Appendix A.8.12

Molluscan Survey Results

A.8.12 Molluscan Survey Results

This appendix presents the results of the molluscan surveys carried out in 2014 and 2017. The 2014 survey results are presented in a stand-alone report included in this Annex: *A Molluscan Survey of Selected Wetland Sites for the Galway City Transport Project* (Moorkens, 2014). Two supplementary sites within the Assessment Boundary were surveyed in 2017 following the same methodology: the southern end of Ballindooley Lough (Ch. 12+350) and the marsh at Castlegar (Ch. 13+000).

At the 2017 Ballindooley Lough site, the following species were recorded: *Anisus leucostoma*, *Galba truncatula*, *Stagnicola fuscus*, *Pisidium personatum*, *Pisidium casertanum*, *Arion intermedius*, *Carychium minimum*, *Deroceras laeve*, *Euconulus alderi*, *Punctum pygmaeum*, *Succinea putris*, *Vertigo antivertigo*, *Vertigo pygmaea* and *Zonitoides nitidus*.

At the Castlegar marsh site, *Galba truncatula*, *Stagnicola fuscus*, *Pisidium personatum*, *Arion ater*, *Carychium minimum*, *Clausilia bidentata*, *Cochlicopa lubrica*, *Deroceras reticulatum*, *Deroceras laeve*, *Euconulus alderi*, *Lehmania marginatus*, *Nesovitrea hammonis*, *Succinea putris*, *Trochulus striolatus* and *Vertigo antivertigo* were recorded in 2017.

As with the 2014 survey, the only species recorded that is listed in a threatened category on the Irish Red Lists is the Marsh whorl snail *Vertigo antivertigo* (listed as Vulnerable, in *Ireland Red List No. 2 – Non-Marine Molluscs* (Byrne et al., 2009)).

Refer to **Figure 8.5.1** for the locations of all sampling sites.

Annex A

A Molluscan Survey of Selected Wetland Sites for the Galway City Transport Project (Moorkens, 2014)

A MOLLUSCAN SURVEY OF SELECTED WETLAND SITES FOR THE GALWAY CITY TRANSPORT PROJECT

September 2014

Evelyn A. Moorkens

Contact Address:

53, Charleville Square,
Rathfarnham,
Dublin 14, Ireland.

Tel: 353 1 4948500 Mob: 353 86 8211385

e-mail: emoorkens@eircom.net

1.0 Introduction

A molluscan survey was undertaken in County Galway within the scheme study area for the N6 Galway City Transport Project. The survey concentrated on habitat areas with potential to support species that are protected by Annex II of the Habitat's Directive, particularly the *Vertigo* species.

The survey was carried from out from 11th August to 24th August 2014.

2.0 Scope of the study

The scope of the study was to carry out a comprehensive molluscan survey within the scheme study area for the N6 Galway City Transport Project, to inform the constraints study within the following remit:

- To assist in the provision of sufficient data from a molluscan perspective to identify the least damaging option, not only in terms of impacts on Special Areas of Conservation (SACs) / Special Protection Areas (SPAs) but also on non-designated habitats for Annex II snail species;

- To determine if there are any currently undesignated populations of Annex II snail species which would qualify for SAC designation; and

- To determine if there are any undesignated areas of habitats of Annex II snail species which could qualify as 'damage' under the Environmental Liability Directive if impacted by the road.

3.0 Methodology

3.1 Habitat identification

Molluscan surveys were undertaken in areas that were indicated by aerial photography and by wider habitat survey as having potential for Annex II molluscan species. Survey for the freshwater pearl mussel *Margaritifera margaritifera* is the subject of a separate report.

The habitats of the other 4 Annex II molluscan species are as follows:

Vertigo geyeri (from Moorkens & Killeen, 2011):

"The whorl snail *Vertigo geyeri* grows to less than 2mm in height. It is stringent in its requirement of saturated water conditions in calcareous, ground water fed flushes that are often limited in size to a few metres square. Their habitats often occur in mosaics of suitable patches within wider fen macrohabitats, that in Ireland can themselves fall within habitats that be as diverse as raised bog laggs, transition mires, lake shores, hill or mountain slopes, and wetlands associated with coastal dunes and machair (Moorkens, 2003). Within these macrohabitats, however, the snail is consistent in where it lives, within the saturated and decaying roots of small sedges (particularly *Carex viridula ssp. brachyrrhyncha*), associated fen mosses (particularly *Drepanocladus revolvens* and *Campyllium stellatum*).

Within its macrohabitat, the snail needs constancy of hydrological conditions, but with enough variation to provide refugia for the meteorological extremes that the habitat must endure. It requires an openness of habitat that prevents succession by shade loving plants and more competitive shade loving snails."

In the context of the habitat within the current constraints study, the potential habitat for *Vertigo geyeri* would be associated with spring fed slopes and seepage zones.

Vertigo angustior (from Moorkens & Killeen, 2011):

"The rare narrow-mouthed whorl snail *Vertigo angustior* grows to less than 2mm in height. At a broad level, it appears to be present in a very wide range of habitat categories of grassland, fen, marsh, salt marsh and flood plain, but the ecotone within which it is restricted means that the exact conditions which its presence demands are rare, and a lot of habitat that is "almost correct" is devoid of the snail, and other sites have an appropriate ecotone restricted to a narrow band only a few metres wide (but of

variable length). Sites where the species is widespread, especially those where a variety of suitable habitats and wetness conditions occur within the one general site are of high importance.

This snail is found associated with decaying vegetation in the litter layer, or in damp moss, in open unshaded habitats. Generally it occurs in open-structured, humid litter, but in very wet conditions can climb 10-15cm up the stems of plants or onto damp decaying timber. In dry conditions it may be found in the soil, just below the litter layer. In grassland situations it occurs at the base of tussocks and in fixed dune grassland among moss patches at the edge of dune slacks or higher and more widespread in dunes that have a naturally high water table or are subject to high levels of precipitation. It may also be found in and under flood debris.

This species requires friable and permanently moist litter, shaded by moderately tall herbaceous or grassy vegetation. It normally occurs in association with permanently moist but free-draining (permeable) soil, not subject to inundation. It is the latter requirement that makes seemingly suitable and widespread habitat unable to sustain a population of *V. angustior*."

In the context of the habitat within the current constraints study, the potential habitat for *Vertigo angustior* would consist of a calcareous transition zone between wetland and free draining grassland, typified by *Iris* beds at the edge of wet fields, or silverweed (*Potentilla anserina*) patches in transition areas.

Vertigo moulinsiana (from Moorkens & Killeen, 2011):

"The rare Desmoulin's whorl snail *Vertigo moulinsiana* is the largest of all the *Vertigo* species, growing to between 2.2 to 2.7mm in height. It lives on living and dead stems and leaves of tall plants in wetland situations.

As well as tall vegetation structure, *V. moulinsiana* requires a stable hydrogeology, where the water-table is at, or slightly above, the ground surface for much of the year and any seasonal flooding is of very low amplitude (Tattersfield & McInnes 2003). It climbs tall vegetation in the summer and autumn, and in winter it descends to litter level, and in severe conditions aestivates on the lower leaves of plants."

In the context of the habitat within the current constraints study, the potential habitat for *Vertigo moulinsiana* would consist of areas with a good distribution of tall *Carex* species, sometimes interspersed with *Schoenus nigricans* and *Phragmites australis.* It must be wet enough for water to rise and surround the surveyor's boot under light pressure. Extensive riverbank reedbeds with a sharp disconnection between the bank and the river makes *Vertigo moulinsiana* survival very unlikely, and similarly lake reedbeds with large water level changes are poor potential habitats, so areas with the most evenness of hydrology were surveyed.

Geomalacus maculosus (from Moorkens & Killeen, 2009):

"In Ireland, the Kerry slug is restricted to the sandstone geology of West Cork and Kerry. Within this range, it lives in two broad habitat types. The first type is oak dominated woodland, or mixed deciduous woodland with a mixture of oak and birch. The habitat is often sloping, with outcropping of rock or with boulders scattered amongst the trees. The second broad habitat is open situations of unimproved oligotrophic open moor or blanket bog with large sandstone boulders."

In the context of the habitat within the current constraints study, it should be taken into consideration that since the publication of this document in 2009, *Geomalacus* has been recorded in County Galway. However, within the scheme study area no potential habitat suitable for this species was identified. However, some potential for *Vertigo* habitat was identified.

Overall, initial surveys and aerial photography indicated that there were four main areas of potential *Vertigo* habitat:

1) Potential areas of reed swamp, wet grassland and fen along the Corrib River corridor;

2) Coolagh Lakes area;

3) Ballindooly Lough area;

4) Turlough features east of the Corrib.

3.2 Methodology

At each site a wide area was investigated and the main habitats with the potential to support *Vertigo* species were sampled. Habitats were sampled by hand, e.g. examination of litter, stems and the underside of timber. Suitable habitat vegetation was sampled by banging leaves onto a white tray, and by the removal of amalgamated litter samples from areas of best potential for *Vertigo* species.

Approximately 2-3 litres of litter was taken from each sampling site, air dried in the laboratory and then sieved through two mesh sizes, 3mm and 0.5mm. The contents of each sieve were examined for snails. An Olympus 40X binocular microscope was used to examine the smaller species.

4.0 Results

The habitat areas surveyed are shown in Figure 1, and described in Table 1. A total of 39 molluscan species were found in the survey, with a range of between 1 and 12 species per site. The full results of molluscan species found are shown in Table 2. Species are listed according to the nomenclature of Anderson (2005).

5.0 Discussion

There were no nationally or internationally rare or protected species found in this survey, but the species assemblage in some areas is of local interest.

There were no protected *Vertigo* species found in the field or in any of the samples, but three other *Vertigo* species *Vertigo pygmaea, V. antivertigo* and *V. substriata* were found at various sites, which suggests that the habitat conditions were not quite even in wetness and/or calcareous enough for the three Annex II *Vertigo* species. The rest of the species are typical of wet grassland, reedbed, riparian fringe and fen habitats. Together the sites display a good range of species assemblage with good variety across the sites, reflecting the level of variation in wetness and vegetative succession of different areas. It should be noted that *Vertigo antivertigo* is listed as vulnerable in the Irish Red Data List of molluscs (Byrne *et al*., 2009).

The best areas of habitat for molluscs found were towards the southern end of Coolagh Lakes, concentrated in the area around Site 110, with high quality fen and transitional habitat. Here the most concentrated searches for *V. geyeri* were undertaken, but no individuals of this species were found in the field or in samples removed.

The scope of the study was to carry out a comprehensive molluscan survey within the study area for the N6 Galway City Transport Project, to inform the constraints study within the remit defined in Section 2. The study was based on ground truth surveys of areas chosen from aerial photographs and habitat studies. Unless further habitat survey identifies previously unknown areas of potential habitat, the sites surveyed are considered to be sufficient to draw conclusions. From the remit, the following conclusions can be drawn:

There is sufficient data from a molluscan perspective to conclude that there are no constraints from a molluscan perspective to the choice of option, not only in terms of impacts on SACs/SPAs but also on non-designated habitats for Annex II snail species, as no undesignated populations of Annex II snail species were found. Thus:

- There is sufficient data from a molluscan perspective to conclude that there will be no direct impacts on Annex II terrestrial snail species within the scheme study area;

- It is confirmed that there were no currently undesignated populations of *Vertigo geyeri, V. angustior, V.moulinsiana* or *G. maculosus* found which would qualify for SAC designation; and

- It is confirmed that there were no new populations of *Vertigo geyeri, V. angustior, V.moulinsiana* or *G. maculosus* found which could be impacted by the

construction or operation of the road and qualify as 'damage' under the Environmental Liability Directive.

6.0 References

Anderson, R. (2005) An annotated list of the non-marine mollusca of Britain and Ireland. *Journal of Conchology* 38, 607-638.

Byrne, A., Moorkens, E.A., Anderson, R., Killeen, I.J. & Regan, E.C. (2009) *Ireland Red List No. 2 – Non-Marine Molluscs.* National Parks and Wildlife Service, Department of the Environment, Heritage andLocal Government, Dublin, Ireland.

Moorkens, E.A. & Killeen, I.J. (2009). *Database of association with habitat and environmental variables for non-shelled slugs and bivalves of Britain and Ireland.* Irish Wildlife Manuals No. 41. National Parks and Wildlife Service, Department of the Environment, Heritage and Local Government, Dublin, Ireland.

Moorkens, E.A. & Killeen, I.J. (2011) Monitoring and Condition Assessment of Populations of *Vertigo geyeri*, *Vertigo angustior* and *Vertigo moulinsiana* in Ireland. *Irish Wildlife Manual*s, No. 55. National Parks and Wildlife Service, Department of Arts, Heritage and Gaeltacht, Dublin, Ireland.

Table 1 Sites surveyed (grid reference is from where sample was collected)

Site 1	**Site 2**	**Site 3**
M28201 27867	M28209 27881	M28125 27906
Wet grassland between path and Corrib on west bank	As for site 1 with *Potentilla anserina*, *Mentha* and *Menyanthes*	Further into fen, *Equisetum, Iris,* reed, *Juncus, Cladium, Epilobium*
		
Site 4	**Site 5**	**Site 6**
M28231 27901	M28180 27851	M28125 27906
Marginal *Cladium* beds	On S side of path, wet grassland with *Potentilla, Iris, Lythrum*, mosses	As site 5 but further NW
		
Site 7	**Site 8**	**Site 9**
M28037 28074	M28025 28109	M28038 28190
Reed bed at drain perpendicular to river at edge of horse grazed field	Bramble scrub on hummock	Dry area with *Schoenus nigricans* (very little thatch)
		

Site 10	**Site 11**	**Site 12**
M28050 28199	M28057 28204	M28065 28269
Dry *Schoenus* fen with *Iris* and *Filipendula*	Denser *Iris* bed	*Carex paniculata* tussocks
		

Site 13	**Site 14**	**Site 15**
M28046 28355	M28022 28380	M27988 28373
Iris bed with *Menyanthes, Carex* and mosses	*Menyanthes* transition into *Cladium* bed	Central area of bog with ling, cottongrass, *sphagnum*
		

Site 16	**Site 17**	**Site 18**
M27906 28368	M27894 28369	M27892 28376
Wetter depression beyond bog with sedges, *Menyanthes, Succisa, Equisetum*	Similar to site 16	Similar to site 16
		

Site 19	**Site 20**	**Site 21**
M27856 28395	M27808 28366	M27996 28392
Similar to site 16	Similar to site 16	Transition grassland near reed bed edge

Site 22	**Site 23**	**Site 24**
M27976 28413	M27955 28434	M27863 28292
Transition grassland near reed bed edge	Transition grassland near reed bed edge	Wetter depression beyond bog with sedges, *Menyanthes, Succisa, Equisetum, Briza*
		

Site 25	**Site 26**	**Site 27**
M28647 27529	M28732 27503	M28759 27488
Phragmites and *Filipendula* stand	Reed bed at woodland edge	*Phragmites* margin with *Potentilla*
		

Site 28	**Site 29**	**Site 30**
M28965 27126	M28998 27132	M28931 27213
Typha ditch near housing estate	*Juncus* bed	Grassland with *Lythrum* and *Iris*
		

Site 31	**Site 32**	**Site 33**
M28926 27248	M28859 27258	M28826 27240
Line of *Typha* in *Juncus* grassland	Calcareous grassland with *Briza*, *Centaurea*, mosses	Hollow in wet grassland with *Potentilla*, mosses, *Blackstonia*
		

Site 34	**Site 35**	**Site 36**
M28797 28606	M28802 28611	M28806 28613
Turlough at Menlough – large *Iris* mounds	Turlough - Edge of *Potentilla* and sedge habitat	Turlough - Edge of *Potentilla* and sedge habitat
		

Site 37	**Site 38**	**Site 39**
M28825 28602	M28814 28587	M28812 28578
Turlough - *Filipendula* and *Potentilla* grassland	Turlough - Slope with *Potentilla* and sedges	Turlough - Bottom of slope with *Potentilla* and sedges
		

Site 40	**Site 41**	**Site 42**
M30980 29063	M30977 29059	M31291 28884
Turlough W of Ballindooley, by wall with *Potentilla* grassland	Turlough – other side of wall, slope with *Phalaris & Filipendula*	Ballindooley Lough area – wet fen with *Carex paniculata, Mentha,* mosses, *Lythrum*
		

Site 43	**Site 44**	**Site 45**
M31275 28884	M31266 28872	M31806 28882
Ballindooley – as for site 42	Ballindooley – similar to site 42	Ballindooley - similar to site 42 with more *Potentilla*
		

Site 46	**Site 47**	**Site 48**
M31349 28851	M31354 28842	M31366 28829
Ballindooley – transition into *Schoenus* fen + *Parnassia & Succisa*	Ballindooley – as site 46 with *Calliergonella* moss mounds	Ballindooley – richer *Schoenus* fen as 46 + *Campylium stellatum* moss
		

Site 49	**Site 50**	**Site 51**
M31409 28830	M31427 28837	M31420 28839
Ballindooley – Near deep drain, fen	Ballindooley – marl lake fringe with *Cladium* and *Phragmites*	Ballindooley - *Cladium* and *Phragmites* and mosses
		

Site 52	**Site 53**	**Site 54**
M31403 28852	M31539 29014	M31525 29043
Ballindooley – near SW edge of lake, fen	Ballindooley – Fen much the same as site 46 + myrtle and *Phragmites*	Ballindooley – Drier edge with *Potentilla, Mentha, Filipendula*
		

Site 55	**Site 56**	**Site 57**
M31553 29067	M31562 29063	M31570 29070
Ballindooley – Transition to richer fen	Ballindooley – rich flush with *Schoenus*, small sedges, mosses etc	Ballindooley – denser *Phragmites*
		

Site 58	**Site 59**	**Site 60**
M31642 29098	M31646 29095	M31673 29155
Ballindooley – *Cladium* bed	Ballindooley – fen at edge of *Cladium* bed	Ballindooley – Transition from *Potentilla* grassland to *Menyathes*, *Carex rostrata*
		

Site 61	**Site 62**	**Site 63**
M31683 29162	M31715 29171	M31682 29244
Ballindooley – *Potentilla* grassland	Ballindooley – *Potentilla* grassland, mosses, *Molinea*	Ballindooley – old ditch with *Carex paniculata* and *Potentilla*
		

Site 64	**Site 65**	**Site 66**
M31716 29276	M31808 27945	M31860 27935
Ballindooley – old ditch with *Carex paniculata* and *Potentilla*	Marked as spring site – no evidence	Castlegar Well - Marked as spring site – no evidence
		

Site 67	**Site 68**	**Site 69**
M31531 30105	M28371 28035	M28388 28070
Marked as spring site – no evidence	Menlough - Wet grassland - *Iris* and *Potentilla*	Menlough - Similar to 68
		

Site 70	**Site 71**	**Site 72**
M28369 28112	M28355 28125	M28312 28174
Menlough - Patch of *Iris* marsh	Menlough – mossier *Iris* patch	Menlough –*Iris* in corner of next field
		

Site 73	**Site 74**	**Site 75**
M28269 28200	M28220 28222	M28265 28076
Menlough – Wet *Juncus* field	Menlough – *Iris* & *Juncus* corner	Menlough – *Typha* marsh with *Mentha* transition to *Equisetum* & *Menyanthes*
		

Site 76	**Site 77**	**Site 78**
M28276 28042	M29458 26884	M29430 26883
Menlough – similar to 75 more moss	Terryland – *Iris* marsh	Terryland – *Iris* marsh with sedge, reed and tall herbs
		

Site 79	**Site 80**	**Site 81**
M29416 26884	M29401 26887	M29372 26922
Terryland – Transition with *Mentha, Equisetum, Carex, Menyanthes*	Terryland – Centre of transition mire	Terryland – Transition with *Iris, Potentilla, Filipendula*
		

Site 82	**Site 83**	**Site 84**
M29376 26934	M29348 26892	M29364 26875
Terryland - Denser *Iris* marsh	Terryland – Tall sedge and reed swamp	Terryland – Transition with *Mentha, Equisetum, Carex, Menyanthes, Iris*
		

Site 85	**Site 86**	**Site 87**
M30615 26600	M30757 26759	M31099 26853
Terryland Stream – Steep reed fringed banks	Terryland Stream & Park – Steep reed fringed banks	Terryland Stream & Park – Dense *Phragmites*, willowherb, bindweed
		

Site 88	**Site 89**	**Site 90**
M31169 27051	M31276 27265	M31288 27274
Mostly *Phalaris*	Dense *Phragmites*, willowherb, bindweed	Dense *Phragmites*, willowherb, bindweed

Site 91	**Site 92**	**Site 93**
M31630 27723	M31638 27690	M28997 27475
Castlegar – Wet grassland transition into reed	Castlegar – Denser reed	Coolagh South – transition from wet grassland to reed
		

Site 94	**Site 95**	**Site 96**
M28978 27511	M28953 27503	M29001 27463
Coolagh S – Transition mire with *Equisetum, Menyanthes, Iris*	Coolagh S – tall herb fen between field and river	Coolagh S – Heavily poached fen edge
		

Site 97	**Site 98**	**Site 99**
M29026 27458	M29064 27455	M29132 27402
Coolagh S – *Cladium* bed with *Sparganium*, poached	Coolagh S – *Juncus* field with *Iris* patches	Coolagh S – Mossy depression with *Juncus* and *Iris*
		

Site 100	**Site 101**	**Site 102**
M29175 27339	M29273 27393	M29306 27380
Coolagh S – Herb fen with *Iris, Lythrum, Filipendula*	Coolagh S – Patches of *Iris*, reed and *Juncus*	Coolagh S – similar to 101 but very dry
		

Site 103	**Site 104**	**Site 105**
M29323 27427	M29244 27428	M29098 27570
Coolagh S – Very dry transition grassland	Coolagh S – *Iris* stands at edge of richly vegetated ditch	Coolagh S – ivy covered limestone walls
		(Potential for *Vertigo pusilla* but not found)

Site 106	**Site 107**	**Site 108**
M29180 27739	M29148 27766	M29004 27945
Coolagh S – Rank wet grassland at edge of ditch	Coolagh S – Ungrazed, rank *Juncus* grassland	Coolagh S – Peaty wet grassland with sedges, *Lythrum* etc
		
Site 109	**Site 110**	**Site 111**
M29043 27934	M29245 27824	M29253 27816
Coolagh S – *Mentha*, mossy pockets, *Carex paniculata*	Coolagh S – Rich transition fen with mix of sedges, mosses, *Mentha*	Coolagh S – similar
		
Site 112	**Site 113**	**Site 114**
M 29254 27807	M29246 27793	M29266 27739
Coolagh S – good potential habitat area	Coolagh S – Good transition habitat area	Coolagh S – Fen transition into grassland
		
Site 115	**Site 116**	**Site 117**
M29240 27726	M29223 27744	M29309 28258
Coolagh S – Drier but mossier patch	Coolagh S – sedge and *Mentha* transition	Turlough, dense *Myosotis* and bistort
		

Site 118		
M29364 28157		
Near turlough, limestone grassland slopes		
		

Table 2: Molluscan survey results

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	
Anisus leucostoma																														*Anisus leucostoma*
Bithynia leachii																														*Bithynia leachii*
Galba truncatula		•	•			•					•		•			•	•	•	•	•				•				•		*Galba truncatula*
Radix balthica																														*Radix balthica*
Stagnicola fuscus					•	•							•	•							•	•	•							*Stagnicola fuscus*
Pisidium personatum																														*Pisidium personatum*
Pisidium obtusale																														*Pisidium obtusale*
Planorbis carinatus													•																	*Planorbis carinatus*
Acanthinula aculeata								•																						*Acanthinula aculeata*
Aegopinella pura	•	•	•		•																				•	•	•			*Aegopinella pura*
Arion distinctus																									•					*Arion distinctus*
Arion intermedius								•																						*Arion intermedius*
Arion rufus					•	•		•							•															*Arion rufus*
Arion subfuscus					•																							•		*Arion subfuscus*
Carychium minimum		•	•			•										•	•	•	•	•										*Carychium minimum*
Carychium tridentatum																														*Carychium tridentatum*
Cepaea nemoralis						•																						•		*Cepaea nemoralis*
Clausilia bidentata		•						•																		•				*Clausilia bidentata*
Cochlicopa lubrica	•		•		•			•																	•	•	•	•		*Cochlicopa lubrica*
Columella aspera				•																										*Columella aspera*
Columella edentula	•																											•		*Columella edentula*
Deroceras reticulatum					•																									*Deroceras reticulatum*
Discus rotundatus								•																		•				*Discus rotundatus*
Euconulus alderi			•													•	•	•	•	•										*Euconulus alderi*
Euconulus fulvus	•				•	•							•																	*Euconulus fulvus*
Helicella itala																														*Helicella itala*
Lauria cylindracea								•																						*Lauria cylindracea*
Nesovitrea hammonis		•	•		•	•		•					•			•	•	•	•	•				•				•		*Nesovitrea hammonis*
Oxyloma elegans																														*Oxyloma elegans*
Punctum pygmaeum		•	•		•	•		•																	•		•	•		*Punctum pygmaeum*
Succinea putris			•	•	•	•	•			•	•		•	•		•	•	•	•	•	•	•	•	•	•		•	•		*Succinea putris*
Trochulus hispidus					•	•																				•	•	•		*Trochulus hispidus*
Vallonia excentrica								•																						*Vallonia excentrica*
Vallonia pulchella																														*Vallonia pulchella*
Vertigo antivertigo																														*Vertigo antivertigo*
Vertigo pygmaea																														*Vertigo pygmaea*
Vertigo substriata	•	•			•																									*Vertigo substriata*
Zonitoides nitidus						•																								*Zonitoides nitidus*

Table 2 continued: Molluscan survey results

	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	
Anisus leucostoma																											•	*Anisus leucostoma*
Bithynia leachii																												*Bithynia leachii*
Galba truncatula	•	•											•	•	•	•				•	•	•	•	•				*Galba truncatula*
Radix balthica																												*Radix balthica*
Stagnicola fuscus																										•		*Stagnicola fuscus*
Pisidium personatum																												*Pisidium personatum*
Pisidium obtusale																												*Pisidium obtusale*
Planorbis carinatus																												*Planorbis carinatus*
Acanthinula aculeata				•																								*Acanthinula aculeata*
Aegopinella pura	•		•	•																								*Aegopinella pura*
Arion distinctus																												*Arion distinctus*
Arion intermedius				•																								*Arion intermedius*
Arion rufus																												*Arion rufus*
Arion subfuscus	•	•	•																						•			*Arion subfuscus*
Carychium minimum				•				•	•	•			•	•	•	•			•				•	•	•	•	•	*Carychium minimum*
Carychium tridentatum	•			•																								*Carychium tridentatum*
Cepaea nemoralis	•		•	•																								*Cepaea nemoralis*
Clausilia bidentata																												*Clausilia bidentata*
Cochlicopa lubrica	•	•	•	•																								*Cochlicopa lubrica*
Columella aspera																												*Columella aspera*
Columella edentula	•	•																										*Columella edentula*
Deroceras reticulatum												•	•															*Deroceras reticulatum*
Discus rotundatus																												*Discus rotundatus*
Euconulus alderi																							•				•	*Euconulus alderi*
Euconulus fulvus	•	•	•	•										•	•			•	•					•	•	•		*Euconulus fulvus*
Helicella itala				•																								*Helicella itala*
Lauria cylindracea																												*Lauria cylindracea*
Nesovitrea hammonis		•		•										•				•						•				*Nesovitrea hammonis*
Oxyloma elegans																					•	•					•	*Oxyloma elegans*
Punctum pygmaeum	•	•		•														•	•	•			•	•	•	•	•	*Punctum pygmaeum*
Succinea putris	•	•			•	•		•		•			•	•	•	•	•	•	•		•		•		•		•	*Succinea putris*
Trochulus hispidus	•		•	•																								*Trochulus hispidus*
Vallonia excentrica																												*Vallonia excentrica*
Vallonia pulchella																												*Vallonia pulchella*
Vertigo antivertigo																		•		•		•	•		•	•	•	*Vertigo antivertigo*
Vertigo pygmaea																										•		*Vertigo pygmaea*
Vertigo substriata																		•	•									*Vertigo substriata*
Zonitoides nitidus																				•		•	•		•		•	*Zonitoides nitidus*

Table 2 continued: Molluscan survey results

	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	
Anisus leucostoma	•																											*Anisus leucostoma*
Bithynia leachii																							•					*Bithynia leachii*
Galba truncatula				•																•	•	•						*Galba truncatula*
Radix balthica																												*Radix balthica*
Stagnicola fuscus	•		•	•															•	•		•	•	•			•	*Stagnicola fuscus*
Pisidium personatum																												*Pisidium personatum*
Pisidium obtusale																												*Pisidium obtusale*
Planorbis carinatus																												*Planorbis carinatus*
Acanthinula aculeata																												*Acanthinula aculeata*
Aegopinella pura												•	•													•		*Aegopinella pura*
Arion distinctus																												*Arion distinctus*
Arion intermedius																												*Arion intermedius*
Arion rufus												•	•	•							•				•			*Arion rufus*
Arion subfuscus																												*Arion subfuscus*
Carychium minimum	•														•	•	•			•		•	•	•			•	*Carychium minimum*
Carychium tridentatum												•		•							•					•		*Carychium tridentatum*
Cepaea nemoralis													•			•												*Cepaea nemoralis*
Clausilia bidentata																												*Clausilia bidentata*
Cochlicopa lubrica													•	•		•		•			•							*Cochlicopa lubrica*
Columella aspera																												*Columella aspera*
Columella edentula												•	•	•							•				•			*Columella edentula*
Deroceras reticulatum												•	•	•							•					•		*Deroceras reticulatum*
Discus rotundatus																												*Discus rotundatus*
Euconulus alderi				•																•								*Euconulus alderi*
Euconulus fulvus			•			•							•			•					•				•		•	*Euconulus fulvus*
Helicella itala																												*Helicella itala*
Lauria cylindracea																												*Lauria cylindracea*
Nesovitrea hammonis																•					•			•				*Nesovitrea hammonis*
Oxyloma elegans																								•				*Oxyloma elegans*
Punctum pygmaeum			•	•	•	•	•					•	•	•	•	•	•	•			•		•	•			•	*Punctum pygmaeum*
Succinea putris	•			•			•					•	•	•	•	•		•	•	•	•	•		•	•		•	*Succinea putris*
Trochulus hispidus													•															*Trochulus hispidus*
Vallonia excentrica																												*Vallonia excentrica*
Vallonia pulchella																												*Vallonia pulchella*
Vertigo antivertigo				•											•	•	•	•		•		•	•	•		•	•	*Vertigo antivertigo*
Vertigo pygmaea					•							•	•	•				•			•				•			*Vertigo pygmaea*
Vertigo substriata												•	•			•	•											*Vertigo substriata*
Zonitoides nitidus															•			•		•		•	•	•				*Zonitoides nitidus*

Table 2 continued: Molluscan survey results

	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	
Anisus leucostoma																										*Anisus leucostoma*
Bithynia leachii											•		•													*Bithynia leachii*
Galba truncatula	•											•														*Galba truncatula*
Radix balthica																										*Radix balthica*
Stagnicola fuscus	•										•	•	•	•					•							*Stagnicola fuscus*
Pisidium personatum																										*Pisidium personatum*
Pisidium obtusale																										*Pisidium obtusale*
Planorbis planorbis											•															*Planorbis planorbis*
Aegopinella pura																										*Aegopinella pura*
Arion distinctus																										*Arion distinctus*
Arion intermedius																										*Arion intermedius*
Arion rufus									•	•	•				•	•									•	*Arion rufus*
Arion subfuscus																										*Arion subfuscus*
Carychium minimum	•										•	•				•		•						•		*Carychium minimum*
Carychium tridentatum								•																		*Carychium tridentatum*
Cepaea nemoralis	•							•	•							•	•			•	•	•	•	•	•	*Cepaea nemoralis*
Clausilia bidentata																						•				*Clausilia bidentata*
Cochlicopa lubrica								•	•																	*Cochlicopa lubrica*
Columella aspera																										*Columella aspera*
Columella edentula								•																		*Columella edentula*
Deroceras reticulatum											•				•					•			•	•	•	*Deroceras reticulatum*
Discus rotundatus																										*Discus rotundatus*
Euconulus alderi																										*Euconulus alderi*
Euconulus fulvus									•							•	•	•								*Euconulus fulvus*
Helicella itala																										*Helicella itala*
Lauria cylindracea																						•				*Lauria cylindracea*
Nesovitrea hammonis																•		•						•		*Nesovitrea hammonis*
Oxychilus cellarius																						•				*Oxychilus cellarius*
Oxyloma elegans																										*Oxyloma elegans*
Punctum pygmaeum								•			•				•	•	•	•	•				•	•		*Punctum pygmaeum*
Succinea putris	•							•	•		•	•	•	•				•	•							*Succinea putris*
Trochulus hispidus																										*Trochulus hispidus*
Vallonia excentrica																										*Vallonia excentrica*
Vallonia pulchella																										*Vallonia pulchella*
Vertigo antivertigo	•										•		•	•		•		•	•							*Vertigo antivertigo*
Vertigo pygmaea								•																		*Vertigo pygmaea*
Vertigo substriata								•																		*Vertigo substriata*
Zonitoides nitidus	•											•		•				•								*Zonitoides nitidus*

Table 2 continued: Molluscan survey results

	109	110	111	112	113	114	115	116	117	118	
Anisus leucostoma											*Anisus leucostoma*
Bithynia leachii											*Bithynia leachii*
Galba truncatula									•		*Galba truncatula*
Radix balthica									•		*Radix balthica*
Stagnicola fuscus	•		•	•							*Stagnicola fuscus*
Pisidium personatum		•	•	•							*Pisidium personatum*
Pisidium obtusale		•	•	•							*Pisidium obtusale*
Planorbis carinatus											*Planorbis carinatus*
Aegopinella pura											*Aegopinella pura*
Arion distinctus											*Arion distinctus*
Arion intermedius											*Arion intermedius*
Arion rufus		•						•			*Arion rufus*
Arion subfuscus											*Arion subfuscus*
Carychium minimum	•										*Carychium minimum*
Carychium tridentatum											*Carychium tridentatum*
Cepaea nemoralis											*Cepaea nemoralis*
Clausilia bidentata											*Clausilia bidentata*
Cochlicopa lubrica										•	*Cochlicopa lubrica*
Columella aspera											*Columella aspera*
Columella edentula											*Columella edentula*
Deroceras reticulatum											*Deroceras reticulatum*
Discus rotundatus											*Discus rotundatus*
Euconulus alderi		•	•	•							*Euconulus alderi*
Euconulus fulvus							•	•			*Euconulus fulvus*
Helicella itala										•	*Helicella itala*
Nesovitrea hammonis		•									*Nesovitrea hammonis*
Oxyloma elegans			•	•							*Oxyloma elegans*
Punctum pygmaeum	•	•	•	•		•	•			•	*Punctum pygmaeum*
Succinea putris	•	•			•	•					*Succinea putris*
Trochulus hispidus											*Trochulus hispidus*
Vallonia excentrica											*Vallonia excentrica*
Vallonia pulchella		•	•								*Vallonia pulchella*
Vertigo antivertigo	•	•	•	•	•			•			*Vertigo antivertigo*
Vertigo pygmaea										•	*Vertigo pygmaea*
Vertigo substriata		•									*Vertigo substriata*
Vitrea contracta										•	*Vitrea contracta*
Zonitoides nitidus		•	•	•							*Zonitoides nitidus*

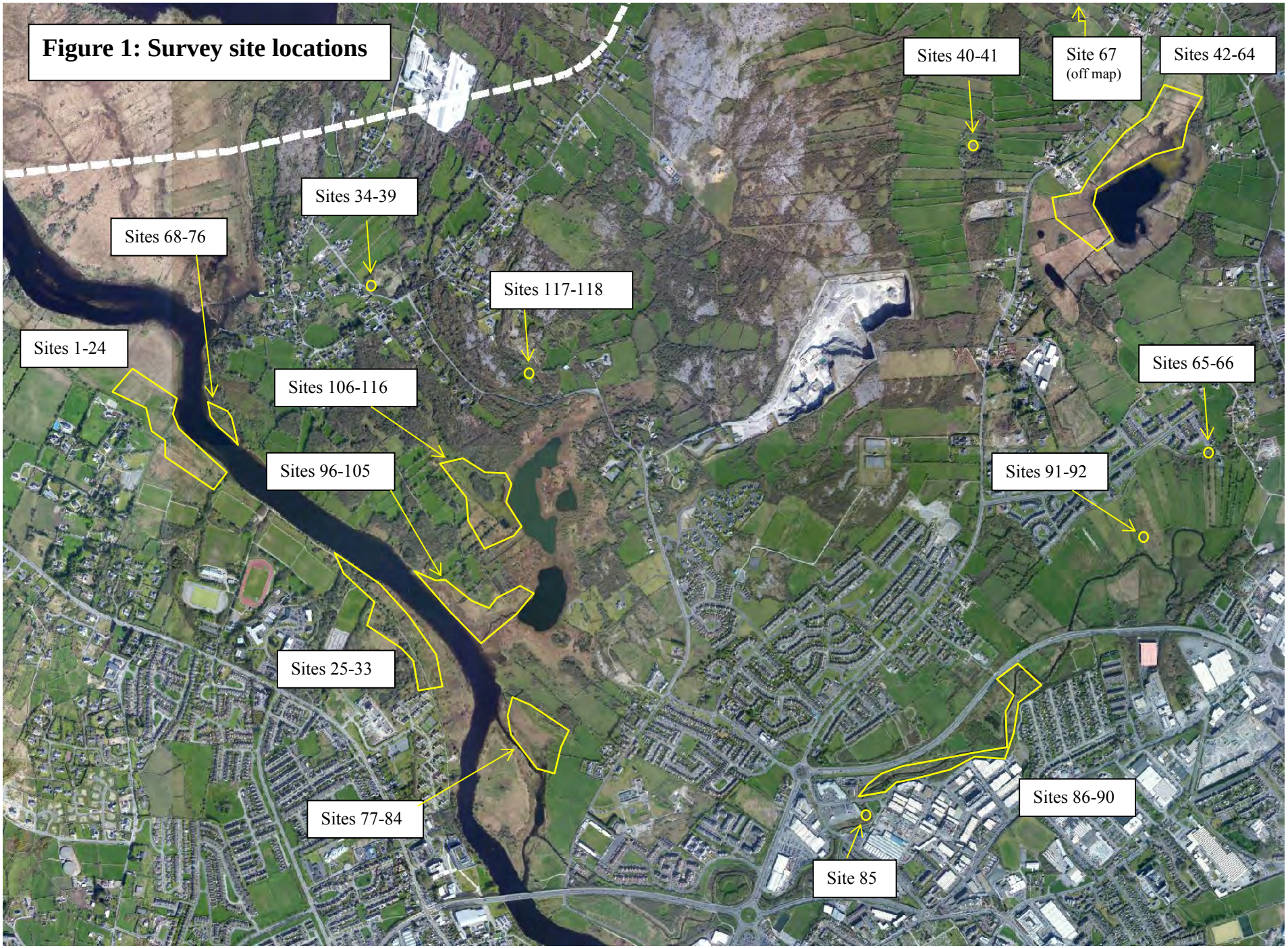
Figure 1: Survey site locations
Sites 40-41
Site 67
(off map)
Sites 42-64
Sites 34-39
Sites 68-76
Sites 117-118
Sites 1-24
Sites 65-66
Sites 106-116
Sites 96-105
Sites 91-92
Sites 25-33
Sites 86-90
Sites 77-84
Site 85