disturbance under N18 bridge (view E from W bank)



Photograph 1.16. Recent dredging/ disturbance to south of N18 bridge (red arrow, view SE from W bank)



Photograph 1.17. Recolonising macrophyte vegetation on recently dredged/ disturbed river channel. Red arrow shows dredging/ scrape marks in mud.



Photograph 1.18. Recolonising macrophyte vegetation (with *Groenlandia densa*) on recently dredged/ disturbed river channel. Red arrow shows dredging/ scrape marks in mud (view to S from E bank)

## APPENDIX B - BALLYNACLOGH RIVER

### Site details

<b>Site name:</b> Ballynaclogh River, E of Dooradoyle, Co. Limerick	<b>Grid Reference:</b> R566546
<b>Vice-county No.:</b> H8	<b>SAC:</b> n/a
<b>Surveyor(s):</b> Dr Joanne Denyer	<b>Survey date:</b> 16/06/20
<b>Elevation (m):</b> <5m	<b>Solid geology:</b> Limestone

### Site notes

#### Site location

The survey area a section of the Ballynaclogh River and adjacent drainage ditch to the south and east (Figure 1.1) within Limerick City. Rossbrien is a separate survey site (Appendix A).

**Figure 2.1. Ballynaclogh River 2020 survey area**



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#### Site description

Ballynaclogh River is 5-10m wide and is widest at the south-eastern end of the survey area (Figure 2.1; Photographs 2.1-2.4). The southern end has clear water with visible stony substrate in some areas and was <0.5m in depth at low tide. Moving west to where the tributary at Rossbrien joins from the north (Figure 2.1; Appendix A), the river becomes narrower, the water is more turbid and slightly deeper (>0.5m) at low tide. It is fringed with reed and large sedge swamp (FS1), tall-herb swamp (FS2) and wet grassland (GS4) and in some places it is difficult to access the open water due to the fringing vegetation on unstable mud. The river is strongly tidal, but the electrical conductivity measurement at the southern end of the section suggests that the water is only slightly brackish (similar salinity to the Rossbrien tributary).

There is a drainage ditch which is located to the south and west of the river channel (Photographs 2.5-2.6). This ranged from 1 to 3m in width and was <0.5m in depth. It did not appear to be tidal, but the electrical conductivity measurement was much higher than in the river. It could be that the ditch is groundwater/ spring-fed, as the vegetation was typical of freshwater conditions. The ditch graded into wet grassland on both sides.

#### Protected site(s)

The survey area is not located within or adjacent to any protected sites. Ballynaclogh River discharges into the Lower River Shannon Special Area of Conservation (SAC).

#### Watercourse habitat type

Fossitt: Drainage ditches (FW4) and tidal rivers (CW2)

#### Annex I habitat(s)

The tall-herb swamp vegetation at the edges of the Ballynaclogh River have affinity to the Annex I habitat **Hydrophilous tall herb fen** [6430] but are small, localised patches only.

#### *Groenlandia densa*

No *Groenlandia densa* was recorded from either the river or the drainage ditch within the survey area.

## APPENDIX B - BALLYNACLOGH RIVER

### Additional notes (Ballynaclogh River) (Photographs 2.1-2.4)

- Water depth: <0.5m at low tide
- Water clarity: 25% clear; 75% slight turbidity
- Algal dominance: 0%
- Rare/ quality species: *Rumex crispus* subsp. *uliginosus*
- Channel form: 100% trapezoidal (river channel shelving banks)
- In-channel vegetation: 75% mid-successional (small amounts of open water and a mixture of submerged, floating and emergent vegetation); 25% early successional (little aquatic plant growth)
- Bankside vegetation cover: <5% shaded (by adjacent willow trees)
- Native macrophyte species (submerged, floating and emergent): *Berula erecta*, *Carex riparia*, *Glyceria maxima*, *Helioscadium nodiflorum*, *Oenanthe crocata* and *Rumex crispus* subsp. *uliginosus*.
- Additional bank species: *Filipendula ulmaria*, *Iris pseudacorus*, *Phalaris arundinacea*, *Phragmites australis*, *Ranunculus repens* and *Senecio aquatica*.
- Non-native macrophyte species: n/a
- Non-native emergent species: n/a
- Salinity: 1130  $\mu\text{S}/\text{cm}$  (brackish)
- pH: 7.7

### Additional notes (Drainage ditch to S and W of Ballynaclogh River) (Photographs 2.5-2.6)

- Water depth: <0.5m deep (not obviously tidal)
- Water clarity: 100% clear
- Algal dominance: 0%
- Rare/ quality species: *Equisetum x litorale*, *Hippuris vulgaris*, *Rumex crispus* subsp. *uliginosus*
- Channel form: 10% trapezoidal (shelving bank on one side); 90% non-trapezoidal (relatively steep sided)
- In-channel vegetation: 70% mid-successional (small amounts of open water and a mixture of submerged, floating and emergent vegetation); 30% late successional (contains over 70% cover of emergent)
- Bankside vegetation cover: 0% heavily shaded
- Native macrophyte species (submerged, floating and emergent): *Alisma plantago-aquatica*, *Callitriche obtusangula*, *Carex riparia*, *Equisetum fluviatile* (locally dominant), *Equisetum x litorale* (locally frequent), *Hippuris vulgaris*, *Lemna minor*, *Mentha aquatica*, *Menyanthes trifoliata*, *Myriophyllum verticillatum*, *Phragmites australis*, *Potamogeton pectinatus*, *Ranunculus flammula*, *Rumex crispus* subsp. *uliginosus*, *Sparganium erectum*, *Typha latifolia*,
- Additional bank species: *Arrhenatherum elatius*, *Dactylorhiza fuchsii*, *Galium aparine*, *Filipendula ulmaria*, *Holcus lanatus*, *Iris pseudacorus*, *Juncus acutiflorus*, *J. inflexus*, *J. conglomeratus* and *Valeriana dioica*.
- Non-native macrophyte species: n/a
- Non-native emergent species: n/a
- Salinity: 4500  $\mu\text{S}/\text{cm}$  (brackish/ spring-fed)
- pH: 7.4

### Current management

- Ballynaclogh River: No obvious signs of management
- Drainage ditch: No obvious signs of management

### Threats

Infilling of the river channel and ditches with vegetation (emergent, submerged and floating) due to lack of management.

### Conservation measures

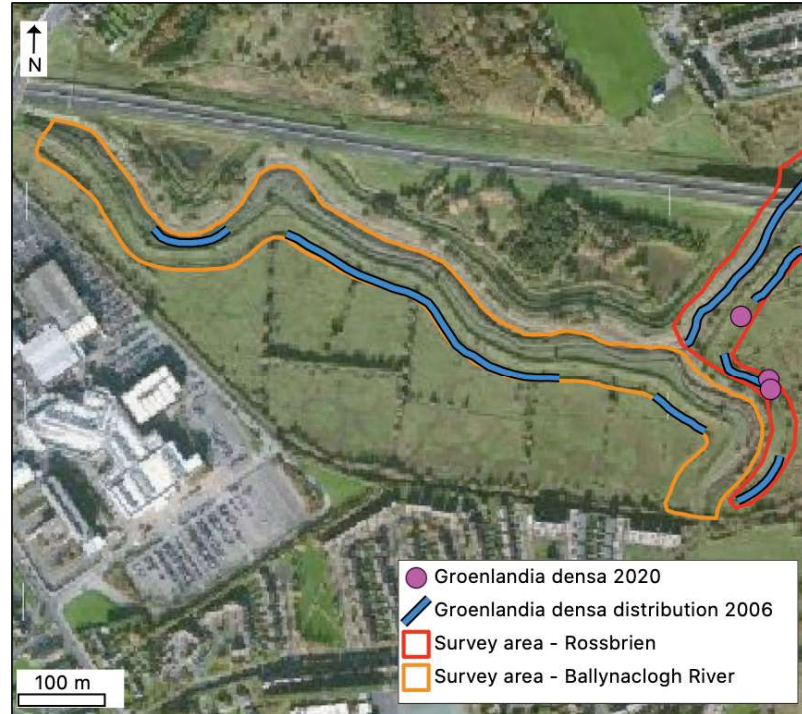
Regular (sensitive) vegetation clearance in selected sections (or one side of the ditch/ river at a time) to improve conditions for early successional macrophyte species such as *Groenlandia densa*

### Historic records

*Groenlandia densa* was last recorded from this area in 2006 (NPWS data provided March 2017) and *A survey of rare and scarce vascular plants in County Limerick* (Reynolds et al., 2006). It was recorded from the western end of the river and several locations in the drainage ditch (Figure 2.2). It was not re-found in either of these watercourses in 2020 (although it was present in the adjacent Rossbrien survey site). *Groenlandia densa* favours early successional stages of vegetation (with open mud or water). The drainage ditch and shallow mud at the edges of the river have infilled with dense vegetation as there does not appear to have been any recent management. This has made conditions currently unfavourable for *Groenlandia densa*.

## APPENDIX B - BALLYNACLOGH RIVER

Figure 2.2. Distribution of *Groenlandia densa* at Ballynaclogh (and Rossbrien) in 2006 vs 2020



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2006 data supplied by NPWS

### PHOTOGRAPHS

#### BALLYNACLOGH RIVER



Photograph 2.1. Main Ballynaclogh River channel (view to NW from S riverbank)



Photograph 2.2. Reedbeds fringing edges of Ballynaclogh River (view to NW from S riverbank)

APPENDIX B - BALLYNACLOGH RIVER



Photograph 2.3. Typical emergent vegetation at edge of main river channel



Photograph 2.4. Open section of river with boulders in S of survey area (view to E from W riverbank)

DRAINAGE DITCH TO SOUTH AND EAST OF BALLYNACLOGH RIVER



Photograph 2.5. Mid-successional vegetation with *Equisetum fluviatile* and *Myriophyllum verticillatum*



Photograph 2.6. Late-successional vegetation dominated by emergents, including *Alisma plantago-aquatica*, *Equisetum x litorale* and *Glyceria maxima*

## APPENDIX C - ABBEY RIVER/ LIMERICK CANAL

### Site details

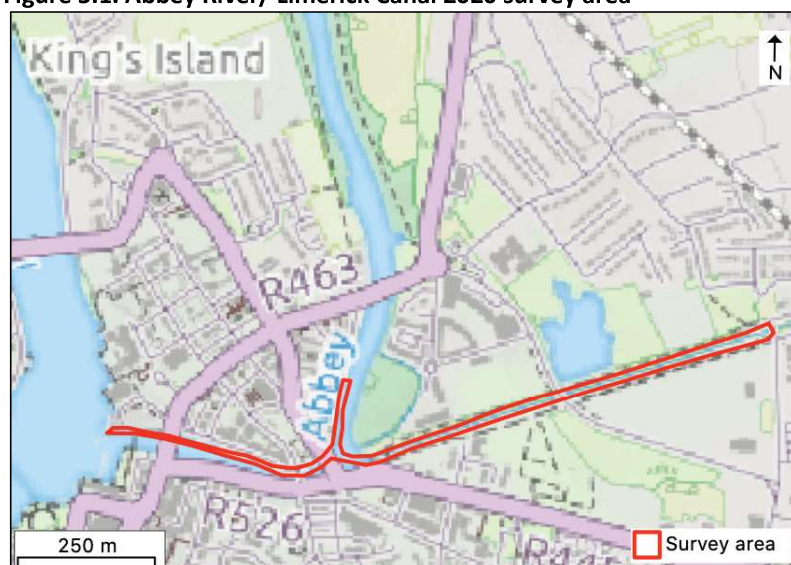
<b>Site name:</b> Abbey River, Limerick Canal, Co. Limerick	<b>Grid Reference:</b> R581574
<b>Vice-county No.:</b> H8	<b>SAC:</b> Within 002165 Lower River Shannon SAC
<b>Surveyor(s):</b> Dr Joanne Denyer	<b>Survey date:</b> 16/06/20
<b>Elevation (m):</b> <5m	<b>Solid geology:</b> Limestone

### Site notes

#### Site location

The survey area includes a section of the Abbey River and Limerick Canal (Figure 3.1) within Limerick City.

**Figure 3.1. Abbey River/ Limerick Canal 2020 survey area**



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#### Site description

The Limerick Canal is 10-12m wide and flows to the west where it joins Abbey River from the north (Figure 1.1). The canal banks support reed and large sedge swamps (FS1), tall-herb swamp (FS2), dry meadow and grassy verge (GS2) and scrub (WS2) vegetation. The Abbey River is c. 30m wide, tidally influenced but predominantly freshwater. It discharges to the west into the River Shannon. In the survey section it is mainly confined between the quay walls stone walls and other stonework (BL1). There is a small area of probably wet willow-alder-ash woodland (WN6) to the north of where the Limerick Canal joins the Abbey River, but this was not accessible from the survey area.

#### Protected site(s)

The survey area of both watercourses is located within the Lower River Shannon Special Area of Conservation (SAC)

#### Watercourse habitat type

Fossitt: Canal (FW3) and Depositing/lowland rivers (FW2)

#### Annex I habitat(s)

The aquatic vegetation in the Limerick Canal is an example of the Annex I habitat **Floating River Vegetation** [3260]. No aquatic *Ranunculus* spp. were recorded, but *Potamogeton lucens* and *Myriophyllum alterniflorum* were frequent with other aquatic macrophyte species. There was occasional *Sparganium* sp. in the Abbey River, but the aquatic vegetation did not have affinity to 3260. The tall-herb swamp vegetation at the edges of the Abbey River and Limerick Canal have affinity to the Annex I habitat **Hydrophilous tall herb fen** [6430]. Floating River Vegetation is a Qualifying Interest for the Lower River Shannon SAC.

#### *Groenlandia densa*

No *Groenlandia densa* was recorded from either the Limerick Canal or the Abbey River survey areas.

#### Additional notes (Limerick canal) (Photographs 3.1-3.4)

- Water depth: c2m (but some sections may be deeper)
- Water clarity: 100% slight turbidity (possible peat influence as water brown in colour although relatively clear)
- Algal dominance: 0%
- Rare/ quality species: *Potamogeton lucens*, *Oenanthe aquatica*
- Channel form: n/a as canal
- In-channel vegetation: 100% mid-successional (small amounts of open water and a mixture of submerged, floating and emergent vegetation)
- Bankside vegetation cover: 15% heavily shaded

## APPENDIX C - ABBEY RIVER/ LIMERICK CANAL

- Native macrophyte species (submerged, floating and emergent): *Ceratophyllum demersum*, *Lemna minor*, *L. trisulca*, *Myosotis scorpioides*, *Myriophyllum verticillatum*, *Nuphar lutea*, *Oenanthe aquatica*, *Oenanthe crocata*, *Potamogeton lucens*, *P. pectinatus*, *Persicaria amphibia*, *Sagittaria sagittifolia* and *Sparganium erectum*.
- Additional bank species: *Angelica sylvestris*, *Arrhenatherum elatius*, *Cirsium arvense*, *Filipendula ulmaria*, *Jacobaea vulgaris*, *Lythrum salicaria*, *Mentha aquatica*, *Phalaris arundinacea*, *Rubus fruticosus* agg., *Scrophularia auriculata* and *Urtica dioica*.
- Non-native macrophyte species: *Elodea nuttallii* (occasional)
- Non-native emergent species: *Heracleum mantegazzianum* (frequent)
- Salinity: not measured
- pH: not measured

### Additional notes (Abbey River) (Photographs 3.5-3.6)

- Water depth: unknown
- Water clarity: 100% slight turbidity
- Algal dominance: 0%
- Rare/ quality species: *Rumex crispus* subsp. *uliginosus*
- Channel form: n/a as river
- In-channel vegetation: n/a as river
- Bankside vegetation cover: <1% heavily shaded
- Native macrophyte species (submerged and floating): *Sparganium erectum*
- Emergent species: *Angelica sylvestris*, *Caltha palustris*, *Filipendula ulmaria*, *Jacobaea aquatica*, *Lythrum salicaria*, *Mentha aquatica*, *Myosotis scorpioides*, *Oenanthe crocata*, *Phragmites australis*, *Rumex crispus* subsp. *uliginosus* and *Scrophularia auriculata*
- Non-native macrophyte species: n/a
- Non-native emergent species: *Heracleum mantegazzianum* and *Impatiens glandulifera* (frequent)
- Salinity: not measured
- pH: not measured

### Current management

No obvious signs of management. Local users of the canal reported that it had not been dredged in recent years.

### Threats

Infilling of the canal with vegetation (emergent, submerged and floating) due to lack of management.

### Conservation measures

Regular (sensitive) vegetation clearance in selected sections (or one side of the canal at a time) to improve conditions for early successional macrophyte species such as *Groenlandia densa*

### Historic records

*Groenlandia densa* was last recorded from the canal in 2006 (NPWS data provided March 2017) and A survey of rare and scarce vascular plants in County Limerick (Reynolds et al., 2006). Population described as 'Several patches of *Groenlandia densa*, all submerged, were seen at each of eight locations along a nearly 1.5km stretch of the canal.' (Reynolds et al., 2006).

## PHOTOGRAPHS

### LIMERICK CANAL



Photograph 3.1 Western end of canal showing fringing emergent vegetation (view to W from N bank)



Photograph 3.2. Dense *Potamogeton lucens* in eastern section of survey area

APPENDIX C - ABBEY RIVER/ LIMERICK CANAL



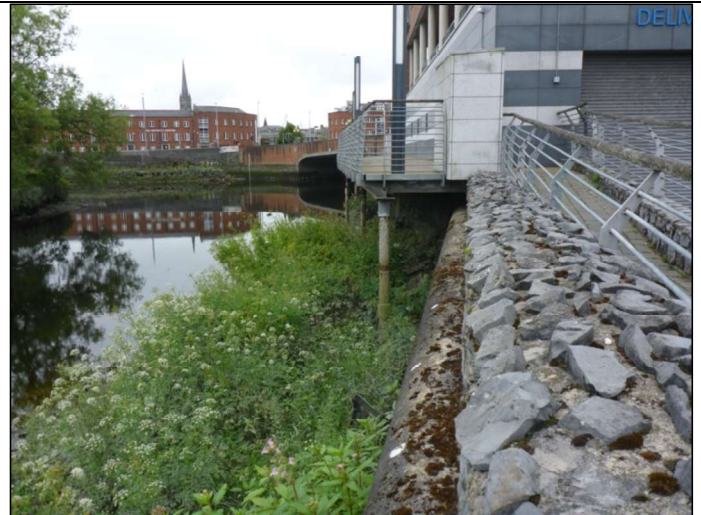
Photograph 3.3 Abundant floating vegetation in eastern section of canal survey area (view to N from S bank)  
**ABBAY RIVER**



Photograph 3.4. Relatively clear water with probably slight peat staining in eastern section of survey area



Photograph 3.5 Exposed mud and stone at edge of Abbey River (view to E from N bank)



Photograph 3.6. Tall-herb swamp in Abbey River to N of where it joins Limerick Canal (view to S from W bank)



## APPENDIX D - SARSFIELD BRIDGE

### Site details

<b>Site name:</b> nr Sarsfield Bridge, River Shannon, Co. Limerick	<b>Grid Reference:</b> R5757
<b>Vice-county No.:</b> H8	<b>SAC:</b> Within 002165 Lower River Shannon SAC
<b>Surveyor(s):</b> Dr Joanne Denyer	<b>Survey date:</b> 16/06/20
<b>Elevation (m):</b> <5m	<b>Solid geology:</b> Limestone

### Site notes

#### Site location

The survey area includes a section of the northern shoreline of the River Shannon to the north of Sarsfield Bridge (Figure 4.1) within Limerick City.

**Figure 4.1. Sarsfield Bridge/ River Shannon 2020 survey area**



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#### Site description

The River Shannon is confined between the quay walls stone walls and other stonework (BL1) in this location (Photographs 4.1-4.2). There may be some exposed mud at low tide, but no plants could be seen at the edges of the river in this location.

#### Protected site(s)

The survey area is located within the Lower River Shannon Special Area of Conservation (SAC)

#### Watercourse habitat type

Fossitt: Depositing/lowland rivers (FW2)

#### Annex I habitat(s)

There was occasional *Sparganium* sp. in the River Shannon in this location, but the aquatic vegetation was very limited and did not have affinity to Annex I habitat **Floating River Vegetation** [3260]. Floating River Vegetation is a Qualifying Interest for the Lower River Shannon SAC.

#### *Groenlandia densa*

No *Groenlandia densa* was recorded from the survey areas (viewed from the quay wall only but no obvious macrophyte vegetation or suitable habitat present).

#### Additional notes (Limerick canal)

- Water depth: unknown
- Water clarity: 100% slight turbidity (underwater vegetation and structures could be seen from the quay wall)
- Algal dominance: 0%
- Rare/ quality species: n/a
- Channel form: n/a as highly modified river
- In-channel vegetation: 100% early-successional and typical of regular dredging/ disturbance
- Bankside vegetation cover: 0% heavily shaded
- Native macrophyte species (submerged, floating and emergent): *Sparganium erectum*
- Additional bank species: None in this location
- Non-native macrophyte species: None in this location
- Non-native emergent species: None in this location
- Salinity: not measured
- pH: not measured

## APPENDIX D - SARSFIELD BRIDGE

### Current management

No obvious signs of management, but likely to be regularly dredged/ disturbed as little vegetation. No obvious shallow water/ shelving at edge of river which would support emergent/ macrophyte vegetation.

### Threats

Water pollution. Regular dredging removing vegetation, shallow water areas and mud (exposed at low tide) at edge of river which provide potential habitat for macrophyte vegetation.

### Conservation measures

Reduction in frequency and depth of dredging at edge of river to allow formation of shallow areas and macrophyte vegetation to regenerate.

### Historic records

*Groenlandia densa* was last recorded from the canal in 1993 (NPWS data provided March 2017). It was not re-found during survey work for *A survey of rare and scarce vascular plants in County Limerick* (Reynolds et al., 2006).

## PHOTOGRAPHS



Photograph 4.1 Sarsfield Bridge and River Shannon (view to SW from N bank)



Photograph 4.2. View of shoreline in vicinity of Sarsfield Bridge

## APPENDIX E - KING'S ISLAND

### Site details

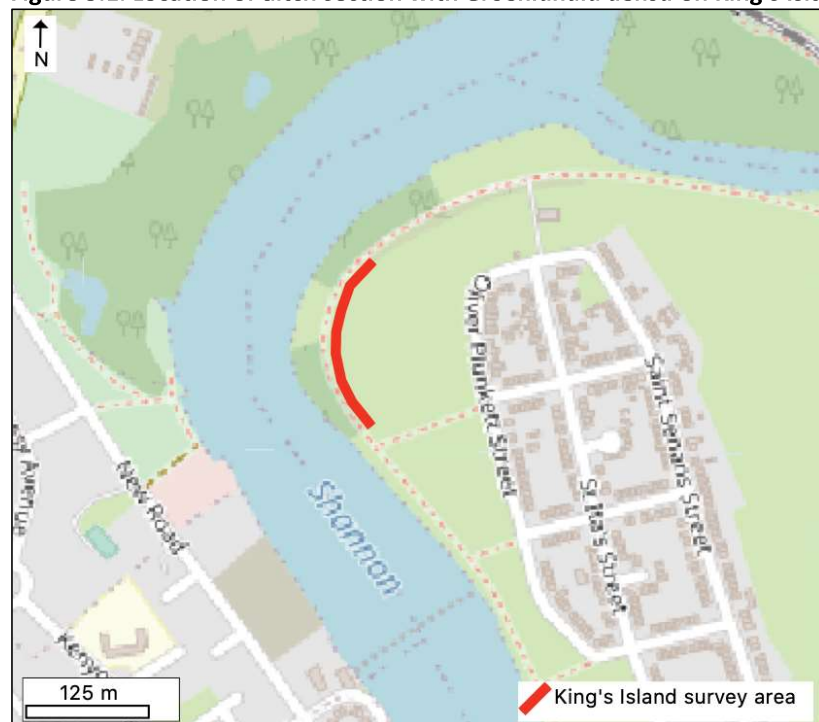
<b>Site name:</b> King's Island, Co. Limerick	<b>Grid Reference:</b> R573586
<b>Vice-county No.:</b> H8	<b>SAC:</b> n/a
<b>Surveyor(s):</b> Dr Joanne Denyer	<b>Survey date:</b> 17/06/20
<b>Elevation (m):</b> <5m	<b>Solid geology:</b> Limestone

### Site notes

#### Site location

The ditch section with *Groenlandia densa* is located on the north-western edge of King's Island, Limerick (Figure 5.1). To the east of the ditch there is an area of wet grassland (GS4) (Photograph 1) and to the west a river embankment, alluvial woodland on flooded, low-lying ground by the river and the River Shannon (Figure 5.1).

**Figure 5.1. Location of ditch section with *Groenlandia densa* on King's Island**



Maps © Thunderforest, Data © OpenStreetMap contributors

#### Site description

The ditch is adjacent to the River Shannon. It is 3-4m wide and generally less than 1m deep. The ditch grades into wet grassland (GS4) to the east and dry meadow and grassy verges (GS2) on the embankment to the east. There is scattered willow scrub (WS2) along the ditch.

#### Protected site(s)

This section of ditch is adjacent to the Lower River Shannon Special Area of Conservation (SAC).

#### Watercourse habitat type

Fossitt: Drainage ditches (FW4)

#### Annex I habitat(s)

The aquatic vegetation in the ditch in 2017 had some affinity to the Annex I habitat **Floating River Vegetation** [3260]. However, the habitat is not a river (or canal) and there was only a low number (and cover) of most typical indicator species. It is therefore not considered to be an example of 3260 as described in the Lower River Shannon SAC Conservation Objectives).

#### *Groenlandia densa*

*Groenlandia densa* was not recorded in the 2020 survey.

#### 2020 Additional notes (Photographs 5.1, 5.2, 5.3, 5.5)

- Water depth: <1.0m deep
- Water clarity: 100% marked turbidity
- Algal dominance: 5%
- Rare/ quality species: n/a
- Channel form: 100% non-trapezoidal (eastern bank with shallow areas and grading into wet grassland)
- In-channel vegetation: 50% mid-successional (small amounts of open water and a mixture of submerged,

#### 2017 Additional notes (Photographs 5.4, 5.6)

- Water depth: <1.0m deep
- Water clarity: 60% clear; 40% slight turbidity
- Algal dominance: 8%
- Rare/ quality species: *Groenlandia densa*, *Chara vulgaris*
- Channel form: 100% non-trapezoidal (eastern bank with shallow areas and grading into wet grassland)
- In-channel vegetation: 100% mid-successional (small amounts of open water and a mixture of submerged,

APPENDIX E - KING'S ISLAND

<p>floating and emergent vegetation); 50% late successional (contains over 70% cover of emergents)</p> <ul style="list-style-type: none"> <li>• Bankside vegetation cover: 0% heavily shaded</li> <li>• Native macrophyte species (submerged, floating and emergent): <i>Lemna minor</i></li> </ul> <ul style="list-style-type: none"> <li>• Non-native macrophyte species: <i>Lemna minuta</i> (40%)</li> <li>• Non-native emergent species: n/a</li> <li>• Salinity: 750-860 <math>\mu\text{S}/\text{cm}</math> (freshwater)</li> <li>• pH: 7.23-7.28</li> </ul>	<p>floating and emergent vegetation); 50% late successional (contains over 70% cover of emergents)</p> <ul style="list-style-type: none"> <li>• Bankside vegetation cover: 0% heavily shaded</li> <li>• Native macrophyte species (submerged, floating and emergent): <i>Chara vulgaris</i>, <i>Callitriche cf obtusangula</i>, <i>Equisetum fluviatile</i>, <i>Glyceria maxima</i>, <i>Groenlandia densa</i>, <i>Iris pseudacorus</i>, <i>Lemna minor</i>, <i>Ranunculus cf trichophyllus</i>, <i>Sparganium sp.</i>, <i>Veronica beccabunga</i>, <i>Veronica catenata</i></li> <li>• Non-native macrophyte species: <i>Lemna minuta</i> (&lt;4%)</li> <li>• Non-native emergent species: n/a</li> <li>• Salinity: 327-540 <math>\mu\text{S}/\text{cm}</math> (freshwater)</li> <li>• pH 7.5-8.43</li> </ul>
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**Current management**

No obvious signs of management

**Threats**

Infilling of the river channel and ditches with vegetation (emergent, submerged and floating) due to lack of management. Dumping of litter and horse manure in the southern section of the ditch leading to eutrophication.

**Conservation measures**

Regular (sensitive) vegetation clearance in selected sections (or one side of the ditch/ river at a time) to improve conditions for early successional macrophyte species such as *Groenlandia densa*. Prompt removal of dumped material.

**Historic records**

*Groenlandia densa* was first (and last) recorded from this ditch in January 2017 (Figure 5.2; Photograph 5.6). There are no records from this ditch (or King's Island) in the *Flora of County Limerick* (Reynolds, 2013), *A survey of rare and scarce vascular plants in County Limerick* (Reynolds et al., 2006) or in the NPWS database (NPWS data provided March 2017). There are other vascular plant records in the *Flora of County Limerick* (Reynolds, 2013) from King's Island. The lack of records for *Groenlandia densa* in this location may either be because this section of ditch was not surveyed, or because the plant was not present until recently.

**Figure 5.2. Distribution of *Groenlandia densa* at King's Island in 2017**



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