Site Report: Ardkill Turlough
TCD Turlough Research project 2006-2011

Turlough Project Code	SAC Name	SAC/NHA No.	County	Townland	RBD	Easting	Northing	Area (ha)
ARD	Ardkill	000461	Mayo	Ardkill	WESTERN	127360	262500	23

File update: July 2015 (S. Waldren)

Site Description

Ardkill turlough, one of the smaller study sites (23 ha), is located near Ballinrobe in south County Mayo and is one of a group of five turloughs that occupy hollows in rolling countryside. Skealoghan and Kilglassan turloughs are situated to the west and east of this site, respectively. Steep slopes occur on the south-western side and a low, central limestone cliff is a distinguishing feature of the site. Of the twelve mapped vegetation communities, *Lolium* grassland and *Polygonum amphibium* were the most extensive. Ardkill soils are highly organic and moderately alkaline. The two soil types occurring at the site were 'Fen Peats' and 'Very shallow well-drained organic'. Sixty percent of the site is under rotational grazing. Ardkill generally has a single, long duration flood. It is a moderately deep basin, particularly the south-western end, which holds water for long periods. The turlough has a relatively low drainage capacity and long recession duration. Parts of the turlough are heavily grazed, with consequent poaching and damage to vegetation.

Ardkill – photo: S. Kimberley

Phytoplankton

Phytoplankton analysis was conducted on sub-samples of monthly spot samples collected for hydrochemical analysis between October 2006 and June 2007. Phytoplankton composition varies significantly over time and data from autumn, mid-winter and spring/early summer are presented below. Taxa were identified to species level where possible. Some taxa were not discriminated beyond general groupings (i.e. small centric diatoms, dinoflagellates and pinnate diatoms). The term non-identifiable alone (or n.i.) was reserved for cases where specimens were not identifiable. Discrimination between n.i. filament, n.i. flagellate, n.i. colony, n.i. green filament was made when applicable. Biovolume (mm^3 m^{-3}) was used as the measure of algal biomass.

October 2006		January 2007		May 2007	
Biovolume (mm^3/m^3)	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*
Chroomonas acuta	4827964	*Monoraphidium*	50096	n.i. filament	115361
Nitzchia sp.	352281	*Monoraphidium*	25510	n.i. pennates	43338
Cryptomonas sp.	102021	n.i. flagellates	13474	n.i. pennates	38435
Actinastrum hantzschii	94992	*Cymbella/Encyonema*	9050	n.i.	19241
Euglena sp.	69204	*Mallomonas akrokomos*	8258	*Nitzchia*	19218

Benthic Algae

Turloughs were inspected for algal mats during the emptying phase in 2007, 2008 and 2009. Turloughs were visited in the first two weeks of March to June 2007 as part of the monthly monitoring of turloughs. Dedicated trips to inspect for algal mats were conducted in 2008 on the 4th of March, the 1st of April, and the 26th, 27th and 28th of May, and in 2009 on the 15th and 16th of June and on the 24th and 25th of July. The presence of both living floating mats and dead drying mats was noted, as well as their extent in the turlough basins. Occurrence of visible filamentous algal mats in the three years of observation is presented below. Y = visible occurrence; * = "extensive cover" (estimated to be 2 to 8% of total area of basin); † = negligible quantity observed; • = turlough was too flooded to permit full observation. Algal mats were observed in Ardkill each year, with extensive algal mats observed in 2009.

Year of Observation		
2007	**2008**	**2009**
Y	Y	Y*

Hydrochemistry

Data shown are the mean ± SD of monthly spot samples collected between October 2006 and June 2007. Mean seasonal Total P and Chlorophyll *a* were used to determine the trophic status of the floodwaters based on OECD trophic categories. The median and range of <u>mean values</u> across all turloughs are also provided. Ardkill has very high concentrations of total phosphorus in the water (the highest recorded), high chlorophyll *a*, and moderately high total nitrogen; the turlough is strongly eutrophic.

Hydrochemical Variable	Ardkill Values		Turlough Summary Stats (n=22)		
	Mean±SD	OECD Trophic Category	Median	Min	Max
pH	8.1 ± 0.2	-	8.1	7.7	8.3
Alkalinity mg l^{-1} $CaCO_3$	220.2 ± 25.0	-	204.0	112.4	236.4
Colour mg l^{-1} PtCo	28.3 ± 8.8	-	26.9	7.9	85.1
Molybdate Reactive Phosphorus µg l^{-1}	42.1 ± 26.6	-	3.4	0.7	42.1
Total Phosphorus µg l^{-1}	82.1 ± 32.6	Eutrophic	24.8	4.0	82.1
Chlorophyll *a* µg l^{-1}	12.7 ± 16.1	Eutrophic	4.9	1.1	33.5
Nitrate-N mg l^{-1}	1.2 ± 1.0		0.7	0.1	1.9
Total Nitrogen mg l^{-1}	1.7 ± 1.0		1.2	0.6	2.3

Aquatic Invertebrates

22 turloughs were sampled for littoral aquatic macroinvertebrates using sweep nets during November 2006 and April 2007. Zooplankton samples were collected in April 2007. Open-water cladocerans and littoral chydorids were sampled using a zooplankton net and perspex tube respectively.

Aquatic Macroinvertebrates			
November 2006	**Count**	**April 2007**	**Count**
Agabus nebulosus	3	*Agabus nebulosus*	1
Agyroneta aquatica	2	*Agabus* sp. (larva)	129
Asellus aquaticus	3	*Asellus aquaticus*	9
Baetidae sp.	1	*Callicorixa praeusta*	1
Cercyon tristis	1	Chironomidae	17
Coenagrion sp.	4	*Cloeon simile*	3
Corixa punctata/iberica	2	*Corixinae* Instar I & II	1
Culicidae	1	*Diptera* Pupae	3
Curculionidae	1	*Dryops* sp. (larva)	12
Dryops sp. (larva)	3	*Hydrachnidia* (Mite)	3
Haliplus fulvus	13	*Hydroporus palustris*	2
Haliplus sp. *ruficollis* group (females)	11	*Hygrotus impressopunctatus*	1
Helophorus brevipalpis	2	*Hygrotus inaequalis*	2
Hydrachnidia (Mite)	8	*Hygrotus* sp. (larva)	4
Hydroporus palustris	59	*Ilybius* sp. (larva)	2
Hygrotus inaequalis	5	*Laccophilus minutus*	1
Hygrotus parallelogramus	2	*Laccophilus* sp. (larva)	2
Limnephilis nigriceps	1	*Limnephilus centralis*	1
Limnephilus lunatus	3	*Lymnaea peregra*	1
Lymnaea peregra	5	Oligochaeta	126
Lymnaea trunculata	4	Ostracoda	95
Megasternum obscurum	2	*Rhantus* sp. (larva)	6
Ochthebius minimus	1	*Succinea* sp.	1
Oligochaeta	7	*Zygoptera* sp. larvae	1
Ostracoda	18		
Parapoynx stratiotata	2		
Planorbis crista	7		
Polycelis nigra/tenuis	1		
Porhydrus lineatus	3		
Rhantus sp. (larva)	2		

Aquatic Macroinvertebrates: Presence of high abundances (> 50 individuals) of Ostracoda recorded in April 2007 indicates nutrient enrichment.

Aquatic Macroinvertebrate Taxa	Presence of high abundances	
	November 2006	April 2007
Diptera	N	N
Ostracoda	N	Y
Odonata	N	N
Trichoptera	N	N

Zooplankton species
Acroperus angustatus
Acroperus harpae
Alona affinis
Alona guttata
Alona rustica
Alona guttata
Alona rustica
Chydorus sphaericus
Daphnia pulex
Eurycercus lamellatus
Lathurona rectirostris
Rhynchotalona rostrata
Simocephalus vetulus

Vegetation

Vegetation description and classification yielded 25 vegetation communities suitable for mapping. Twelve vegetation communities were mapped in Ardkill turlough; as noted by Goodwillie (1992), this high diversity is likely driven by the deep flooding of the turlough. High conservation value communities are denoted by *. 102 plant species were recorded, indicating a relatively high diversity of vascular plants, though no species of particular note were recorded in Ardkill. Ardkill contains the *Filipendula ulmaria-Potentilla erecta-Viola* sp. community which is of conservation interest as it may be restricted to turloughs; however, this community occurs widely in several turloughs, and there is only a small amount of this community in Ardkill.

Vegetation Community	**Area (Ha)**
A. stolonifera-Glyceria fluitans	2.32
A. stolonifera-P. anserina-F. rubra	2.37
Carex nigra-Equisetum fluviatile	0.84
Carex nigra-R. flammula	0.05
E. palustris-P. arundinacea	1.08
**F. ulmaria-P. erecta-Viola sp*	0.21
Lolium grassland	7.56
P. anserina-Carex nigra	1.47
Polygonum amphibium	4.03
Poa annua-Plantago major	0.14
Tall herb	1.74
Woodland/scrub	0.58
Other/Unknown	0.46
Number of vegetation communities	12
Number of plant species	102

Vascular Plant Species

Nomenclature follows Parnell, J & Curtis, T. (2012) *Webb's An Irish Flora*, University of Cork Press.

Achillea millefolium	*Galeopsis angustifolia*	*Poa annua*
Agrostis capillaris	*Galium boreale*	*Poa trivialis*
Agrostis stolonifera	*Galium palustre*	*Polygonum amphibium*
Alisma plantago-aquatica	*Galium saxitile*	*Polygonum aviculare*
Alopecurus geniculatus	*Galium uliginosum*	*Polygonum hydropiper*
Apium inundatum	*Galium verum*	*Polygonum lapathifolium*
Bellis perennis	*Glyceria fluitans*	*Polygonum persicaria*
Caltha palustris	*Holcus lanatus*	*Potamogeton natans*
Capsella bursa-pastoris	*Hydrocotyle vulgaris*	*Potentilla anserina*
Cardamine pratensis	*Iris pseudacorus*	*Potentilla erecta*
Carex disticha	*Juncus articulatus*	*Potentilla reptans*
Carex flacca	*Juncus bufonius*	*Prunella vulgaris*
Carex hirta	*Lathyrus pratensis*	*Prunus spinosa*
Carex hostiana	*Lemna trisulca*	*Ranunculus acris*
Carex nigra	*Leontodon autumnalis*	*Ranunculus flammula*
Carex panicea	*Leontodon hispidus*	*Ranunculus repens*
Carex viridula agg.	*Leontodon saxatilis*	*Ranunculus trichophyllus*
Centaurea nigra	*Linum catharticum*	*Rorippa amphibia*
Cerastium fontanum	*Lolium perenne*	*Rubus caesius*
Cirsium arvense	*Lotus corniculatus*	*Rumex acetosa*
Cirsium dissectum	*Lysimachia vulgaris*	*Rumex crispus*
Cirsium palustre	*Lythrum salicaria*	*Salix repens*
Cirsium vulgare	*Matricaria discoidea*	*Schoenoplectus lacustris*
Crataegus monogyna	*Mentha aquatica*	*Senecio aquaticus*
Cynosurus cristatus	*Menyanthes trifoliata*	*Sparganium emersum*
Danthonia decumbens	*Molinia caerulea*	*Sparganium erectum*
Deschampsia cespitosa	*Myosotis scorpioides*	*Stellaria media*
Eleocharis palustris	*Oenanthe aquatica*	*Taraxacum officinale* agg.
Elymus repens	*Phalaris arundinacea*	*Trifolium repens*
Equisetum fluviatile	*Phleum bertolonii*	*Urtica dioica*
Festuca arundinacea	*Phleum pratense*	*Veronica scutellata*
Festuca pratensis	*Plantago lanceolata*	*Vicia cracca*
Festuca rubra	*Plantago major*	*Viola riviniana*
Filipendula ulmaria	*Plantago media*	*Viola* sp.

Soils and Grazing

Soils were classified using a modified version of soil categories generated by the Teagasc/EPA Soils and Subsoils Mapping project (Fealy *et al*., 2009). The classification scheme principally uses parent material (calcareous/non-calcareous), depth class (shallow/deep) and drainage class (well drained/poorly drained) to assign soils to one of nine broad categories. Ardkill has extensive areas of Fen Peats, and very shallow well-drained organic soils occupy the upper slopes. The mean ± SD of a range of soil properties are also provided, in addition to the median and range of each variable across turloughs. Ardkill soils are moderately alkaline and highly organic, with significant amounts of calcium carbonate. Mean Total Nitrogen and Total Phosphorus are towards the high end of the range for turloughs.

Soil Types/Grazing Extent	% Turlough Area
Fen Peat	64.9
Very shallow well drained organic	35.5
Extent of rotationally grazed area	60

Soil Property (n=6)	Ardkill	Turlough Summary Stats (n=22)		
	Mean ± SD	Median	Min	Max
pH	7.8 ± 0.3	7.20	5.94	8.29
% Organic Matter content	36.2 ± 10.3	25.8	10.2	69.1
% Inorganic content	31.0 ± 4.4	43.2	25.7	85.0
% Calcium carbonate content	32.8 ± 12.3	11.3	2.48	43.7
Total Nitrogen mg kg^{-1}	15400 ± 4042	11142	4983	24233
Total Phosphorus mg kg^{-1}	844 ± 121	905	245	1594

Hydrology

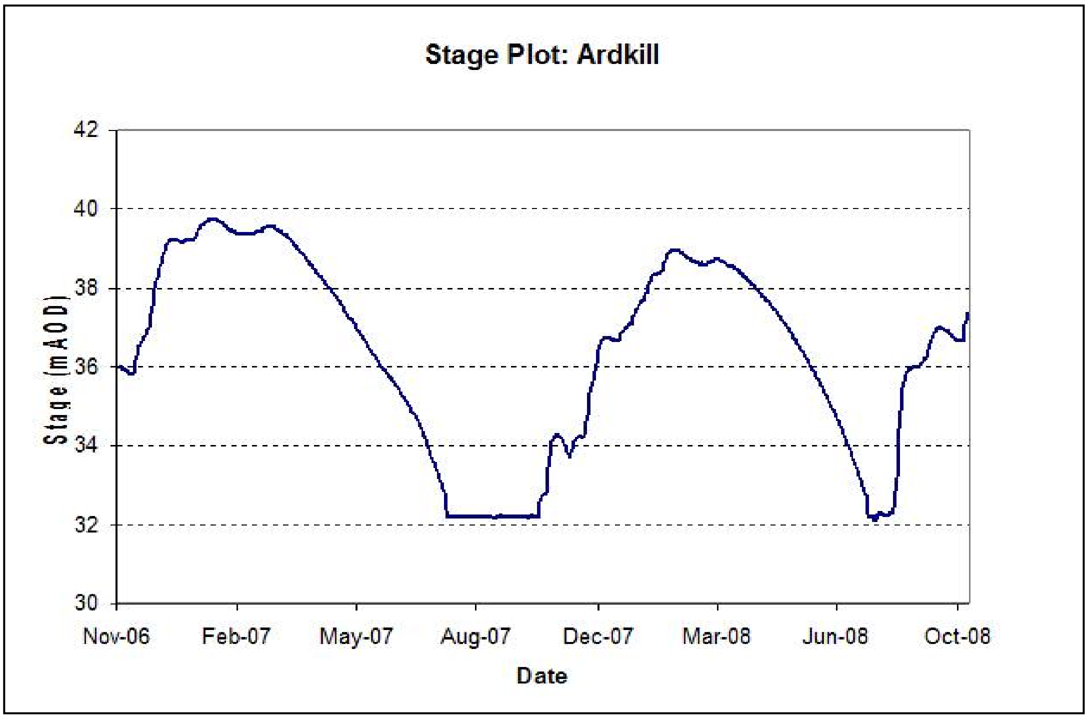
Water levels were recorded at hourly intervals using a variety of Schlumberger Divers® (Marton Geotechnical Ltd, Suffolk, UK) placed at or near the lowest point in each turlough. Divers measure the pressure of the water and air column above them, and from this the depth of water can be calculated. GPS surveys were carried out on 21 monitoring sites (Tullynafrankagh omitted) in order to develop digital terrain models (DTMs) from which contour maps, stage-volume and stage-surface area relationships are produced. The inflow magnitude is indicative of the properties of a turlough's catchment area and flow capacity, while outflow is a function of the drainage capacity of the system.

Ardkill generally has a single, long duration flood. It is a moderately deep basin, particularly the south-western end, which holds water for long periods. The turlough has a relatively low drainage capacity and a long recession duration.

Ardkill shows some hydrological relationship with Kilglassan and Skealoghan. Kilglassan and Skealoghan show very similar profiles of water depth, albeit with time lags which vary throughout the year; Ardkill shows related maxima and minima but with a far wider range of water depths (for further details see *Chapter 2: Hydrology*).

Hydrological Information	Ardkill Values	Turlough Summary Stats (n=21)		
		Median	Min	Max
Start of Hydrological Recording	05/11/2006	-	-	-
End of Hydrological Recording	13/10/2008	-	-	-
Days Recorded	708	-	-	-
Equipment Failure	13/10/2008 onwards	-	-	-
Hydroperiod (days)	293	213	135	348
Maximum Floodwater Depth (m)	7.7	4.9	3	15.4
Maximum Floodwater Volume ('000 m^3)	652.6	877.9	355.6	4008.1
Maximum Flooded Area (ha)	22.34	38.61	13.71	78.12
Average Basin Depth (m)	2.8	2.28	0.85	6.76
Average Daily Inflow (m^3 s^{-1})	0.439	0.684	0.254	10.253
Average Daily Outflow (m^3 s^{-1})	0.086	0.271	0.086	2.018
Drainage Capacity (m^3 s^{-1})	0.075	0.154	0.069	1.156
Recession Duration (days)	100.6	57.3	11	142.5

Stage plot for Ardkill turlough



Zone of Groundwater Contribution (ZOC) Risk Assessments

GIS based risk assessments were conducted with a view to identifying turloughs at risk of failing to meet WFD water quality objectives. These risk assessments were conducted by Compass Informatics Ltd and were based on Risk Assessment Sheet GWDTERA2a (Guidance Document No. GW9) on assessing risks to turloughs from phosphate (Working Group on Groundwater 2004) and Pathway Susceptibilities and Pressure Magnitudes were integrated to produce Impact Potential maps and predicted Risk Categories for the turlough ZOC. The TCD Risk Category is derived from a revised Impact Potential matrix. The predicted Risk Categories were adjusted using mean seasonal floodwater Total P ($\mu g\ l^{-1}$) (see Section 4.5.4 of the Risk Assessment Sheet GWDTERA2a). The risk categories include 1A: at significant risk; 1B: probably at significant risk; 2A: Not at significant risk (low confidence); 2B: Not at significant risk (higher confidence). Ardkill has a high percentage of pasture in the ZOC, and is considered to be at significant risk.

ZOC Area (Km^2)	Predicted WFD Risk Category	Adjusted WFD Risk Category	Predicted TCD Risk Category	Adjusted TCD Risk Category
3.1	2B	1A	1B	1A

ZOC Pressure Variable	
CORINE BARE ROCK %	0
CORINE PEAT BOGS%	0
CORINE ALL NATURAL AND SEMI-NATURAL AREAS%	0
CORINE IMPROVED PASTURE%	60
CORINE UNIMPROVED PASTURE%	40
CORINE ALL PASTURE%	100
CORINE OTHER AGRICULTURAL LANDS%	0
TEAGASC/EPA HABITATS ROCK%	0
TEAGASC/EPA HABITATS BOGS/PEATS%	0
TEAGASC/EPA HABITATS FORESTS/SCRUBS%	2
TEAGASC/EPA HABITATS WATER%	2
TEAGASC/EPA HABITATS DRY GRASSLAND%	93
TEAGASC/EPA HABITATS WET GRASSLAND%	4
TEAGASC TOTAL GRASSLAND%	97
TOTAL LIVESTOCK UNIT/ha of ZOC	1
TILLAGE%	1
No. SEPTIC TANKS km^{-2} ZOC	6
No. SEPTIC TANKS/km^{-2} EXTREME PATHWAY SUSCEPTIBILITY	0
HIGH PATHWAY SUSCEPTIBILITY%	0
EXTR+HIGH PATHWAY SUSCEPTIBILITY%	7
WELL DRAINED SOIL %	94
POORLY DRAINED SOIL%	5

Site Conservation Assessment

The following site conservation assessment was undertaken to feed into the national reporting structure for assessing conservation status as required under Article 17 of the Habitats Directive. A suite of indicators and associated targets were derived to assess ecological structure and function. Future prospects were assessed through the evaluation of the impact of current and recent pressures and likely future threats to the site. The assessment follows a rules based approach to determine whether Structures & functions and Future Prospects should be assessed as good (green), inadequate (amber) or bad (red). For further details, see Chapter 10 (Conservation Status Assessment).

Please note an updated approach to assessing site condition has been proposed and is outlined in Chapter 12 (Monitoring Methods for Turloughs).

Conservation Condition Summary

Structure & Function	**Bad**
Future Prospects	**Bad**
Site Conservation Condition	**Bad**

Structure and Function Status:

Indicator	*Comments*
Hydrological Function: ***Good***	Some drainage work known in the ZOC but not considered to significantly impact on the functioning of the turlough
Water Quality: ***Bad***	82.1 µg P $l^{-1.}$ The highest mean TP recorded.
Biological Responses: ***Bad***	
Algal communities: -2	Extensive algal mats were recorded; high max CHL
Vegetation communities: 0	Moderate cover of both positive and negative indicator communities
Rumex **cover: 0**	12.4% frequency
Important plants: 0	No important species
Important aquatic invertebrates: 0	No important species
Overall Structure & Function: ***Bad***	

Pressures:*

Code	*Impact*	*Notes*
H02.06 Diffuse groundwater pollution due to agricultural and forestry activities (ZOC)	H	Very heavy nutrient inputs occur from a local farm, noted as a potential problem by Goodwillie (1992) and now clearly manifest in the groundwater quality
A04.01.01 Intensive cattle grazing (turlough)	M	Locally intensive grazing, evidenced by poaching
A04.01.02 Intensive sheep grazing (turlough)	M	Moderate numbers of sheep graze part of the turlough, but their impact is high: sheep impact in turloughs is greater than that of cattle
A05.02 Stock feeding (within and adjacent to turlough)	L	

*the codes for pressures and threats are those used in EU Habitats Directive Article 17 reporting for 2013

Threats:

Code	Impact	Notes
H01.05 Diffuse pollution to surface waters due to agricultural and forestry activities	H	Agricultural impacts are the result of a farm immediately adjacent to the turlough – they are flagged here as *effectively* directly entering the turlough
H02.06 Diffuse groundwater pollution due to agricultural and forestry activities (ZOC)	H	Severe pressures due to enrichment from local sources are likely to continue and have increasing impacts
A04.01.01 Intensive cattle grazing (turlough)	M	Grazing intensity is likely to increase, driven by Food Harvest 2020
A04.01.02 Intensive sheep grazing (turlough)	M	Likely to increase, driven by Food Harvest 2020 due to pasture in ZOC
A02.01 Agricultural intensification (ZOC)	L	Possible intensification in ZOC due to high amount of pasture
A10.02 Removal of stone walls and embankments (in turlough)	L	A general problem in many turloughs, likely to lead to more widespread animal movement and consequently reduced diversity within turloughs
M01.03 Flooding and rising precipitations	L	A potential general problem in turloughs driven by predicted climate change

Future Prospects: **Bad** – Ardkill faces significant ongoing pressures that have already affected the ecological structure and function, though several important vegetation communities remain. These are likely to be at significant risk due to the imminent threats, mainly from groundwater pollution from an adjacent source, and secondarily from intensive grazing.

Overall Assessment: **Bad** – though Ardkill continues to function hydrologically, it is severely impacted by groundwater nutrient enrichment. It still retains some of the important vegetation communities noted by Goodwillie (1992 – who considered Ardkill to be of national conservation importance), but it is likely the main pressures acting on Ardkill are relatively recent and there will likely be further degradation of the vegetation. Ardkill faces considerable threats of medium to high impact, therefore the conservation status is assessed as bad.

Maps

Maps are provided of:

1. Elevation contours, based on GIS digital terrain models from points by differential GPS topographic survey (for further details, see *Chapter 3: Hydrology*)
2. Grazing in land parcels
3. Approximate sampling points for water chemistry and aquatic invertebrates
4. Soil nutrient sampling points
5. Points for soil survey (note: soils were surveyed to the turlough boundary defined by Goodwillie, 1992; see map 9)
6. Soils (note: soils were mapped by combining the EPA Subsoils base map with the point soil descriptions; for further details see *Chapter 6: Soils and Landuse*)
7. Vegetation relevés
8. Vegetation communities (note: relevés do not always match to mapped communities due to small scale variation; for further details of mapping see *Chapter 7: Turlough Vegetation: Description, Mapping and Ecology*)
9. Vegetation maps digitised from Goodwillie, R. (1992) *Turlough's Over 50 Hectares*. Report to NPWS
10. Estimated zone of groundwater contribution (ZOC)


Legend
Elevation Countours
Turlough Boundary
OSi 2005 Orthophotographs
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Date: Jan. 2014
COUNTY MAYO
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ARDKILL TURLOUGH
ELEVATION CONTOURS
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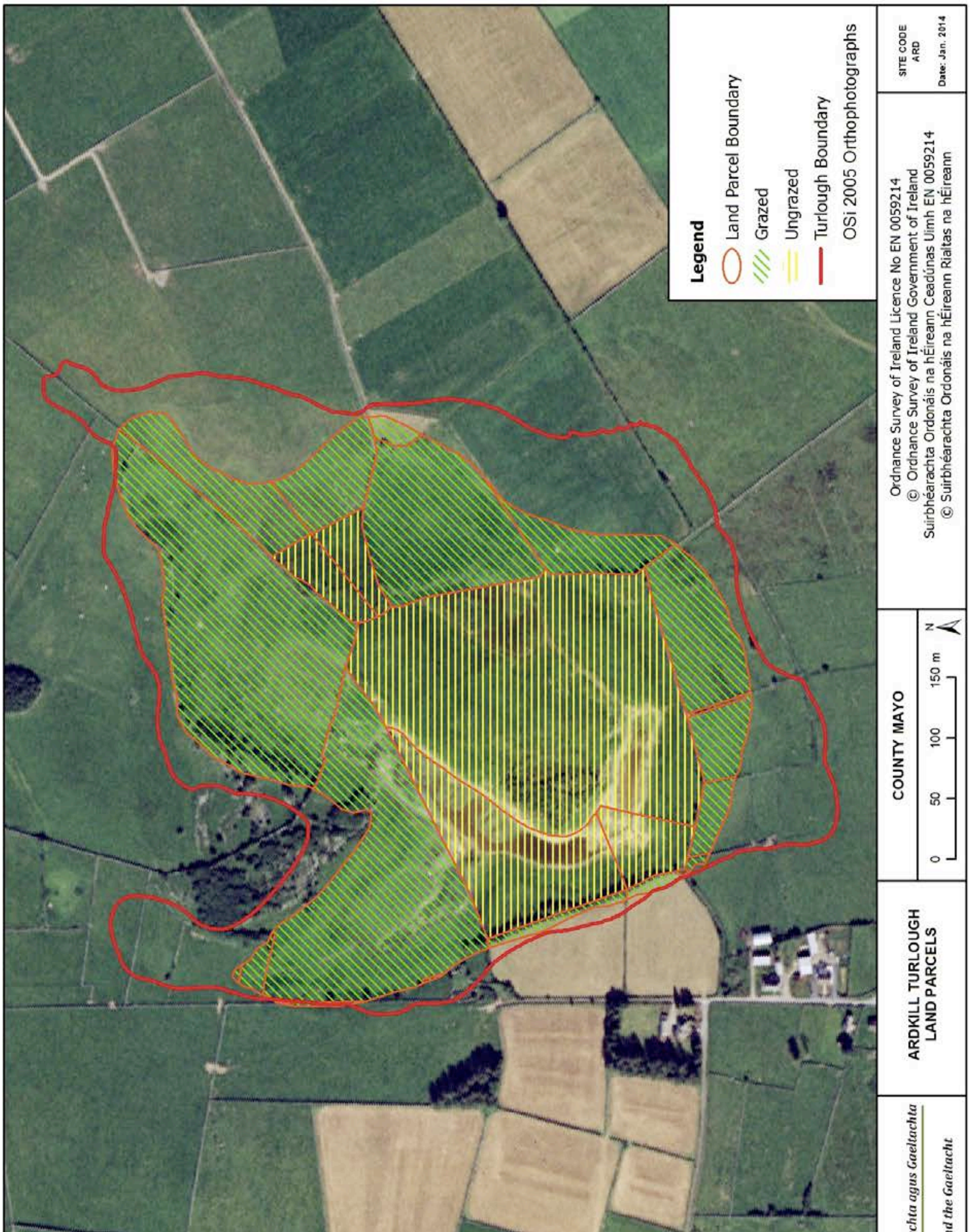
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht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Land Parcel Boundary
Grazed
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Turlough Boundary
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Date: Jan. 2014
COUNTY MAYO
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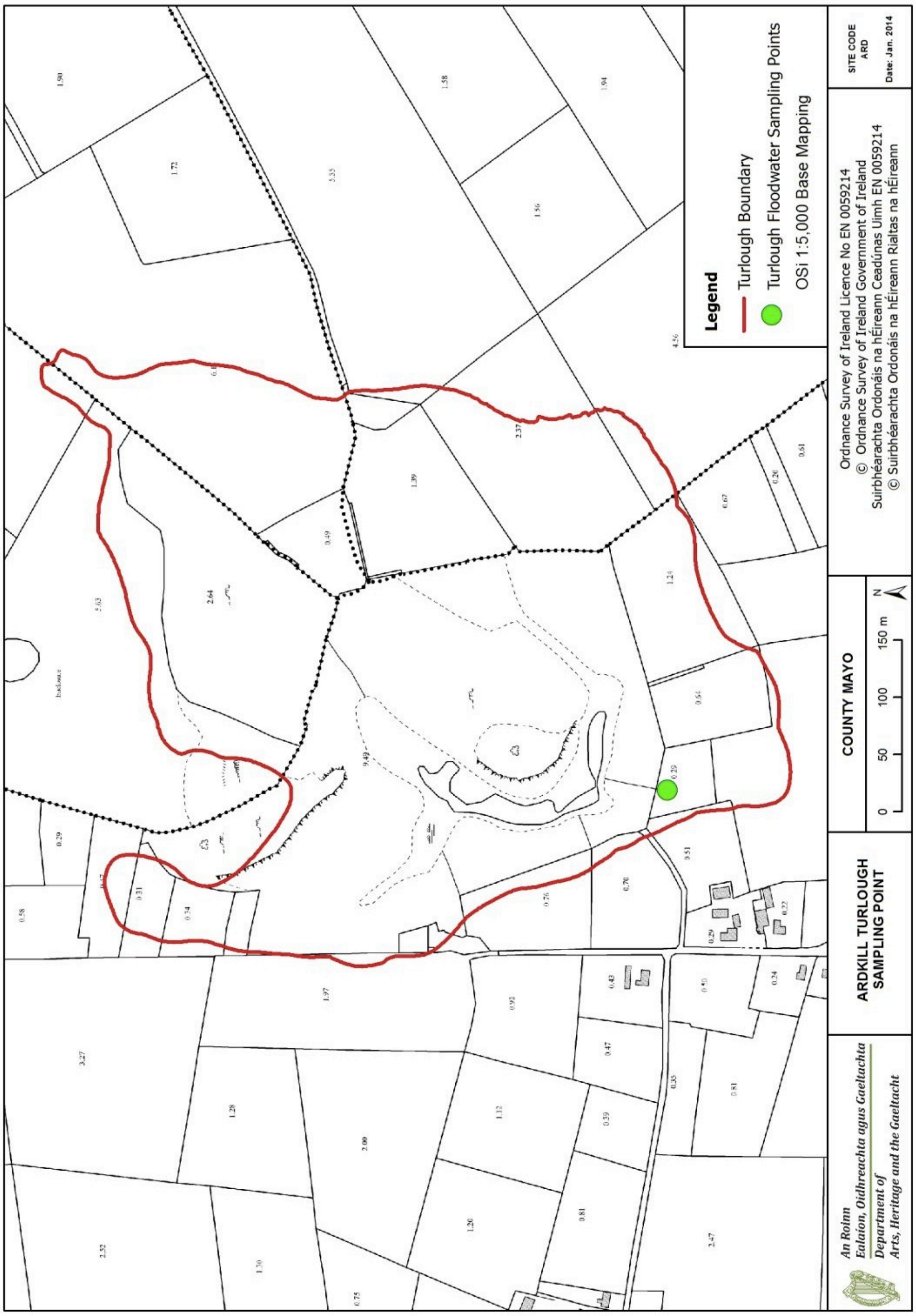
ARDKILL TURLOUGH LAND PARCELS
An Roinn Ealaíon, Oidhreachta agus Gaeltachta
Department of Arts, Heritage and the Gaeltacht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Turlough Boundary
Turlough Floodwater Sampling Points
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ARDKILL TURLOUGH SAMPLING POINT
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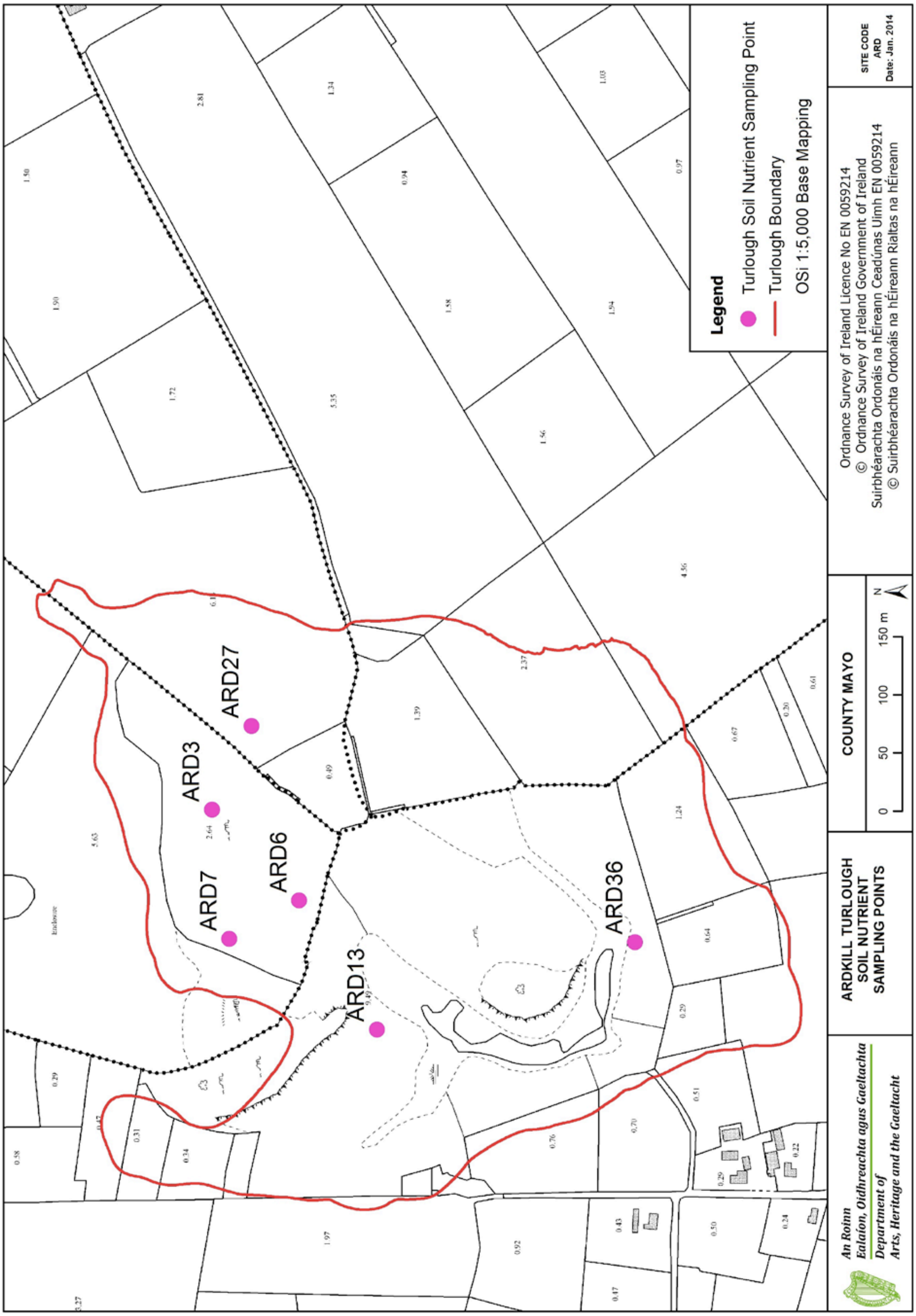
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Turlough Soil Nutrient Sampling Point
Turlough Boundary
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ARDKILL TURLOUGH
SOIL NUTRIENT
SAMPLING POINTS
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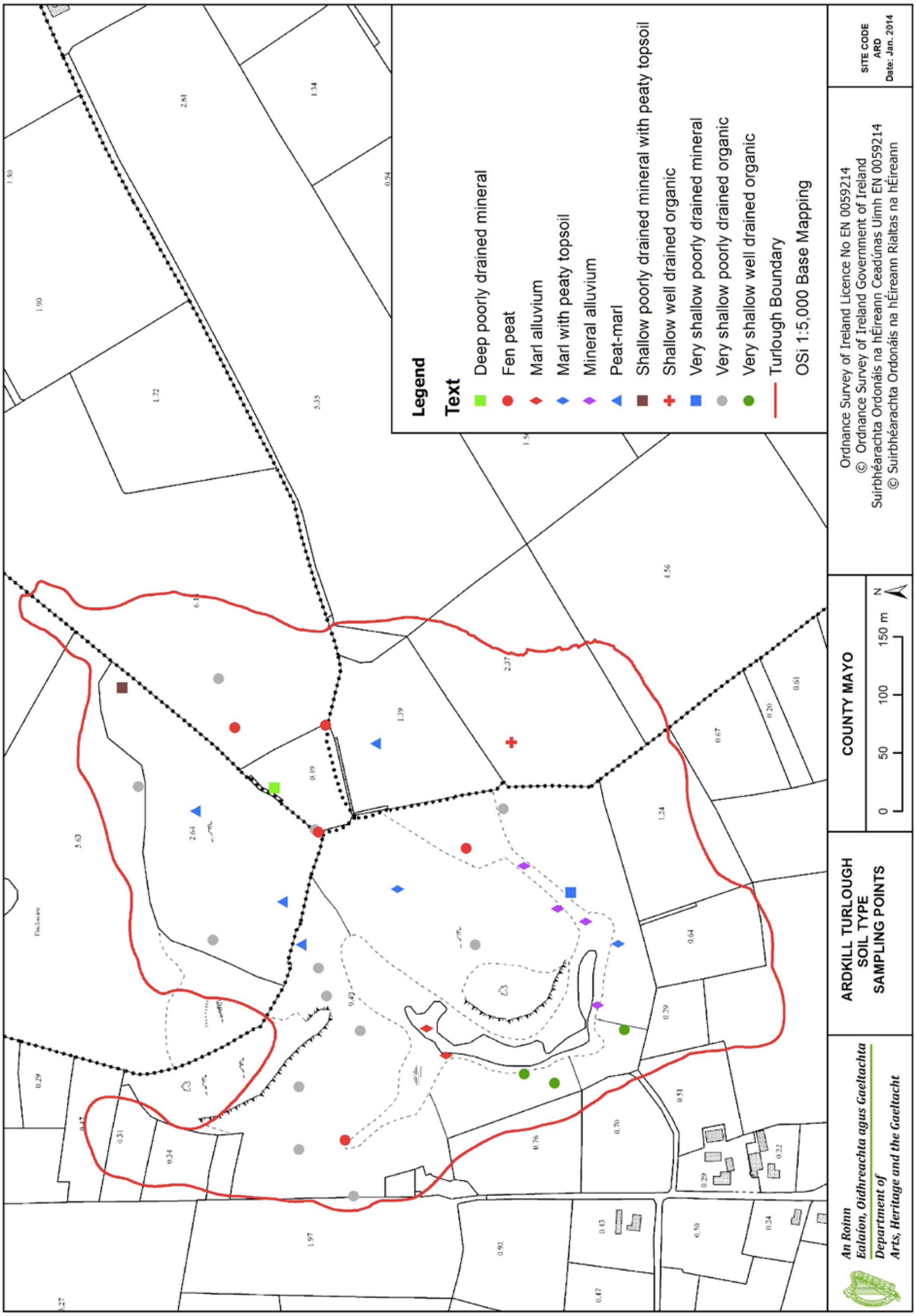
Enclosure


Legend
Text
Deep poorly drained mineral
Fen peat
Marl alluvium
Marl with peaty topsoil
Mineral alluvium
Peat-marl
Shallow poorly drained mineral with peaty topsoil
Shallow well drained organic
Very shallow poorly drained mineral
Very shallow poorly drained organic
Very shallow well drained organic
Turlough Boundary
OSi 1:5,000 Base Mapping
SITE CODE
ARD
Date: Jan. 2014
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COUNTY MAYO
0 50 100 150 m
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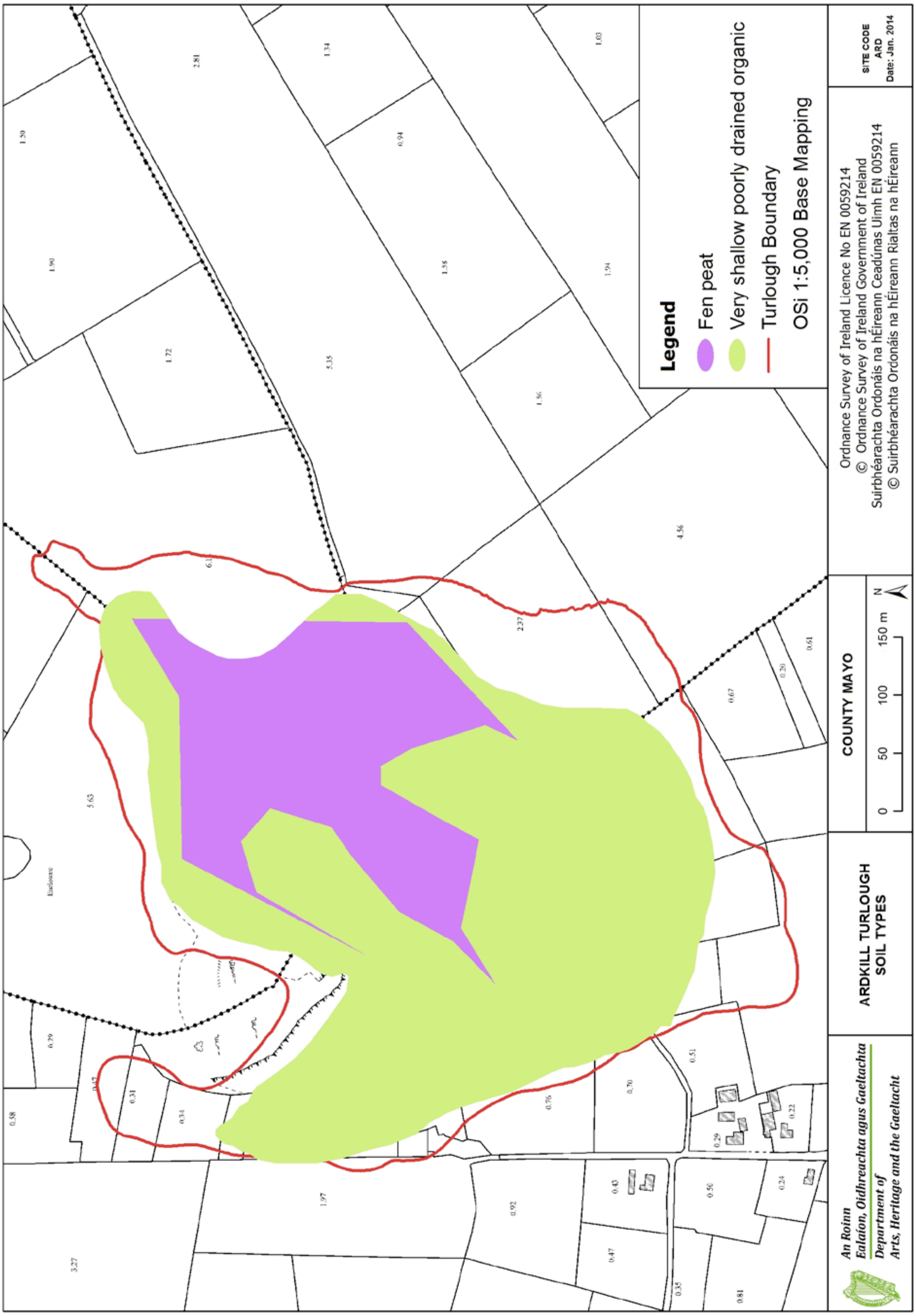
ARDKILL TURLOUGH
SOIL TYPE
SAMPLING POINTS
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht


Legend
Fen peat
Very shallow poorly drained organic
Turlough Boundary
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SITE CODE
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Date: Jan. 2014
COUNTY MAYO
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ARDKILL TURLOUGH
SOIL TYPES
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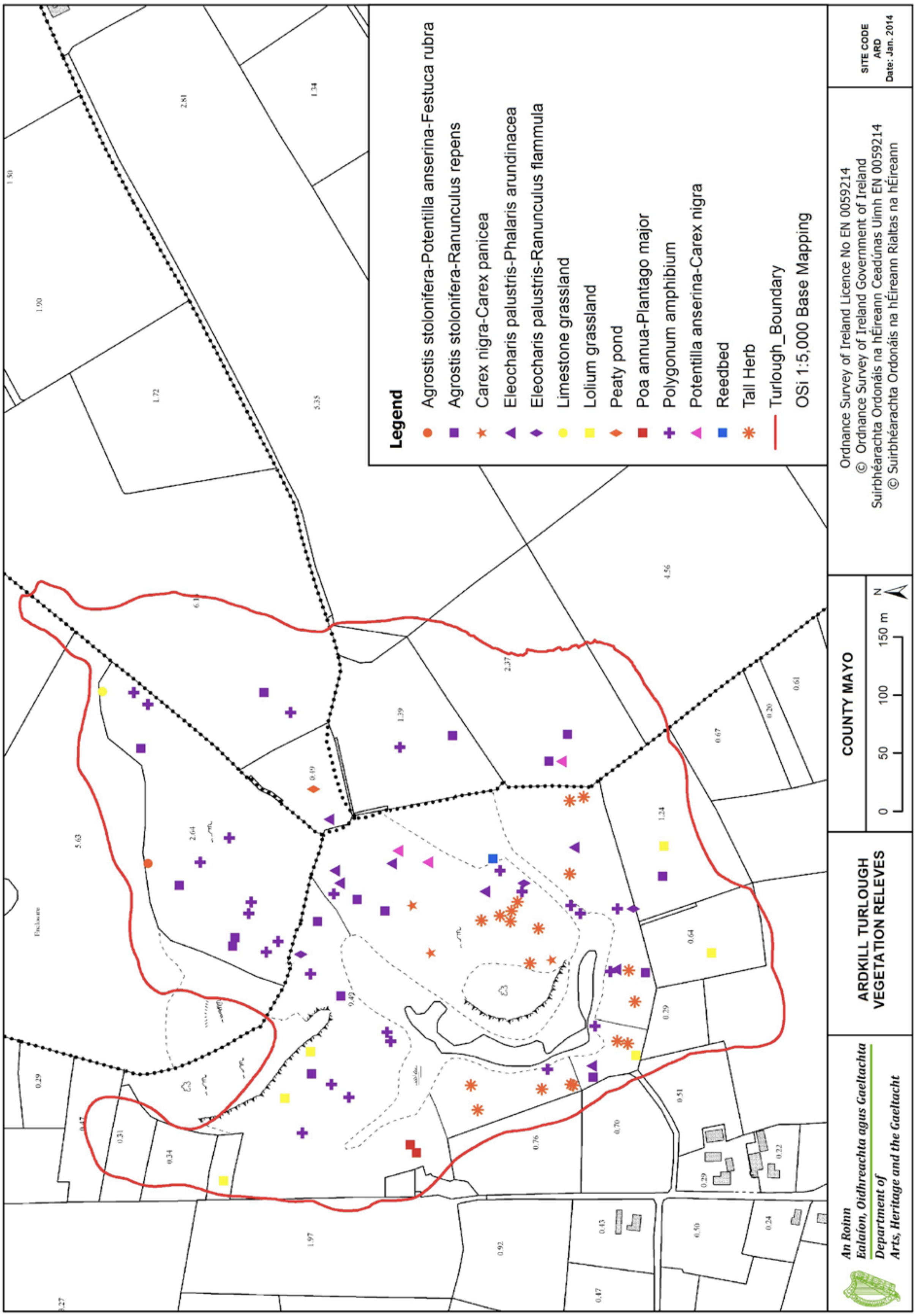
Department of
Arts, Heritage and the Gaeltacht


Legend
Agrostis stolonifera-Potentilla anserina-Festuca rubra
Agrostis stolonifera-Ranunculus repens
Carex nigra-Carex panicea
Eleocharis palustris-Phalaris arundinacea
Eleocharis palustris-Ranunculus flammula
Limestone grassland
Lolium grassland
Peaty pond
Poa annua-Plantago major
Polygonum amphibium
Potentilla anserina-Carex nigra
Reedbed
Tall Herb
Turlough_Boundary
OSi 1:5,000 Base Mapping
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SITE CODE
ARD
Date: Jan. 2014
COUNTY MAYO
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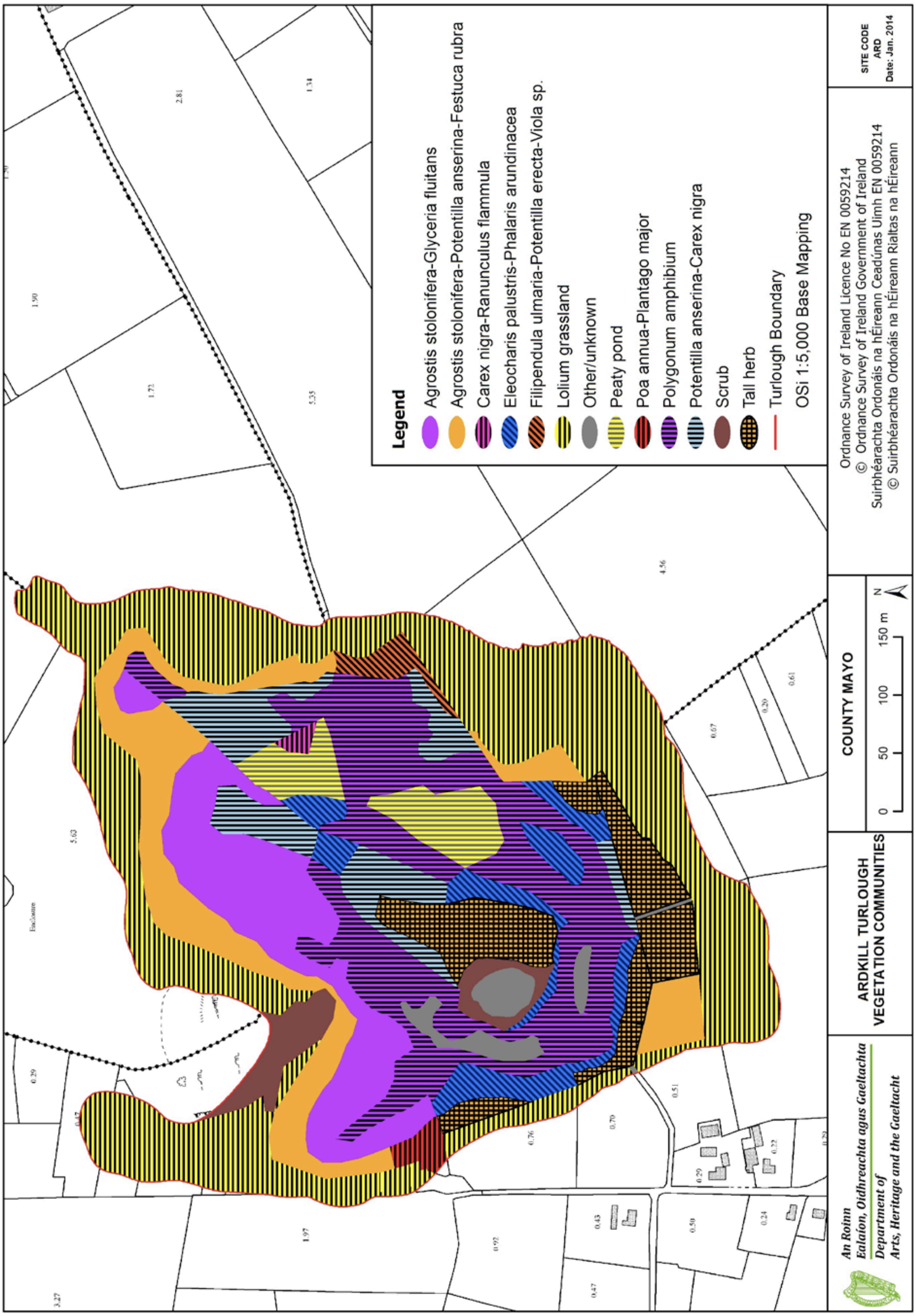
ARDKILL TURLOUGH
VEGETATION RELEVES
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht


Legend
Agrostis stolonifera-Glyceria fluitans
Agrostis stolonifera-Potentilla anserina-Festuca rubra
Carex nigra-Ranunculus flammula
Eleocharis palustris-Phalaris arundinacea
Filipendula ulmaria-Potentilla erecta-Viola sp.
Lolium grassland
Other/unknown
Peaty pond
Poa annua-Plantago major
Polygonum amphibium
Potentilla anserina-Carex nigra
Scrub
Tall herb
Turlough Boundary
OSi 1:5,000 Base Mapping
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SITE CODE
ARD
Date: Jan. 2014
COUNTY MAYO
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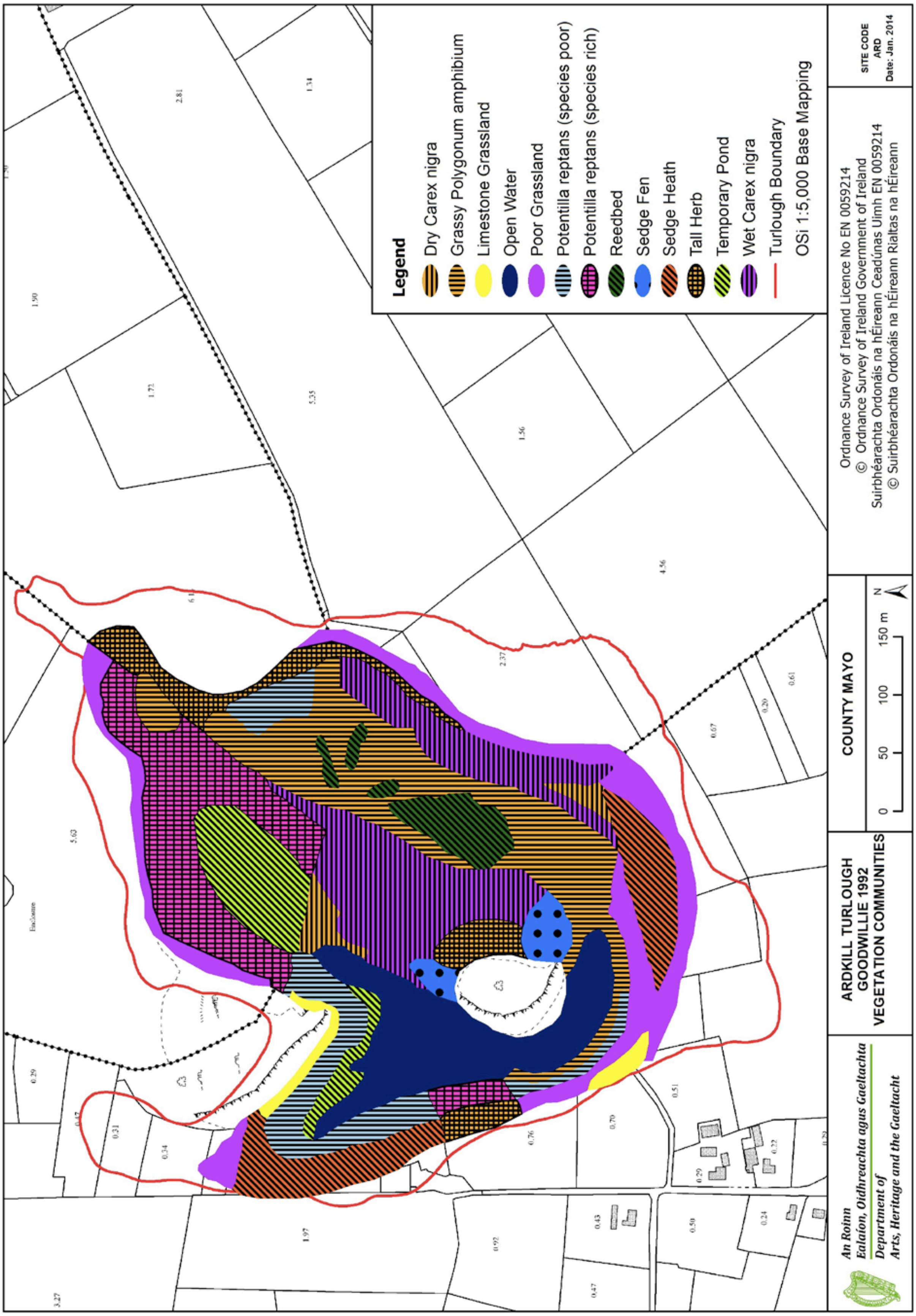
ARDKILL TURLOUGH
VEGETATION COMMUNITIES
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht



Legend
Dry Carex nigra
Grassy Polygonum amphibium
Limestone Grassland
Open Water
Poor Grassland
Potentilla reptans (species poor)
Potentilla reptans (species rich)
Reedbed
Sedge Fen
Sedge Heath
Tall Herb
Temporary Pond
Wet Carex nigra
Turlough Boundary
OSi 1:5,000 Base Mapping
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Date: Jan. 2014
COUNTY MAYO
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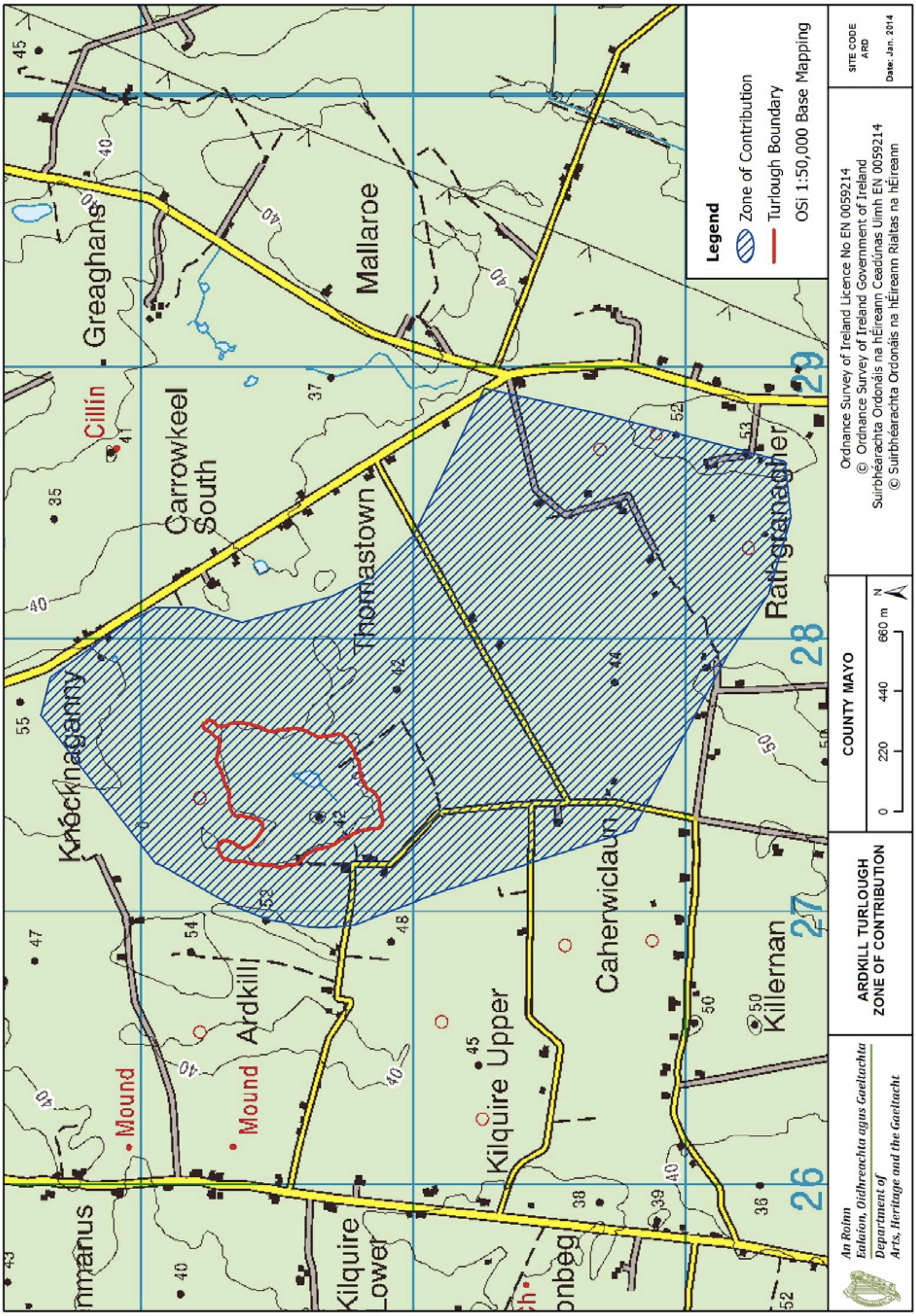
ARDKILL TURLOUGH
GOODWILLIE 1992
VEGETATION COMMUNITIES
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht


Legend
Zone of Contribution
Turlough Boundary
OSi 1:50,000 Base Mapping
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SITE CODE ARD
Date: Jan. 2014
COUNTY MAYO
0 220 440 660 m
N
ARDKILL TURLOUGH
ZONE OF CONTRIBUTION
An Roinn Ealaíon, Oidhreachta agus Gaeltachta
Department of Arts, Heritage and the Gaeltacht
Greaghans
Mallaroe
Cillín
Carrowkeel South
Thomastown
Knocknaganny
Rathgranagher
Ardkill
Mound
Mound
Kilquire Upper
Caherwiclaun
Killernan
Kilquire Lower
26
27
28
29

Site Report: Ballindereen Turlough
TCD Turlough Research project 2006-2011

Turlough Project Code	SAC Name	SAC/NHA No.	County	Townland	RBD	Easting	Northing	Area (ha)
BAL	Lough Fingall Complex	000606	Galway	Ballindereen	WESTERN	141060	214920	68

File update: July 2015 (S. Waldren)

Site Description

Ballindereen turlough, occurring within the Lough Fingall Complex SAC, is one of the larger turloughs in the study, at 69.5 ha. It is located to the south-east of the village of Ballindereen (Co. Galway), c. 2km from the coast. It is divided into two by a central laneway. Fourteen vegetation communities were mapped in this turlough; the *Eleocharis palustris-Ranunculus flammula* and *Schoenus nigricans* fen communities were the dominant vegetation types. The soils in Ballindereen are alkaline and organic, with significant amounts of calcium carbonate. There are extensive areas of shallow organic soils. The majority of the turlough (84%) is under rotational grazing. The hydrological data suggest that this turlough is characterised by one major flood event per annum, with a low drainage capacity. There is evidence of previous drainage within the turlough. Vegetation change suggests that grazing pressure has increased since Goodwillie's (survey), and there is evidence of seeding *Lolium* grassland.

Ballindereen – photo: S. Kimberley

Phytoplankton

Phytoplankton analysis was conducted on sub-samples of monthly spot samples collected for hydrochemical analysis between October 2006 and June 2007. Phytoplankton composition varies significantly over time and data from autumn, mid-winter and spring/early summer are presented below. Taxa were identified to species level where possible. Some taxa were not discriminated beyond general groupings (i.e. small centric diatoms, dinoflagellates and pinnate diatoms). The term non-identifiable alone (or n.i.) was reserved for cases where specimens were not identifiable. Discrimination between n.i. filament, n.i. flagellate, n.i. colony, n.i. green filament was made when applicable. Biovolume (mm^3 m^{-3}) was used as the measure of algal biomass.

October 2006		January 2007		May 2007	
Biovolume (mm^3/m^3)	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*
Synedra	266345	*n.i. centrics*	2175696	*Monoraphidium*	42404
Monoraphidium	40088	*Cymbella/Encyonema*	1317337	*n.i.*	28955
Nitzchia	38120	*Chroomonas acuta*	242644	*n.i. colony*	28336
Tribonema	34064	*Fragilaria capucina*	98169	*Crucigeniella*	12228
Mougeotia	21564	*Fragilaria/Synedra*	76973	*Cosmarium*	8821

Benthic Algae

Turloughs were inspected for algal mats during the emptying phase in 2007, 2008 and 2009. Turloughs were visited in the first two weeks of March to June 2007 as part of the monthly monitoring of turloughs. Dedicated trips to inspect for algal mats were conducted in 2008 on the 4th of March, the 1st of April, and the 26th, 27th and 28th of May, and in 2009 on the 15th and 16th of June and on the 24th and 25th of July. The presence of both living floating mats and dead drying mats was noted, as well as their extent in the turlough basins. Occurrence of visible filamentous algal mats in the three years of observation is presented below. Y = visible occurrence; * = “extensive cover” (estimated to be 2 to 8% of total area of basin); † = negligible quantity observed; • = turlough was too flooded to permit full observation. Algal mats were observed in 2008 in Ballinderreen, with a very small quantity also seen in 2007.

Year of Observation		
2007	**2008**	**2009**
Y†	Y	N

Hydrochemistry

Data shown are the mean ± SD of monthly spot samples collected between October 2006 and June 2007. Mean seasonal Total P and Chlorophyll *a* were used to determine the trophic status of the floodwaters based on OECD trophic categories. The median and range of <u>mean values</u> across all turloughs are also provided.

Hydrochemical Variable	Ballindereen Values		Turlough Summary Stats (n=22)		
	Mean±SD	OECD Trophic Category	Median	Min	Max
pH	8.2±0.1		8.1	7.7	8.3
Alkalinity mg l^{-1} $CaCO_3$	183.6±20.2		204.0	112.4	236.4
Colour mg l^{-1} PtCo	17.4±6.4		26.9	7.9	85.1
Molybdate Reactive Phosphorus µg l^{-1}	1.1±0.4		3.4	0.7	42.1
Total Phosphorus µg l^{-1}	12.4±8.5	Mesotrophic	24.8	4.0	82.1
Chlorophyll *a* µg l^{-1}	3.0±2.7	Mesotrophic	4.9	1.1	33.5
Nitrate-N mg l^{-1}	0.2±0.2		0.7	0.1	1.9
Total Nitrogen mg l^{-1}	0.7±0.4		1.2	0.6	2.3

Aquatic Invertebrates

22 turloughs were sampled for littoral aquatic macroinvertebrates using sweep nets during November 2006 and April 2007. Zooplankton samples were collected in April 2007. Open-water cladocerans and littoral chydorids were sampled using a zooplankton net and perspex tube respectively.

Aquatic Macroinvertebrates			
November 2006	**Count**	**April 2007**	**Count**
Agabus sp. (larva)	37	*Agabus* sp. (larva)	82
Agyroneta aquatica	2	*Anisoptera* sp. larvae	2
Asellus aquaticus	5	*Asellus aquaticus*	66
Culicidae	5	Chironomidae	3
Curculionidae	1	*Cloeon dipterum*	7
Dryops sp.	1	*Corixinae* Instar I & II	7
Dryops sp. (larva)	2	Curculionidae	1
Glyphotaelius pellucides	1	*Diptera* Pupae	7
Helophorus brevipalpis	4	*Haliplus lineatocollis*	1
Hydrachnidia sp. (larva)	2	*Hydroporus palustris*	2
Hydroporus erythrocephalus	3	*Hydroporus pubescens*	3
Limnephilus auricula	12	*Hygrotus inaequalis*	4
Limnephilus decipiens	33	*Ilybius* sp. (larva)	1
Limnephilus lunatus	25	*Limnephilus decipiens*	2
Lymnaea peregra	1	*Limnephilus marmoratus*	1
Lymnaea trunculata	9	*Lymnaea peregra*	2
Ochthebius minimus	1	*Lymnaea trunculata*	3
Ostracoda	162	Oligochaeta	5
Phacopteryx brevipennis	51	*Phacopteryx brevipennis*	2
Rhantus sp. (larva)	4	*Rhantus* sp. (larva)	1
Stratiomyidae	1	*Succinea* sp.	15
Succinea sp.	1	*Sympetrum sanguinem*	1
Vallonia pulchella	86		

Aquatic Macroinvertebrates: Presence of high abundances (> 50 individuals) of Ostracoda recorded in November 2006 indicates nutrient enrichment. However, the presence of high abundances of Trichoptera in November 2006 (> 50 individuals) suggests nutrient poor conditions; hydrochemistry (above) suggests mesotrophic conditions.

Aquatic Macroinvertebrate Taxa	**Presence of high abundances**	
	November 2006	**April 2007**
Diptera	N	N
Ostracoda	Y	N
Odonata	N	N
Trichoptera	Y	N

Zooplankton species
Acroperus angustatus
Acroperus harpae
Alona affinis
Alona excisa
Alona guttata
Alona intermedia
Alona rustica
Alonella excisa
Chydorus sphaericus
Daphnia pulex
Eurycercus lamellatus
Graptoleberis testudinaria
Lathurona rectirostris
Simocephalus vetulus

Vegetation

Vegetation description and classification yielded 25 vegetation communities suitable for mapping. Fourteen vegetation communities were mapped in Balindereen turlough. High conservation value communities are denoted by *. Fourteen vegetation communities were mapped in Ballindereen, the *Eleocharis palustris-Ranunculus flammula* and *Schoenus nigricans* fen communities were the dominant vegetation types and both communities are of conservation importance, as is the flooded pavement community. 87 plant species were recorded indicating a moderately high level of diversity, species of conservation importance include the turlough specialists *Teucrium scordium* and *Viola persicifolia*.

Vegetation Community	**Area (Ha)**
A. stolonifera-Glyceria fluitans	0.21
A. stolonifera-P. anserina - F. rubra	3.07
A. stolonifera-R. repens	1.73
Carex nigra-C. panicea	2.99+0.05
E. palustris-P. arundinacea	0.04
**Eleocharis palustris-R. flammula*	18.06
*Flooded pavement	2.9
Limestone grassland	3.23
Lolium grassland	7.14
Molinia caerulea-Carex panicea	2.11
Other/unknown	0.96
P. anserina-Carex nigra	3.79
**Schoenus nigricans* fen	17.93
Tall herb	0.2
Woodland/scrub	3.96
Number of vegetation communities	14
Number of plant species	87

Vascular Plant Species

Nomenclature follows Parnell, J & Curtis, T. (2012) *Webb's An Irish Flora*, University of Cork Press.

Achillea millefolium	*Euphrasia species*	*Plantago lanceolata*
Achillea ptarmica	*Festuca arundinacea*	*Plantago maritima*
Agrostis stolonifera	*Festuca rubra*	*Poa pratensis*
Alisma plantago-aquatica	*Filipendula ulmaria*	*Polygala vulgaris*
Antennaria dioica	*Fraxinus excelsior*	*Polygonum persicaria*
Apium inundatum	*Galium boreale*	*Potentilla anserina*
Asperula cynanchica	*Galium palustre*	*Potentilla erecta*
Baldellia ranunculoides	*Galium uliginosum*	*Potentilla reptans*
Bellis perennis	*Galium verum*	*Prunella vulgaris*
Briza media	*Geranium sanguineum*	*Prunus spinosa*
Calluna vulgaris	*Glyceria fluitans*	*Ranunculus flammula*
Campanula rotundifolia	*Hydrocotyle vulgaris*	*Ranunculus repens*
Cardamine pratensis	*Juncus acutiflorus*	*Ranunculus trichophyllus*
Carex flacca	*Juncus articulatus*	*Rhamnus cathartica*
Carex hirta	*Knautia arvensis*	*Rosa pimpinellifolia*
Carex hostiana	*Leontodon autumnalis*	*Rubus fruticosus* agg.
Carex nigra	*Leontodon hispidus*	*Rumex crispus*
Carex panicea	*Linum catharticum*	*Salix repens*
Carex viridula agg.	*Littorella uniflora*	*Samolus valerandi*
Carex viridula sp. oedocarpa	*Lolium perenne*	*Schoenus nigricans*
Cerastium fontanum	*Lotus corniculatus*	*Succisa pratensis*
Cirsium arvense	*Lythrum salicaria*	*Taraxacum officinale* agg.
Cirsium dissectum	*Mentha aquatica*	*Teucrium scordium*
Crataegus monogyna	*Molinia caerulea*	*Thymus praecox*
Cynosurus cristatus	*Myosotis scorpioides*	*Trifolium repens*
Danthonia decumbens	*Odontites verna*	*Veronica scutellata*
Deschampsia cespitosa	*Ophioglossum vulgatum*	*Vicia cracca*
Elymus repens	*Parnassia palustris*	*Viola canina*
Equisetum arvense	*Phalaris arundinacea*	*Viola persicifolia*

Soils and Grazing

Soils were classified using a modified version of soil categories generated by the Teagasc/EPA Soils and Subsoils Mapping project (Fealy *et al.*, 2009). The classification scheme principally uses parent material (calcareous/non-calcareous), depth class (shallow/deep) and drainage class (well drained/poorly drained) to assign soils to one of nine broad categories. The mean ± SD of a range of soil properties are also provided, in addition to the median and range of each variable across turloughs. Ballindereen soils are alkaline and organic, with significant amounts of calcium carbonate and moderate amounts of total Nitrogen and total Phosphorus.

Soil Types/Grazing Extent	**% Turlough Area**
Deep well drained mineral	1.7
Very shallow well drained organic	25.6
Very shallow poorly drained organic	66.1
Fen Peat	6.6
Extent of rotationally grazed area	84

Soil Property (n=6)	**Ballindereen**	**Turlough Summary Stats (n=22)**		
	Mean ± SD	**Median**	**Min**	**Max**
pH	8.0 ± 0.2	7.20	5.94	8.29
% Organic Matter content	21.5 ± 4.3	25.8	10.2	69.1
% Inorganic content	39.9 ± 11.4	43.2	25.7	85.0
% Calcium carbonate content	38.6 ± 14.5	11.3	2.48	43.7
Total Nitrogen mg kg^{-1}	9708 ± 1231	11142	4983	24233
Total Phosphorus mg kg^{-1}	761 ± 137	905	245	1594

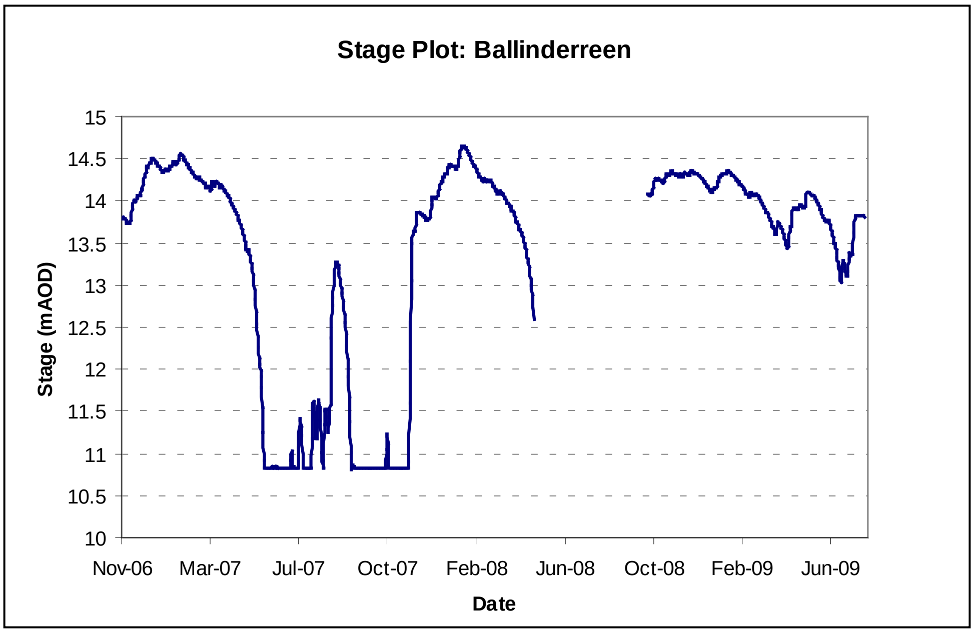
Hydrology

Water levels were recorded at hourly intervals using a variety of Schlumberger Divers® (Marton Geotechnical Ltd, Suffolk, UK) placed at or near the lowest point in each turlough. Divers measure the pressure of the water and air column above them, and from this the depth of water can be calculated. GPS surveys were carried out on 21 monitoring sites (Tullynafrankagh omitted) in order to develop digital terrain models (DTMs) from which contour maps, stage-volume and stage-surface area relationships are produced. The inflow magnitude is indicative of the properties of a turlough's catchment area and flow capacity, while outflow is a function of the drainage capacity of the system.

Ballindereen is a moderately large but shallow turlough, with generally one long flood per year, and a fairly low drainage capacity. There is evidence of previous drainage within the turlough.

Hydrological Information	Ballindereen Values	Turlough Summary Stats (n=21)		
		Median	Min	Max
Start of Hydrological Recording	05/11/2006	-	-	-
End of Hydrological Recording	05/08/2009	-	-	-
Days Recorded	557 + 294	-	-	-
Equipment Failure	From 15/5/2008 to 15/10/2008	-	-	-
Hydroperiod (days)	211	213	135	348
Maximum Floodwater Depth (m)	4.3	4.9	3	15.4
Maximum Floodwater Volume ('000 m^3)	592.6	877.9	355.6	4008.1
Maximum Flooded Area (ha)	69.52	38.61	13.71	78.12
Average Basin Depth (m)	0.85	2.28	0.85	6.76
Average Daily Inflow ($m^3 s^{-1}$)	0.594	0.684	0.254	10.253
Average Daily Outflow ($m^3 s^{-1}$)	0.271	0.271	0.086	2.018
Drainage Capacity ($m^3 s^{-1}$)	0.088	0.154	0.069	1.156
Recession Duration (days)	78.3	57.3	11	142.5

Stage plot for Ballindereen turlough



Zone of Groundwater Contribution (ZOC) Risk Assessments

GIS based risk assessments were conducted with a view to identifying turloughs at risk of failing to meet WFD water quality objectives. These risk assessments were conducted by Compass Informatics Ltd and were based on Risk Assessment Sheet GWDTERA2a (Guidance Document No. GW9) on assessing risks to turloughs from phosphate (Working Group on Groundwater 2004) and Pathway Susceptibilities and Pressure Magnitudes were integrated to produce Impact Potential maps and predicted Risk Categories for the turlough ZOC. The TCD Risk Category is derived from a revised Impact Potential matrix. The predicted Risk Categories were adjusted using mean seasonal floodwater Total P (µg l^{-1}) (see Section 4.5.4 of the Risk Assessment Sheet GWDTERA2a). The risk categories include 1A: at significant risk; 1B: probably at significant risk; 2A: Not at significant risk (low confidence); 2B: Not at significant risk (higher confidence).

ZOC Area (Km^2)	Predicted WFD Risk Category	Adjusted WFD Risk Category	Predicted TCD Risk Category	Adjusted TCD Risk Category
2	1A	1B	1A	1B

ZOC Pressure Variable	
CORINE BARE ROCK %	0
CORINE PEAT BOGS%	0
CORINE ALL NATURAL AND SEMI-NATURAL AREAS%	77
CORINE IMPROVED PASTURE%	7
CORINE UNIMPROVED PASTURE%	0
CORINE ALL PASTURE%	7
CORINE OTHER AGRICULTURAL LANDS%	15
TEAGASC/EPA HABITATS ROCK%	23
TEAGASC/EPA HABITATS BOGS/PEATS%	1
TEAGASC/EPA HABITATS FORESTS/SCRUBS%	7
TEAGASC/EPA HABITATS WATER%	1
TEAGASC/EPA HABITATS DRY GRASSLAND%	62
TEAGASC/EPA HABITATS WET GRASSLAND%	5
TEAGASC TOTAL GRASSLAND%	1
TOTAL LIVESTOCK UNIT/ha of ZOC	1
TILLAGE%	12
No. SEPTIC TANKS km^{-2} ZOC	13
No. SEPTIC TANKS/km^{-2} EXTREME PATHWAY SUSCEPTIBILITY	0
HIGH PATHWAY SUSCEPTIBILITY%	98
EXTR+HIGH PATHWAY SUSCEPTIBILITY%	66
WELL DRAINED SOIL %	8
POORLY DRAINED SOIL%	5

Site Conservation Assessment

The following site conservation assessment was undertaken to feed into the national reporting structure for assessing conservation status as required under Article 17 of the Habitats Directive. A suite of indicators and associated targets were derived to assess ecological structure and function. Future prospects were assessed through the evaluation of the impact of current and recent pressures and likely future threats to the site. The assessment follows a rules based approach to determine whether Structures & functions and Future Prospects should be assessed as good (green), inadequate (amber) or bad (red). For further details, see Chapter 10 (Conservation Status Assessment).

Please note an updated approach to assessing site condition has been proposed and is outlined in Chapter 12 (Monitoring Methods for Turloughs).

Conservation Condition Summary

Structure & Function	**Favourable**
Future Prospects	**Inadequate**
Site Conservation Condition	**Inadequate**

Structure and Function Status:

Indicator	*Comments*
Hydrological Function: *Good*	Drainage has lowered the flood level in the past but is not considered to be currently impacting the ecological function
Water Quality: *Good*	12.4 µg P l^{-1}
Biological Responses: *Very Good*	
Algal communities: 0	Although algal mats were recorded they were never extensive, and the maximum CHLa was low
Vegetation communities: 2	High cover of positive indicator communities
***Rumex* cover: 0**	3% frequency
Important plants: 2	*Viola persicifolia, Teucrium scordium, Plantago maritima*
Important aquatic invertebrates: 1	*Alona rustica, Alonella exisa*
Overall Structure & Function: *Good*	

Pressures:*

Code	*Impact*	*Notes*
A04.01.01 Intensive cattle grazing	H	Large proportion of turlough is grazed, some land parcels very heavily grazed
H02.07 Diffuse groundwater pollution due to non-sewered population (ZOC)	M	Moderate number of farms and septic tanks in the ZOC
B01 Forest planting on open ground (ZOC)	L	Limited afforestation in the ZOC
E01.03 Dispersed habitation (ZOC)	L	But impact likely to be via H02.07
J02.05 Modification of hydrographic functioning, general (=drainage in turlough)	L	Drainage has impacted in the past to some degree

Threats:

Code	Impact	Notes
J02.05 Modification of hydrographic functioning, general (=drainage)	H	Calls for reinstatement of drainage could present a substantial threat
A04.01.01 Intensive cattle grazing (local)	M	Possible intensification of cattle farming within the turlough
H02.06 Diffuse groundwater pollution due to agricultural and forestry activities (ZOC)	M	Possible intensification of farming within the ZOC
A02.01 Agricultural intensification (ZOC)	M	Likely driven by Food Harvest 2020 due to pasture in ZOC
A10.02 Removal of stone walls and embankments (in turlough)	L	A general problem in many turloughs, likely to lead to more widespread animal movement and consequently reduced diversity within turloughs
M01.03 Flooding and rising precipitations	L	A potential general problem in turloughs driven by predicted climate change

*the codes for pressures and threats are those used in EU Habitats Directive Article 17 reporting for 2013

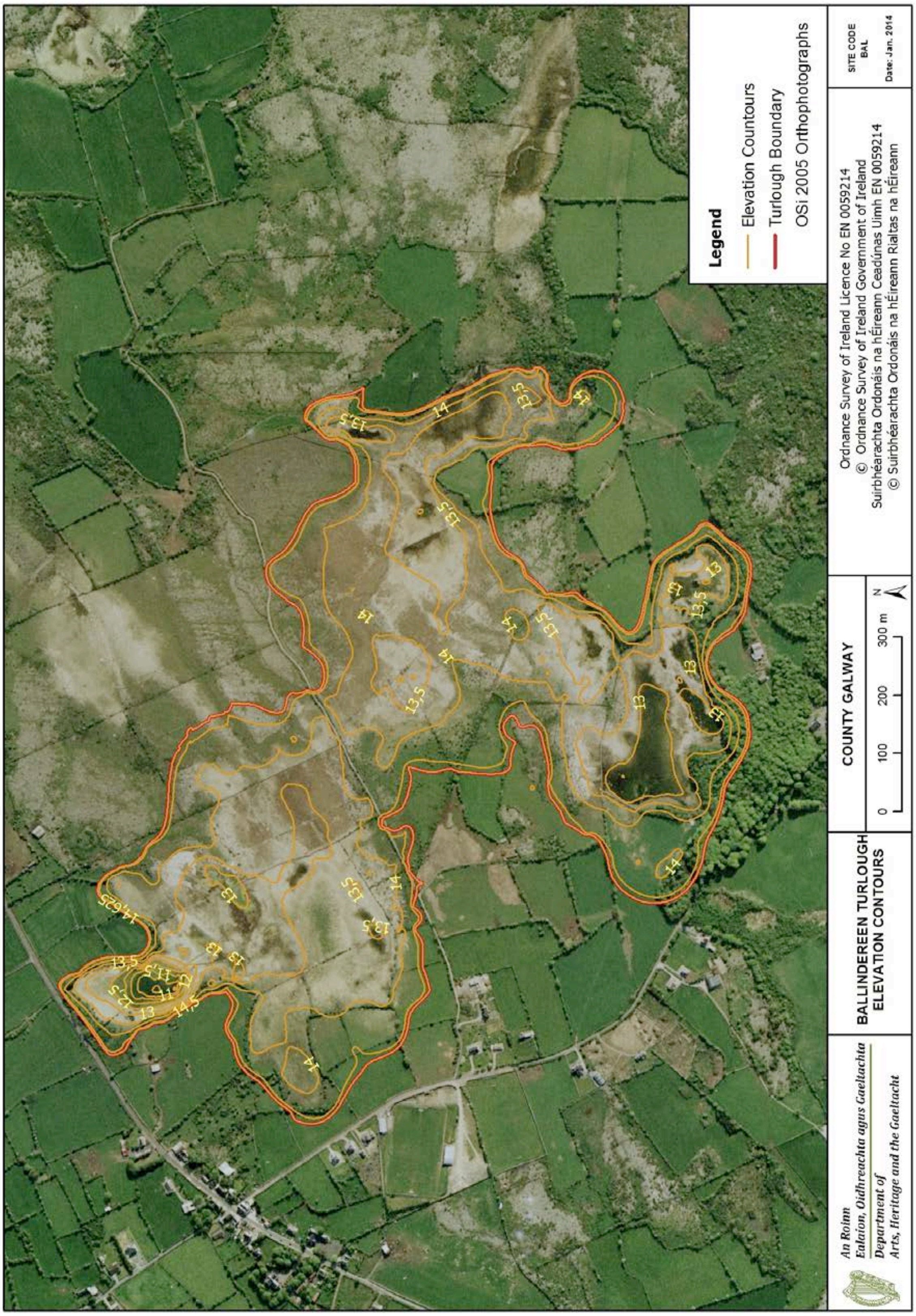
Future Prospects: **Inadequate** – several medium impact threats are likely, including increased use for grazing.

Overall Assessment: **Inadequate** – Structure and function is favourable, but future prospects are inadequate due to potential drainage and increasing grazing pressure. These threats need to be mitigated to ensure that they do not impact on the structure and function of this turlough.

Maps

Maps are provided of:

1. Elevation contours, based on GIS digital terrain models from points by differential GPS topographic survey (for further details, see *Chapter 3: Hydrology*)
2. Grazing in land parcels
3. Approximate sampling points for water chemistry and aquatic invertebrates
4. Soil nutrient sampling points
5. Points for soil survey (note: soils were surveyed to the turlough boundary defined by Goodwillie, 1992; see map 9)
6. Soils (note: soils were mapped by combining the EPA Subsoils base map with the point soil descriptions; for further details see *Chapter 6: Soils and Landuse*)
7. Vegetation communities (note: relevés do not always match to mapped communities due to small scale variation; for further details of mapping see *Chapter 7: Turlough Vegetation: Description, Mapping and Ecology*)
8. Vegetation maps digitised from Goodwillie, R. (1992) *Turlough's Over 50 Hectares*. Report to NPWS
9. Estimated zone of groundwater contribution (ZOC)


Legend
Elevation Countours
Turlough Boundary
OSi 2005 Orthophotographs
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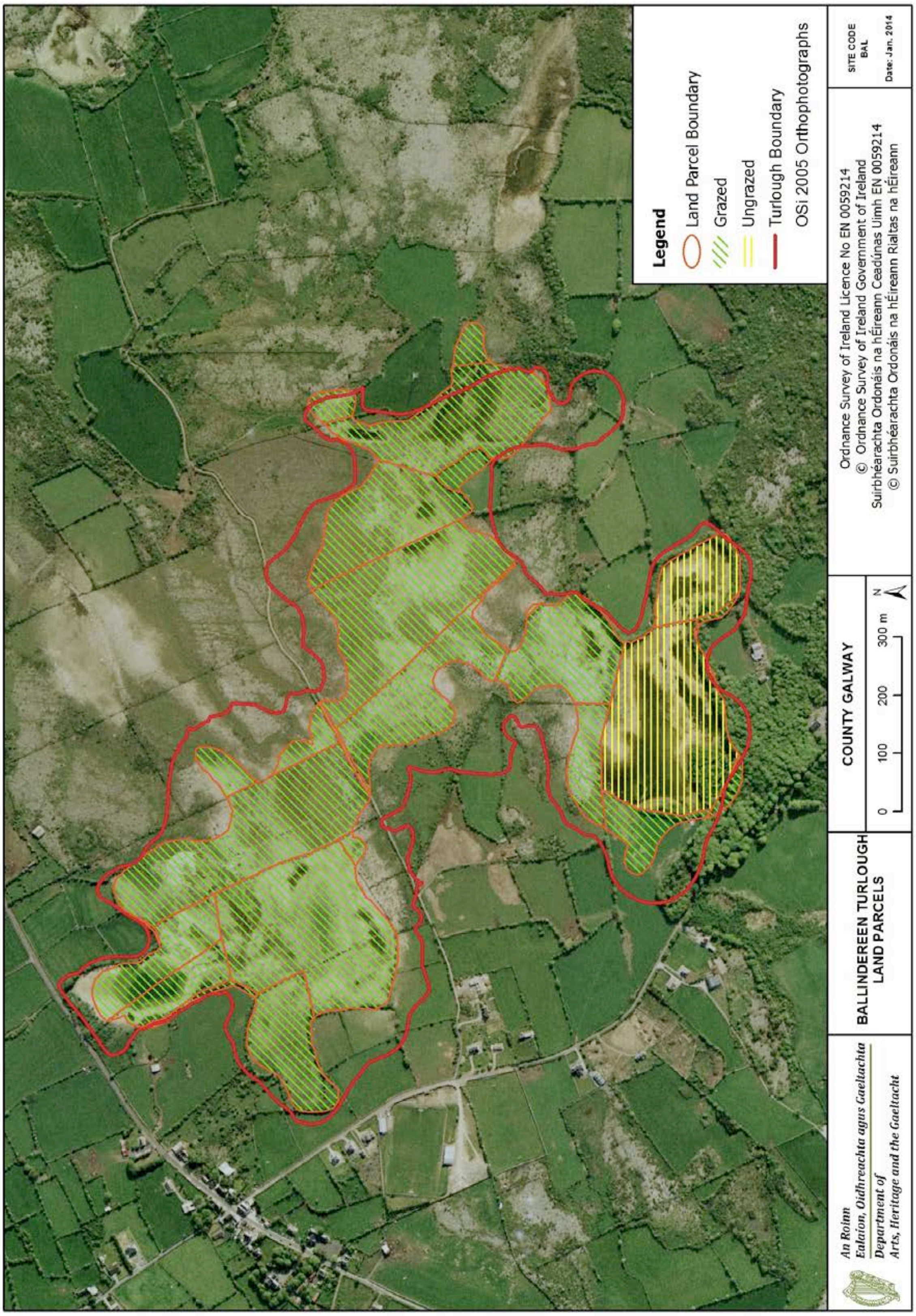
SITE CODE
BAL
Date: Jan. 2014
COUNTY GALWAY
0
100
200
300 m
N
BALLINDEREEN TURLOUGH
ELEVATION CONTOURS
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht
13.5
14
13
11
12
14.5
14.625


Legend
Land Parcel Boundary
Grazed
Ungrazed
Turlough Boundary
OSi 2005 Orthophotographs
SITE CODE
BAL
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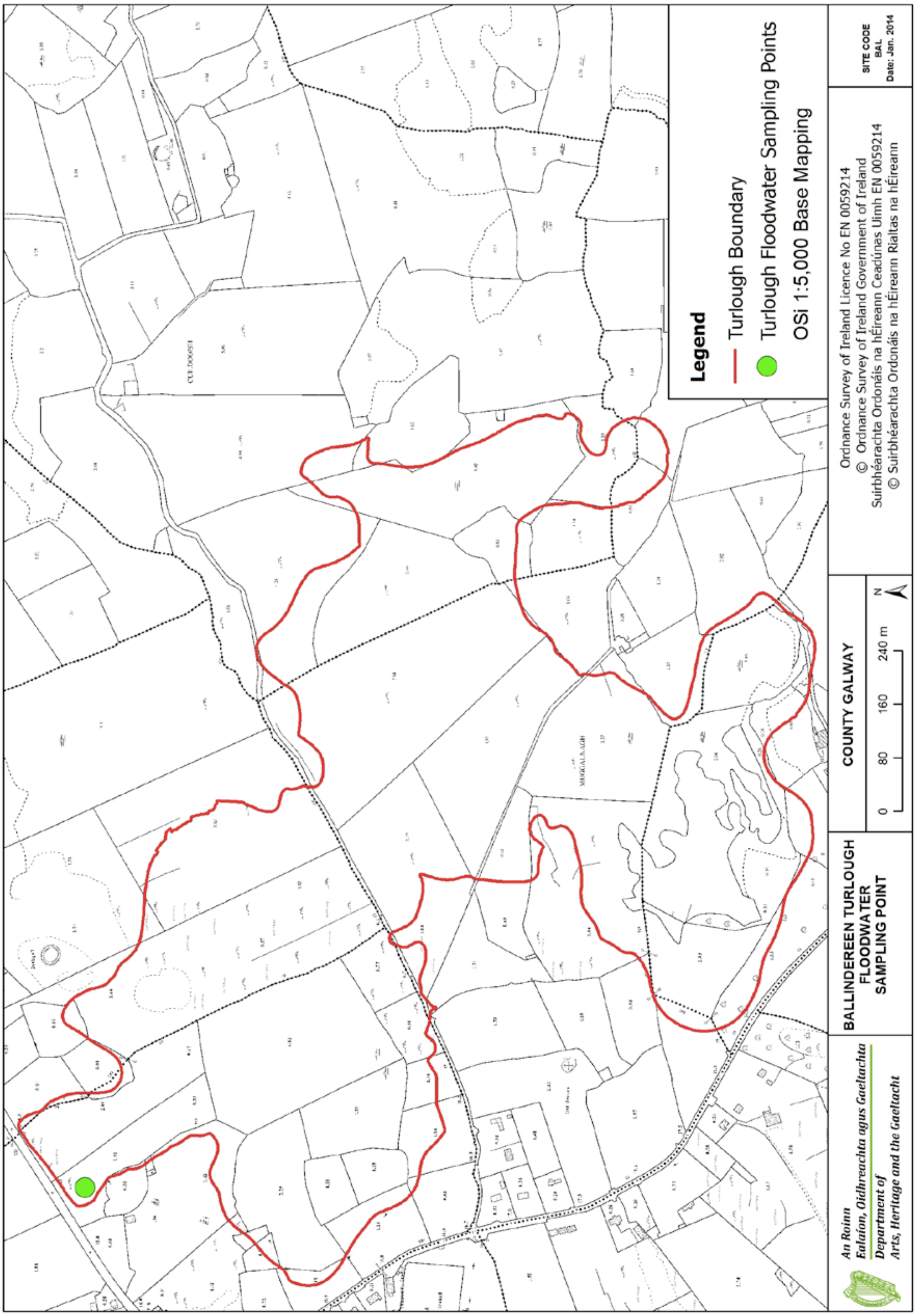
COUNTY GALWAY
0
100
200
300 m
N
BALLINDEREEN TURLOUGH
LAND PARCELS
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht



Legend
Turlough Boundary
Turlough Floodwater Sampling Points
OSi 1:5,000 Base Mapping
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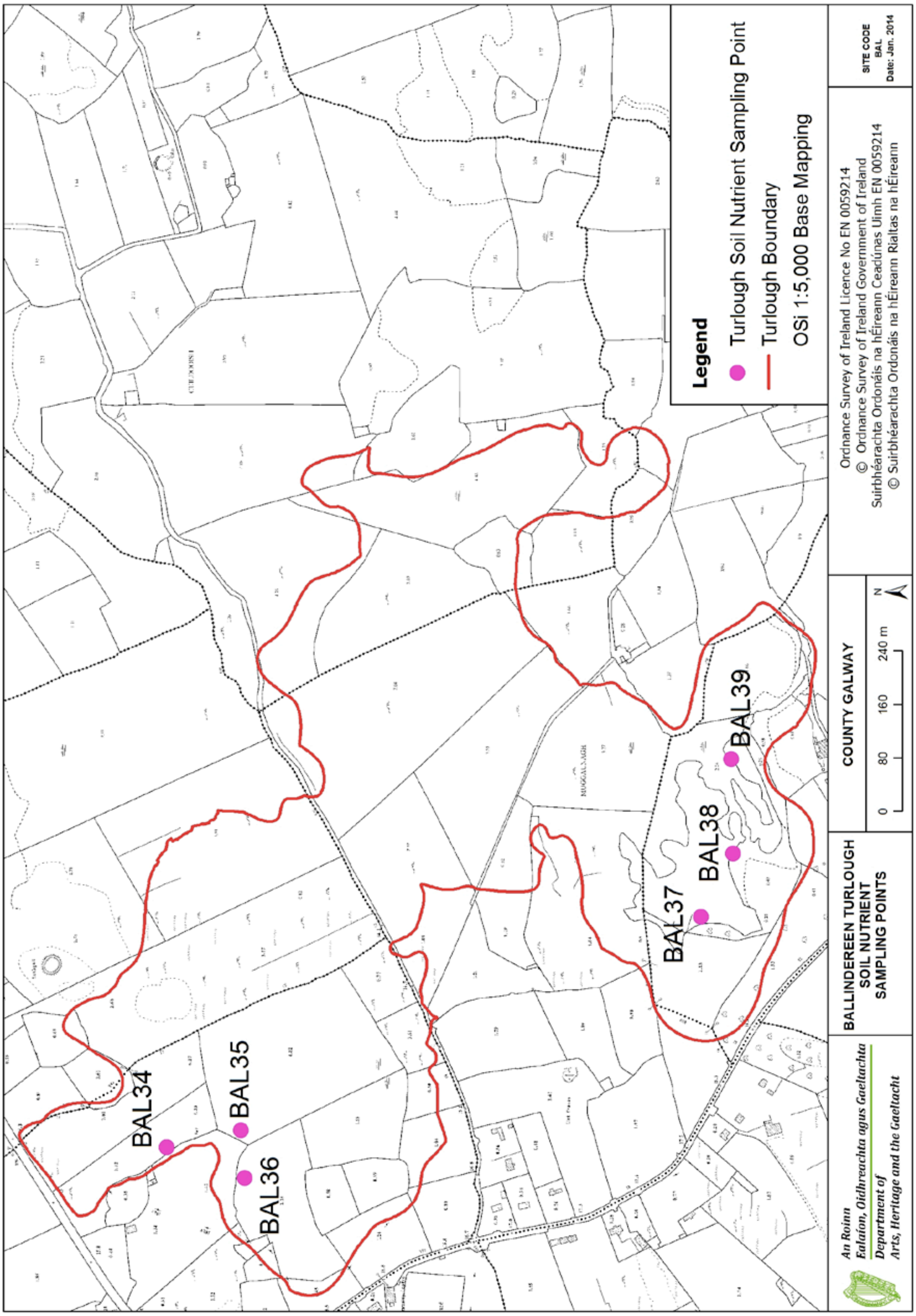
SITE CODE
BAL
Date: Jan. 2014
COUNTY GALWAY
0 80 160 240 m
N
BALLINDEREEN TURLOUGH
FLOODWATER
SAMPLING POINT
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht



Legend
Turlough Soil Nutrient Sampling Point
Turlough Boundary
OSi 1:5,000 Base Mapping
BAL34
BAL35
BAL36
BAL37
BAL38
BAL39
BALLINDEREEN TURLOUGH
SOIL NUTRIENT
SAMPLING POINTS
COUNTY GALWAY
0
80
160
240 m
N
SITE CODE
BAL
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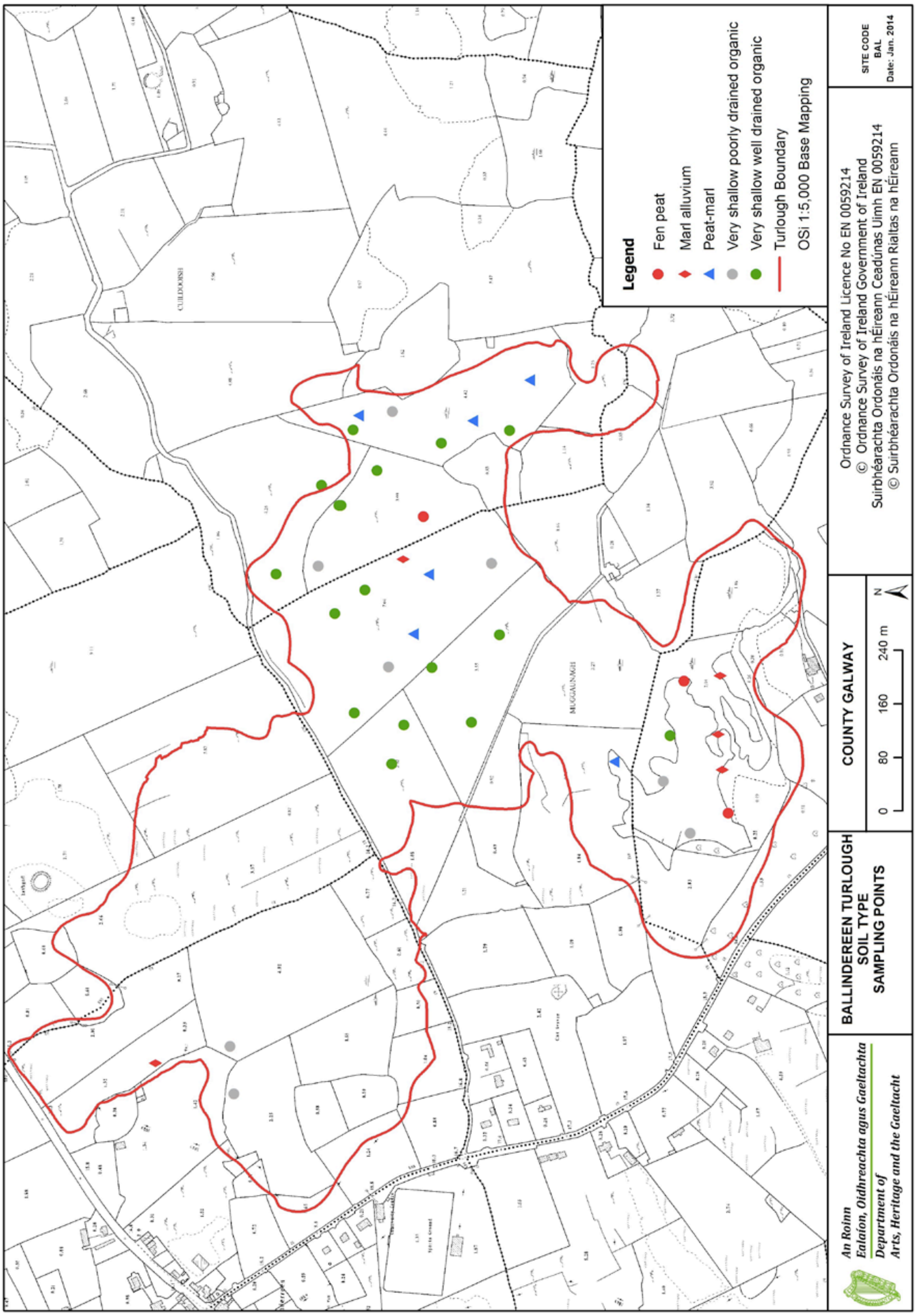

Legend
Fen peat
Marl alluvium
Peat-marl
Very shallow poorly drained organic
Very shallow well drained organic
Turlough Boundary
OSi 1:5,000 Base Mapping
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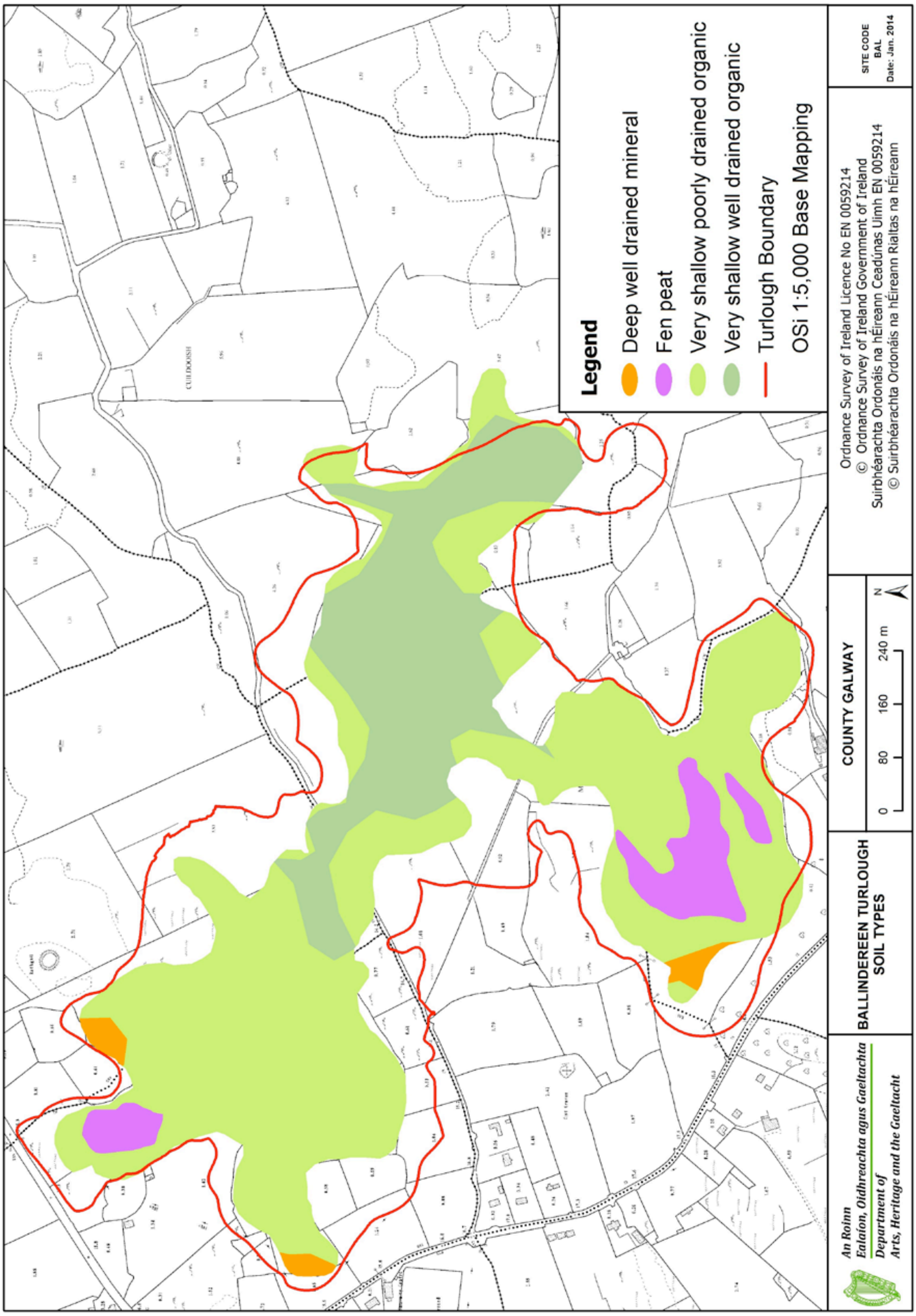
SITE CODE
BAL
Date: Jan. 2014
COUNTY GALWAY
0
80
160
240 m
N
BALLINDEREEN TURLOUGH
SOIL TYPE
SAMPLING POINTS
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht
CULDOORISH
MUGGAUNAGH


Legend
Deep well drained mineral
Fen peat
Very shallow poorly drained organic
Very shallow well drained organic
Turlough Boundary
OSi 1:5,000 Base Mapping
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SITE CODE
BAL
Date: Jan. 2014
COUNTY GALWAY
0 80 160 240 m
N
BALLINDEREEN TURLOUGH
SOIL TYPES
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
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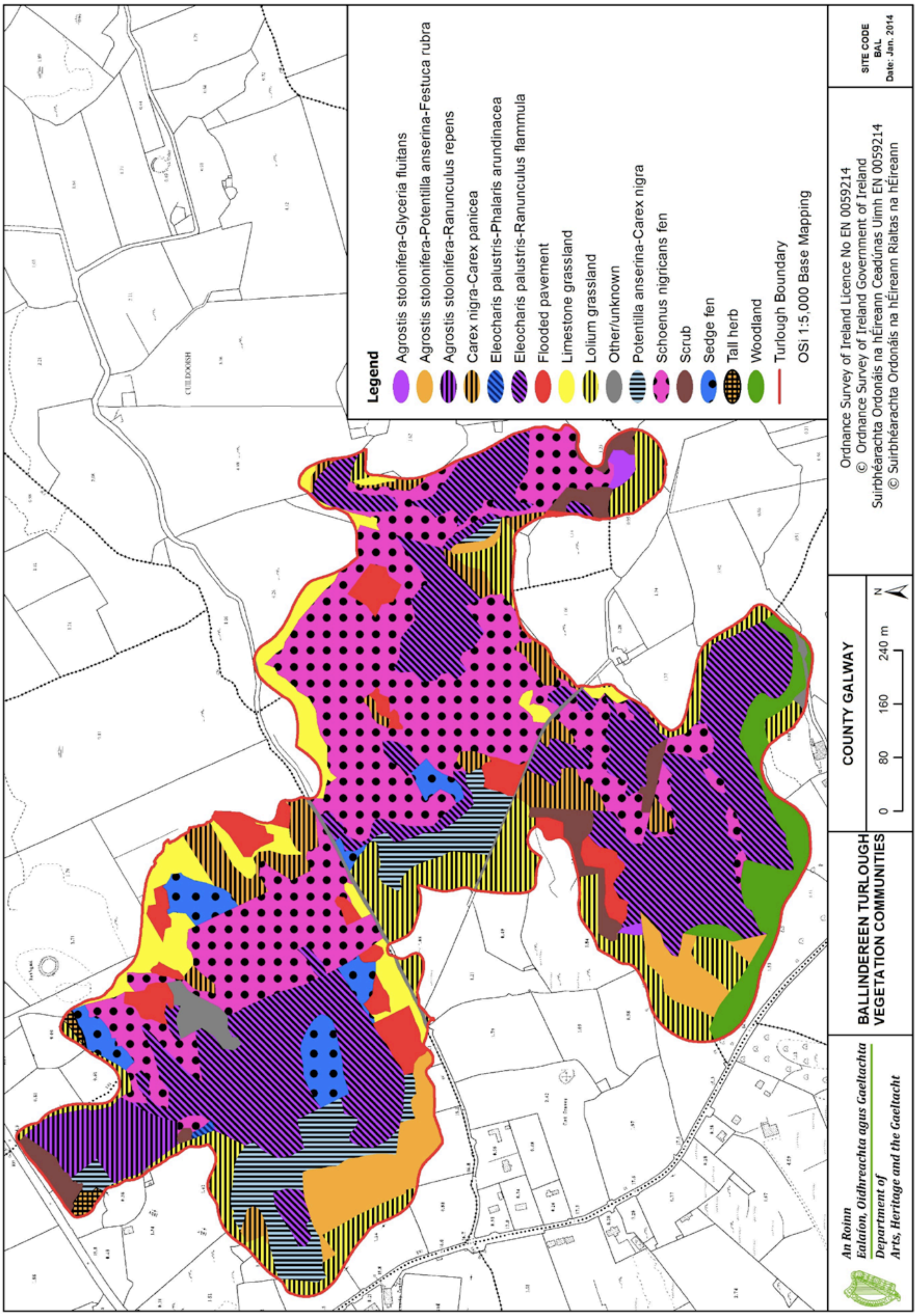
Arts, Heritage and the Gaeltacht


Legend
Agrostis stolonifera-Glyceria fluitans
Agrostis stolonifera-Potentilla anserina-Festuca rubra
Agrostis stolonifera-Ranunculus repens
Carex nigra-Carex panicea
Eleocharis palustris-Phalaris arundinacea
Eleocharis palustris-Ranunculus flammula
Flooded pavement
Limestone grassland
Lolium grassland
Other/unknown
Potentilla anserina-Carex nigra
Schoenus nigricans fen
Scrub
Sedge fen
Tall herb
Woodland
Turlough Boundary
OSi 1:5,000 Base Mapping
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht
BALLINDEREEN TURLOUGH
VEGETATION COMMUNITIES
COUNTY GALWAY
0 80 160 240 m
N
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SITE CODE
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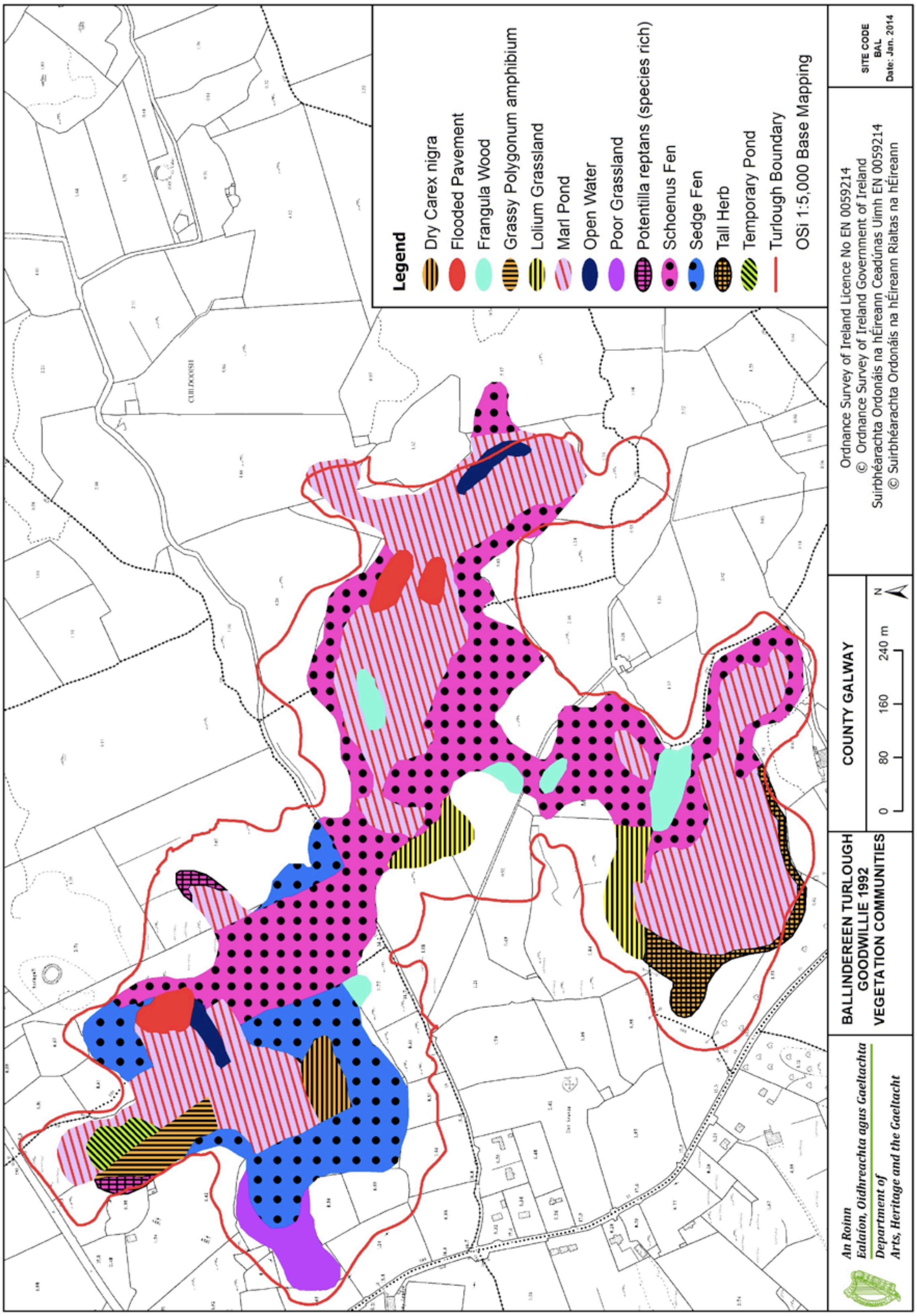
Date: Jan. 2014
CUILDOOISH


Legend
Dry Carex nigra
Flooded Pavement
Frangula Wood
Grassy Polygonum amphibium
Lolium Grassland
Marl Pond
Open Water
Poor Grassland
Potentilla reptans (species rich)
Schoenus Fen
Sedge Fen
Tall Herb
Temporary Pond
Turlough Boundary
OSi 1:5,000 Base Mapping
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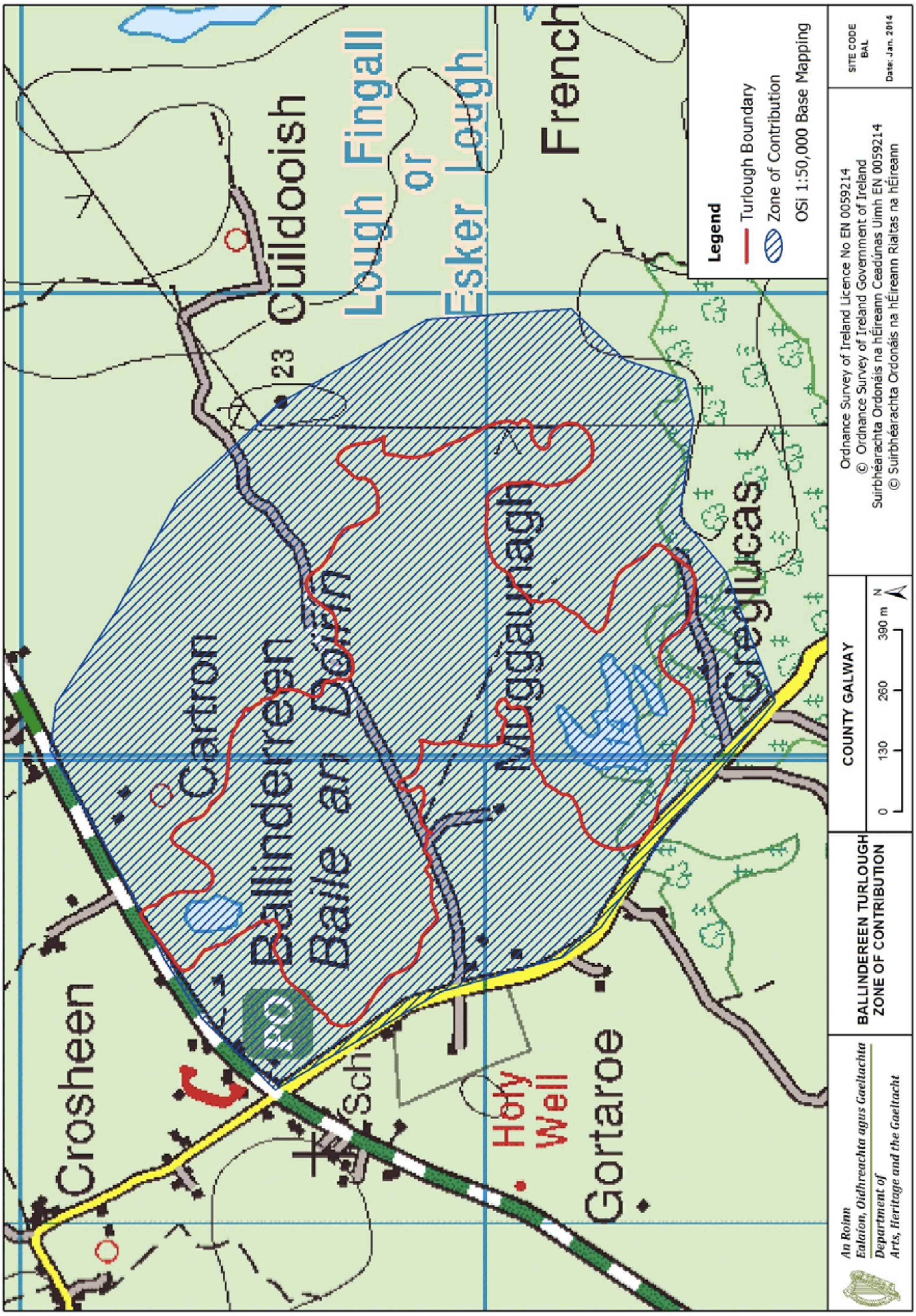
SITE CODE
BAL
Date: Jan. 2014
COUNTY GALWAY
0
80
160
240 m
N
BALLINDEREEN TURLOUGH
GOODWILLIE 1992
VEGETATION COMMUNITIES
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht
CURLOOSH



Legend
Turlough Boundary
Zone of Contribution
OSi 1:50,000 Base Mapping
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SITE CODE
BAL
Date: Jan. 2014
COUNTY GALWAY
0
130
260
390 m
N
BALLINDEREEN TURLOUGH
ZONE OF CONTRIBUTION
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht
Crosheen
Gortaroe
Holy Well
Sch
PO
Cartron
Ballindereen
Baile an Doirín
Mulgaunagh
Creeglucas
Cuildooish
23
Lough Fingall
or
Esker Lough
French

Site Report: Blackrock Turlough
TCD Turlough Research project 2006-2011

Turlough Project Code	SAC Name	SAC/NHA No.	County	Townland	RBD	Easting	Northing	Area (ha)
BLA	Peterswell Turlough	000318	Galway	Peterswell	WESTERN	149780	208130	59.3

File update: July 2015 (S. Waldren)

Site Description

Blackrock turlough, also known as Peterswell, is situated to the northwest of Peterswell village (Co. Galway). The turlough extends to 59.3 ha; it has an elongated basin, oriented roughly north-south. The south-eastern edge is steeply sloped and wooded, with another steep slope on the opposite side of the basin, but elsewhere slopes are more gentle. Occasional large rocks are evident throughout the turlough, as well as a number of sink holes in the floor. The turlough is partly fed by the Owenshree river, which enters at the northern end and then sinks within the basin. Ten vegetation types were recorded in Blackrock turlough; the *Potentilla anserina*-*Potentilla reptans* community was by far the dominant vegetation type, while abundant *Lolium* grassland was also mapped. Blackrock soils are moderately acidic and mineral, with low amounts of calcium carbonate. The majority of the turlough area is composed of very shallow well-drained mineral soil. The entire turlough basin is rotationally grazed. The hydrological data indicate that Blackrock generally experiences a significant annual flooding event, with further flooding occurring occasionally; it is generally a very flashy turlough and has even been recorded dry in mid winter. Of all the turloughs in this study, Blackrock turlough has the deepest floodwater depth (>15 m), largest maximum floodwater volume, fastest daily inflow and largest drainage capacity; the extreme hydrology might have possibly changed the extent of the turlough since Goodwillie's (1992) survey. Some of the limestone grassland mapped by Goodwillie seems to have been lost, probably by increased grazing pressure in the upper margins of the turlough.

Blackrock – photo: S. Kimberley

Phytoplankton

Phytoplankton analysis was conducted on sub-samples of monthly spot samples collected for hydrochemical analysis between October 2006 and June 2007. Phytoplankton composition varies significantly over time and data from autumn, mid-winter and spring/early summer are presented below. Taxa were identified to species level where possible. Some taxa were not discriminated beyond general groupings (i.e. small centric diatoms, dinoflagellates and pinnate diatoms). The term non-identifiable alone (or n.i.) was reserved for cases where specimens were not identifiable. Discrimination between n.i. filament, n.i. flagellate, n.i. colony, n.i. green filament was made when applicable. Biovolume ($mm^3\ m^{-3}$) was used as the measure of algal biomass.

October 2006		January 2007		May 2007	
Biovolume (mm^3/m^3)	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*
Navicula	56000	Fragilaria/Synedra	763034	Synedra	235114
n.i. green cells	29407	Nitzchia	184585	Diatoma moniliformis	227966
n.i. pennates	10933	n.i. centrics	99234	n.i. pennates	66801
Fragilaria/Synedra	10114	n.i. pennates	18549	Cryptomonas	20907
Chroomonas acuta	5010	n.i. 'strange flagellate'	5758	n.i. pennates	10144

Benthic Algae

Turloughs were inspected for algal mats during the emptying phase in 2007, 2008 and 2009. Turloughs were visited in the first two weeks of March to June 2007 as part of the monthly monitoring of turloughs. Dedicated trips to inspect for algal mats were conducted in 2008 on the 4th of March, the 1st of April, and the 26th, 27th and 28th of May, and in 2009 on the 15th and 16th of June and on the 24th and 25th of July. The presence of both living floating mats and dead drying mats was noted, as well as their extent in the turlough basins. Occurrence of visible filamentous algal mats in the three years of observation is presented below. Y = visible occurrence; * = "extensive cover" (estimated to be 2 to 8% of total area of basin); † = negligible quantity observed; • = turlough was too flooded to permit full observation. Algal mats were not observed in Blackrock, possibly due to the strong water colour.

Year of Observation		
2007	**2008**	**2009**
N	N	N

Hydrochemistry

Data shown are the mean ± SD of monthly spot samples collected between October 2006 and June 2007. Mean seasonal Total P and Chlorophyll *a* were used to determine the trophic status of the floodwaters based on OECD trophic categories. The median and range of <u>mean values</u> across all turloughs are also provided. Blackrock had very highly coloured water, and high total phosphorus.

Hydrochemical Variable	Blackrock Values		Turlough Summary Stats (n=22)		
	Mean±SD	**OECD Trophic Category**	**Median**	**Min**	**Max**
pH	7.9 ± 0.1		8.1	7.7	8.3
Alkalinity mg l^{-1} $CaCO_3$	166.9 ± 58.4		204.0	112.4	236.4
Colour mg l^{-1} PtCo	72.2 ± 32.0		26.9	7.9	85.1
Molybdate Reactive Phosphorus µg l^{-1}	27.3 ± 9.5		3.4	0.7	42.1
Total Phosphorus µg l^{-1}	52.4 ± 15.7	Eutrophic	24.8	4.0	82.1
Chlorophyll *a* µg l^{-1}	1.3 ± 0.7	Oligotrophic	4.9	1.1	33.5
Nitrate-N mg l^{-1}	1.2 ± 0.4		0.7	0.1	1.9
Total Nitrogen mg l^{-1}	1.7 ± 0.3		1.2	0.6	2.3

Aquatic Invertebrates

22 turloughs were sampled for littoral aquatic macroinvertebrates using sweep nets during November 2006 and April 2007. Zooplankton samples were collected in April 2007. Open-water cladocerans and littoral chydorids were sampled using a zooplankton net and perspex tube respectively.

Aquatic Macroinvertebrates			
November 2006	**Count**	**April 2007**	**Count**
Chaoboridae	1	No floodwater present	
Chironomidae	1		
Cloeon dipterum	17		
Laccophilus minutus	1		
Lymnaea truncula ta	2		
Oligochaeta	2		
Ostracoda	84		
Porhydrus lineatus	1		
Rhantus sp. (larva)	1		

Aquatic Macroinvertebrates: Presence of high abundances (> 50 individuals) of Ostracoda recorded in November 2006 indicates nutrient enrichment.

Aquatic Macroinvertebrate Taxa	Presence of high abundances	
	November 2006	**April 2007**
Diptera	N	
Ostracoda	Y	
Odonata	N	
Trichoptera	N	

Zooplankton species
No floodwater present in April 2007

Vegetation

Vegetation description and classification yielded 25 vegetation communities suitable for mapping. Ten vegetation communities were mapped in Blackrock turlough; they are generally reflective of the eutrophic conditions, including the dominant *Lolium* grassland and *Potentilla anserina-P. reptans* commnities. Blackrock also contains the *Filipendula ulmaria-Potentilla erecta-Viola* sp. and *Eleocharis acicularis* communities, both of which are of conservation importance. High conservation value communities are denoted by *. Sixty plant species were recorded, the most notable of which are *Eleocharis acicularis* and *Viola persicifolia*.

Vegetation Community	Area (Ha)
A. stolonifera-Glyceria fluitans	0.21
A. stolonifera-P. anserina - F. rubra	5.69
A. stolonifera-R. repens	0.78
Carex nigra-R. flammula	0.72
**Eleocharis acicularis*	0.08
**F. ulmaria-P. erecta-Viola sp*	3.24
Lolium grassland	15.87
Other/unknown	2.12
P. anserina-P. reptans	24.14
Poa annua-Plantago major	3.43
Woodland/scrub	4.08
Number of vegetation communities	10
Number of plant species	60

Vascular Plant Species

Nomenclature follows Parnell, J & Curtis, T. (2012) *Webb's An Irish Flora*, University of Cork Press.

Agrostis stolonifera	*Geum rivale*	*Potentilla reptans*
Capsella bursa-pastoris	*Glyceria fluitans*	*Prunus spinosa*
Cardamine pratensis	*Gnaphalium uliginosum*	*Ranunculus repens*
Cardamine pratensis	*Juncus bufonius*	*Rhamnus cathartica*
Carex flacca	*Leontodon autumnalis*	*Rorippa palustris*
Carex hirta	*Lolium perenne*	*Rosa canina*
Carex nigra	*Lotus corniculatus*	*Rubus fruticosus* agg.
Carex panicea	*Matricaria discoidea*	*Rumex acetosa*
Cerastium fontanum	*Mentha aquatica*	*Rumex crispus*
Cirsium arvense	*Ophioglossum vulgatum*	*Rumex obtusifolius*
Cirsium dissectum	*Phleum pratense*	*Sagina nodosa*
Crataegus monogyna	*Plantago lanceolata*	*Sagina procumbens*
Eleocharis acicularis	*Plantago major*	*Stellaria media*
Elymus repens	*Plantago media*	*Succisa pratensis*
Euphorbia exigua	*Poa annua*	*Trifolium pratense*
Festuca arundinacea	*Polygonum amphibium*	*Trifolium repens*
Festuca rubra	*Polygonum aviculare*	*Vicia cracca*
Filipendula ulmaria	*Polygonum hydropiper*	*Viola canina*
Galium boreale	*Potentilla anserina*	*Viola persicifolia*
Galium palustre	*Potentilla erecta*	*Viola* sp.
Galium verum		

Soils and Grazing

Soils were classified using a modified version of soil categories generated by the Teagasc/EPA Soils and Subsoils Mapping project (Fealy *et al.*, 2009). The classification scheme principally uses parent material (calcareous/non-calcareous), depth class (shallow/deep) and drainage class (well drained/poorly drained) to assign soils to one of nine broad categories. Blackrock has extensive areas shallow and very shallow mineral soils, mostly well-drained. The mean ± SD of a range of soil properties are also provided, in addition to the median and range of each variable across turloughs. Blackrock soils are moderately acidic and mineral, with low amounts of calcium carbonate.

Soil Types/Grazing Extent	**% Turlough Area**
Very shallow well drained mineral	50.3
Shallow well drained mineral	15.6
Shallow poorly drained mineral	33.2
Extent of rotationally grazed area	100

Soil Property (n=6)	**Blackrock**	**Turlough Summary Stats (n=22)**		
	Mean ± SD	**Median**	**Min**	**Max**
pH	6.6 ± 0.2	7.20	5.94	8.29
% Organic Matter content	14.6 ± 2.6	25.8	10.2	69.1
% Inorganic Content	80.4 ± 3.1	43.2	25.7	85.0
% Calcium carbonate content	5.02 ± 0.7	11.3	2.48	43.7
Total Nitrogen mg kg^{-1}	7050 ± 1388	11142	4983	24233
Total Phosphorus mg kg^{-1}	1123 ± 618	905	245	1594

Hydrology

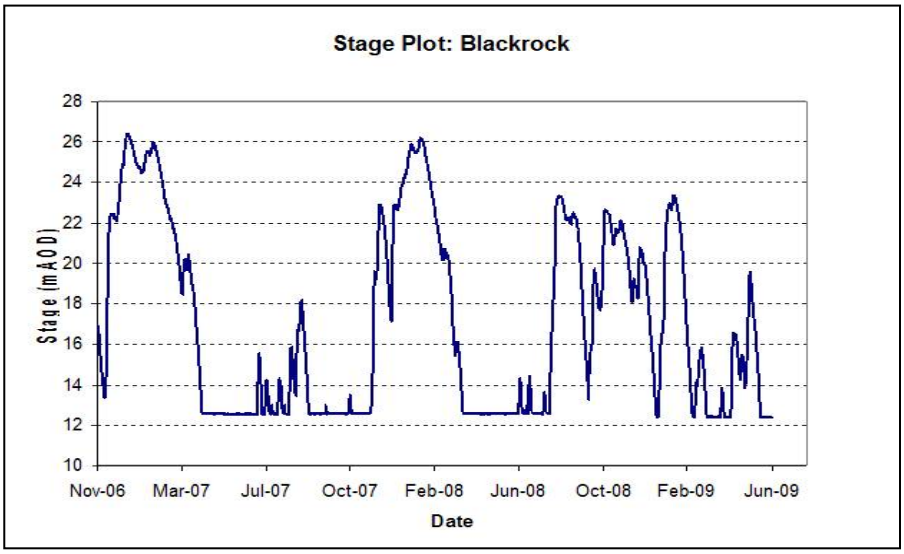
Water levels were recorded at hourly intervals using a variety of Schlumberger Divers® (Marton Geotechnical Ltd, Suffolk, UK) placed at or near the lowest point in each turlough. Divers measure the pressure of the water and air column above them, and from this the depth of water can be calculated. GPS surveys were carried out on 21 monitoring sites (Tullynafrankagh omitted) in order to develop digital terrain models (DTMs) from which contour maps, stage-volume and stage-surface area relationships are produced. The inflow magnitude is indicative of the properties of a turlough's catchment area and flow capacity, while outflow is a function of the drainage capacity of the system.

Blackrock generally experiences a significant annual flooding event, with further flooding occurring occasionally; it is generally a flashy turlough and has even been recorded dry in mid winter. Of all the turloughs in this study, Blackrock has the deepest floodwater depth, largest maximum floodwater volume, fastest daily inflow and largest drainage capacity.

Blackrock is partly fed by the Owenshree river which drains from the Slieve Aughty mountains which have acidic bedrock. The turlough is the first in a series of conduit fed turloughs which includes Lough Coy, Coole/Garryland, and Caherglassan. This system consequently has a very large zone of groundwater contribution.

Hydrological Information	Blackrock Values	Turlough Summary Stats (n=21)		
		Median	Min	Max
Start of Hydrological Recording	05/11/2006	-	-	-
End of Hydrological Recording	23/06/2009	-	-	-
Days Recorded	961	-	-	-
Equipment Failure	None recorded	-	-	-
Hydroperiod (days)	169	213	135	348
Maximum Floodwater Depth (m)	15.4	4.9	3	15.4
Maximum Floodwater Volume ('000 m^3)	4008.1	877.9	355.6	4008.1
Maximum Flooded Area (ha)	59.29	38.61	13.71	78.12
Average Basin Depth (m)	6.76	2.28	0.85	6.76
Average Daily Inflow ($m^3 s^{-1}$)	10.253	0.684	0.254	10.253
Average Daily Outflow ($m^3 s^{-1}$)	2.018	0.271	0.086	2.018
Drainage Capacity ($m^3 s^{-1}$)	1.156	0.154	0.069	1.156
Recession Duration (days)	40.1	57.3	11	142.5

Stage plot for Blackrock turlough



Zone of Groundwater Contribution (ZOC) Risk Assessments

GIS based risk assessments were conducted with a view to identifying turloughs at risk of failing to meet WFD water quality objectives. These risk assessments were conducted by Compass Informatics Ltd and were based on Risk Assessment Sheet GWDTERA2a (Guidance Document No. GW9) on assessing risks to turloughs from phosphate (Working Group on Groundwater 2004) and Pathway Susceptibilities and Pressure Magnitudes were integrated to produce Impact Potential maps and predicted Risk Categories for the turlough ZOC. The TCD Risk Category is derived from a revised Impact Potential matrix. The predicted Risk Categories were adjusted using mean seasonal floodwater Total P ($\mu g\ l^{-1}$) (see Section 4.5.4 of the Risk Assessment Sheet GWDTERA2a). The risk categories include 1A: at significant risk; 1B: probably at significant risk; 2A: Not at significant risk (low confidence); 2B: Not at significant risk (higher confidence).

ZOC Area (Km^2)	Predicted WFD Risk Category	Adjusted WFD Risk Category	Predicted TCD Risk Category	Adjusted TCD Risk Category
80.9	2A	2A	1B	1A

ZOC Pressure Variable	
CORINE BARE ROCK %	0
CORINE PEAT BOGS%	16
CORINE ALL NATURAL AND SEMI-NATURAL AREAS%	16
CORINE IMPROVED PASTURE%	29
CORINE UNIMPROVED PASTURE%	28
CORINE ALL PASTURE%	57
CORINE OTHER AGRICULTURAL LANDS%	10
TEAGASC/EPA HABITATS ROCK%	1
TEAGASC/EPA HABITATS BOGS/PEATS%	14
TEAGASC/EPA HABITATS FORESTS/SCRUBS%	13
TEAGASC/EPA HABITATS WATER%	0
TEAGASC/EPA HABITATS DRY GRASSLAND%	62
TEAGASC/EPA HABITATS WET GRASSLAND%	10
TEAGASC TOTAL GRASSLAND%	1
TOTAL LIVESTOCK UNIT/ha of ZOC	0
TILLAGE%	8
No. SEPTIC TANKS km^{-2} ZOC	6
No. SEPTIC TANKS/Km^{-2} EXTREME PATHWAY SUSCEPTIBILITY	59
HIGH PATHWAY SUSCEPTIBILITY%	75
EXTR+HIGH PATHWAY SUSCEPTIBILITY%	57
WELL DRAINED SOIL %	42
POORLY DRAINED SOIL%	0

Site Conservation Assessment

The following site conservation assessment was undertaken to feed into the national reporting structure for assessing conservation status as required under Article 17 of the Habitats Directive. A suite of indicators and associated targets were derived to assess ecological structure and function. Future prospects were assessed through the evaluation of the impact of current and recent pressures and likely future threats to the site. The assessment follows a rules based approach to determine whether Structures & functions and Future Prospects should be assessed as good (green), inadequate (amber) or bad (red). For further details, see Chapter 10 (Conservation Status Assessment).

Please note an updated approach to assessing site condition has been proposed and is outlined in Chapter 12 (Monitoring Methods for Turloughs).

Conservation Condition Summary

Structure & Function	**Inadequate**
Future Prospects	**Inadequate**
Site Conservation Condition	**Inadequate**

Structure and Function Status:

Indicator	***Comments***
Hydrological Function: *Good*	Some drainage work is known in the ZOC but not considered to significantly impact on the functioning of the turlough
Water Quality: *Bad*	52.4 µg P $l^{-1.}$
Biological Responses: *Intermediate*	Rather mixed responses across categories
Algal communities: 0	No algal mats were recorded, low max CHL; likely due to the highly coloured water due to runoff from the Slieve Aughty forestry activity
Vegetation communities: 0	Moderate cover of both positive and negative indicator communities
***Rumex* cover: -1**	81.1% frequency, very high
Important plants: 1	*Viola persicifolia*
Important aquatic invertebrates: 0	No important species
Overall Structure & Function: *Inadequate*	

Pressures:*

Code	***Impact***	***Notes***
H02.06 Diffuse groundwater pollution due to agricultural and forestry activities (ZOC)	H	Pollution due to agriculture and through forestry activity in the Slieve Aughty mountains, also likely from adjacent abattoir
A04.01.01 Intensive cattle grazing (turlough)	M	Moderate grazing within turlough
E02.01 Factory (adjacent to or within turlough)	M	Abattoir adjacent to turlough likely releases nutrient to groundwater
H02.07 Diffuse groundwater pollution due to non-sewered population (ZOC)	L	Relatively low level of habitation in ZOC
B01 Forest planting on open ground (ZOC)	L	Forest planting continuing, but main pressure from forestry is from existing forests via groundwater pollution

*the codes for pressures and threats are those used in EU Habitats Directive Article 17 reporting for 2013

Threats:

Code	Impact	Notes
H02.06 Diffuse groundwater pollution due to agricultural and forestry activities (ZOC)	H	Ongoing significant pressure
A02.01 Agricultural intensification (ZOC)	M	Likely based on the pasture in the lower elevation parts of the ZOC
A04.01.01 Intensive cattle grazing (turlough)	M	Highly productive but extent of grazing likely limited by flashy flooding and extreme depth
E02.01 Factory (adjacent to turlough)	M	Abattoir adjacent to turlough
H02.07 Diffuse groundwater pollution due to non-sewered population (ZOC)	L	
A04.03 Abandonment of pastoral systems, lack of grazing (ZOC)	L	Removal of grazing from the turlough has the potential to greatly modify the vegetation due to the high productivity
A10.02 Removal of stone walls and embankments (in turlough)	L	A general problem in many turloughs, likely to lead to more widespread animal movement and consequently reduced diversity within turloughs
M01.03 Flooding and rising precipitations	L	A potential general problem in turloughs driven by predicted climate change
A02.03 Grassland removal for arable land (ZOC)	L	Possible shift to maize production locally

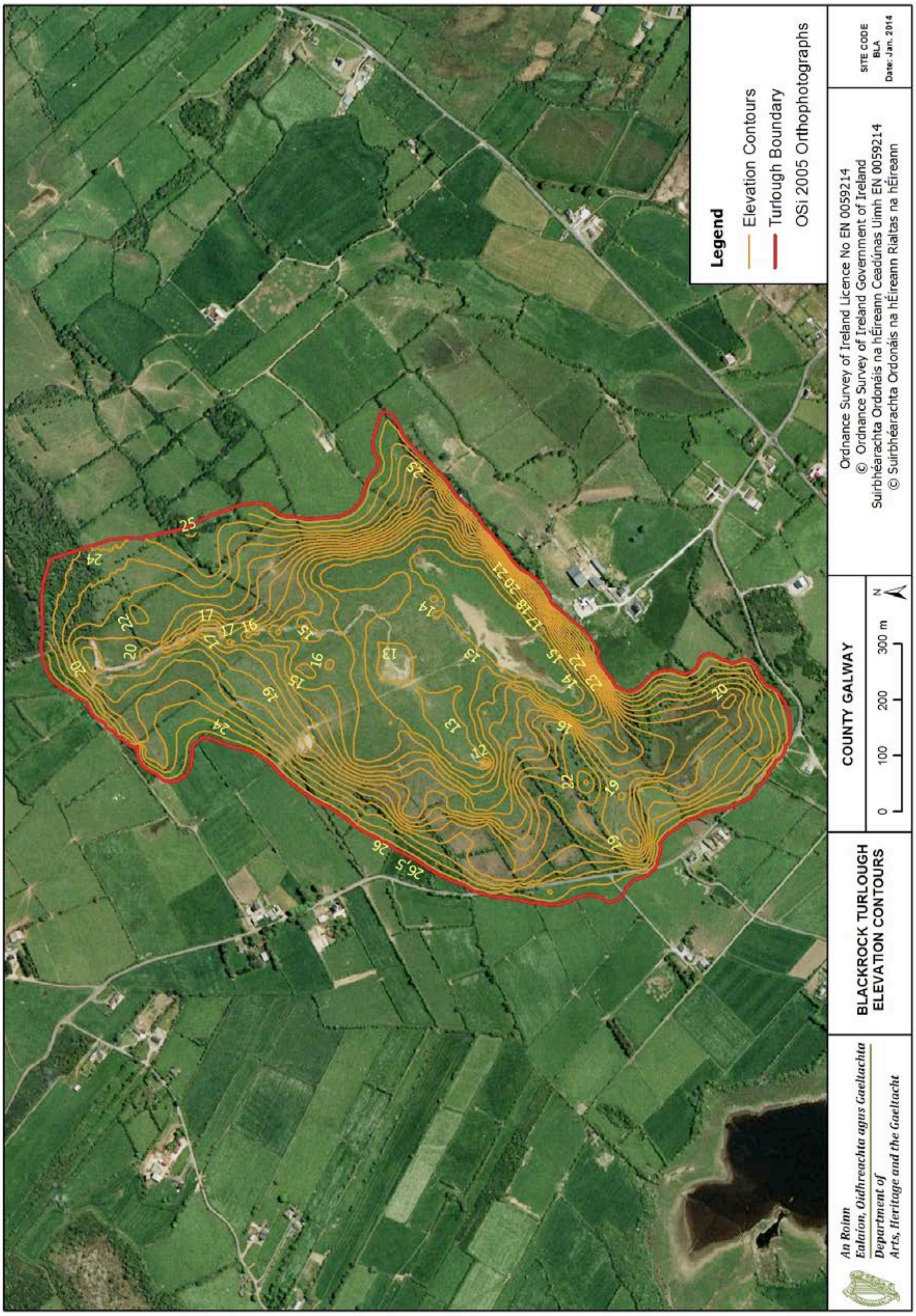
Future Prospects: **Inadequate** – there are a relatively high number of medium impact threats likely to further degrade the ecological structure and function; many of these threats are on-going pressures from within the ZOC, chiefly affecting groundwater quality.

Overall Assessment: **Inadequate** – Blackrock is a hydrologically interesting turlough but suffers from high nutrient inputs, likely caused by a combination of agricultural and domestic diffuse pollution, and pollution from forestry activities in the upper elevations of the ZOC. As with other turloughs in the Gort chain, the impact of this forestry on acidic peat soils is evidenced by the highly coloured floodwater, which generally restrict the development of algal communities, and perhaps explains the generally poor aquatic invertebrate communities. Even so, Blackrock retains some important plant communities and several rare or threatened vascular plants.

Maps

Maps are provided of:

1. Elevation contours, based on GIS digital terrain models from points by differential GPS topographic survey (for further details, see *Chapter 3: Hydrology*)
2. Grazing in land parcels
3. Approximate sampling points for water chemistry and aquatic invertebrates
4. Soil nutrient sampling points
5. Points for soil survey (note: soils were surveyed to the turlough boundary defined by Goodwillie, 1992; see map 9)
6. Soils (note: soils were mapped by combining the EPA Subsoils base map with the point soil descriptions; for further details see *Chapter 6: Soils and Landuse*)
7. Vegetation relevés
8. Vegetation communities (note: relevés do not always match to mapped communities due to small scale variation; for further details of mapping see *Chapter 7: Turlough Vegetation: Description, Mapping and Ecology*)
9. Vegetation maps digitised from Goodwillie, R. (1992) *Turlough's Over 50 Hectares*. Report to NPWS
10. Estimated zone of groundwater contribution (ZOC)


Legend
Elevation Contours
Turlough Boundary
OSi 2005 Orthophotographs
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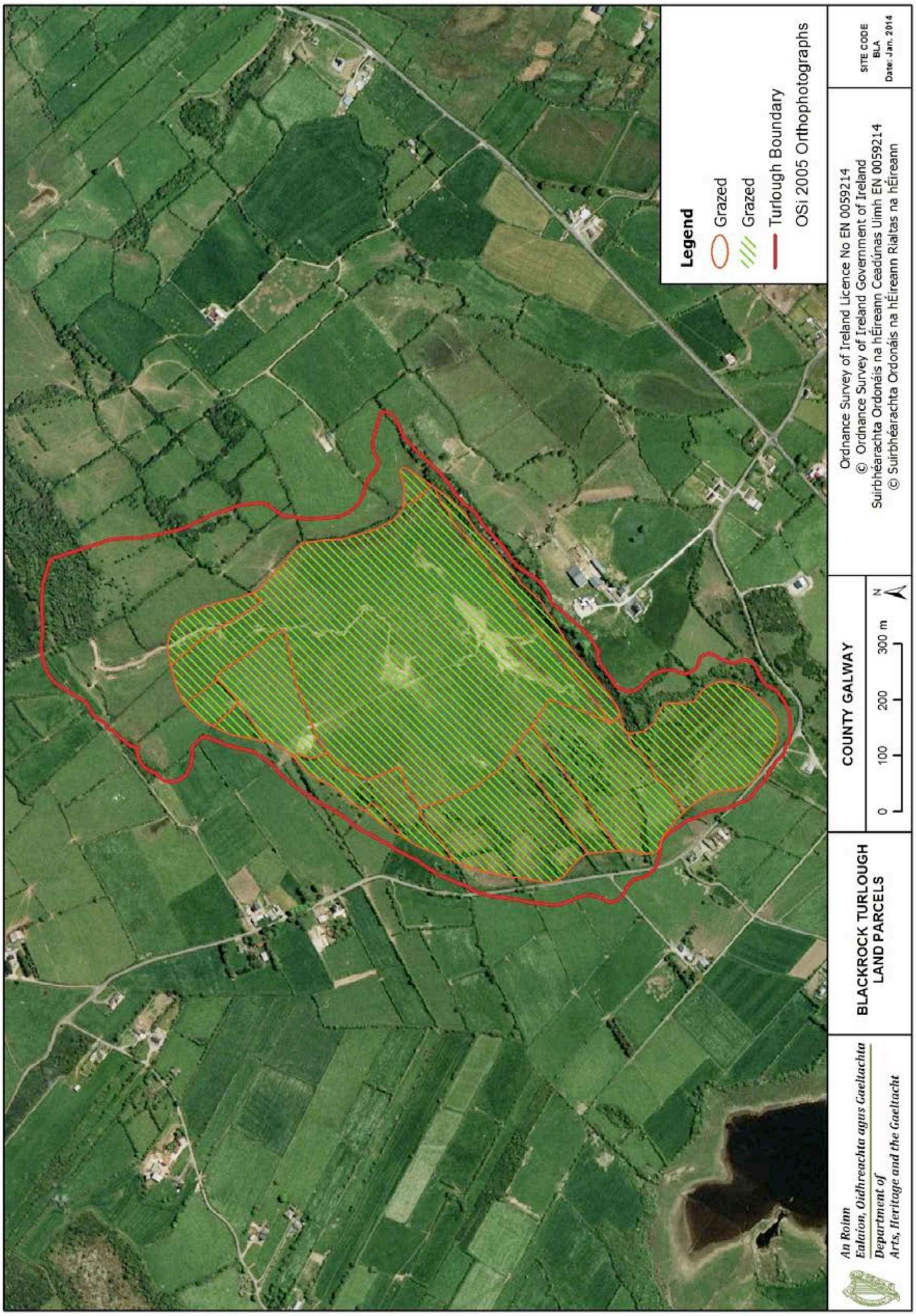
SITE CODE
BLA
Date: Jan. 2014
COUNTY GALWAY
0 100 200 300 m
N
BLACKROCK TURLOUGH
ELEVATION CONTOURS
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht


Legend
Grazed
Grazed
Turlough Boundary
OSi 2005 Orthophotographs
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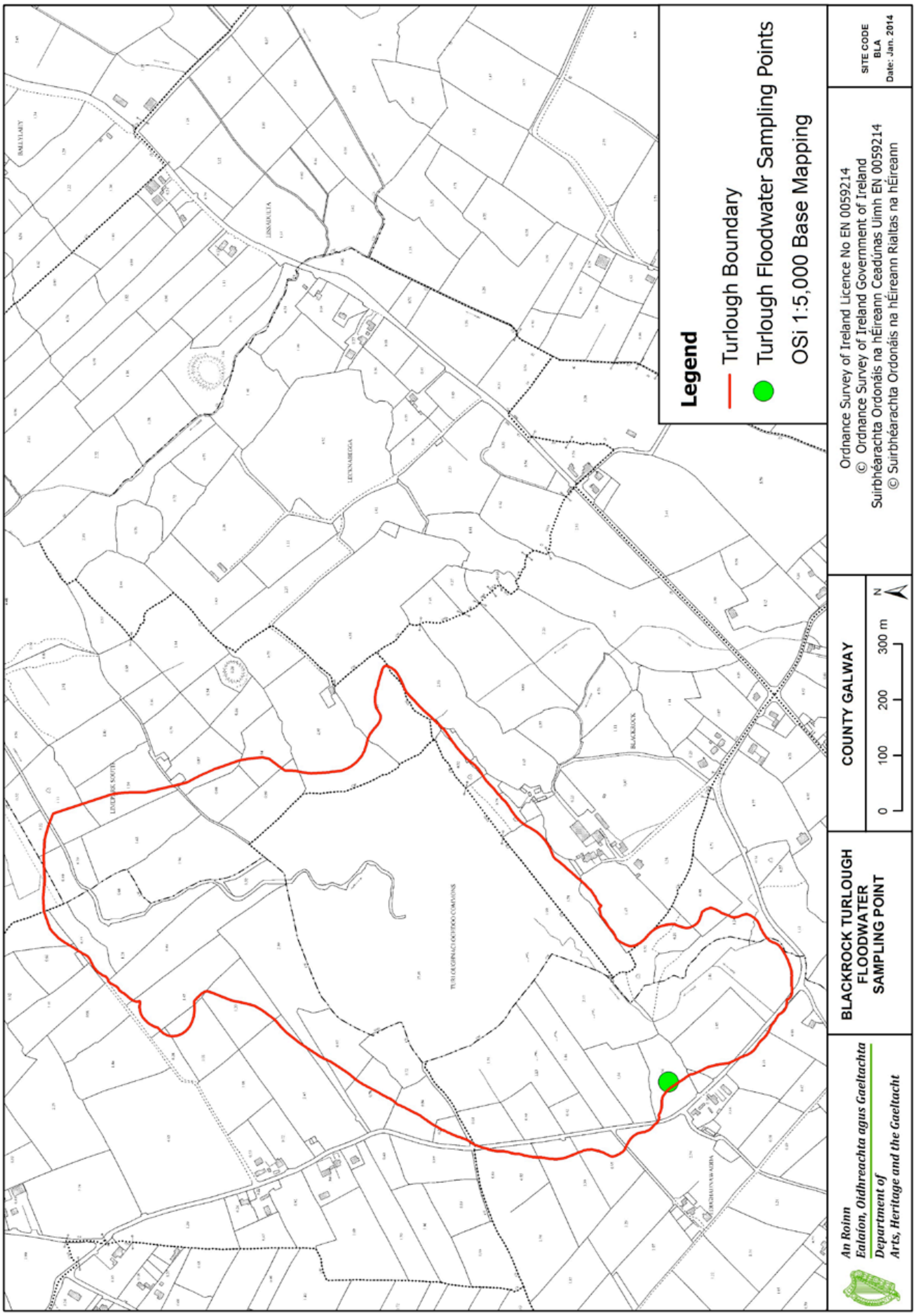
BLA
Date: Jan. 2014
COUNTY GALWAY
0
100
200
300 m
N
BLACKROCK TURLOUGH
LAND PARCELS
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht


Legend
Turlough Boundary
Turlough Floodwater Sampling Points
OSi 1:5,000 Base Mapping
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SITE CODE
BLA
Date: Jan. 2014
COUNTY GALWAY
0 100 200 300 m
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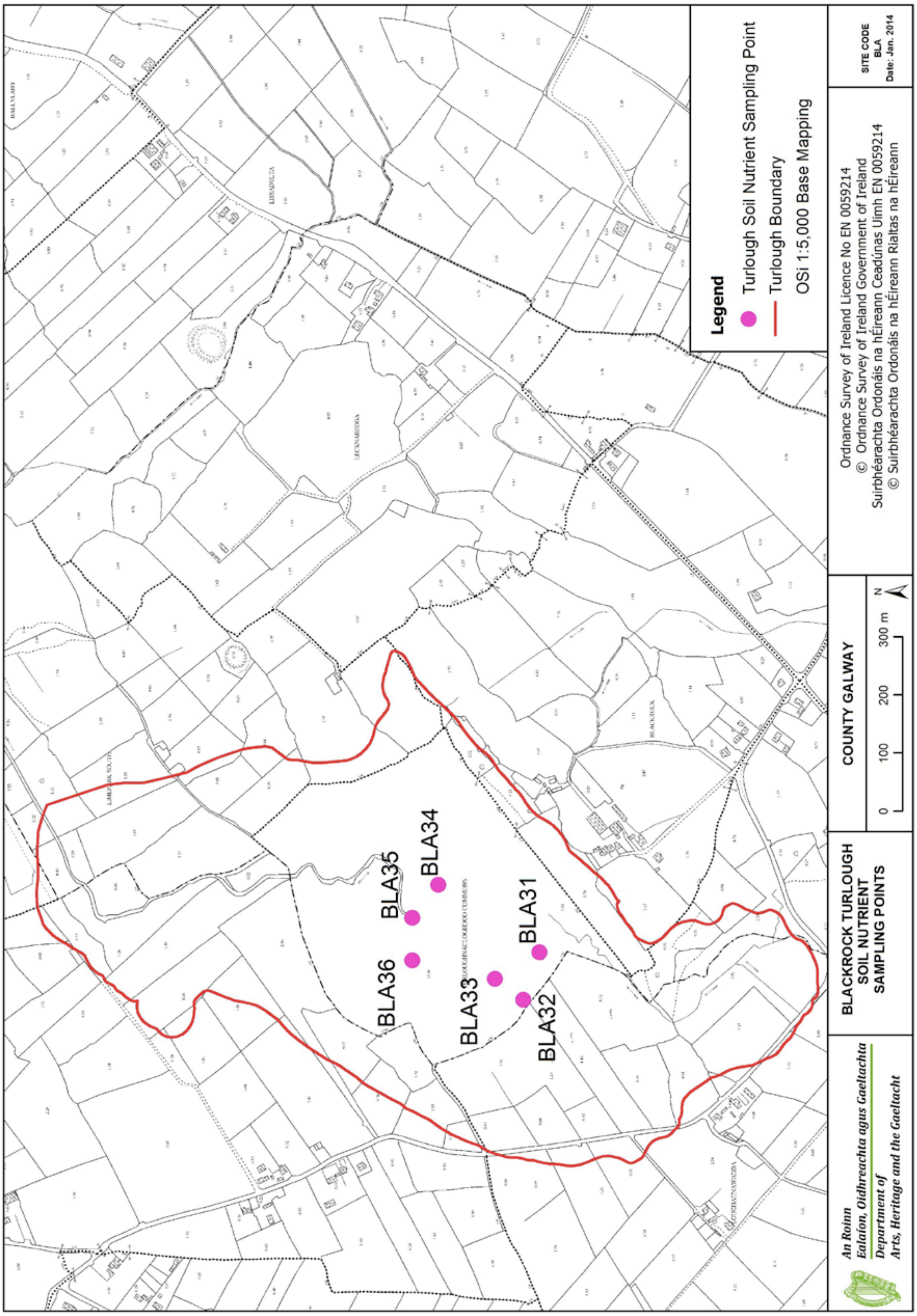
BLACKROCK TURLOUGH FLOODWATER SAMPLING POINT
An Roinn Ealaíon, Oidhreachta agus Gaeltachta
Department of Arts, Heritage and the Gaeltacht


BLA31
BLA32
BLA33
BLA34
BLA35
BLA36
Legend
Turlough Soil Nutrient Sampling Point
Turlough Boundary
OSi 1:5,000 Base Mapping
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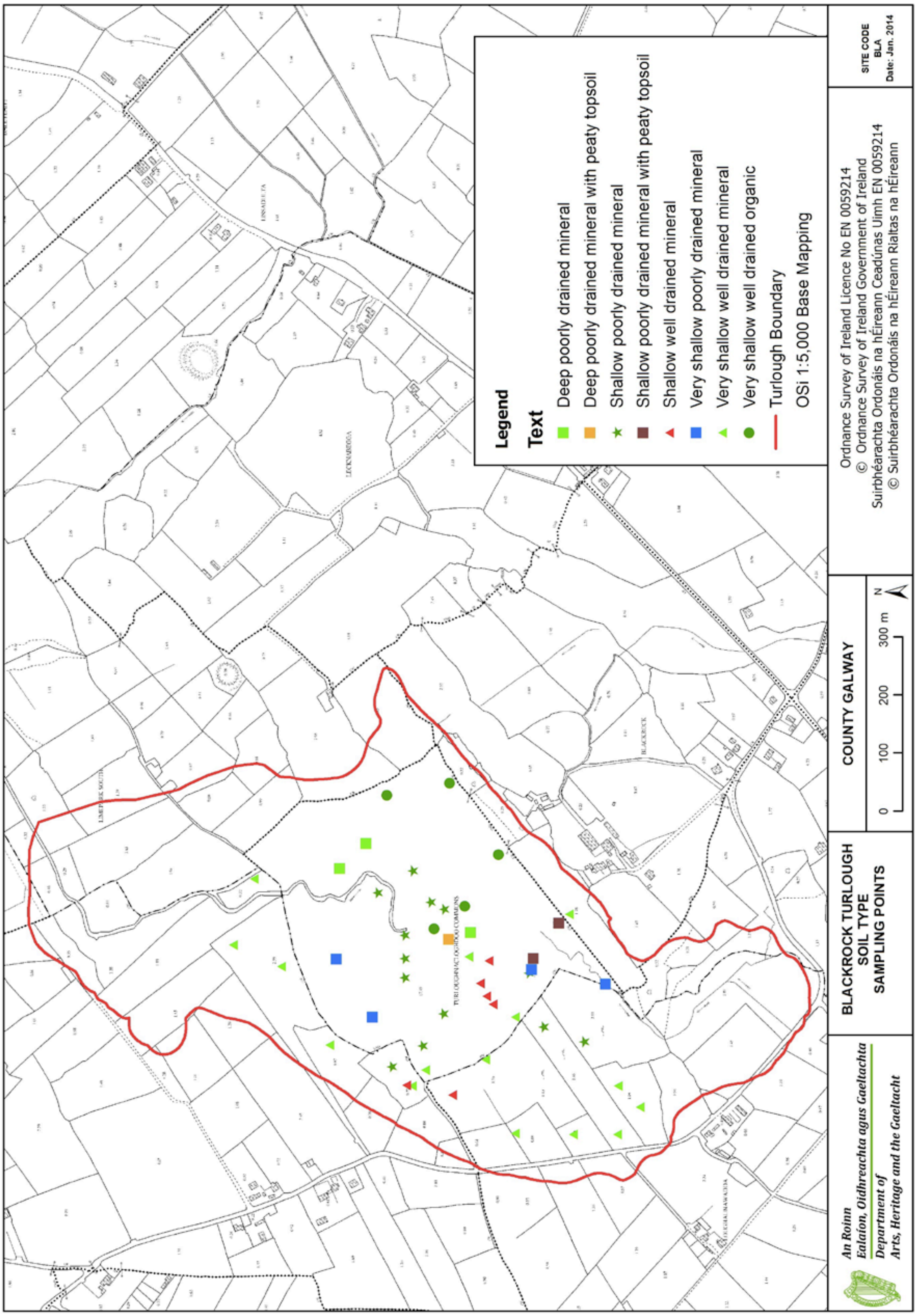
SITE CODE
BLA
Date: Jan. 2014
BLACKROCK TURLOUGH
SOIL NUTRIENT
SAMPLING POINTS
COUNTY GALWAY
0 100 200 300 m
N
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht


Legend
Text
Deep poorly drained mineral
Deep poorly drained mineral with peaty topsoil
Shallow poorly drained mineral
Shallow poorly drained mineral with peaty topsoil
Shallow well drained mineral
Very shallow poorly drained mineral
Very shallow well drained mineral
Very shallow well drained organic
Turlough Boundary
OSi 1:5,000 Base Mapping
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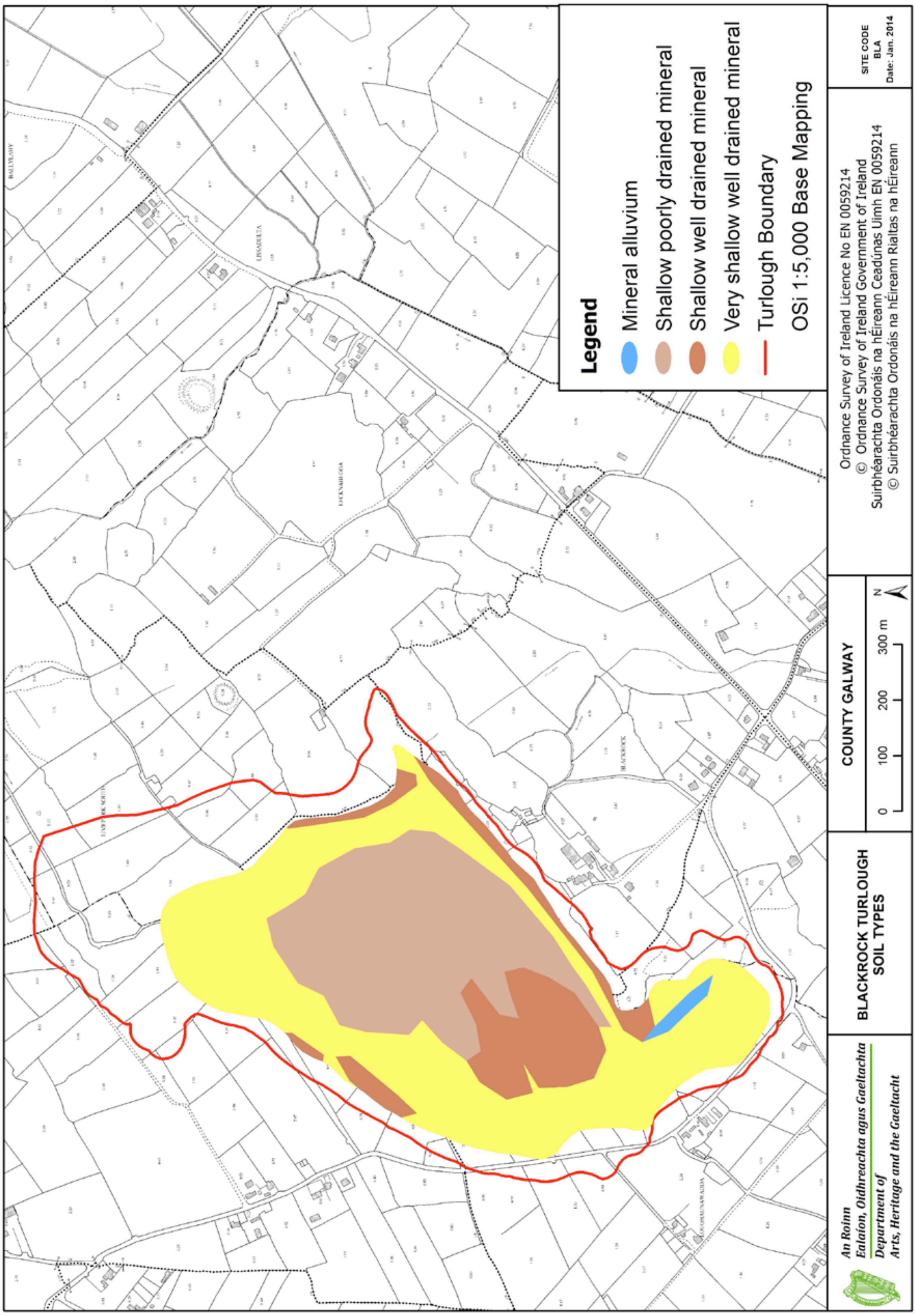
SITE CODE
BLA
Date: Jan. 2014
COUNTY GALWAY
0
100
200
300 m
N
BLACKROCK TURLOUGH
SOIL TYPE
SAMPLING POINTS
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht


Legend
Mineral alluvium
Shallow poorly drained mineral
Shallow well drained mineral
Very shallow well drained mineral
Turlough Boundary
OSi 1:5,000 Base Mapping
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BLA
Date: Jan. 2014
COUNTY GALWAY
0 100 200 300 m
N
BLACKROCK TURLOUGH
SOIL TYPES
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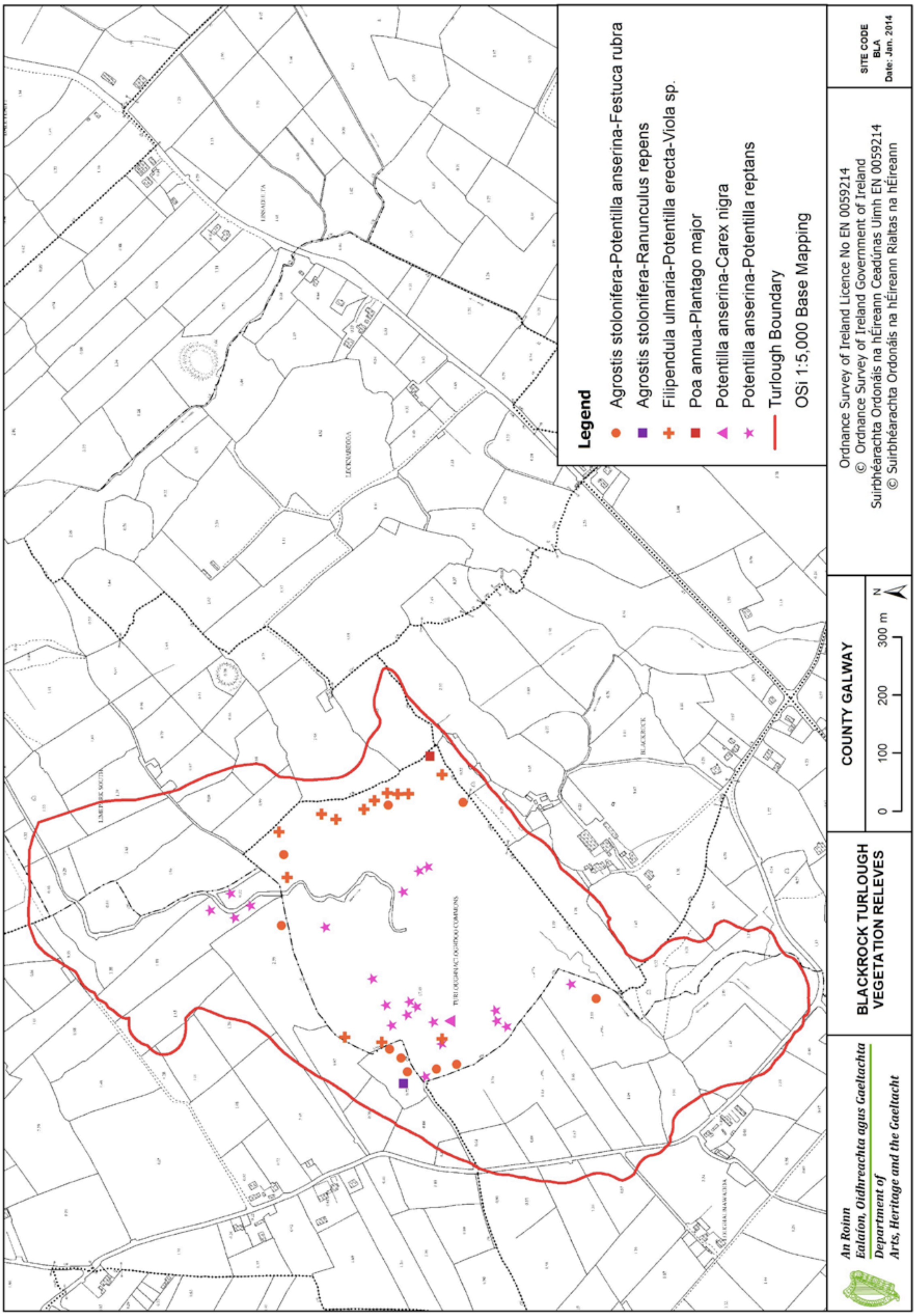
Department of
Arts, Heritage and the Gaeltacht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Agrostis stolonifera-Potentilla anserina-Festuca rubra
Agrostis stolonifera-Ranunculus repens
Filipendula ulmaria-Potentilla erecta-Viola sp.
Poa annua-Plantago major
Potentilla anserina-Carex nigra
Potentilla anserina-Potentilla reptans
Turlough Boundary
OSi 1:5,000 Base Mapping
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SITE CODE
BLA
Date: Jan. 2014
COUNTY GALWAY
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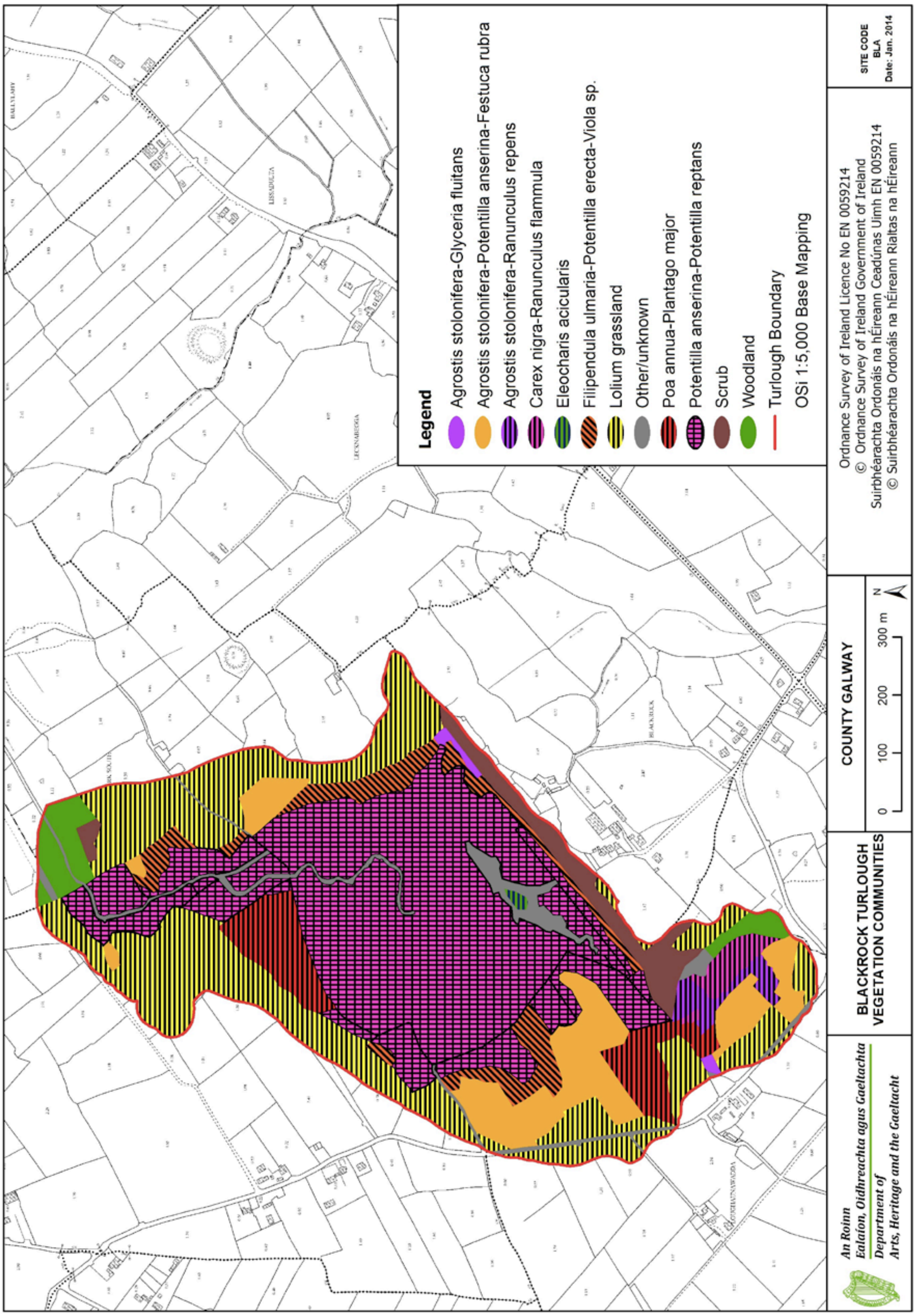
BLACKROCK TURLOUGH
VEGETATION RELEVES
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht


Legend
Agrostis stolonifera-Glyceria fluitans
Agrostis stolonifera-Potentilla anserina-Festuca rubra
Agrostis stolonifera-Ranunculus repens
Carex nigra-Ranunculus flammula
Eleocharis acicularis
Filipendula ulmaria-Potentilla erecta-Viola sp.
Lolium grassland
Other/unknown
Poa annua-Plantago major
Potentilla anserina-Potentilla reptans
Scrub
Woodland
Turlough Boundary
OSi 1:5,000 Base Mapping
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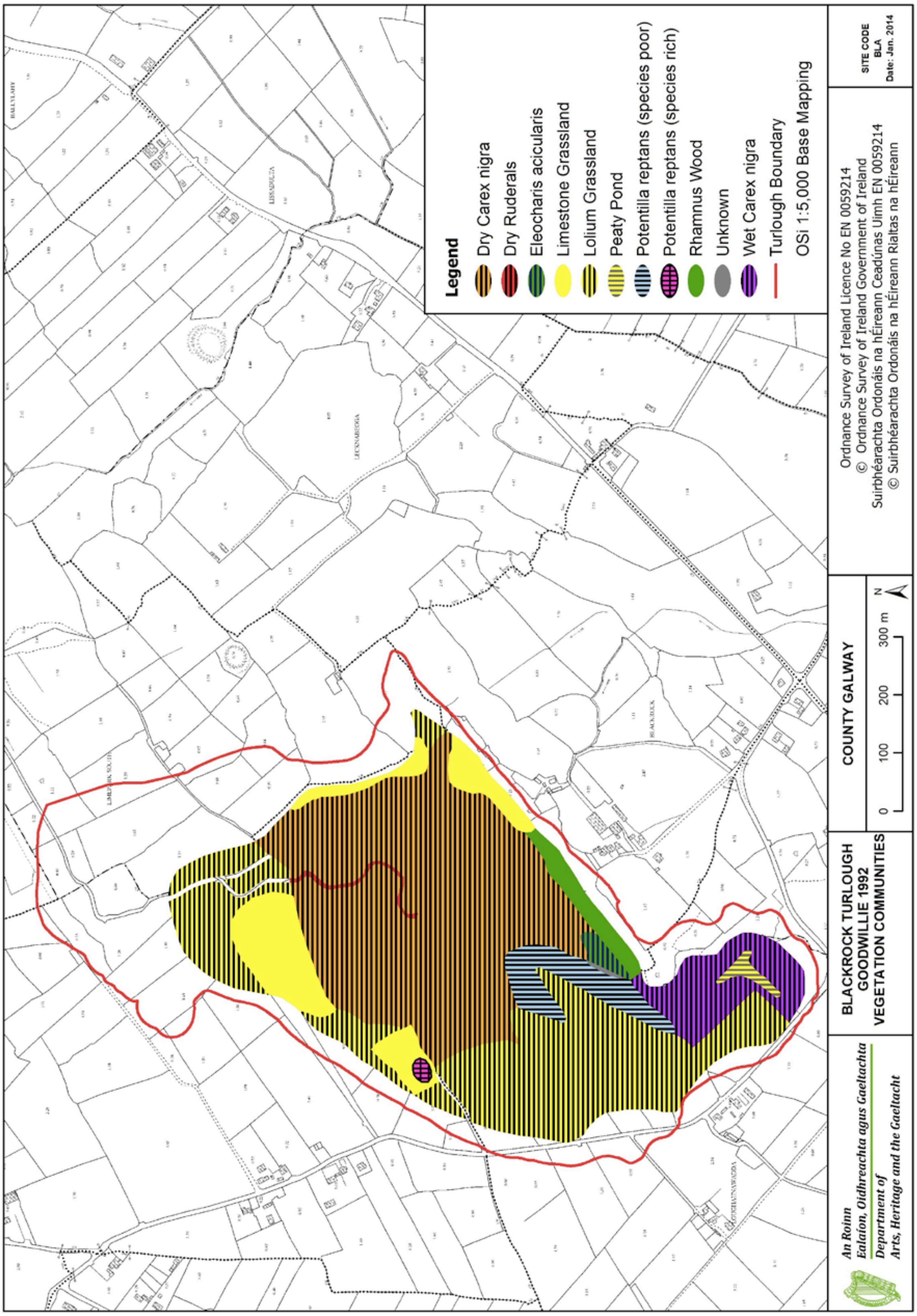
SITE CODE
BLA
Date: Jan. 2014
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht
BLACKROCK TURLOUGH
VEGETATION COMMUNITIES
COUNTY GALWAY
0
100
200
300 m
N


Legend
Dry Carex nigra
Dry Ruderals
Eleocharis acicularis
Limestone Grassland
Lolium Grassland
Peaty Pond
Potentilla reptans (species poor)
Potentilla reptans (species rich)
Rhamnus Wood
Unknown
Wet Carex nigra
Turlough Boundary
OSi 1:5,000 Base Mapping
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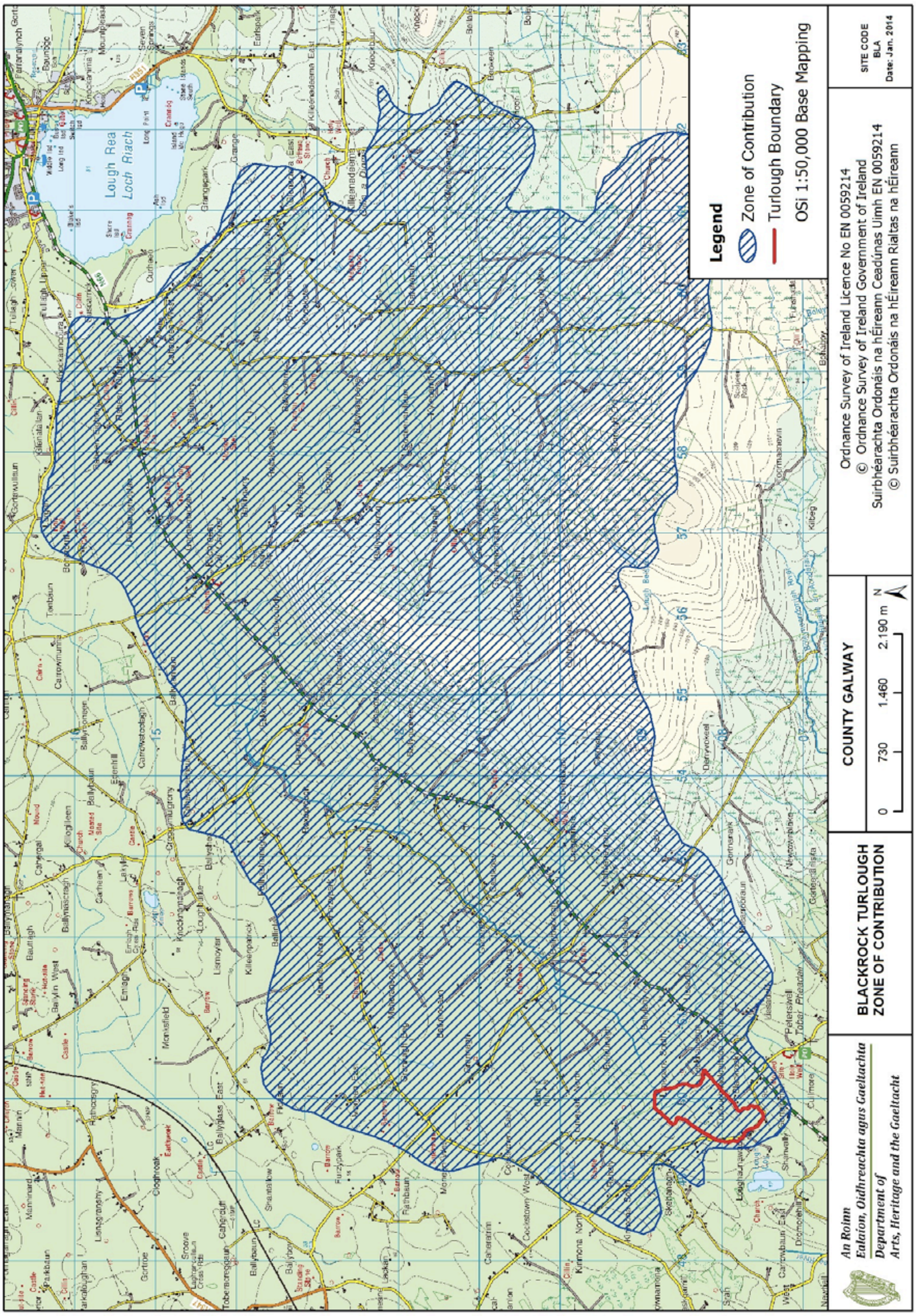
SITE CODE
BLA
Date: Jan. 2014
COUNTY GALWAY
0
100
200
300 m
N
BLACKROCK TURLOUGH
GOODWILLIE 1992
VEGETATION COMMUNITIES
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht


Legend
Zone of Contribution
Turlough Boundary
OSi 1:50,000 Base Mapping
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SITE CODE
BLA
Date: Jan. 2014
BLACKROCK TURLOUGH
ZONE OF CONTRIBUTION
COUNTY GALWAY
0 730 1,460 2,190 m
N
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht
Lough Rea
Loch Riach

Site Report: Brierfield Turlough
TCD Turlough Research project 2006-2011

Turlough Project Code	SAC Name	NHA No.	County	Townland	RBD	Easting	Northing	Area (ha)
BRI	Non-SAC	000594	Roscommon	Brierfield	SHANNON	181600	276560	59

File update: July 2015 (S. Waldren)

Site Description

Brierfield turlough, which is an NHA rather than a SAC, is a relatively large turlough (59 ha) situated to the east of Castleplunket in central Co. Roscommon. The basin is V-shaped, with arms extending to the south-west and north-west (Goodwillie, 1992). Steep ridges occur around the majority of a relatively flat basin floor. Twelve vegetation types were mapped in Brierfield turlough. Very extensive areas of *Carex nigra-Ranunculus flammula* and *Potentilla anserina-Carex nigra* were recorded. Brierfield soils are circumneutral and peaty, with significant amounts of calcium carbonate. 'Alluvial marl with peaty topsoil' was by far the dominant soil type. Approximately half of the turlough area (54%) is under rotational grazing. The hydrological data indicate that Brierfield turlough experiences one significant flood every per year and that the site is relatively slow to flood and drain; there is some evidence from vegetation that the turlough may flood for longer than when surveyed by Goodwillie.

Brierfield – photo: S. Kimberley

Phytoplankton

Phytoplankton analysis was conducted on sub-samples of monthly spot samples collected for hydrochemical analysis between October 2006 and June 2007. Phytoplankton composition varies significantly over time and data from autumn, mid-winter and spring/early summer are presented below. Taxa were identified to species level where possible. Some taxa were not discriminated beyond general groupings (i.e. small centric diatoms, dinoflagellates and pinnate diatoms). The term non-identifiable alone (or n.i.) was reserved for cases where specimens were not identifiable. Discrimination between n.i. filament, n.i. flagellate, n.i. colony, n.i. green filament was made when applicable. Biovolume ($mm^3\ m^{-3}$) was used as the measure of algal biomass.

October 2006		**January 2007**		**May 2007**	
Biovolume (mm^3/m^3)	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*
Mougeotia	1054641	*n.i. pennates*	23241	*n.i. pennates*	23040
Synedra	222952	*Cryptomonas*	6985	*Fragilaria/Synedra*	18791
n.i. filament	92796	*Dinobryon*	3844	*Cryptomonas*	9067
n.i. 'strange flagellate'	23520	*n.i. 'strange flagellate'*	2869	*Chroomonas acuta*	6967
Aulacoseira	21570	*n.i.*	1845	*Achnanthidium minutissima*	6955

Benthic Algae

Turloughs were inspected for algal mats during the emptying phase in 2007, 2008 and 2009. Turloughs were visited in the first two weeks of March to June 2007 as part of the monthly monitoring of turloughs. Dedicated trips to inspect for algal mats were conducted in 2008 on the 4th of March, the 1st of April, and the 26th, 27th and 28th of May, and in 2009 on the 15th and 16th of June and on the 24th and 25th of July. The presence of both living floating mats and dead drying mats was noted, as well as their extent in the turlough basins. Occurrence of visible filamentous algal mats in the three years of observation is presented below. Y = visible occurrence; * = “extensive cover” (estimated to be 2 to 8% of total area of basin); † = negligible quantity observed; • = turlough was too flooded to permit full observation. Algal mats were only observed in Brierfield in 2008 in very small quantity.

Year of Observation		
2007	**2008**	**2009**
N	Y†	N

Hydrochemistry

Data shown are the mean ± SD of monthly spot samples collected between October 2006 and June 2007. Mean seasonal Total P and Chlorophyll *a* were used to determine the trophic status of the floodwaters based on OECD trophic categories. The median and range of <u>mean values</u> across all turloughs are also provided.

Hydrochemical Variable	Brierfield Values		Turlough Summary Stats (n=22)		
	Mean±SD	OECD Trophic Category	Median	Min	Max
pH	8.1±0.2		8.1	7.7	8.3
Alkalinity mg l^{-1} $CaCO_3$	210.2±25.9		204.0	112.4	236.4
Colour mg l^{-1} PtCo	35.6±11.9		26.9	7.9	85.1
Molybdate Reactive Phosphorus µg l^{-1}	1.9±0.8		3.4	0.7	42.1
Total Phosphorus µg l^{-1}	19.8±9.5	Mesotrophic	24.8	4.0	82.1
Chlorophyll *a* µg l^{-1}	5.0±3.1	Mesotrophic	4.9	1.1	33.5
Nitrate-N mg l^{-1}	0.1±0.1		0.7	0.1	1.9
Total Nitrogen mg l^{-1}	0.6±0.1		1.2	0.6	2.3

Aquatic Invertebrates

22 turloughs were sampled for littoral aquatic macroinvertebrates using sweep nets during November 2006 and April 2007. Zooplankton samples were collected in April 2007. Open-water cladocerans and littoral chydorids were sampled using a zooplankton net and perspex tube respectively.

Aquatic Macroinvertebrates			
November 2006	**Count**	**April 2007**	**Count**
Agabus labiatus	1	*Agabus* sp. (larva)	11
Agabus sp. (larva)	7	*Agyroneta aquatica*	1
Agyroneta aquatica	4	Chironomidae	32
Chironomidae	8	*Corixa punctata*	1
Diptera Pupae	1	Culicidae	5
Dryops sp. (larva)	5	Diptera Pupae	2
Euconulus alderi	8	*Dryops* sp. (larva)	2
Halticinae sp.	5	*Euconulus alderi*	1
Helophorus brevipalpis	3	*Halticinae* sp.	1
Hydaticus sp. (larva)	2	*Hydroporus palustris*	3
Ilybius sp. (larva)	1	*Hygrotus inaequalis*	1
Limnephilus auricula	7	*Ilybius* sp. (larva)	1
Limnephilus decipiens	2	*Limnephilus lunatus*	1
Lymnaea peregra	2	*Lymnaea glabra*	14
Lymnaea truncultata	22	*Lymnaea trunculata*	1
Oligochaeta	21	*Nemoura cinerea*	2
Ostracoda	34	Oligochaeta	8
Phacopteryx brevipennis	47	Ostracoda	7
Pisidium/Sphaerium spp.	3	*Planorbis leucostoma*	1
Planorbis leucostoma	1	Psychodidae	3
Rhantus frontalis	1	Tipulidae	1
Rhantus sp. (larva)	4		
Succinea sp.	29		
Tipulidae	1		
Valvata cristata	1		

Aquatic Macroinvertebrates: Presence of high abundances of Trichoptera (> 50 individuals) in November 2006 indicates nutrient poor conditions.

Aquatic Macroinvertebrate Taxa	**Presence of high abundances**	
	November 2006	**April 2007**
Diptera	N	N
Ostracoda	N	N
Odonata	N	N
Trichoptera	Y	N

Zooplankton species
Alona quadrangularis
Chydorus ovalis
Chydorus sphaericus
Daphnia pulex
Eurycercus lamellatus
Graptoleberis testudinaria
Lathurona rectirostris
Pleuroxus laevis

Vegetation

Vegetation description and classification yielded 25 vegetation communities suitable for mapping. Ten vegetation communities were mapped in Brierfield turlough, the dominant cmmunities were *Carex nigra-Ranunculus. flammula* and *Potentilla anserina-Carex nigra*. No communities of high conservation value were recorded. Ninety-seven plant species were recorded, indicating a high diversity, but no species of conservation importance were recorded.

Vegetation Community	**Area (Ha)**
A. stolonifera-Glyceria fluitans	0.55
A. stolonifera-P. anserina - F. rubra	3.68
Carex nigra-C. panicea	4.49
Carex nigra-R. flammula	22.8
E. palustris-P. arundinacea	2.38
Lolium grassland	0.28
Other/unknown	3.48
P. anserina-Carex nigra	10.84
Polygonum amphibium	6.91
Tall herb	3.78
Woodland/scrub	0.13
Number of vegetation communities	10
Number of plant species	97

Vascular Plant Species

Nomenclature follows Parnell, J & Curtis, T. (2012) *Webb's An Irish Flora*, University of Cork Press.

Achillea millefolium	*Festuca arundinacea*	*Phleum pratense*
Agrostis capillaris	*Festuca rubra*	*Plantago lanceolata*
Agrostis stolonifera	*Filipendula ulmaria*	*Plantago major*
Alisma plantago-aquatica	*Galium palustre*	*Polygonum amphibium*
Anagallis tenella	*Galium verum*	*Potentilla anserina*
Apium nodiflorum	*Glyceria fluitans*	*Potentilla erecta*
Bellis perennis	*Hippuris vulgaris*	*Potentilla reptans*
Briza media	*Holcus lanatus*	*Prunella vulgaris*
Cardamine hirsuta	*Hydrocotyle vulgaris*	*Ranunculus acris*
Cardamine pratensis	*Hypochaeris radicata*	*Ranunculus flammula*
Carex disticha	*Iris pseudacorus*	*Ranunculus lingua*
Carex flacca	*Juncus acutiflorus*	*Ranunculus repens*
Carex hirta	*Juncus articulatus*	*Ranunculus sceleratus*
Carex hostiana	*Juncus effusus*	*Rorippa amphibia*
Carex leporina	*Juncus inflexus*	*Rorippa nasturtium-aquaticum*
Carex nigra	*Lathyrus pratensis*	*Rumex acetosa*
Carex panicea	*Leontodon autumnalis*	*Rumex crispus*
Carex pulicaris	*Leontodon hispidus*	*Sagina nodosa*
Carex rostrata	*Lolium perenne*	*Sagina procumbens*
Carex viridula agg.	*Lotus corniculatus*	*Salix aurita*
Cerastium fontanum	*Lychnis flos-cuculi*	*Salix repens*
Cirsium arvense	*Lythrum portula*	*Senecio aquaticus*
Cirsium dissectum	*Lythrum salicaria*	*Sparganium erectum*
Cirsium palustre	*Mentha aquatica*	*Succisa pratensis*
Cirsium vulgare	*Menyanthes trifoliata*	*Taraxacum officinale* agg.
Cynosurus cristatus	*Molinia caerulea*	*Trifolium pratense*
Danthonia decumbens	*Myosotis scorpioides*	*Trifolium repens*
Eleocharis palustris	*Oenanthe aquatica*	*Urtica dioica*
Elymus repens	*Ophioglossum vulgatum*	*Valeriana officinalis*
Epilobium hirsutum	*Parnassia palustris*	*Veronica catenata*
Equisetum fluviatile	*Pedicularis palustris*	*Veronica scutellata*
Equisetum palustre	*Phalaris arundinacea*	*Vicia cracca*
Eriophorum angustifolium		

Soils and Grazing

Soils were classified using a modified version of soil categories generated by the Teagasc/EPA Soils and Subsoils Mapping project (Fealy *et al*., 2009). The classification scheme principally uses parent material (calcareous/non-calcareous), depth class (shallow/deep) and drainage class (well drained/poorly drained) to assign soils to one of nine broad categories. The mean ± SD of a range of soil properties are also provided, in addition to the median and range of each variable across turloughs. Brierfield soils are circumneutral and peaty, with significant amounts of calcium carbonate.

Soil Types/Grazing Extent	% Turlough Area
Shallow well drained mineral	0.4
Deep poorly drained mineral	4.6
Alluvial marl with peaty topsoil	95
Extent of rotationally grazed area	54

Soil Property (n=6)	Brierfield	Turlough Summary Stats (n=22)		
	Mean ± SD	Median	Min	Max
pH	7.2 ± 0.9	7.20	5.94	8.29
% Organic Matter content	44.6 ± 23.9	25.8	10.2	69.1
% Inorganic content	35.8 ± 29.1	43.2	25.7	85.0
% Calcium carbonate content	19.6 ± 22.5	11.3	2.48	43.7
Total Nitrogen mg kg^{-1}	19458 ± 10574	11142	4983	24233
Total Phosphorus mg kg^{-1}	939 ± 237	905	245	1594

Hydrology

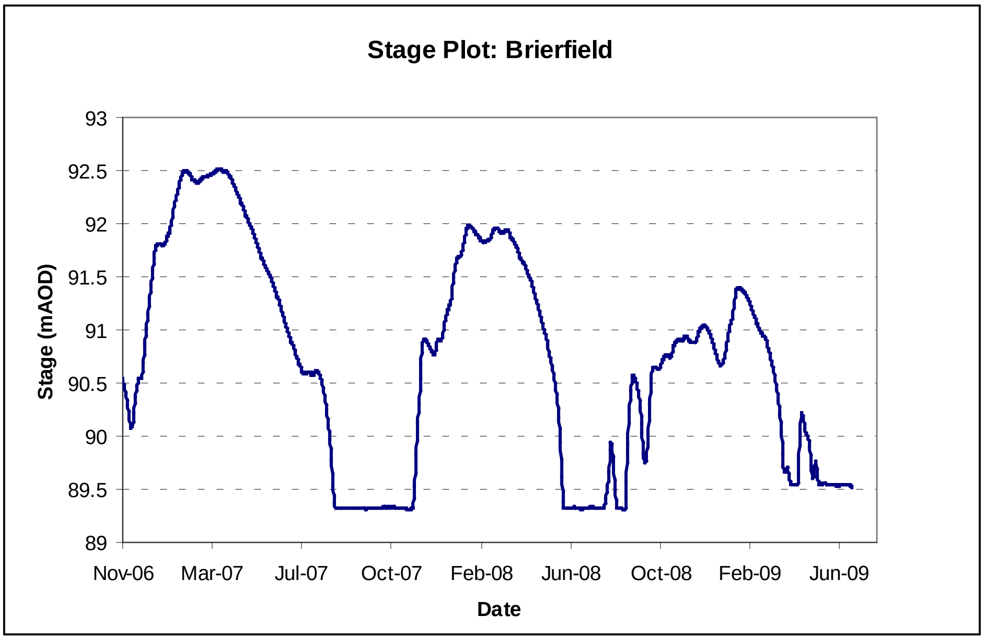
Water levels were recorded at hourly intervals using a variety of Schlumberger Divers® (Marton Geotechnical Ltd, Suffolk, UK) placed at or near the lowest point in each turlough. Divers measure the pressure of the water and air column above them, and from this the depth of water can be calculated. GPS surveys were carried out on 21 monitoring sites (Tullynafrankagh omitted) in order to develop digital terrain models (DTMs) from which contour maps, stage-volume and stage-surface area relationships are produced. The inflow magnitude is indicative of the properties of a turlough's catchment area and flow capacity, while outflow is a function of the drainage capacity of the system.

Hydrological data indicate that Brierfield is subjected to long duration flooding to a moderate depth, drainage capacity is moderately low and the recession duration rather high.

Brierfield is geographically close to Carrowreagh and Rathnalulleagh, and there is some evidence of a hydrological link bewteen Brierfield and Carrowreagh. Brierfield is the upper most turlough with Rathnalulleagh at the lowest elevation. Carrowreagh and Rathnalulleagh show very similar water level profiles, with Rathnalulleagh lagging Carrowreagh; the much shallower Brierfield shows similar peak flood times to Carrowreagh but is likely to belong to a different system.

Hydrological Information	Brierfield Values	Turlough Summary Stats (n=21)		
		Median	Min	Max
Start of Hydrological Recording	04/11/2006	-	-	-
End of Hydrological Recording	08/07/2009	-	-	-
Days Recorded	977	-	-	-
Equipment Failure	None recorded	-	-	-
Hydroperiod (days)	267	213	135	348
Maximum Floodwater Depth (m)	4.2	4.9	3	15.4
Maximum Floodwater Volume ('000 m^3)	933.5	877.9	355.6	4008.1
Maximum Flooded Area	54.10	38.61	13.71	78.12
Average Basin Depth (m)	1.73	2.28	0.85	6.76
Average Daily Inflow ($m^3 s^{-1}$)	0.38	0.684	0.254	10.253
Average Daily Outflow ($m^3 s^{-1}$)	0.134	0.271	0.086	2.018
Drainage Capacity ($m^3 s^{-1}$)	0.109	0.154	0.069	1.156
Recession Duration (days)	99.4	57.3	11	142.5

Stage plot for Brierfield turlough



Zone of Groundwater Contribution (ZOC) Risk Assessments

GIS based risk assessments were conducted with a view to identifying turloughs at risk of failing to meet WFD water quality objectives. These risk assessments were conducted by Compass Informatics Ltd and were based on Risk Assessment Sheet GWDTERA2a (Guidance Document No. GW9) on assessing risks to turloughs from phosphate (Working Group on Groundwater 2004) and Pathway Susceptibilities and Pressure Magnitudes were integrated to produce Impact Potential maps and predicted Risk Categories for the turlough ZOC. The TCD Risk Category is derived from a revised Impact Potential matrix. The predicted Risk Categories were adjusted using mean seasonal floodwater Total P (µg l^{-1}) (see Section 4.5.4 of the Risk Assessment Sheet GWDTERA2a). The risk categories include 1A: at significant risk; 1B: probably at significant risk; 2A: Not at significant risk (low confidence); 2B: Not at significant risk (higher confidence).

ZOC Area (Km^2)	Predicted WFD Risk Category	Adjusted WFD Risk Category	Predicted TCD Risk Category	Adjusted TCD Risk Category
4	1B	1B	1B	1B

ZOC Pressure Variable	
CORINE BARE ROCK %	0
CORINE PEAT BOGS%	0
CORINE ALL NATURAL AND SEMI-NATURAL AREAS%	21
CORINE IMPROVED PASTURE%	46
CORINE UNIMPROVED PASTURE%	21
CORINE ALL PASTURE%	67
CORINE OTHER AGRICULTURAL LANDS%	11
TEAGASC/EPA HABITATS ROCK%	0
TEAGASC/EPA HABITATS BOGS/PEATS%	0
TEAGASC/EPA HABITATS FORESTS/SCRUBS%	7
TEAGASC/EPA HABITATS WATER%	12
TEAGASC/EPA HABITATS DRY GRASSLAND%	66
TEAGASC/EPA HABITATS WET GRASSLAND%	15
TEAGASC TOTAL GRASSLAND%	1
TOTAL LIVESTOCK UNIT/ha of ZOC	0
TILLAGE%	5
No. SEPTIC TANKS km^{-2} ZOC	8
No. SEPTIC TANKS/Km^{-2} EXTREME PATHWAY SUSCEPTIBILITY	0
HIGH PATHWAY SUSCEPTIBILITY%	37
EXTR+HIGH PATHWAY SUSCEPTIBILITY%	37
WELL DRAINED SOIL %	63
POORLY DRAINED SOIL%	0

Site Conservation Assessment

The following site conservation assessment was undertaken to feed into the national reporting structure for assessing conservation status as required under Article 17 of the Habitats Directive. A suite of indicators and associated targets were derived to assess ecological structure and function. Future prospects were assessed through the evaluation of the impact of current and recent pressures and likely future threats to the site. The assessment follows a rules based approach to determine whether Structures & functions and Future Prospects should be assessed as good (green), inadequate (amber) or bad (red). For further details, see Chapter 10 (Conservation Status Assessment).

Please note an updated approach to assessing site condition has been proposed and is outlined in Chapter 12 (Monitoring Methods for Turloughs).

Conservation Condition Summary

Structure & Function	**Inadequate**
Future Prospects	**Inadequate**
Site Conservation Condition	**Inadequate**

Structure and Function Status:

Indicator	Comments
Hydrological Function: *Intermediate*	Drainage has altered the flooding regime, and there is also evidence of drainage within the ZOC that may affect the turlough
Water Quality: *Good (marginal)*	19.8 µg P l^{-1}. Only just in the 'good' category
Biological Responses: *Intermediate*	
Algal communities: 0	No algal mats recorded (a negligible quantity in 2008), low max CHL
Vegetation communities: 0	Low cover of negative indicators, almost no positive indicator cover
***Rumex* cover: 0**	2% frequency
Important plants: 0	None present
Important aquatic invertebrates: 1	*Agabus labiatus, Graptodytes bilineatus*
Overall Structure & Function: *Inadequate*	

Pressures:

Code	Impact	Notes
A04.01.01 Intensive cattle grazing (turlough)	H	High grazing levels in some land parcels coupled with high percentage of the turlough grazed
A05.02 Stock feeding (within and adjacent to turlough)	M	Some evidence of stock feeding within the turlough
H02.07 Diffuse groundwater pollution due to non-sewered population (ZOC)	L	Low inputs likely from domestic effluent
H02.06 Diffuse groundwater pollution due to agricultural and forestry activities (ZOC)	L	Likely inputs due to agriculture and forestry
J02.05 Modification of hydrographic functioning, general (=drainage in turlough)	L	Some evidence of drainage within the turlough
B01 Forest planting on open ground (ZOC)	L	Some afforestation in the ZOC

Threats:

Code	Impact	Notes
A04.01.01 Intensive cattle grazing (turlough)	M	Likely a continuing pressure
J02.05 Modification of hydrographic functioning, general (=drainage in turlough)	M	Not included in an SAC, so potentially at risk from drainage
H02.06 Diffuse groundwater pollution due to agricultural and forestry activities (ZOC)	M	Potential impacts due to development of agriculture and forestry in ZOC
A10.02 Removal of stone walls and embankments (in turlough)	L	A general problem in many turloughs, likely to lead to more widespread animal movement and consequently reduced diversity within turloughs
M01.03 Flooding and rising precipitations	L	A potential general problem in turloughs driven by predicted climate change
A02.01 Agricultural intensification (ZOC)	L	Likely to be relatively based on the amount of pasture in ZOC
H02.07 Diffuse groundwater pollution due to non-sewered population (ZOC)	L	
A02.03 Grassland removal for arable land (ZOC)	L	Possible shift to arable production locally
H02.06 Diffuse groundwater pollution due to agricultural and forestry activities (ZOC)	L	

Future Prospects: **Inadequate** – the majority of the threats are of relatively low impact; however the structure and function are already inadequate, with relatively high water TP and some of the biological indicators intermediate. Additionally, there is no potential protection afforded by SAC status.

Overall Assessment: **Inadequate** – due to the combination of inadequate structure and function and future prospects.

Maps

Maps are provided of:

1. Elevation contours, based on GIS digital terrain models from points by differential GPS topographic survey (for further details, see *Chapter 3: Hydrology*)
2. Grazing in land parcels
3. Approximate sampling points for water chemistry and aquatic invertebrates
4. Soil nutrient sampling points
5. Points for soil survey (note: soils were surveyed to the turlough boundary defined by Goodwillie, 1992; see map 9)
6. Soils (note: soils were mapped by combining the EPA Subsoils base map with the point soil descriptions; for further details see *Chapter 6: Soils and Landuse*)
7. Vegetation relevés
8. Vegetation communities (note: relevés do not always match to mapped communities due to small scale variation; for further details of mapping see *Chapter 7: Turlough Vegetation: Description, Mapping and Ecology*)
9. Estimated zone of groundwater contribution (ZOC)


Legend
Turlough Boundary
Elevation Countours
OSi 2005 Orthophotographs
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SITE CODE
BRI
Date: Jan. 2014
COUNTY ROSCOMMON
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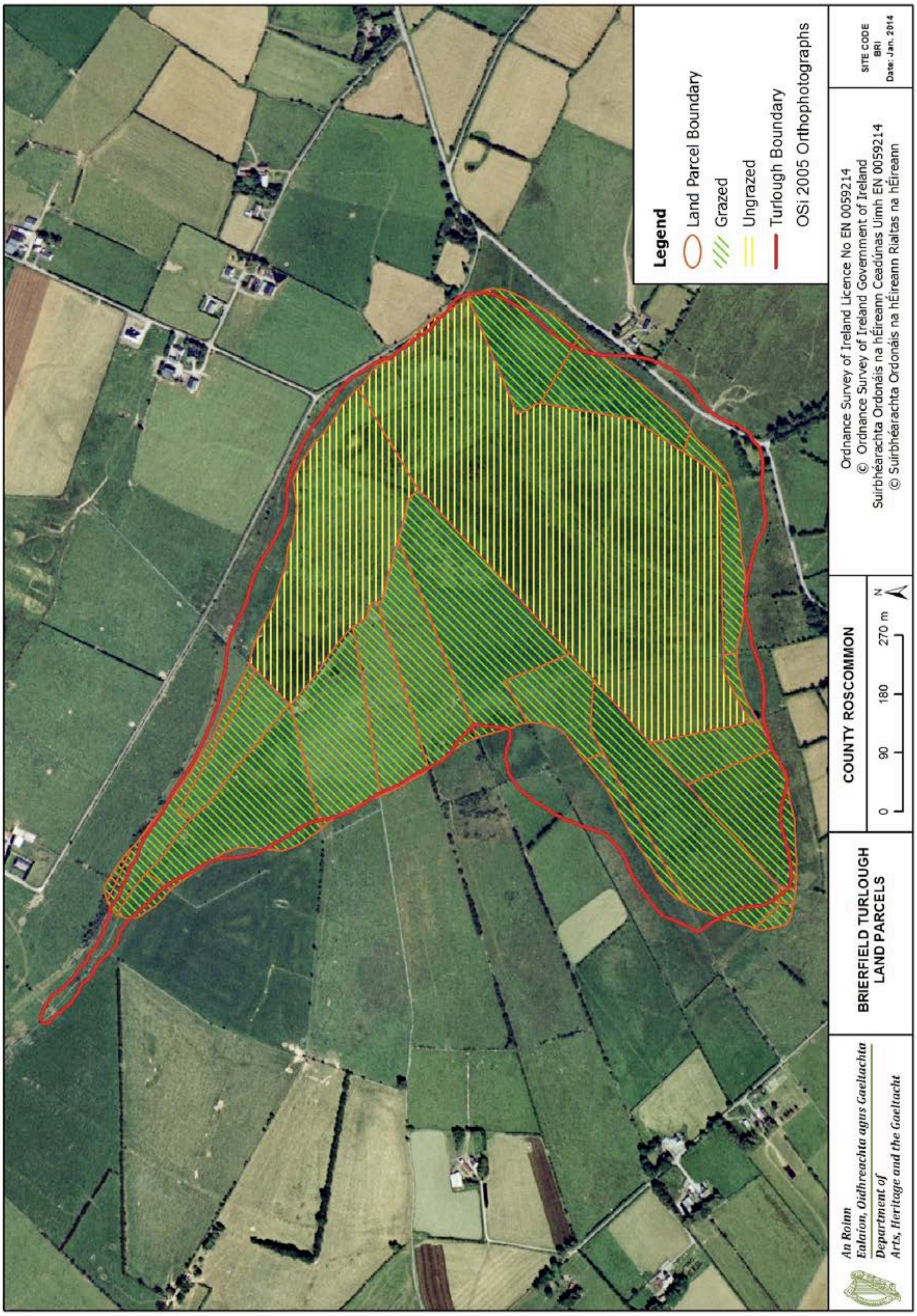
BRIERFIELD TURLOUGH
ELEVATION CONTOURS
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht


Legend
Land Parcel Boundary
Grazed
Ungrazed
Turlough Boundary
OSi 2005 Orthophotographs
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Date: Jan. 2014
COUNTY ROSCOMMON
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LAND PARCELS
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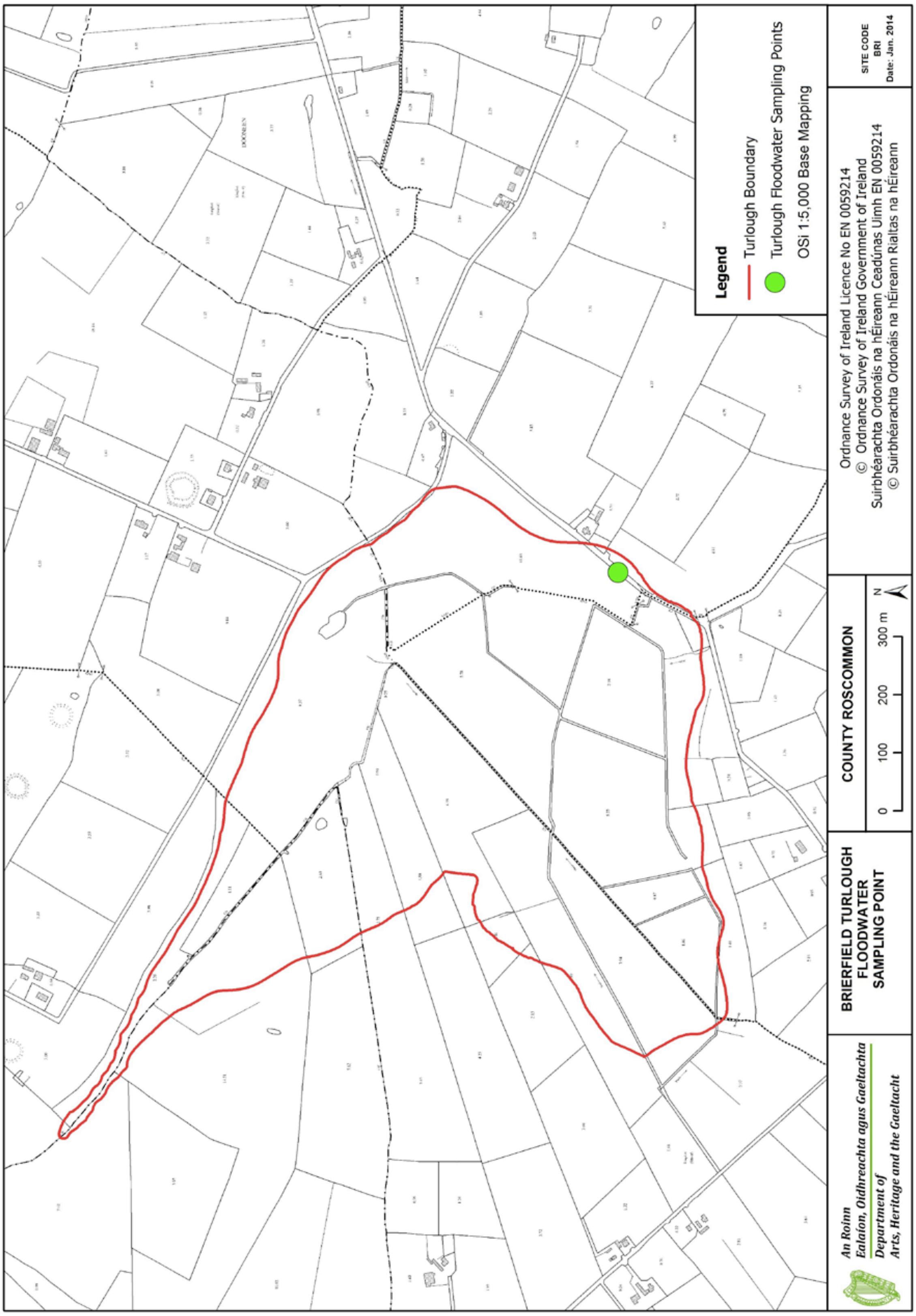
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Turlough Boundary
Turlough Floodwater Sampling Points
OSi 1:5,000 Base Mapping
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COUNTY ROSCOMMON
0 100 200 300 m
N
BRIERFIELD TURLOUGH
FLOODWATER
SAMPLING POINT
An Roinn
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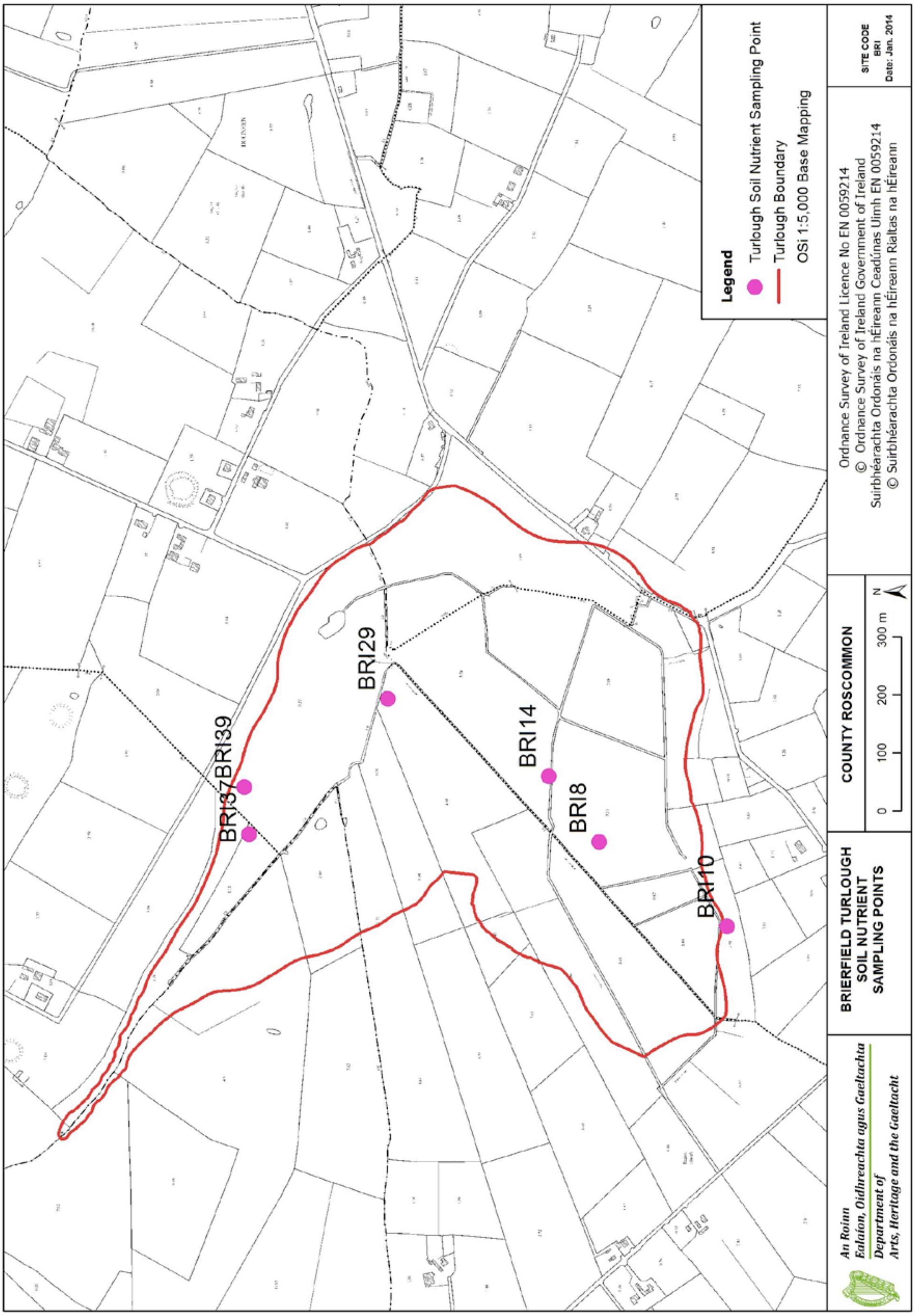
BRI37
BRI39
BRI29
BRI14
BRI8
BRI10
Legend
Turlough Soil Nutrient Sampling Point
Turlough Boundary
OSi 1:5,000 Base Mapping
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Date: Jan. 2014
BRIERFIELD TURLOUGH
SOIL NUTRIENT
SAMPLING POINTS
COUNTY ROSCOMMON
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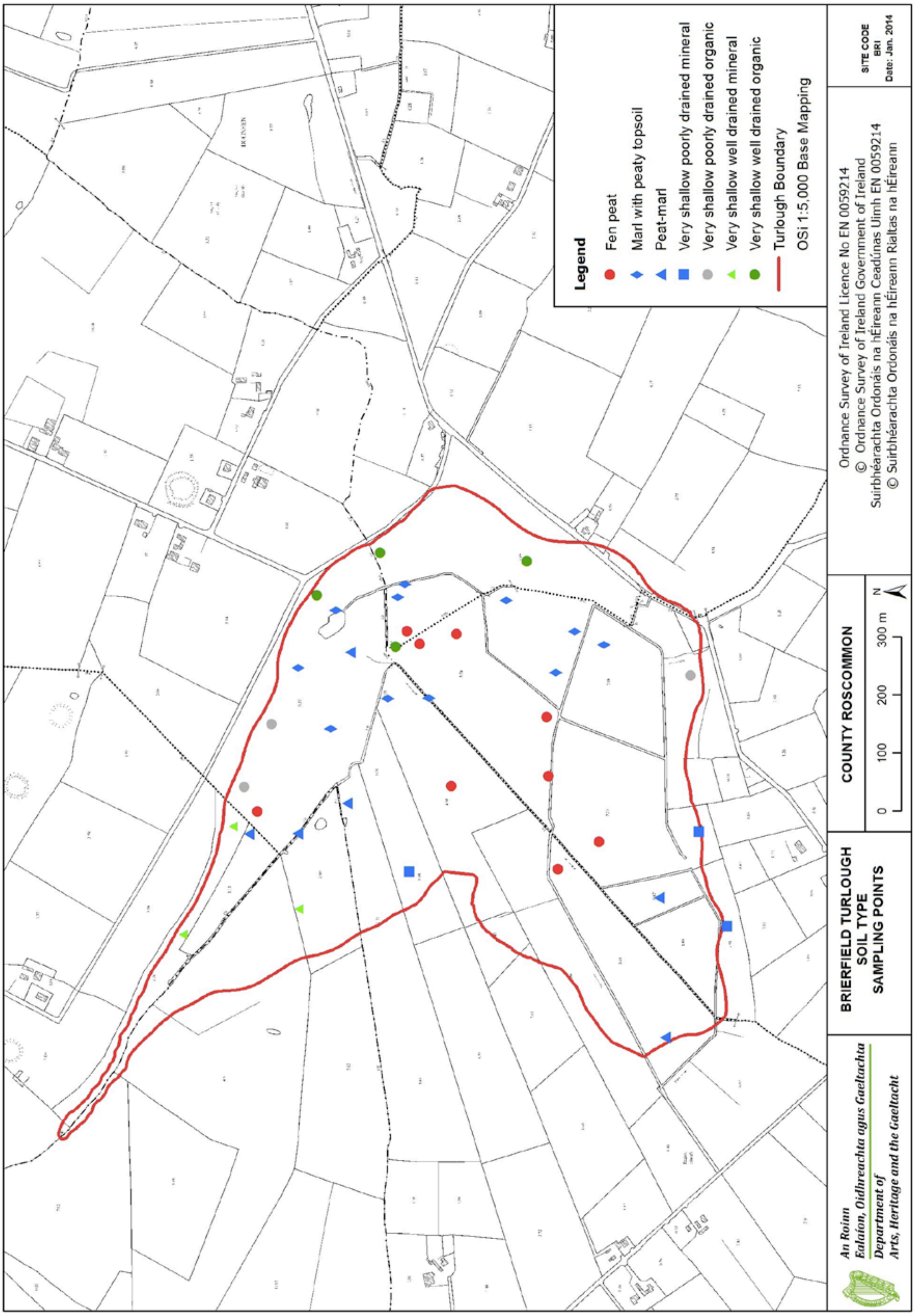
Legend
Fen peat
Marl with peaty topsoil
Peat-marl
Very shallow poorly drained mineral
Very shallow poorly drained organic
Very shallow well drained mineral
Very shallow well drained organic
Turlough Boundary
OSi 1:5,000 Base Mapping
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SITE CODE
BRI
Date: Jan. 2014
COUNTY ROSCOMMON
0 100 200 300 m
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BRIERFIELD TURLOUGH
SOIL TYPE
SAMPLING POINTS
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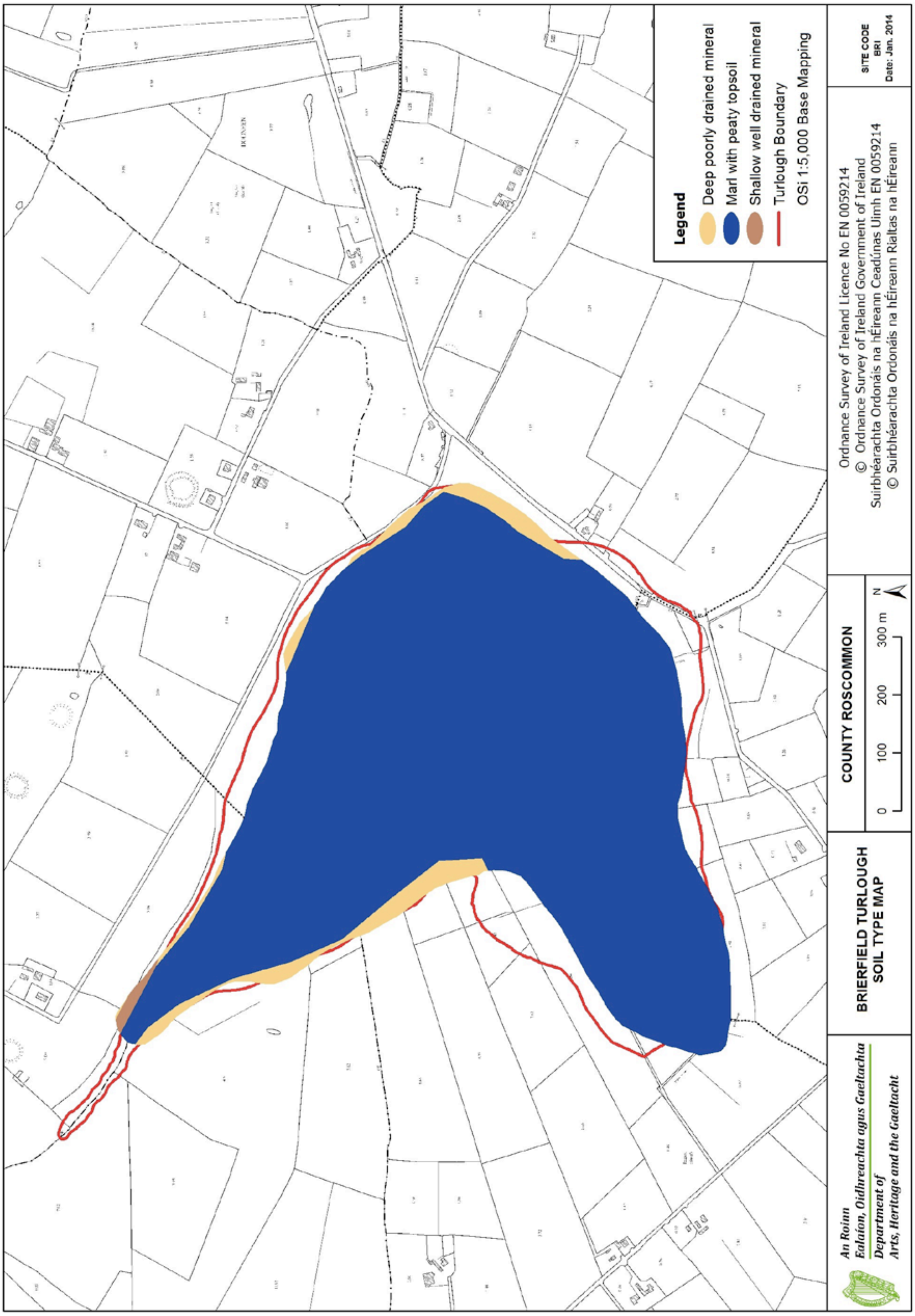
Legend
Deep poorly drained mineral
Marl with peaty topsoil
Shallow well drained mineral
Turlough Boundary
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COUNTY ROSCOMMON
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BRIERFIELD TURLOUGH
SOIL TYPE MAP
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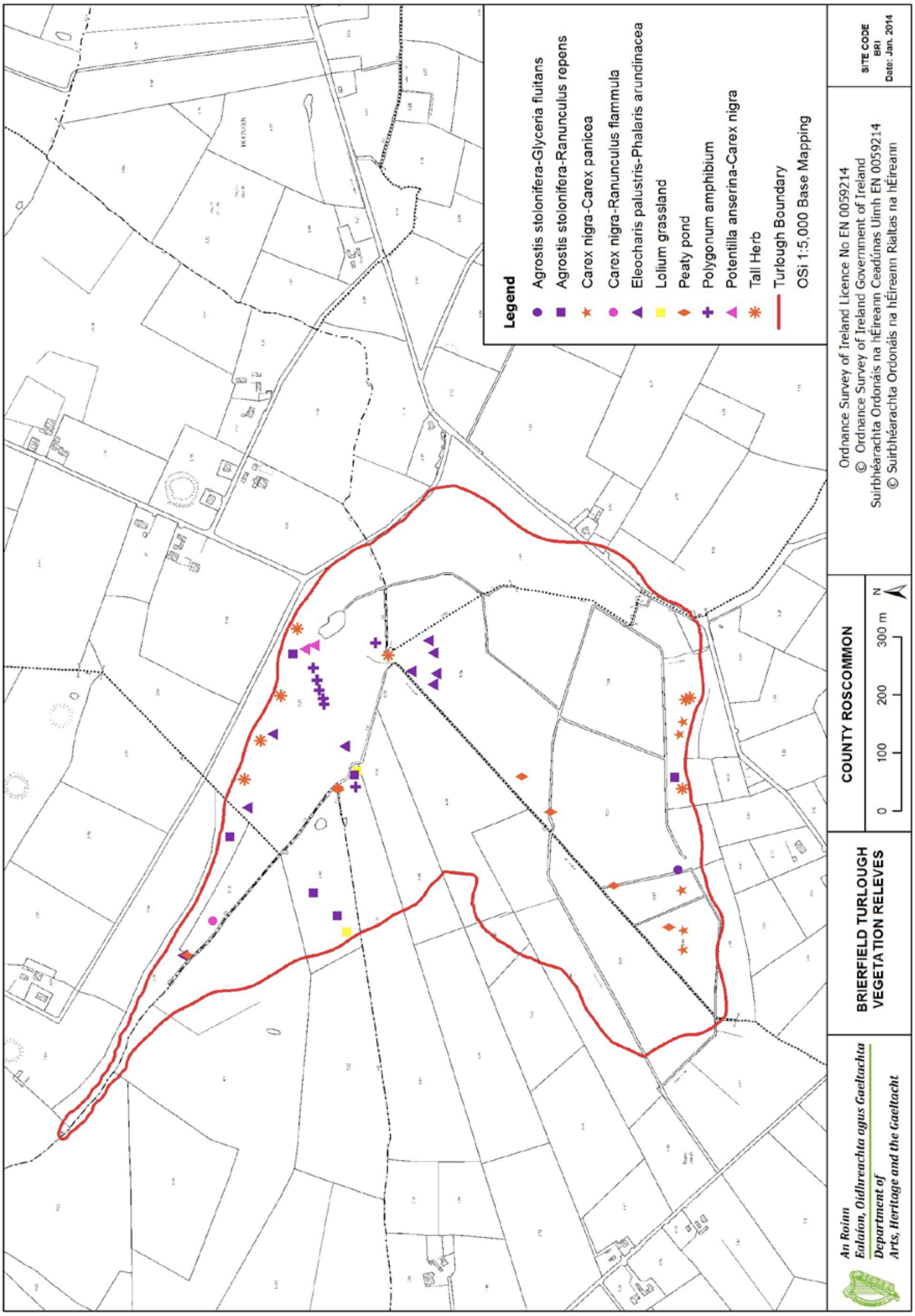
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Agrostis stolonifera-Glyceria fluitans
Agrostis stolonifera-Ranunculus repens
Carex nigra-Carex panicea
Carex nigra-Ranunculus flammula
Eleocharis palustris-Phalaris arundinacea
Lolium grassland
Peaty pond
Polygonum amphibium
Potentilla anserina-Carex nigra
Tall Herb
Turlough Boundary
OSi 1:5,000 Base Mapping
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BRI
Date: Jan. 2014
COUNTY ROSCOMMON
0 100 200 300 m
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BRIERFIELD TURLOUGH
VEGETATION RELEVES
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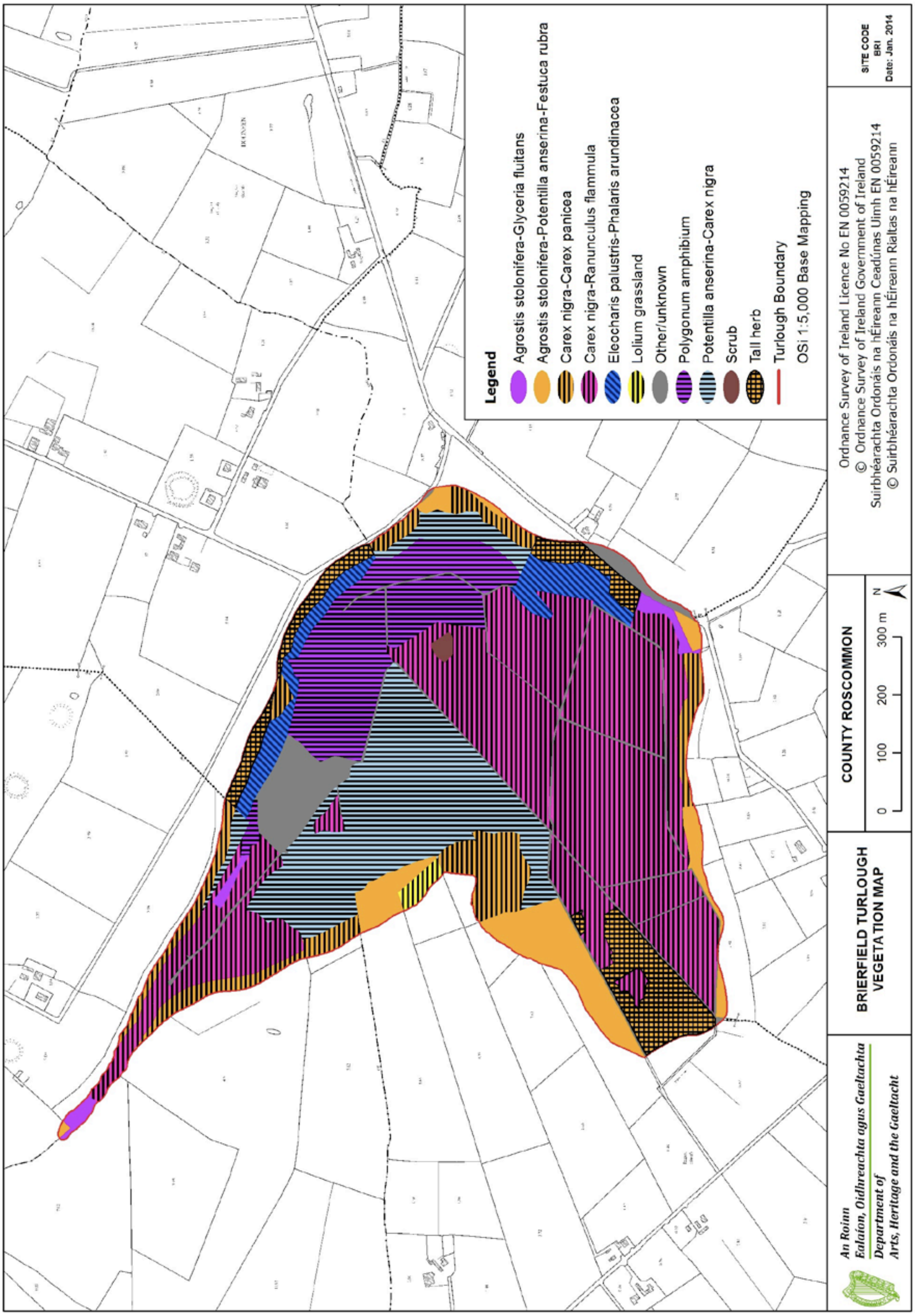
Legend
Agrostis stolonifera-Glyceria fluitans
Agrostis stolonifera-Potentilla anserina-Festuca rubra
Carex nigra-Carex panicea
Carex nigra-Ranunculus flammula
Eleocharis palustris-Phalaris arundinacea
Lolium grassland
Other/unknown
Polygonum amphibium
Potentilla anserina-Carex nigra
Scrub
Tall herb
Turlough Boundary
OSi 1:5,000 Base Mapping
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SITE CODE
BRI
Date: Jan. 2014
COUNTY ROSCOMMON
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300 m
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BRIERFIELD TURLOUGH
VEGETATION MAP
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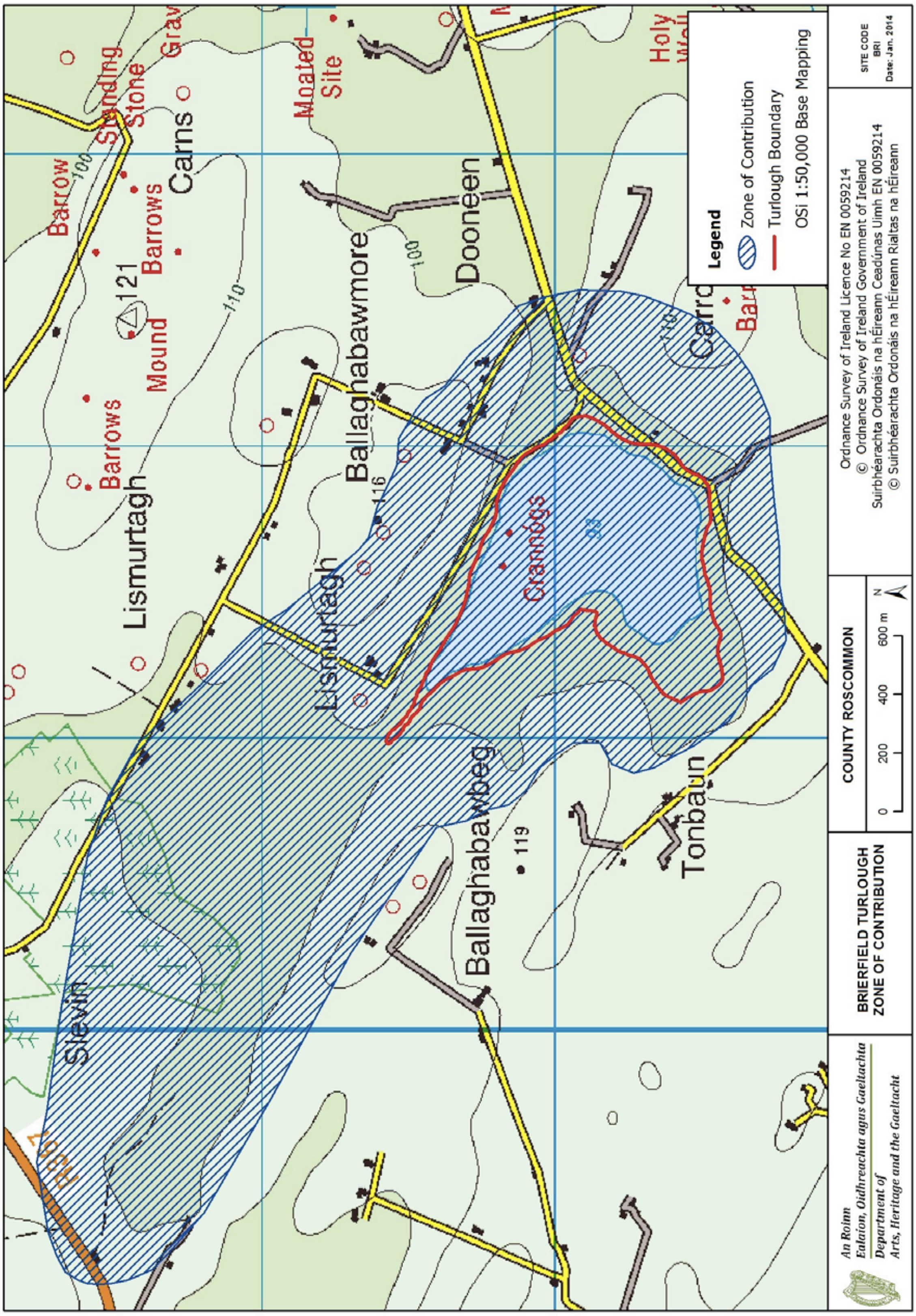

Legend
Zone of Contribution
Turlough Boundary
OSi 1:50,000 Base Mapping
BRIERFIELD TURLOUGH
ZONE OF CONTRIBUTION
COUNTY ROSCOMMON
0 200 400 600 m
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SITE CODE
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Lismurtagh
Ballaghabawmore
Ballaghabawbeg
Dooneen
Tonbaun
Slevin
Carns
Barrows
Barrow
Mound
Standing Stone
Moated Site
Crannógs
Holy Well
121
116
119
93
100
110
R367

Site Report: Caherglassan Turlough
TCD Turlough Research project 2006-2011

Turlough Project Code	SAC Name	NHA No.	County	Townland	RBD	Easting	Northing	Area (ha)
CAH	Caherglassan Turlough	000238	Galway	Killomoran	WESTERN	141550	206340	63

File update: July 2015 (S. Waldren)

Site Description

Caherglassan turlough is a large turlough (63 ha) with SAC status located in the Kilmoran townland of south east Co. Galway. Gentle, grassy slopes surround the majority of a semi-permanent lake which rarely dries out. A steep, rocky outcrop area occurs in the north-western section of the basin (Goodwillie, 1992). Nine vegetation types were recorded at this site; *Potentilla anserina-Potentilla-reptans* and woodland/scrub were the distinctly dominant vegetation types. The majority of the turlough area (72.4%) is composed of the 'Shallow, poorly-drained mineral' soil type, with extensive areas (27.6%) of the 'Alluvial mineral' soil type also evident. All of the turlough is rotationally grazed. Caherglassan turlough has a relatively flashy hydrological regime and a high drainage capacity, water levels show a small diurnal influence of tides. The turlough is fairly extensively grazed; even so, there is some evidence of alleviation of grazing pressure since Goodwillie's survey, with perhaps changes in the pattern of grazing across the turlough

Caherglassan – photo: S. Kimberley

Phytoplankton

Phytoplankton analysis was conducted on sub-samples of monthly spot samples collected for hydrochemical analysis between October 2006 and June 2007. Phytoplankton composition varies significantly over time and data from autumn, mid-winter and spring/early summer are presented below. Taxa were identified to species level where possible. Some taxa were not discriminated beyond general groupings (i.e. small centric diatoms, dinoflagellates and pinnate diatoms). The term non-identifiable alone (or n.i.) was reserved for cases where specimens were not identifiable. Discrimination between n.i. filament, n.i. flagellate, n.i. colony, n.i. green filament was made when applicable. Biovolume (mm^3 m^{-3}) was used as the measure of algal biomass.

October 2006		January 2007		May 2007	
Biovolume (mm^3/m^3)	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*
Mallomonas	456501	*Fragilaria/Synedra*	127213	*n.i.*	2050732
Monoraphidium	311332	*Navicula*	73920	*Asterionella formosa*	990793
n.i.	151603	*Oscillatoria*	42777	*Cryptomonas*	97588
Monoraphidium	86846	*Fragilaria capucina*	15220	*Oscillatoria*	89600
n.i. centrics	51513	*n.i. pennates*	11609	*Navicula*	14292

Benthic Algae

Turloughs were inspected for algal mats during the emptying phase in 2007, 2008 and 2009. Turloughs were visited in the first two weeks of March to June 2007 as part of the monthly monitoring of turloughs. Dedicated trips to inspect for algal mats were conducted in 2008 on the 4th of March, the 1st of April, and the 26th, 27th and 28th of May, and in 2009 on the 15th and 16th of June and on the 24th and 25th of July. The presence of both living floating mats and dead drying mats was noted, as well as their extent in the turlough basins. Occurrence of visible filamentous algal mats in the three years of observation is presented below. Y = visible occurrence; * = "extensive cover" (estimated to be 2 to 8% of total area of basin); † = negligible quantity observed; • = turlough was too flooded to permit full observation. No algal mats were observed in Caherglassan turlough during 2007, 2008 or 2009, possibly due to the strong colour of the water.

Year of Observation		
2007	**2008**	**2009**
N	N	N

Hydrochemistry

Data shown are the mean ± SD of monthly spot samples collected between October 2006 and June 2007. Mean seasonal Total P and Chlorophyll *a* were used to determine the trophic status of the floodwaters based on OECD trophic categories. The median and range of <u>mean values</u> across all turloughs are also provided. Caherglassan had low alkalinity, high colour and moderately high total phosphorus.

Hydrochemical Variable	Caherglassan Values		Turlough Summary Stats (n=22)		
	Mean±SD	OECD Trophic Category	Median	Min	Max
pH	7.9 ± 0.5		8.1	7.7	8.3
Alkalinity mg l^{-1} $CaCO_3$	112.4 ± 28.1		204.0	112.4	236.4
Colour mg l^{-1} PtCo	85.1 ± 48.9		26.9	7.9	85.1
Molybdate Reactive Phosphorus µg l^{-1}	18.8 ± 6.9		3.4	0.7	42.1
Total Phosphorus µg l^{-1}	43.2 ± 12.1	Eutrophic	24.8	4.0	82.1
Chlorophyll *a* µg l^{-1}	3.3 ± 4.3	Mesotrophic	4.9	1.1	33.5
Nitrate-N mg l^{-1}	0.7 ± 0.2		0.7	0.1	1.9
Total Nitrogen mg l^{-1}	1.2 ± 0.2		1.2	0.6	2.3

Aquatic Invertebrates

22 turloughs were sampled for littoral aquatic macroinvertebrates using sweep nets during November 2006 and April 2007. Zooplankton samples were collected in April 2007. Open-water cladocerans and littoral chydorids were sampled using a zooplankton net and perspex tube respectively.

Aquatic Macroinvertebrates			
November 2006	**Count**	**April 2007**	**Count**
Agabus nebulosus	1	*Asellus aquaticus*	32
Agabus sp (larva)	89	*Asellus meridianus*	4
Asellus meridianus	3	*Baetidae* sp.	1
Deronectes depressus	1	*Caenis horaria*	3
Haliplus sp. ruficollis group (females)	13	Chironomidae	8
Hesperocorixa sahlbergi	1	Diptera Pupae	26
Hesperocorixa sahlbergi Instar III	1	*Haliplus* sp. (larva)	1
Hydaticus sp (larva)	19	*Haliplus wehnckei*	1
Hydrachnidia (Mite)	3	*Hydroporus palustris*	1
Hydroporus palustris	4	*Hygrotus quinquelineatus*	1
Hygrotus quinquelineatus	4	*Limnephilus decipiens*	1
Ilybius sp. (larva)	11	*Lymnaea peregra*	3
Limnephilus lunatus	1	Ostracoda	12
Lymnaea trunculata	2	*Phacopteryx brevipennis*	1
Ostracoda	361	*Physa fontinalis*	2
Phacopteryx brevipennis	1	*Planorbis contortus*	128
Porhydrus lineatus	3	*Polycelis nigra/tenuis*	1
Rhantus sp. (larva)	9	Psychodidae	2
Sigara concinna Instar IV	1	*Sigara dorsalis*	4
Sigara dorsalis	13	*Sigara falleni*	2
		Trichoptera sp. Pupa	1

Aquatic Macroinvertebrates: Presence of high abundances (> 50 individuals) of Diptera and Ostracoda recorded in November 2006 and April 2007 indicates nutrient enrichment.

Aquatic Macroinvertebrate Taxa	Presence of high abundances	
	November 2006	April 2007
Diptera	N	Y
Ostracoda	Y	N
Odonata	N	N
Trichoptera	N	N

Zooplankton species
Alona affinis
Chydorus latus
Chydorus sphaericus
Daphnia pulex
Eurycercus lamellatus
Graptoleberis testudinaria
Simocephalus vetulus

Vegetation

Vegetation description and classification yielded 25 vegetation communities suitable for mapping. Nine vegetation communities were mapped in Caherglassan turlough; the dominant communities are the *Potentilla anserina – Potentilla reptans* community and woodland & scrub: the latter seems to have increased since Goodwillie's survey published in 1992. Caherglassan also contains the important *Eleocharis acicularis* community alongside the permanent pools and streams in the base of the turlough, the *Filipendula ulmaria-Potentilla erecta-Viola* community (which may be restricted to turloughs), and small amounts of Flooded Pavement. High conservation value communities are denoted by *. Forty-eight vascular plant species were recorded, including important *Eleocharis acicularis* and *Viola persicifolia*.

Vegetation Community	Area (Ha)
A. stolonifera-P. anserina - F. rubra	1.96
**Eleocharis acicularis*	1.52
**F. ulmaria-P. erecta-Viola sp*	6.3
*Flooded pavement	0.52
Limestone grassland	0.41
Lolium grassland	6.21
Open water	10.46
Other/unknown	0.97
P. anserina-P. reptans	16.25
Poa annua-Plantago major	0.16
Woodland/scrub	18.57
Number of vegetation communities	9
Number of plant species	48

Vascular Plant Species

Nomenclature follows Parnell, J & Curtis, T. (2012) *Webb's An Irish Flora*, University of Cork Press.

Agrostis stolonifera	*Galium boreale*	*Potentilla anserina*
Carex flacca	*Galium palustre*	*Potentilla erecta*
Carex hirta	*Galium verum*	*Potentilla reptans*
Carex nigra	*Hydrocotyle vulgaris*	*Ranunculus repens*
Carex panicea	*Leontodon autumnalis*	*Rhamnus cathartica*
Centaurea nigra	*Leontodon saxatilis*	*Rumex acetosa*
Cerastium fontanum	*Lolium perenne*	*Rumex crispus*
Cirsium arvense	*Lotus corniculatus*	*Rumex obtusifolius*
Cirsium dissectum	*Mentha aquatica*	*Salix cinerea s. oleifolia*
Crataegus monogyna	*Mentha arvensis*	*Stellaria media*
Eleocharis acicularis	*Molinia caerulea*	*Succisa pratensis*
Eleocharis palustris	*Phalaris arundinacea*	*Taraxacum officinale* agg.
Elymus repens	*Plantago lanceolata*	*Trifolium pratense*
Festuca rubra	*Plantago major*	*Trifolium repens*
Filipendula ulmaria	*Poa trivialis*	*Viola persicifolia*
Fraxinus excelsior	*Polygonum amphibium*	*Viola riviniana*

Soils and Grazing

Soils were classified using a modified version of soil categories generated by the Teagasc/EPA Soils and Subsoils Mapping project (Fealy *et al.*, 2009). The classification scheme principally uses parent material (calcareous/non-calcareous), depth class (shallow/deep) and drainage class (well drained/poorly drained) to assign soils to one of nine broad categories. Caherglassan has extensive areas of poorly-drained mineral soils. The mean ± SD of a range of soil properties are also provided, in addition to the median and range of each variable across turloughs. Caherglassan soils are moderately acidic and mineral, with low amounts of calcium carbonate and organic matter. Mean Total Nitrogen is towards the low end of the range for turloughs, whereas Mean Total Phospohorus is towards the high end of the range. Note that all land parcels were grazed, although there is usually some permanent water remaining in the turlough.

Soil Types/Grazing Extent	% Turlough Area
Very shallow poorly drained mineral	50.5
Shallow poorly drained mineral	21.9
Mineral Alluvium	27.6
Grazing Extent	100

Soil Property (n=6)	Caherglassan	Turlough Summary Stats (n=22)		
	Mean ± SD	Median	Min	Max
pH	6.4±0.7	7.20	5.94	8.29
% Organic Matter content	13.8±1.7	25.8	10.2	69.1
% Calcium carbonate content	4.37±1.7	43.2	25.7	85.0
% Inorganic Content	81.8±2.3	11.3	2.48	43.7
Total Nitrogen mg kg^{-1}	6263±884	11142	4983	24233
Total Phosphorus mg kg^{-1}	1016±449	905	245	1594

Hydrology

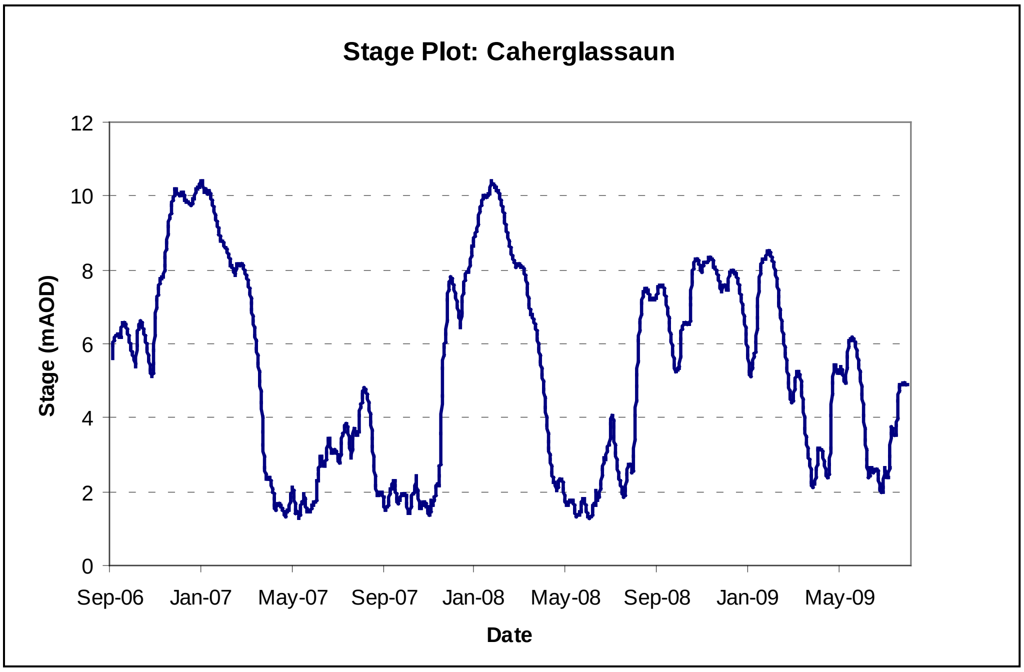
Water levels were recorded at hourly intervals using a variety of Schlumberger Divers® (Marton Geotechnical Ltd, Suffolk, UK) placed at or near the lowest point in each turlough. Divers measure the pressure of the water and air column above them, and from this the depth of water can be calculated. GPS surveys were carried out on 21 monitoring sites (Tullynafrankagh omitted) in order to develop digital terrain models (DTMs) from which contour maps, stage-volume and stage-surface area relationships are produced. The inflow magnitude is indicative of the properties of a turlough's catchment area and flow capacity, while outflow is a function of the drainage capacity of the system.

Caherglassan turlough has a relatively flashy hydrological regime and a high drainage capacity, water levels show a small diurnal influence of tides (groundwater backing up under tidal influence, but no seawater ingress). It has moderate inflow, outflow, drainage and recession durations.

Caherglassan forms part of a series of conduit fed turloughs which includes Blackrock (also known as Peterswell), Lough Coy and Coole/Garryland. Blackrock, the first in the series, is partly fed by the Owenshree river which drains from the Slieve Aughty mountains, which have acidic bedrock. This system consequently has a very large zone of groundwater contribution.

Hydrological Information	Caherglassan Values	Turlough Summary Stats (n=21)		
		Median	Min	Max
Start of Hydrological Recording	24/09/2006	-	-	-
End of Hydrological Recording	05/08/2009	-	-	-
Days Recorded	1046	-	-	-
Equipment Failure	None recorded	-	-	-
Hydroperiod (days)	200	213	135	348
Maximum Floodwater Depth (m)	9.4	4.9	3	15.4
Maximum Floodwater Volume ('000 m^3)	2998.9	877.9	355.6	4008.1
Maximum Flooded Area (ha)	62.61	38.61	13.71	78.12
Average Basin Depth (m)	4.79	2.28	0.85	6.76
Average Daily Inflow (m^3 s^{-1})	2.496	0.684	0.254	10.253
Average Daily Outflow (m^3 s^{-1})	1.192	0.271	0.086	2.018
Drainage Capacity (m^3 s^{-1})	0.701	0.154	0.069	1.156
Recession Duration (days)	49.5	57.3	11	142.5

Stage plot for Caherglassan turlough



Zone of Groundwater Contribution (ZOC) Risk Assessments

GIS based risk assessments were conducted with a view to identifying turloughs at risk of failing to meet WFD water quality objectives. These risk assessments were conducted by Compass Informatics Ltd and were based on Risk Assessment Sheet GWDTERA2a (Guidance Document No. GW9) on assessing risks to turloughs from phosphate (Working Group on Groundwater 2004) and Pathway Susceptibilities and Pressure Magnitudes were integrated to produce Impact Potential maps and predicted Risk Categories for the turlough ZOC. The TCD Risk Category is derived from a revised Impact Potential matrix. The predicted Risk Categories were adjusted using mean seasonal floodwater Total P ($\mu g\ l^{-1}$) (see Section 4.5.4 of the Risk Assessment Sheet GWDTERA2a). The risk categories include 1A: at significant risk; 1B: probably at significant risk; 2A: Not at significant risk (low confidence); 2B: Not at significant risk (higher confidence).

ZOC Area (Km^2)	Predicted WFD Risk Category	Adjusted WFD Risk Category	Predicted TCD Risk Category	Adjusted TCD Risk Category
398	2B	1A	1B	1A

ZOC Pressure Variable	
CORINE BARE ROCK %	6
CORINE PEAT BOGS%	16
CORINE ALL NATURAL AND SEMI-NATURAL AREAS%	29
CORINE IMPROVED PASTURE%	21
CORINE UNIMPROVED PASTURE%	17
CORINE ALL PASTURE%	38
CORINE OTHER AGRICULTURAL LANDS%	9
TEAGASC/EPA HABITATS ROCK%	6
TEAGASC/EPA HABITATS BOGS/PEATS%	18
TEAGASC/EPA HABITATS FORESTS/SCRUBS%	22
TEAGASC/EPA HABITATS WATER%	2
TEAGASC/EPA HABITATS DRY GRASSLAND%	46
TEAGASC/EPA HABITATS WET GRASSLAND%	6
TEAGASC TOTAL GRASSLAND%	1
TOTAL LIVESTOCK UNIT/ha of ZOC	0
TILLAGE%	6
No. SEPTIC TANKS km^{-2} ZOC	5
No. SEPTIC TANKS/Km^{-2} EXTREME PATHWAY SUSCEPTIBILITY	52
HIGH PATHWAY SUSCEPTIBILITY%	80
EXTR+HIGH PATHWAY SUSCEPTIBILITY%	48
WELL DRAINED SOIL %	49
POORLY DRAINED SOIL%	6

Site Conservation Assessment

The following site conservation assessment was undertaken to feed into the national reporting structure for assessing conservation status as required under Article 17 of the Habitats Directive. A suite of indicators and associated targets were derived to assess ecological structure and function. Future prospects were assessed through the evaluation of the impact of current and recent pressures and likely future threats to the site. The assessment follows a rules based approach to determine whether Structures & functions and Future Prospects should be assessed as good (green), inadequate (amber) or bad (red). For further details, see Chapter 10 (Conservation Status Assessment).

Please note an updated approach to assessing site condition has been proposed and is outlined in Chapter 12 (Monitoring Methods for Turloughs).

Conservation Condition Summary

Structure & Function	**Inadequate**
Future Prospects	**Inadequate**
Site Conservation Condition	**Inadequate**

Structure and Function Status:

Indicator	Comments
Hydrological Function: *Good*	Of note is the fluctuation in water level in response to tidal stage
Water Quality: *Intermediate*	43.2 µg P l^{-1}. Towards the high end of this category
Biological Responses: *Intermediate*	Very mixed across categories, some good but others poor
Algal communities: -1	No algal mats recorded, likely due to the highly coloured water due to runoff from the Slieve Aughty forestry activity; however, high max CHL
Vegetation communities: 1	Moderately high cover of positive indicators, mostly due to woodland scrub in upper zones and *Eleocharis acicularis* community in lower muddy areas
***Rumex* cover: -1**	89.5% frequency, the highest recorded
Important plants: 1	*Viola persicifolia*
Important aquatic invertebrates: 0	None present
Overall Structure & Function: *Inadequate*	

Pressures:

Code	Impact	Notes
A04.01.01 Intensive cattle grazing (turlough)	H	High grazing levels in some land parcels coupled with high percentage of the turlough grazed
H02.06 Diffuse groundwater pollution due to agricultural and forestry activities (ZOC)	H	Pollution due to agriculture and through forestry activity in the Slieve Aughtey mountains
A08 Fertilisation (within turlough)	M	Turlough known to have had fertiliser application within the turlough basin
B01 Forest planting on open ground (ZOC)	M	Forest planting continuing, but main pressure from forestry is from existing forests via groundwater pollution
H02.07 Diffuse groundwater pollution due to non-sewered population (ZOC)	L	
A05.02 Stock feeding (within and adjacent to turlough)	L	Some evidence of stock feeding within the turlough

Threats:

Code	Impact	Notes
H02.06 Diffuse groundwater pollution due to agricultural and forestry activities (ZOC)	H	Likely a continuing severe pressure
H01.05 Diffuse pollution to surface waters due to agricultural and forestry activities (ZOC)	H	Considered to be a threat due to continued slurry and fertiliser application; flagged up here due to its particularly severe impact
A02.01 Agricultural intensification (ZOC)	M	Likely a moderate threat due to extensive pasture in lower altitude ZOC
A04.01.01 Intensive cattle grazing (turlough)	M	Continuing pressure
A10.02 Removal of stone walls and embankments (in turlough)	L	
M01.03 Flooding and rising precipitations	L	
H02.07 Diffuse groundwater pollution due to non-sewered population (ZOC)	L	
A04.03 Abandonment of pastoral systems, lack of grazing (ZOC)	L	Likely to be low based on the pasture in the lower elevation parts of the ZOC
A02.03 Grassland removal for arable land (ZOC)	L	

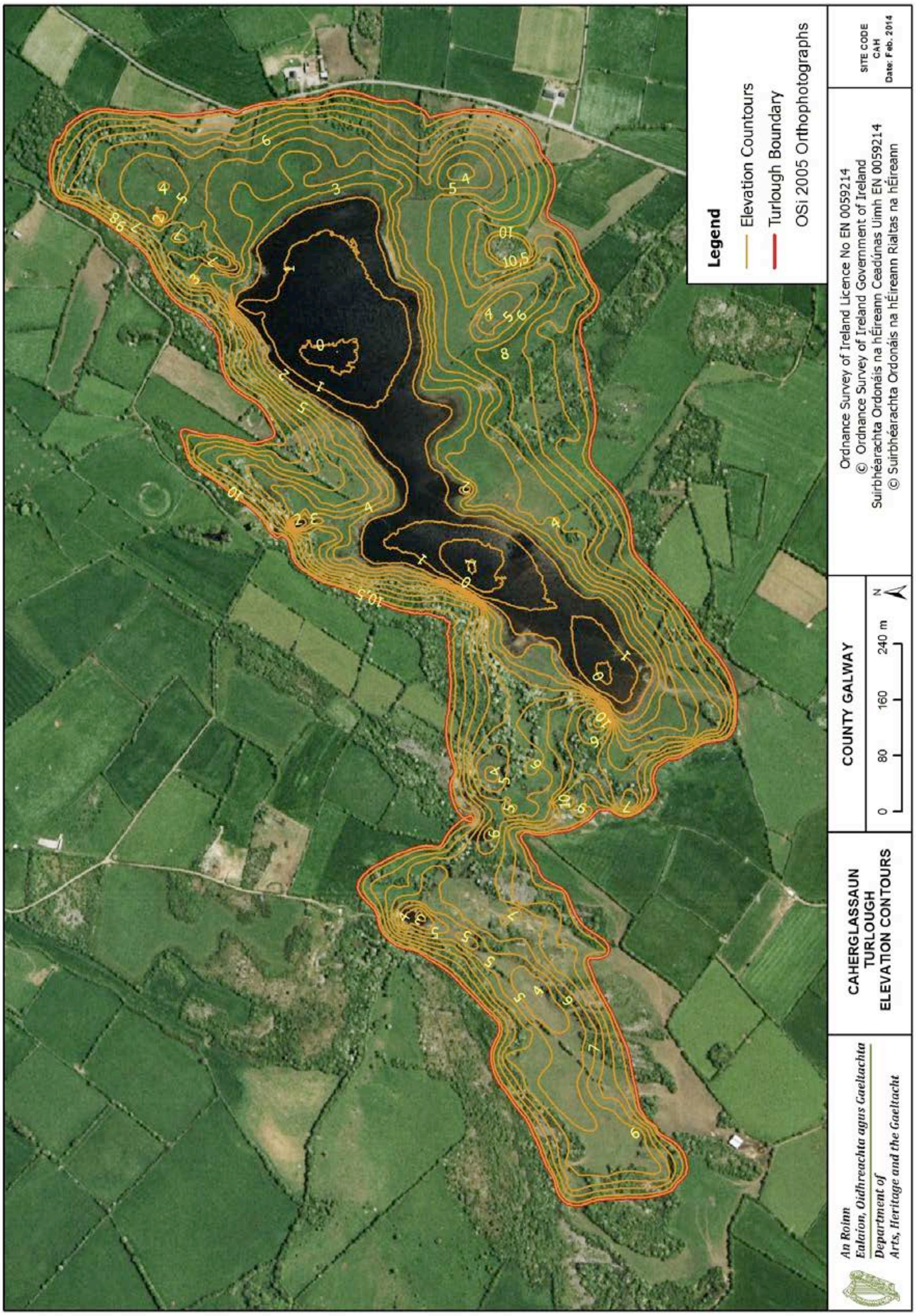
Future Prospects: **Inadequate** – already faces high pressures from nutrient enrichment, both from ZOC and from local inputs into turlough, and these likely to continue.

Overall Assessment: **Inadequate** – structure and functions are already impacted by pressures and these are likely to persist well into the future. However, some of the biological indicators are in good status, and the turlough still contains some important plant species and vegetation communities; there is some evidence of the spread of woodland and scrub since Goodwillie's report of 1992. This suggests that if strong conservation prescriptions could be applied and adhered to, the conservation status might be considerably improved.

Maps

Maps are provided of:

1. Elevation contours, based on GIS digital terrain models from points by differential GPS topographic survey (for further details, see *Chapter 3: Hydrology*)
2. Grazing in land parcels
3. Approximate sampling points for water chemistry and aquatic invertebrates
4. Soil nutrient sampling points
5. Points for soil survey (note: soils were surveyed to the turlough boundary defined by Goodwillie, 1992; see map 9)
6. Soils (note: soils were mapped by combining the EPA Subsoils base map with the point soil descriptions; for further details see *Chapter 6: Soils and Landuse*)
7. Vegetation relevés
8. Vegetation communities (note: relevés do not always match to mapped communities due to small scale variation; for further details of mapping see *Chapter 7: Turlough Vegetation: Description, Mapping and Ecology*)
9. Vegetation maps digitised from Goodwillie, R. (1992) *Turlough's Over 50 Hectares*. Report to NPWS
10. Estimated zone of groundwater contribution (ZOC)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Elevation Countours
Turlough Boundary
OSi 2005 Orthophotographs
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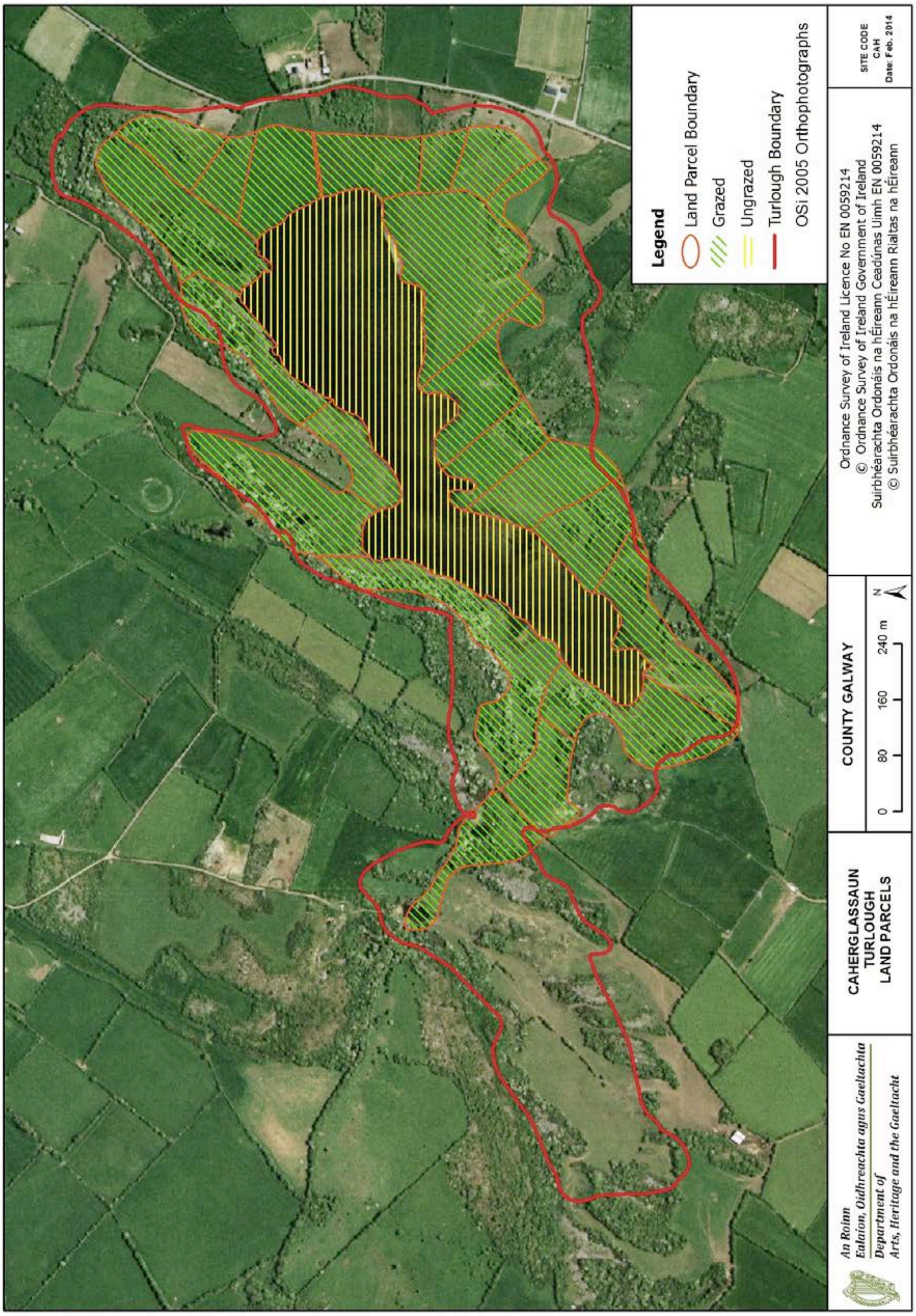
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Land Parcel Boundary
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Ungrazed
Turlough Boundary
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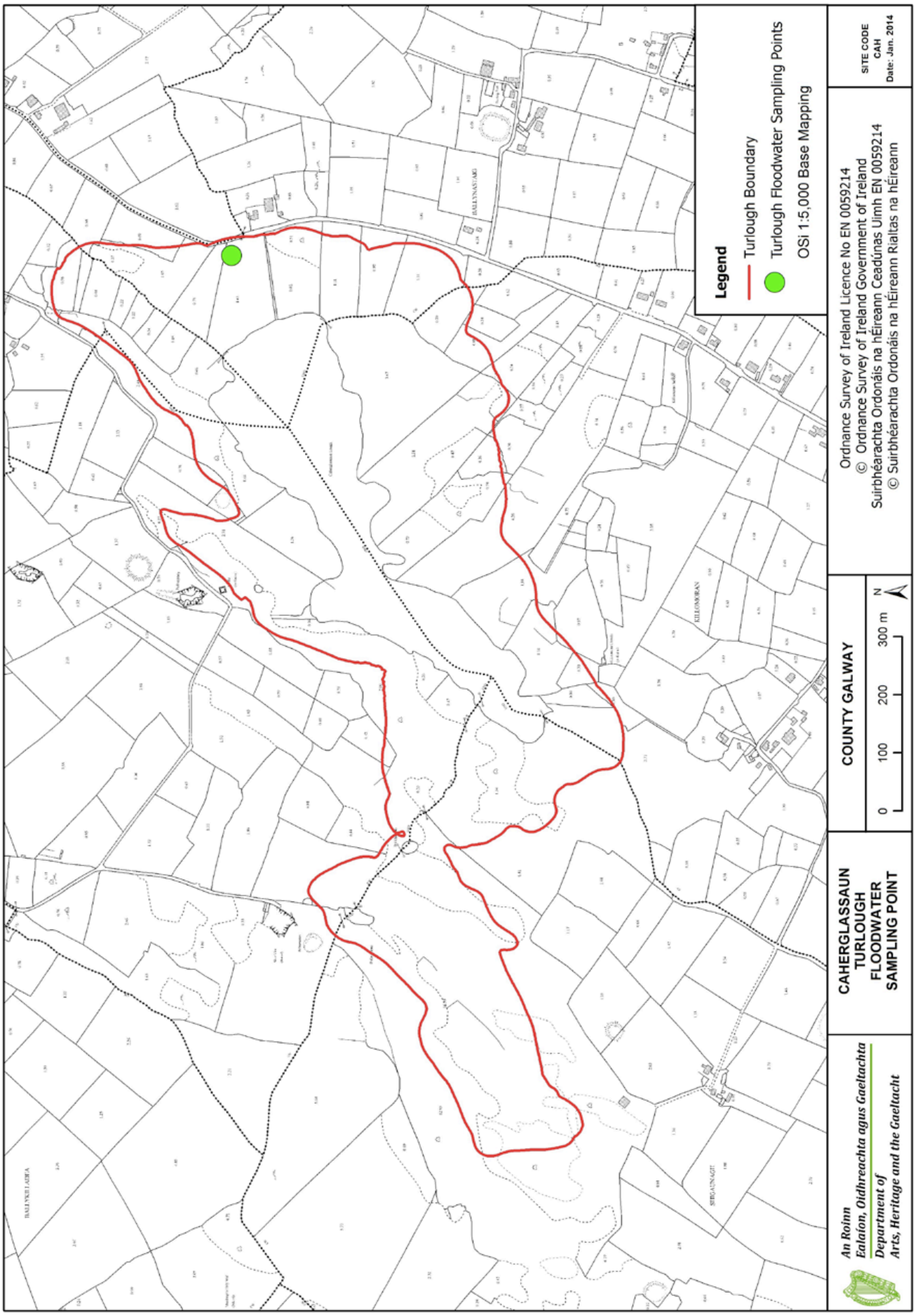
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Turlough Boundary
Turlough Floodwater Sampling Points
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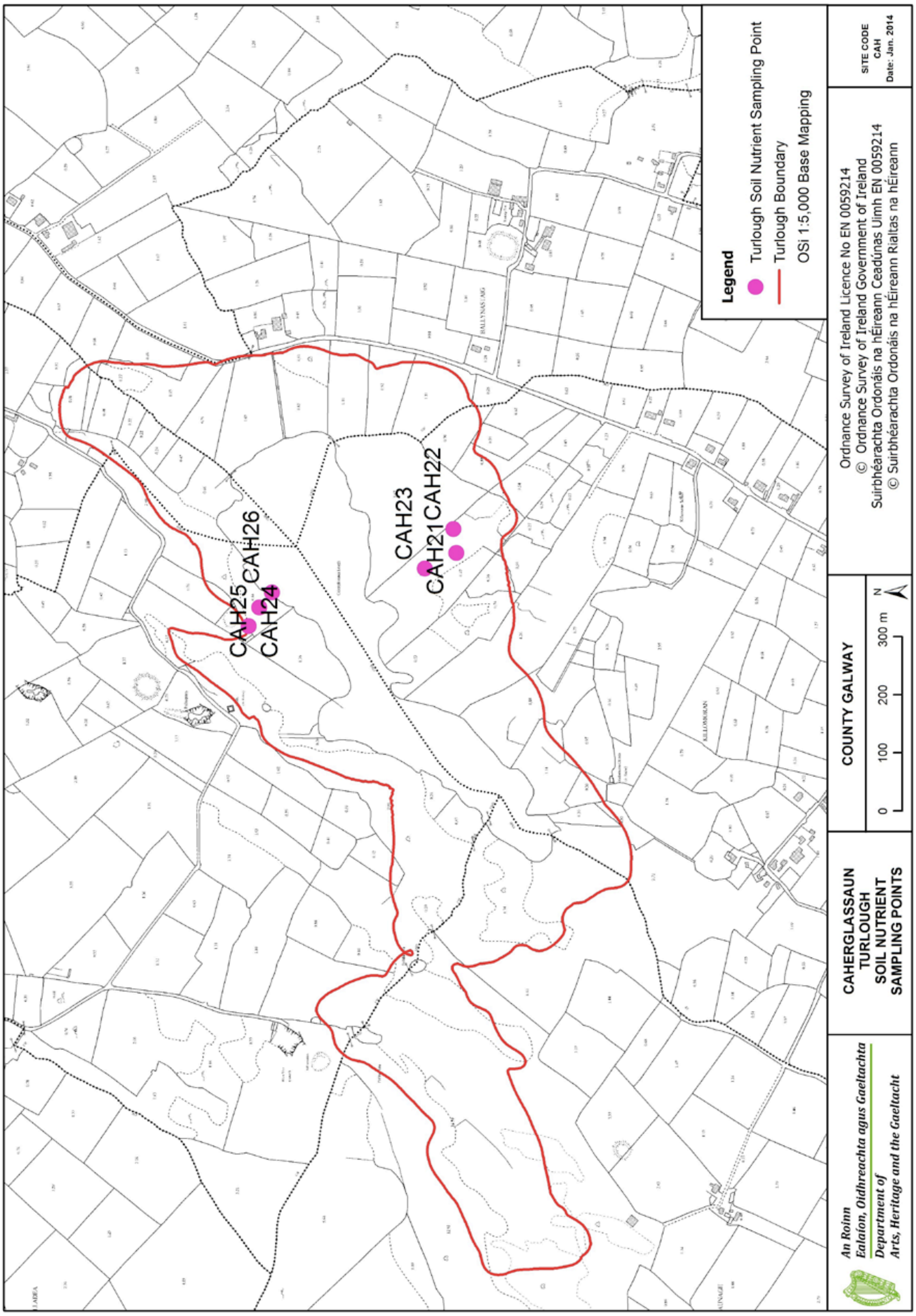
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Turlough Soil Nutrient Sampling Point
Turlough Boundary
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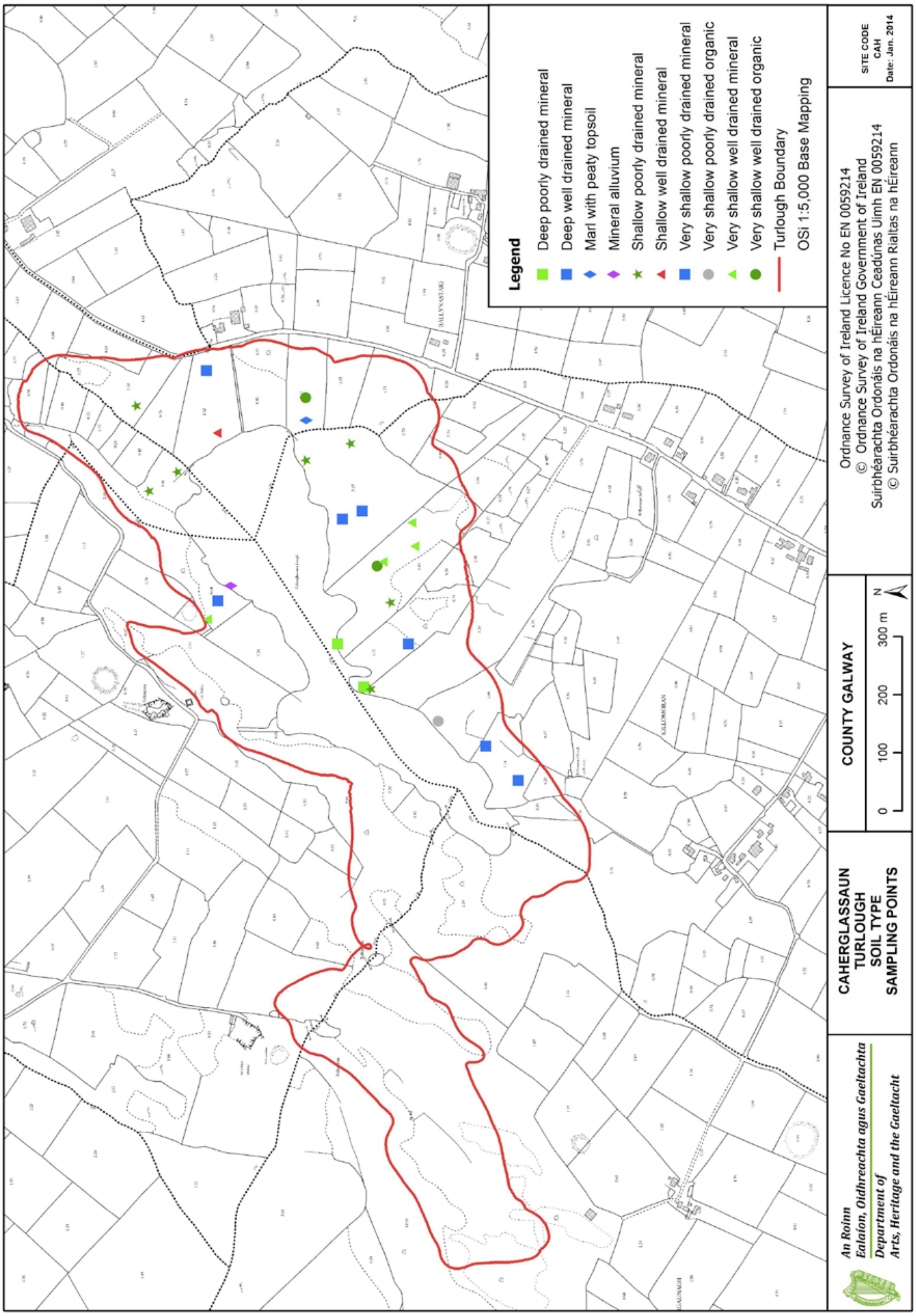

Legend
Deep poorly drained mineral
Deep well drained mineral
Marl with peaty topsoil
Mineral alluvium
Shallow poorly drained mineral
Shallow well drained mineral
Very shallow poorly drained mineral
Very shallow poorly drained organic
Very shallow well drained mineral
Very shallow well drained organic
Turlough Boundary
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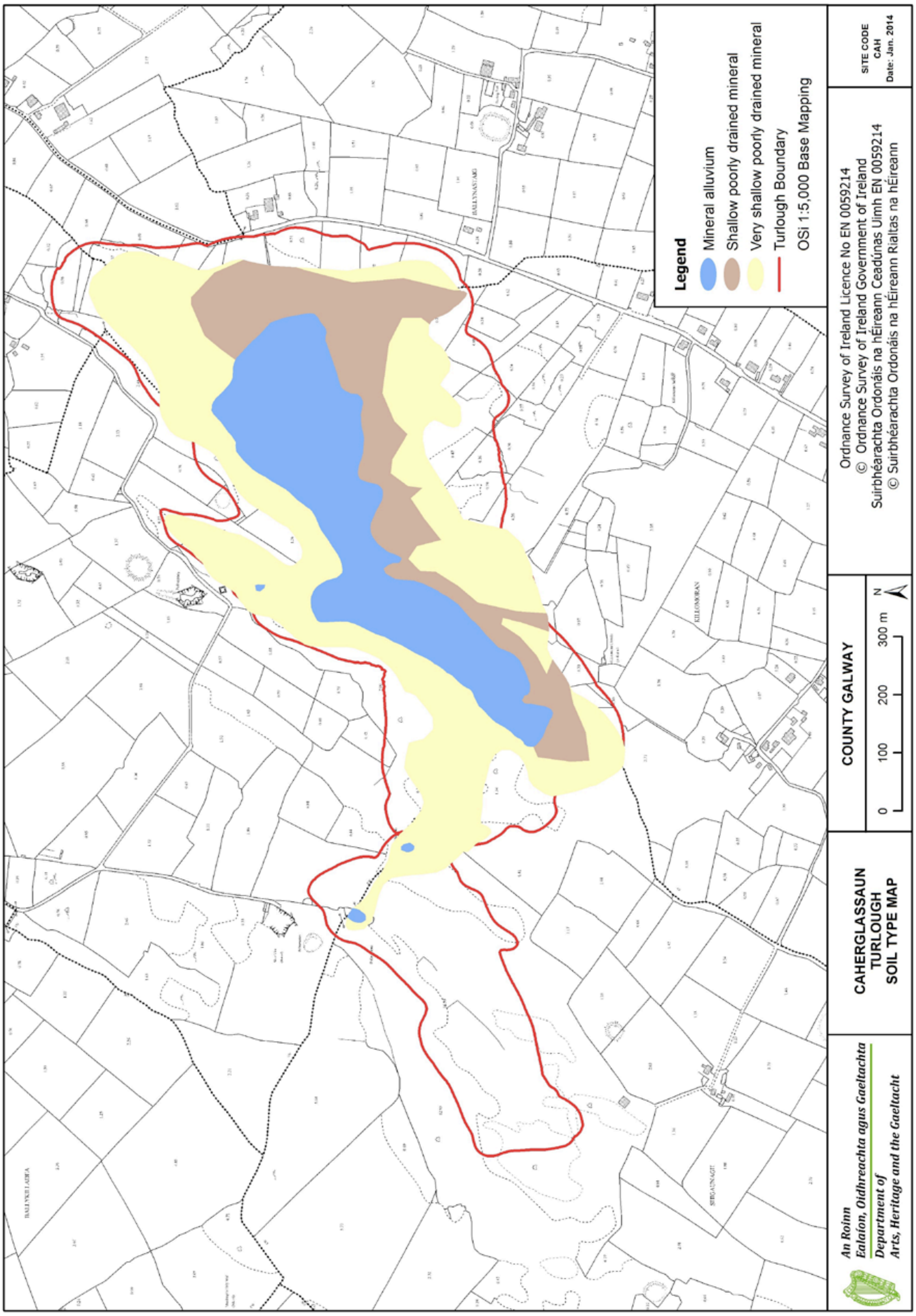
Legend
Mineral alluvium
Shallow poorly drained mineral
Very shallow poorly drained mineral
Turlough Boundary
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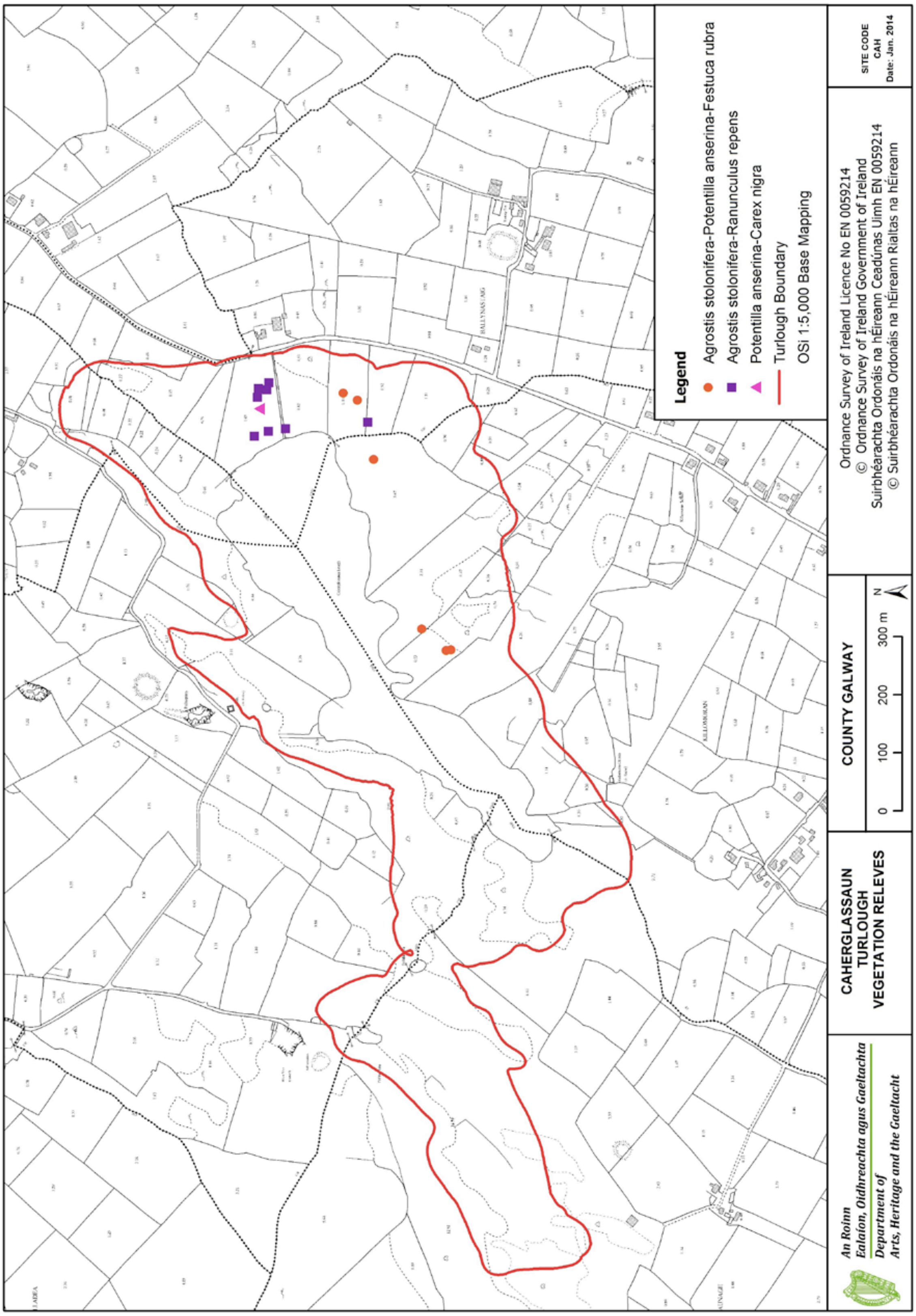
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Agrostis stolonifera-Potentilla anserina-Festuca rubra
Agrostis stolonifera-Ranunculus repens
Potentilla anserina-Carex nigra
Turlough Boundary
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COUNTY GALWAY
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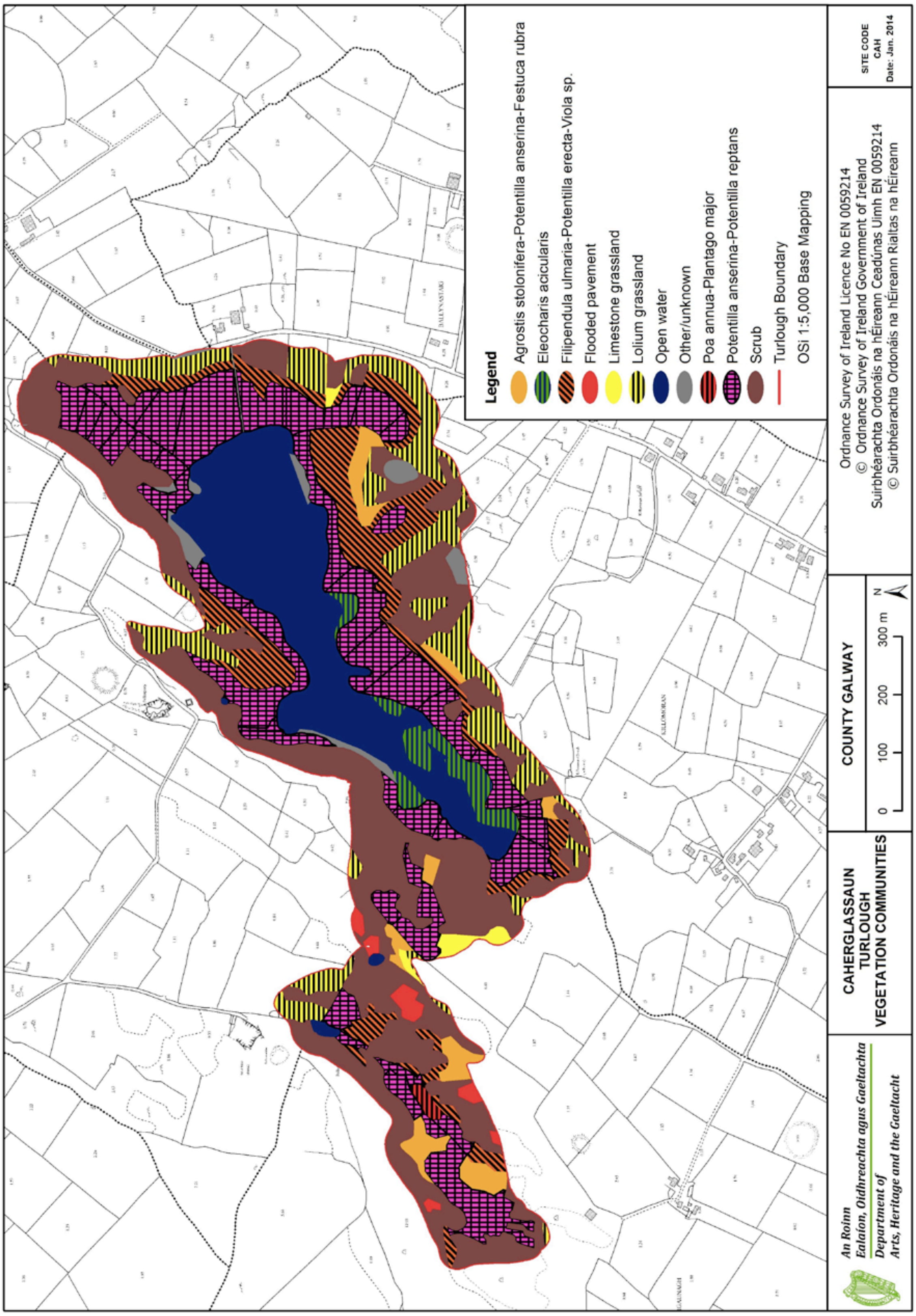
Legend
Agrostis stolonifera-Potentilla anserina-Festuca rubra
Eleocharis acicularis
Filipendula ulmaria-Potentilla erecta-Viola sp.
Flooded pavement
Limestone grassland
Lolium grassland
Open water
Other/unknown
Poa annua-Plantago major
Potentilla anserina-Potentilla reptans
Scrub
Turlough Boundary
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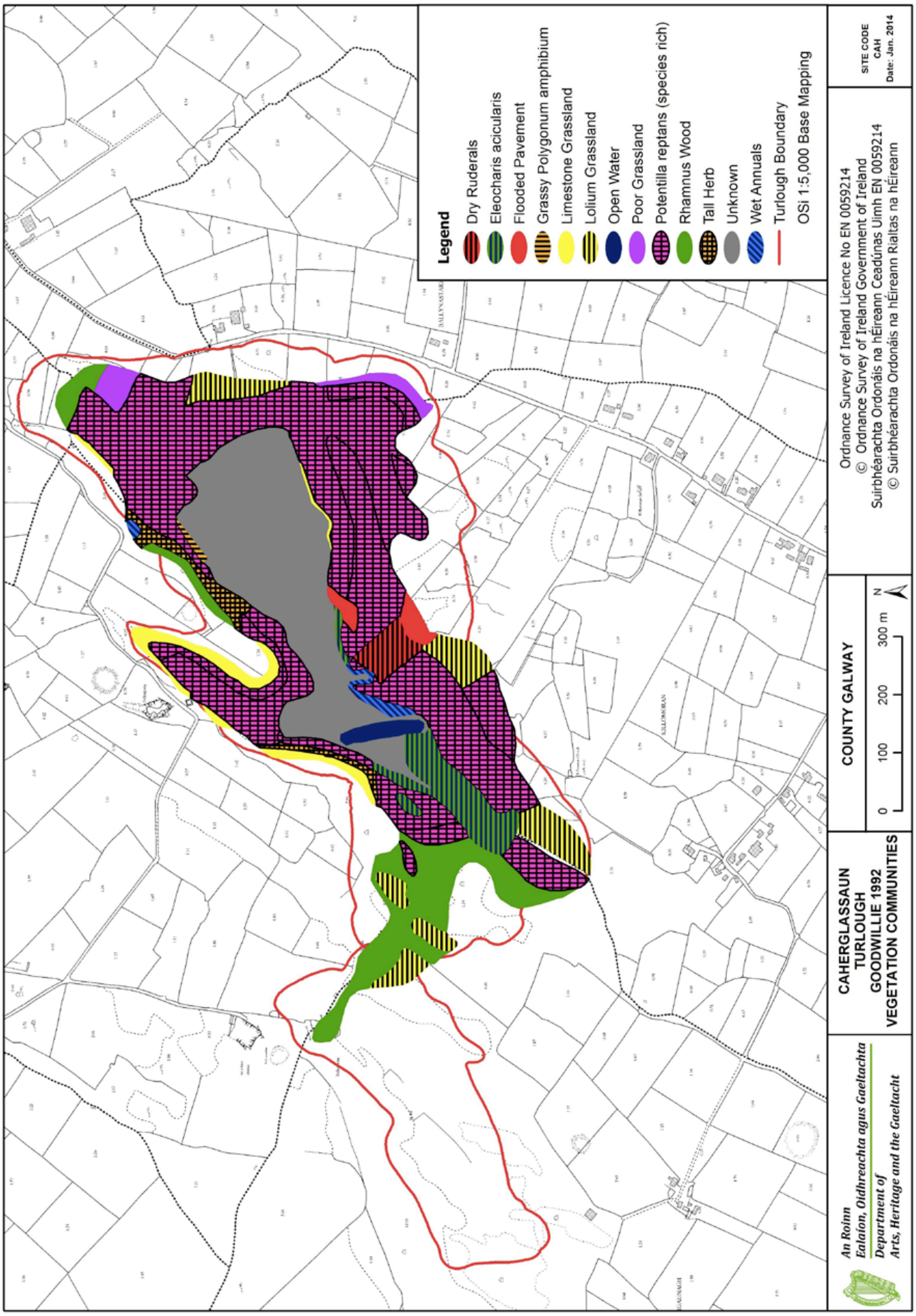
Legend
Dry Ruderals
Eleocharis acicularis
Flooded Pavement
Grassy Polygonum amphibium
Limestone Grassland
Lolium Grassland
Open Water
Poor Grassland
Potentilla reptans (species rich)
Rhamnus Wood
Tall Herb
Unknown
Wet Annuals
Turlough Boundary
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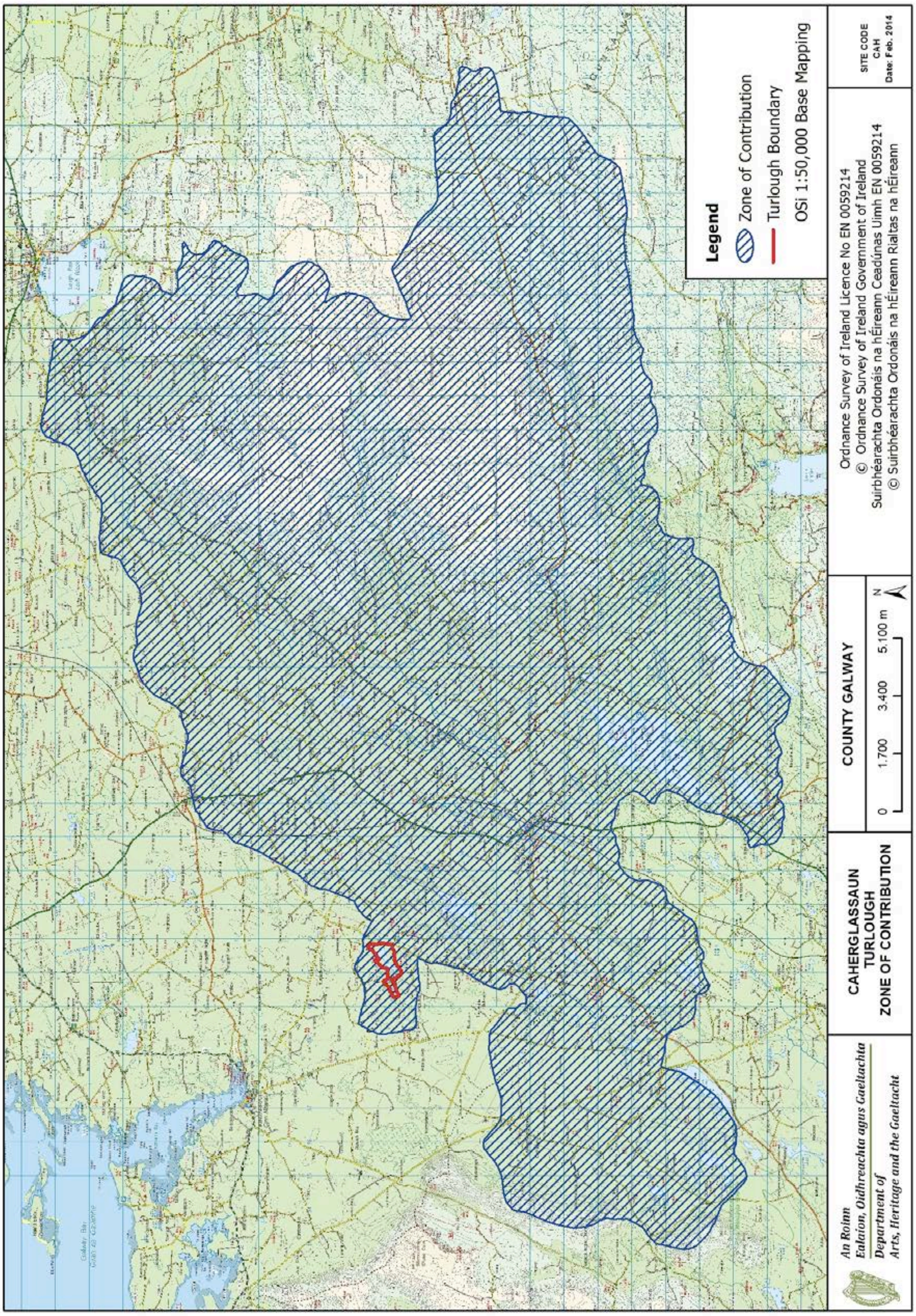

Legend
Zone of Contribution
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TURLOUGH
ZONE OF CONTRIBUTION
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht

Site Report: Caranavoodaun Turlough
TCD Turlough Research project 2006-2011

Turlough Project Code	SAC Name	SAC/NHA No.	County	Townland	RBD	Easting	Northing	Area (ha)
CARA	Castletaylor complex	000242	Galway	Caranavoudaun	WESTERN	145450	215450	34

File update: July 2015 (S. Waldren)

Site Description

Caranavoodaun turlough lies north of Ardrahan, Co. Galway, and occurs within the Castletaylor Complex SAC. The maximum flooded area was recorded as 34.6 ha. The southern part of the basin slopes gently to the base of the turlough, while the northern slopes are steeper. A permanent pool is present in the centre of the basin. Twelve vegetation communities were mapped in Caranavoodaun; the *Eleocharis palustris-Ranunculus flammula* community was the dominant vegetation type, occurring over most of the bottom of the basin. Caranavoodaun soils are alkaline and highly organic, with significant amounts of calcium carbonate; Fen peat was the dominant soil type found. All of the turlough is rotationally grazed. The hydrological data suggest that there is generally one significant flooding event per annum, with smaller fluctuations occurring throughout the year. The vegetation suggests that the turlough may now be wetter in the central part than when surveyed by Goodwillie (1992), with more aquatic communities. There is localised heavy cattle grazing and poaching damage.

Caranavoodaun – photo: S. Kimberley

Phytoplankton

Phytoplankton analysis was conducted on sub-samples of monthly spot samples collected for hydrochemical analysis between October 2006 and June 2007. Phytoplankton composition varies significantly over time and data from autumn, mid-winter and spring/early summer are presented below. Taxa were identified to species level where possible. Some taxa were not discriminated beyond general groupings (i.e. small centric diatoms, dinoflagellates and pinnate diatoms). The term non-identifiable alone (or n.i.) was reserved for cases where specimens were not identifiable. Discrimination between n.i. filament, n.i. flagellate, n.i. colony, n.i. green filament was made when applicable. Biovolume (mm^3 m^{-3}) was used as the measure of algal biomass.

October 2006		January 2007		May 2007	
Biovolume (mm^3/m^3)	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*
Navicula	*130474*	*Gomphonema*	*6720*	*n.i. pennates*	*12411*
Oocystis solitaria	*92400*	*n.i. pennates*	*4148*	*Oedogonium*	*8446*
Synedra	*48335*	*Achnanthidium minutissima*	*3149*	*n.i.*	*7756*
n.i. dinoflagellate	*44476*	*Fragilaria/Synedra*	*3102*	*Synedra*	*5010*
Monoraphidium	*11228*	*Nitzchia*	*2853*	*Pseudoquadrigula britannica*	*4191*

Benthic Algae

Turloughs were inspected for algal mats during the emptying phase in 2007, 2008 and 2009. Turloughs were visited in the first two weeks of March to June 2007 as part of the monthly monitoring of turloughs. Dedicated trips to inspect for algal mats were conducted in 2008 on the 4th of March, the 1st of April, and the 26th, 27th and 28th of May, and in 2009 on the 15th and 16th of June and on the 24th and 25th of July. The presence of both living floating mats and dead drying mats was noted, as well as their extent in the turlough basins. Occurrence of visible filamentous algal mats in the three years of observation is presented below. Y = visible occurrence; * = "extensive cover" (estimated to be 2 to 8% of total area of basin); † = negligible quantity observed; • = turlough was too flooded to permit full observation. Very small areas of algal mats were observed in Caranavodaun in 2008.

Year of Observation		
2007	**2008**	**2009**
N	Y†	N

Hydrochemistry

Data shown are the mean ± SD of monthly spot samples collected between October 2006 and June 2007. Mean seasonal Total P and Chlorophyll *a* were used to determine the trophic status of the floodwaters based on OECD trophic categories. The median and range of <u>mean values</u> across all turloughs are also provided.

Hydrochemical Variable	Caranavoodaun Values		Turlough Summary Stats (n=22)		
	Mean±SD	**OECD Trophic Category**	**Median**	**Min**	**Max**
pH	8.2±0.2		8.1	7.7	8.3
Alkalinity mg l^{-1} $CaCO_3$	217.1±30.0		204.0	112.4	236.4
Colour mg l^{-1} PtCo	24.9±10.8		26.9	7.9	85.1
Molybdate Reactive Phosphorus µg l^{-1}	1.5±0.7		3.4	0.7	42.1
Total Phosphorus µg l^{-1}	11.0±3.8	Mesotrophic	24.8	4.0	82.1
Chlorophyll *a* µg l^{-1}	2.8±2.8	Mesotrophic	4.9	1.1	33.5
Nitrate-N mg l^{-1}	1.9±1.4		0.7	0.1	1.9
Total Nitrogen mg l^{-1}	2.3±1.4		1.2	0.6	2.3

Aquatic Invertebrates

22 turloughs were sampled for littoral aquatic macroinvertebrates using sweep nets during November 2006 and April 2007. Zooplankton samples were collected in April 2007. Open-water cladocerans and littoral chydorids were sampled using a zooplankton net and perspex tube respectively.

Aquatic Macroinvertebrates			
November 2006	**Count**	**April 2007**	**Count**
Agabus nebulosus	1	*Agabus nebulosus*	1
Agabus sp. (larva)	26	*Agabus* sp (larva)	11
Agyroneta aquatica	1	Anisoptera sp. larvae	7
Anisoptera sp. (larva)	11	*Berosus signaticollis*	6
Aplexa hypnorum	3	Chironomidae	1
Berosus signaticollis	67	*Cloeon dipterum*	7
Colymbetes fuscus	1	Culicidae	38
Culicidae	7	Curculionidae	2
Curculionidae	1	Diptera Pupae	1
Erpobdella octoculata	1	*Glossiphonia complanata*	1
Graptodytes bilineatus	6	*Haliplus variegatus*	1
Hydaticus sp. (larva)	15	*Hydrachnidia* (Mite)	1
Hydrachnidia (Mite)	3	*Hygrotus quinquelineatus*	1
Hygrotus inaequalis	1	*Lestes dryas*	23
Ilybius sp. (larva)	4	*Lestes* sp.	64
Lestes sp.	18	*Limnephilus auricula*	6
Limnephilidae sp. Instar II	72	*Limnephilus centralis*	3
Limnephilidae sp. Instar III	36	*Limnephilus marmoratus*	9
Limnephilus auricula	33	*Lymnaea peregra*	1
Limnephilus lunatus	31	*Lymnaea trunculata*	5
Limnephilus marmoratus	14	*Pisidium/Sphaerium* spp.	3
Lymnaea peregra	44	*Porhydrus lineatus*	2
Lymnaea trunculata	47	*Rhantus* sp. (larva)	2
Ostracoda	27	*Sympetrum sanguinem*	55
Phacopteryx brevipennis	2	Tipulidae	1
Pisidium/Sphaerium spp.	1		
Rhantus sp. (larva)	3		
Succinea sp. (larva)	1		
Tipulidae	2		

Aquatic Macroinvertebrates: Presence of high abundances (> 50 individuals) of Odonata and Trichoptera (> 50 individuals) indicate nutrient poor conditions.

Aquatic Macroinvertebrate Taxa	**Presence of high abundances**	
	November 2006	**April 2007**
Diptera	N	N
Ostracoda	N	N
Odonata	Y	Y
Trichoptera	Y	N

Zooplankton species
Alona affinis
Alona excisa
Alona guttata
Alona rustica
Alonella excisa
Alonella nana
Chydorus sphaericus
Daphnia pulex
Eurycercus glacialis
Graptoleberis testudinaria
Lathurona rectirostris
Pleuroxus laevis

Vegetation

Vegetation description and classification yielded 25 vegetation communities suitable for mapping. Caranavoodaun has a high community diversity, and twelve vegetation communities were recorded, dominated by the oligotrophic *Eleocharis palustris – Ranunculus flammula* community, the *Molinia caerulea – Carex panicea* community and woodland & scrub. Areas of Flooded Pavement also occur, High conservation value communities are denoted by *. 103 plant species were recorded, including one of few occurrences of *Selaginella selaginoides* in turloughs.

Vegetation Community	Area (Ha)
A. stolonifera-P. anserina - F. rubra	0.22
Carex nigra-C. panicea	0.57
E. palustris-P. arundinacea	0.34
Eleocharis palustris-R. flammula	13.52
*Flooded pavement	0.95
Limestone grassland	2.24
Lolium grassland	1.5
**Molinia caerulea-Carex panicea*	7.77
Open water	0.16
Other/unknown	0.28
P. anserina-P. reptans	0.15
Polygonum amphibium	0.05
Schoenus nigricans fen	0.14
Woodland/scrub	6.12
Number of vegetation communities	12
Number of plant species	103

Vascular Plant Species

Nomenclature follows Parnell, J & Curtis, T. (2012) *Webb's An Irish Flora*, University of Cork Press.

Achillea ptarmica	*Frangula alnus*	*Plantago maritima*
Agrostis capillaris	*Fraxinus excelsior*	*Poa pratensis*
Agrostis stolonifera	*Galium boreale*	*Polygala vulgaris*
Anagallis tenella	*Galium palustre*	*Polygonum amphibium*
Antennaria dioica	*Galium verum*	*Potamogeton natans*
Apium inundatum	*Geranium sanguineum*	*Potamogeton polygonifolius*
Asperula cynanchica	*Glyceria fluitans*	*Potentilla anserina*
Baldellia ranunculoides	*Hedera helix*	*Potentilla erecta*
Bellis perennis	*Hieracium pilosella*	*Potentilla palustris*
Briza media	*Holcus lanatus*	*Potentilla reptans*
Callitriche sp	*Hydrocotyle vulgaris*	*Prunella vulgaris*
Campanula rotundifolia	*Hypochaeris radicata*	*Prunus spinosa*
Cardamine pratensis	*Juncus articulatus*	*Ranunculus flammula*
Carex flacca	*Juncus bulbosus*	*Ranunculus repens*
Carex hirta	*Juniperus communis*	*Rhamnus cathartica*
Carex hostiana	*Koeleria cristata*	*Rosa pimpinellifolia*
Carex nigra	*Leontodon autumnalis*	*Samolus valerandi*
Carex panicea	*Leontodon hispidus*	*Schoenus nigricans*
Carex pulicaris	*Leontodon saxatilis*	*Selaginella selaginoides*
Carex viridula agg.	*Leucanthemum vulgare*	*Sorbus aria*
Carex viridula ssp. *brachyrrhyncha*	*Linum catharticum*	*Sparganium emersum*
Centaurea nigra	*Littorella uniflora*	*Stellaria media*
Centaurium erythraea	*Lolium perenne*	*Succisa pratensis*
Cerastium fontanum	*Lotus corniculatus*	*Taraxacum officinale* agg.
Cirsium arvense	*Mentha aquatica*	*Teucrium scorodonia*
Cirsium dissectum	*Molinia caerulea*	*Thymus praecox*
Cynosurus cristatus	*Odontites verna*	*Trifolium pratense*
Dactylorhiza incarnata	*Oenanthe aquatica*	*Trifolium repens*
Danthonia decumbens	*Parnassia palustris*	*Veronica beccabunga*
Eleocharis multicaulis	*Phalaris arundinacea*	*Veronica scutellata*
Eleocharis palustris	*Phleum bertolonii*	*Veronica serpyllifolia*
Euphrasia species	*Pimpinella saxifraga*	*Vicia cracca*
Festuca arundinacea	*Plantago lanceolata*	*Viola canina*
Festuca ovina	*Plantago major*	*Viola* sp.
Filipendula ulmaria		

Soils and Grazing

Soils were classified using a modified version of soil categories generated by the Teagasc/EPA Soils and Subsoils Mapping project (Fealy *et al.*, 2009). The classification scheme principally uses parent material (calcareous/non-calcareous), depth class (shallow/deep) and drainage class (well drained/poorly drained) to assign soils to one of nine broad categories. The mean ± SD of a range of soil properties are also provided, in addition to the median and range of each variable across turloughs. Caranavoodaun has extensive areas of Fen Peats, and very shallow well-drained organic soils occupy the upper slopes. The mean ± SD of a range of soil properties are also provided, in addition to the median and range of each variable across turloughs. Caranavoodaun soils are alkaline and highly organic, with significant amounts of calcium carbonate.

Soil Types/Grazing Extent	% Turlough Area
Very shallow well drained organic	33.4
Fen peat	64.1
Alluvial marl with peaty topsoil	2.5
Extent of rotationally grazed area	100

Soil Property (n=6)	Caranavoodaun	Turlough Summary Stats (n=22)		
	Mean ± SD	Median	Min	Max
pH	8.0 ± 0.2	7.20	5.94	8.29
% Organic Matter content	38.0 ± 18.5	25.8	10.2	69.1
% Inorganic content	27.5 ± 16.2	43.2	25.7	85.0
% Calcium carbonate content	34.6 ± 31.4	11.3	2.48	43.7
Total Nitrogen mg kg^{-1}	15893 ± 7540	11142	4983	24233
Total Phosphorus mg kg^{-1}	814 ± 365	905	245	1594

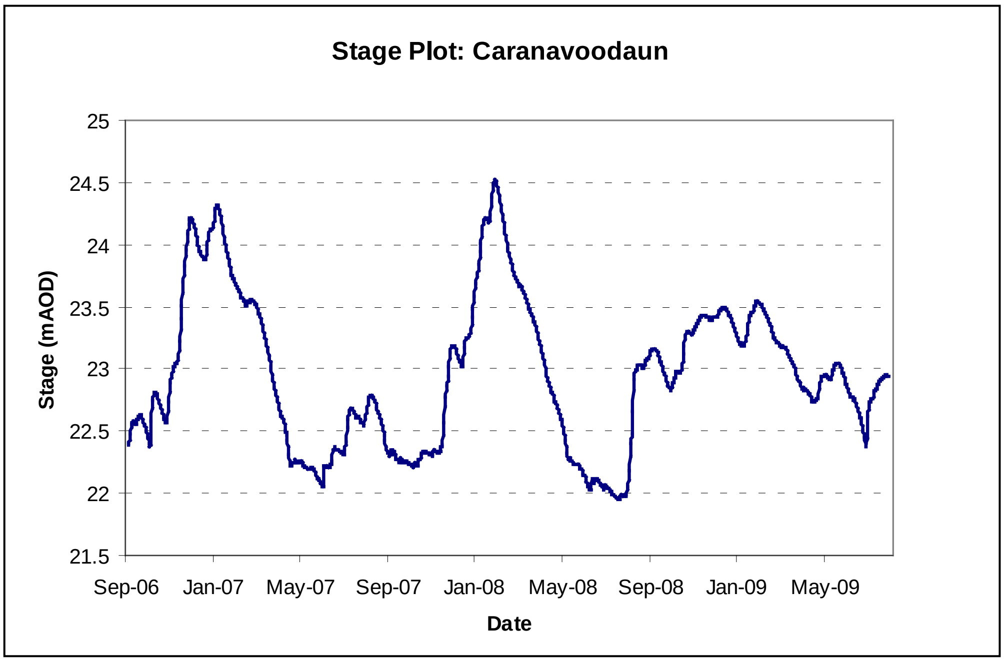
Hydrology

Water levels were recorded at hourly intervals using a variety of Schlumberger Divers® (Marton Geotechnical Ltd, Suffolk, UK) placed at or near the lowest point in each turlough. Divers measure the pressure of the water and air column above them, and from this the depth of water can be calculated. GPS surveys were carried out on 21 monitoring sites (Tullynafrankagh omitted) in order to develop digital terrain models (DTMs) from which contour maps, stage-volume and stage-surface area relationships are produced. The inflow magnitude is indicative of the properties of a turlough's catchment area and flow capacity, while outflow is a function of the drainage capacity of the system.

The hydrological data suggest that there is generally one significant flooding event per annum, with smaller fluctuations occurring throughout the year. The turlough is relatively shallow, has moderately low inflow and outflow, but has a low drainage capacity, resulting in a relatively high recession duration. There is a small, deep hollow in the north-east arm of the turlough.

Hydrological Information	Caranavoodan Values	Turlough Summary Stats (n=21)		
		Median	**Min**	**Max**
Start of Hydrological Recording	24/09/2006	-	-	-
End of Hydrological Recording	04/08/2009	-	-	-
Days Recorded	4045	-	-	-
Equipment Failure	None recorded	-	-	-
Hydroperiod (days)	205	213	135	348
Maximum Floodwater Depth (m)	3.8	4.9	3	15.4
Maximum Floodwater Volume ('000 m^3)	498.5	877.9	355.6	4008.1
Maximum Flooded Area (ha)	34.55	38.61	13.71	78.12
Average Basin Depth (m)	1.44	2.28	0.85	6.76
Average Daily Inflow (m^3 s^{-1})	0.309	0.684	0.254	10.253
Average Daily Outflow (m^3 s^{-1})	0.162	0.271	0.086	2.018
Drainage Capacity (m^3 s^{-1})	0.072	0.154	0.069	1.156
Recession Duration (days)	80.7	57.3	11	142.5

Stage plot for Caranavoodaun turlough



Zone of Groundwater Contribution (ZOC) Risk Assessments

GIS based risk assessments were conducted with a view to identifying turloughs at risk of failing to meet WFD water quality objectives. These risk assessments were conducted by Compass Informatics Ltd and were based on Risk Assessment Sheet GWDTERA2a (Guidance Document No. GW9) on assessing risks to turloughs from phosphate (Working Group on Groundwater 2004) and Pathway Susceptibilities and Pressure Magnitudes were integrated to produce Impact Potential maps and predicted Risk Categories for the turlough ZOC. The TCD Risk Category is derived from a revised Impact Potential matrix. The predicted Risk Categories were adjusted using mean seasonal floodwater Total P (μg l^{-1}) (see Section 4.5.4 of the Risk Assessment Sheet GWDTERA2a). The risk categories include 1A: at significant risk; 1B: probably at significant risk; 2A: Not at significant risk (low confidence); 2B: Not at significant risk (higher confidence).

ZOC Area (Km^2)	Predicted WFD Risk Category	Adjusted WFD Risk Category	Predicted TCD Risk Category	Adjusted TCD Risk Category
9	1B	1A	1B	1A

ZOC Pressure Variable	
CORINE BARE ROCK %	0
CORINE PEAT BOGS%	0
CORINE ALL NATURAL AND SEMI-NATURAL AREAS%	20
CORINE IMPROVED PASTURE%	50
CORINE UNIMPROVED PASTURE%	18
CORINE ALL PASTURE%	68
CORINE OTHER AGRICULTURAL LANDS%	12
TEAGASC/EPA HABITATS ROCK%	0
TEAGASC/EPA HABITATS BOGS/PEATS%	0
TEAGASC/EPA HABITATS FORESTS/SCRUBS%	9
TEAGASC/EPA HABITATS WATER%	1
TEAGASC/EPA HABITATS DRY GRASSLAND%	87
TEAGASC/EPA HABITATS WET GRASSLAND%	2
TEAGASC TOTAL GRASSLAND%	1
TOTAL LIVESTOCK UNIT/ha of ZOC	1
TILLAGE%	14
No. SEPTIC TANKS km^{-2} ZOC	12
No. SEPTIC TANKS/Km^{-2} EXTREME PATHWAY SUSCEPTIBILITY	0
HIGH PATHWAY SUSCEPTIBILITY%	69
EXTR+HIGH PATHWAY SUSCEPTIBILITY%	97
WELL DRAINED SOIL %	1
POORLY DRAINED SOIL%	0

Site Conservation Assessment

The following site conservation assessment was undertaken to feed into the national reporting structure for assessing conservation status as required under Article 17 of the Habitats Directive. A suite of indicators and associated targets were derived to assess ecological structure and function. Future prospects were assessed through the evaluation of the impact of current and recent pressures and likely future threats to the site. The assessment follows a rules based approach to determine whether Structures & functions and Future Prospects should be assessed as good (green), inadequate (amber) or bad (red). For further details, see Chapter 10 (Conservation Status Assessment).

Please note an updated approach to assessing site condition has been proposed and is outlined in Chapter 12 (Monitoring Methods for Turloughs).

Conservation Condition Summary

Structure & Function	**Favourable**
Future Prospects	**Inadequate/Favourable**
Site Conservation Condition	**Inadequate/Favourable**

Structure and Function Status:

Indicator	*Comments*
Hydrological Function: *Good*	Drainage has lowered the flood level in the past but is not considered to be currently impacting the ecological function
Water Quality: *Good*	11.0 µg P l^{-1}
Biological Responses: *Very Good*	
Algal communities: 0	No algal mats recorded (negligible quantities in 2008), low max CHL
Vegetation communities: 2	High cover of positive indicator communities typical of oligotrophic turloughs
***Rumex* cover: 1**	Absent
Important plants: 1	*Frangula alnus, Plantago maritima*
Important aquatic invertebrates: 2	*Alona rustica, Alonella exisa, Berosus signaticollis, Lestes dryas, Sympetrum sanguineum, Eurycercus glacialis*
Overall Structure & Function: *Good*	

Pressures:

Code	*Impact*	*Notes*
A04.01.01 Intensive cattle grazing (turlough)	M	Moderate cattle grazing within the turlough
H02.07 Diffuse groundwater pollution due to non-sewered population (ZOC)	M	There are a reasonably high number of dwellings in the ZOC, some very close to the turlough; likely contribution to slight nutrient enrichment
H02.06 Diffuse groundwater pollution due to agricultural and forestry activities (ZOC)	L(ZOC)	
B01 Forest planting on open ground (ZOC)	L(ZOC)	
E01.03 Dispersed habitation (ZOC)	L(ZOC)	There are a reasonably high number of dwellings in the ZOC, some very close to the turlough, the major impact of these is likely through groundwater pollution

Threats:

Code	Impact	Notes
A02.01 Agricultural intensification (ZOC)	H	Likely to increase due to prevalence of pasture in ZOC
H02.06 Diffuse groundwater pollution due to agricultural and forestry activities (ZOC)	M	Likely to increase due to prevalence of pasture in ZOC
A04.01.01 Intensive cattle grazing (turlough)	M	Continuing pressure
H02.07 Diffuse groundwater pollution due to non-sewered population (ZOC)	L	Continuing pressure
A10.02 Removal of stone walls and embankments (in turlough)	L	
M01.03 Flooding and rising precipitations	L	
J02.07.02 Groundwater abstractions for public water supply (ZOC)	L	Possible threat due to demand caused by density of dispersed dwellings in vicinity of turlough

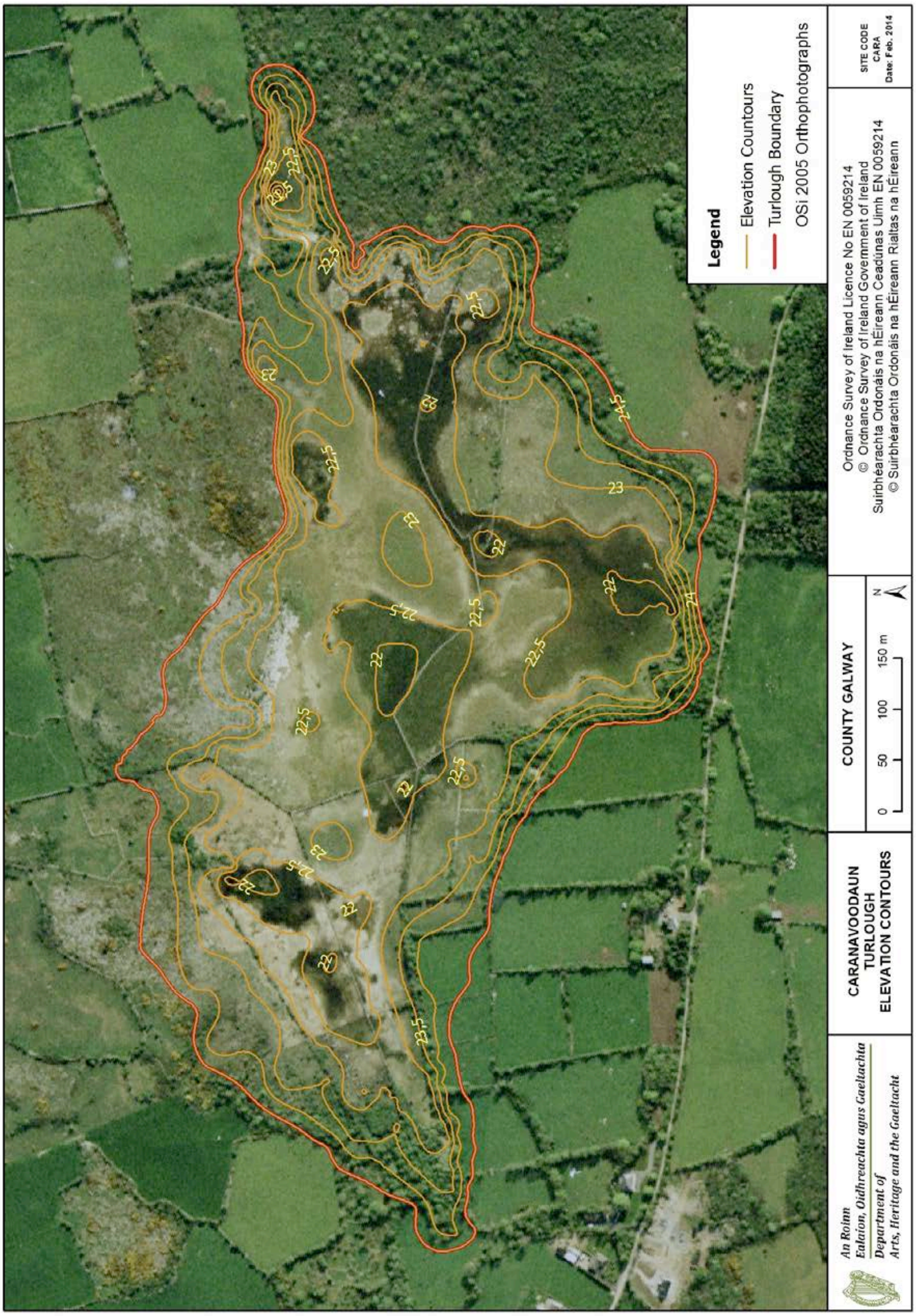
Future Prospects: **Inadequate/Favourable** – borderline: Caranavoodaun is currently in good ecological condition with vegetation and aquatic invertebrate communities and moderate to low pressures, however water quality is poorer than in other oligotrophic turloughs. There are a number of threats likely to impact on this state due to foreseen intensification of agricultural output in the vicinity of and within the turlough, and due to the high frequency of rural dwellings in the ZOC and especially very close to the turlough.

Overall Assessment: **Inadequate/Favourable** – the currently good ecological conditions are potentially compromised by several threats; borderline Inadequate to Favourable. Caranavoodaun is currently in very good conservation status and of probable international significance, all efforts should be taken to mitigate the threats identified.

Maps

Maps are provided of:

1. Elevation contours, based on GIS digital terrain models from points by differential GPS topographic survey (for further details, see *Chapter 3: Hydrology*)
2. Grazing in land parcels
3. Approximate sampling points for water chemistry and aquatic invertebrates
4. Soil nutrient sampling points
5. Points for soil survey (note: soils were surveyed to the turlough boundary defined by Goodwillie, 1992; see map 9)
6. Soils (note: soils were mapped by combining the EPA Subsoils base map with the point soil descriptions; for further details see *Chapter 6: Soils and Landuse*)
7. Vegetation relevés
8. Vegetation communities (note: relevés do not always match to mapped communities due to small scale variation; for further details of mapping see *Chapter 7: Turlough Vegetation: Description, Mapping and Ecology*)
9. Vegetation maps digitised from Goodwillie, R. (1992) *Turlough's Over 50 Hectares*. Report to NPWS
10. Estimated zone of groundwater contribution (ZOC)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Elevation Countours
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Date: Feb. 2014
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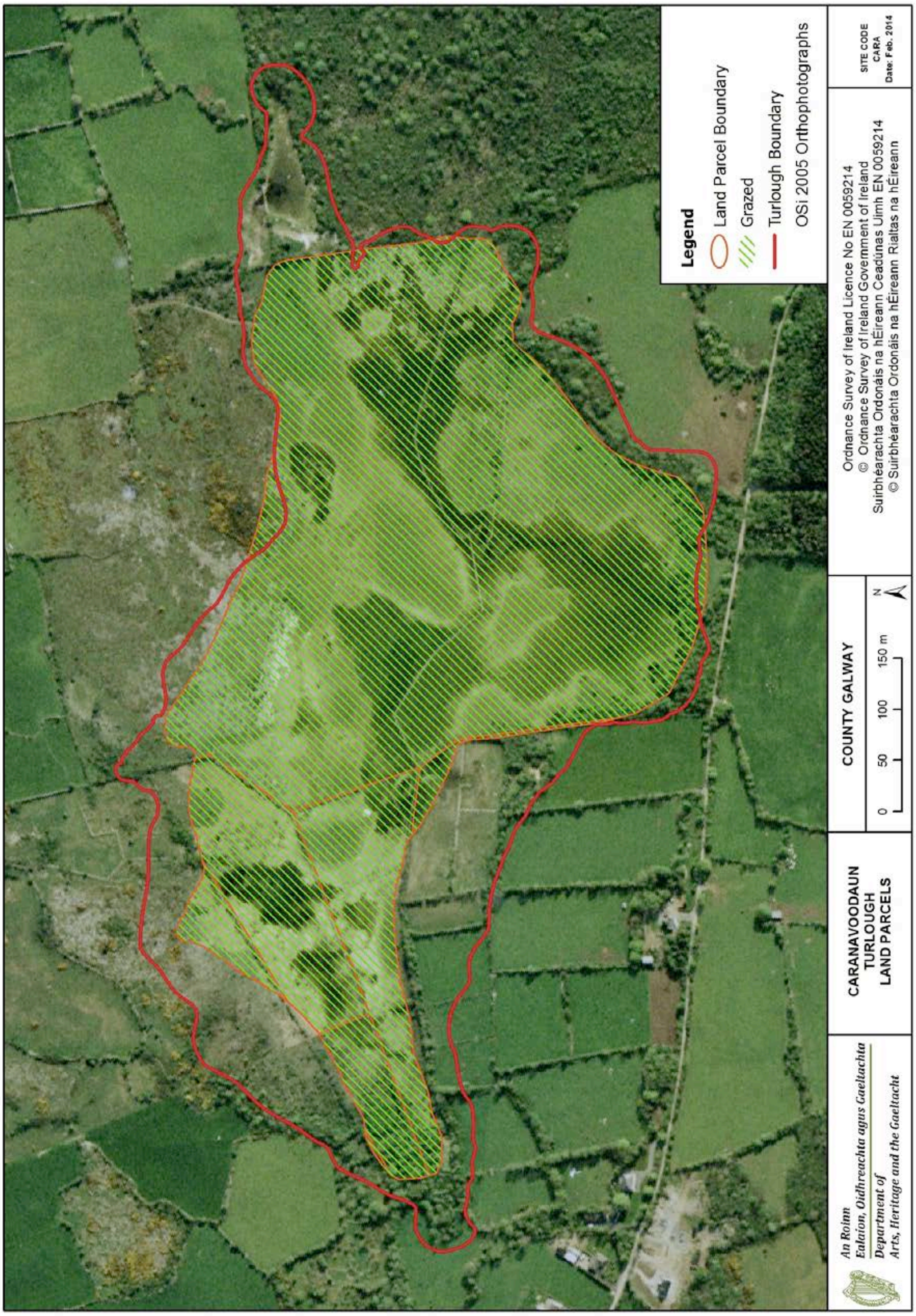
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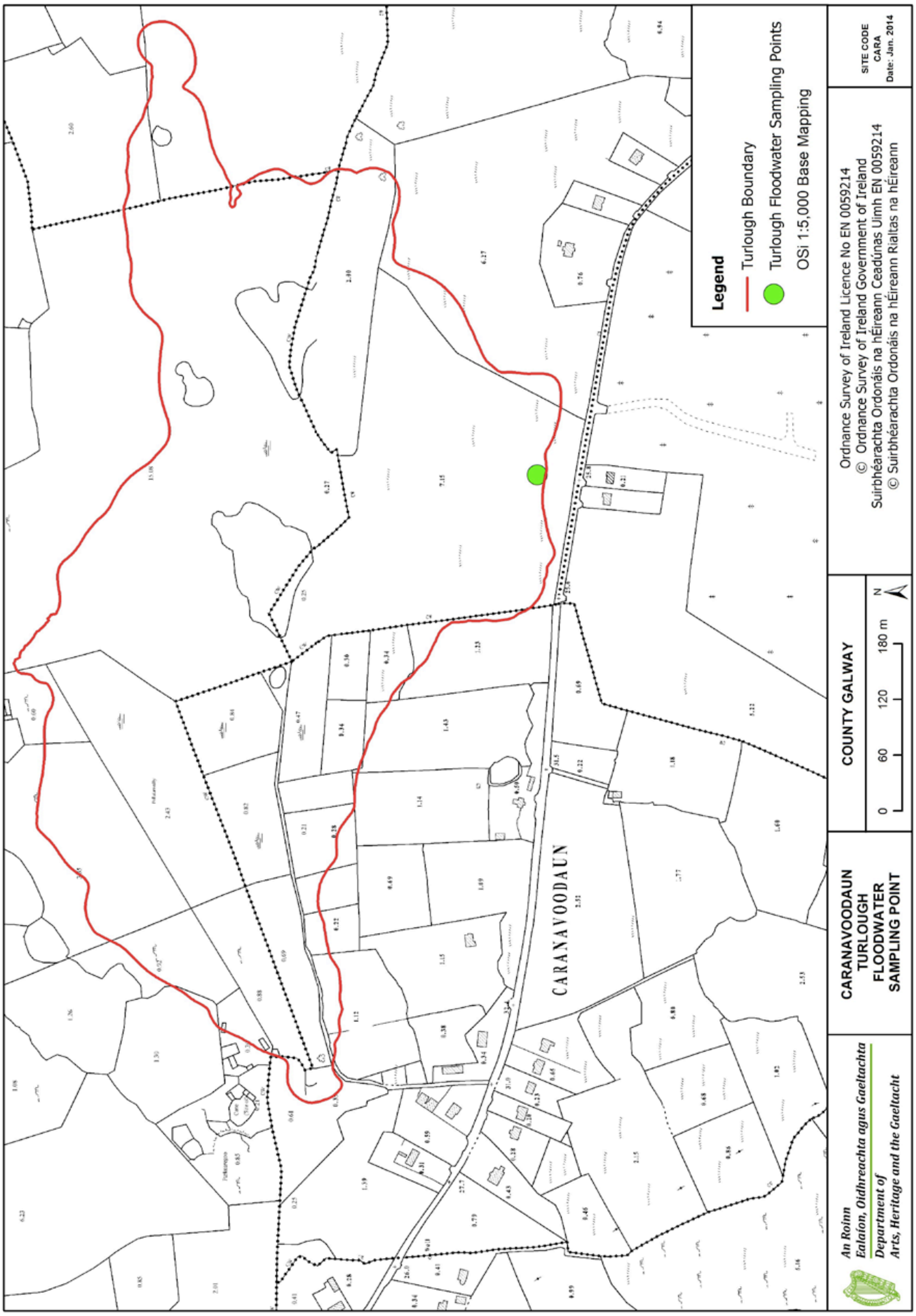

Legend
Turlough Boundary
Turlough Floodwater Sampling Points
OSi 1:5,000 Base Mapping
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CARANAVOODAUN TURLOUGH FLOODWATER SAMPLING POINT
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Department of
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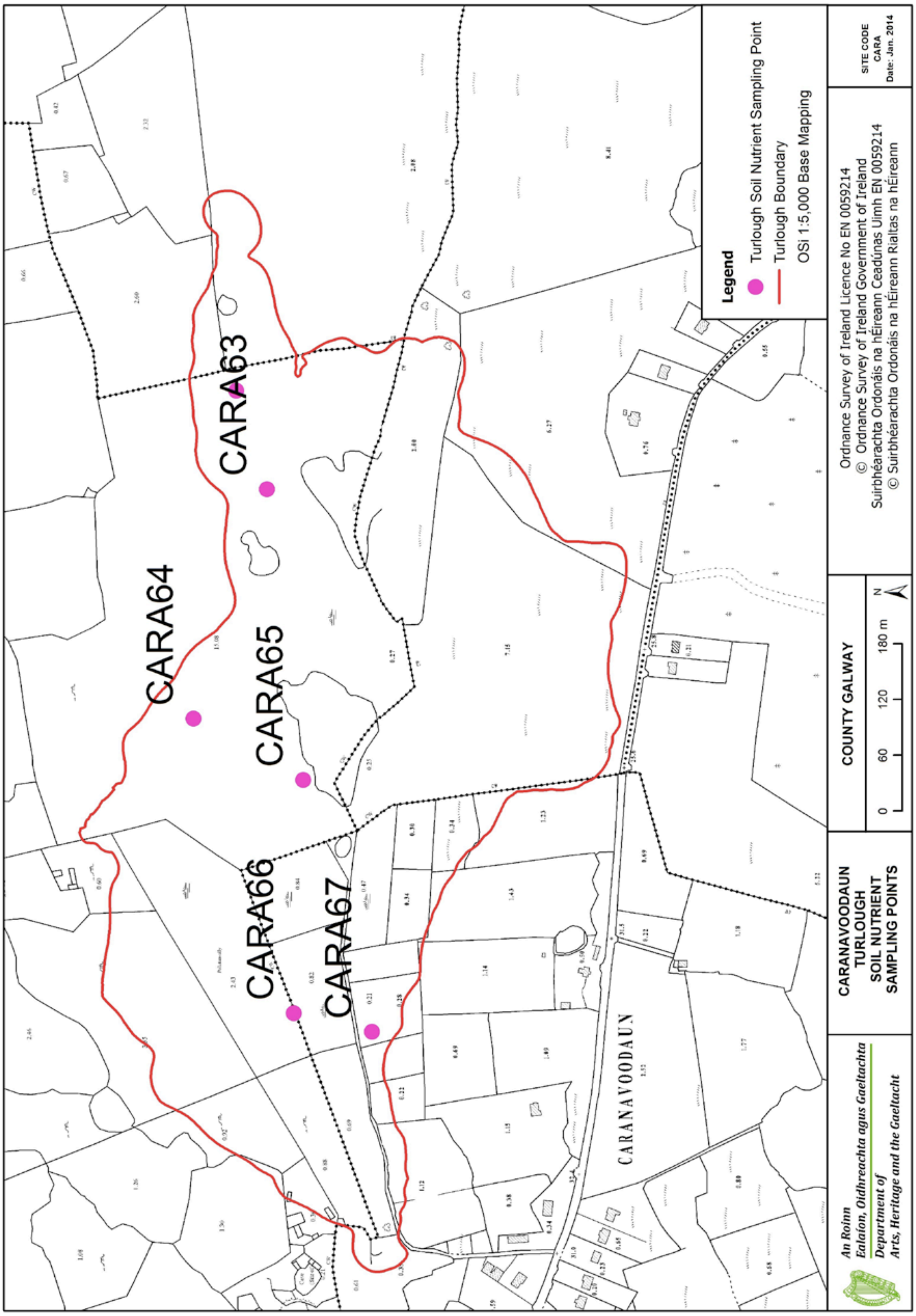
CARANAVOODAUN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Legend
Turlough Soil Nutrient Sampling Point
Turlough Boundary
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Date: Jan. 2014
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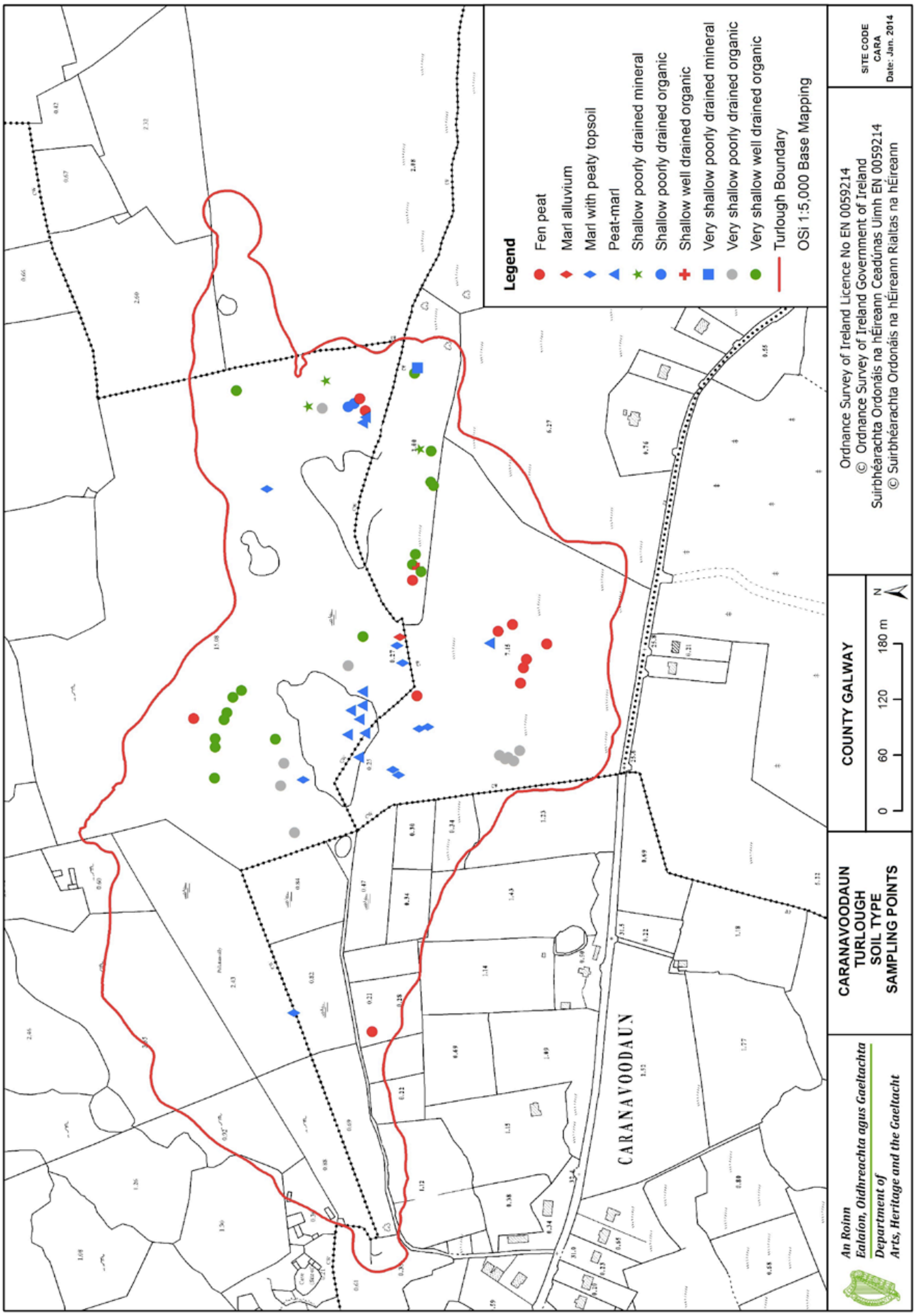
CARANAVOODAUN


Legend
Fen peat
Marl alluvium
Marl with peaty topsoil
Peat-marl
Shallow poorly drained mineral
Shallow poorly drained organic
Shallow well drained organic
Very shallow poorly drained mineral
Very shallow poorly drained organic
Very shallow well drained organic
Turlough Boundary
OSi 1:5,000 Base Mapping
SITE CODE
CARA
Date: Jan. 2014
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COUNTY GALWAY
0
60
120
180 m
N
CARANAVOODAUN
TURLOUGH
SOIL TYPE
SAMPLING POINTS
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
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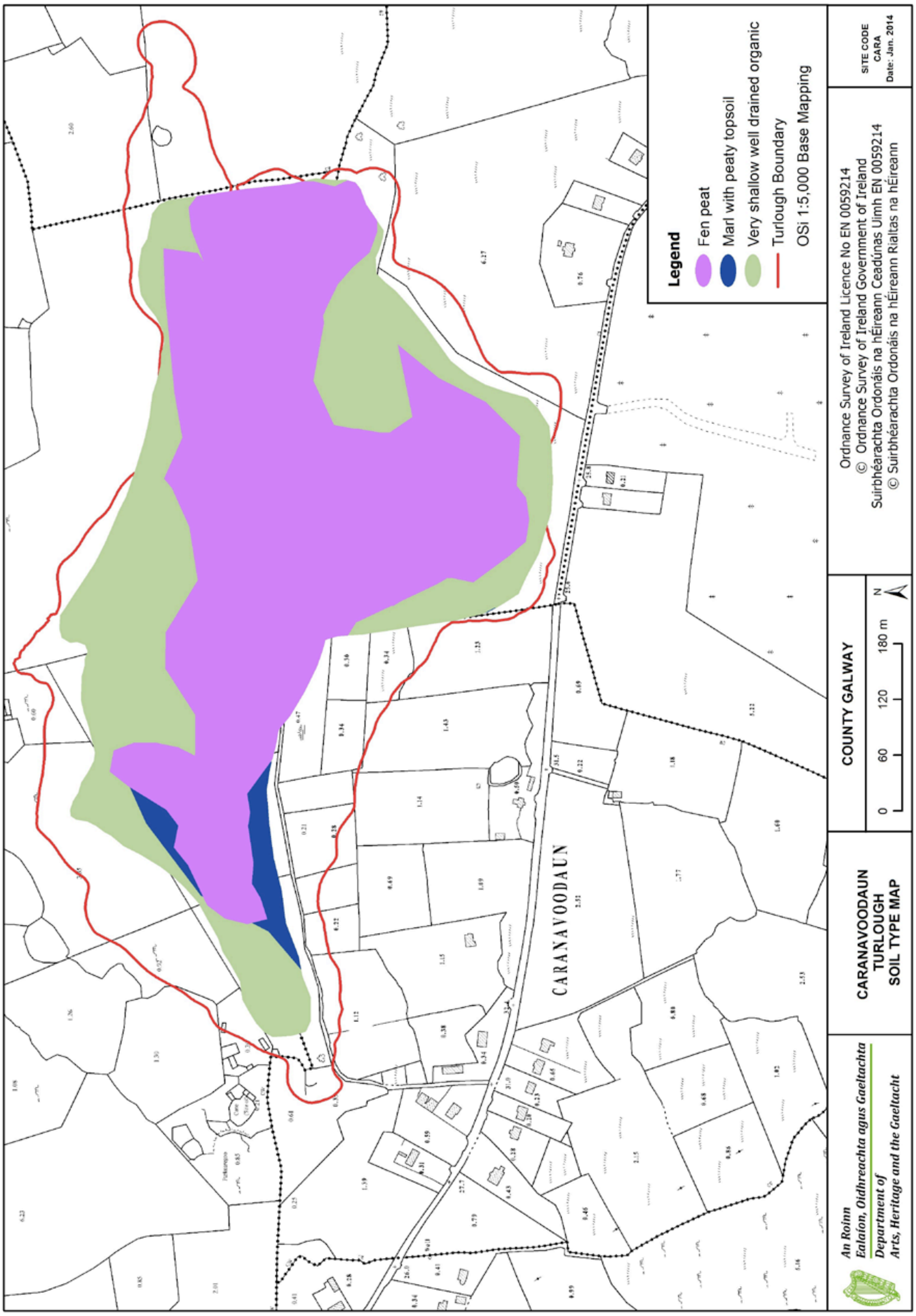
Legend
Fen peat
Marl with peaty topsoil
Very shallow well drained organic
Turlough Boundary
OSi 1:5,000 Base Mapping
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SITE CODE CARA
Date: Jan. 2014
COUNTY GALWAY
0 60 120 180 m
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CARANAVOODAUN TURLOUGH SOIL TYPE MAP
An Roinn Ealaíon, Oidhreachta agus Gaeltachta
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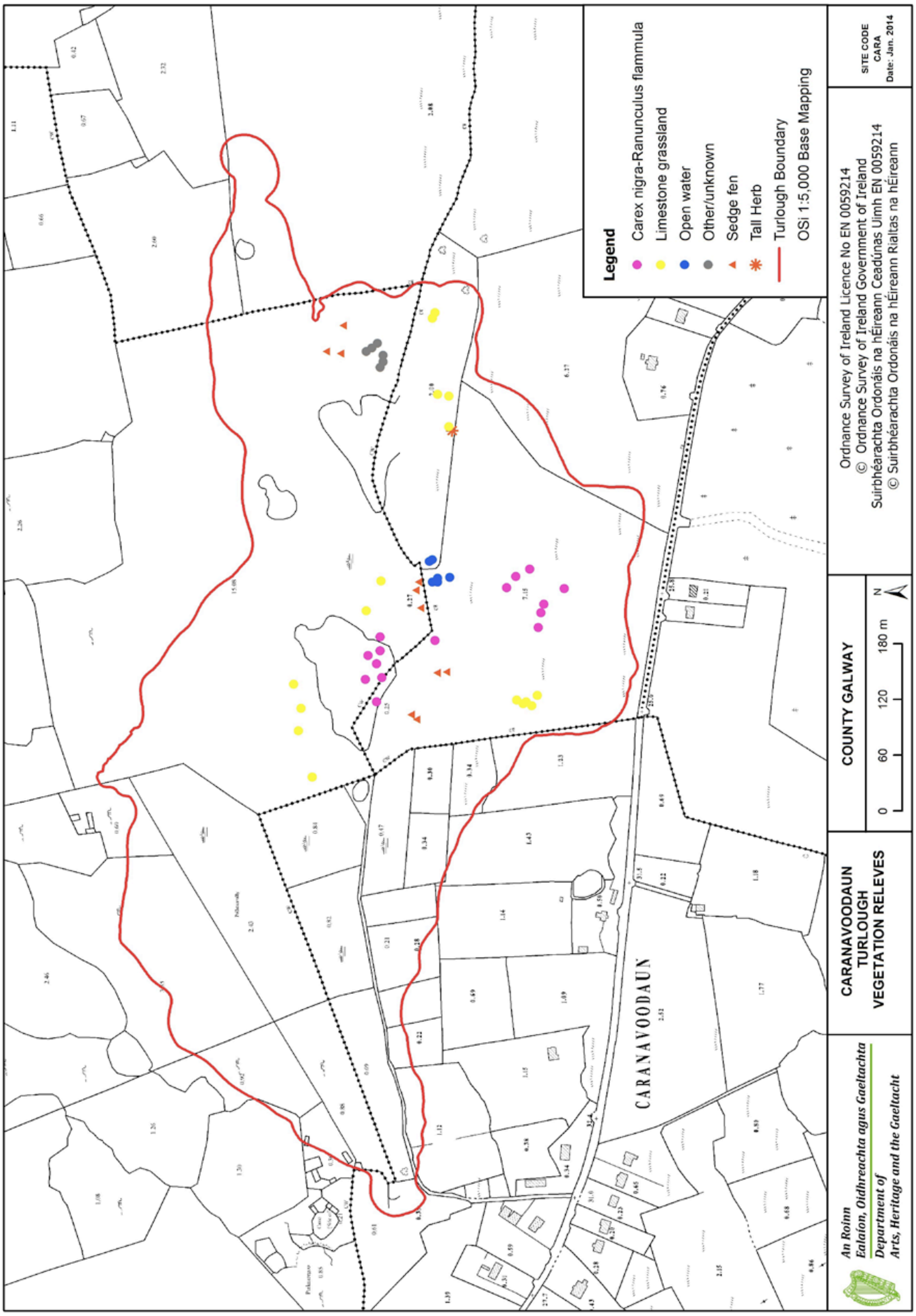
Legend
Carex nigra-Ranunculus flammula
Limestone grassland
Open water
Other/unknown
Sedge fen
Tall Herb
Turlough Boundary
OSi 1:5,000 Base Mapping
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COUNTY GALWAY
0 60 120 180 m
N
CARANAVOODAUN
TURLOUGH
VEGETATION RELEVES
An Roinn
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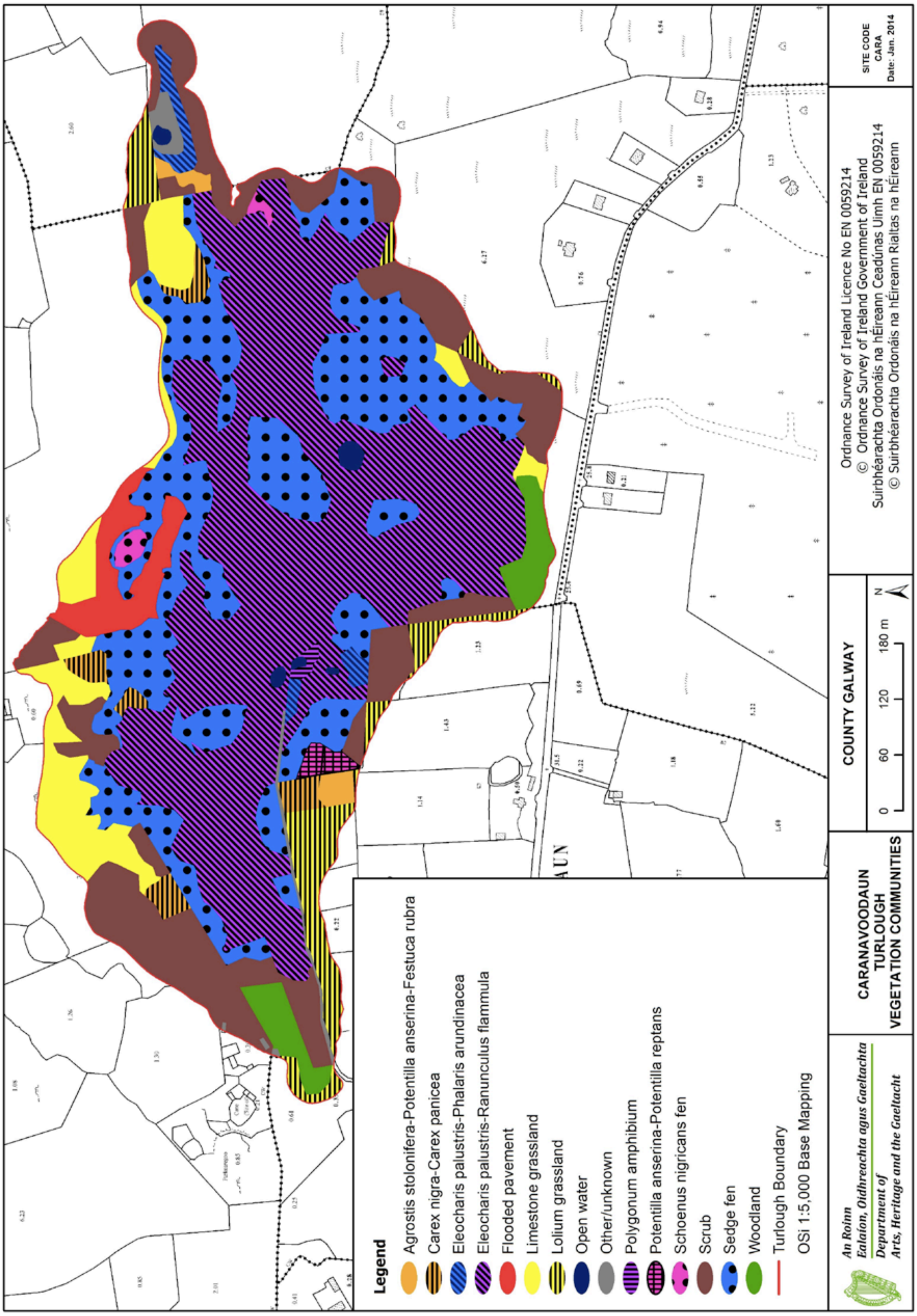
CARANAVOODAUN


Legend
Agrostis stolonifera-Potentilla anserina-Festuca rubra
Carex nigra-Carex panicea
Eleocharis palustris-Phalaris arundinacea
Eleocharis palustris-Ranunculus flammula
Flooded pavement
Limestone grassland
Lolium grassland
Open water
Other/unknown
Polygonum amphibium
Potentilla anserina-Potentilla reptans
Schoenus nigricans fen
Scrub
Sedge fen
Woodland
Turlough Boundary
OSi 1:5,000 Base Mapping
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Arts, Heritage and the Gaeltacht
CARANAVOODAUN
TURLOUGH
VEGETATION COMMUNITIES
COUNTY GALWAY
0 60 120 180 m
N
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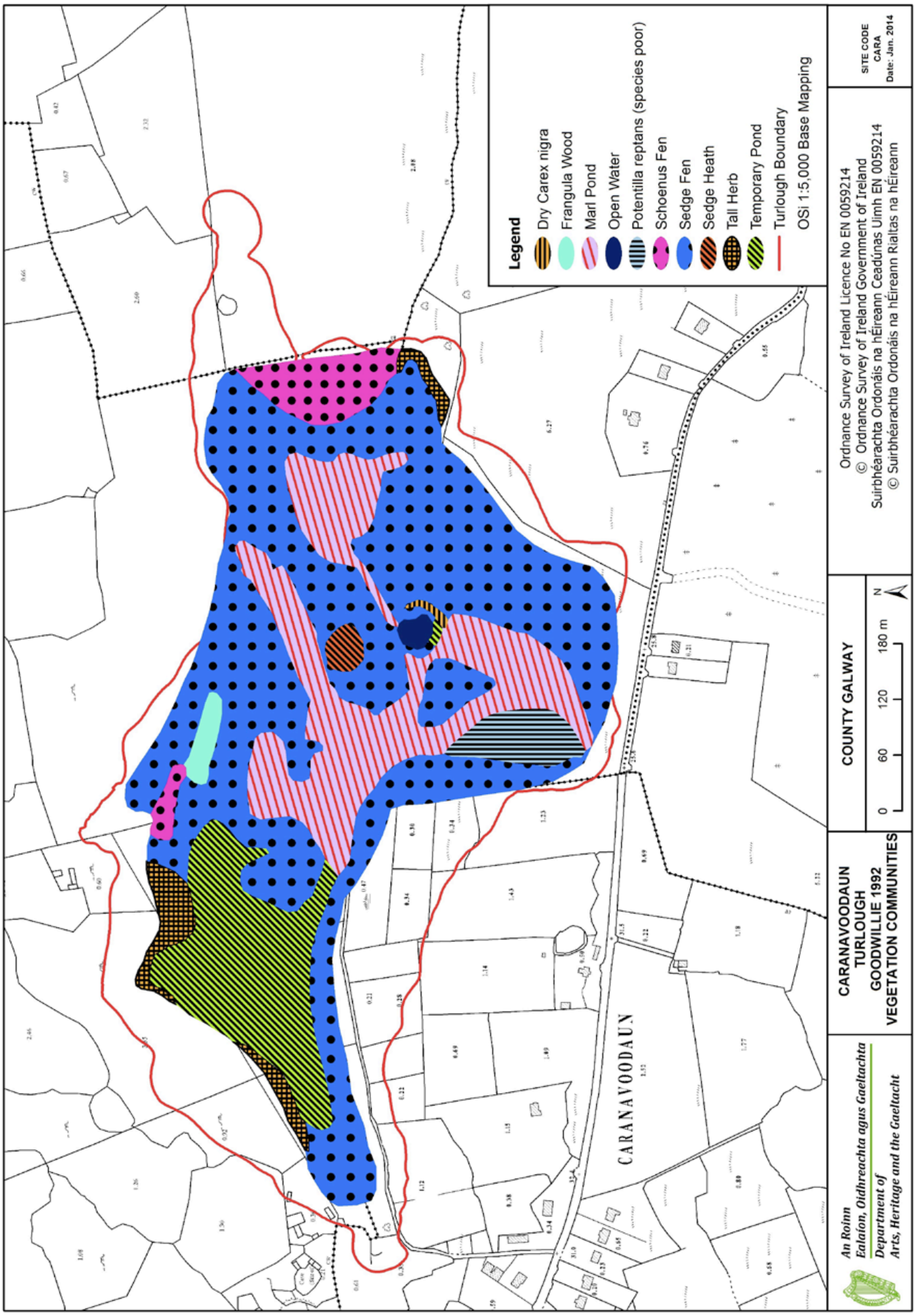
Date: Jan. 2014


Legend
Dry Carex nigra
Frangula Wood
Marl Pond
Open Water
Potentilla reptans (species poor)
Schoenus Fen
Sedge Fen
Sedge Heath
Tall Herb
Temporary Pond
Turlough Boundary
OSi 1:5,000 Base Mapping
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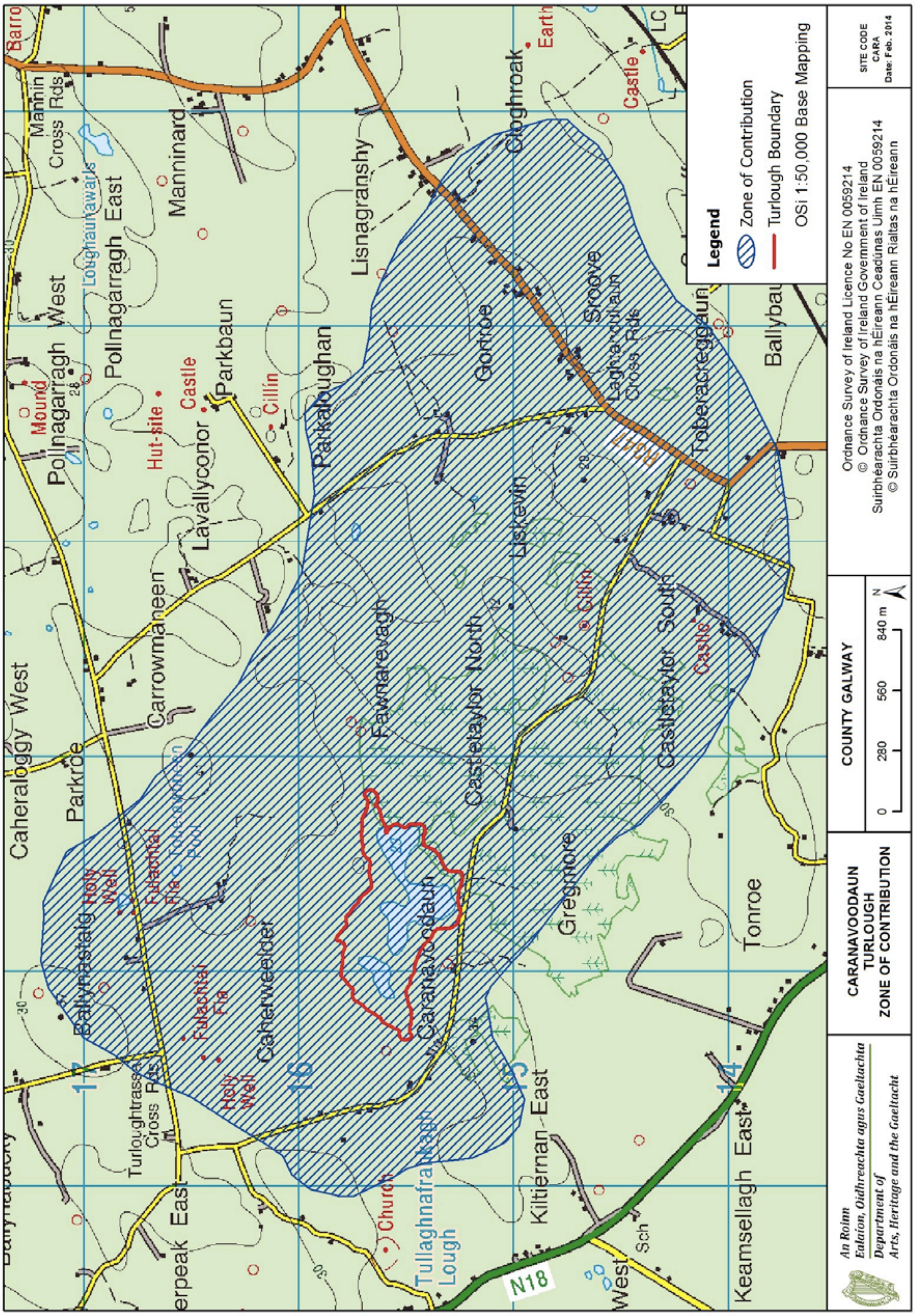
SITE CODE
CARA
Date: Jan. 2014
COUNTY GALWAY
0 60 120 180 m
N
CARANAVOODAUN
TURLOUGH
GOODWILLIE 1992
VEGETATION COMMUNITIES
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht
CARANAVOODAUN


CARANAVOODAUN
TURLOUGH
ZONE OF CONTRIBUTION
COUNTY GALWAY
0 280 560 840 m
N
Legend
Zone of Contribution
Turlough Boundary
OSi 1:50,000 Base Mapping
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SITE CODE
CARA
Date: Feb. 2014
An Roinn
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Department of
Arts, Heritage and the Gaeltacht
Caranavoodaun
Castletaylor North
Castletaylor South
Fawnarevagh
Liskevin
Gortroe
Parkatoughan
Lisnagranshy
Cloghroak
Srroove
Toberacreggaun
Gregmore
Tonroe
Caherweelder
Ballynastaig
Carrowmaneen
Caheraloggy West
Parkroe
Lavallyconor
Parkbaun
Pollnagarragh West
Pollnagarragh East
Manninard
Kiltiernan East
Keamsellagh East
Tullaghnafrankagh Lough
Turloughtrasna Cross Rds
Ballybaun
N18
Holy Well
Fulachtaí Fia
Castle
Cillín
Hut-site
Mound
Church

Site Report: Carrowreagh Turlough
TCD Turlough Research project 2006-2011

Turlough Project Code	SAC Name	SAC/NHA No.	County	Townland	RBD	Easting	Northing	Area (ha)
CARR	Non-SAC	000597	Roscommon	Carrowreagh	SHANNON	178420	275080	29

File update: July 2015 (S. Waldren)

Site Description

Carrowreagh turlough, which has NHA rather than SAC status, is situated near Castleplunket in central Co. Roscommon, just north of Rathnalluleagh turlough. It is a relatively compact basin (29 ha) with an elongated shape, extending north-west to south east. The turlough is bisected by a road. Eight vegetation types were mapped at this site; the dominant vegetation types were *Agrostis stolonifera-Potentilla-anserina-Festuca rubra*, *Carex nigra-Carex panicea*, *Lolium* grassland and *Potentilla anserina-Carex nigra*. Carrowreagh soils are moderately acidic, with low amounts of calcium carbonate. The soils are comprised of shallow poorly-drained mineral soil types. The majority of the turlough (84%) is under rotational grazing. Hydrological data indicate that the turlough is relatively quick to flood and drain, and that the site typically experiences one major flood event per year. The vegetation communities of the eastern part suggest it remains wetter for longer than during Goodwillie's survey (1992). Goodwillie's limestone grassland has gone, probably due to heavy grazing from sheep and cattle, coupled with nutrient inputs.

Carrowreagh – photo: S. Kimberley

Phytoplankton

Phytoplankton analysis was conducted on sub-samples of monthly spot samples collected for hydrochemical analysis between October 2006 and June 2007. Phytoplankton composition varies significantly over time and data from autumn, mid-winter and spring/early summer are presented below. Taxa were identified to species level where possible. Some taxa were not discriminated beyond general groupings (i.e. small centric diatoms, dinoflagellates and pinnate diatoms). The term non-identifiable alone (or n.i.) was reserved for cases where specimens were not identifiable. Discrimination between n.i. filament, n.i. flagellate, n.i. colony, n.i. green filament was made when applicable. Biovolume (mm^3 m^{-3}) was used as the measure of algal biomass.

October 2006		January 2007		May 2007	
Biovolume (mm^3/m^3)	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*
n.i. pennates	524693	*n.i. pennates*	49039	*n.i.*	155958
n.i. green colonies	26637	*n.i. flagellate ('Synura')*	42560	*Monoraphidium*	135592
Micractinium pusillum	19200	*Navicula*	35499	*n.i. centrics*	126934
Euglena	17555	*n.i.*	18007	*Cryptomonas*	83259
Cosmarium	12216	*Fragilaria/Synedra*	5345	*Ulothrix tenerrima*	58088

Benthic Algae

Turloughs were inspected for algal mats during the emptying phase in 2007, 2008 and 2009. Turloughs were visited in the first two weeks of March to June 2007 as part of the monthly monitoring of turloughs. Dedicated trips to inspect for algal mats were conducted in 2008 on the 4th of March, the 1st of April, and the 26th, 27th and 28th of May, and in 2009 on the 15th and 16th of June and on the 24th and 25th of July. The presence of both living floating mats and dead drying mats was noted, as well as their extent in the turlough basins. Occurrence of visible filamentous algal mats in the three years of observation is presented below. Y = visible occurrence; * = "extensive cover" (estimated to be 2 to 8% of total area of basin); † = negligible quantity observed; • = turlough was too flooded to permit full observation. Algal mats were observed in Carrowreagh in 2007 and 2008.

Year of Observation		
2007	2008	2009
Y	Y	N

Hydrochemistry

Data shown are the mean ± SD of monthly spot samples collected between October 2006 and June 2007. Mean seasonal Total P and Chlorophyll *a* were used to determine the trophic status of the floodwaters based on OECD trophic categories. The median and range of <u>mean values</u> across all turloughs are also provided.

Hydrochemical Variable	Carrowreagh Values		Turlough Summary Stats (n=22)		
	Mean±SD	OECD Trophic Category	Median	Min	Max
pH	8.2±0.2		8.1	7.7	8.3
Alkalinity mg l^{-1} $CaCO_3$	218.8±14.7		204.0	112.4	236.4
Colour mg l^{-1} PtCo	47.8±22.6		26.9	7.9	85.1
Molybdate Reactive Phosphorus µg l^{-1}	8.2±7.5		3.4	0.7	42.1
Total Phosphorus µg l^{-1}	42.8±7.7	Eutrophic	24.8	4.0	82.1
Chlorophyll *a* µg l^{-1}	12.1±9.5	Eutrophic	4.9	1.1	33.5
Nitrate-N mg l^{-1}	0.4±0.4		0.7	0.1	1.9
Total Nitrogen mg l^{-1}	0.9±0.5		1.2	0.6	2.3

Aquatic Invertebrates

22 turloughs were sampled for littoral aquatic macroinvertebrates using sweep nets during November 2006 and April 2007. Zooplankton samples were collected in April 2007. Open-water cladocerans and littoral chydorids were sampled using a zooplankton net and perspex tube respectively.

Aquatic Macroinvertebrates			
November 2006	**Count**	**April 2007**	**Count**
Agabus sp. (larva)	93	*Agabus bipustulatus*	1
Chironomidae	4	*Agabus* sp. (larva)	19
Curculionidae	1	Chironomidae	192
Hydaticus sp. (larva)	23	Curculionidae	1
Hydrachnidia (Mite)	2	*Halticinae* sp.	1
Ilybius sp. (larva)	14	*Helophorus brevipalpis*	1
Limnephilidae sp. Instar III	1	Oligochaeta	33
Limnephilus auricula	3	Ostracoda	35
Limnephilus decipiens	6	Psychodidae	1
Lymnaea peregra	4		
Lymnaea trunculata	2		
Notonecta glauca	1		
Oligochaeta	2		
Ostracoda	31		
Phacopteryx brevipennis	24		
Pisidium/Sphaerium spp.	1		
Rhantus sp. (larva)	18		
Succinea sp.	13		
Valvata cristata	2		

Aquatic Macroinvertebrates: Presence of high abundances (> 50 individuals) of Diptera April 2007 indicates nutrient enrichment.

Aquatic Macroinvertebrate Taxa	**Presence of high abundances**	
	November 2006	**April 2007**
Diptera	N	Y
Ostracoda	N	N
Odonata	N	N
Trichoptera	N	N

Zooplankton species
Agabus sp. (larva)
Chironomidae
Curculionidae
Hydaticus sp (larva)
Hydrachnidia (Mite)

Vegetation

Vegetation description and classification yielded 25 vegetation communities suitable for mapping. Eight vegetation communities were mapped in Carrowreagh turlough, the dominant communities being *Agrostis stolonifera – Potentilla anserina – Festuca rubra*, with large amounts of *Carex nigra – Carex panicea*, *Lolium* grassland and *Potentilla anserina – Carex nigra*. High conservation value communities are denoted by *. Eighty-eight plant species were recorded.

Vegetation Community	Area (Ha)
A. stolonifera-P. anserina - F. rubra	9.17
Carex nigra-C. panicea	4.25
Carex nigra-R. flammula	2.63
Lolium grassland	4.77
Open water	0.01
Other/unknown	0.75
P. anserina-Carex nigra	5.18
P. anserina-P. reptans	0.78
Poa annua-Plantago major	0.05
Tall herb	1.5
Number of vegetation communities	8
Number of plant species	88

Vascular Plant Species

Nomenclature follows Parnell, J & Curtis, T. (2012) *Webb's An Irish Flora*, University of Cork Press.

Agrostis capillaris	*Festuca pratensis*	*Phleum bertolonii*
Agrostis stolonifera	*Festuca rubra*	*Plantago lanceolata*
Alisma plantago-aquatica	*Filipendula ulmaria*	*Plantago major*
Alopecurus geniculatus	*Galium palustre*	*Poa annua*
Bellis perennis	*Geum rivale*	*Poa pratensis*
Bidens tripartita	*Glechoma hederacea*	*Polygonum aviculare*
Caltha palustris	*Glyceria fluitans*	*Polygonum persicaria*
Capsella bursa-pastoris	*Gnaphalium uliginosum*	*Potentilla anserina*
Cardamine flexuosa	*Hippuris vulgaris*	*Potentilla erecta*
Cardamine pratensis	*Holcus lanatus*	*Potentilla reptans*
Carex disticha	*Hydrocotyle vulgaris*	*Prunella vulgaris*
Carex flacca	*Iris pseudacorus*	*Ranunculus acris*
Carex hirta	*Juncus acutiflorus*	*Ranunculus flammula*
Carex hostiana	*Juncus articulatus*	*Ranunculus repens*
Carex nigra	*Juncus effusus*	*Rorippa palustris*
Carex panicea	*Juncus inflexus*	*Rumex acetosa*
Carex viridula agg.	*Lathyrus pratensis*	*Rumex crispus*
Cerastium fontanum	*Lemna minor*	*Rumex obtusifolius*
Cirsium arvense	*Leontodon autumnalis*	*Senecio aquaticus*
Cirsium dissectum	*Leontodon hispidus*	*Sparganium erectum*
Cirsium palustre	*Lolium perenne*	*Stellaria media*
Cynosurus cristatus	*Lotus corniculatus*	*Succisa pratensis*
Danthonia decumbens	*Lythrum portula*	*Taraxacum officinale* agg.
Deschampsia cespitosa	*Lythrum salicaria*	*Trifolium pratense*
Eleocharis palustris	*Matricaria discoidea*	*Trifolium repens*
Elymus repens	*Mentha aquatica*	*Triglochin palustris*
Equisetum fluviatile	*Molinia caerulea*	*Veronica beccabunga*
Equisetum palustre	*Myosotis scorpioides*	*Veronica catenata*
Eriophorum angustifolium	*Phalaris arundinacea*	*Veronica scutellata*
Festuca arundinacea		

Soils and Grazing

Soils were classified using a modified version of soil categories generated by the Teagasc/EPA Soils and Subsoils Mapping project (Fealy et al., 2009). The classification scheme principally uses parent material (calcareous/non-calcareous), depth class (shallow/deep) and drainage class (well drained/poorly drained) to assign soils to one of nine broad categories. The mean ± SD of a range of soil properties are also provided, in addition to the median and range of each variable across turloughs. Carrowreagh is dominated by shallow poorly-drained mineral soils. Carrowreagh soils are moderately acidic and organic/mineral, with low amounts of calcium carbonate. Mean Total Nitrogen and Total Phosphorus are towards the high end of the range for turloughs.

Soil Types/Grazing Extent	% Turlough Area
Very shallow poorly drained mineral	47
Shallow poorly drained mineral	53
Extent of rotationally grazed area	100

Soil Property (n=6)	Carrowreagh	Turlough Summary Stats (n=22)		
	Mean ± SD	Median	Min	Max
pH	6.1 ± 0.4	7.20	5.94	8.29
% Organic Matter content	27.4 ± 13.0	25.8	10.2	69.1
% Inorganic content	66.6 ± 19.7	43.2	25.7	85.0
% Calcium carbonate content	5.99 ± 8.2	11.3	2.48	43.7
Total Nitrogen mg kg^{-1}	11783 ± 5105	11142	4983	24233
Total Phosphorus mg kg^{-1}	1056 ± 304	905	245	1594

Hydrology

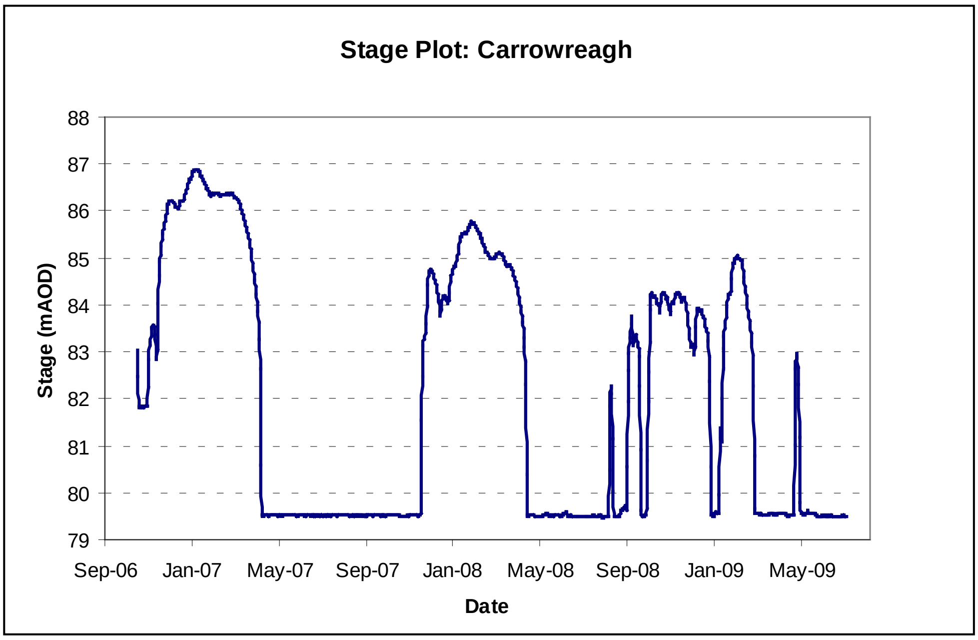
Water levels were recorded at hourly intervals using a variety of Schlumberger Divers® (Marton Geotechnical Ltd, Suffolk, UK) placed at or near the lowest point in each turlough. Divers measure the pressure of the water and air column above them, and from this the depth of water can be calculated. GPS surveys were carried out on 21 monitoring sites (Tullynafrankagh omitted) in order to develop digital terrain models (DTMs) from which contour maps, stage-volume and stage-surface area relationships are produced. The inflow magnitude is indicative of the properties of a turlough's catchment area and flow capacity, while outflow is a function of the drainage capacity of the system.

Hydrological data indicate that the site typically experiences one major flood event per year. The turlough is fairly deep, with inflow, outflow, drainage and recession duration all very close to the median values.

Carrowreagh shows close hydrological linkage with Rathnalulleagh and to some extent Brierfield. Brierfield is the upper most turlough with Rathnalulleagh at the lowest elevation. Carrowreagh and Rathnalulleagh show very similar water level profiles, with Rathnalulleagh lagging Carrowreagh; the much shallower Brierfield shows similar peak flood times to Carrowreagh but is likely to belong to a different system.

Hydrological Information	Carrowreagh Values	Turlough Summary Stats (n=21)		
		Median	Min	Max
Start of Hydrological Recording	04/11/2006	-	-	-
End of Hydrological Recording	08/07/2009	-	-	-
Days Recorded	977	-	-	-
Equipment Failure	None recorded	-	-	-
Hydroperiod (days)	186	213	135	348
Maximum Floodwater Depth (m)	8.1	4.9	3	15.4
Maximum Floodwater Volume ('000 m^3)	546.2	877.9	355.6	4008.1
Maximum Flooded Area	28.25	38.61	13.71	78.12
Average Basin Depth (m)	1.93	2.28	0.85	6.76
Average Daily Inflow ($m^3 s^{-1}$)	0.523	0.684	0.254	10.253
Average Daily Outflow ($m^3 s^{-1}$)	0.214	0.271	0.086	2.018
Drainage Capacity ($m^3 s^{-1}$)	0.152	0.154	0.069	1.156
Recession Duration (days)	41.6	57.3	11	142.5

Stage plot for Carrowreagh turlough



Zone of Groundwater Contribution (ZOC) Risk Assessments

GIS based risk assessments were conducted with a view to identifying turloughs at risk of failing to meet WFD water quality objectives. These risk assessments were conducted by Compass Informatics Ltd and were based on Risk Assessment Sheet GWDTERA2a (Guidance Document No. GW9) on assessing risks to turloughs from phosphate (Working Group on Groundwater 2004) and Pathway Susceptibilities and Pressure Magnitudes were integrated to produce Impact Potential maps and predicted Risk Categories for the turlough ZOC. The TCD Risk Category is derived from a revised Impact Potential matrix. The predicted Risk Categories were adjusted using mean seasonal floodwater Total P (µg l^{-1}) (see Section 4.5.4 of the Risk Assessment Sheet GWDTERA2a). The risk categories include 1A: at significant risk; 1B: probably at significant risk; 2A: Not at significant risk (low confidence); 2B: Not at significant risk (higher confidence).

ZOC Area (Km^2)	Predicted WFD Risk Category	Adjusted WFD Risk Category	Predicted TCD Risk Category	Adjusted TCD Risk Category
19	1B	1A	1B	1A

ZOC Pressure Variable	
CORINE BARE ROCK %	0
CORINE PEAT BOGS%	0
CORINE ALL NATURAL AND SEMI-NATURAL AREAS%	0
CORINE IMPROVED PASTURE%	48
CORINE UNIMPROVED PASTURE%	48
CORINE ALL PASTURE%	96
CORINE OTHER AGRICULTURAL LANDS%	4
TEAGASC/EPA HABITATS ROCK%	0
TEAGASC/EPA HABITATS BOGS/PEATS%	1
TEAGASC/EPA HABITATS FORESTS/SCRUBS%	0
TEAGASC/EPA HABITATS WATER%	0
TEAGASC/EPA HABITATS DRY GRASSLAND%	89
TEAGASC/EPA HABITATS WET GRASSLAND%	11
TEAGASC TOTAL GRASSLAND%	1
TOTAL LIVESTOCK UNIT/ha of ZOC	0
TILLAGE%	6
No. SEPTIC TANKS km^{-2} ZOC	6
No. SEPTIC TANKS/Km^{-2} EXTREME PATHWAY SUSCEPTIBILITY	0
HIGH PATHWAY SUSCEPTIBILITY%	36
EXTR+HIGH PATHWAY SUSCEPTIBILITY%	62
WELL DRAINED SOIL %	38
POORLY DRAINED SOIL%	0

Site Conservation Assessment

The following site conservation assessment was undertaken to feed into the national reporting structure for assessing conservation status as required under Article 17 of the Habitats Directive. A suite of indicators and associated targets were derived to assess ecological structure and function. Future prospects were assessed through the evaluation of the impact of current and recent pressures and likely future threats to the site. The assessment follows a rules based approach to determine whether Structures & functions and Future Prospects should be assessed as good (green), inadequate (amber) or bad (red). For further details, see Chapter 10 (Conservation Status Assessment).

Please note an updated approach to assessing site condition has been proposed and is outlined in Chapter 12 (Monitoring Methods for Turloughs).

Conservation Condition Summary

Structure & Function	**Inadequate**
Future Prospects	**Inadequate**
Site Conservation Condition	**Inadequate**

Structure and Function Status:

Indicator	***Comments***
Hydrological Function: *Good*	
Water Quality: *Intermediate*	42.8 µg P l^{-1}. Towards the high end of this category
Biological Responses: *Intermediate*	
Algal communities: -1	Algal mats recorded in 2007 and 2008, but not extensive; maximum (and mean) CHL high.
Vegetation communities: 0	Relatively little of interest
***Rumex* cover: 0/-1**	50%, borderline poor
Important plants: 0	None recorded
Important aquatic invertebrates: 0	None recorded
Overall Structure & Function: *Inadequate*	Relatively little of biological interest, although without impaired hydrological function

Pressures:

Code	***Impact***	***Notes***
H02.06 Diffuse groundwater pollution due to agricultural and forestry activities (ZOC)	H	
A04.01.01 Intensive cattle grazing (turlough)	H	
H02.07 Diffuse groundwater pollution due to non-sewered population (ZOC)	L	

Threats:

Code	Impact	Notes
A02.01 Agricultural intensification (ZOC)	H	Likely to increase significantly due to prevalence of pasture in ZOC
H02.06 Diffuse groundwater pollution due to agricultural and forestry activities (ZOC)	H	Likely to increase significantly due to prevalence of pasture in ZOC
A04.01.01 Intensive cattle grazing (turlough)	M	Continuing pressure
J02.05 Modification of hydrographic functioning, general (=drainage in turlough)	M	Likely threat as turlough is not within a designated SAC
H02.07 Diffuse groundwater pollution due to non-sewered population (ZOC)	L	
M01.03 Flooding and rising precipitations	L	
A04.03 Abandonment of pastoral systems, lack of grazing (ZOC)	L	Possible impact due to high productivity of turlough
A10.02 Removal of stone walls and embankments (in turlough)	L	

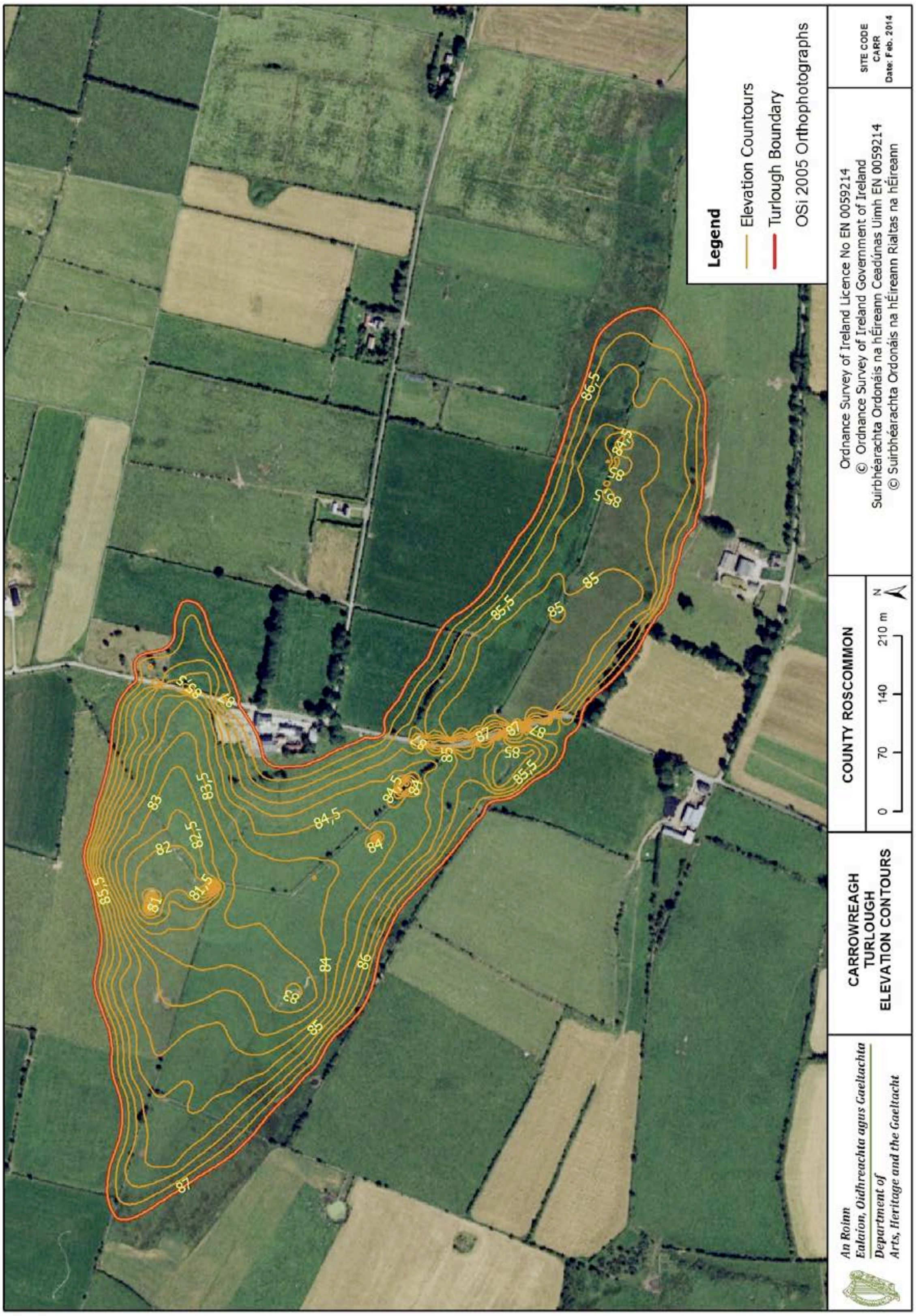
Future Prospects: **Inadequate** – ecological structure and function are inadequate, although there are currently relatively few pressures. Threats are predicted to increase, and lack of SAC designation may increase the impact of several threats.

Overall Assessment: **Inadequate** – Carrowreagh has comparatively little biological interest, moderate to poor water quality and several threats of moderate or high impact. It could possibly be assessed as Bad.

Maps

Maps are provided of:

1. Elevation contours, based on GIS digital terrain models from points by differential GPS topographic survey (for further details, see *Chapter 3: Hydrology*)
2. Grazing in land parcels
3. Approximate sampling points for water chemistry and aquatic invertebrates
4. Soil nutrient sampling points
5. Points for soil survey (note: soils were surveyed to the turlough boundary defined by Goodwillie, 1992; see map 9)
6. Soils (note: soils were mapped by combining the EPA Subsoils base map with the point soil descriptions; for further details see *Chapter 6: Soils and Landuse*)
7. Vegetation relevés
8. Vegetation communities (note: relevés do not always match to mapped communities due to small scale variation; for further details of mapping see *Chapter 7: Turlough Vegetation: Description, Mapping and Ecology*)
9. Vegetation maps digitised from Goodwillie, R. (1992) *Turlough's Over 50 Hectares*. Report to NPWS
10. Estimated zone of groundwater contribution (ZOC)


Legend
Elevation Countours
Turlough Boundary
OSi 2005 Orthophotographs
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Suirbhéarachta Ordonáis na hÉireann Ceadúnas Uimh EN 0059214
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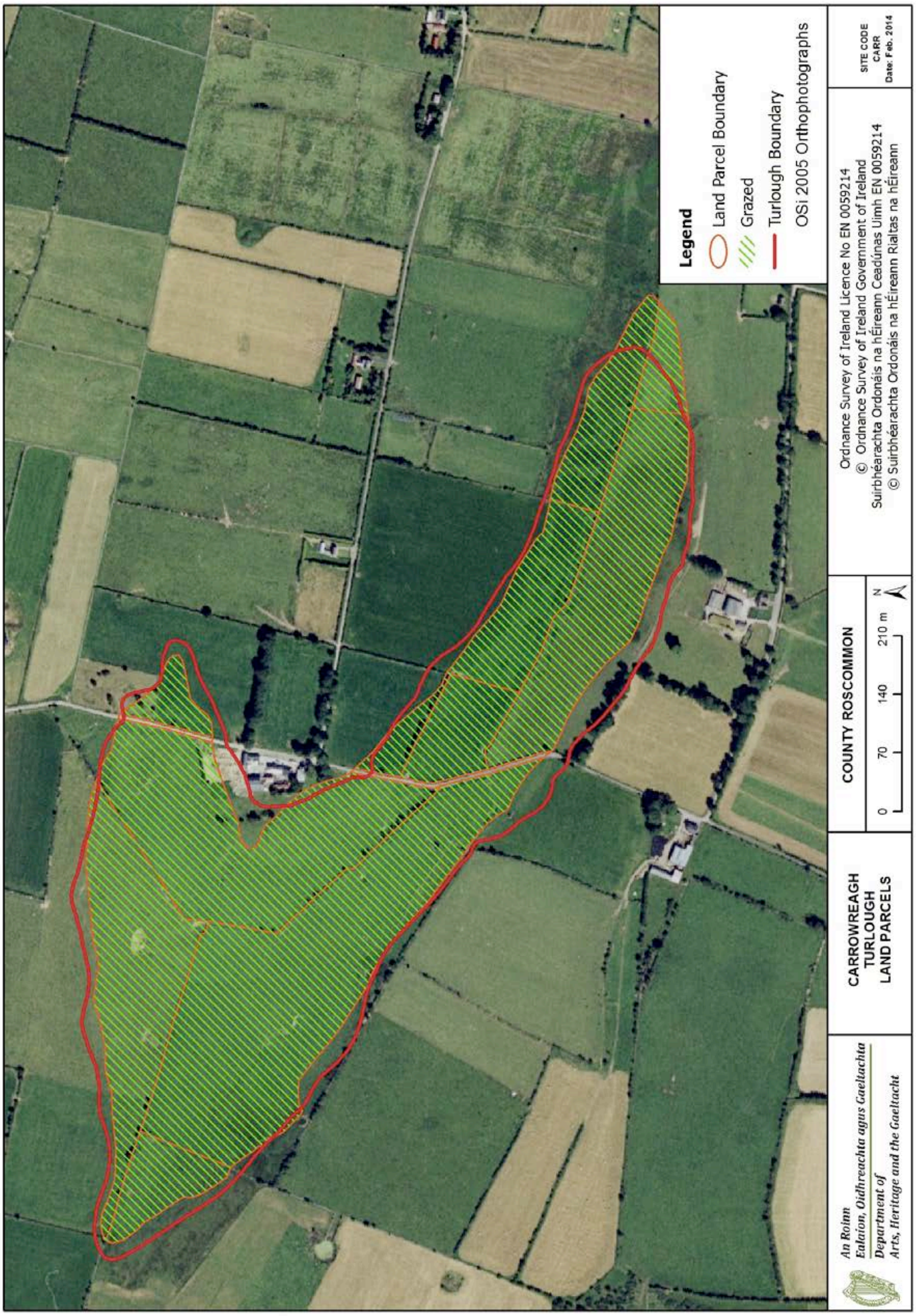
SITE CODE
CARR
Date: Feb. 2014
COUNTY ROSCOMMON
0 70 140 210 m
N
CARROWREAGH
TURLOUGH
ELEVATION CONTOURS
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht


Legend
Land Parcel Boundary
Grazed
Turlough Boundary
OSi 2005 Orthophotographs
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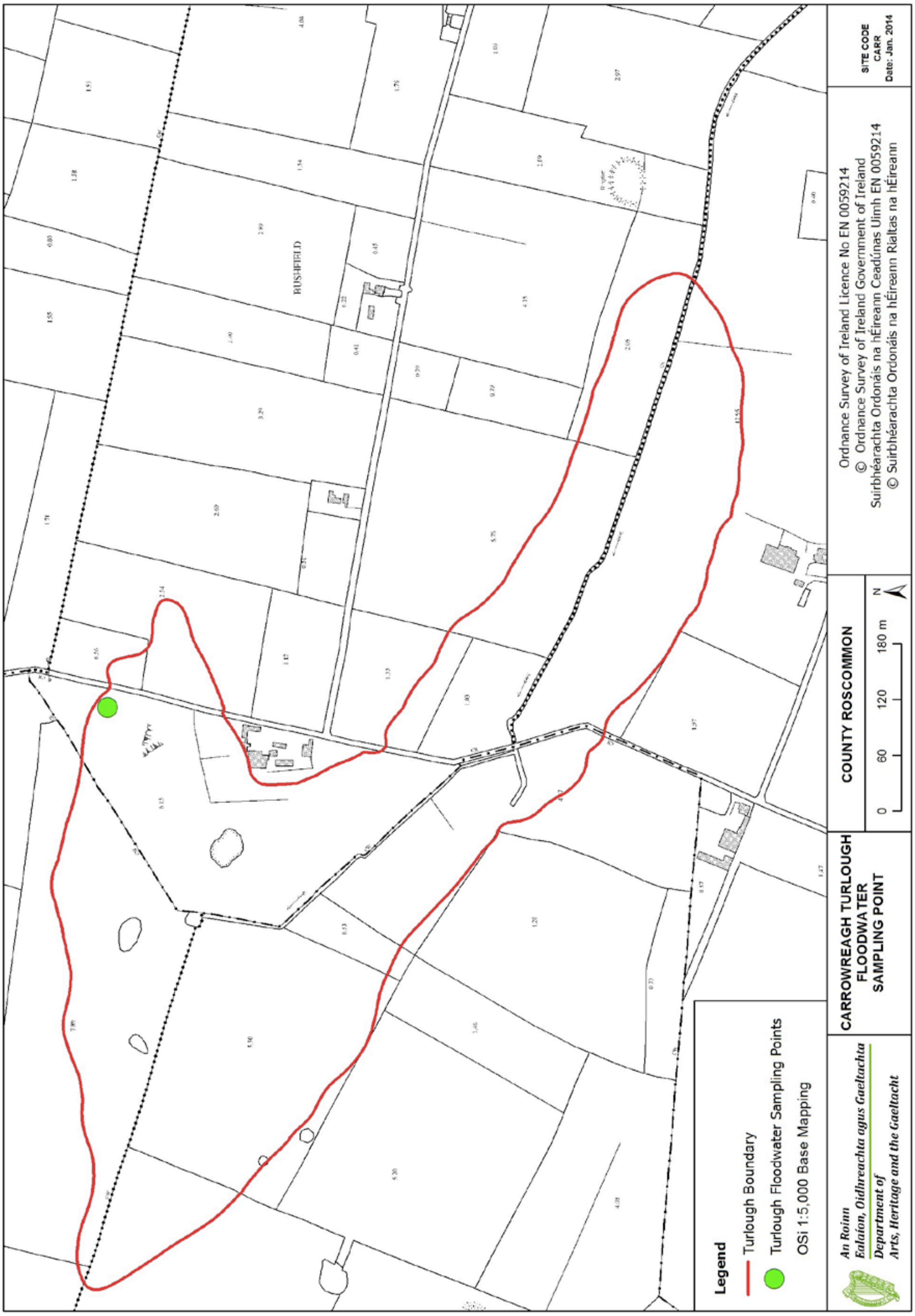
SITE CODE
CARR
Date: Feb. 2014
COUNTY ROSCOMMON
0 70 140 210 m
N
CARROWREAGH
TURLOUGH
LAND PARCELS
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht


BUSHFIELD
Legend
Turlough Boundary
Turlough Floodwater Sampling Points
OSi 1:5,000 Base Mapping
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht
CARROWREAGH TURLOUGH
FLOODWATER
SAMPLING POINT
COUNTY ROSCOMMON
0 60 120 180 m
N
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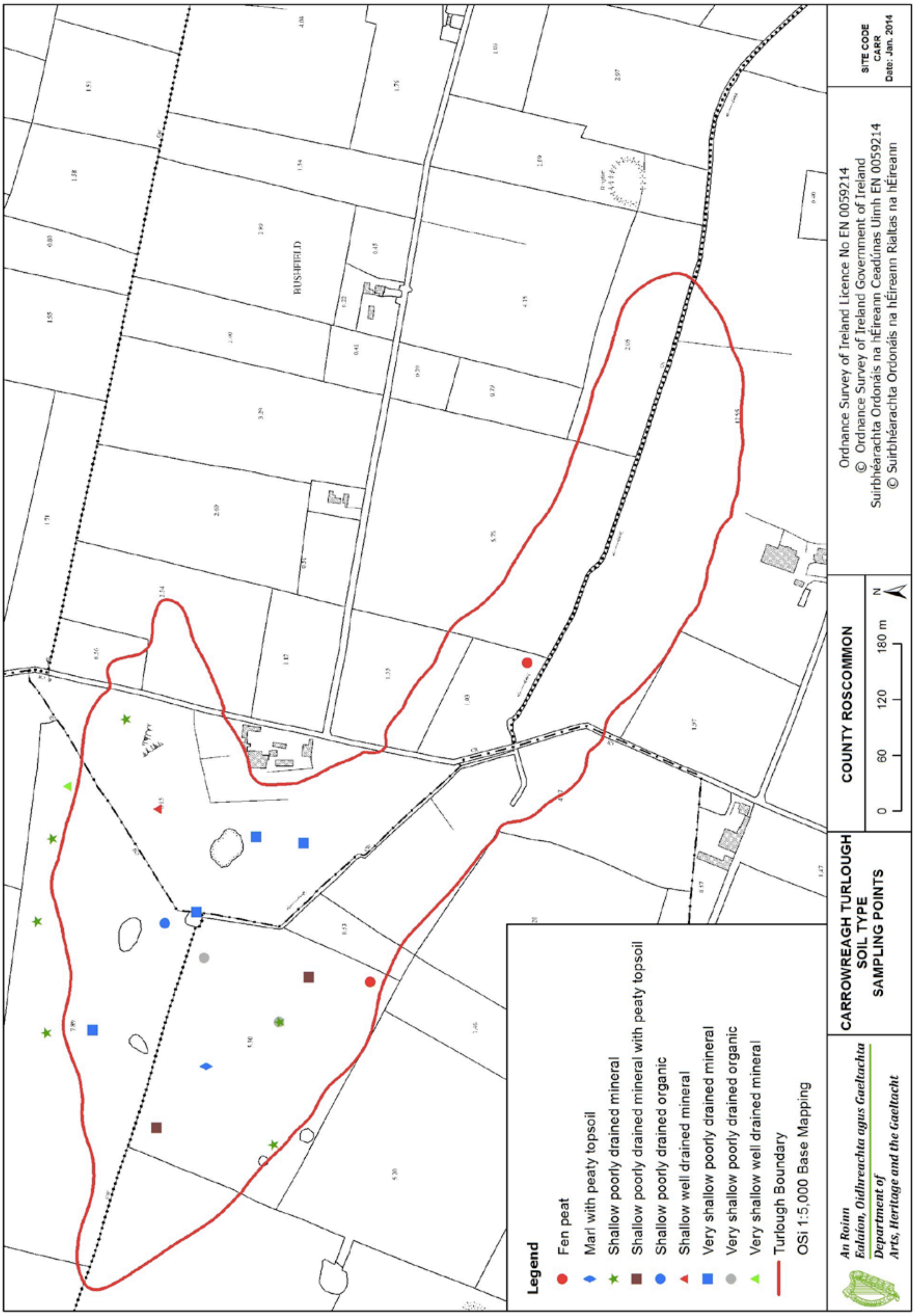
SITE CODE
CARR
Date: Jan. 2014



CARROWREAGH TURLOUGH
SOIL TYPE
SAMPLING POINTS
COUNTY ROSCOMMON
0 60 120 180 m
N
SITE CODE
CARR
Date: Jan. 2014
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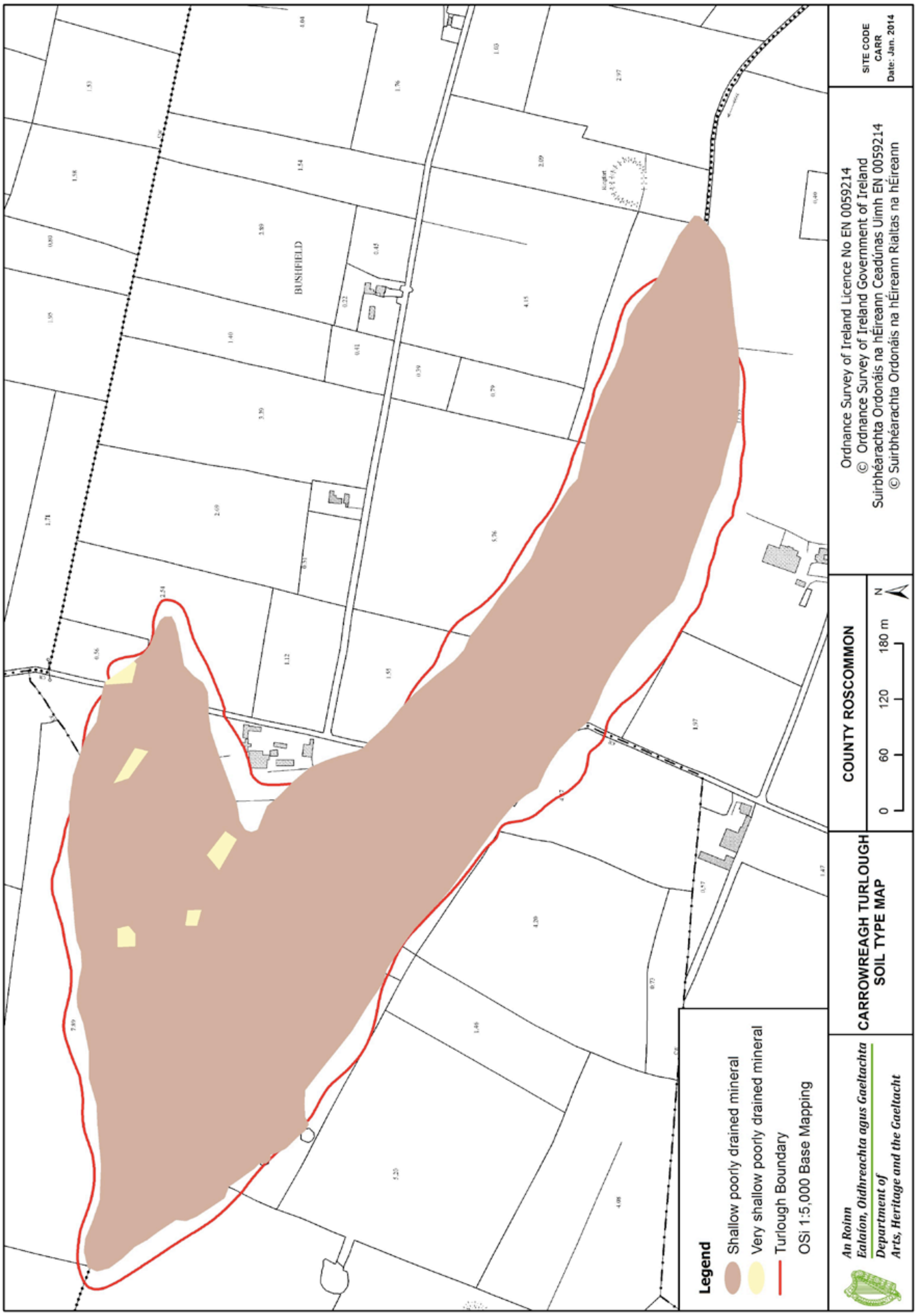
Legend
Fen peat
Marl with peaty topsoil
Shallow poorly drained mineral
Shallow poorly drained mineral with peaty topsoil
Shallow poorly drained organic
Shallow well drained mineral
Very shallow poorly drained mineral
Very shallow poorly drained organic
Very shallow well drained mineral
Turlough Boundary
OSi 1:5,000 Base Mapping
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht
RUSHFIELD



Legend
Shallow poorly drained mineral
Very shallow poorly drained mineral
Turlough Boundary
OSi 1:5,000 Base Mapping
An Roinn
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CARROWREAGH TURLOUGH
SOIL TYPE MAP
COUNTY ROSCOMMON
0 60 120 180 m
N
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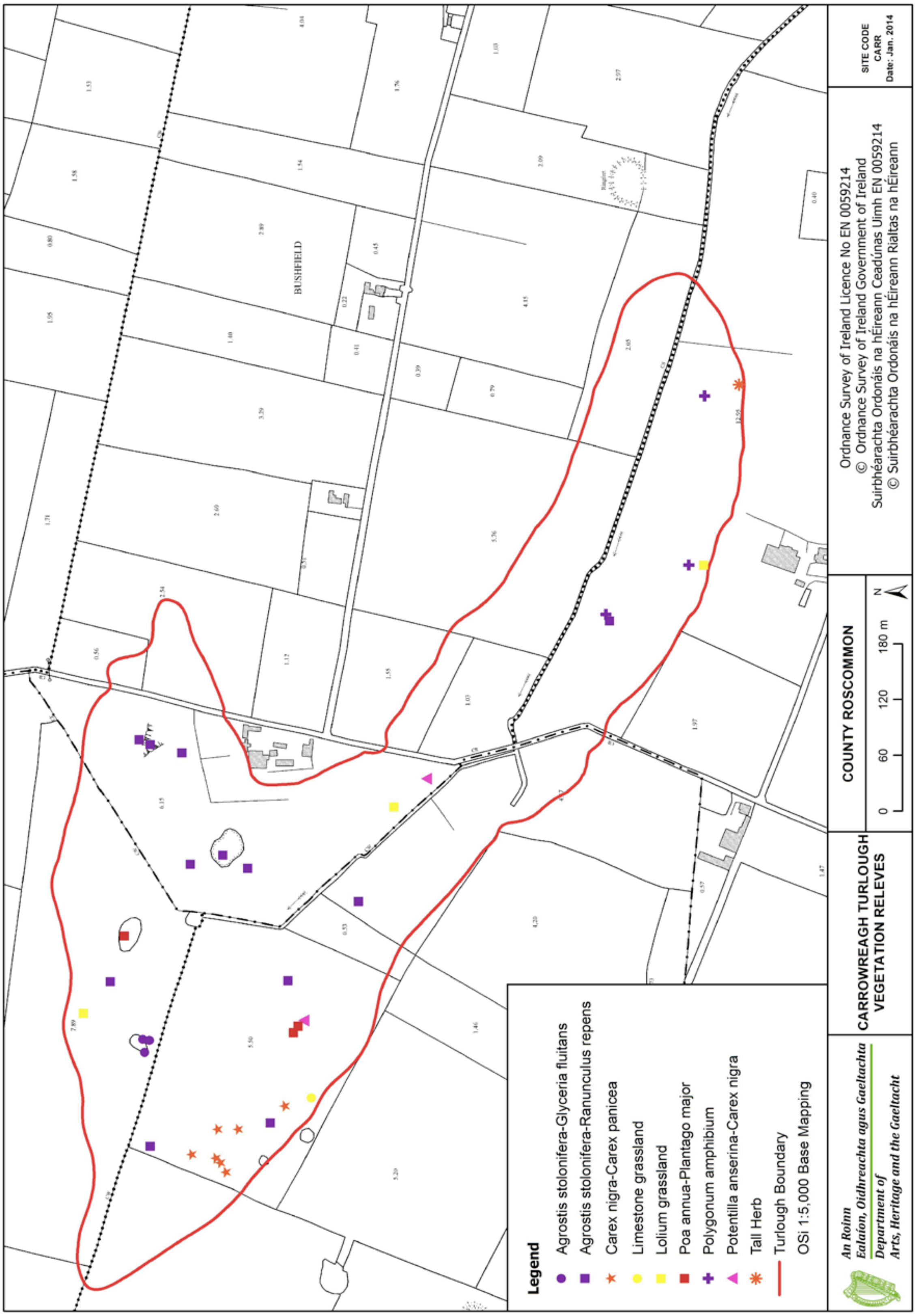
SITE CODE
CARR
Date: Jan. 2014
BUSHFIELD


Legend
Agrostis stolonifera-Glyceria fluitans
Agrostis stolonifera-Ranunculus repens
Carex nigra-Carex panicea
Limestone grassland
Lolium grassland
Poa annua-Plantago major
Polygonum amphibium
Potentilla anserina-Carex nigra
Tall Herb
Turlough Boundary
OSi 1:5,000 Base Mapping
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht
CARROWREAGH TURLOUGH
VEGETATION RELEVES
COUNTY ROSCOMMON
0 60 120 180 m
N
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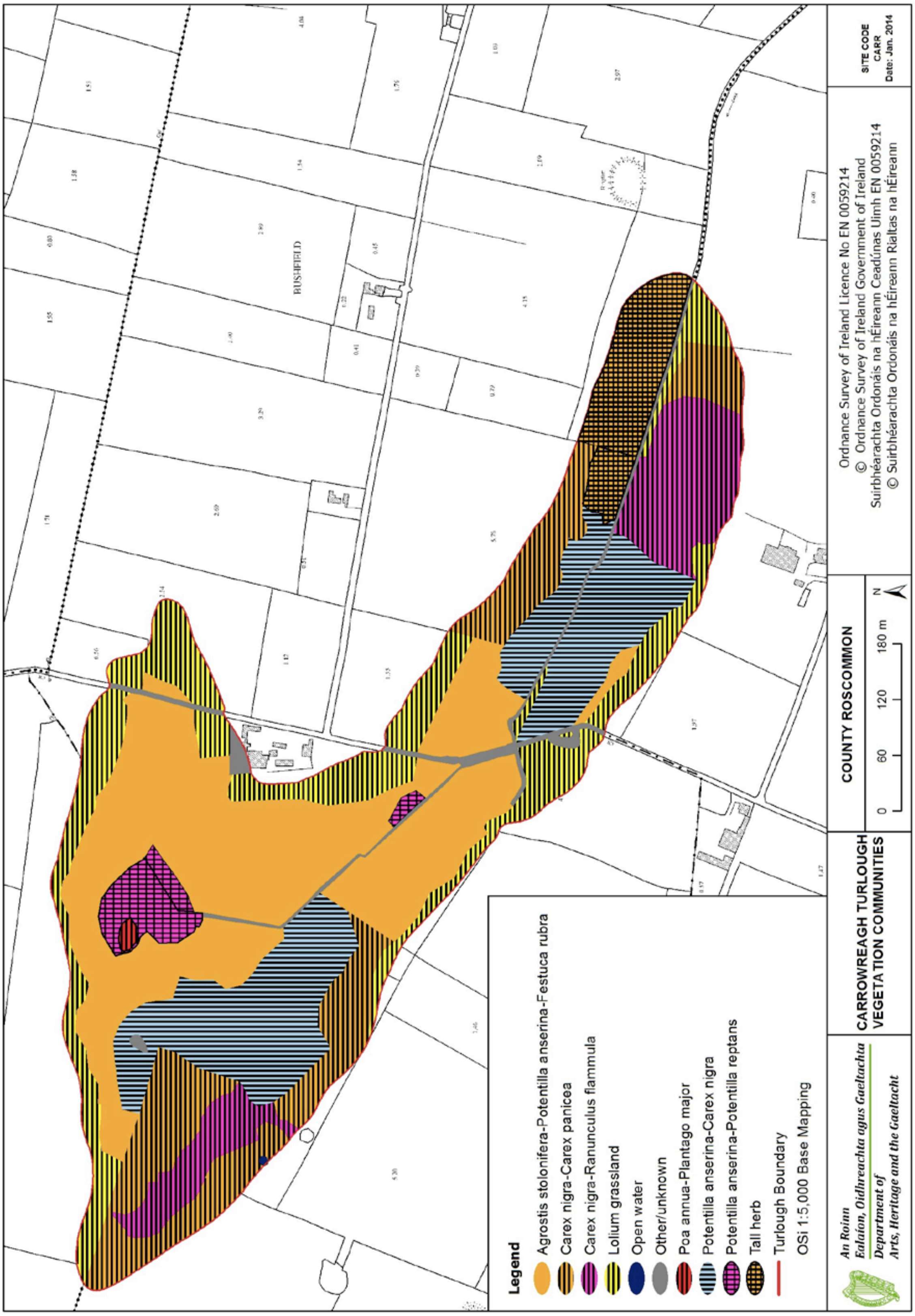
SITE CODE
CARR
Date: Jan. 2014
BUSHFIELD


Legend
Agrostis stolonifera-Potentilla anserina-Festuca rubra
Carex nigra-Carex panicea
Carex nigra-Ranunculus flammula
Lolium grassland
Open water
Other/unknown
Poa annua-Plantago major
Potentilla anserina-Carex nigra
Potentilla anserina-Potentilla reptans
Tall herb
Turlough Boundary
OSi 1:5,000 Base Mapping
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht
CARROWREAGH TURLOUGH
VEGETATION COMMUNITIES
COUNTY ROSCOMMON
0 60 120 180 m
N
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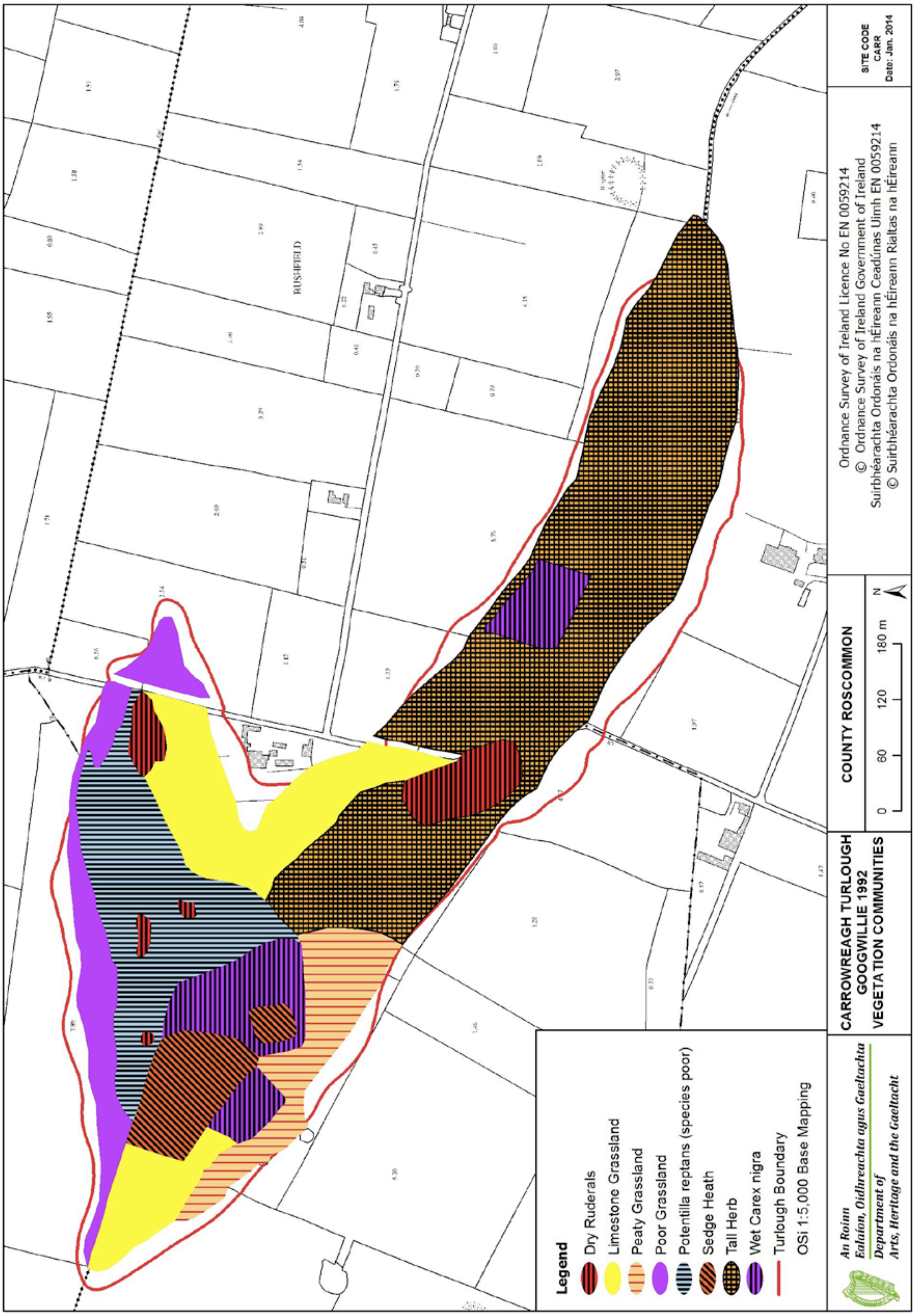
SITE CODE
CARR
Date: Jan. 2014
BUSHFIELD


RUSHFIELD
Legend
Dry Ruderals
Limestone Grassland
Peaty Grassland
Poor Grassland
Potentilla reptans (species poor)
Sedge Heath
Tall Herb
Wet Carex nigra
Turlough Boundary
OSi 1:5,000 Base Mapping
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht
CARROWREAGH TURLOUGH
GOOGWILLIE 1992
VEGETATION COMMUNITIES
COUNTY ROSCOMMON
0 60 120 180 m
N
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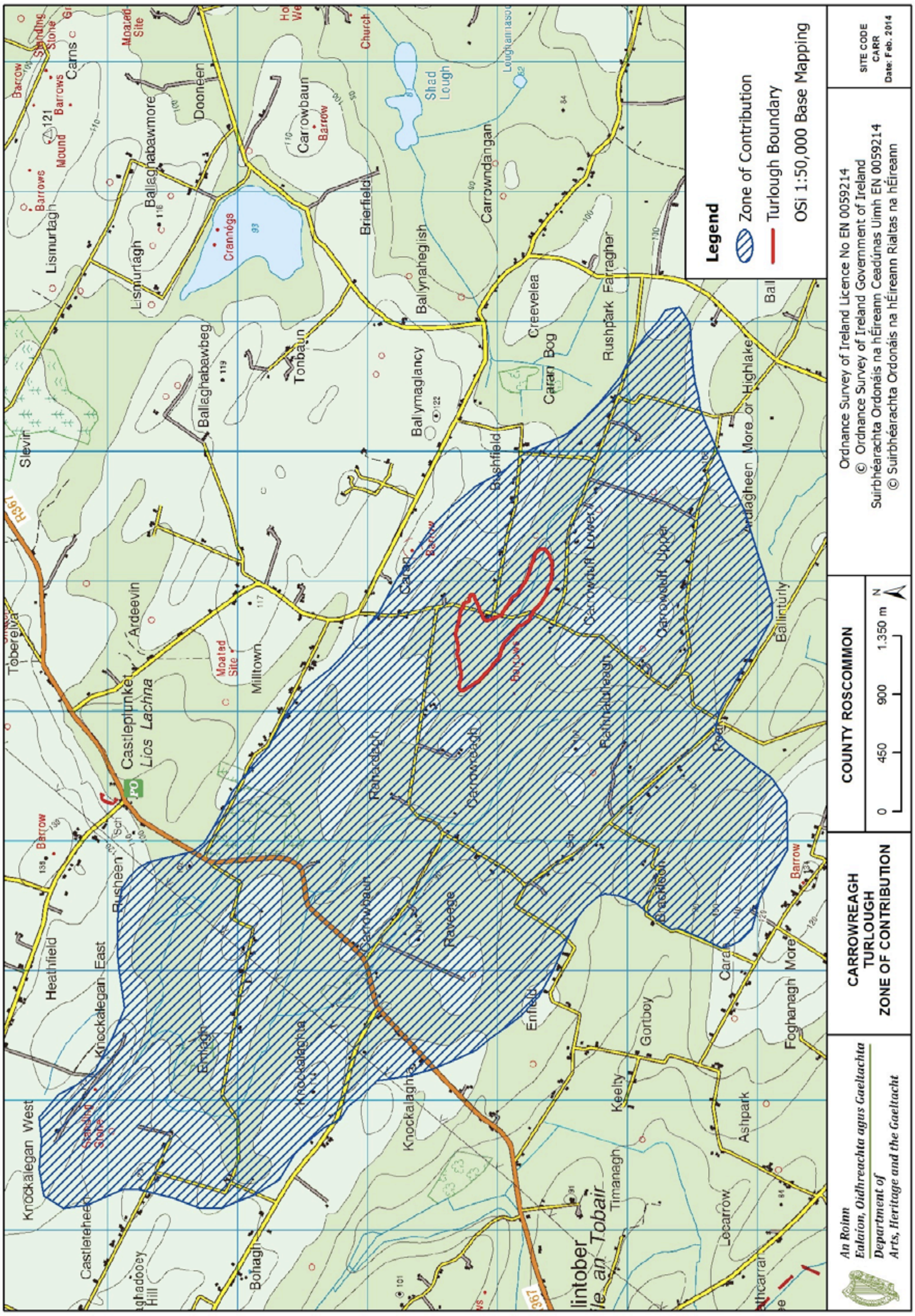
SITE CODE
CARR
Date: Jan. 2014


Legend
Zone of Contribution
Turlough Boundary
OSi 1:50,000 Base Mapping
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SITE CODE
CARR
Date: Feb. 2014
COUNTY ROSCOMMON
0 450 900 1,350 m
N
CARROWREAGH
TURLOUGH
ZONE OF CONTRIBUTION
An Roinn
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Department of
Arts, Heritage and the Gaeltacht

Site Report: Coolcam Turlough
TCD Turlough Research project 2006-2011

Turlough Project Code	SAC Name	SAC/NHA No.	County	Townland	RBD	Easting	Northing	Area (ha)
COO	Coolcam Turlough	000218	Roscommon	Coolcam	SHANNON	157420	271390	56

File update: July 2015 (S. Waldren)

Site Description

Coolcam turlough, which is designated as an SAC, occurs on the border of Co. Roscommon and Co. Galway, just south of Ballinlough, not far from Croaghill turlough. This is one of the larger turloughs included in the study, at 78.1 ha. It consists of two basins separated by a narrow esker; one smaller (known as Coolcam Lough), which dries out every summer, and a larger part which lies to the south east and seems to retain water throughout the year. Fifteen vegetation communities were mapped in Coolcam turlough. The dominant vegetation types mapped were the *Polygonum amphibium* community, the Open water community and the *Eleocharis palustris-Ranunculus flammula* community. Coolcam soils are moderately alkaline and mineral, and the alluvial mineral soil type occurs in almost 95% of the turlough area. Almost half of the turlough area is rotationally grazed. The hydrological data suggest that this turlough experiences one significant flooding event per annum; evidence from vegetation and comments from locals suggest that it dries out much less frequently than 10 years ago.

Coolcam – photo: S. Kimberley

Phytoplankton

Phytoplankton analysis was conducted on sub-samples of monthly spot samples collected for hydrochemical analysis between October 2006 and June 2007. Phytoplankton composition varies significantly over time and data from autumn, mid-winter and spring/early summer are presented below. Taxa were identified to species level where possible. Some taxa were not discriminated beyond general groupings (i.e. small centric diatoms, dinoflagellates and pinnate diatoms). The term non-identifiable alone (or n.i.) was reserved for cases where specimens were not identifiable. Discrimination between n.i. filament, n.i. flagellate, n.i. colony, n.i. green filament was made when applicable. Biovolume (mm^3 m^{-3}) was used as the measure of algal biomass.

October 2006		January 2007		May 2007	
Biovolume (mm^3/m^3)	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*
Nitzchia	*107411*	*n.i. centrics*	*1369983*	*n.i. filament*	*133919*
Eudorina	*54908*	*n.i. dinoflagellate*	*580829*	*Cryptomonas*	*17832*
Navicula	*27959*	*Chlamydomonas*	*184789*	*n.i. green colonies*	*17453*
Monoraphidium	*27942*	*Navicula*	*133944*	*Achnanthidium minutissima*	*15322*
Dinobryon	*25816*	*n.i. pennates*	*89980*	*Navicula*	*13791*

Benthic Algae

Turloughs were inspected for algal mats during the emptying phase in 2007, 2008 and 2009. Turloughs were visited in the first two weeks of March to June 2007 as part of the monthly monitoring of turloughs. Dedicated trips to inspect for algal mats were conducted in 2008 on the 4th of March, the 1st of April, and the 26th, 27th and 28th of May, and in 2009 on the 15th and 16th of June and on the 24th and 25th of July. The presence of both living floating mats and dead drying mats was noted, as well as their extent in the turlough basins. Occurrence of visible filamentous algal mats in the three years of observation is presented below. Y = visible occurrence; * = "extensive cover" (estimated to be 2 to 8% of total area of basin); † = negligible quantity observed; • = turlough was too flooded to permit full observation. No algal mats were observed in Coolcam in any year.

Year of Observation		
2007	**2008**	**2009**
N	N	N

Hydrochemistry

Data shown are the mean ± SD of monthly spot samples collected between October 2006 and June 2007. Mean seasonal Total P and Chlorophyll *a* were used to determine the trophic status of the floodwaters based on OECD trophic categories. The median and range of mean values across all turloughs are also provided.

Hydrochemical Variable	Coolcam Values		Turlough Summary Stats (n=22)		
	Mean±SD	OECD Trophic Category	Median	Min	Max
pH	8.2±0.2		8.1	7.7	8.3
Alkalinity mg l^{-1} $CaCO_3$	214.0±29.0		204.0	112.4	236.4
Colour mg l^{-1} PtCo	22.9±7.1		26.9	7.9	85.1
Molybdate Reactive Phosphorus µg l^{-1}	3.7±4.1		3.4	0.7	42.1
Total Phosphorus µg l^{-1}	34.0±21.3	Mesotrophic	24.8	4.0	82.1
Chlorophyll *a* µg l^{-1}	18.1±11.6	Eutrophic	4.9	1.1	33.5
Nitrate-N mg l^{-1}	0.9±0.6		0.7	0.1	1.9
Total Nitrogen mg l^{-1}	1.3±0.7		1.2	0.6	2.3

Aquatic Invertebrates

22 turloughs were sampled for littoral aquatic macroinvertebrates using sweep nets during November 2006 and April 2007. Zooplankton samples were collected in April 2007. Open-water cladocerans and littoral chydorids were sampled using a zooplankton net and perspex tube respectively.

Aquatic Macroinvertebrates			
November 2006	**Count**	**April 2007**	**Count**
Agabus sp. (larva)	2	*Agabus nebulosus*	1
Chironomidae	58	*Agabus* sp. (larva)	42
Colymbetes fuscus	2	*Agyroneta aquatica*	1
Haliplus fulvus	6	*Callicorixa praeusta*	1
Hydaticus sp. (larva)	6	Chironomidae	4
Hydroporus palustris	6	*Cloeon simile*	48
Hygrotus inaequalis	2	Diptera Pupae	1
Ilybius sp. (larva)	12	*Dryops* sp. (larva)	1
Limnephilidae *sp. Instar II*	74	*Dytiscus* sp. (larva)	1
Limnephilidae *sp. Instar III*	54	*Gammarus lacustris*	1
Limnephilus auricula	14	*Gammarus sp juveniles*	25
Limnephilus decipiens	4	*Haliplus confinis*	1
Limnephilus lunatus	21	*Haliplus fulvus*	5
Limnephilus marmoratus	48	*Haliplus* sp. *ruficollis* group (females)	1
Lymnaea palustris	18	*Hydrachnidia* (Mite)	5
Lymnaea peregra	50	*Hydroporus palustris*	2
Lymnaea trunculata	10	*Hygrotus inaequalis*	3
Ochthebius minimus	4	*Ilybius* sp. (larva)	4
Oligochaeta	8	*Lymnaea peregra*	12
Ostracoda	8	Oligochaeta	1
Pisidium/Sphaerium spp.	8	*Porhydrus lineatus*	15
Sigara distincta	2	Psychodidae	5
Sigara dorsalis	4	*Rhantus* sp. (larva)	2
Sigara fallenoidea	2	*Sigara dorsalis*	5
Succinea sp.	2	*Succinea* sp.	2
		Tipulidae	2

Aquatic Macroinvertebrates: Presence of high abundances (> 50 individuals) of Diptera and recorded in November 2006 indicates nutrient enrichment, however the presence of high abundances of Trichoptera in 2006 (> 50 individuals) suggest nutrient poor conditions. Hydrochemistry (above) suggests meso- to eutrophic conditions.

Aquatic Macroinvertebrate Taxa	**Presence of high abundances**	
	November 2006	**April 2007**
Diptera	Y	N
Ostracoda	N	N
Odonata	N	N
Trichoptera	Y	N

Zooplankton species
Acroperus harpae
Alona affinis
Chydorus latus
Chydorus sphaericus
Daphnia pulex
Eurycercus lamellatus
Simocephalus vetulus

Vegetation

Vegetation description and classification yielded 25 vegetation communities suitable for mapping. Fifteeen vegetation communities were mapped in Coolcam turlough. The dominant vegetation types mapped were the *Polygonum amphibium* community, the Open water community and the *Eleocharis palustris-Ranunculus flammula* community. High conservation value communities are denoted by *. Seventy-two plant species were recorded.

Vegetation Community	Area (Ha)
A. stolonifera-Glyceria fluitans	0.34
A. stolonifera-P. anserina - F. rubra	1.4
A. stolonifera-R. repens	0.1
C. nigra-C.panicea	0.68
Carex nigra-R. flammula	0.63
E. palustris-P. arundinacea	2.27
Eleocharis palustris-R. flammula	9.61
**F. ulmaria-P. erecta-Viola* sp	0.69
Limestone grassland	0.12
Lolium grassland	1.7
**Molinia caerulea-Carex panicea*	1.56
Open water	13.55
Other/unknown	1.49
P. anserina-Carex nigra	1.97
Polygonum amphibium	18.99
Tall herb	0.6
Woodland/scrub	0.01
Number of vegetation communities	15
Number of plant species	73

Vascular Plant Species

Nomenclature follows Parnell, J & Curtis, T. (2012) *Webb's An Irish Flora*, University of Cork Press.

Achillea millefolium	*Filipendula ulmaria*	*Plantago major*
Agrostis capillaris	*Galium palustre*	*Poa annua*
Agrostis stolonifera	*Glyceria fluitans*	*Polygonum amphibium*
Alchemilla filicaulis	*Holcus lanatus*	*Polygonum aviculare*
Alisma lanceolatum	*Hydrocotyle vulgaris*	*Potamogeton gramineus*
Alisma plantago-aquatica	*Juncus acutiflorus*	*Potentilla anserina*
Antennaria dioica	*Juncus articulatus*	*Potentilla erecta*
Apium nodiflorum	*Juncus bulbosus*	*Potentilla reptans*
Briza media	*Lathyrus pratensis*	*Prunella vulgaris*
Cardamine pratensis	*Leontodon autumnalis*	*Ranunculus acris*
Carex flacca	*Leontodon hispidus*	*Ranunculus flammula*
Carex hirta	*Leucanthemum vulgare*	*Ranunculus repens*
Carex nigra	*Linum catharticum*	*Rumex obtusifolius*
Carex panicea	*Littorella uniflora*	*Salix repens*
Carex viridula agg.	*Lolium perenne*	*Senecio aquaticus*
Centaurea nigra	*Lotus corniculatus*	*Stellaria media*
Cerastium fontanum	*Matricaria discoidea*	*Succisa pratensis*
Cirsium dissectum	*Mentha aquatica*	*Taraxacum officinale* agg.
Cirsium palustre	*Mentha arvensis*	*Trifolium pratense*
Cynosurus cristatus	*Molinia caerulea*	*Trifolium repens*
Daucus carota	*Myosotis scorpioides*	*Urtica dioica*
Eleocharis palustris	*Oenanthe aquatica*	*Veronica beccabunga*
Equisetum fluviatile	*Phalaris arundinacea*	*Veronica* species
Festuca arundinacea	*Plantago lanceolata*	*Vicia cracca*
Festuca rubra		

Soils and Grazing

Soils were classified using a modified version of soil categories generated by the Teagasc/EPA Soils and Subsoils Mapping project (Fealy *et al.*, 2009). The classification scheme principally uses parent material (calcareous/non-calcareous), depth class (shallow/deep) and drainage class (well drained/poorly drained) to assign soils to one of nine broad categories. Coolcam has extensive mineral alluvial soils. The mean ± SD of a range of soil properties are also provided, in addition to the median and range of each variable across turloughs. Coolcam soils are moderately alkaline and mineral.

Soil Types/Grazing Extent	% Turlough Area
Shallow poorly drained mineral	1.9
Alluvial marl	0.7
Alluvial mineral	94.8
Extent of rotationally grazed area	45

Soil Property (n=6)	Coolcam	Turlough Summary Stats (n=22)		
	Mean ± SD	Median	Min	Max
pH	7.8 ± 0.6	7.20	5.94	8.29
% Organic Matter content	10.2 ± 3.3	25.8	10.2	69.1
% Inorganic content	85.0 ± 4.4	43.2	25.7	85.0
% Calcium carbonate content	4.78 ± 4.7	11.3	2.48	43.7
Total Nitrogen mg kg^{-1}	4983 ± 1191	11142	4983	24233
Total Phosphorus mg kg^{-1}	245 ± 36	905	245	1594

Hydrology

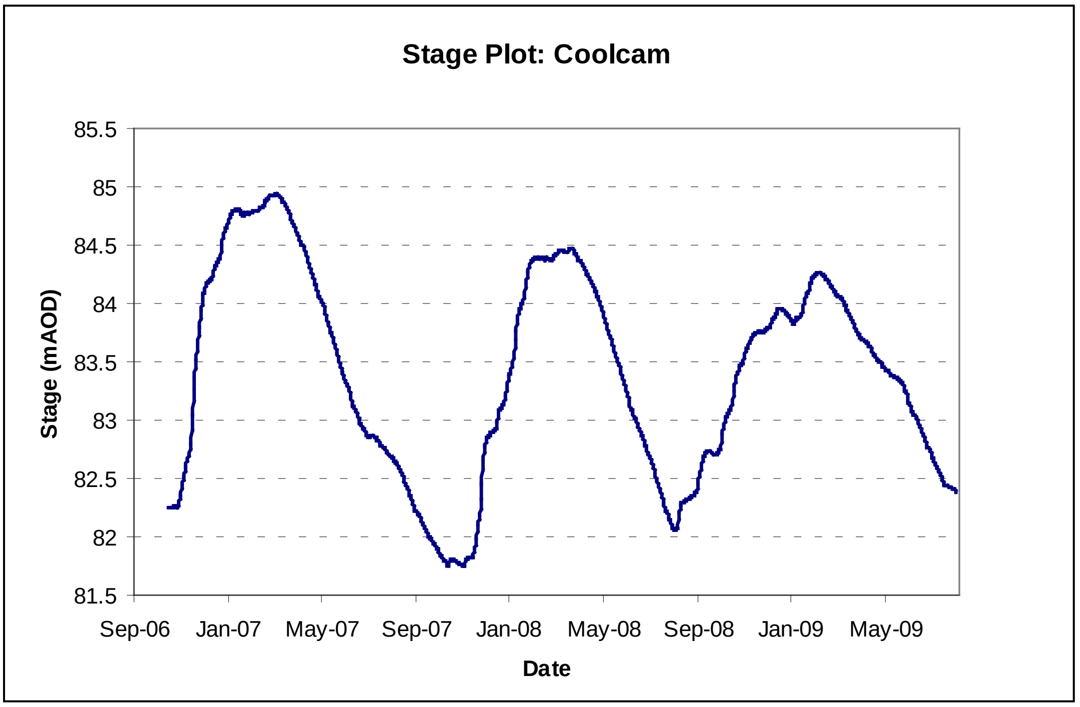
Water levels were recorded at hourly intervals using a variety of Schlumberger Divers® (Marton Geotechnical Ltd, Suffolk, UK) placed at or near the lowest point in each turlough. Divers measure the pressure of the water and air column above them, and from this the depth of water can be calculated. GPS surveys were carried out on 21 monitoring sites (Tullynafrankagh omitted) in order to develop digital terrain models (DTMs) from which contour maps, stage-volume and stage-surface area relationships are produced. The inflow magnitude is indicative of the properties of a turlough's catchment area and flow capacity, while outflow is a function of the drainage capacity of the system.

The hydrological data suggest that this turlough experiences one significant flooding event per annum. The turlough has average depth, inflow, outflow and drainage, but a high recession duration.

Coolcam is hydrologically linked with Croaghill, its floor is some 2 m lower than Croaghill. Water levels show similar profiles in the two turlough, though Coolcam lags behind Croaghill by around 17 days (for further details, see Chapter 2: Hydrology).

Hydrological Information	Coolcam Values	Turlough Summary Stats (n=21)		
		Median	Min	Max
Start of Hydrological Recording	04/11/2006	-	-	-
End of Hydrological Recording	06/08/2009	-	-	-
Days Recorded	1006	-	-	-
Equipment Failure	None recorded	-	-	-
Hydroperiod (days)	346	213	135	348
Maximum Floodwater Depth (m)	4.5	4.9	3	15.4
Maximum Floodwater Volume ('000 m^3)	1570.2	877.9	355.6	4008.1
Maximum Flooded Area	78.12	38.61	13.71	78.12
Average Basin Depth (m)	2.01	2.28	0.85	6.76
Average Daily Inflow (m^3 s^{-1})	0.684	0.684	0.254	10.253
Average Daily Outflow (m^3 s^{-1})	0.193	0.271	0.086	2.018
Drainage Capacity (m^3 s^{-1})	0.129	0.154	0.069	1.156
Recession Duration (days)	140.9	57.3	11	142.5

Stage plot for Coolcam turlough



Zone of Groundwater Contribution (ZOC) Risk Assessments

GIS based risk assessments were conducted with a view to identifying turloughs at risk of failing to meet WFD water quality objectives. These risk assessments were conducted by Compass Informatics Ltd and were based on Risk Assessment Sheet GWDTERA2a (Guidance Document No. GW9) on assessing risks to turloughs from phosphate (Working Group on Groundwater 2004) and Pathway Susceptibilities and Pressure Magnitudes were integrated to produce Impact Potential maps and predicted Risk Categories for the turlough ZOC. The TCD Risk Category is derived from a revised Impact Potential matrix. The predicted Risk Categories were adjusted using mean seasonal floodwater Total P ($\mu g\ l^{-1}$) (see Section 4.5.4 of the Risk Assessment Sheet GWDTERA2a). The risk categories include 1A: at significant risk; 1B: probably at significant risk; 2A: Not at significant risk (low confidence); 2B: Not at significant risk (higher confidence).

ZOC Area (Km^2)	Predicted WFD Risk Category	Adjusted WFD Risk Category	Predicted TCD Risk Category	Adjusted TCD Risk Category
6	1B	1A	1B	1A

ZOC Pressure Variable	
CORINE BARE ROCK %	0
CORINE PEAT BOGS%	0
CORINE ALL NATURAL AND SEMI-NATURAL AREAS%	19
CORINE IMPROVED PASTURE%	39
CORINE UNIMPROVED PASTURE%	39
CORINE ALL PASTURE%	79
CORINE OTHER AGRICULTURAL LANDS%	3
TEAGASC/EPA HABITATS ROCK%	0
TEAGASC/EPA HABITATS BOGS/PEATS%	0
TEAGASC/EPA HABITATS FORESTS/SCRUBS%	0
TEAGASC/EPA HABITATS WATER%	14
TEAGASC/EPA HABITATS WET GRASSLAND%	70
TEAGASC/EPA HABITATS DRY GRASSLAND%	16
TOT_LU/Ha of ZOC	1
TILLAGE%	0
No. SEPTIC TANKS km^{-2} ZOC	6
No. SEPTIC TANKS km^{-2} EXTREME PATHWAY SUSCEPTIBILITY	4
HIGH PATHWAY SUSCEPTIBILITY%	1
EXTR+HIGH PATHWAY SUSCEPTIBILITY%	27
WELL DRAINED SOIL %	70
POORLY DRAINED SOIL%	15

Site Conservation Assessment

The following site conservation assessment was undertaken to feed into the national reporting structure for assessing conservation status as required under Article 17 of the Habitats Directive. A suite of indicators and associated targets were derived to assess ecological structure and function. Future prospects were assessed through the evaluation of the impact of current and recent pressures and likely future threats to the site. The assessment follows a rules based approach to determine whether Structures & functions and Future Prospects should be assessed as good (green), inadequate (amber) or bad (red). For further details, see Chapter 10 (Conservation Status Assessment).

Please note an updated approach to assessing site condition has been proposed and is outlined in Chapter 12 (Monitoring Methods for Turloughs).

Conservation Condition Summary

Structure & Function	**Inadequate**
Future Prospects	**Inadequate/Favourable**
Site Conservation Condition	**Inadequate**

Structure and Function Status:

Indicator	***Comments***
Hydrological Function: *Good*	
Water Quality: *Intermediate*	34.0 µg P l^{-1}.
Biological Responses: *Intermediate*	
Algal communities: -1	No algal mats have been recorded, but max CHL is high
Vegetation communities: 1	Moderate cover of positive indicators, low cover of negative indicators
***Rumex* cover: 1**	3.7%
Important plants: 0	None recorded
Important aquatic invertebrates: 0	None recorded
Overall Structure & Function: *Inadequate*	Some good aspects to the vegetation despite overall inadequate status

Pressures:

Code	Impact	Notes
H02.06 Diffuse groundwater pollution due to agricultural and forestry activities (ZOC)	M	
A08 Fertilisation (within turlough)	M	Some evidence of fertiliser input within turlough
H02.07 Diffuse groundwater pollution due to non-sewered population (ZOC)	L	Relatively modest number of dwellings in the ZOC
C01.07 Mining and extraction activities not referred to above (marl, limestone; in turlough)	L	Quarry adjacent to the turlough, likely to have some local impact
A04.01.01 Intensive cattle grazing (turlough)	L	Low grazing impact, slightly less than half of the turlough grazed
A04.01.01 Intensive cattle grazing (turlough)	L	Low grazing impact, slightly less than half of the turlough grazed

Threats:

Code	Impact	Notes
H02.06 Diffuse groundwater pollution due to agricultural and forestry activities (ZOC)	M	Pressure likely to continue due to prevalence of pasture in ZOC
A02.01 Agricultural intensification (ZOC)	L	Likely to increase moderately due to prevalence of pasture in ZOC
A10.02 Removal of stone walls and embankments (in turlough)	L	
M01.03 Flooding and rising precipitations	L	
A04.01.01 Intensive cattle grazing (turlough)	L	
A02.03 Grassland removal for arable land (ZOC)	L	

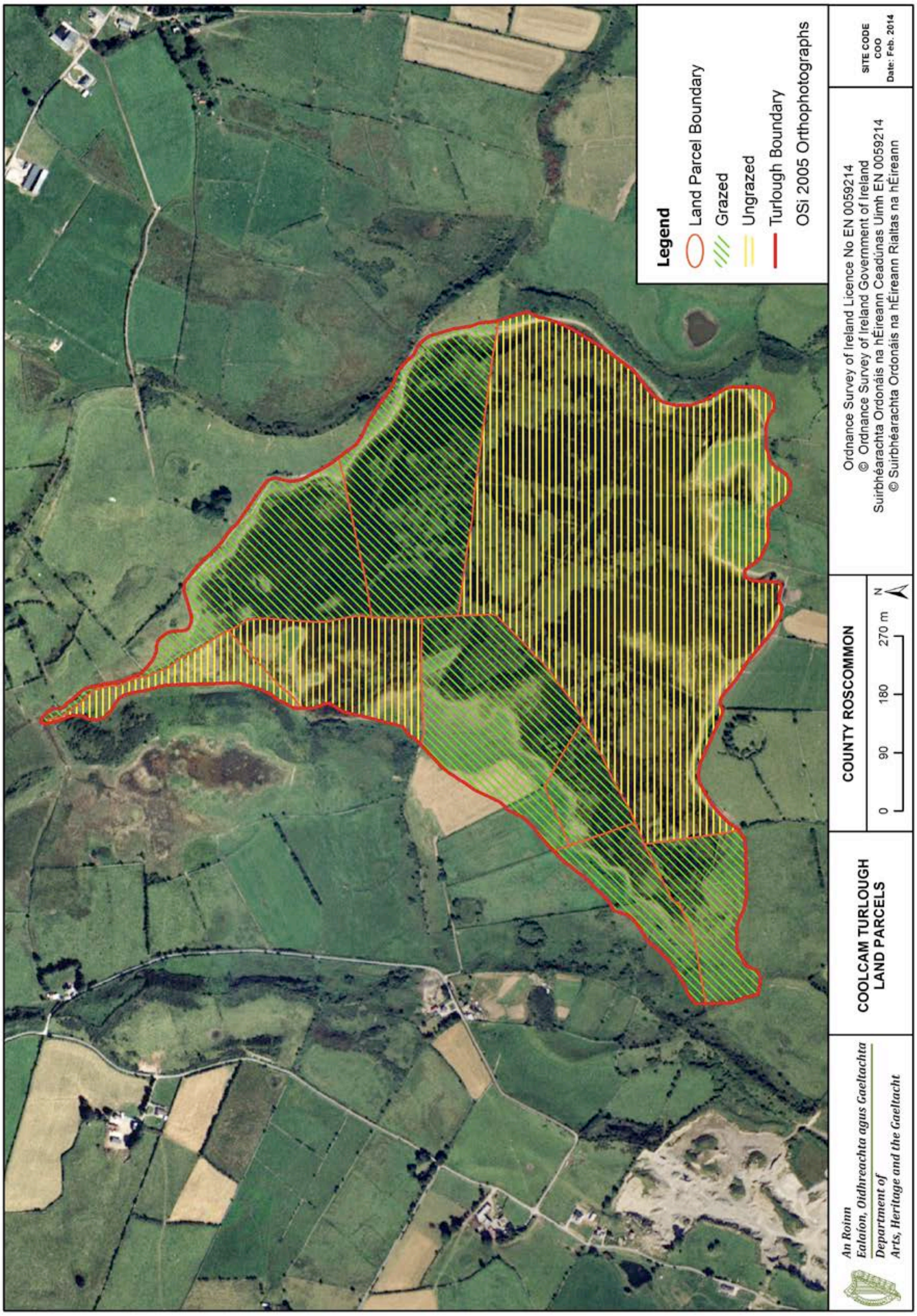
Future Prospects: **Inadequate/Favourable** – relatively low level of threat, but these not likely to improve the intermediate structure and function assessment; borderline case.

Overall Assessment: **Inadequate** – for reasons just outlined. However, some aspects of the structure and function are favourable; if nutrient inputs could be reduced it might be possible to improve the biological status of this turlough, providing improved future prospects and an overall good structure and function.

Maps

Maps are provided of:

1. Grazing in land parcels
2. Approximate sampling points for water chemistry and aquatic invertebrates
3. Soil nutrient sampling points
4. Points for soil survey (note: soils were surveyed to the turlough boundary defined by Goodwillie, 1992; see map 9)
5. Soils (note: soils were mapped by combining the EPA Subsoils base map with the point soil descriptions; for further details see *Chapter 6: Soils and Landuse*)
6. Vegetation relevés
7. Vegetation communities (note: relevés do not always match to mapped communities due to small scale variation; for further details of mapping see *Chapter 7: Turlough Vegetation: Description, Mapping and Ecology*)
8. Vegetation maps digitised from Goodwillie, R. (1992) *Turlough's Over 50 Hectares*. Report to NPWS
9. Estimated zone of groundwater contribution (ZOC)


Legend
Land Parcel Boundary
Grazed
Ungrazed
Turlough Boundary
OSi 2005 Orthophotographs
Ordnance Survey of Ireland Licence No EN 0059214
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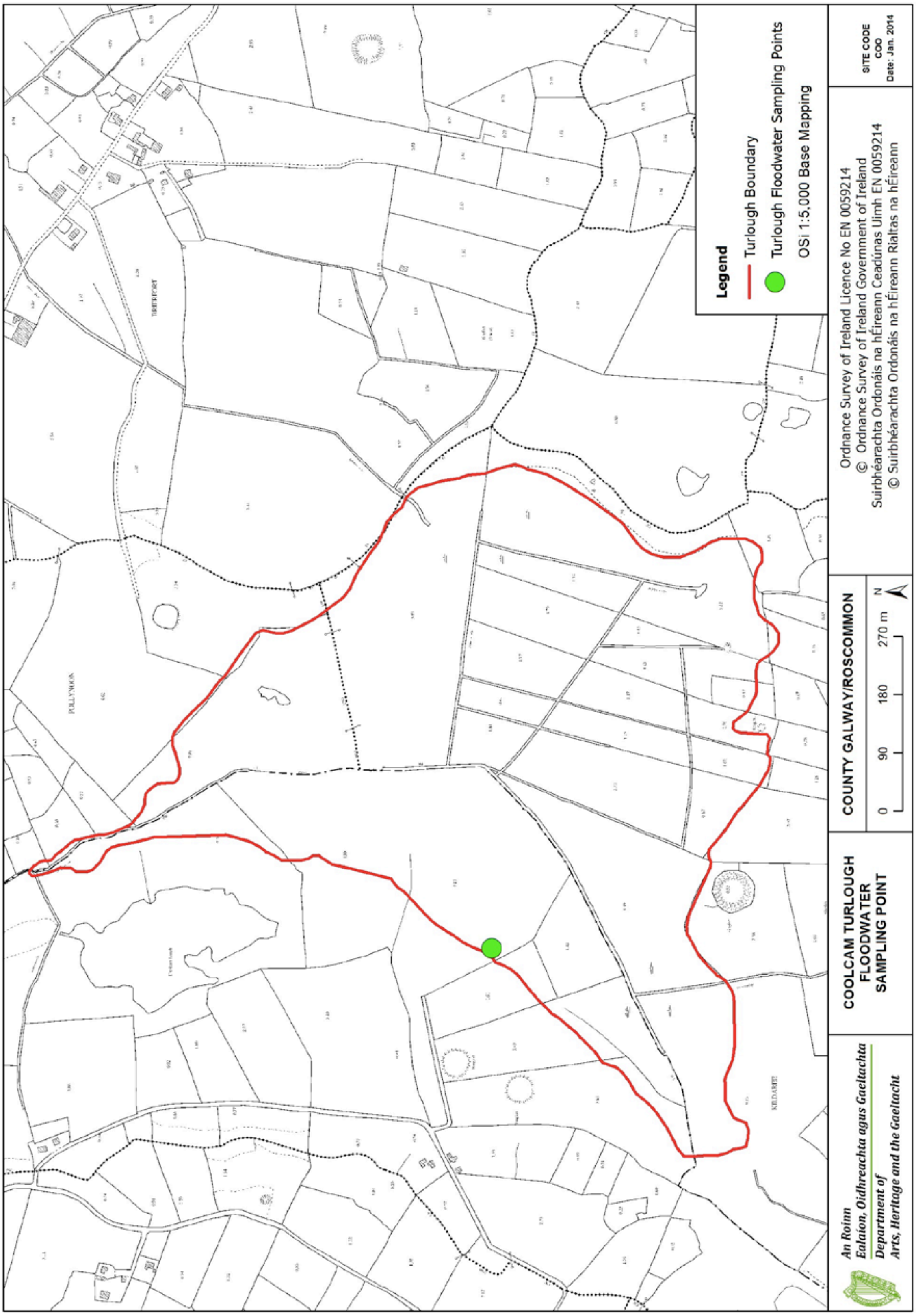
SITE CODE
COO
Date: Feb. 2014
COUNTY ROSCOMMON
0 90 180 270 m
N
COOLCAM TURLOUGH
LAND PARCELS
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht


Legend
Turlough Boundary
Turlough Floodwater Sampling Points
OSi 1:5,000 Base Mapping
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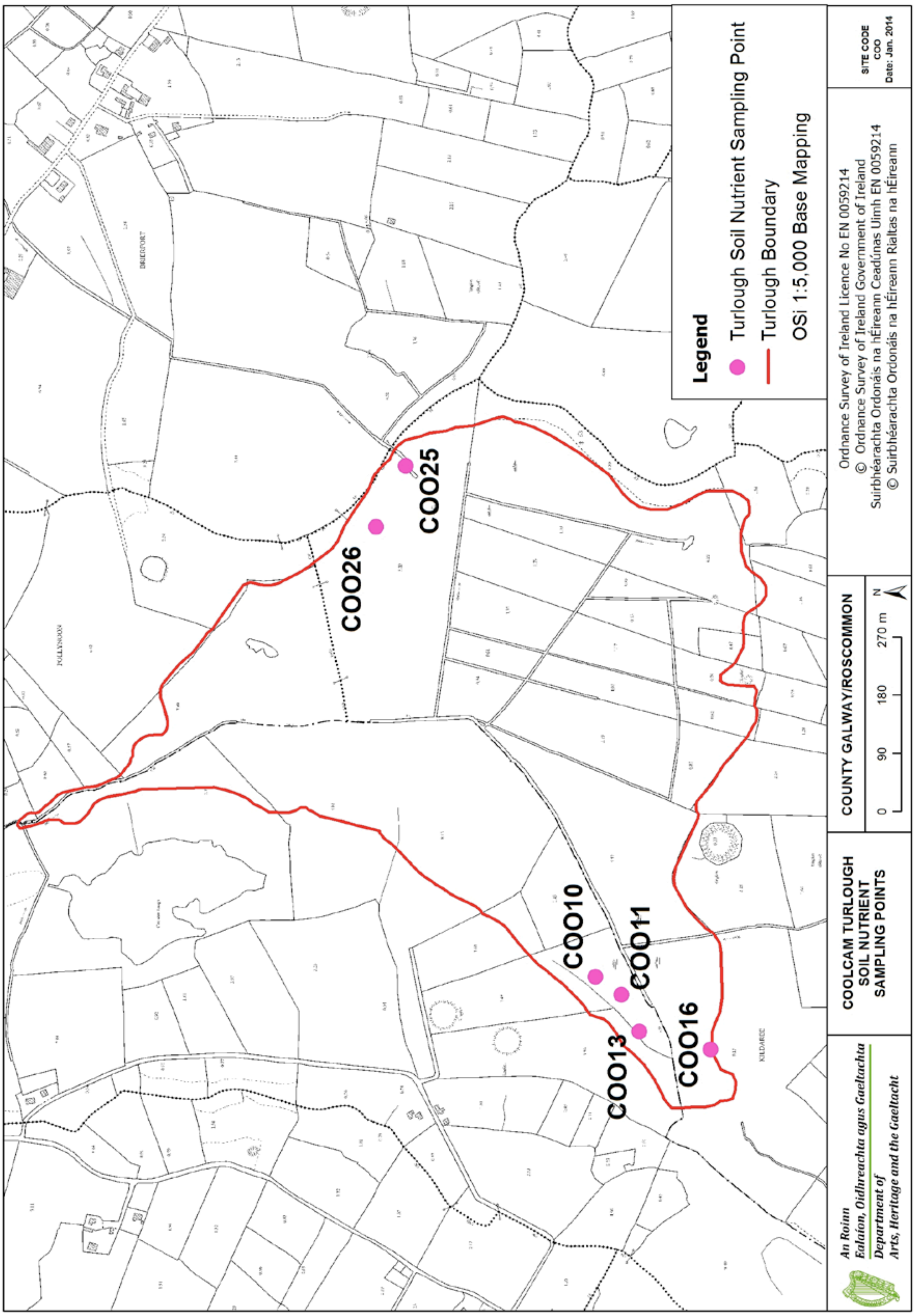
COO
Date: Jan. 2014
COUNTY GALWAY/ROSCOMMON
0 90 180 270 m
N
COOLCAM TURLOUGH
FLOODWATER
SAMPLING POINT
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht


COO25
COO26
COO10
COO11
COO13
COO16
Legend
Turlough Soil Nutrient Sampling Point
Turlough Boundary
OSi 1:5,000 Base Mapping
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SITE CODE
COO
Date: Jan. 2014
COUNTY GALWAY/ROSCOMMON
0 90 180 270 m
N
COOLCAM TURLOUGH
SOIL NUTRIENT
SAMPLING POINTS
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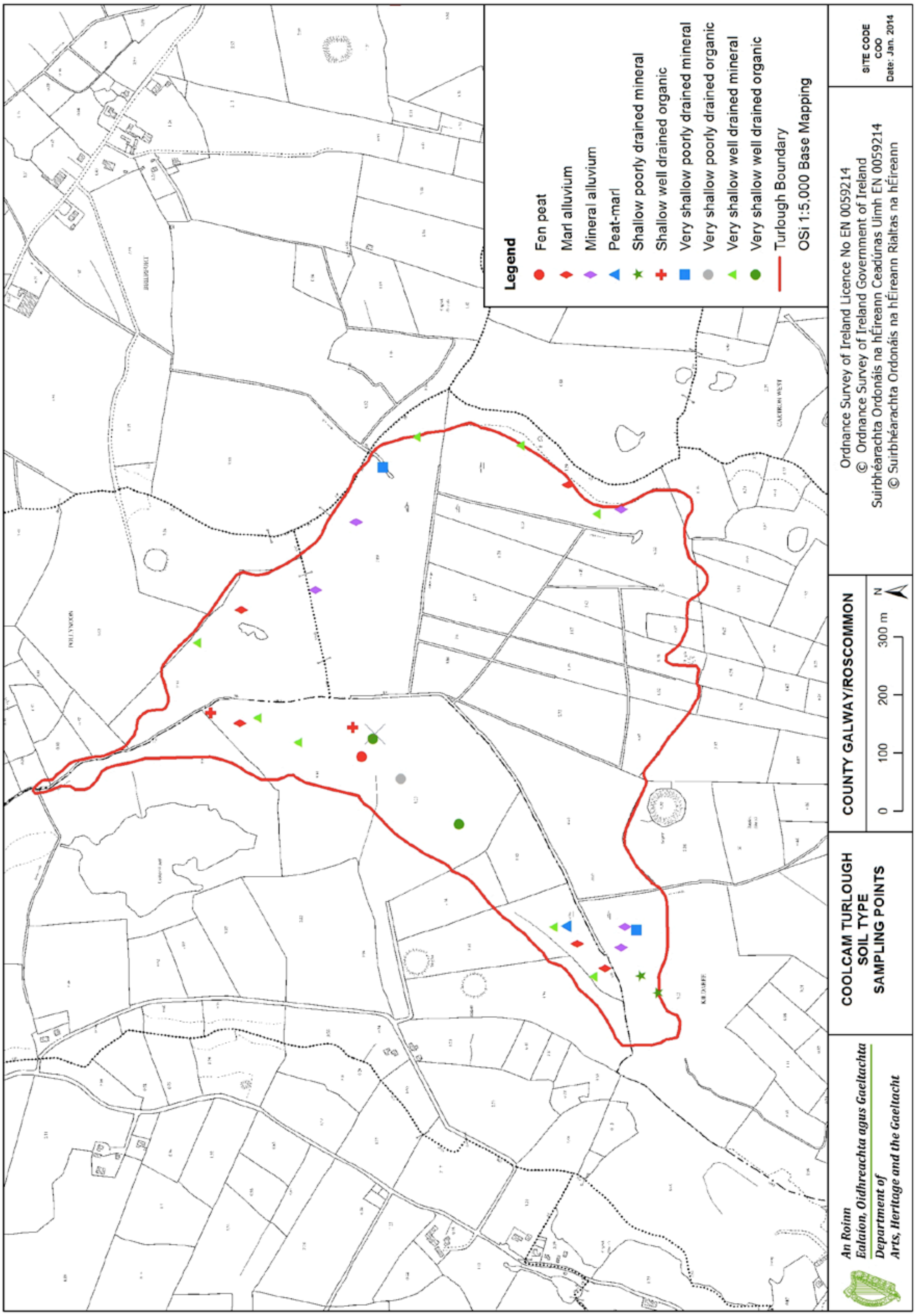
Department of
Arts, Heritage and the Gaeltacht


Legend
Fen peat
Marl alluvium
Mineral alluvium
Peat-marl
Shallow poorly drained mineral
Shallow well drained organic
Very shallow poorly drained mineral
Very shallow poorly drained organic
Very shallow well drained mineral
Very shallow well drained organic
Turlough Boundary
OSi 1:5,000 Base Mapping
SITE CODE
COO
Date: Jan. 2014
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COUNTY GALWAY/ROSCOMMON
0 100 200 300 m
N
COOLCAM TURLOUGH
SOIL TYPE
SAMPLING POINTS
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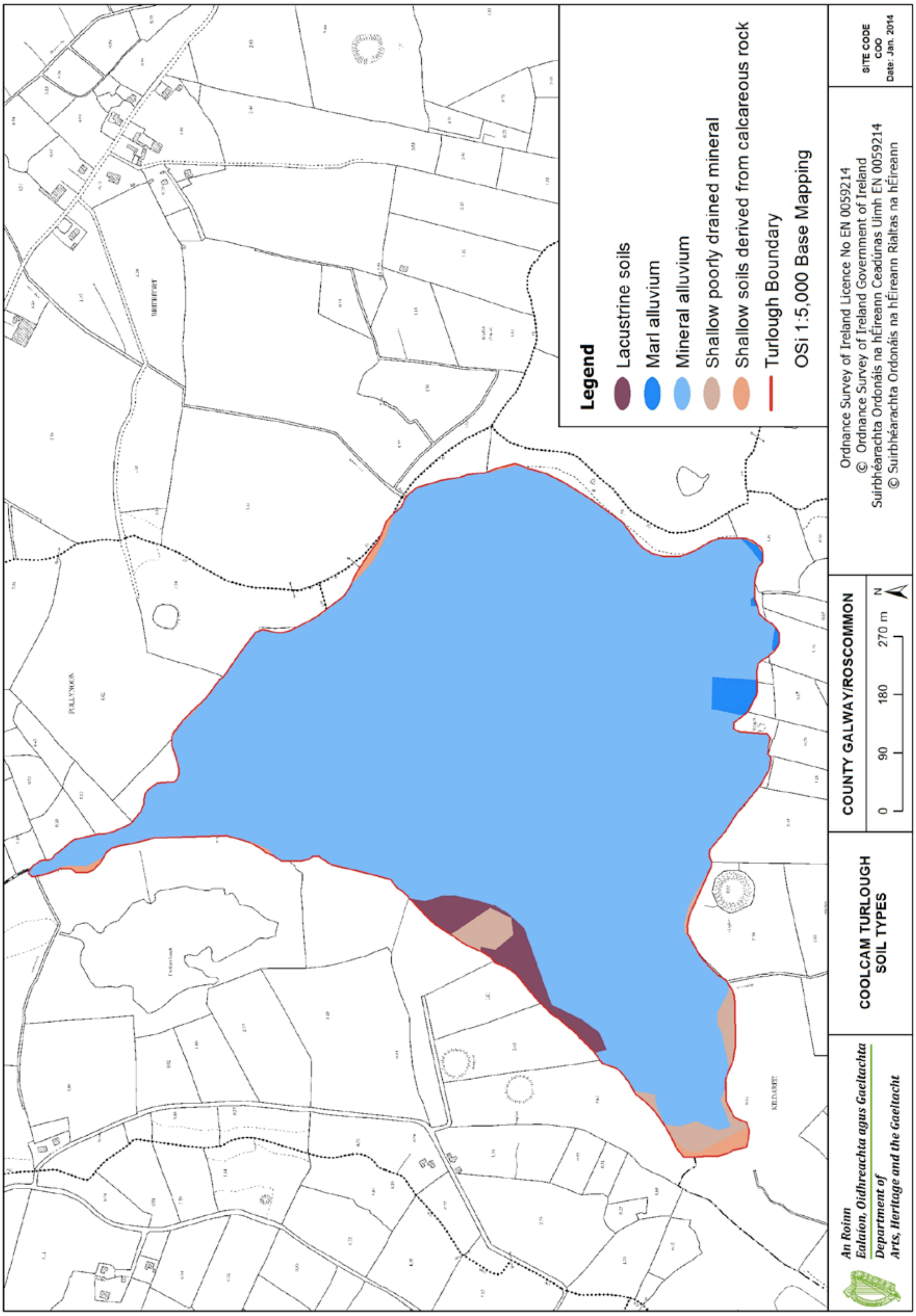
Legend
Lacustrine soils
Marl alluvium
Mineral alluvium
Shallow poorly drained mineral
Shallow soils derived from calcareous rock
Turlough Boundary
OSi 1:5,000 Base Mapping
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COO
Date: Jan. 2014
COUNTY GALWAY/ROSCOMMON
0
90
180
270 m
N
COOLCAM TURLOUGH
SOIL TYPES
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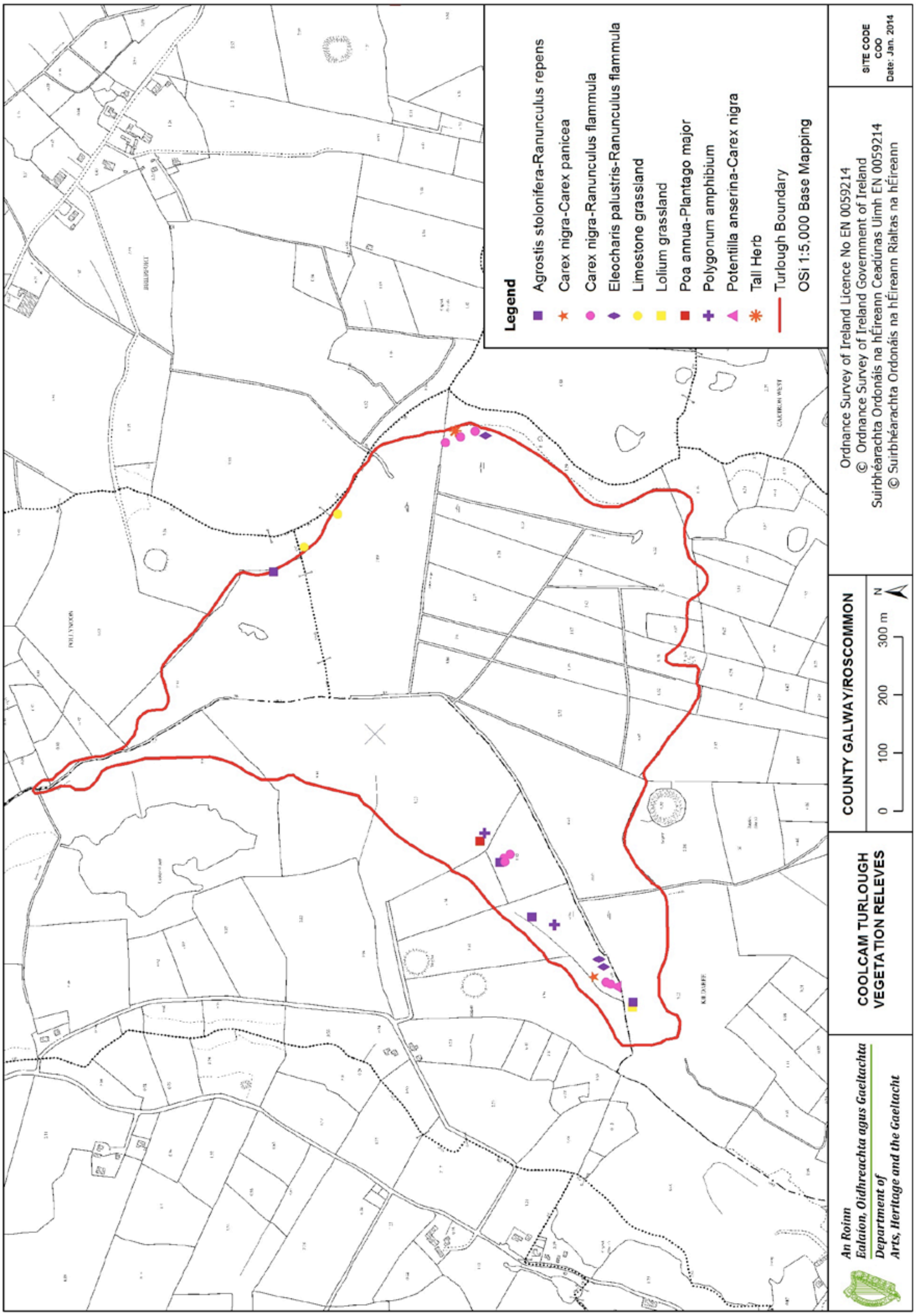
Legend
Agrostis stolonifera-Ranunculus repens
Carex nigra-Carex panicea
Carex nigra-Ranunculus flammula
Eleocharis palustris-Ranunculus flammula
Limestone grassland
Lolium grassland
Poa annua-Plantago major
Polygonum amphibium
Potentilla anserina-Carex nigra
Tall Herb
Turlough Boundary
OSi 1:5,000 Base Mapping
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SITE CODE
COO
Date: Jan. 2014
COUNTY GALWAY/ROSCOMMON
0 100 200 300 m
N
COOLCAM TURLOUGH
VEGETATION RELEVES
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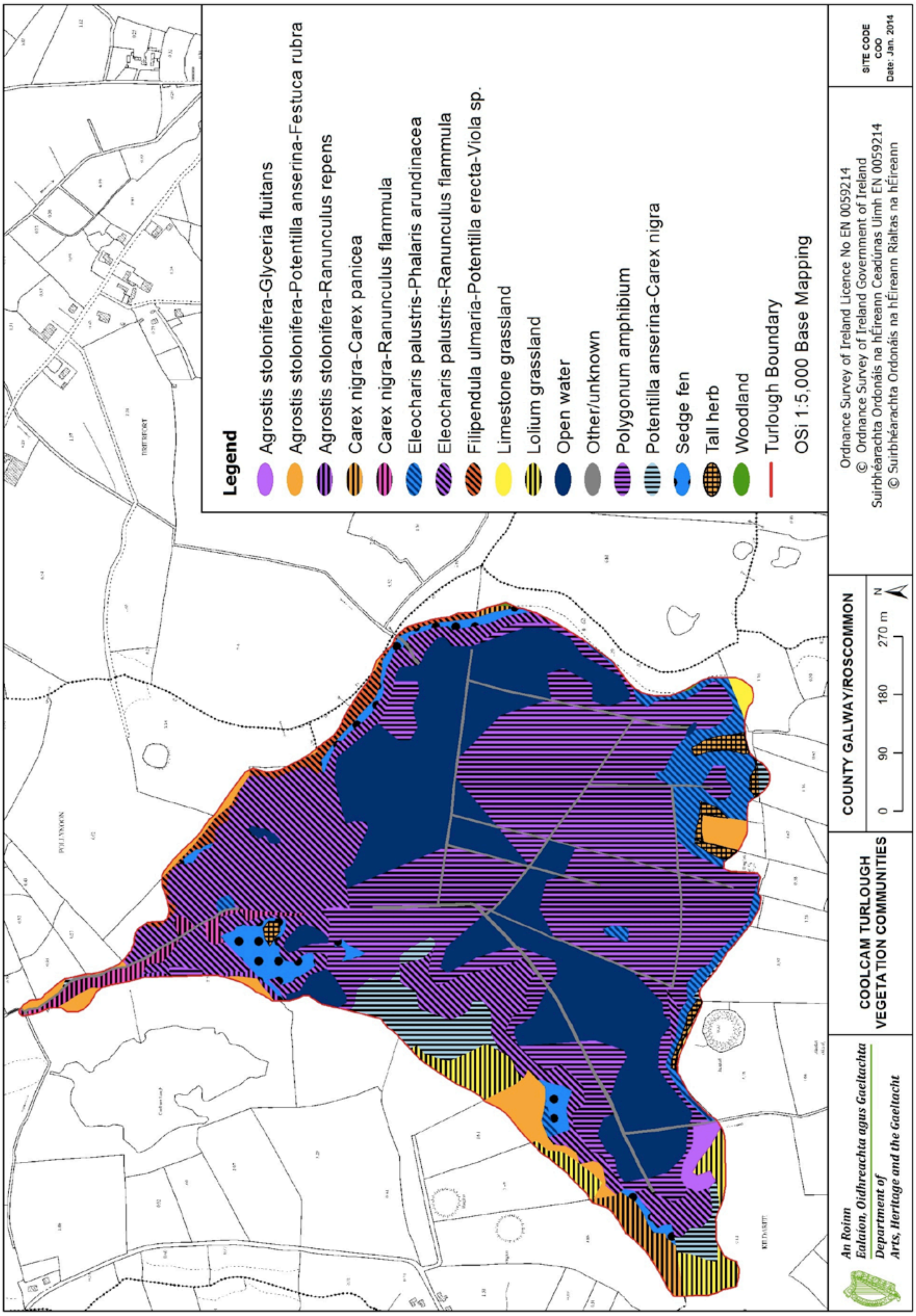
Legend
Agrostis stolonifera-Glyceria fluitans
Agrostis stolonifera-Potentilla anserina-Festuca rubra
Agrostis stolonifera-Ranunculus repens
Carex nigra-Carex panicea
Carex nigra-Ranunculus flammula
Eleocharis palustris-Phalaris arundinacea
Eleocharis palustris-Ranunculus flammula
Filipendula ulmaria-Potentilla erecta-Viola sp.
Limestone grassland
Lolium grassland
Open water
Other/unknown
Polygonum amphibium
Potentilla anserina-Carex nigra
Sedge fen
Tall herb
Woodland
Turlough Boundary
OSi 1:5,000 Base Mapping
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COO
Date: Jan. 2014
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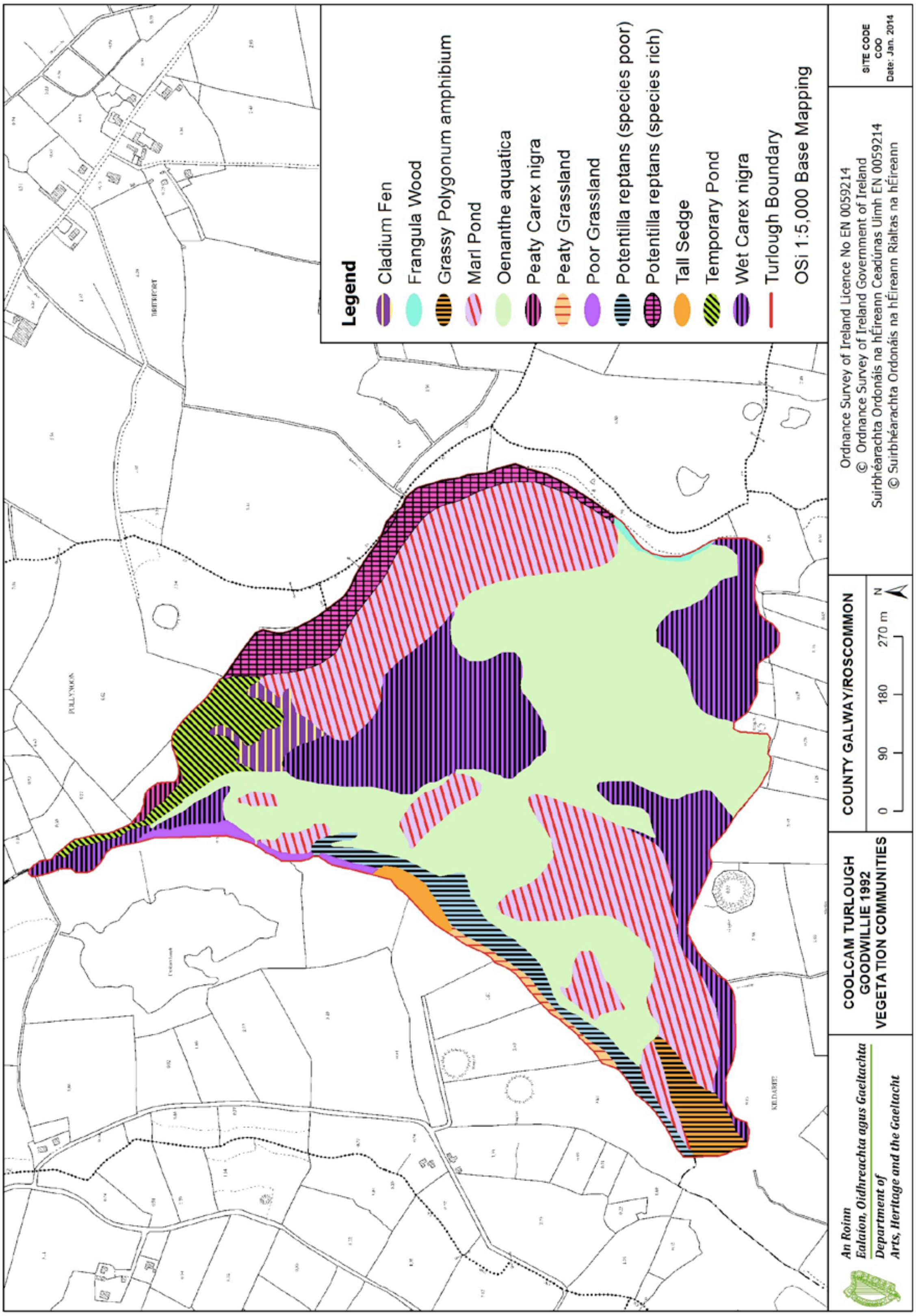
Department of
Arts, Heritage and the Gaeltacht
COOLCAM TURLOUGH
VEGETATION COMMUNITIES
COUNTY GALWAY/ROSCOMMON
0 90 180 270 m
N


Legend
Cladium Fen
Frangula Wood
Grassy Polygonum amphibium
Marl Pond
Oenanthe aquatica
Peaty Carex nigra
Peaty Grassland
Poor Grassland
Potentilla reptans (species poor)
Potentilla reptans (species rich)
Tall Sedge
Temporary Pond
Wet Carex nigra
Turlough Boundary
OSi 1:5,000 Base Mapping
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SITE CODE
COO
Date: Jan. 2014
COUNTY GALWAY/ROSCOMMON
0 90 180 270 m
N
COOLCAM TURLOUGH
GOODWILLIE 1992
VEGETATION COMMUNITIES
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Department of
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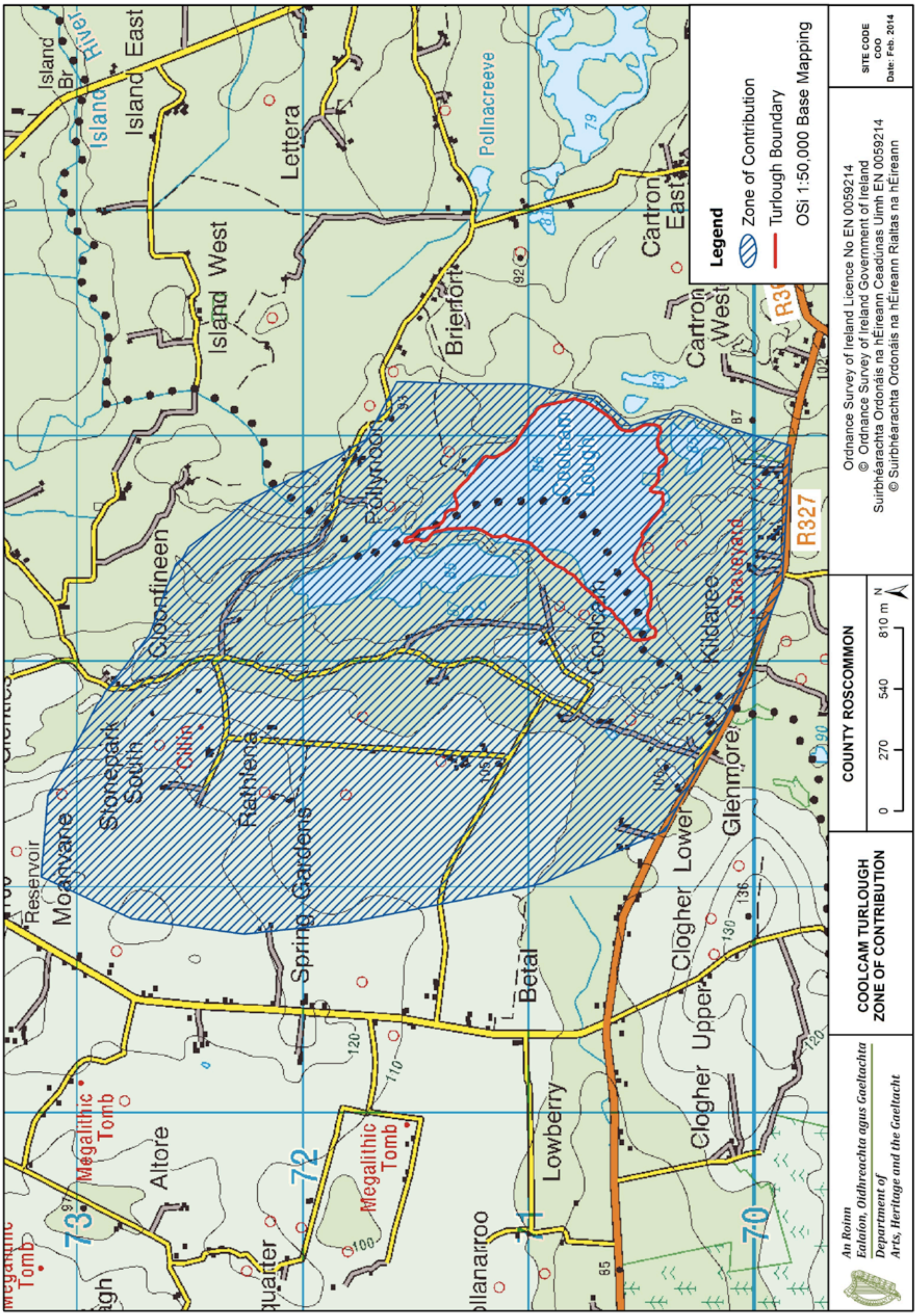
COOLCAM TURLOUGH
ZONE OF CONTRIBUTION
COUNTY ROSCOMMON
Legend
Zone of Contribution
Turlough Boundary
OSi 1:50,000 Base Mapping
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SITE CODE
COO
Date: Feb. 2014
0 270 540 810 m
N
An Roinn
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Department of
Arts, Heritage and the Gaeltacht
Coolcam Lough
Coolcam
Pollynoon
Cloonfineen
Stonepark South
Rathlena
Spring Gardens
Moanvane
Kildaree
Glenmore
Graveyard
Cillín
Brierfort
Cartron West
Cartron East
Island West
Island East
Lettera
Pollnacreeve
Clogher Lower
Clogher Upper
Betal
Lowberry
Altore
Megalithic Tomb
Reservoir
R327

Site Report: Croaghill Turlough
TCD Turlough Research project 2006-2011

Turlough Project Code	SAC Name	SAC/NHA No.	County	Townland	RBD	Easting	Northing	Area (ha)
CAH	Croaghill Turlough	000255	Galway	Carrowneany	SHANNON	159631	270711	38

File update: July 2015 (S. Waldren)

Site Description

Croaghill turlough occurs close to the Dunmore-Ballymoe road (Co. Galway), just east of Coolcam turlough, and extends to 38.6 ha. Designated as an SAC, eskers and drift slopes occur along the edges of this turlough. The main body of the turlough is connected to two smaller areas in the north-west by a narrow channel. Eleven vegetation communities were mapped in this turlough; the *Polygonum amphibium* community was the dominant vegetation type, indicating that this turlough is wet. Croaghill soils are moderately acidic and peaty, with low amounts of calcium carbonate. More than 90% of the turlough area is Fen peat, and 76% of the turlough area is rotationally grazed. The hydrological data suggest that Croaghill turlough experiences a single significant flooding event per annum. As with the hydrologically-linked Coolcam, there is evidence that Croaghill has longer duration flooding than at the time of Goodwillie's survey.

Croaghill – photo: S. Kimberley

Phytoplankton

Phytoplankton analysis was conducted on sub-samples of monthly spot samples collected for hydrochemical analysis between October 2006 and June 2007. Phytoplankton composition varies significantly over time and data from autumn, mid-winter and spring/early summer are presented below. Taxa were identified to species level where possible. Some taxa were not discriminated beyond general groupings (i.e. small centric diatoms, dinoflagellates and pinnate diatoms). The term non-identifiable alone (or n.i.) was reserved for cases where specimens were not identifiable. Discrimination between n.i. filament, n.i. flagellate, n.i. colony, n.i. green filament was made when applicable. Biovolume ($mm^3 m^{-3}$) was used as the measure of algal biomass.

October 2006		**January 2007**		**May 2007**	
Biovolume (mm^3/m^3)	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*
Mallomonas akrokomos	579412	*Achnanthidium minutissima*	1738237	*Dinobryon*	701177
Gomphonema	358805	*n.i. pennates*	619754	*Trachelomonas*	367496
Cryptomonas	230022	*Mallomonas akrokomos*	55115	*Mougeotia*	73920
n.i. pennates	162125	*Chroomonas acuta*	50752	*Oscillatoria*	71230
Navicula	145106	*Cryptomonas*	49195	*n.i. pennates*	64059

Benthic Algae

Turloughs were inspected for algal mats during the emptying phase in 2007, 2008 and 2009. Turloughs were visited in the first two weeks of March to June 2007 as part of the monthly monitoring of turloughs. Dedicated trips to inspect for algal mats were conducted in 2008 on the 4th of March, the 1st of April, and the 26th, 27th and 28th of May, and in 2009 on the 15th and 16th of June and on the 24th and 25th of July. The presence of both living floating mats and dead drying mats was noted, as well as their extent in the turlough basins. Occurrence of visible filamentous algal mats in the three years of observation is presented below. Y = visible occurrence; * = "extensive cover" (estimated to be 2 to 8% of total area of basin); † = negligible quantity observed; • = turlough was too flooded to permit full observation. Algal mats were observed only in 2007.

Year of Observation		
2007	**2008**	**2009**
Y	N	N

Hydrochemistry

Data shown are the mean ± SD of monthly spot samples collected between October 2006 and June 2007. Mean seasonal Total P and Chlorophyll *a* were used to determine the trophic status of the floodwaters based on OECD trophic categories. The median and range of <u>mean values</u> across all turloughs are also provided.

Hydrochemical Variable	Croaghill Values		Turlough Summary Stats (n=22)		
	Mean±SD	OECD Trophic Category	Median	Min	Max
pH	8.2±0.2		8.1	7.7	8.3
Alkalinity mg l^{-1} $CaCO_3$	220.2±21.3		204.0	112.4	236.4
Colour mg l^{-1} PtCo	43.8±16.3		26.9	7.9	85.1
Molybdate Reactive Phosphorus µg l^{-1}	3.5±2.3		3.4	0.7	42.1
Total Phosphorus µg l^{-1}	25.0±16.6	Mesotrophic	24.8	4.0	82.1
Chlorophyll *a* µg l^{-1}	7.6±10.3	Mesotrophic	4.9	1.1	33.5
Nitrate-N mg l^{-1}	0.7±0.7		0.7	0.1	1.9
Total Nitrogen mg l^{-1}	1.2±.7		1.2	0.6	2.3

Aquatic Invertebrates

22 turloughs were sampled for littoral aquatic macroinvertebrates using sweep nets during November 2006 and April 2007. Zooplankton samples were collected in April 2007. Open-water cladocerans and littoral chydorids were sampled using a zooplankton net and perspex tube respectively.

Aquatic Macroinvertebrates			
November 2006	**Count**	**April 2007**	**Count**
Dryops sp. (larva)	1	*Agabus* sp. (larva)	76
Euconulus alderi	2	Chironomidae	6
Haliplus lineatocollis	1	Corixinae Instar I & II	1
Hydrachnidia (Mite)	8	Curculionidae	2
Hygrotus impressopunctatus	1	Diptera Pupae	2
Ilybius sp. (larva)	1	*Dryops* sp. (larva)	2
Limnephilidae sp. Instar II	9	*Dytiscus* sp. (larva)	1
Limnephilidae sp. Instar III	7	*Euconulus alderi*	2
Limnephilus *auricula*	4	*Hydaticus* sp. (larva)	1
Limnephilus decipiens	3	*Hydrachnidia* sp. (larva)	7
Lymnaea peregra	3	*Ilybius* sp. (larva)	1
Lymnaea trunculata	9	*Lestes dryas*	1
Notonecta glauca	1	*Lestes* sp.	2
Ostracoda	42	*Lymnaea peregra*	1
Phacopteryx brevipennis	19	Ostracoda	32
Planorbis crista	16	*Phacopteryx brevipennis*	1
Succinea sp.	5	*Sigara dorsalis*	1
Tipulidae	1	*Succinea* sp.	1
Valvata cristata	11	*Sympetrum sanguinem*	6

Aquatic Macroinvertebrates:

Aquatic Macroinvertebrate Taxa	**Presence of high abundances (>50)**	
	November 2006	**April 2007**
Diptera	N	N
Ostracoda	N	N
Odonata	N	N
Trichoptera	N	N

Zooplankton species
Alona affinis
Alona intermedia
Alona rectangula
Alona rustica
Alonella excisa
Chydorus piger
Chydorus sphaericus

Vegetation

Vegetation description and classification yielded 25 vegetation communities suitable for mapping. Eleven vegetation communities were mapped in this turlough; the *Polygonum amphibium* community was the dominant vegetation type, indicating that this turlough is wet. The *Potentilla anserina – Potentilla reptans* community was also abundant. High conservation value communities are denoted by *. 81 plant species were recorded.

Vegetation Community	Area (Ha)
A. stolonifera-Glyceria fluitans	1.02
A. stolonifera-P. anserina-F. rubra	1.92
Carex nigra-C. panicea	2.67
Carex nigra-Equisetum fluviatile	0.06
Carex nigra-R. flammula	3.23
E. palustris-P. arundinacea	0.85
Lolium grassland	2.89
Open water	0.67
Other/unknown	0.76
P. anserina-Carex nigra	8.16
P. anserina-P. reptans	0.33
Polygonum amphibium	11.81
Tall herb	4.01
Number of vegetation communities	11
Number of plant species	81

Vascular Plant Species

Nomenclature follows Parnell, J & Curtis, T. (2012) *Webb's An Irish Flora*, University of Cork Press.

Agrostis capillaris	*Festuca arundinacea*	*Plantago lanceolata*
Agrostis stolonifera	*Festuca pratensis*	*Plantago major*
Alisma plantago-aquatica	*Filipendula ulmaria*	*Polygonum amphibium*
Alopecurus geniculatus	*Galium palustre*	*Polygonum aviculare*
Apium inundatum	*Glyceria fluitans*	*Potamogeton natans*
Baldellia ranunculoides	*Holcus lanatus*	*Potentilla anserina*
Caltha palustris	*Hydrocotyle vulgaris*	*Potentilla erecta*
Cardamine hirsuta	*Iris pseudacorus*	*Potentilla palustris*
Cardamine pratensis	*Juncus acutiflorus*	*Potentilla reptans*
Carex disticha	*Juncus articulatus*	*Ranunculus acris*
Carex divisa	*Juncus bulbosus*	*Ranunculus flammula*
Carex hirta	*Juncus conglomeratus*	*Ranunculus repens*
Carex hostiana	*Juncus effusus*	*Ranunculus trichophyllus*
Carex nigra	*Lemna minor*	*Rhinanthus minor*
Carex panicea	*Leontodon autumnalis*	*Rumex acetosa*
Carex rostrata	*Lolium perenne*	*Rumex crispus*
Cerastium fontanum	*Lotus corniculatus*	*Sagina procumbens*
Cirsium arvense	*Lysimachia vulgaris*	*Salix aurita*
Cirsium palustre	*Mentha aquatica*	*Senecio aquaticus*
Cynosurus cristatus	*Mentha arvensis*	*Sparganium emersum*
Deschampsia cespitosa	*Menyanthes trifoliata*	*Sparganium erectum*
Eleocharis palustris	*Molinia caerulea*	*Stellaria media*
Elymus repens	*Myosotis scorpioides*	*Taraxacum officinale* agg.
Epilobium palustre	*Oenanthe aquatica*	*Trifolium repens*
Epilobium parviflorum	*Ophioglossum vulgatum*	*Veronica scutellata*
Equisetum fluviatile	*Phalaris arundinacea*	*Veronica species*
Equisetum palustre	*Phleum bertolonii*	*Vicia cracca*

Soils and Grazing

Soils were classified using a modified version of soil categories generated by the Teagasc/EPA Soils and Subsoils Mapping project (Fealy *et al.*, 2009). The classification scheme principally uses parent material (calcareous/non-calcareous), depth class (shallow/deep) and drainage class (well drained/poorly drained) to assign soils to one of nine broad categories. Croaghil is dominated by fen peats. The mean ± SD of a range of soil properties are also provided, in addition to the median and range of each variable across turloughs. Croaghill soils are moderately acidic and peaty, with low amounts of calcium carbonate. Mean Total Nitrogen is towards the high end of the range (and very variable among samples) for turloughs, though total Phosphorus is moderate.

Soil Types/Grazing Extent	% Turlough Area
Shallow well drained mineral	1.4
Very shallow poorly drained organic	7.6
Fen Peat	90.8
Extent of rotationally grazed area	76

Soil Property (n=6)	Croaghill	Turlough Summary Stats (n=22)		
	Mean ± SD	Median	Min	Max
pH	6.8±	7.20	5.94	8.29
% Organic Matter content	41.6±27.8	25.8	10.2	69.1
% Inorganic content	54.6±28.8	43.2	25.7	85.0
% Calcium carbonate content	3.8±2.4	11.3	2.48	43.7
Total Nitrogen mg kg^{-1}	15883±11881	11142	4983	24233
Total Phosphorus mg kg^{-1}	896±391	905	245	1594

Hydrology

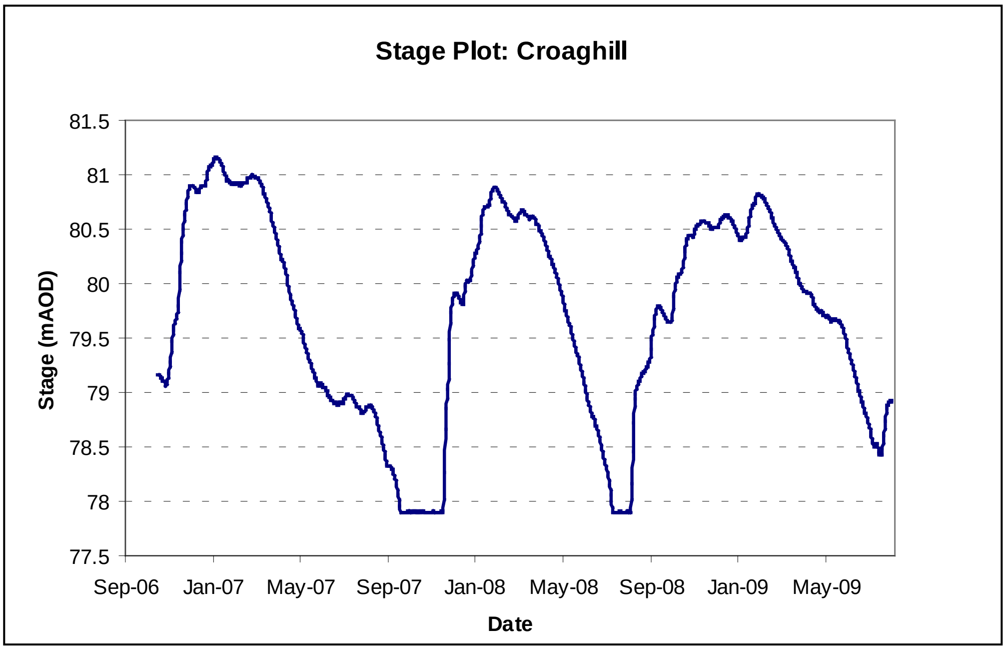
Water levels were recorded at hourly intervals using a variety of Schlumberger Divers® (Marton Geotechnical Ltd, Suffolk, UK) placed at or near the lowest point in each turlough. Divers measure the pressure of the water and air column above them, and from this the depth of water can be calculated. GPS surveys were carried out on 21 monitoring sites (Tullynafrankagh omitted) in order to develop digital terrain models (DTMs) from which contour maps, stage-volume and stage-surface area relationships are produced. The inflow magnitude is indicative of the properties of a turlough's catchment area and flow capacity, while outflow is a function of the drainage capacity of the system.

The hydrological data suggest that Croaghill turlough experiences a single significant flooding event per annum. The turlough has fairly average depth, the slightly low inflow and outflow coupled with low drainage result in a slightly high receession duration.

Croaghill is hydrologically linked with Coolcam, its floor is some 2 m higher than Coolcam. Water levels show similar profiles in the two turlough, though Coolcam lags behind Croaghill by around 17 days (for further details, see *Chapter 2: Hydrology*).

Hydrological Information	Croaghill Values	Turlough Summary Stats (n=21)		
		Median	Min	Max
Start of Hydrological Recording	04/11/2006	-	-	-
End of Hydrological Recording	06/08/2009	-	-	-
Days Recorded	1006	-	-	-
Equipment Failure	None recorded	-	-	-
Hydroperiod (days)	348	213	135	348
Maximum Floodwater Depth (m)	4.4	4.9	3	15.4
Maximum Floodwater Volume ('000 m^3)	636	877.9	355.6	4008.1
Maximum Flooded Area	38.61	38.61	13.71	78.12
Average Basin Depth (m)	1.65	2.28	0.85	6.76
Average Daily Inflow ($m^3 s^{-1}$)	0.496	0.684	0.254	10.253
Average Daily Outflow ($m^3 s^{-1}$)	0.117	0.271	0.086	2.018
Drainage Capacity ($m^3 s^{-1}$)	0.103	0.154	0.069	1.156
Recession Duration (days)	71.8	57.3	11	142.5

Stage plot for Croaghill turlough



Zone of Groundwater Contribution (ZOC) Risk Assessments

GIS based risk assessments were conducted with a view to identifying turloughs at risk of failing to meet WFD water quality objectives. These risk assessments were conducted by Compass Informatics Ltd and were based on Risk Assessment Sheet GWDTERA2a (Guidance Document No. GW9) on assessing risks to turloughs from phosphate (Working Group on Groundwater 2004) and Pathway Susceptibilities and Pressure Magnitudes were integrated to produce Impact Potential maps and predicted Risk Categories for the turlough ZOC. The TCD Risk category derived from a revised Impact Potential matrix. The predicted Risk Categories were adjusted using mean seasonal floodwater Total P (μg l^{-1}) (see Section 4.5.4 of the Risk Assessment Sheet GWDTERA2a). The risk categories include 1A: at significant risk; 1B: probably at significant risk; 2A: Not at significant risk (low confidence); 2B: Not at significant risk (higher confidence).

ZOC Area (Km^2)	Predicted WFD Risk Category	Adjusted WFD Risk Category	Predicted TCD Risk Category	Adjusted TCD Risk Category
10	2A	1B	1B	1B

ZOC Pressure Variable	
CORINE BARE ROCK %	0
CORINE PEAT BOGS%	0
CORINE ALL NATURAL AND SEMI-NATURAL AREAS%	17
CORINE IMPROVED PASTURE%	38
CORINE UNIMPROVED PASTURE%	39
CORINE ALL PASTURE%	78
CORINE OTHER AGRICULTURAL LANDS%	4
TEAGASC/EPA HABITATS ROCK%	0
TEAGASC/EPA HABITATS BOGS/PEATS%	1
TEAGASC/EPA HABITATS FORESTS/SCRUBS%	0
TEAGASC/EPA HABITATS WATER%	10
TEAGASC/EPA HABITATS DRY GRASSLAND%	79
TEAGASC/EPA HABITATS WET GRASSLAND%	10
TEAGASC TOTAL GRASSLAND%	1
TOTAL LIVESTOCK UNIT/ha of ZOC	0
TILLAGE%	8
No. SEPTIC TANKS km^{-2} ZOC	5
No. SEPTIC TANKS km^{-2} EXTREME PATHWAY SUSCEPTIBILITY	1
HIGH PATHWAY SUSCEPTIBILITY%	19
EXTR+HIGH PATHWAY SUSCEPTIBILITY%	73
WELL DRAINED SOIL %	16
POORLY DRAINED SOIL%	0

Site Conservation Assessment

The following site conservation assessment was undertaken to feed into the national reporting structure for assessing conservation status as required under Article 17 of the Habitats Directive. A suite of indicators and associated targets were derived to assess ecological structure and function. Future prospects were assessed through the evaluation of the impact of current and recent pressures and likely future threats to the site. The assessment follows a rules based approach to determine whether Structures & functions and Future Prospects should be assessed as good (green), inadequate (amber) or bad (red). For further details, see Chapter 10 (Conservation Status Assessment).

Please note an updated approach to assessing site condition has been proposed and is outlined in Chapter 12 (Monitoring Methods for Turloughs).

Conservation Condition Summary

Structure & Function	**Inadequate**
Future Prospects	**Inadequate**
Site Conservation Condition	**Inadequate**

Structure and Function Status:

Indicator	*Comments*
Hydrological Function: ***Good***	
Water Quality: ***Intermediate***	25.0 µg P l^{-1}. Towards the lower end of this category.
Biological Responses: ***Intermediate***	Moderate vegetation interest but contains important aquatic invertebrates
Algal communities: -1	Algal mats were recorded in 2008 but were not extensive; however max CHL is high
Vegetation communities: 0	Low cover of negative indicators, but a complete lack of positive indicators
Rumex **cover: 0**	17.3%
Important plants: 0	None recorded
Important aquatic invertebrates: 2	*Alona rustica, Alonella exisa, Eurycercus glacialis*
Overall Structure & Function: ***Inadequate***	

Pressures:

Code	*Impact*	*Notes*
A04.01.01 Intensive cattle grazing (turlough)	M	
H02.06 Diffuse groundwater pollution due to agricultural and forestry activities (ZOC)	M	
H02.07 Diffuse groundwater pollution due to non-sewered population (ZOC)	L	Relatively modest number of dwellings in the ZOC
A05.02 Stock feeding (within and adjacent to turlough)	L	Some evidence of stock feeding within the turlough

Threats:

Code	Impact	Notes
A04.01.01 Intensive cattle grazing (turlough)	M	Continuing pressure
H02.06 Diffuse groundwater pollution due to agricultural and forestry activities (ZOC)	M	Pressure likely to continue due to prevalence of pasture in ZOC
A02.01 Agricultural intensification (ZOC)	L	Likely to increase moderately due to prevalence of pasture in ZOC
A10.02 Removal of stone walls and embankments (in turlough)	L	
M01.03 Flooding and rising precipitations	L	
H02.07 Diffuse groundwater pollution due to non-sewered population (ZOC)	L	
A02.03 Grassland removal for arable land (ZOC)	L	

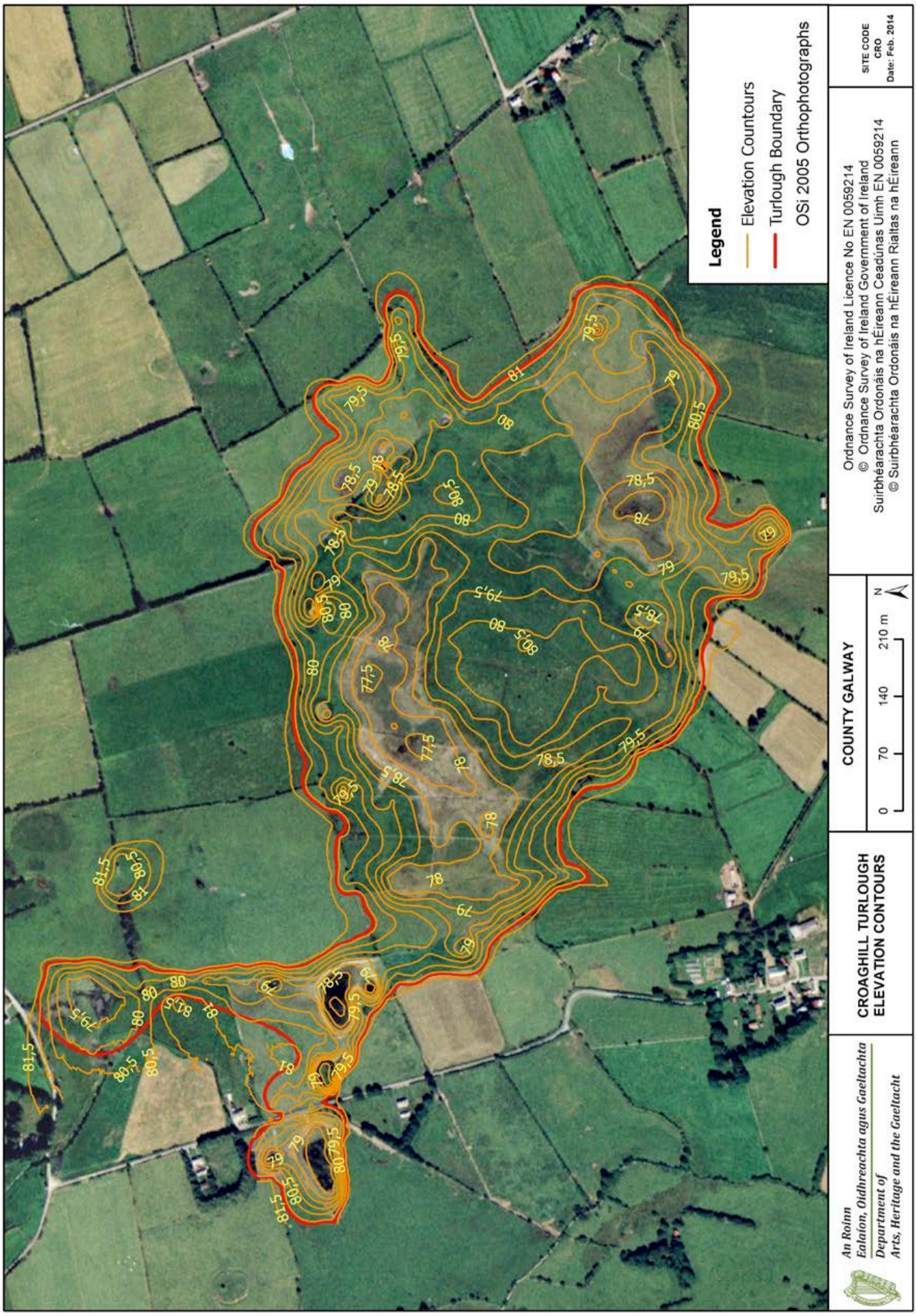
Future Prospects: **Inadequate** – as with Coolcam, relatively moderate to low threats, but current pressures not likely to be reduced to allow the current inadequate structure and functioning (poorer than Coolcam) to improve.

Overall Assessment: **Inadequate** – for reasons just outlined. Likely to be less easy to restore to favourable status than Coolcam, as very few notable plants or important vegetation communities occur; however, Croaghill contains important aquatic invertebrates, and water chemistry is reasonable. Perhaps a reduction in grazing might allow vegetation to recover over time, and might reduce local nutrient inputs thereby facilitating continued survival of important aquatic invertebrates.

Maps

Maps are provided of:

1. Elevation contours, based on GIS digital terrain models from points by differential GPS topographic survey (for further details, see *Chapter 3: Hydrology*)
2. Grazing in land parcels
3. Approximate sampling points for water chemistry and aquatic invertebrates
4. Soil nutrient sampling points
5. Points for soil survey (note: soils were surveyed to the turlough boundary defined by Goodwillie, 1992; see map 9)
6. Soils (note: soils were mapped by combining the EPA Subsoils base map with the point soil descriptions; for further details see *Chapter 6: Soils and Landuse*)
7. Vegetation relevés
8. Vegetation communities (note: relevés do not always match to mapped communities due to small scale variation; for further details of mapping see *Chapter 7: Turlough Vegetation: Description, Mapping and Ecology*)
9. Vegetation maps digitised from Goodwillie, R. (1992) *Turlough's Over 50 Hectares*. Report to NPWS
10. Estimated zone of groundwater contribution (ZOC)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Elevation Countours
Turlough Boundary
OSi 2005 Orthophotographs
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SITE CODE
CRO
Date: Feb. 2014
COUNTY GALWAY
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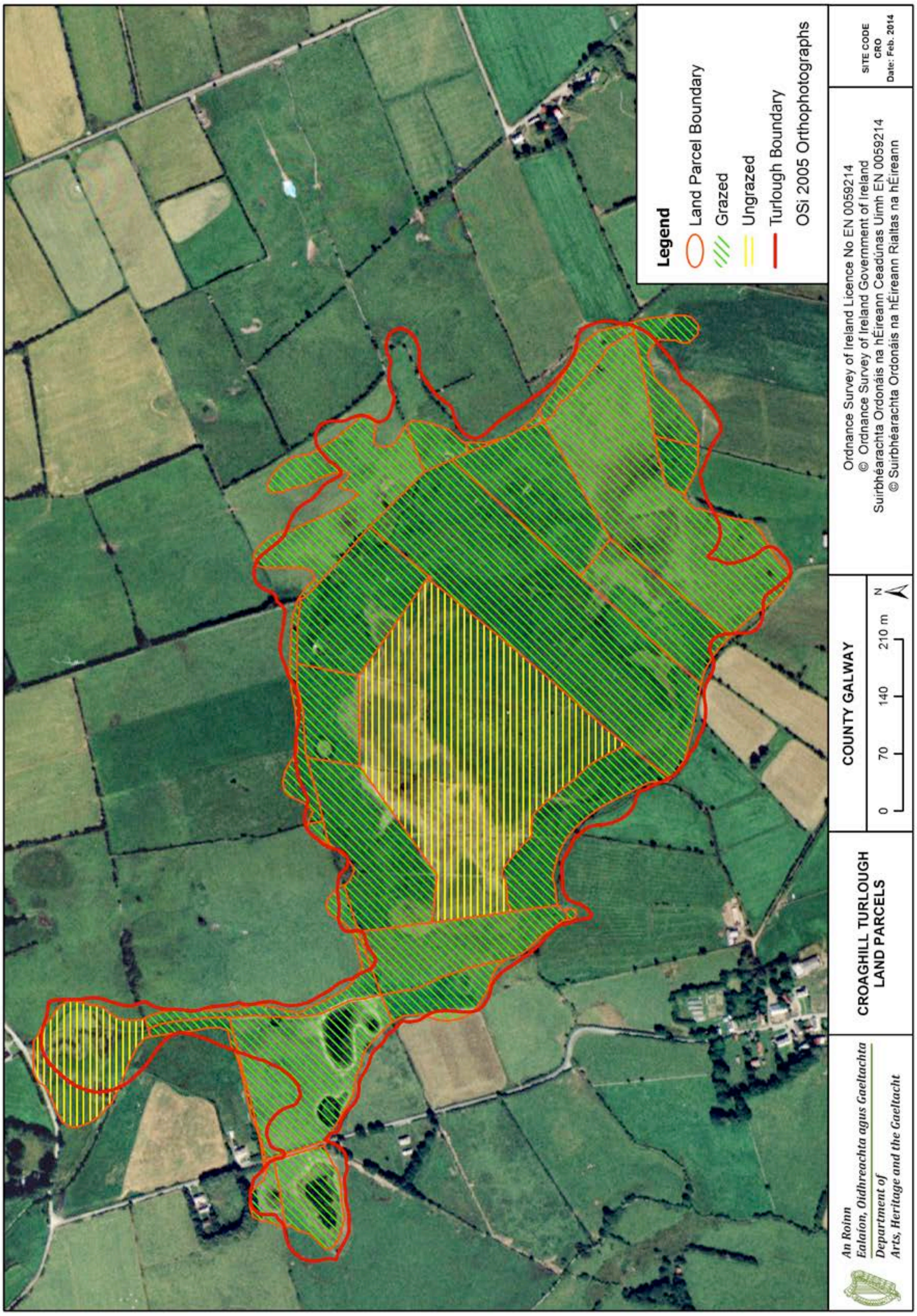
CROAGHILL TURLOUGH
ELEVATION CONTOURS
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht


Legend
Land Parcel Boundary
Grazed
Ungrazed
Turlough Boundary
OSi 2005 Orthophotographs
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Date: Feb. 2014
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COUNTY GALWAY
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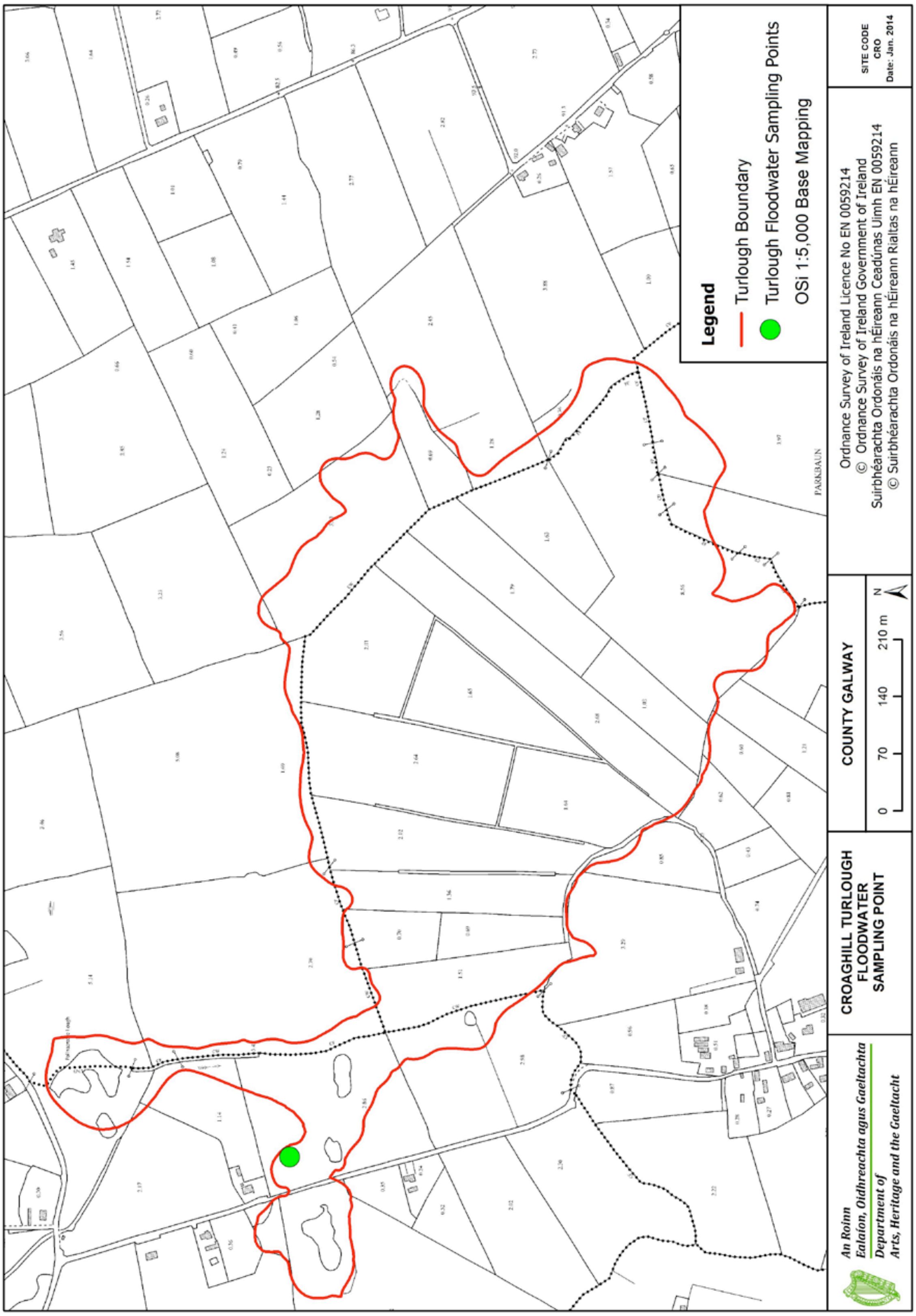
CROAGHILL TURLOUGH
LAND PARCELS
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht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Turlough Boundary
Turlough Floodwater Sampling Points
OSi 1:5,000 Base Mapping
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Date: Jan. 2014
COUNTY GALWAY
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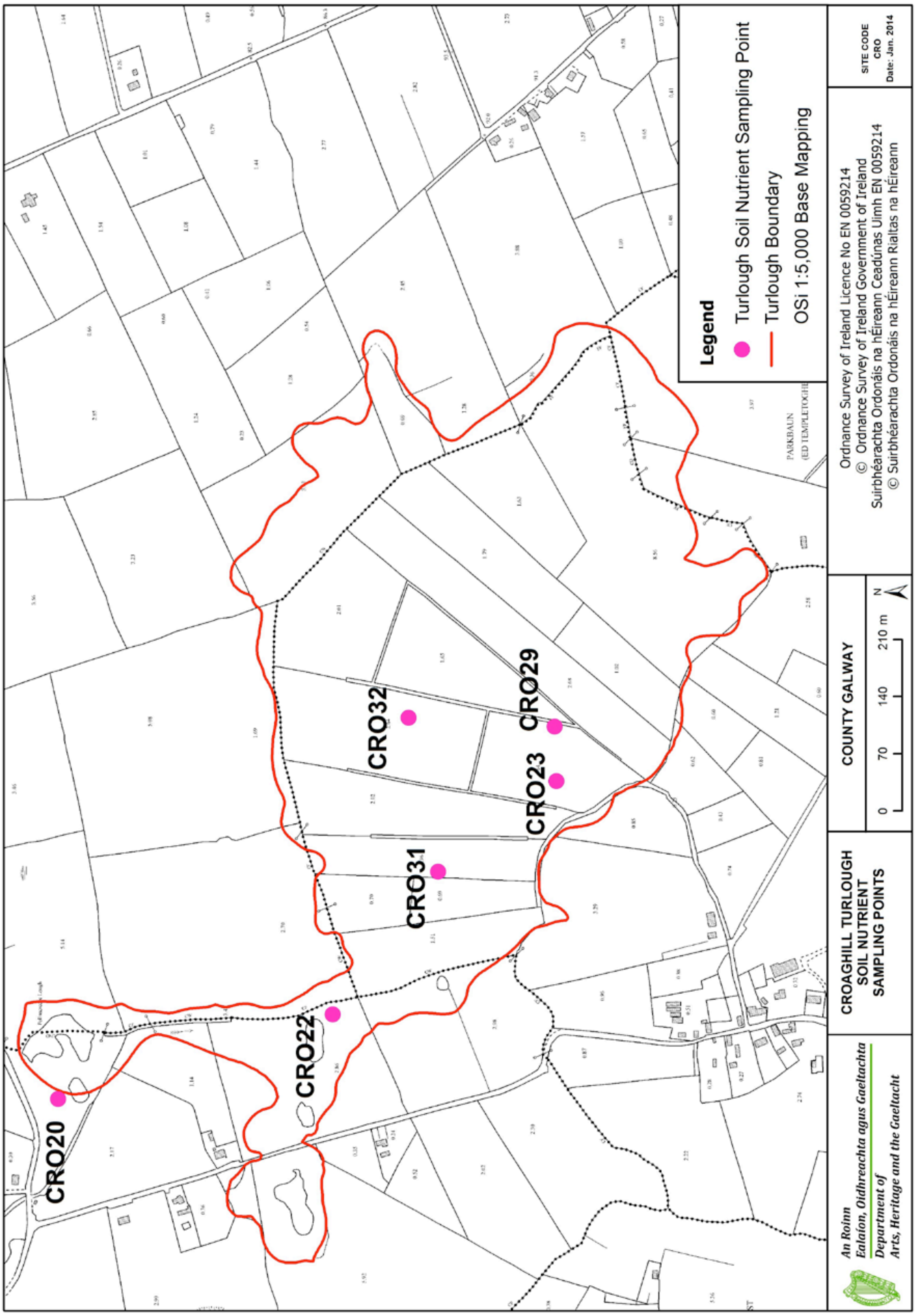
CROAGHILL TURLOUGH FLOODWATER SAMPLING POINT
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht
PARKBAUN


CRO20
CRO22
CRO31
CRO23
CRO32
CRO29
Legend
Turlough Soil Nutrient Sampling Point
Turlough Boundary
OSi 1:5,000 Base Mapping
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Date: Jan. 2014
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CROAGHILL TURLOUGH
SOIL NUTRIENT
SAMPLING POINTS
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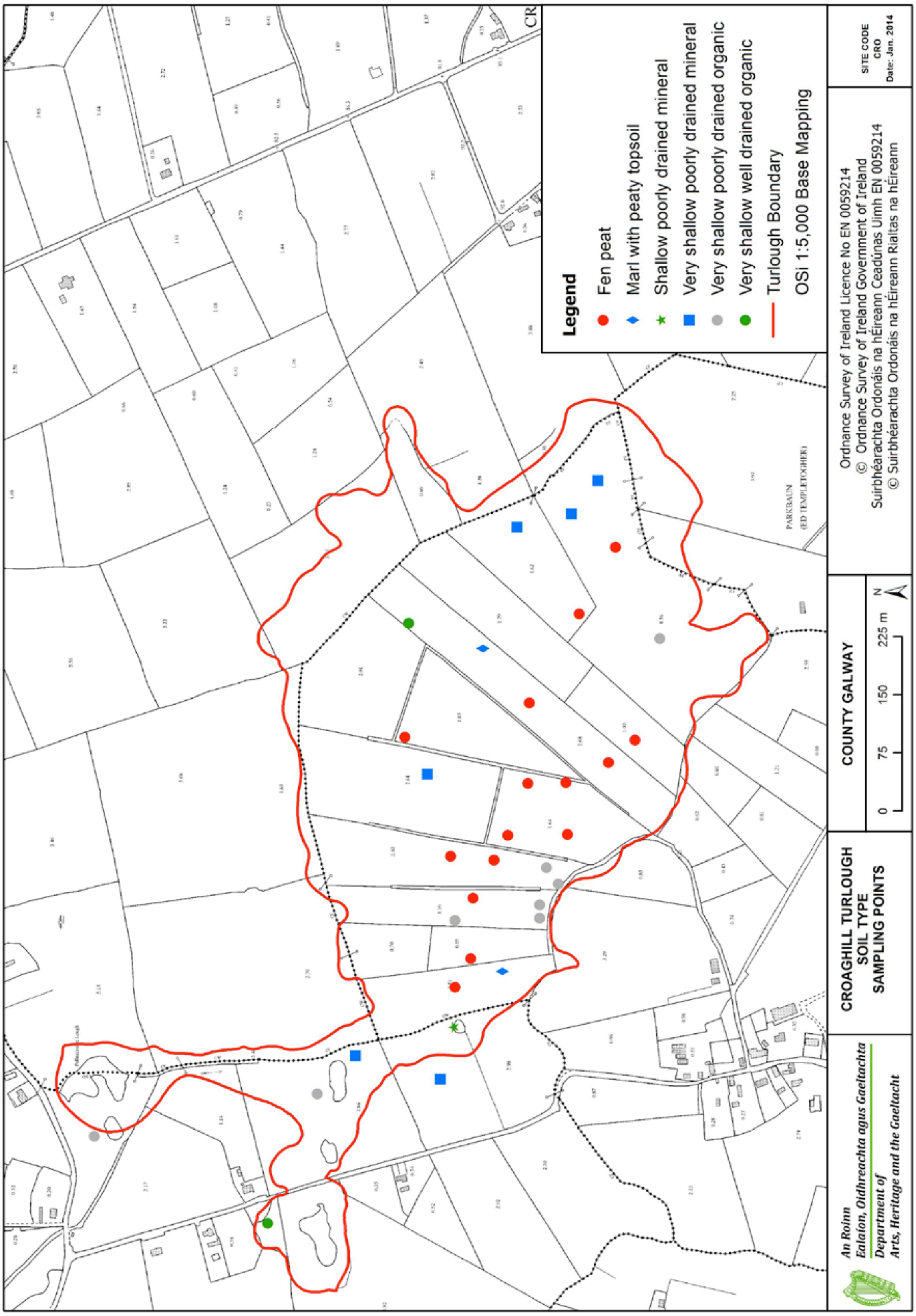
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht
PARKBAUN
(ED TEMPLETOGHER)


Legend
Fen peat
Marl with peaty topsoil
Shallow poorly drained mineral
Very shallow poorly drained mineral
Very shallow poorly drained organic
Very shallow well drained organic
Turlough Boundary
OSi 1:5,000 Base Mapping
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SITE CODE
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Date: Jan. 2014
PARKBAUN
(ED TEMPLETOGHER)
COUNTY GALWAY
0 75 150 225 m
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CROAGHILL TURLOUGH
SOIL TYPE
SAMPLING POINTS
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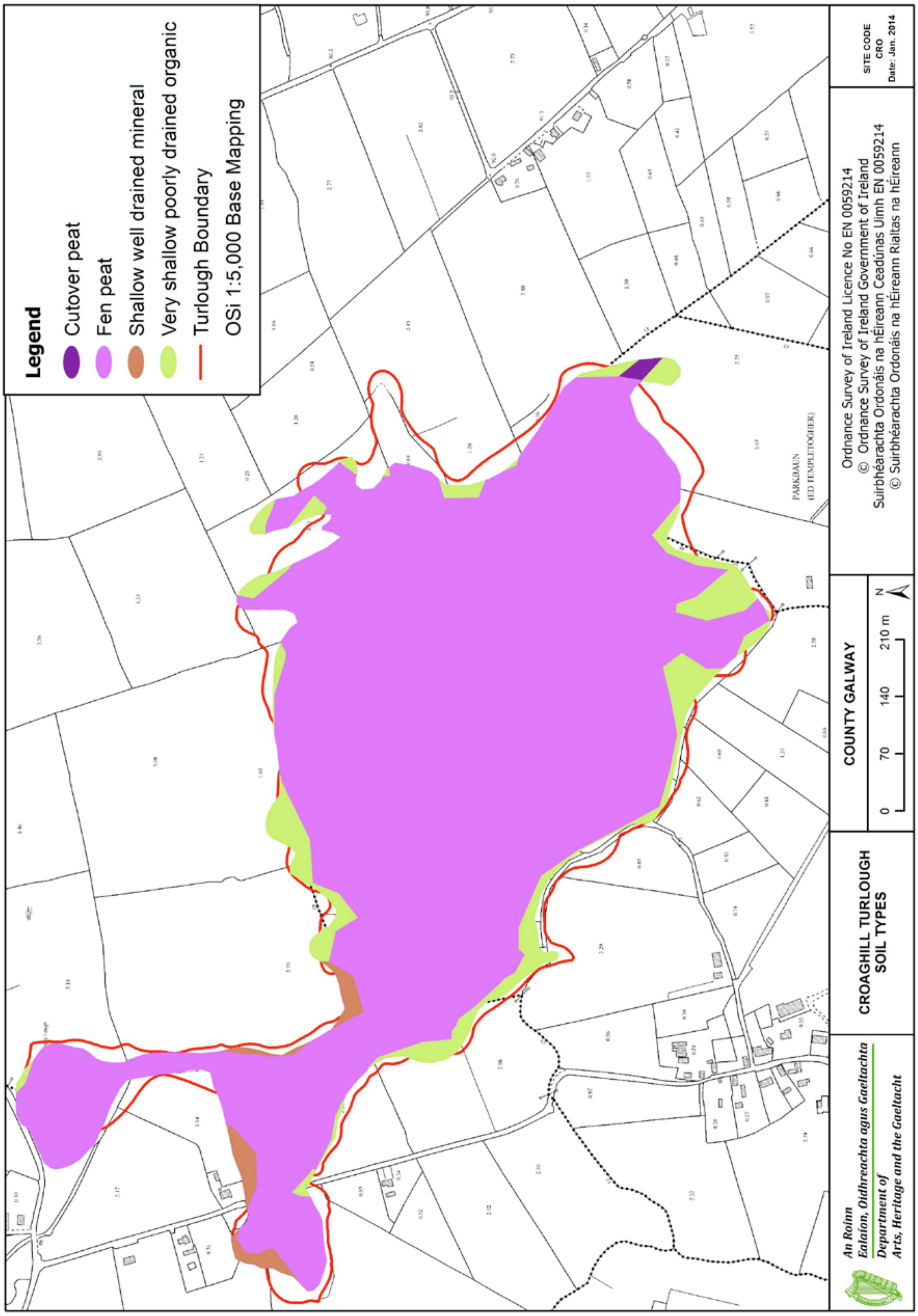
Department of
Arts, Heritage and the Gaeltacht



Legend
Cutover peat
Fen peat
Shallow well drained mineral
Very shallow poorly drained organic
Turlough Boundary
OSi 1:5,000 Base Mapping
PARKBAUN
(ED TEMPLETOGHER)
CROAGHILL TURLOUGH
SOIL TYPES
COUNTY GALWAY
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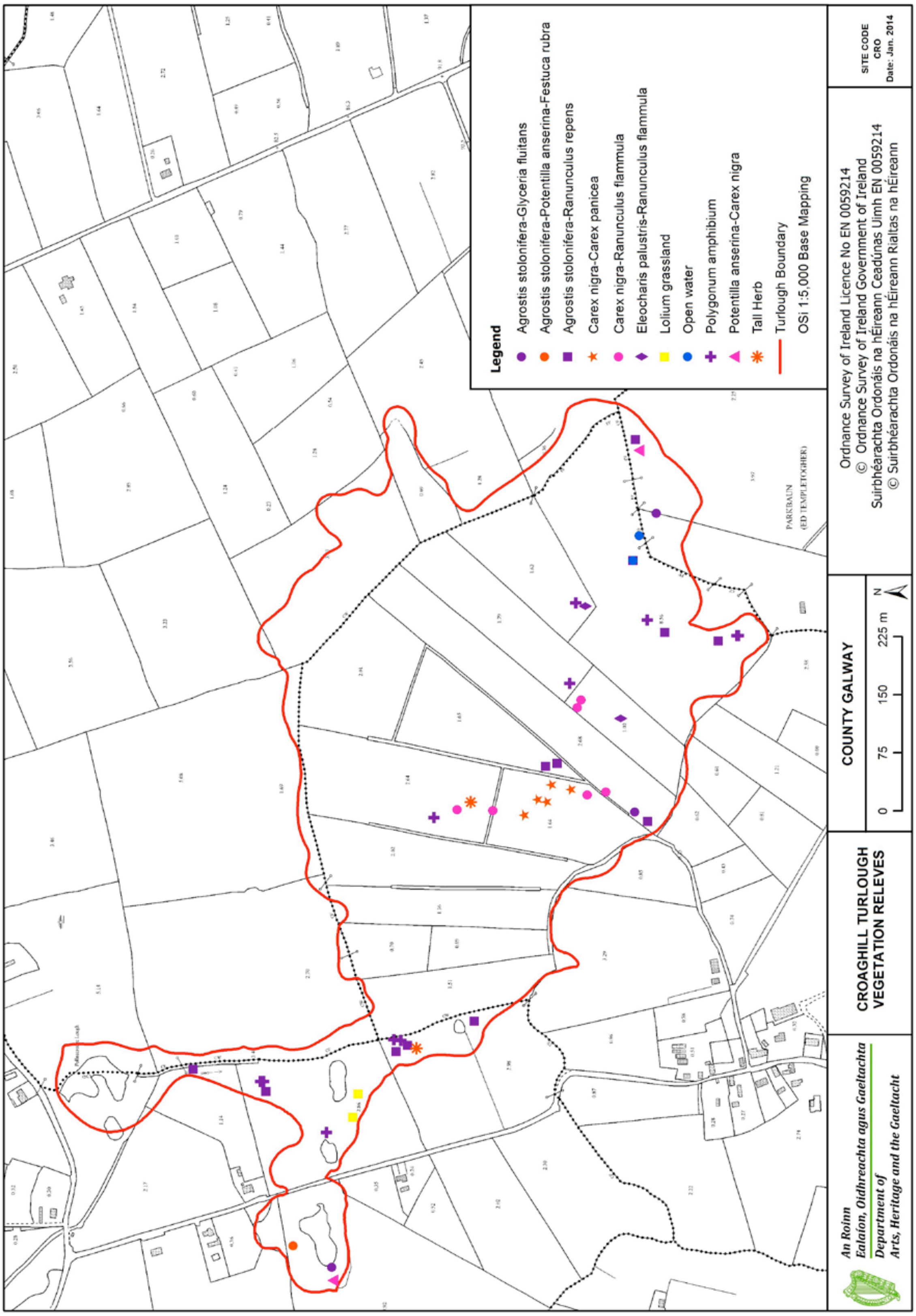
Arts, Heritage and the Gaeltacht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Agrostis stolonifera-Glyceria fluitans
Agrostis stolonifera-Potentilla anserina-Festuca rubra
Agrostis stolonifera-Ranunculus repens
Carex nigra-Carex panicea
Carex nigra-Ranunculus flammula
Eleocharis palustris-Ranunculus flammula
Lolium grassland
Open water
Polygonum amphibium
Potentilla anserina-Carex nigra
Tall Herb
Turlough Boundary
OSi 1:5,000 Base Mapping
PARKBAUN
(ED TEMPLETOGHER)
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CROAGHILL TURLOUGH
VEGETATION RELEVES
COUNTY GALWAY
0
75
150
225 m
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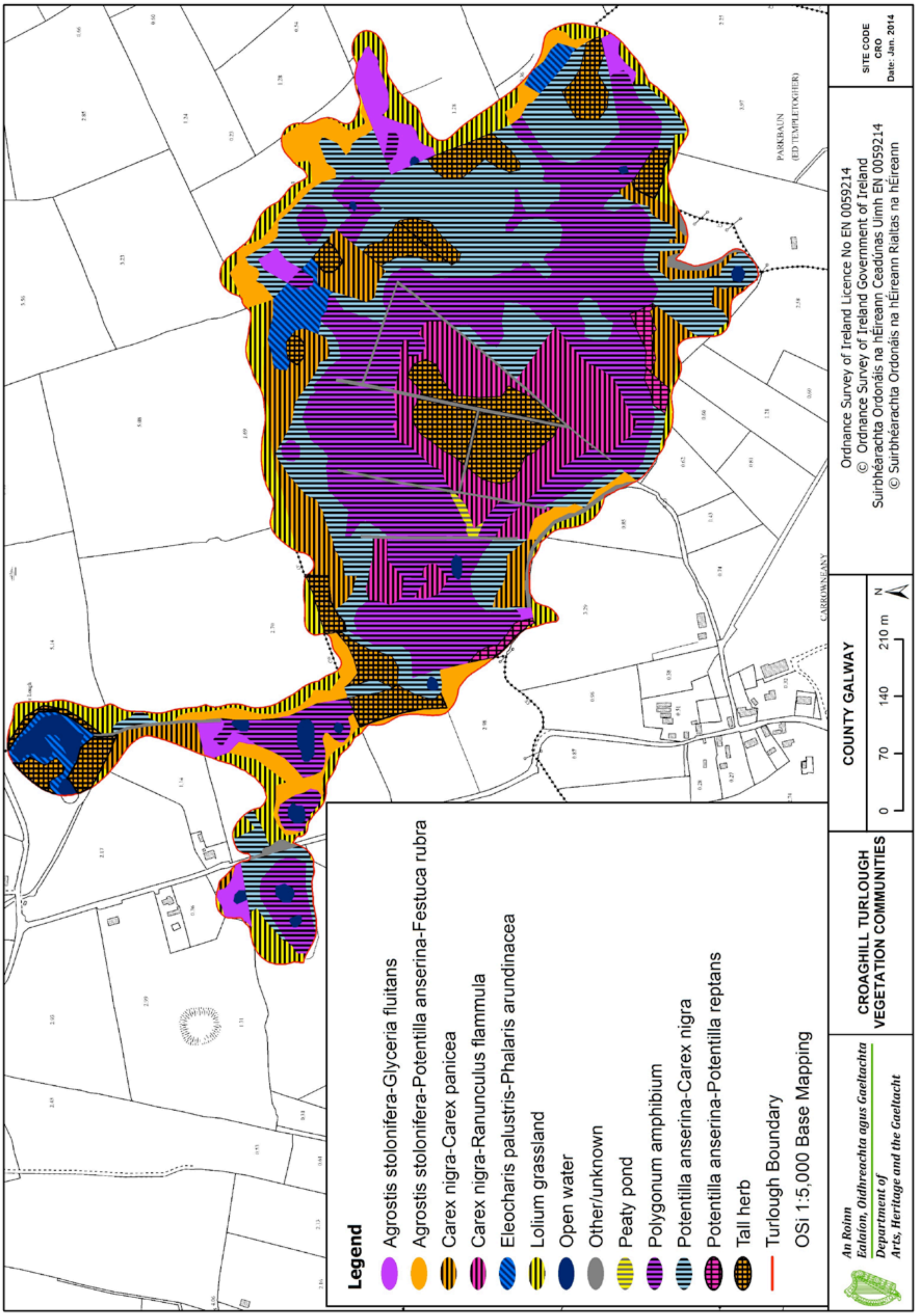
Legend
Agrostis stolonifera-Glyceria fluitans
Agrostis stolonifera-Potentilla anserina-Festuca rubra
Carex nigra-Carex panicea
Carex nigra-Ranunculus flammula
Eleocharis palustris-Phalaris arundinacea
Lolium grassland
Open water
Other/unknown
Peaty pond
Polygonum amphibium
Potentilla anserina-Carex nigra
Potentilla anserina-Potentilla reptans
Tall herb
Turlough Boundary
OSi 1:5,000 Base Mapping
PARKRAUN
(ED TEMPLETOGHER)
CARROWNEANY
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
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CROAGHILL TURLOUGH
VEGETATION COMMUNITIES
COUNTY GALWAY
0 70 140 210 m
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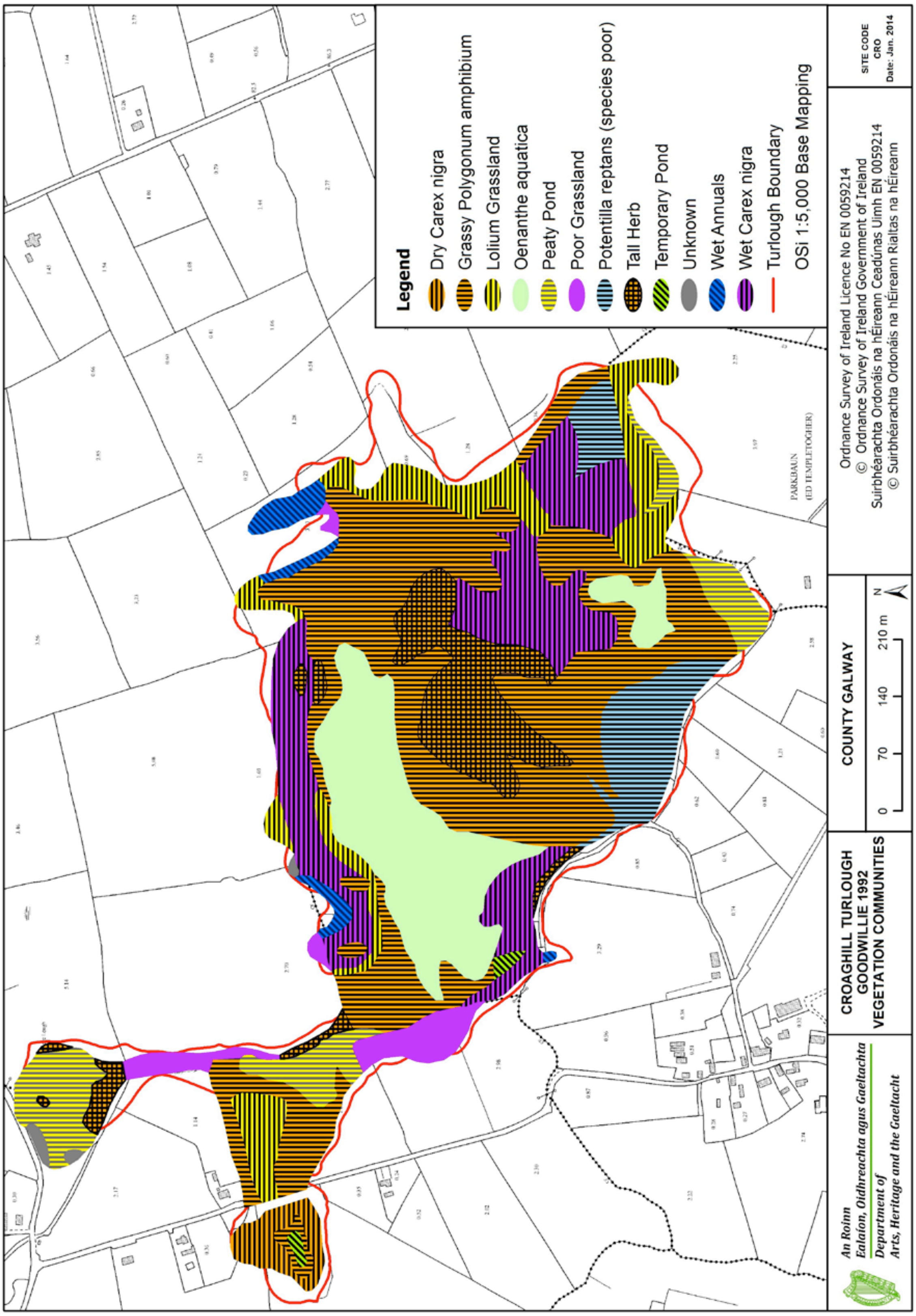
Legend
Dry Carex nigra
Grassy Polygonum amphibium
Lolium Grassland
Oenanthe aquatica
Peaty Pond
Poor Grassland
Potentilla reptans (species poor)
Tall Herb
Temporary Pond
Unknown
Wet Annuals
Wet Carex nigra
Turlough Boundary
OSi 1:5,000 Base Mapping
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Date: Jan. 2014
COUNTY GALWAY
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CROAGHILL TURLOUGH
GOODWILLIE 1992
VEGETATION COMMUNITIES
An Roinn
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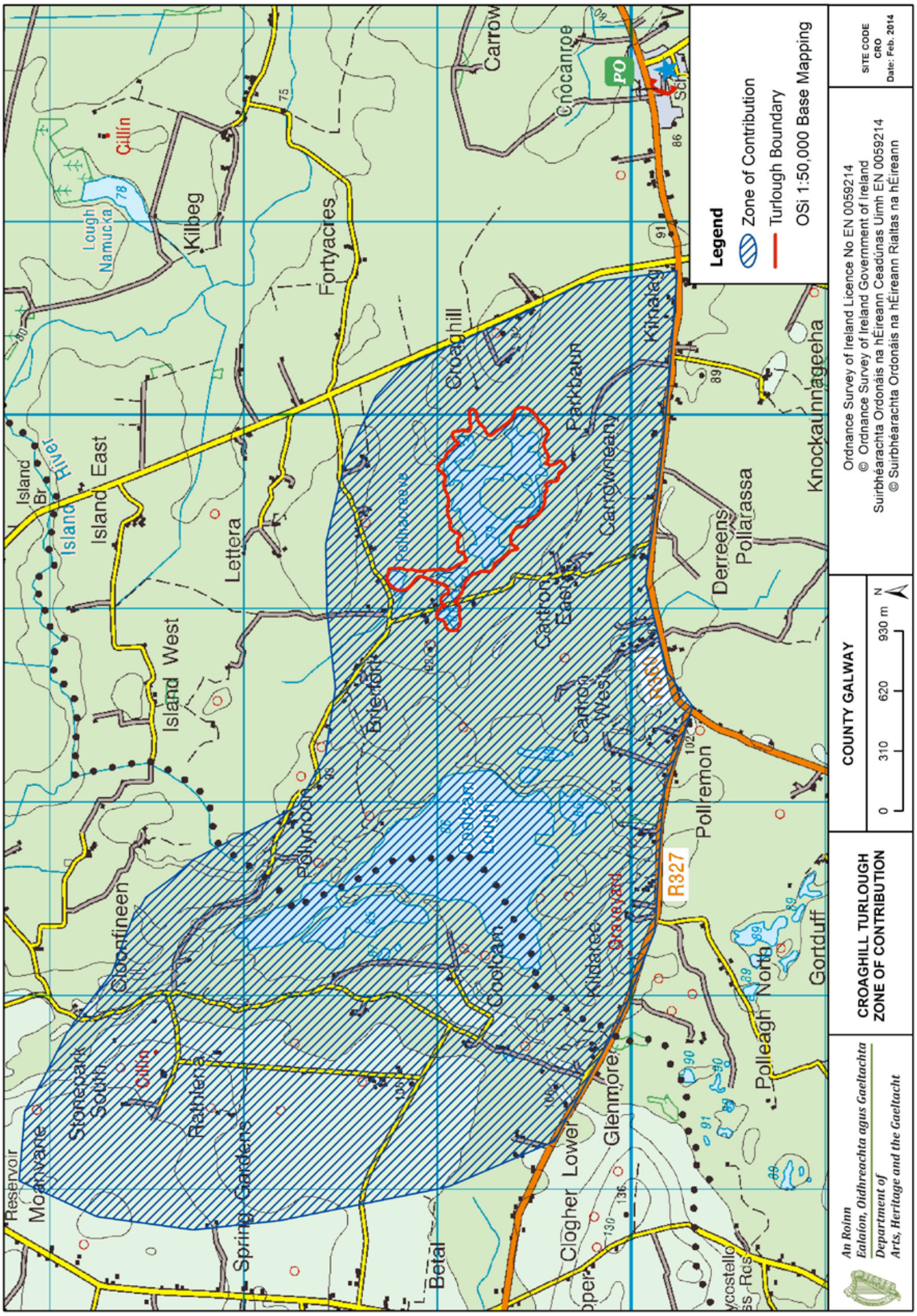
PARKBAUN
(ED TEMPLETOGHER)


CROAGHILL TURLOUGH
ZONE OF CONTRIBUTION
COUNTY GALWAY
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SITE CODE
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Date: Feb. 2014
Legend
Zone of Contribution
Turlough Boundary
OSi 1:50,000 Base Mapping
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Croaghill
Coolcam Lough
Pollnacroeve
R327
R360
Island River
Lough Namucka
Island East
Island West
Lettera
Fortyacres
Kilbeg
Cloonfineen
Stonepark South
Rathlena
Spring Gardens
Moanvane
Pollynoon
Briarfort
Coolcam
Kildaree
Glenmore
Cartron East
Cartron West
Carrowneany
Parkbaun
Kilnalag
Chocanroe
Derreens
Pollarassa
Knockaunnageeha
Pollremon
Gortduff
Polleagh North
Clogher Lower
Betal
Cillín
Graveyard
Reservoir

Site Report: Garryland Turlough
TCD Turlough Research project 2006-2011

Turlough Project Code	SAC Name	SAC/NHA No.	County	Townland	RBD	Easting	Northing	Area (ha)
GAR	Coole-Garryland Complex	000252	Galway	Garryland	WESTERN	141750	204050	20

File update: July 2015 (S. Waldren)

Site Description

Garryland turlough lies near Gort in south-east Co. Galway and within the sprawling Coole-Garryland SAC complex. The turlough is a relatively compact basin (20 ha), surrounded by woodland. The site is characterised by smooth, often steep grassy slopes and a central ridge, which gives the turlough a horseshoe shape (Goodwillie, 1992). Large boulders are scattered throughout the site and a rocky outcrop occurs in the western section of the basin. Only five vegetation communities were recorded at this site, the dominant vegetation type was *Agrostis stolonifera - Ranunculus repens*. Garryland soils are moderately acidic and inorganic, with low amounts of calcium carbonate. The soils are comprised of shallow, poorly-drained mineral soil types. All of the turlough is under rotational grazing. The absence of fencing or stone walls and the presence of very closely cropped vegetation distinguish this turlough from the other study sites. Hydrological data indicate that the site has an above average drainage capacity and a relatively flashy hydrological regime, with often more than one significant flood event occurring per annum.

Garryland – photo: S. Kimberley

Phytoplankton

Phytoplankton analysis was conducted on sub-samples of monthly spot samples collected for hydrochemical analysis between October 2006 and June 2007. Phytoplankton composition varies significantly over time and data from autumn, mid-winter and spring/early summer are presented below. Taxa were identified to species level where possible. Some taxa were not discriminated beyond general groupings (i.e. small centric diatoms, dinoflagellates and pinnate diatoms). The term non-identifiable alone (or n.i.) was reserved for cases where specimens were not identifiable. Discrimination between n.i. filament, n.i. flagellate, n.i. colony, n.i. green filament was made when applicable. Biovolume (mm^3 m^{-3}) was used as the measure of algal biomass.

October 2006		**January 2007**		**May 2007**	
Biovolume (mm^3/m^3)	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*
Mallomonas	6214	n.i. pennates	535	Eunotia faba	227299
n.i. centrics	2708	Monoraphidium	364	Cryptomonas	153936
Aulacoseira	946	n.i.	269	Monoraphidium	47226
n.i. pennates	774	Fragilaria/Synedra	211	Eudorina	26095
Mallomonas akrokomos	737	Chroomonas acuta	201	Achnanthidium minutissima	3665

Benthic Algae

Turloughs were inspected for algal mats during the emptying phase in 2007, 2008 and 2009. Turloughs were visited in the first two weeks of March to June 2007 as part of the monthly monitoring of turloughs. Dedicated trips to inspect for algal mats were conducted in 2008 on the 4th of March, the 1st of April, and the 26th, 27th and 28th of May, and in 2009 on the 15th and 16th of June and on the 24th and 25th of July. The presence of both living floating mats and dead drying mats was noted, as well as their extent in the turlough basins. Occurrence of visible filamentous algal mats in the three years of observation is presented below. Y = visible occurrence; * = "extensive cover" (estimated to be 2 to 8% of total area of basin); † = negligible quantity observed; • = turlough was too flooded to permit full observation. Extensive algal mats were observed in Garryland in 2008, the water level was too high in 2009 to accurately determine any presence of algal mats.

Year of Observation		
2007	**2008**	**2009**
N	Y*	•

Hydrochemistry

Data shown are the mean ± SD of monthly spot samples collected between October 2006 and June 2007. Mean seasonal Total P and Chlorophyll *a* were used to determine the trophic status of the floodwaters based on OECD trophic categories. The median and range of mean values across all turloughs are also provided.

Hydrochemical Variable	Garryland Values		Turlough Summary Stats (n=22)		
	Mean±SD	OECD Trophic Category	Median	Min	Max
pH	7.7		8.1	7.7	8.3
Alkalinity mg l^{-1} $CaCO_3$	122.1		204.0	112.4	236.4
Colour mg l^{-1} PtCo	79.7		26.9	7.9	85.1
Molybdate Reactive Phosphorus µg l^{-1}	10.9		3.4	0.7	42.1
Total Phosphorus µg l^{-1}	24.6	Mesotrophic	24.8	4.0	82.1
Chlorophyll *a* µg l^{-1}	1.1	Oligotrophic	4.9	1.1	33.5
Nitrate-N mg l^{-1}	0.6		0.7	0.1	1.9
Total Nitrogen mg l^{-1}	1.1		1.2	0.6	2.3

Aquatic Invertebrates

22 turloughs were sampled for littoral aquatic macroinvertebrates using sweep nets during November 2006 and April 2007. Zooplankton samples were collected in April 2007. Open-water cladocerans and littoral chydorids were sampled using a zooplankton net and perspex tube respectively.

Aquatic Macroinvertebrates			
November 2006	**Count**	**April 2007**	**Count**
Agabus sp (larva)	33	*Agabus* sp. (larva)	57
Apatania sp.	2	Anisoptera sp. (larva)	2
Asellus aquaticus	2	*Asellus meridianus*	386
Asellus meridianus	18	Chironomidae	37
Cloeon dipterum	324	*Cloeon dipterum*	252
Coenagrionidae	4	*Corixa punctata*	2
Corixa punctata/iberica	2	Diptera Pupae	18
Diptera Pupae	2	*Dryops* sp. (larva)	5
Dryops sp (larva)	2	*Gammarus lacustris*	5
Gammarus lacustris	4	*Hydrachnidia* (Mite)	12
Helobdella stagnalis	4	*Hygrobia hermanni*	1
Hygrotus quinquelineatus	2	*Hygrotus quinquelineatus*	33
Oligochaeta	28	*Notonecta glauca*	2
Ostracoda	12	Oligochaeta	2
Polycelis nigra/tenuis	4	Ostracoda	33
		Planorbis contortus	2
		Planorbis leucostoma	2
		Planorbis planorbis	24
		Porhydrus lineatus	2
		Rhantus sp. (larva)	2
		Zygoptera sp. (larva)	5

Aquatic Macroinvertebrates: Presence of high abundances (> 50 individuals) of Diptera recorded in April 2007 indicates nutrient enrichment.

Aquatic Macroinvertebrate Taxa	**Presence of high abundances**	
	November 2006	**April 2007**
Diptera	N	Y
Ostracoda	N	N
Odonata	N	N
Trichoptera	N	N

Zooplankton species
Alona affinis
Alona guttata
Alona quadrangularis
Alonella excisa
Chydorus sphaericus
Daphnia pulex
Pleuroxus laevis
Pleuroxus trigonellus
Polyphemus pediculus

Vegetation

Vegetation description and classification yielded 25 vegetation communities suitable for mapping. Garryland has a low diversity of plant communities and only five were recorded, the dominant vegetation type was *Agrostis stolonifera - Ranunculus repens.* High conservation value communities are denoted by *. Fifty-eigth plant species were recorded, amongst which *Limosella aquatica, Rorippa islandica* and *Viola persicifolia* were notable.

Vegetation Community	Area (Ha)
A. stolonifera-R. repens	11.27
Carex nigra-C. panicea	0.51
**Eleocharis acicularis*	0.4
**F. ulmaria-P. erecta-Viola sp*	2.07
Other/unknown	3.59
Woodland/scrub	2.48
Number of vegetation communities	5
Number of plant species	59

Vascular Plant Species

Nomenclature follows Parnell, J & Curtis, T. (2012) *Webb's An Irish Flora*, University of Cork Press.

Achillea ptarmica	*Galium palustre*	*Polygonum arenastrum*
Agrostis stolonifera	*Galium uliginosum*	*Polygonum aviculare*
Bellis perennis	*Galium verum*	*Polygonum hydropiper*
Callitriche sp	*Gnaphalium uliginosum*	*Polygonum minus*
Carex hirta	*Hydrocotyle vulgaris*	*Polygonum persicaria*
Carex hostiana	*Iris pseudacorus*	*Potentilla anserina*
Carex nigra	*Juncus acutiflorus*	*Potentilla erecta*
Carex panicea	*Juncus articulatus*	*Potentilla reptans*
Carex vesicaria	*Leontodon autumnalis*	*Prunella vulgaris*
Cerastium fontanum	*Leontodon hispidus*	*Ranunculus repens*
Chenopodium rubrum	*Leontodon saxatilis*	*Ranunculus trichophyllus*
Eleocharis acicularis	*Limosella aquatica*	*Rorippa amphibia*
Eleocharis palustris	*Lolium perenne*	*Rorippa islandica*
Equisetum fluviatile	*Lotus corniculatus*	*Rumex conglomeratus*
Euphrasia species	*Lythrum portula*	*Taraxacum officinale* agg.
Festuca arundinacea	*Mentha aquatica*	*Trifolium repens*
Festuca ovina	*Phalaris arundinacea*	*Urtica dioica*
Festuca pratensis	*Plantago major*	*Viola canina*
Filipendula ulmaria	*Poa annua*	*Viola persicifolia*
Galium boreale	*Polygonum amphibium*	

Soils and Grazing

Soils were classified using a modified version of soil categories generated by the Teagasc/EPA Soils and Subsoils Mapping project (Fealy *et al.*, 2009). The classification scheme principally uses parent material (calcareous/non-calcareous), depth class (shallow/deep) and drainage class (well drained/poorly drained) to assign soils to one of nine broad categories. Garryland has extensive areas of mineral soils. The mean ± SD of a range of soil properties are also provided, in addition to the median and range of each variable across turloughs. Garryland soils are moderately acidic and inorganic, with low amounts of calcium carbonate.

Soil Types/Grazing Extent	% Turlough Area
Very shallow poorly drained mineral	50.6
Shallow poorly drained mineral	44.3
Deep poorly drained mineral	5.1
Extent of rotationally grazed area	100

Soil Property (n=6)	Garryland	Turlough Summary Stats (n=22)		
	Mean ± SD	Median	Min	Max
pH	5.9 ± 0.6	7.20	5.94	8.29
% Organic Matter content	22.6 ± 8.4	25.8	10.2	69.1
% Inorganic content	71.6 ± 8.6	43.2	25.7	85.0
% Calcium carbonate content	5.8 ± 0.4	11.3	2.48	43.7
Total Nitrogen mg kg^{-1}	9756 ± 3379	11142	4983	24233
Total Phosphorus mg kg^{-1}	920 ± 270	905	245	1594

Hydrology

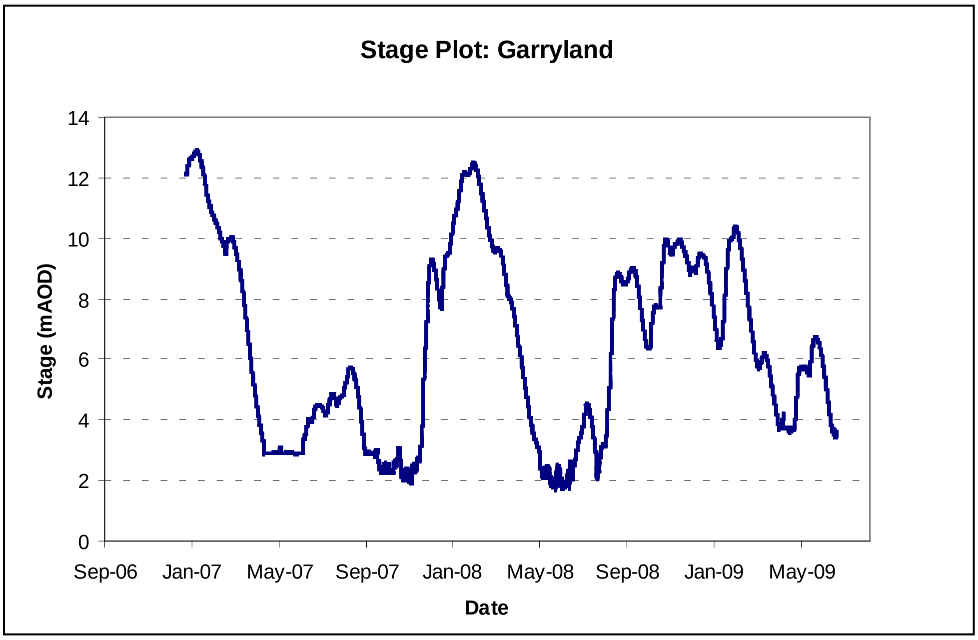
Water levels were recorded at hourly intervals using a variety of Schlumberger Divers® (Marton Geotechnical Ltd, Suffolk, UK) placed at or near the lowest point in each turlough. Divers measure the pressure of the water and air column above them, and from this the depth of water can be calculated. GPS surveys were carried out on 21 monitoring sites (Tullynafrankagh omitted) in order to develop digital terrain models (DTMs) from which contour maps, stage-volume and stage-surface area relationships are produced. The inflow magnitude is indicative of the properties of a turlough's catchment area and flow capacity, while outflow is a function of the drainage capacity of the system.

Hydrological data indicate that the site has an above average drainage capacity and a relatively flashy hydrological regime, with often more than one significant flood event occurring per annum. Inflow, outflow and drainage are all moderately high, and the recession duration is average.

Garryland forms part of a series of conduit fed turloughs which includes Blackrock (also known as Peterswell), Lough Coy, Coole, and Caherglassan. Blackrock, the first in the series, is partly fed by the Owenshree river which drains from the Slieve Aughty mountains, which have acidic bedrock. This system consequently has a very large zone of groundwater contribution.

Hydrological Information	Garryland Values	Turlough Summary Stats (n=21)		
		Median	Min	Max
Start of Hydrological Recording	10/01/2007	-	-	-
End of Hydrological Recording	23/06/2009	-	-	-
Days Recorded	895	-	-	-
Equipment Failure	None recorded	-	-	-
Hydroperiod (days)	211	213	135	348
Maximum Floodwater Depth (m)	10.9	4.9	3	15.4
Maximum Floodwater Volume ('000 m^3)	2330.4	877.9	355.6	4008.1
Maximum Flooded Area	42.08	38.61	13.71	78.12
Average Basin Depth (m)	5.54	2.28	0.85	6.76
Average Daily Inflow ($m^3 s^{-1}$)	1.832	0.684	0.254	10.253
Average Daily Outflow ($m^3 s^{-1}$)	0.626	0.271	0.086	2.018
Drainage Capacity ($m^3 s^{-1}$)	0.496	0.154	0.069	1.156
Recession Duration (days)	54.4	57.3	11	142.5

Stage plot for Garryland turlough



Zone of Groundwater Contribution (ZOC) Risk Assessments

GIS based risk assessments were conducted with a view to identifying turloughs at risk of failing to meet WFD water quality objectives. These risk assessments were conducted by Compass Informatics Ltd and were based on Risk Assessment Sheet GWDTERA2a (Guidance Document No. GW9) on assessing risks to turloughs from phosphate (Working Group on Groundwater 2004) and Pathway Susceptibilities and Pressure Magnitudes were integrated to produce Impact Potential maps and predicted Risk Categories for the turlough ZOC. The TCD Risk Category is derived from a revised Impact Potential matrix. The predicted Risk Categories were adjusted using mean seasonal floodwater Total P ($\mu g\ l^{-1}$) (see Section 4.5.4 of the Risk Assessment Sheet GWDTERA2a). The risk categories include 1A: at significant risk; 1B: probably at significant risk; 2A: Not at significant risk (low confidence); 2B: Not at significant risk (higher confidence).

ZOC Area (Km^2)	Predicted WFD Risk Category	Adjusted WFD Risk Category	Predicted TCD Risk Category	Adjusted TCD Risk Category
393	2B	1B	1B	1B

ZOC Pressure Variable	
CORINE BARE ROCK %	6
CORINE PEAT BOGS%	16
CORINE ALL NATURAL AND SEMI-NATURAL AREAS%	29
CORINE IMPROVED PASTURE%	21
CORINE UNIMPROVED PASTURE%	17
CORINE ALL PASTURE%	38
CORINE OTHER AGRICULTURAL LANDS%	9
TEAGASC/EPA HABITATS ROCK%	6
TEAGASC/EPA HABITATS BOGS/PEATS%	19
TEAGASC/EPA HABITATS FORESTS/SCRUBS%	22
TEAGASC/EPA HABITATS WATER%	2
TEAGASC/EPA HABITATS DRY GRASSLAND%	46
TEAGASC/EPA HABITATS WET GRASSLAND%	6
TEAGASC TOTAL GRASSLAND%	1
TOTAL LIVESTOCK UNIT/ha of ZOC	0
TILLAGE%	6
No. SEPTIC TANKS km^{-2} ZOC	5
No. SEPTIC TANKS km^{-2} EXTREME PATHWAY SUSCEPTIBILITY	53
HIGH PATHWAY SUSCEPTIBILITY%	80
EXTR+HIGH PATHWAY SUSCEPTIBILITY%	47
WELL DRAINED SOIL %	50
POORLY DRAINED SOIL%	6

Site Conservation Assessment

The following site conservation assessment was undertaken to feed into the national reporting structure for assessing conservation status as required under Article 17 of the Habitats Directive. A suite of indicators and associated targets were derived to assess ecological structure and function. Future prospects were assessed through the evaluation of the impact of current and recent pressures and likely future threats to the site. The assessment follows a rules based approach to determine whether Structures & functions and Future Prospects should be assessed as good (green), inadequate (amber) or bad (red). For further details, see Chapter 10 (Conservation Status Assessment).

Please note an updated approach to assessing site condition has been proposed and is outlined in Chapter 12 (Monitoring Methods for Turloughs).

Conservation Condition Summary

Structure & Function	**Favourable**
Future Prospects	**Inadequate**
Site Conservation Condition	**Inadequate**

Structure and Function Status:

Indicator	Comments
Hydrological Function: *Good*	
Water Quality: Intermediate	24.6 µg P l^{-1}.
Biological Responses: *Good*	
Algal communities: -1	Extensive algal mats were recorded in 2008, but max CHL is low (probably due to highly coloured water – as in Blackrock, Caherglassan)
Vegetation communities: 1	Moderate cover of positive indicators, negative indicators absent
***Rumex* cover: 1**	2.4% frequency, very low
Important plants: 2	*Limosella aquatica, Rorippa islandica, Viola persicifolia*
Important aquatic invertebrates: 1	*Alonella exisa*
Overall Structure & Function: *Good*	

Pressures:

Code	Impact	Notes
A04.01.02 Intensive sheep grazing (turlough)	H	The major pressure, due to sheep very closely cropping the sward
A04.01.01 Intensive cattle grazing (turlough)	M	Moderate cattle grazing
H02.06 Diffuse groundwater pollution due to agricultural and forestry activities (ZOC)	M	Pollution due to agriculture and through forestry activity in the Slieve Aughtey mountains
B01 Forest planting on open ground (ZOC)	L	Forest planting continuing, but main pressure from forestry is from existing forests via groundwater pollution
H02.07 Diffuse groundwater pollution due to non-sewered population (ZOC)	L	
C01.07 Mining and extraction activities not referred to above (marl, limestone; in turlough)	L	A small amount of limestone extraction to the north

Threats:

Indicator	Comments	Indicator
A04.01.02 Intensive sheep grazing (turlough)	M	On-going pressure, not likely to have as much impact going forward
A02.01 Agricultural intensification (ZOC)	M	Likely to increase significantly due to prevalence of pasture in ZOC
H02.06 Diffuse groundwater pollution due to agricultural and forestry activities (ZOC)	M	Ongoing pressure
A04.01.01 Intensive cattle grazing (turlough)	M	Ongoing pressure
M01.03 Flooding and rising precipitations	L	
H02.07 Diffuse groundwater pollution due to non-sewered population (ZOC)	L	
A02.03 Grassland removal for arable land (ZOC)	L	Possible increase in maize production
A10.02 Removal of stone walls and embankments (in turlough)	L	

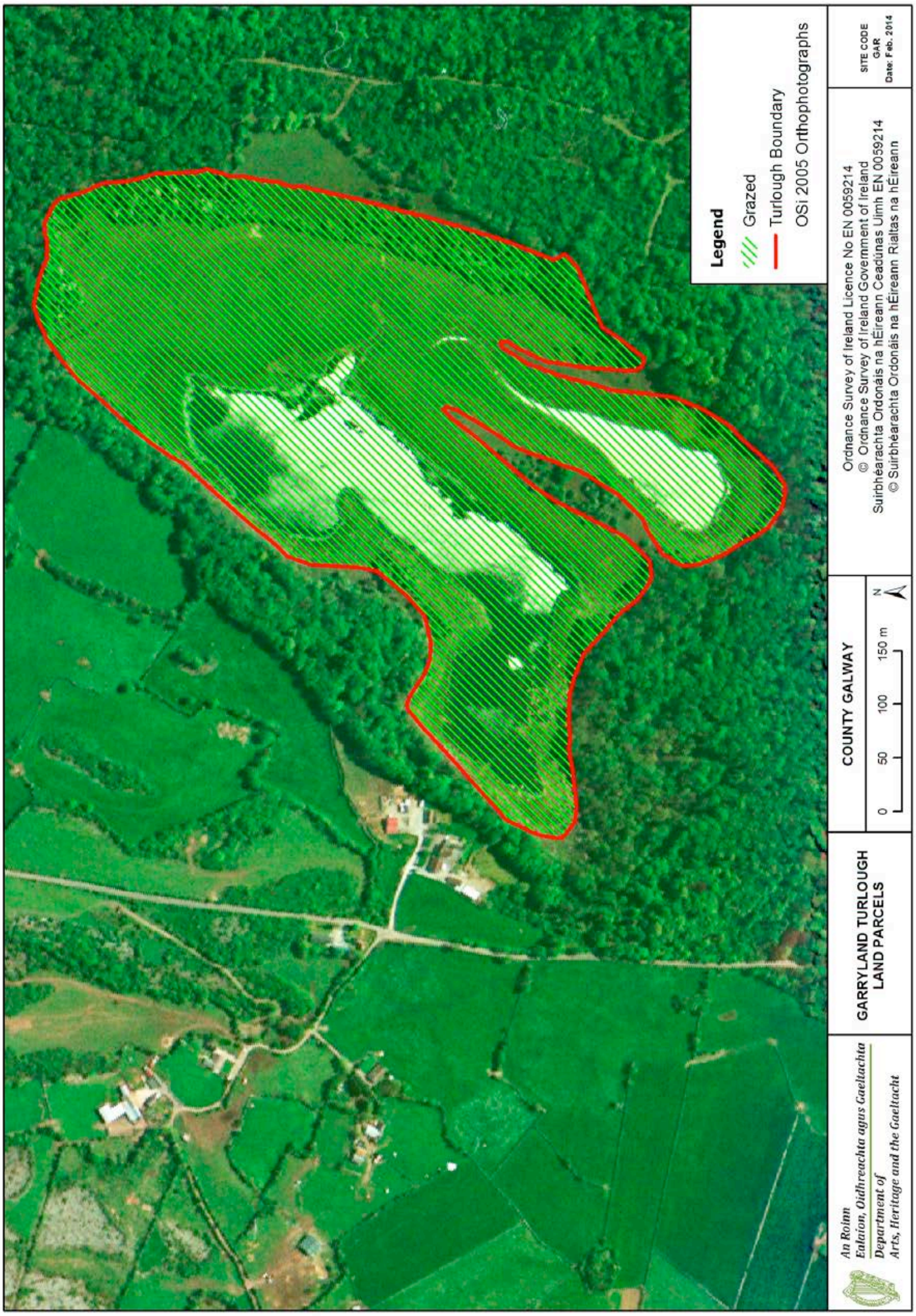
Future Prospects: **Inadequate** – moderate levels of threat suggest that current favourable structure and function may deteriorate, likely through increased pollution loads. Intensive sheep grazing has probably already had a significant impact (especially on sward height) despite the currently good structure and function, the future threat of sheep grazing is not likely to have such a large impact.

Overall Assessment: **Inadequate** – mostly because threats are likely to result in a deterioration of the structure and function. Removal of sheep grazing would likely help improve the sward and may also reduce some local nutrient inputs. A moderate level of cattle grazing would be required to maintain the important mud communities in Garryland, but care should be taken to ensure that grazing levels from cattle are not too excessive.

Maps

Maps are provided of:

1. Grazing in land parcels
2. Approximate sampling points for water chemistry and aquatic invertebrates
3. Soil nutrient sampling points
4. Points for soil survey (note: soils were surveyed to the turlough boundary defined by Goodwillie, 1992; see map 9)
5. Soils (note: soils were mapped by combining the EPA Subsoils base map with the point soil descriptions; for further details see *Chapter 6: Soils and Landuse*)
6. Vegetation relevés
7. Vegetation communities (note: relevés do not always match to mapped communities due to small scale variation; for further details of mapping see *Chapter 7: Turlough Vegetation: Description, Mapping and Ecology*)
8. Vegetation maps digitised from Goodwillie, R. (1992) *Turlough's Over 50 Hectares*. Report to NPWS
9. Estimated zone of groundwater contribution (ZOC)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Grazed
Turlough Boundary
OSi 2005 Orthophotographs
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SITE CODE
GAR
Date: Feb. 2014
COUNTY GALWAY
0 50 100 150 m
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GARRYLAND TURLOUGH
LAND PARCELS
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Department of
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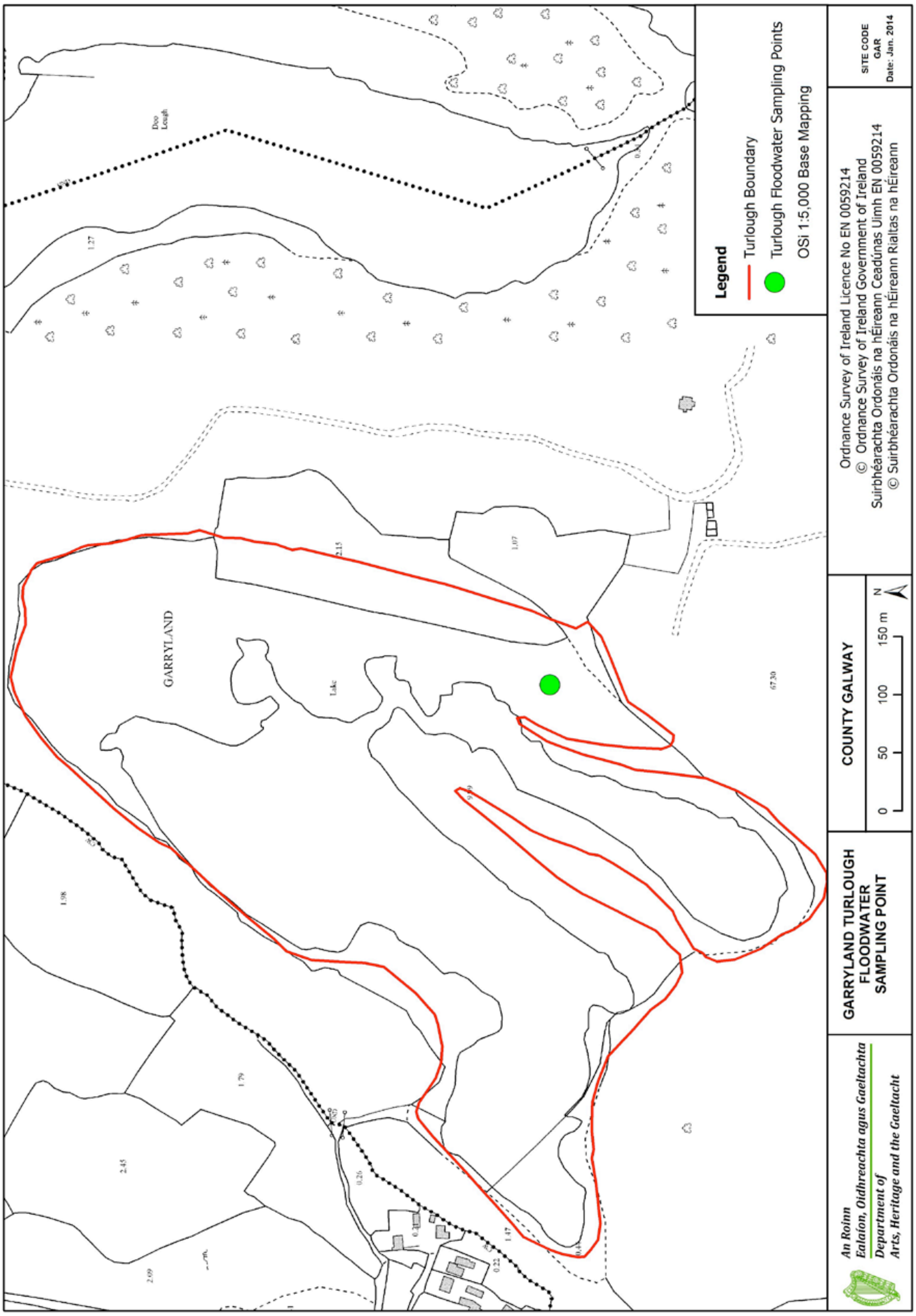

Legend
Turlough Boundary
Turlough Floodwater Sampling Points
OSi 1:5,000 Base Mapping
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GARRYLAND TURLOUGH FLOODWATER SAMPLING POINT
COUNTY GALWAY
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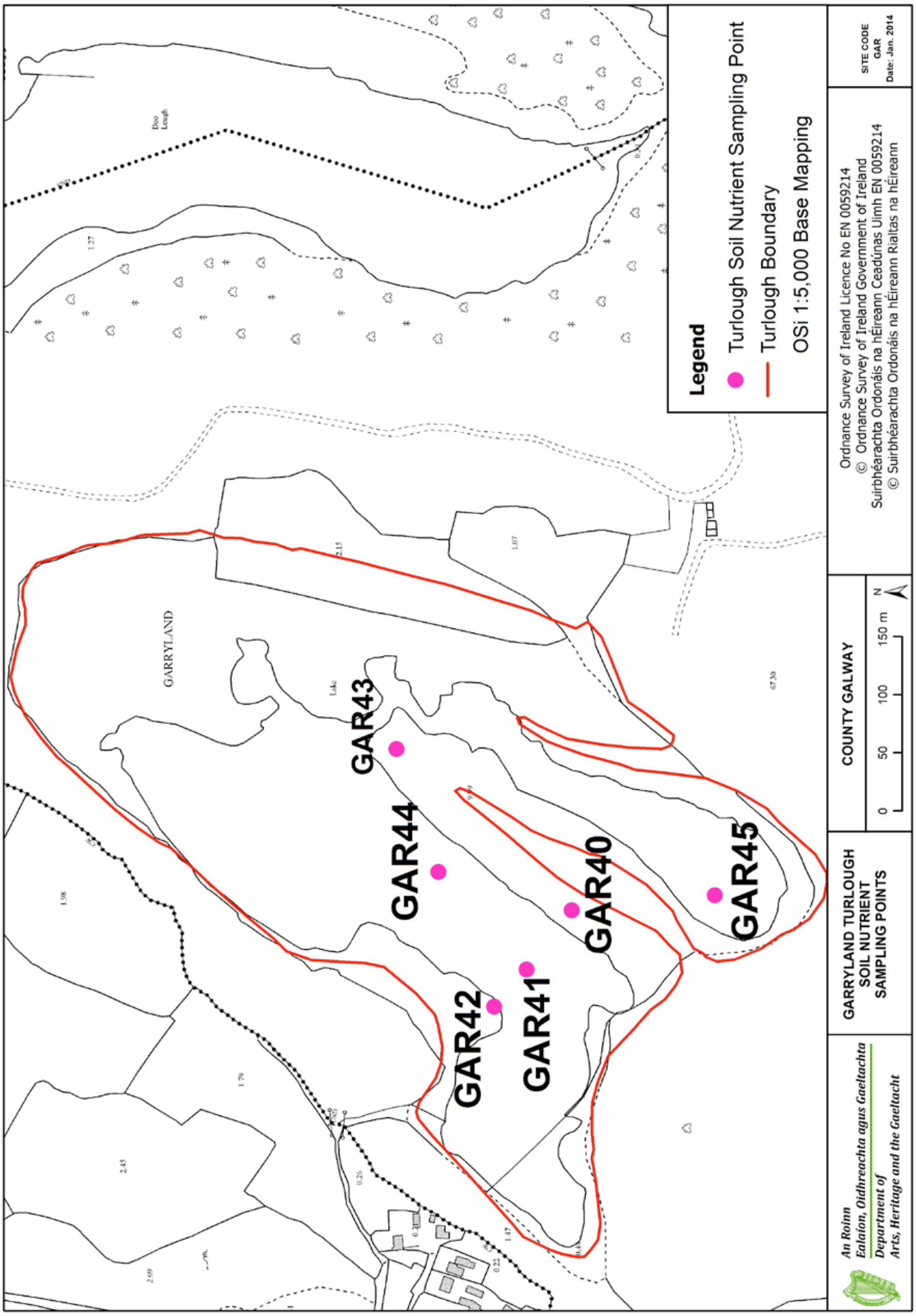
GARRYLAND
Lake
Doo Lough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Turlough Soil Nutrient Sampling Point
Turlough Boundary
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Date: Jan. 2014
COUNTY GALWAY
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GARRYLAND TURLOUGH
SOIL NUTRIENT
SAMPLING POINTS
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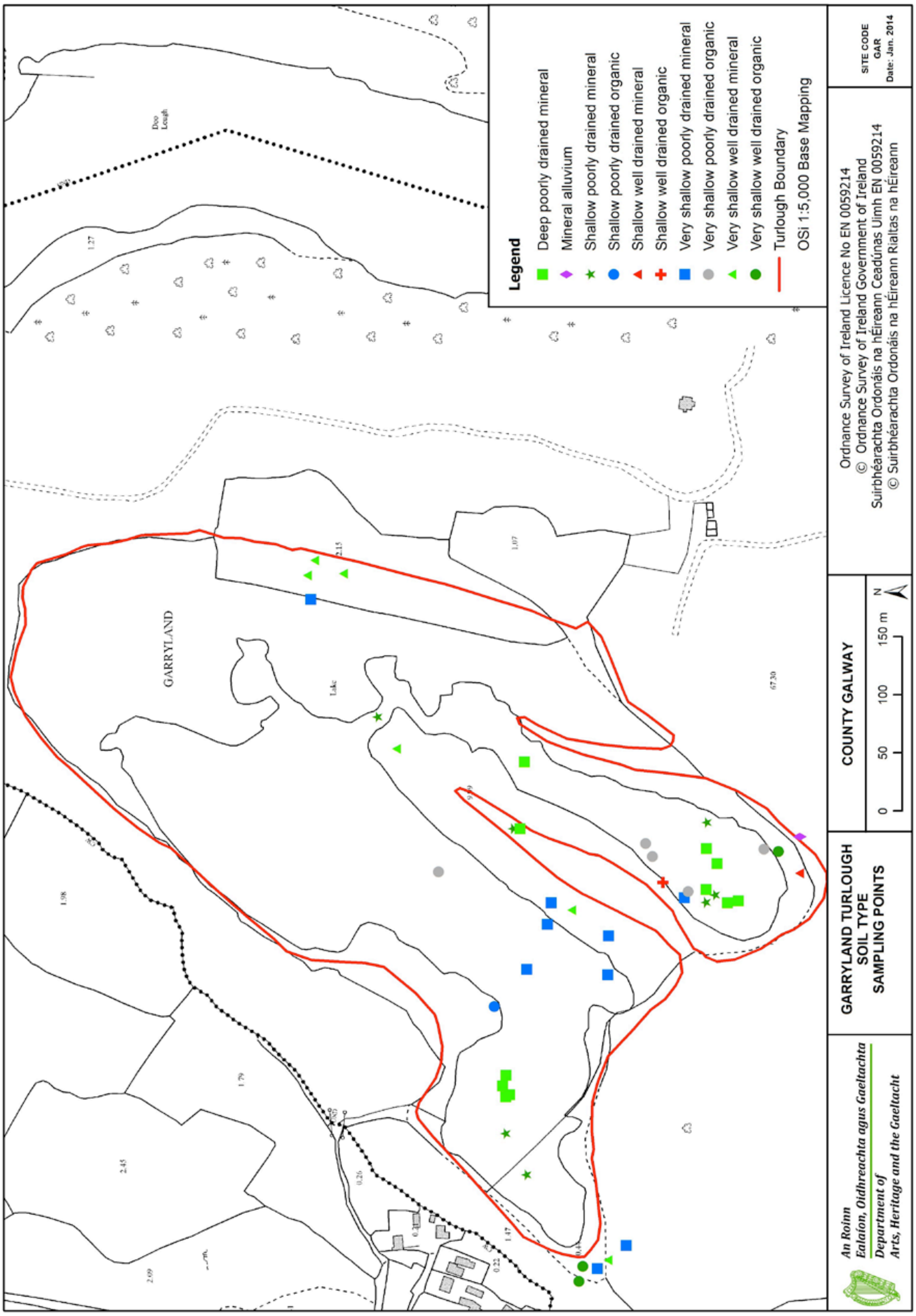

Legend
Deep poorly drained mineral
Mineral alluvium
Shallow poorly drained mineral
Shallow poorly drained organic
Shallow well drained mineral
Shallow well drained organic
Very shallow poorly drained mineral
Very shallow poorly drained organic
Very shallow well drained mineral
Very shallow well drained organic
Turlough Boundary
OSi 1:5,000 Base Mapping
GARRYLAND
Lake
Doo Lough
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Date: Jan. 2014
COUNTY GALWAY
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SOIL TYPE
SAMPLING POINTS
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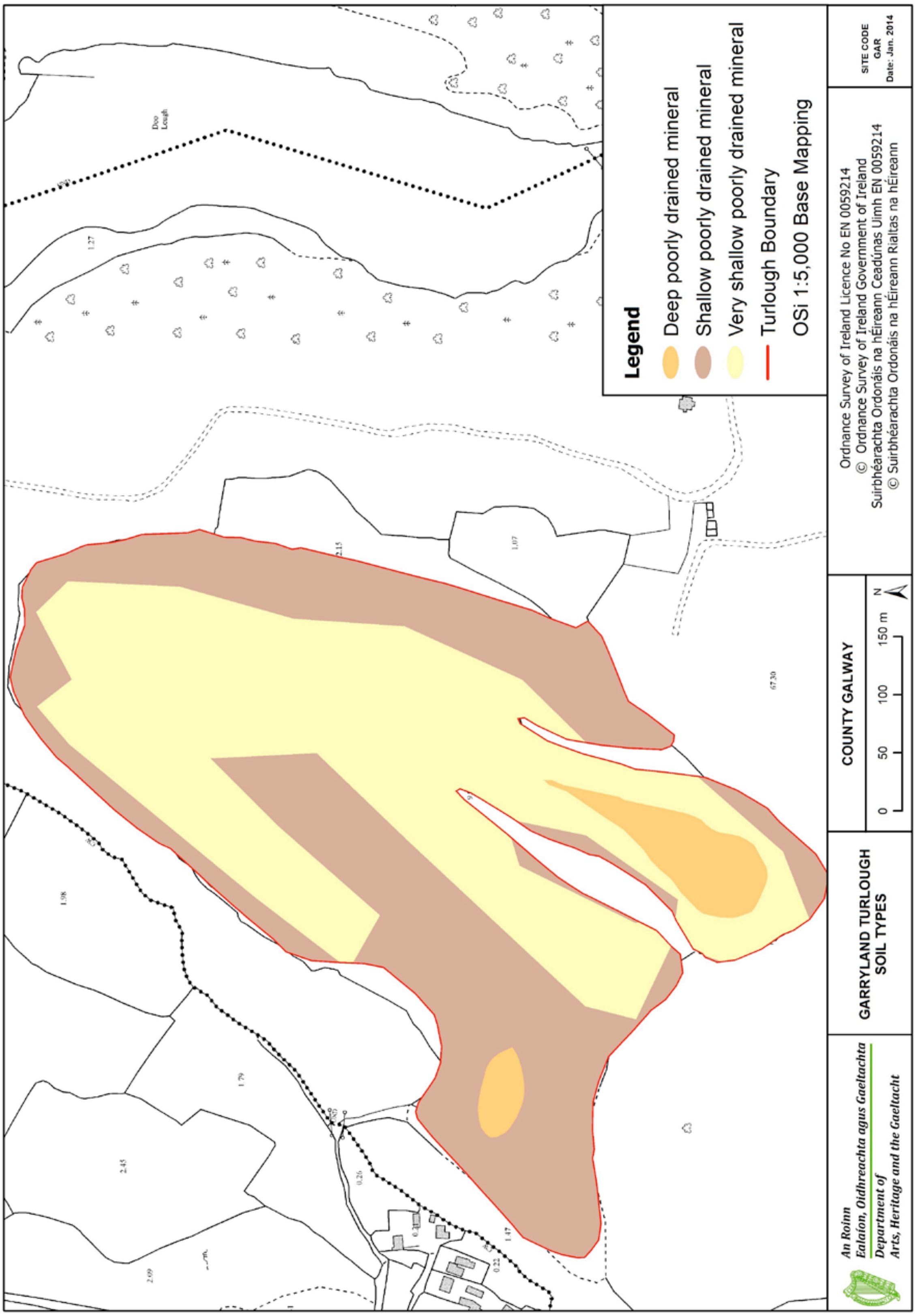
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Deep poorly drained mineral
Shallow poorly drained mineral
Very shallow poorly drained mineral
Turlough Boundary
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SOIL TYPES
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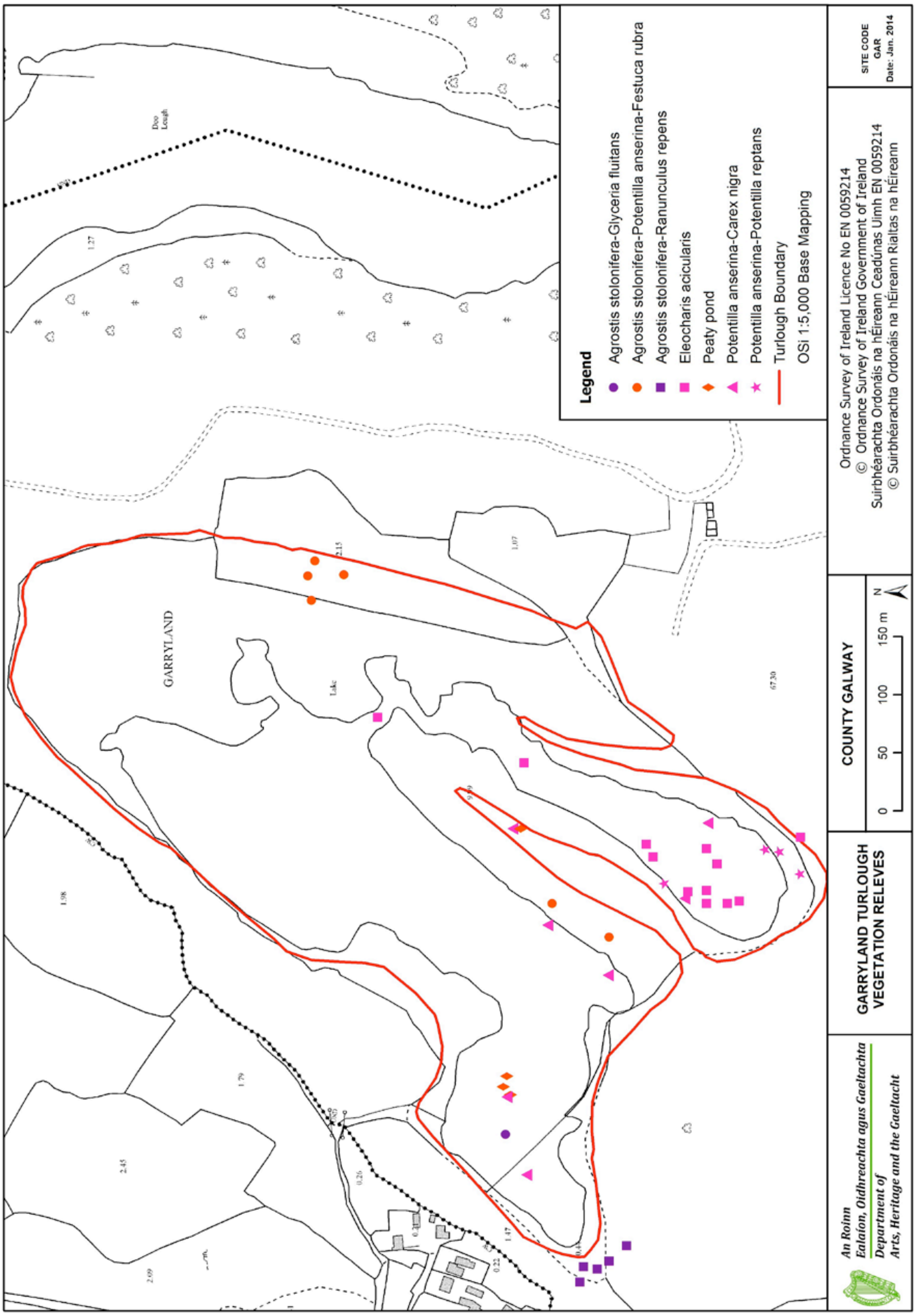

Legend
Agrostis stolonifera-Glyceria fluitans
Agrostis stolonifera-Potentilla anserina-Festuca rubra
Agrostis stolonifera-Ranunculus repens
Eleocharis acicularis
Peaty pond
Potentilla anserina-Carex nigra
Potentilla anserina-Potentilla reptans
Turlough Boundary
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COUNTY GALWAY
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VEGETATION RELEVES
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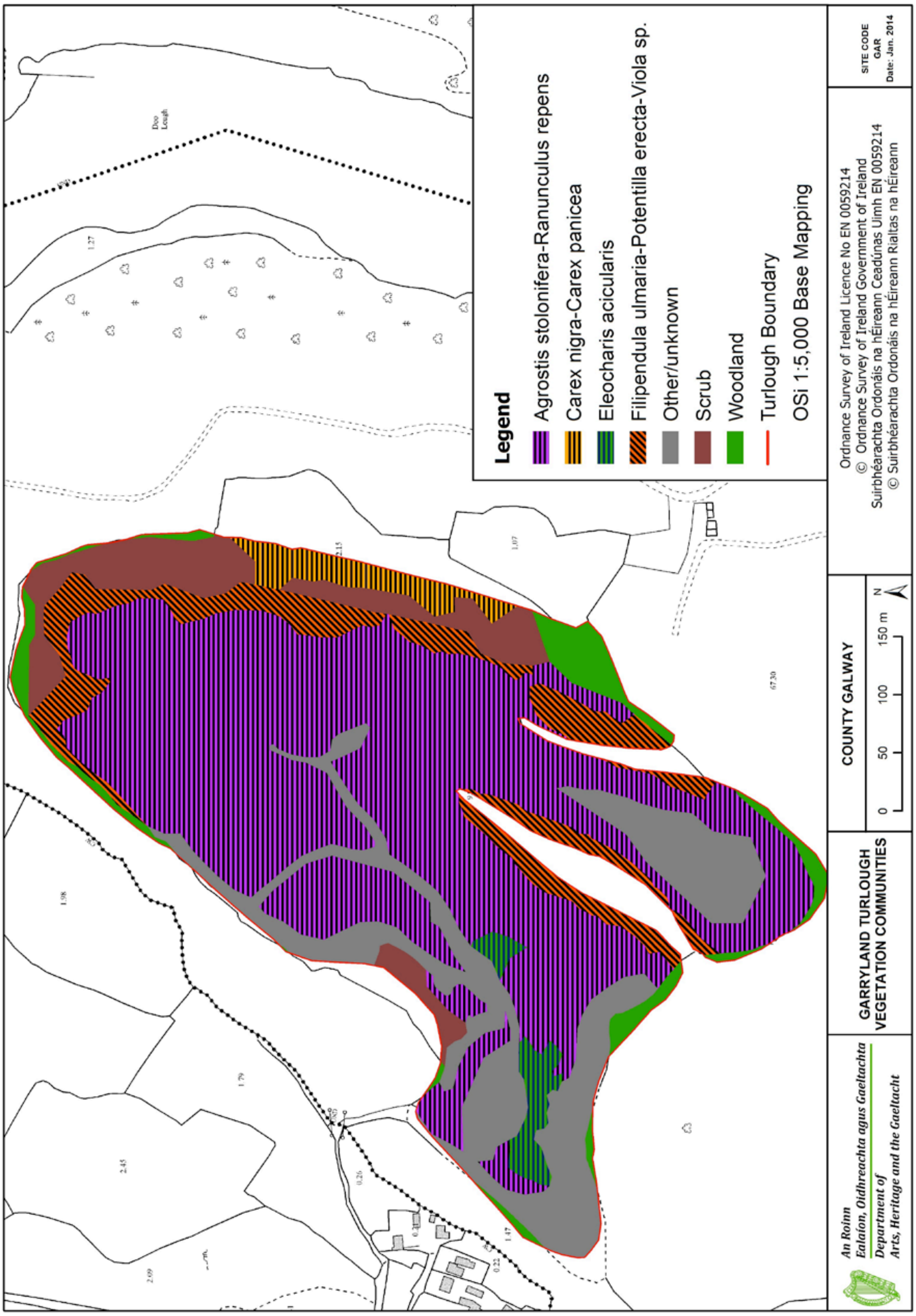
GARRYLAND
Lake
Doo Lough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Carex nigra-Carex panicea
Eleocharis acicularis
Filipendula ulmaria-Potentilla erecta-Viola sp.
Other/unknown
Scrub
Woodland
Turlough Boundary
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COUNTY GALWAY
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VEGETATION COMMUNITIES
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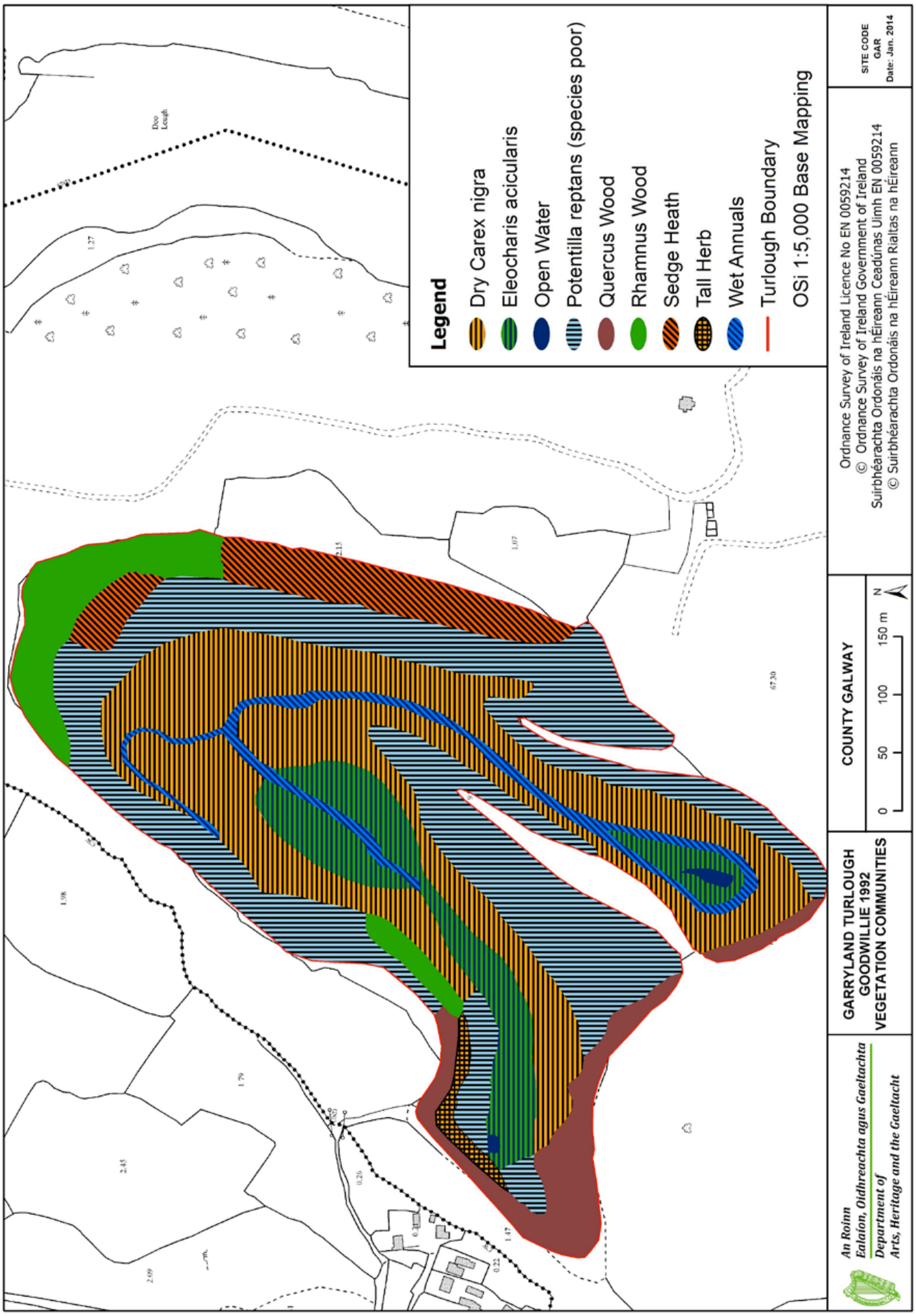
Arts, Heritage and the Gaeltacht
Doo Lough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Dry Carex nigra
Eleocharis acicularis
Open Water
Potentilla reptans (species poor)
Quercus Wood
Rhamnus Wood
Sedge Heath
Tall Herb
Wet Annuals
Turlough Boundary
OSi 1:5,000 Base Mapping
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COUNTY GALWAY
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GARRYLAND TURLOUGH
GOODWILLIE 1992
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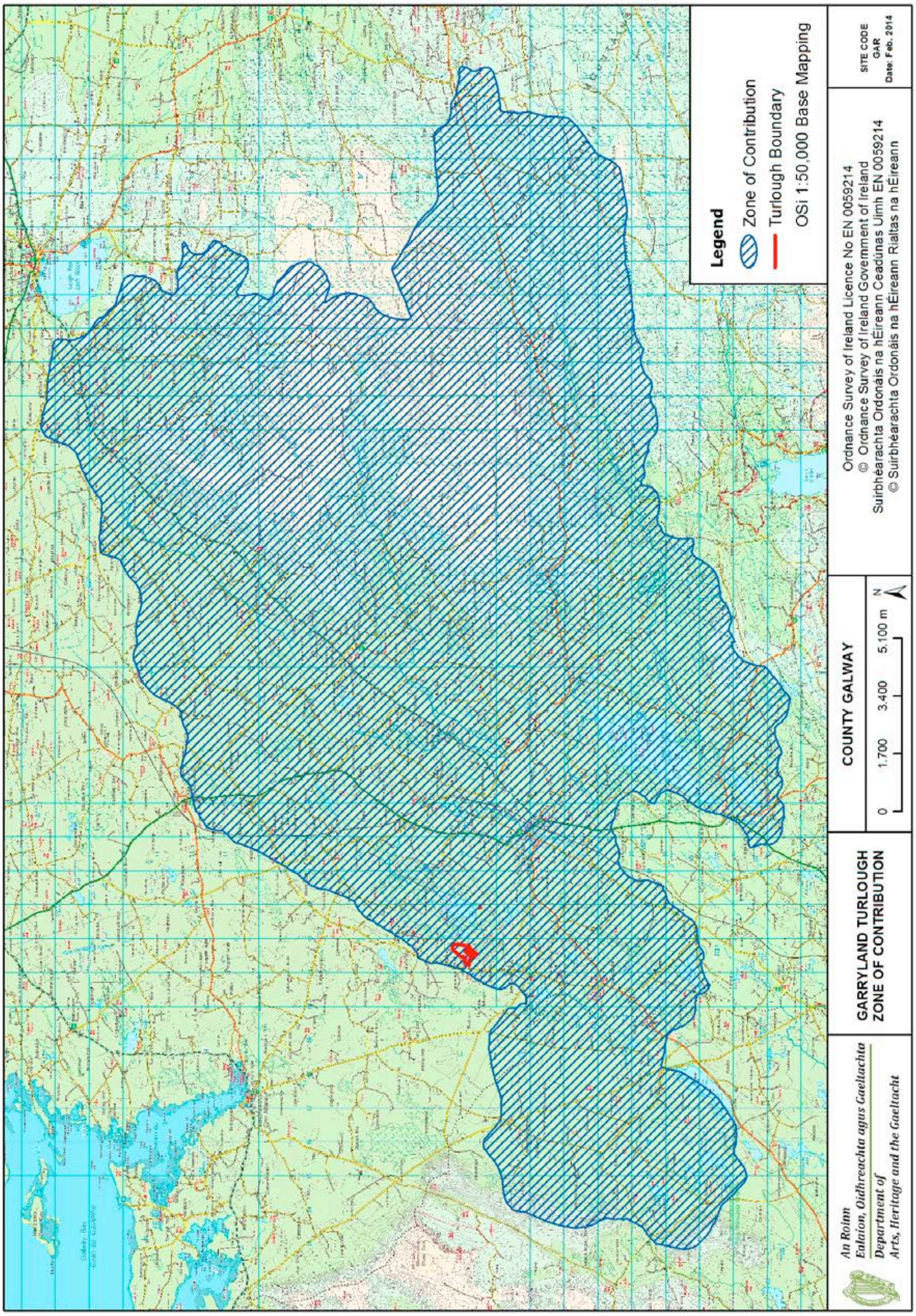
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COUNTY GALWAY
0 1,700 3,400 5,100 m
N
GARRYLAND TURLOUGH
ZONE OF CONTRIBUTION
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Site Report: Kilglassan Turlough
TCD Turlough Research project 2006-2011

Turlough Project Code	SAC Name	SAC/NHA No.	County	Townland	RBD	Easting	Northing	Area (ha)
KIL	Kilglassan/ Cahervoostia	000504	Mayo	Kilglassan	WESTERN	127860	264550	46

File update: July 2015 (S. Waldren)

Site Description

Kilglassan turlough occurs near Ballinrobe, south Co. Mayo within the Kilglassan/Cahervoostia SAC complex. Skealoghan and Ardkill turloughs lie to the south-west of this site. Kilglassan turlough has a long, narrow shape and is bisected by a road. The south-eastern basin is significantly larger than the north-western section. The turlough is surrounded by grassy slopes which are often steep. The north-western section has an extensive flat area. Eleven vegetation types were recorded; the dominant vegetation types were *Potentilla anserina-Carex nigra*, *Polygonum amphibium* and *Carex nigra-Carex panicea*. Kilglassan soils are moderately alkaline and peaty, with significant amount of calcium carbonate. The two recorded soil types were 'Fen peats' and 'Very shallow well drained organic'. All of the turlough is under rotational grazing. Kilglassan turlough has a non-flashy hydrological regime and an average drainage capacity.

Kilglassan – photo: S. Kimberley

Phytoplankton

Phytoplankton analysis was conducted on sub-samples of monthly spot samples collected for hydrochemical analysis between October 2006 and June 2007. Phytoplankton composition varies significantly over time and data from autumn, mid-winter and spring/early summer are presented below. Taxa were identified to species level where possible. Some taxa were not discriminated beyond general groupings (i.e. small centric diatoms, dinoflagellates and pinnate diatoms). The term non-identifiable alone (or n.i.) was reserved for cases where specimens were not identifiable. Discrimination between n.i. filament, n.i. flagellate, n.i. colony, n.i. green filament was made when applicable. Biovolume (mm^3 m^{-3}) was used as the measure of algal biomass.

October 2006		January 2007		May 2007	
Biovolume (mm^3/m^3)	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*
Cryptomonas	*2695*	*Navicula*	*86983*	*n.i.*	*165121*
Mallomonas akrokomos	*2688*	*Gomphonema*	*64286*	*Chroomonas acuta*	*111031*
n.i. pennates	*916*	*Eunotia bilunaris*	*14772*	*Scenedesmus*	*93738*
n.i. filament	*261*	*Achnanthidium minutissima*	*12640*	*Gomphonema*	*50610*
Anabaena	*238*	*Cymbella/Encyonema*	*5856*	*Oedogonium*	*24397*

Benthic Algae

Turloughs were inspected for algal mats during the emptying phase in 2007, 2008 and 2009. Turloughs were visited in the first two weeks of March to June 2007 as part of the monthly monitoring of turloughs. Dedicated trips to inspect for algal mats were conducted in 2008 on the 4th of March, the 1st of April, and the 26th, 27th and 28th of May, and in 2009 on the 15th and 16th of June and on the 24th and 25th of July. The presence of both living floating mats and dead drying mats was noted, as well as their extent in the turlough basins. Occurrence of visible filamentous algal mats in the three years of observation is presented below. Y = visible occurrence; * = "extensive cover" (estimated to be 2 to 8% of total area of basin); † = negligible quantity observed; • = turlough was too flooded to permit full observation. Algal mats were observed in Kilglassan in 2009, but were not extensive.

Year of Observation		
2007	**2008**	**2009**
N	N	Y

Hydrochemistry

Data shown are the mean ± SD of monthly spot samples collected between October 2006 and June 2007. Mean seasonal Total P and Chlorophyll *a* were used to determine the trophic status of the floodwaters based on OECD trophic categories. The median and range of <u>mean values</u> across all turloughs are also provided.

Hydrochemical Variable	Kilglassan Values		Turlough Summary Stats (n=22)		
	Mean±SD	OECD Trophic Category	Median	Min	Max
pH	8.2±0.1	-	8.1	7.7	8.3
Alkalinity mg l^{-1} $CaCO_3$	216.2±39.4	-	204.0	112.4	236.4
Colour mg l^{-1} PtCo	27.7±10.5	-	26.9	7.9	85.1
Molybdate Reactive Phosphorus µg l^{-1}	4.6±3.6	-	3.4	0.7	42.1
Total Phosphorus µg l^{-1}	27.2±11.6	Mesotrophic	24.8	4.0	82.1
Chlorophyll *a* µg l^{-1}	5.0±3.4	Mesotrophic	4.9	1.1	33.5
Nitrate-N mg l^{-1}	1.1±1.0		0.7	0.1	1.9
Total Nitrogen mg l^{-1}	1.5±1.0		1.2	0.6	2.3

Aquatic Invertebrates

22 turloughs were sampled for littoral aquatic macroinvertebrates using sweep nets during November 2006 and April 2007. Zooplankton samples were collected in April 2007. Open-water cladocerans and littoral chydorids were sampled using a zooplankton net and perspex tube respectively.

Aquatic Macroinvertebrates			
November 2006	**Count**	**April 2007**	**Count**
Agyroneta aquatica	3	*Agabus* sp. (larva)	185
Cercyon granarius	1	*Anisoptera* sp. (larva)	8
Curculionidae	2	*Asellus aquaticus*	8
Dryops sp.	5	Chironomidae	13
Dryops sp. (larva)	4	*Cloeon dipterum*	39
Glyphotaelius pellucides	1	*Cloeon simile*	9
Helophorus brevipalpis	6	*Corixinae* Instar I & II	14
Hydaticus seminiger	1	Diptera Pupae	2
Hydrobius fuscipes	1	*Dryops* sp.	1
Ilybius sp. (larva)	1	*Helophorus brevipalpis*	1
Limnephilus marmoratus	2	*Hydrachnidia* (Mite)	2
Lymnaea glabra	1	*Hygrotus inaequalis*	3
Lymnaea palustris	1	*Hygrotus* sp. (larva)	4
Lymnaea peregra	56	*Ilybius* sp. (larva)	1
Lymnaea trunculata	4	*Laccophilus* sp. (larva)	3
Megasternum obscurum	4	*Limnephilus auricula*	2
Ochthebius minimus	3	*Limnephilus centralis*	5
Oligochaeta	1	*Limnephilus lunatus*	2
Planorbis contortus	6	*Limnephilus marmoratus*	1
Psephenidae	1	*Lymnaea peregra*	4
Psychodidae	6	*Lymnaea trunculata*	1
Rhantus frontalis	1	Oligochaeta	32
Rhantus sp. (larva)	1	*Planorbis contortus*	2
Succinea sp.	1	*Planorbis crista*	2
Tipulidae	1	*Polycelis nigra/tenuis*	4
Valvata piscinalis	1	*Rhantus* sp. (larva)	13
Zonitoides sp.	4	*Sigara lateralis*	1
		Succinea sp.	17
		Sympetrum sanguinem	18
		Trichoptera sp. pupa	1
		Zygoptera sp. (larva)	1

Aquatic Macroinvertebrates:

Aquatic Macroinvertebrate Taxa	Presence of high abundances (>50)	
	November 2006	**April 2007**
Diptera	N	N
Ostracoda	N	N
Odonata	N	N
Trichoptera	N	N

Zooplankton species
Alona affinis
Alonella excisa
Chydorus sphaericus
Daphnia pulex
Eurycercus lamellatus
Graptoleberis testudinaria
Lathurona rectirostris
Pleuroxus trigonellus
Simocephalus vetulus

Vegetation

Vegetation description and classification yielded 25 vegetation communities suitable for mapping. Eleven vegetation communities were mapped in Kilglassan turlough. The dominant communities were *Potentilla anserina – Carex nigra, Polygonum amphibium* and *Carex nigra-Carex panicea*. High conservation value communities are denoted by *. Sixty-eight plant species were recorded.

Vegetation Community	**Area (Ha)**
A. stolonifera-Glyceria fluitans	0.88
A. stolonifera-P. anserina - F. rubra	2.75
A. stolonifera-R. repens	3.61
Carex nigra-C. panicea	6.17
Carex nigra-Equisetum fluviatile	0.41
Carex nigra-R. flammula	2.07
**F. ulmaria-P. erecta-Viola sp*	2.16
Lolium grassland	4.18
Open water	0.07
Other/unknown	0.46
P. anserina-Carex nigra	14.38
Polygonum amphibium	8.21
Woodland/scrub	0.2
Number of vegetation communities	11
Number of plant species	68

Vascular Plant Species

Nomenclature follows Parnell, J & Curtis, T. (2012) *Webb's An Irish Flora*, University of Cork Press.

Agrostis capillaris	*Galium uliginosum*	*Poa annua*
Agrostis stolonifera	*Glyceria fluitans*	*Polygonum amphibium*
Alisma plantago-aquatica	*Holcus lanatus*	*Potentilla anserina*
Bellis perennis	*Hydrocotyle vulgaris*	*Potentilla erecta*
Caltha palustris	*Juncus acutiflorus*	*Potentilla reptans*
Cardamine pratensis	*Juncus conglomeratus*	*Prunella vulgaris*
Carex flacca	*Juncus effusus*	*Ranunculus acris*
Carex hirta	*Juncus inflexus*	*Ranunculus flammula*
Carex hostiana	*Knautia arvensis*	*Ranunculus repens*
Carex nigra	*Leontodon autumnalis*	*Ranunculus trichophyllus*
Carex panicea	*Leontodon hispidus*	*Rorippa amphibia*
Carex rostrata	*Lolium perenne*	*Rumex acetosa*
Carex viridula agg.	*Lotus corniculatus*	*Rumex crispus*
Carex viridula ssp. *oedocarpa*	*Mentha aquatica*	*Senecio aquaticus*
Cerastium fontanum	*Menyanthes trifoliata*	*Sparganium emersum*
Cirsium palustre	*Molinia caerulea*	*Sparganium erectum*
Cynosurus cristatus	*Oenanthe aquatica*	*Stellaria media*
Eleocharis palustris	*Phalaris arundinacea*	*Taraxacum officinale* agg.
Equisetum fluviatile	*Phleum bertolonii*	*Trifolium pratense*
Festuca pratensis	*Phleum pratense*	*Trifolium repens*
Festuca rubra	*Plantago lanceolata*	*Veronica scutellata*
Filipendula ulmaria	*Plantago major*	*Veronica serpyllifolia*
Galium palustre	*Plantago maritima*	

Soils and Grazing

Soils were classified using a modified version of soil categories generated by the Teagasc/EPA Soils and Subsoils Mapping project (Fealy *et al.*, 2009). The classification scheme principally uses parent material (calcareous/non-calcareous), depth class (shallow/deep) and drainage class (well drained/poorly drained) to assign soils to one of nine broad categories. Kilglassan has extensive areas of Fen Peats and very shallow well-drained organic soils. The mean ± SD of a range of soil properties are also provided, in addition to the median and range of each variable across turloughs. Kilglassan soils are moderately alkaline and peaty with significant amounts of calcium carbonate.

Soil Types/Grazing Extent	% Turlough Area
Very shallow well drained organic	34.4
Fen Peat	65.6
Extent of rotationally grazed area	100

Soil Property (n=6)	Kilglassan	Turlough Summary Stats (n=22)		
	Mean ± SD	Median	Min	Max
pH	7.4 ± 0.5	7.20	5.94	8.29
% Organic Matter content	34.0 ± 10.4	25.8	10.2	69.1
% Inorganic content	44.5 ± 8.0	43.2	25.7	85.0
% Calcium carbonate content	21.5 ± 11.9	11.3	2.48	43.7
Total Nitrogen mg kg^{-1}	17450 ± 4918	11142	4983	24233
Total Phosphorus mg kg^{-1}	1226 ± 495	905	245	1594

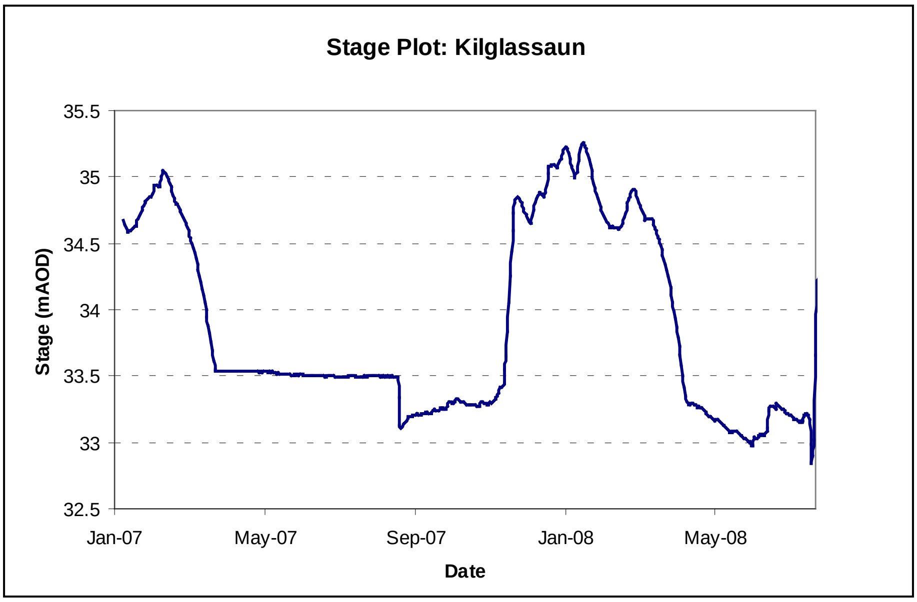
Hydrology

Water levels were recorded at hourly intervals using a variety of Schlumberger Divers® (Marton Geotechnical Ltd, Suffolk, UK) placed at or near the lowest point in each turlough. Divers measure the pressure of the water and air column above them, and from this the depth of water can be calculated. GPS surveys were carried out on 21 monitoring sites (Tullynafrankagh omitted) in order to develop digital terrain models (DTMs) from which contour maps, stage-volume and stage-surface area relationships are produced. The inflow magnitude is indicative of the properties of a turlough's catchment area and flow capacity, while outflow is a function of the drainage capacity of the system.

Kilglassan turlough has a non-flashy hydrological regime and an average drainage capacity. Kilglassan is hydrologically linked with Skealoghan, and to a lesser degree with Ardkill. Kilglassan and Skealoghan show very similar profiles of water depth, albeit with time lags which vary throughout the year (for further details see *Chapter 2: Hydrology*).

Hydrological Information	Kilglassan Values	Turlough Summary Stats (n=21)		
		Median	Min	Max
Start of Hydrological Recording	04/02/2007	-	-	-
End of Hydrological Recording	21/08/2008	-	-	-
Days Recorded	564	-	-	-
Equipment Failure	21/8/2008 onwards	-	-	-
Hydroperiod (days)	223	213	135	348
Maximum Floodwater Depth (m)	4.9	4.9	3	15.4
Maximum Floodwater Volume ('000 m^3)	809.6	877.9	355.6	4008.1
Maximum Flooded Area	51.04	38.61	13.71	78.12
Average Basin Depth (m)	1.59	2.28	0.85	6.76
Average Daily Inflow ($m^3 s^{-1}$)	1.626	0.684	0.254	10.253
Average Daily Outflow ($m^3 s^{-1}$)	0.488	0.271	0.086	2.018
Drainage Capacity ($m^3 s^{-1}$)	0.185	0.154	0.069	1.156
Recession Duration (days)	50.7	57.3	11	142.5

Stage plot for Kilglassan turlough



Zone of Groundwater Contribution (ZOC) Risk Assessments

GIS based risk assessments were conducted with a view to identifying turloughs at risk of failing to meet WFD water quality objectives. These risk assessments were conducted by Compass Informatics Ltd and were based on Risk Assessment Sheet GWDTERA2a (Guidance Document No. GW9) on assessing risks to turloughs from phosphate (Working Group on Groundwater 2004) and Pathway Susceptibilities and Pressure Magnitudes were integrated to produce Impact Potential maps and predicted Risk Categories for the turlough ZOC. The TCD Risk Category is derived from a revised Impact Potential matrix. The predicted Risk Categories were adjusted using mean seasonal floodwater Total P ($\mu g\ l^{-1}$) (see Section 4.5.4 of the Risk Assessment Sheet GWDTERA2a). The risk categories include 1A: at significant risk; 1B: probably at significant risk; 2A: Not at significant risk (low confidence); 2B: Not at significant risk (higher confidence).

ZOC Area (km^2)	Predicted WFD Risk Category	Adjusted WFD Risk Category	Predicted TCD Risk Category	Adjusted TCD Risk Category
15	2A	1B	1B	1B

ZOC Pressure Variable	
CORINE BARE ROCK %	0
CORINE PEAT BOGS%	0
CORINE ALL NATURAL AND SEMI-NATURAL AREAS%	0
CORINE IMPROVED PASTURE%	69
CORINE UNIMPROVED PASTURE%	18
CORINE ALL PASTURE%	87
CORINE OTHER AGRICULTURAL LANDS%	13
TEAGASC/EPA HABITATS ROCK%	0
TEAGASC/EPA HABITATS BOGS/PEATS%	2
TEAGASC/EPA HABITATS FORESTS/SCRUBS%	0
TEAGASC/EPA HABITATS WATER%	0
TEAGASC/EPA HABITATS DRY GRASSLAND%	93
TEAGASC/EPA HABITATS WET GRASSLAND%	4
TEAGASC TOTAL GRASSLAND%	97
TOTAL LIVESTOCK UNIT/ha of ZOC	1
TILLAGE%	1
No. SEPTIC TANKS km^{-2} ZOC	9
No. SEPTIC TANKS km^{-2} EXTREME PATHWAY SUSCEPTIBILITY	5
HIGH PATHWAY SUSCEPTIBILITY%	0
EXTR+HIGH PATHWAY SUSCEPTIBILITY%	10
WELL DRAINED SOIL %	84
POORLY DRAINED SOIL%	16

Site Conservation Assessment

The following site conservation assessment was undertaken to feed into the national reporting structure for assessing conservation status as required under Article 17 of the Habitats Directive. A suite of indicators and associated targets were derived to assess ecological structure and function. Future prospects were assessed through the evaluation of the impact of current and recent pressures and likely future threats to the site. The assessment follows a rules based approach to determine whether Structures & functions and Future Prospects should be assessed as good (green), inadequate (amber) or bad (red). For further details, see Chapter 10 (Conservation Status Assessment).

Please note an updated approach to assessing site condition has been proposed and is outlined in Chapter 12 (Monitoring Methods for Turloughs).

Conservation Condition Summary

Structure & Function	**Bad**
Future Prospects	**Inadequate**
Site Conservation Condition	**Bad**

Structure and Function Status:

Indicator	*Comments*
Hydrological Function: Bad	Drainage has affected the upper part of the turlough basin, and there is evidence of additional drainage having a potential impact within the ZOC
Water Quality: Intermediate	27.2 µg P l^{-1}.
Biological Responses: Intermediate	
Algal communities: -1	Algal mats were recorded but were not extensive; maximum CHL*a* was high
Vegetation communities: 0	Low cover of positive indicators, moderately low cover of negative indicators
***Rumex* cover: 0**	10.3% frequency, just above the ‘good’ category
Important plants: 1	*Plantago maritima*
Important aquatic invertebrates: 1	*Alonella exisa*
Overall Structure & Function: Bad	Mostly due to the impacts of drainage; marginal Bad/Inadequate

Pressures:

Code	Impact	Notes
A04.01.01 Intensive cattle grazing (turlough)	M	Moderate grazing impact, whole turlough is grazed
A08 Fertilisation (within turlough)	M	Evidence of fertiliser inputs directly into turlough
J02.05 Modification of hydrographic functioning, general (=drainage in turlough)	M	Drainage has impacted on turlough structure and function
H02.06 Diffuse groundwater pollution due to agricultural and forestry activities (ZOC and local)	M	Moderate nutrient enrichment
H02.07 Diffuse groundwater pollution due to non-sewered population (ZOC)	L	
A05.02 Stock feeding (within and adjacent to turlough)	L	Some evidence of stock feeding adjacent to the turlough

Threats:

Code	Impact	Notes
J02.05 Modification of hydrographic functioning, general (=drainage in turlough)	H	On-going pressure, with further drainage likely
H01.05 Diffuse pollution to surface waters due to agricultural and forestry activities (ZOC)	H	Prevalence of slurry spreading adjacent to the turlough
H02.06 Diffuse groundwater pollution due to agricultural and forestry activities (ZOC)	M	Ongoing pressure
A04.01.01 Intensive cattle grazing (turlough)	M	Ongoing pressure
M01.03 Flooding and rising precipitations	L	
H02.07 Diffuse groundwater pollution due to non-sewered population (ZOC)	L	Relatively low threat due to low numbers of dwellings
A02.01 Agricultural intensification (ZOC)	L	
A02.03 Grassland removal for arable land (ZOC)	L	Possible increase in maize production
A10.02 Removal of stone walls and embankments (in turlough)	L	

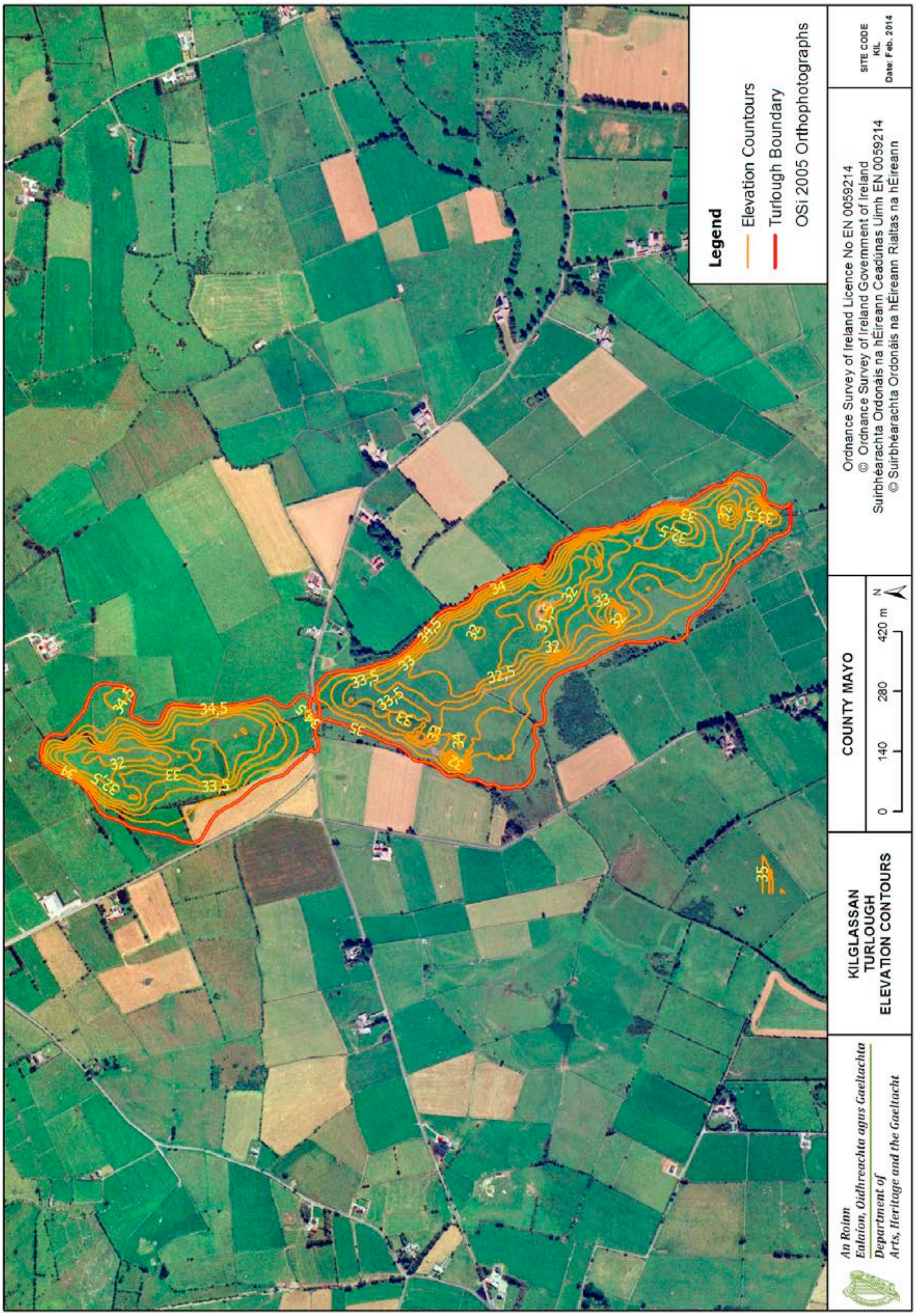
Future Prospects: **Inadequate –** numerous threats of high and moderate impact.

Overall Assessment: **Bad** – structure and function are impaired by current pressures, the impacts of many are likely to increase in magnitude in the future.

Maps

Maps are provided of:

1. Elevation contours, based on GIS digital terrain models from points by differential GPS topographic survey (for further details, see *Chapter 3: Hydrology*)
2. Grazing in land parcels
3. Approximate sampling points for water chemistry and aquatic invertebrates
4. Soil nutrient sampling points
5. Points for soil survey (note: soils were surveyed to the turlough boundary defined by Goodwillie, 1992; see map 9)
6. Soils (note: soils were mapped by combining the EPA Subsoils base map with the point soil descriptions; for further details see *Chapter 6: Soils and Landuse*)
7. Vegetation relevés
8. Vegetation communities (note: relevés do not always match to mapped communities due to small scale variation; for further details of mapping see *Chapter 7: Turlough Vegetation: Description, Mapping and Ecology*)
9. Vegetation maps digitised from Goodwillie, R. (1992) *Turlough's Over 50 Hectares*. Report to NPWS
10. Estimated zone of groundwater contribution (ZOC)



Legend
Elevation Countours
Turlough Boundary
OSi 2005 Orthophotographs
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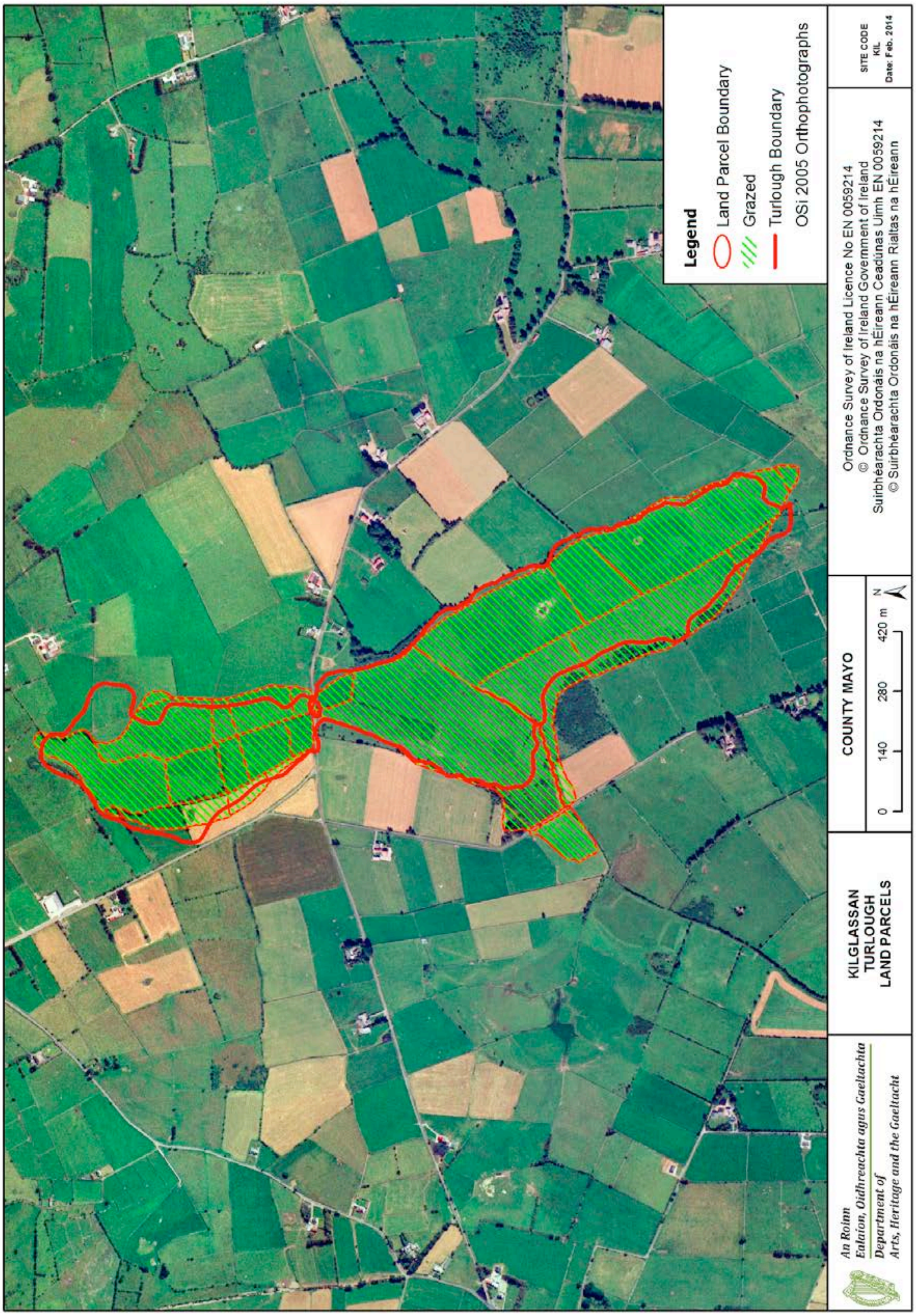
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Land Parcel Boundary
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Turlough Boundary
OSi 2005 Orthophotographs
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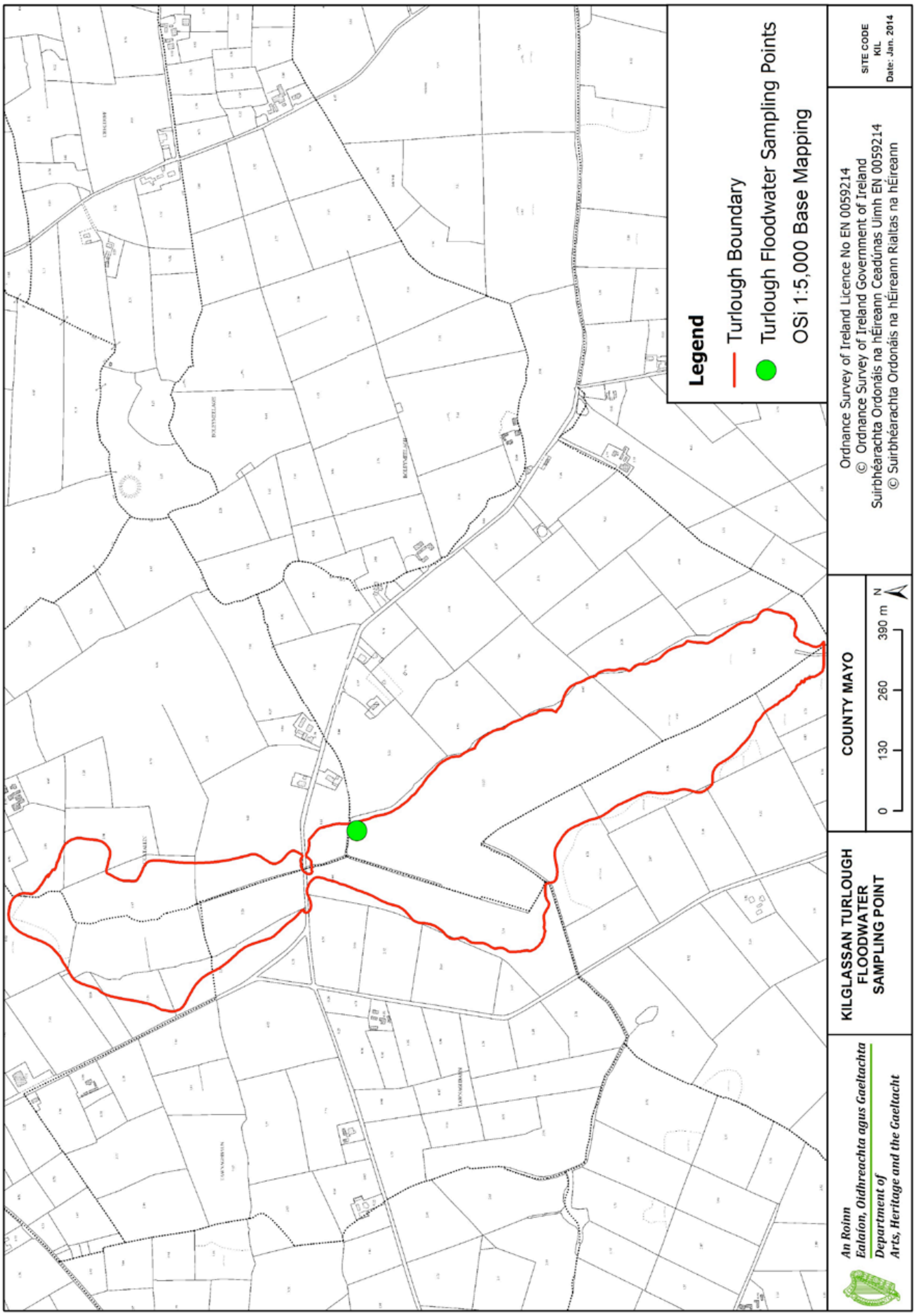
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Turlough Boundary
Turlough Floodwater Sampling Points
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KILGLASSAN TURLOUGH FLOODWATER SAMPLING POINT
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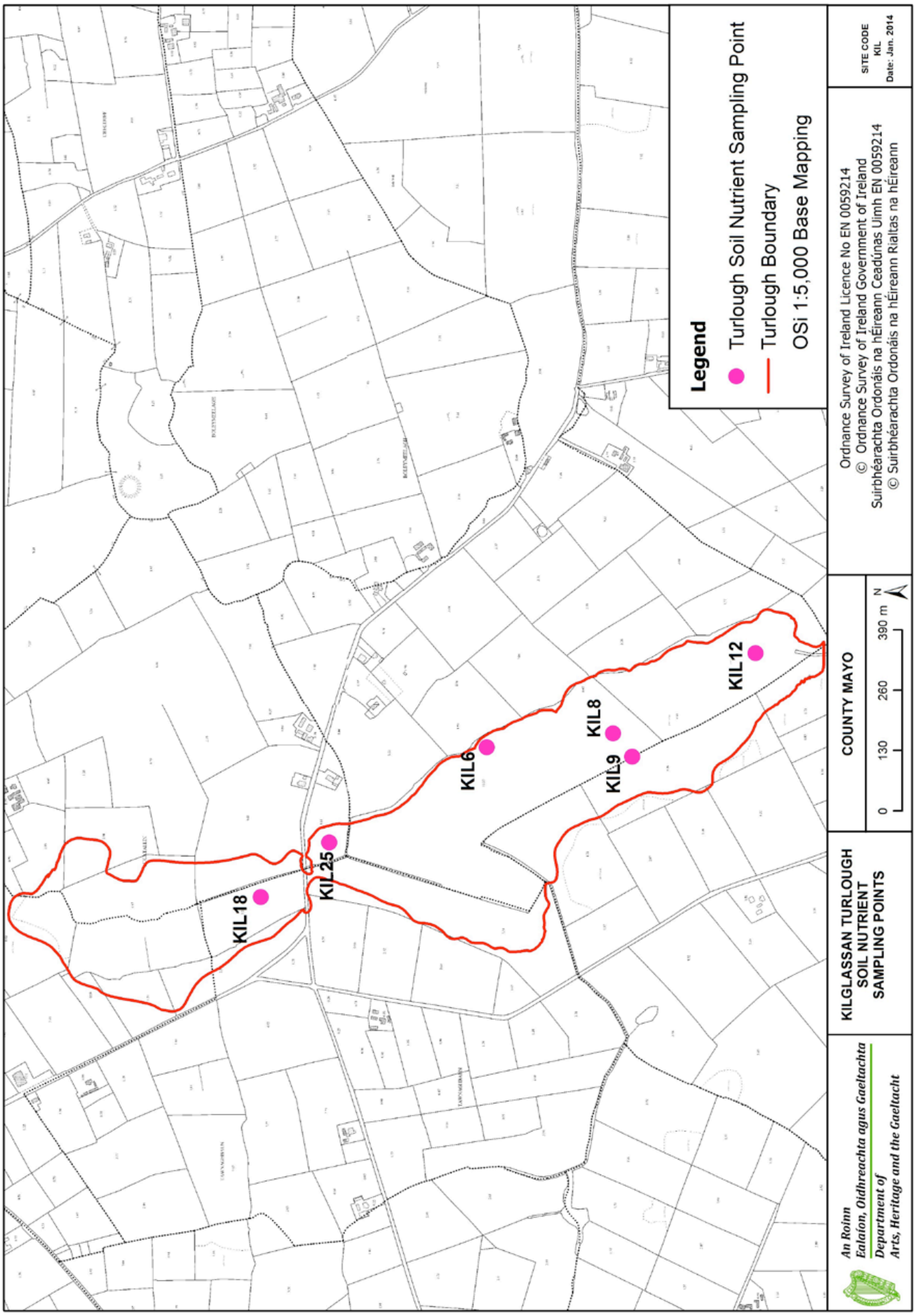
Department of Arts, Heritage and the Gaeltacht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Turlough Soil Nutrient Sampling Point
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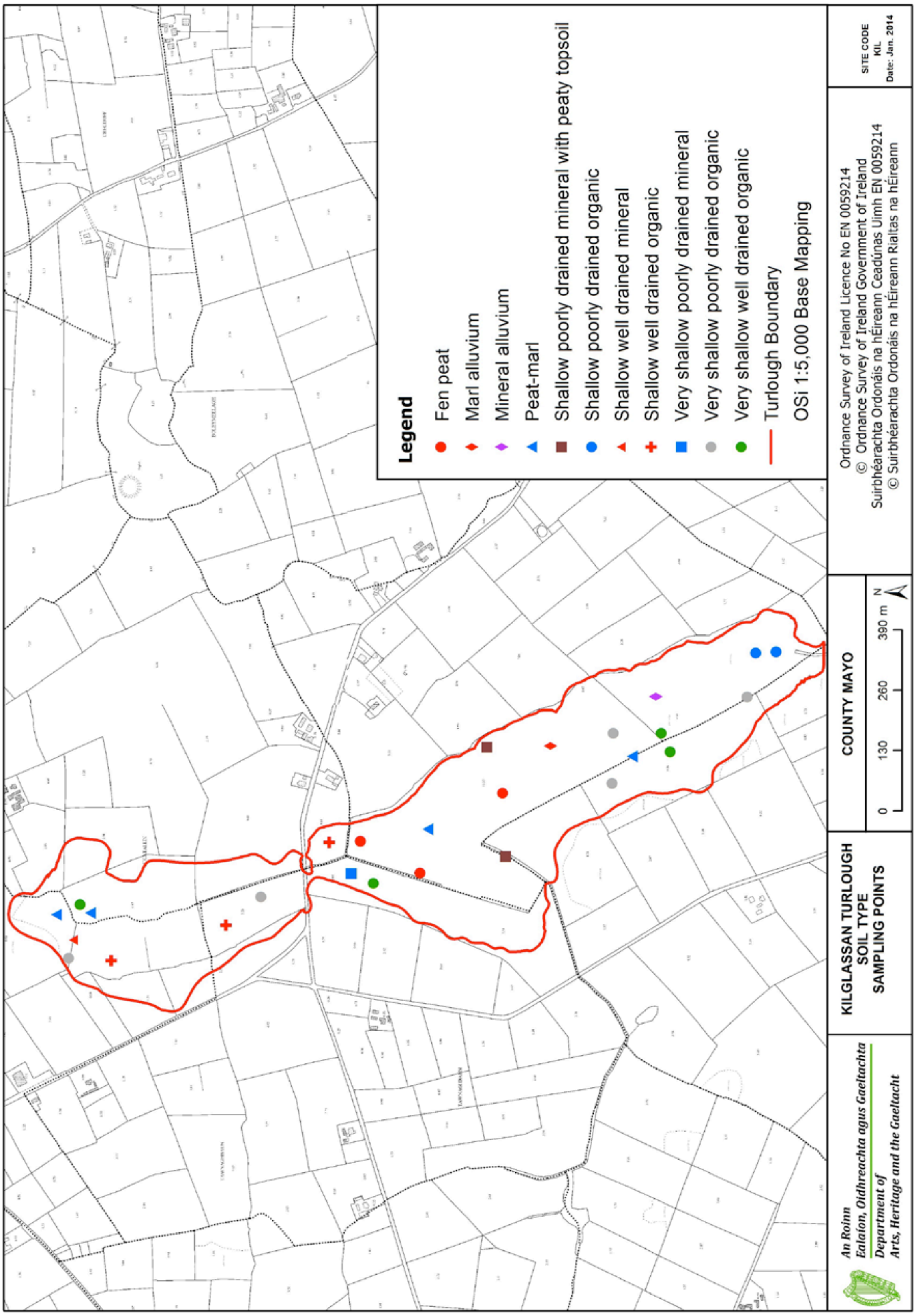
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Fen peat
Marl alluvium
Mineral alluvium
Peat-marl
Shallow poorly drained mineral with peaty topsoil
Shallow poorly drained organic
Shallow well drained mineral
Shallow well drained organic
Very shallow poorly drained mineral
Very shallow poorly drained organic
Very shallow well drained organic
Turlough Boundary
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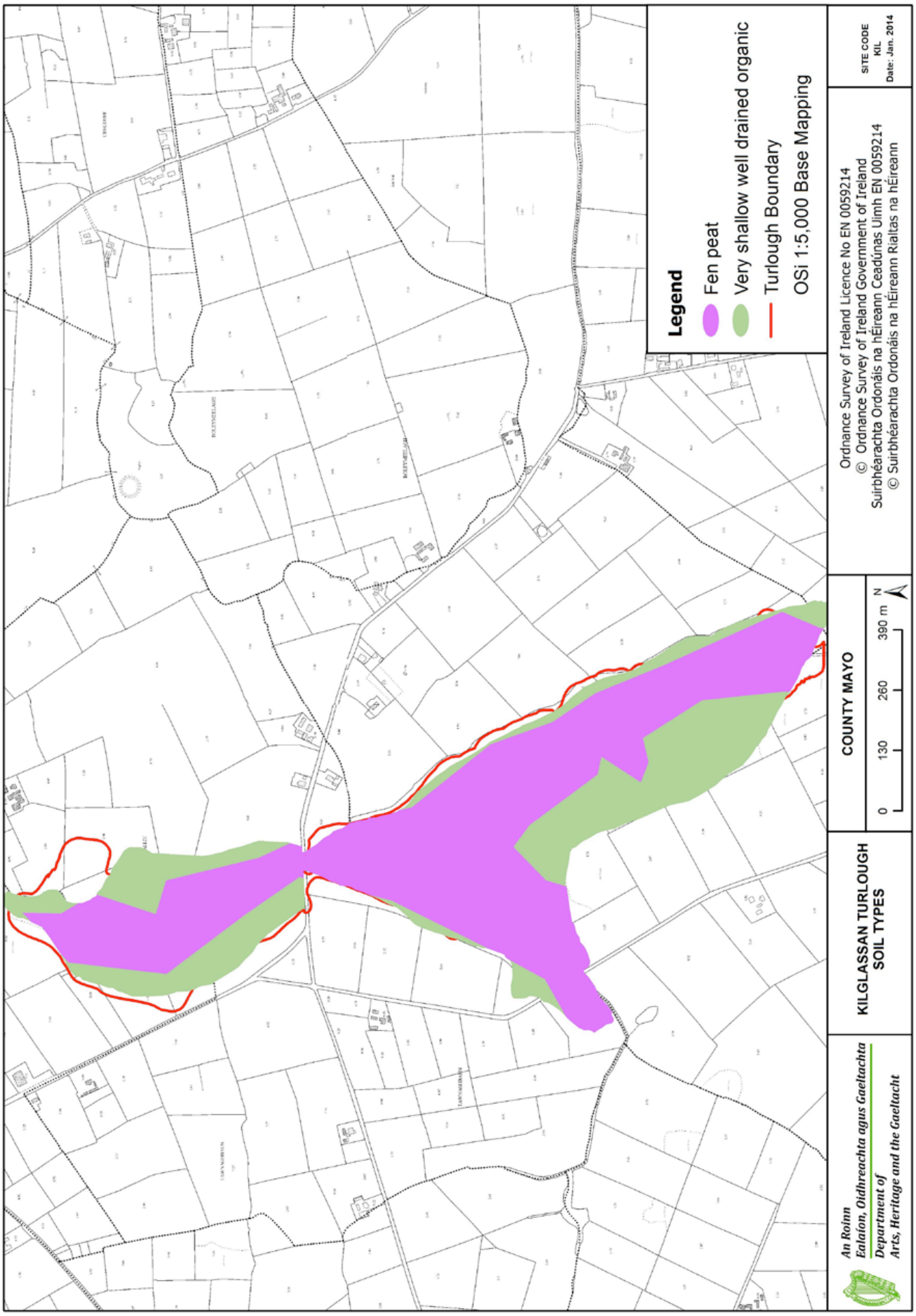
Legend
Fen peat
Very shallow well drained organic
Turlough Boundary
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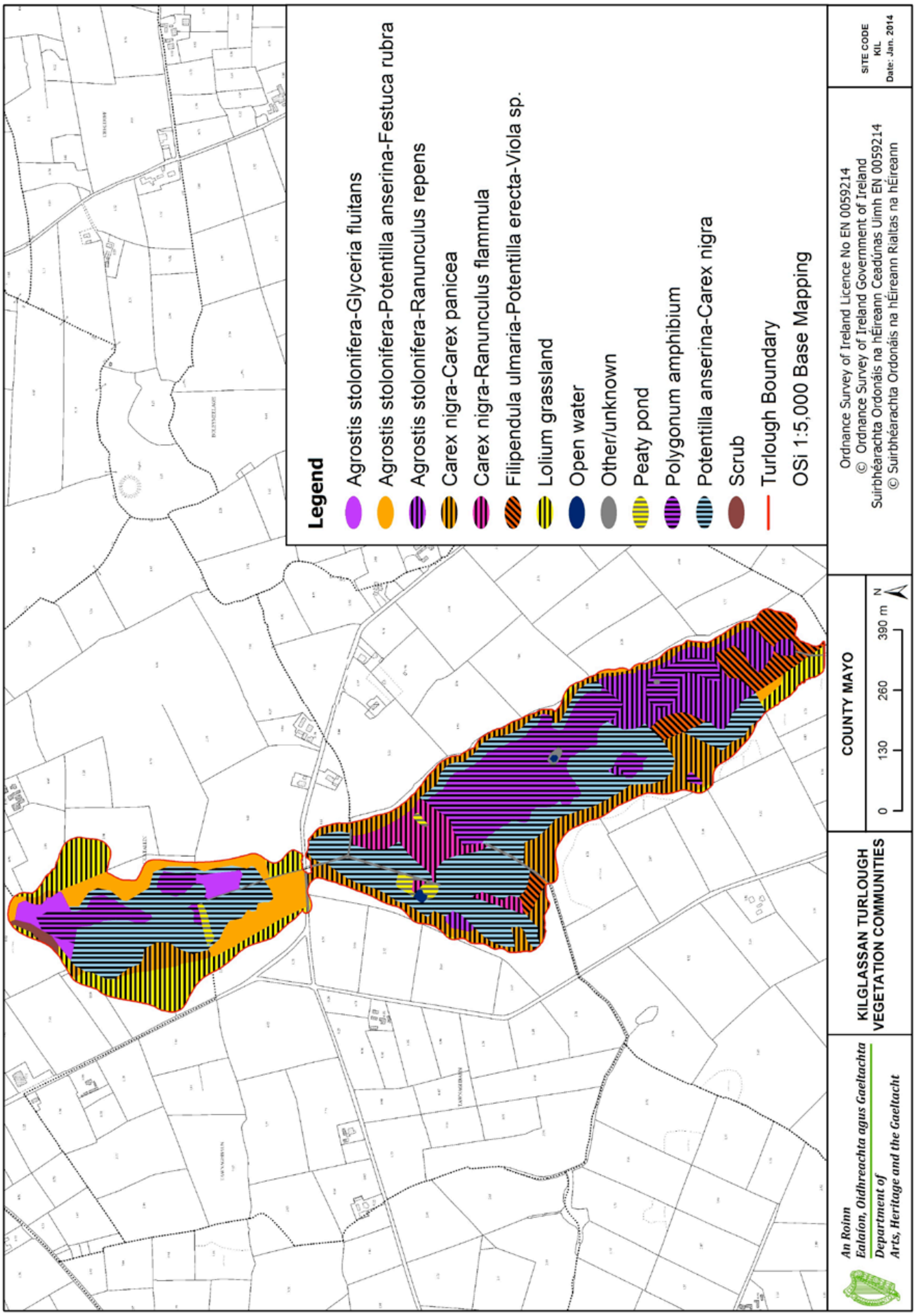

Legend
Agrostis stolonifera-Glyceria fluitans
Agrostis stolonifera-Potentilla anserina-Festuca rubra
Agrostis stolonifera-Ranunculus repens
Carex nigra-Carex panicea
Carex nigra-Ranunculus flammula
Filipendula ulmaria-Potentilla erecta-Viola sp.
Lolium grassland
Open water
Other/unknown
Peaty pond
Polygonum amphibium
Potentilla anserina-Carex nigra
Scrub
Turlough Boundary
OSi 1:5,000 Base Mapping
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Date: Jan. 2014
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VEGETATION COMMUNITIES
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
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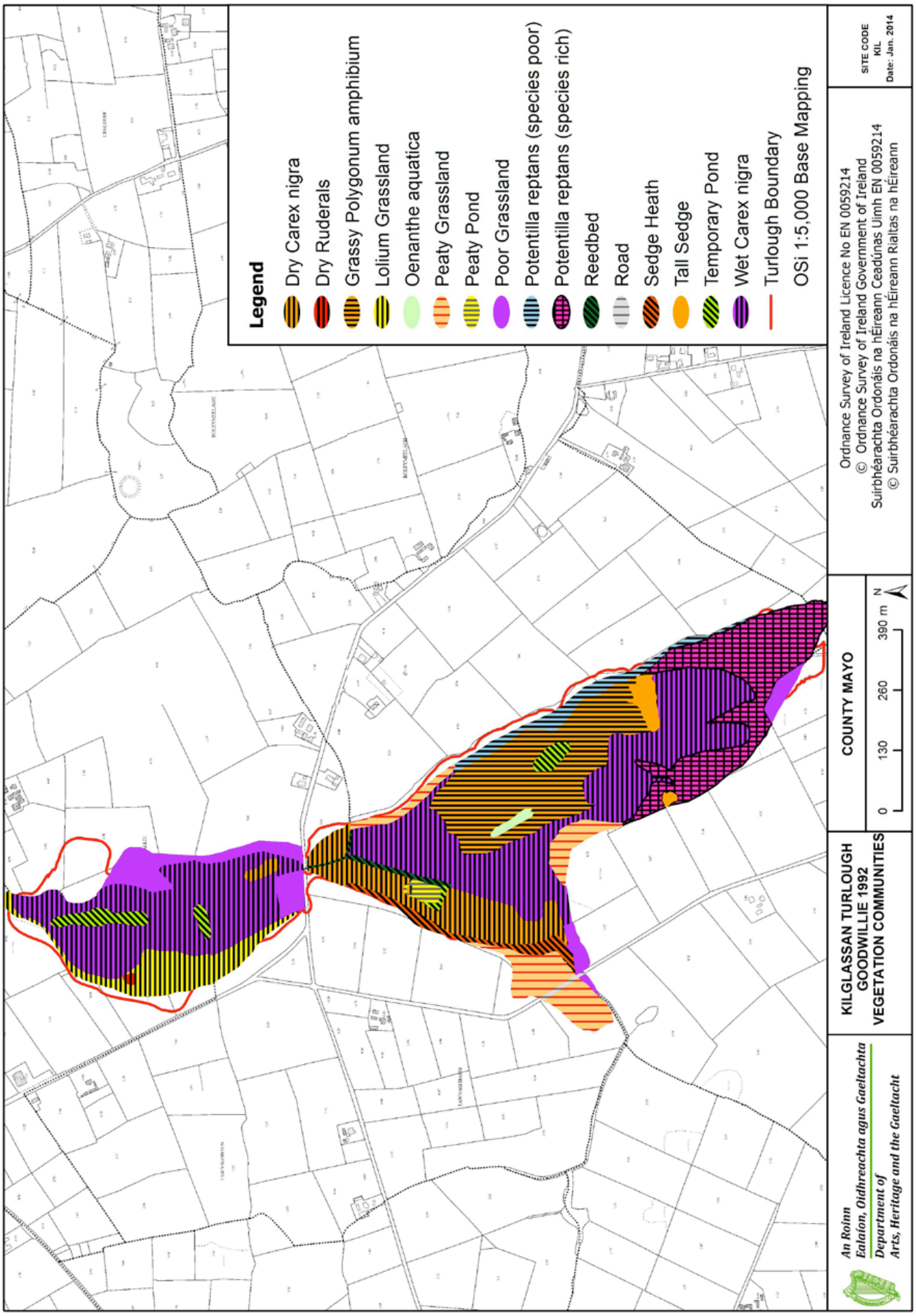
Legend
Dry Carex nigra
Dry Ruderals
Grassy Polygonum amphibium
Lolium Grassland
Oenanthe aquatica
Peaty Grassland
Peaty Pond
Poor Grassland
Potentilla reptans (species poor)
Potentilla reptans (species rich)
Reedbed
Road
Sedge Heath
Tall Sedge
Temporary Pond
Wet Carex nigra
Turlough Boundary
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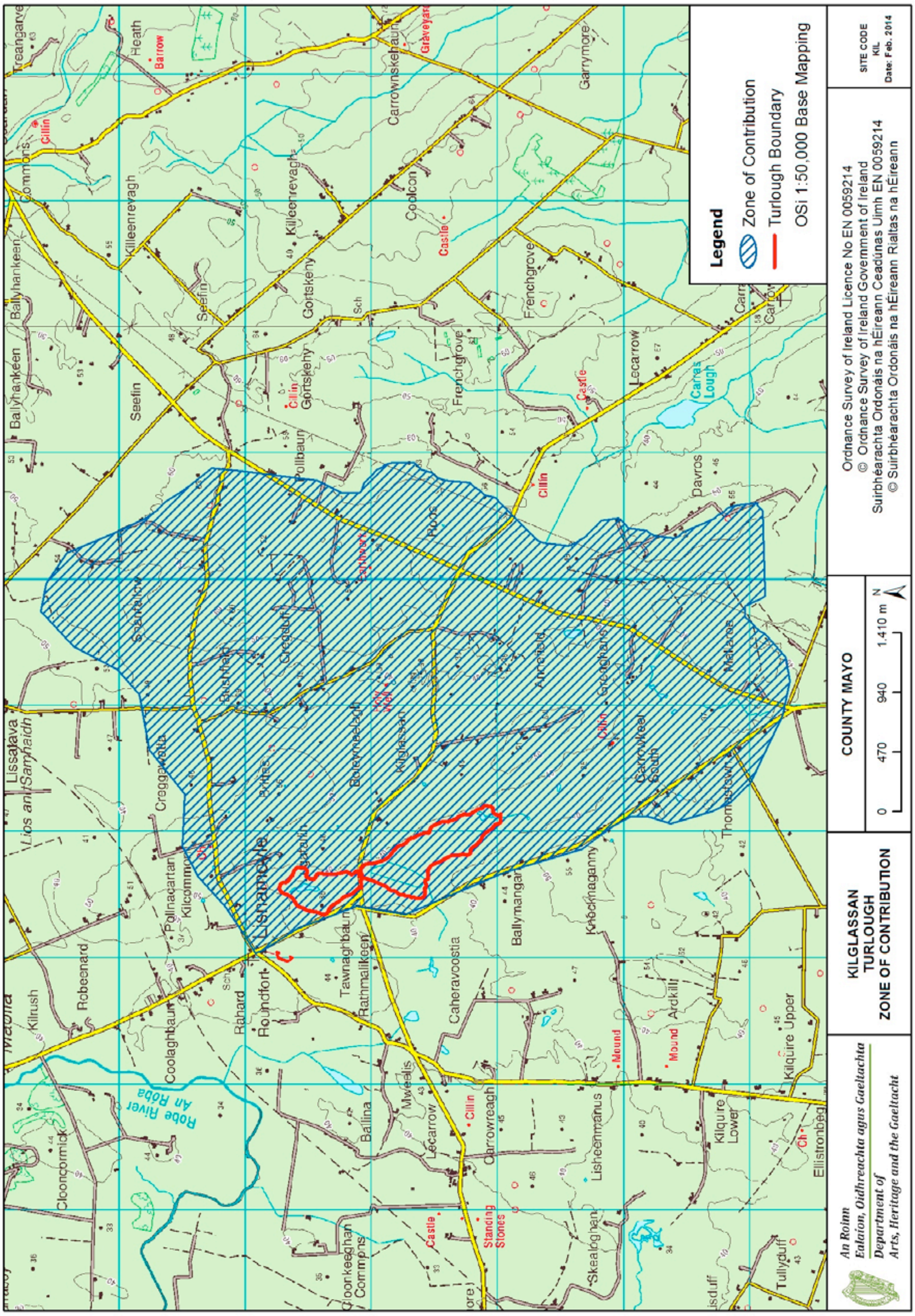
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Zone of Contribution
Turlough Boundary
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KILGLASSAN TURLOUGH ZONE OF CONTRIBUTION
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Department of Arts, Heritage and the Gaeltacht

Site Report: Knockaunroe Turlough
TCD Turlough Research project 2006-2011

Turlough Project Code	SAC Name	SAC/NHA No.	County	Townland	RBD	Easting	Northing	Area (ha)
KNO	East Burren Complex	001926	Clare	Knockaunroe	SHANNON	131400	194180	81

File update: July 2015 (S. Waldren)

Site Description

Knockaunroe turlough occurs in the flat limestone pavement to the south-west of Mullach Mor (Co. Clare), in the East Burren Complex SAC. There is exposed limestone pavement to the north; the southerly end has a thin cover of soil. There are two subsidiary basins; one to the south, and one at the eastern end across the road. Knockaunroe was the largest turlough in this study, with an extent of 78.8 ha. The turlough has a great diversity of vegation communities, sixteen were recorded; the dominant vegetation types were the *Eleocharis palustris-Ranunculus flammula* community and the flooded pavement community. Knockaunroe has circumneutral highly organic soils, and the dominant soil type is peat-marl. This turlough is hardly grazed, with just 1% of the area under rotational grazing, although the lack of fencing means that there is access for wild and feral grazers (e.g. feral goats). The turlough has an above average drainage capacity. Extensive flooding typically occurs once a year although the water level may vary markedly during flooded periods.

Knockaunroe – photo: S. Kimberley

Phytoplankton

Phytoplankton analysis was conducted on sub-samples of monthly spot samples collected for hydrochemical analysis between October 2006 and June 2007. Phytoplankton composition varies significantly over time and data from autumn, mid-winter and spring/early summer are presented below. Taxa were identified to species level where possible. Some taxa were not discriminated beyond general groupings (i.e. small centric diatoms, dinoflagellates and pinnate diatoms). The term non-identifiable alone (or n.i.) was reserved for cases where specimens were not identifiable. Discrimination between n.i. filament, n.i. flagellate, n.i. colony, n.i. green filament was made when applicable. Biovolume (mm^3 m^{-3}) was used as the measure of algal biomass.

October 2006		**January 2007**		**May 2007**	
Biovolume (mm^3/m^3)	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*
Cryptomonas	95352	*Fragilaria/Synedra*	271822	*n.i.*	148614
Dinobryon	6788	*n.i. pennates*	159305	*Tribonema*	115789
n.i.	259	*n.i.*	45024	*Cymbella cesatii*	109300
Chroomonas acuta	122	*Achnanthidium minutissima*	44990	*Chroococcus*	92587
Cryptomonas	95352	*n.i. 'strange flagellate'*	26488	*n.i. centrics*	89880

Benthic Algae

Turloughs were inspected for algal mats during the emptying phase in 2007, 2008 and 2009. Turloughs were visited in the first two weeks of March to June 2007 as part of the monthly monitoring of turloughs. Dedicated trips to inspect for algal mats were conducted in 2008 on the 4th of March, the 1st of April, and the 26th, 27th and 28th of May, and in 2009 on the 15th and 16th of June and on the 24th and 25th of July. The presence of both living floating mats and dead drying mats was noted, as well as their extent in the turlough basins. Occurrence of visible filamentous algal mats in the three years of observation is presented below. Y = visible occurrence; * = "extensive cover" (estimated to be 2 to 8% of total area of basin); † = negligible quantity observed; • = turlough was too flooded to permit full observation. Minimal areas of algal mats were noted in Knockaunroe in 2009, though it should be noted that the water level was very high at the time of this visit.

Year of Observation		
2007	**2008**	**2009**
N	N	Y†

Hydrochemistry

Data shown are the mean ± SD of monthly spot samples collected between October 2006 and June 2007. Mean seasonal Total P and Chlorophyll *a* were used to determine the trophic status of the floodwaters based on OECD trophic categories. The median and range of mean values across all turloughs are also provided.

Hydrochemical Variable	Knockaunroe Values		Turlough Summary Stats (n=22)		
	Mean±SD	OECD Trophic Category	Median	Min	Max
pH	8.1 ± 0.1		8.1	7.7	8.3
Alkalinity mg l^{-1} $CaCO_3$	138.5 ± 3.1		204.0	112.4	236.4
Colour mg l^{-1} PtCo	10.4 ± 3.4		26.9	7.9	85.1
Molybdate Reactive Phosphorus µg l^{-1}	0.7 ± 0.4		3.4	0.7	42.1
Total Phosphorus µg l^{-1}	4.2 ± 1.8	Oligotrophic	24.8	4.0	82.1
Chlorophyll *a* µg l^{-1}	1.2 ± 0.7	Oligotrophic	4.9	1.1	33.5
Nitrate-N mg l^{-1}	0.3 ± 0.2		0.7	0.1	1.9
Total Nitrogen mg l^{-1}	0.6 ± 0.2		1.2	0.6	2.3

Aquatic Invertebrates

22 turloughs were sampled for littoral aquatic macroinvertebrates using sweep nets during November 2006 and April 2007. Zooplankton samples were collected in April 2007. Open-water cladocerans and littoral chydorids were sampled using a zooplankton net and perspex tube respectively.

Aquatic Macroinvertebrates			
November 2006	**Count**	**April 2007**	**Count**
Agabus sp. (larva)	4	*Agabus* sp. (larva)	1
Agyroneta aquatica	8	*Agyroneta aquatica*	2
Anisoptera sp. (larva)	6	*Bithynia tentaculata*	1
Asellus aquaticus	1	Chironomidae	14
Caenis horaria	2	*Cloeon dipterum*	1
Culicidae	1	*Cloeon simile*	33
Gammarus lacustris	1	Diptera Pupae	1
Hydrachnidia (Mite)	1	*Hydroporus obscurus*	5
Hydroporus obscurus	1	*Hydroporus palustris*	5
Limnephilidae sp. Instar II	13	*Hygrotus inaequalis*	4
Limnephilidae sp. Instar III	13	*Limnephilus decipiens*	1
Limnephilus decipiens	4	*Lymnaea trunculata*	2
Limnephilus lunatus	13	*Planorbis planorbis*	1
Lymnaea trunculata	3	*Porhydrus lineatus*	4
Oligochaeta	39	*Rhantus* sp. (larva)	2
Phacopteryx brevipennis	2	*Sympetrum sanguinem*	3
Porhydrus lineatus	1		
Rhantus sp. (larva)	1		

Aquatic Macroinvertebrates:

Aquatic Macroinvertebrate Taxa	**Presence of high abundances (>50)**	
	November 2006	**April 2007**
Diptera	N	N
Ostracoda	N	N
Odonata	N	N
Trichoptera	N	N

Zooplankton species
Alona affinis
Alonella excisa
Alonella nana
Chydorus sphaericus
Eurycercus lamellatus
Graptoleberis testudinaria
Lathurona rectirostris
Simocephalus vetulus

Vegetation

Vegetation description and classification yielded 25 vegetation communities suitable for mapping. Knockaunroe is extremely diverse, with a large number of vegetation communities and a high vascular plant diversity, including many important plant species such as *Potentilla fruticosa, Teucrium scordium* and *Viola persicifolia*. Sixteen vegetation communities were mapped in Knockaunroe; major communities included the oligotrophic *Eleocharis palustris-Ranunculus flammula* community, important areas of Flooded Pavement, *Molinia caerulea-Carex panicea*, and surprisingly high amounts of *Lolium* grassland for such an oligotrophic turlough; the latter reflects improvement in fields to the south of the site which are inundated at high flood levels. High conservation value communities are denoted by *.

Vegetation Community	**Area (Ha)**
**F. ulmaria-P. erecta-Viola sp*	0.15
A. stolonifera-Glyceria fluitans	0.06
A. stolonifera-P. anserina - F. rubra	0.21
**M. caerulea-C. panicea*	11.24
Carex nigra-C. Panicea	2.05
Carex nigra-Equisetum fluviatile	0.2
Eleocharis palustris-R. flammula	19.22
*Flooded pavement	16.03
Limestone grassland	1.44
Lolium grassland	13.03
Open water	0.37
Other/unknown	5.46
Polygonum amphibium	0.63
Reedbed	4.61
Schoenus nigricans fen	0.3
Woodland/scrub	5.97
Number of vegetation communities	16
Number of plant species	109

Vascular Plant Species

Nomenclature follows Parnell, J & Curtis, T. (2012) *Webb's An Irish Flora*, University of Cork Press.

Achillea millefolium	*Galium palustre*	*Potentilla erecta*
Achillea ptarmica	*Galium uliginosum*	*Potentilla fruticosa*
Agrostis capillaris	*Galium verum*	*Prunella vulgaris*
Agrostis stolonifera	*Geranium sanguineum*	*Prunus spinosa*
Angelica sylvestris	*Glechoma hederacea*	*Ranunculus acris*
Apium inundatum	*Glyceria fluitans*	*Ranunculus flammula*
Baldellia ranunculoides	*Gymnadenia conopsea*	*Ranunculus repens*
Briza media	*Hieracium pilosella*	*Ranunculus trichophyllus*
Calluna vulgaris	*Hydrocotyle vulgaris*	*Rhamnus cathartica*
Cardamine pratensis	*Hypericum pulchrum*	*Rhinanthus minor*
Carex elata	*Juncus acutiflorus*	*Rosa pimpinellifolia*
Carex flacca	*Juncus articulatus*	*Rubus caesius*
Carex hostiana	*Juncus bulbosus*	*Rubus fruticosus* agg.
Carex nigra	*Juncus effusus*	*Rumex acetosa*
Carex panicea	*Leontodon autumnalis*	*Rumex crispus*
Carex viridula agg.	*Leontodon hispidus*	*Salix cinerea s. cinerea*
Catapodium rigidium	*Leontodon saxatilis*	*Salix repens*
Centaurea nigra	*Linum catharticum*	*Samolus valerandi*
Cirsium dissectum	*Littorella uniflora*	*Schoenoplectus lacustris*
Cladium mariscus	*Lotus corniculatus*	*Schoenus nigricans*
Crataegus monogyna	*Lythrum portula*	*Scirpus fluitans*
Cynosurus cristatus	*Lythrum salicaria*	*Sedum acre*
Danthonia decumbens	*Mentha aquatica*	*Succisa pratensis*
Eleocharis multicaulis	*Menyanthes trifoliata*	*Taraxacum officinale* agg.
Eleocharis palustris	*Molinia caerulea*	*Teucrium scordium*
Elodea canadensis	*Myosotis scorpioides*	*Thalictrum minus*
Elymus repens	*Parnassia palustris*	*Thymus praecox*
Equisetum fluviatile	*Phalaris arundinacea*	*Trifolium pratense*
Erica cinerea	*Phleum bertolonii*	*Trifolium repens*
Euphrasia species	*Phleum pratense*	*Utricularia minor*
Festuca arundinacea	*Phragmites australis*	*Veronica beccabunga*
Festuca ovina	*Plantago lanceolata*	*Veronica species*
Festuca rubra	*Plantago maritima*	*Vicia cracca*
Filipendula ulmaria	*Polygonum amphibium*	*Viola canina*
Frangula alnus	*Potamogeton natans*	*Viola riviniana*
Fraxinus excelsior	*Potentilla anserina*	*Viola persicifolia.*
Galium boreale		

Soils and Grazing

Soils were classified using a modified version of soil categories generated by the Teagasc/EPA Soils and Subsoils Mapping project (Fealy *et al.*, 2009). The classification scheme principally uses parent material (calcareous/non-calcareous), depth class (shallow/deep) and drainage class (well drained/poorly drained) to assign soils to one of nine broad categories. Knockaunroe has extensive areas of peat-marl and very shallow poorly-drained organic soils are associated with the upper slopes. The mean ± SD of a range of soil properties are also provided, in addition to the median and range of each variable across turloughs. Knockaunroe has circumneutral highly organic soils, with the highest mean organic contents recorded. The low calcium carbonate contents do not reflect the large expanse of peat-marl, as soil sampling was restricted to upper levels owing to prolonged flooding. This turlough had the highest recorded mean Total Nitrogen and Total Phosphorus concentrations were towards the high end of the range across sites.

Soil Types/Grazing Extent	**% Turlough Area**
Very shallow poorly drained organic	9
Peat-Marl	74.6
Extent of rotationally grazed area	1

Soil Property (n=6)	**Knockaunroe**	**Turlough Summary Stats (n=22)**		
	Mean ± SD	**Median**	**Min**	**Max**
pH	7.06 ± 0.6	7.20	5.94	8.29
% Organic Matter content	69.1 ± 15.5	25.8	10.2	69.1
% Inorganic content	25.7 ± 13.4	43.2	25.7	85.0
% Calcium carbonate content	5.2 ± 2.5	11.3	2.48	43.7
Total Nitrogen mg kg^{-1}	24233 ± 9468	11142	4983	24233
Total Phosphorus mg kg^{-1}	1080 ± 410	905	245	1594

Hydrology

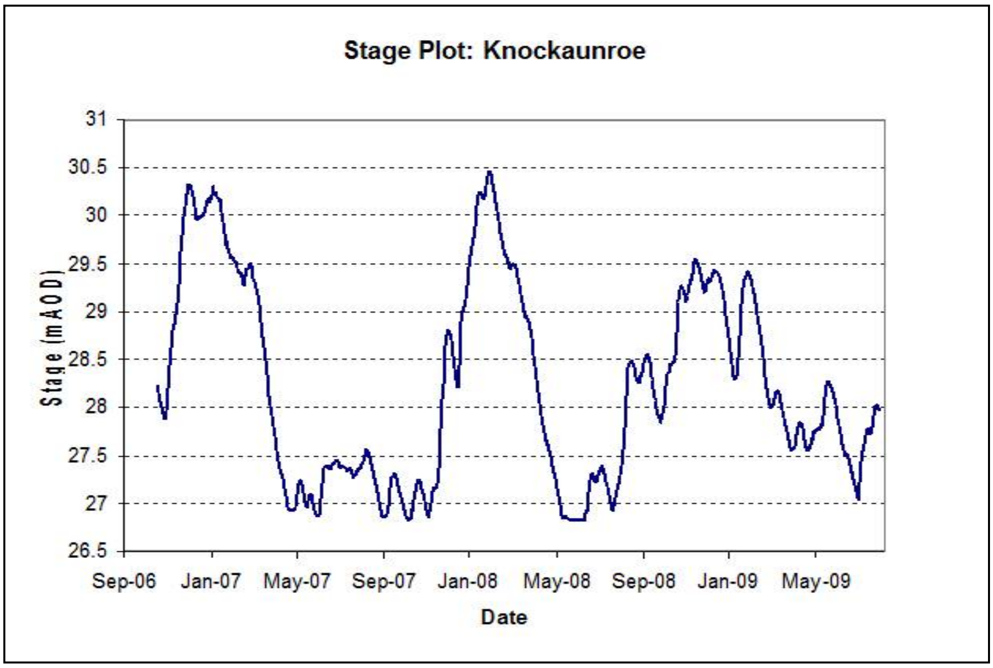
Water levels were recorded at hourly intervals using a variety of Schlumberger Divers® (Marton Geotechnical Ltd, Suffolk, UK) placed at or near the lowest point in each turlough. Divers measure the pressure of the water and air column above them, and from this the depth of water can be calculated. GPS surveys were carried out on 21 monitoring sites (Tullynafrankagh omitted) in order to develop digital terrain models (DTMs) from which contour maps, stage-volume and stage-surface area relationships are produced. The inflow magnitude is indicative of the properties of a turlough's catchment area and flow capacity, while outflow is a function of the drainage capacity of the system.

Knockaunroe has an above average drainage capacity, relatively high inflows and outflow, but an average recession duration. Extensive flooding typically occurs once a year although the water level may vary markedly during flooded periods.

Knockaunroe is hydrologically linked with Lough Gealain, the base of which is slightly higher in elevation; water level changes at Knockaunroe lag about 24 hrs behind those in Lough Gealain (see *Chapter 2: Hydrology* for further details).

Hydrological Information	Knockaunroe Values	Turlough Summary Stats (n=21)		
		Median	Min	Max
Start of Hydrological Recording	05/11/2006	-	-	-
End of Hydrological Recording	05/08/2009	-	-	-
Days Recorded	1004	-	-	-
Equipment Failure	None recorded	-	-	-
Hydroperiod (days)	213	213	135	348
Maximum Floodwater Depth (m)	4.9	4.9	3	15.4
Maximum Floodwater Volume ('000 m^3)	919.9	877.9	355.6	4008.1
Maximum Flooded Area	35.79	38.61	13.71	78.12
Average Basin Depth (m)	2.57	2.28	0.85	6.76
Average Daily Inflow (m^3 s^{-1})	1.333	0.684	0.254	10.253
Average Daily Outflow (m^3 s^{-1})	0.582	0.271	0.086	2.018
Drainage Capacity (m^3 s^{-1})	0.396	0.154	0.069	1.156
Recession Duration (days)	53.8	57.3	11	142.5

Stage plot for Knockaunroe



Zone of Groundwater Contribution (ZOC) Risk Assessments

GIS based risk assessments were conducted with a view to identifying turloughs at risk of failing to meet WFD water quality objectives. These risk assessments were conducted by Compass Informatics Ltd and were based on Risk Assessment Sheet GWDTERA2a (Guidance Document No. GW9) on assessing risks to turloughs from phosphate (Working Group on Groundwater 2004) and Pathway Susceptibilities and Pressure Magnitudes were integrated to produce Impact Potential maps and predicted Risk Categories for the turlough ZOC. The TCD Risk Category is derived from a revised Impact Potential matrix. The predicted Risk Categories were adjusted using mean seasonal floodwater Total P (μg l^{-1}) (see Section 4.5.4 of the Risk Assessment Sheet GWDTERA2a). The risk categories include 1A: at significant risk; 1B: probably at significant risk; 2A: Not at significant risk (low confidence); 2B: Not at significant risk (higher confidence).

ZOC Area (Km^2)	Predicted WFD Risk Category	Adjusted WFD Risk Category	Predicted TCD Risk Category	Adjusted TCD Risk Category
17.0	1B	1B	1B	1B

ZOC Pressure Variable	
CORINE BARE ROCK %	57
CORINE PEAT BOGS%	0
CORINE ALL NATURAL AND SEMI-NATURAL AREAS%	9
CORINE IMPROVED PASTURE%	26
CORINE UNIMPROVED PASTURE%	0
CORINE ALL PASTURE%	26
CORINE OTHER AGRICULTURAL LANDS%	3
TEAGASC/EPA HABITATS ROCK%	56
TEAGASC/EPA HABITATS BOGS/PEATS%	1
TEAGASC/EPA HABITATS FORESTS/SCRUBS%	2
TEAGASC/EPA HABITATS WATER%	1
TEAGASC/EPA HABITATS DRY GRASSLAND%	39
TEAGASC/EPA HABITATS WET GRASSLAND%	1
TEAGASC TOTAL GRASSLAND%	40
TOTAL LIVESTOCK UNIT/ha of ZOC	0
TILLAGE%	0
No. SEPTIC TANKS km^{-2} ZOC	3
No. SEPTIC TANKS km^{-2} EXTREME PATHWAY SUSCEPTIBILITY	2
HIGH PATHWAY SUSCEPTIBILITY%	0
EXTR+HIGH PATHWAY SUSCEPTIBILITY%	78
WELL DRAINED SOIL %	95
POORLY DRAINED SOIL%	4

Site Conservation Assessment

The following site conservation assessment was undertaken to feed into the national reporting structure for assessing conservation status as required under Article 17 of the Habitats Directive. A suite of indicators and associated targets were derived to assess ecological structure and function. Future prospects were assessed through the evaluation of the impact of current and recent pressures and likely future threats to the site. The assessment follows a rules based approach to determine whether Structures & functions and Future Prospects should be assessed as good (green), inadequate (amber) or bad (red). For further details, see Chapter 10 (Conservation Status Assessment).

Please note an updated approach to assessing site condition has been proposed and is outlined in Chapter 12 (Monitoring Methods for Turloughs).

Conservation Condition Summary

Structure & Function	**Favourable**
Future Prospects	**Favourable**
Site Conservation Condition	**Favourable**

Structure and Function Status:

Indicator	*Comments*
Hydrological Function: *Good*	
Water Quality: *Very Good*	4.2 µg P l^{-1}. Very low, oligotrophic
Biological Responses: *Very Good*	
Algal communities: 0	No algal mats recorded (negligible amounts only in 2009), low max CHL
Vegetation communities: 2	High cover of positive indicator communities typical of oligotrophic turloughs, but some *Lolium* grassland suggesting some local improvement
***Rumex* cover: 0**	Frequency 4.7%
Important plants: 2	*Potentilla fruticosa, Viola persicifolia, Teucrium scordium, Frangula alnus, Plantago maritima*
Important aquatic invertebrates: 1	*Alonella exisa, Sympetrum sanguineum*
Overall Structure & Function: *Good*	A classic oligotrophic turlough in very good ecological condition

Pressures:

Code	*Impact*	*Notes*
A05.02 Stock feeding (within and adjacent to turlough)	L	Some evidence of stock being fed adjacent to the SE of turlough
C01.03 Peat extraction (turlough)	L	Evidence of past peat cutting but likely ceased very long ago

Threats:

Code	Impact	Notes
A10.02 Removal of stone walls and embankments (in turlough)	L	
M01.03 Flooding and rising precipitations	L	
A02.01 Agricultural intensification (ZOC)	L	Low level intensification possible in part of ZOC
A04.01.01 Intensive cattle grazing (turlough)	L	

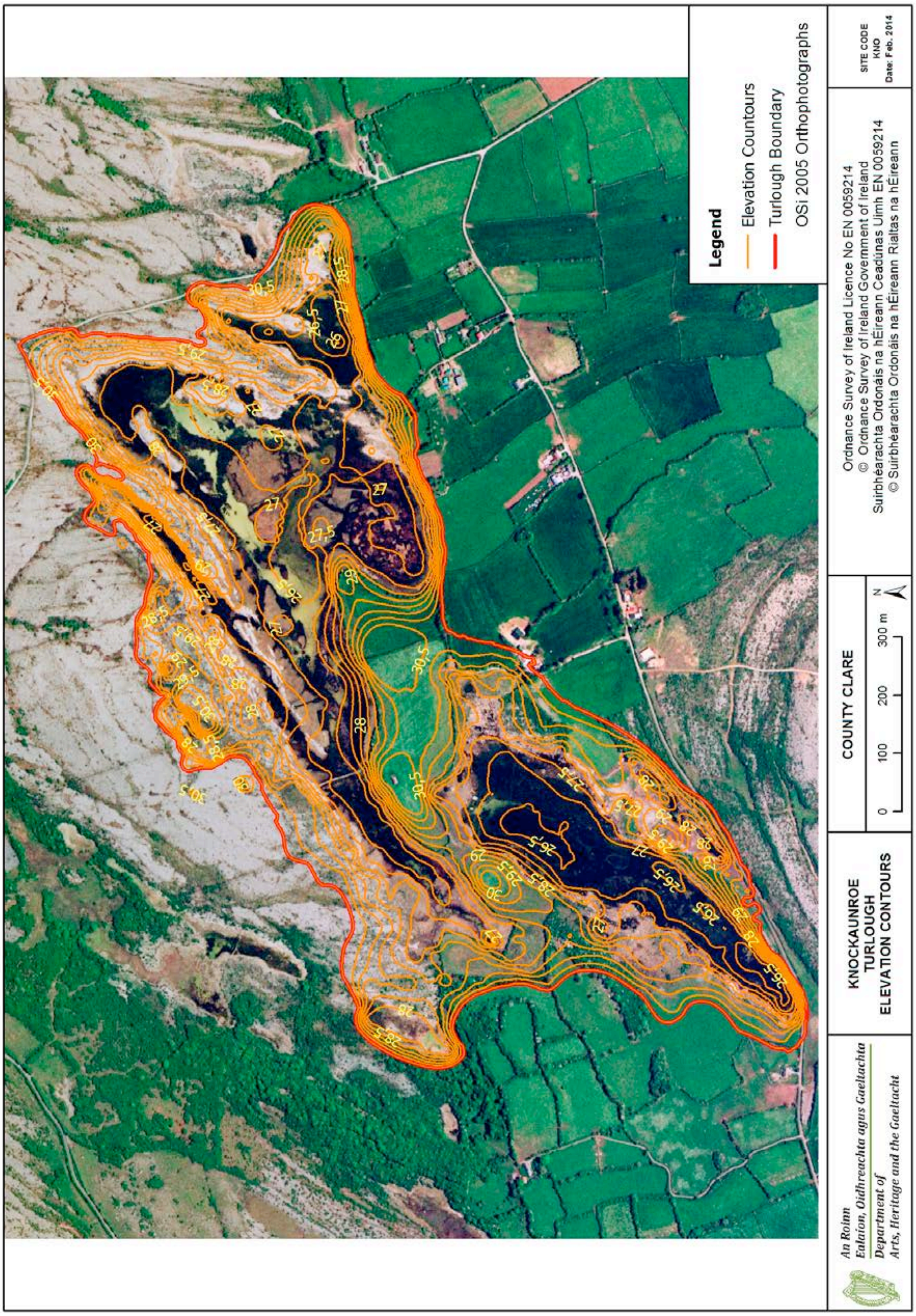
Future Prospects: **Favourable** – low impact threats only.

Overall Assessment: **Favourable** – Knockaunroe is a classic oligotrophic turlough, with excellent diverse biological communities and currently very few low impact pressures. However, any change in groundwater nutrient status would put the current excellent ecological status at risk, so there is a need to monitor the situation to enable immediate action to be taken should adverse conditions prevail.

Maps

Maps are provided of:

1. Elevation contours, based on GIS digital terrain models from points by differential GPS topographic survey (for further details, see *Chapter 3: Hydrology*)
2. Grazing in land parcels
3. Approximate sampling points for water chemistry and aquatic invertebrates
4. Soil nutrient sampling points
5. Points for soil survey (note: soils were surveyed to the turlough boundary defined by Goodwillie, 1992; see map 9)
6. Soils (note: soils were mapped by combining the EPA Subsoils base map with the point soil descriptions; for further details see *Chapter 6: Soils and Landuse*)
7. Vegetation relevés
8. Vegetation communities (note: relevés do not always match to mapped communities due to small scale variation; for further details of mapping see *Chapter 7: Turlough Vegetation: Description, Mapping and Ecology*)
9. Vegetation maps digitised from Goodwillie, R. (1992) *Turlough's Over 50 Hectares*. Report to NPWS
10. Estimated zone of groundwater contribution (ZOC)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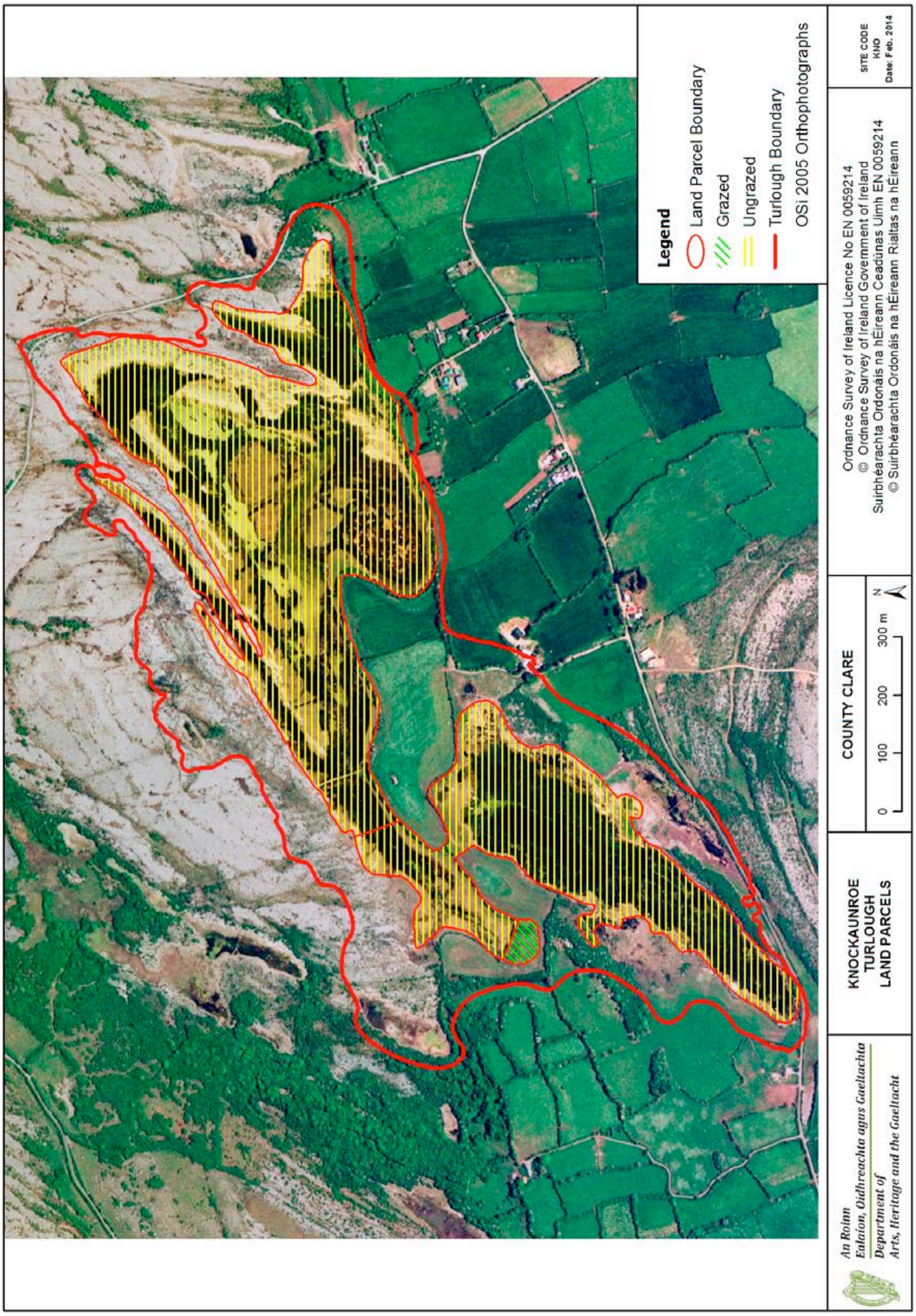
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Land Parcel Boundary
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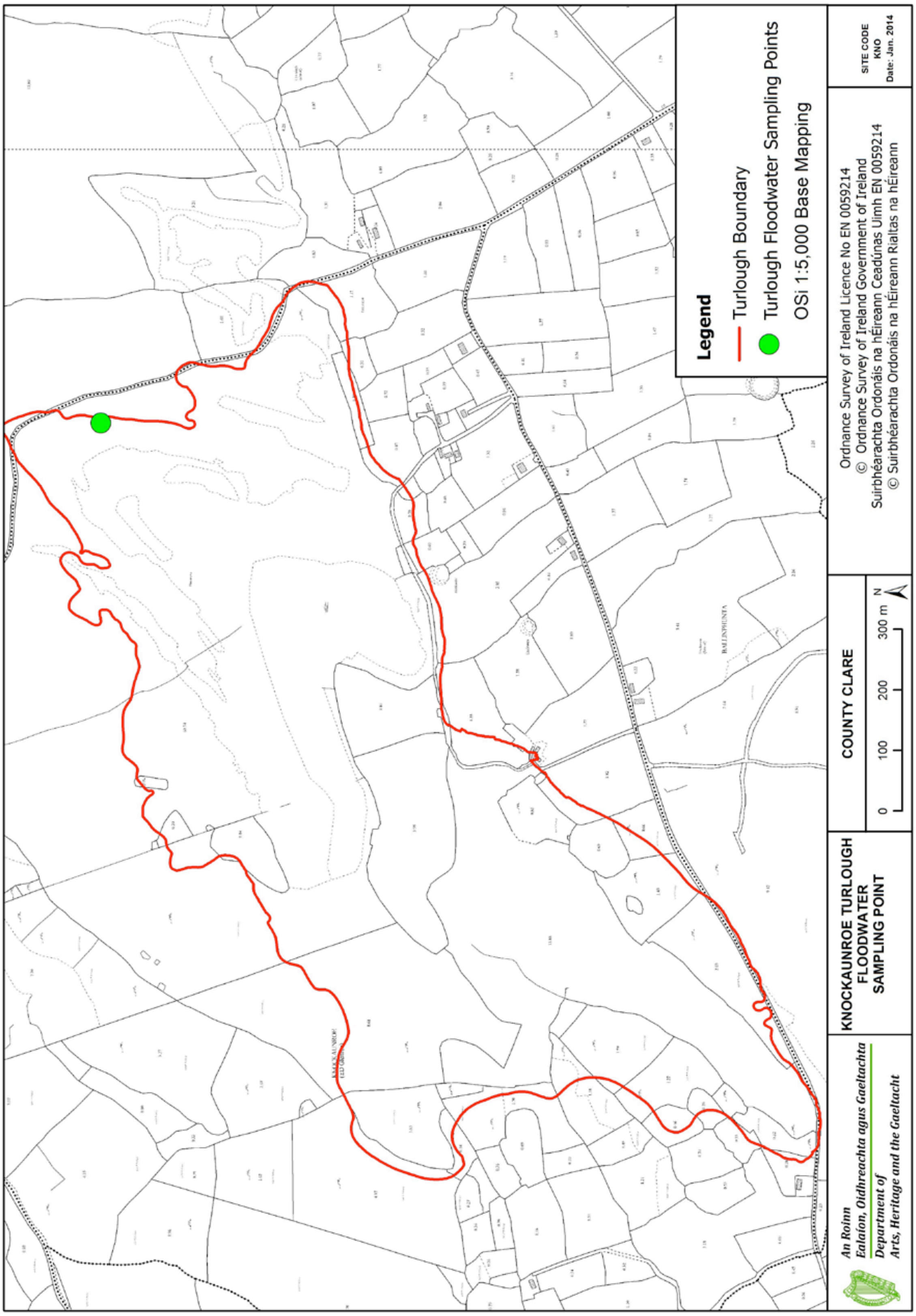
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Turlough Boundary
Turlough Floodwater Sampling Points
OSi 1:5,000 Base Mapping
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SITE CODE
KNO
Date: Jan. 2014
COUNTY CLARE
0 100 200 300 m
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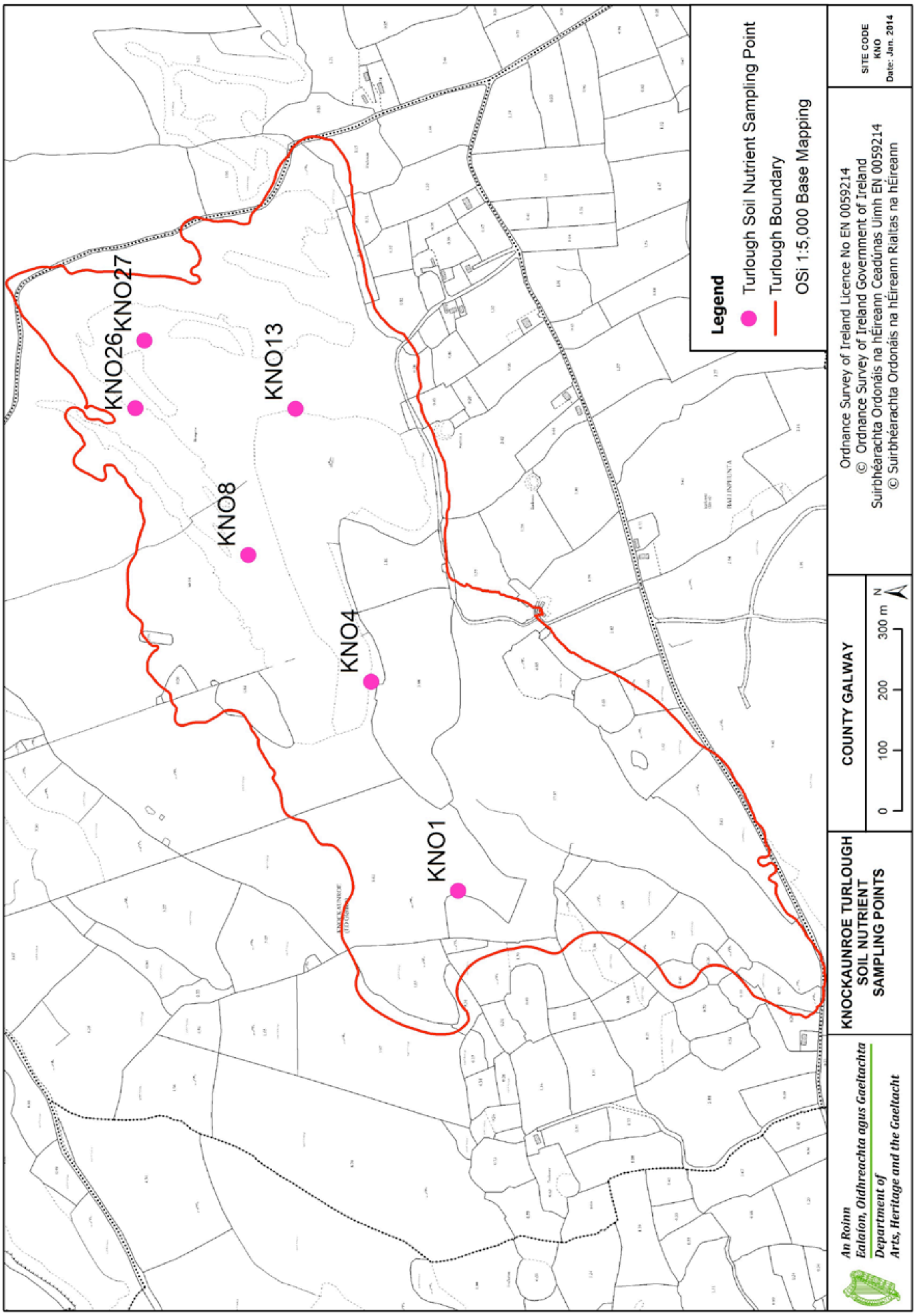
KNOCKAUNROE TURLOUGH FLOODWATER SAMPLING POINT
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht


KNO26
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KNO13
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KNO4
KNO1
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Turlough Soil Nutrient Sampling Point
Turlough Boundary
OSi 1:5,000 Base Mapping
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SITE CODE
KNO
Date: Jan. 2014
COUNTY GALWAY
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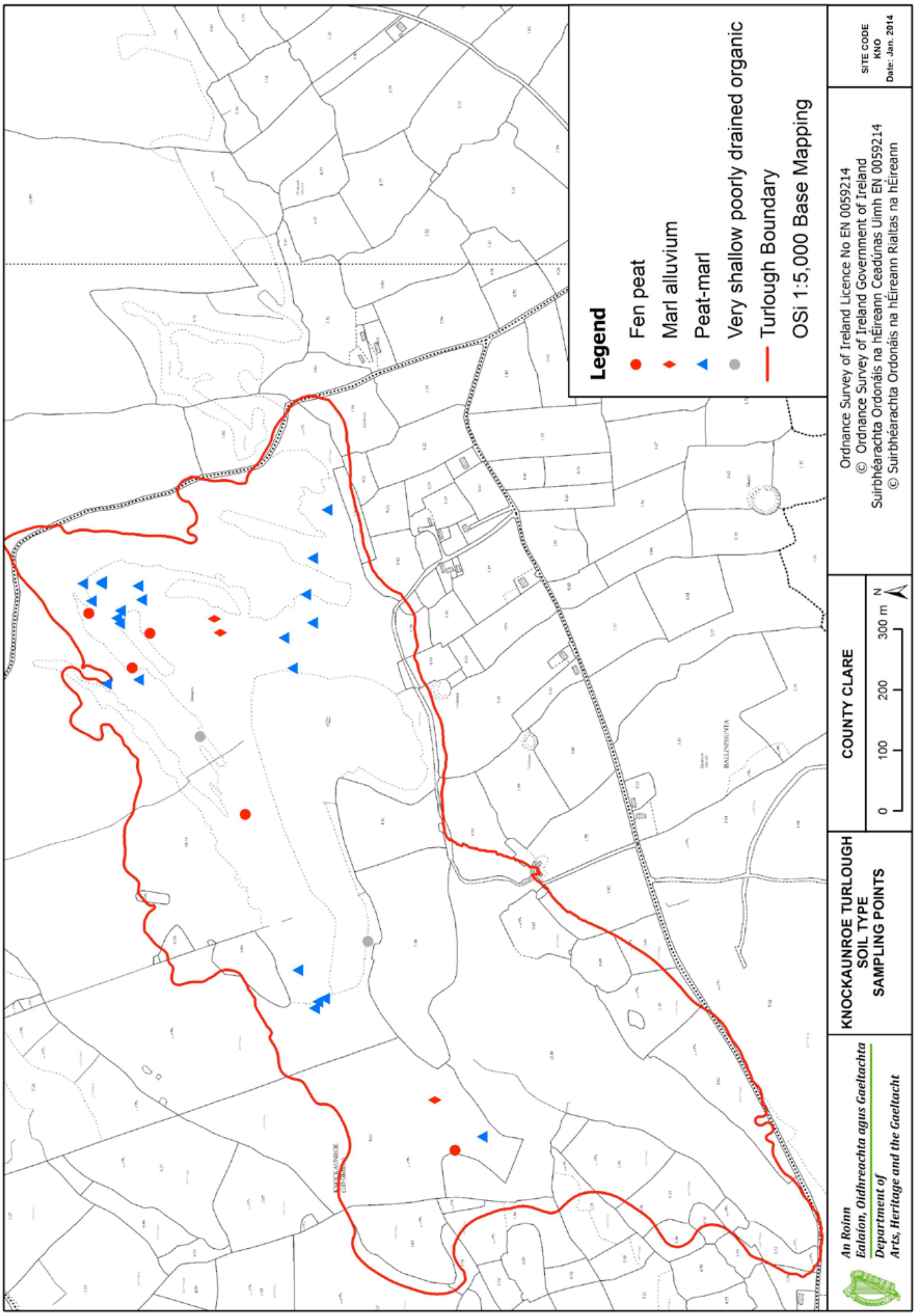
100
200
300 m
N
KNOCKAUNROE TURLOUGH
SOIL NUTRIENT
SAMPLING POINTS
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht


Legend
Fen peat
Marl alluvium
Peat-marl
Very shallow poorly drained organic
Turlough Boundary
OSi 1:5,000 Base Mapping
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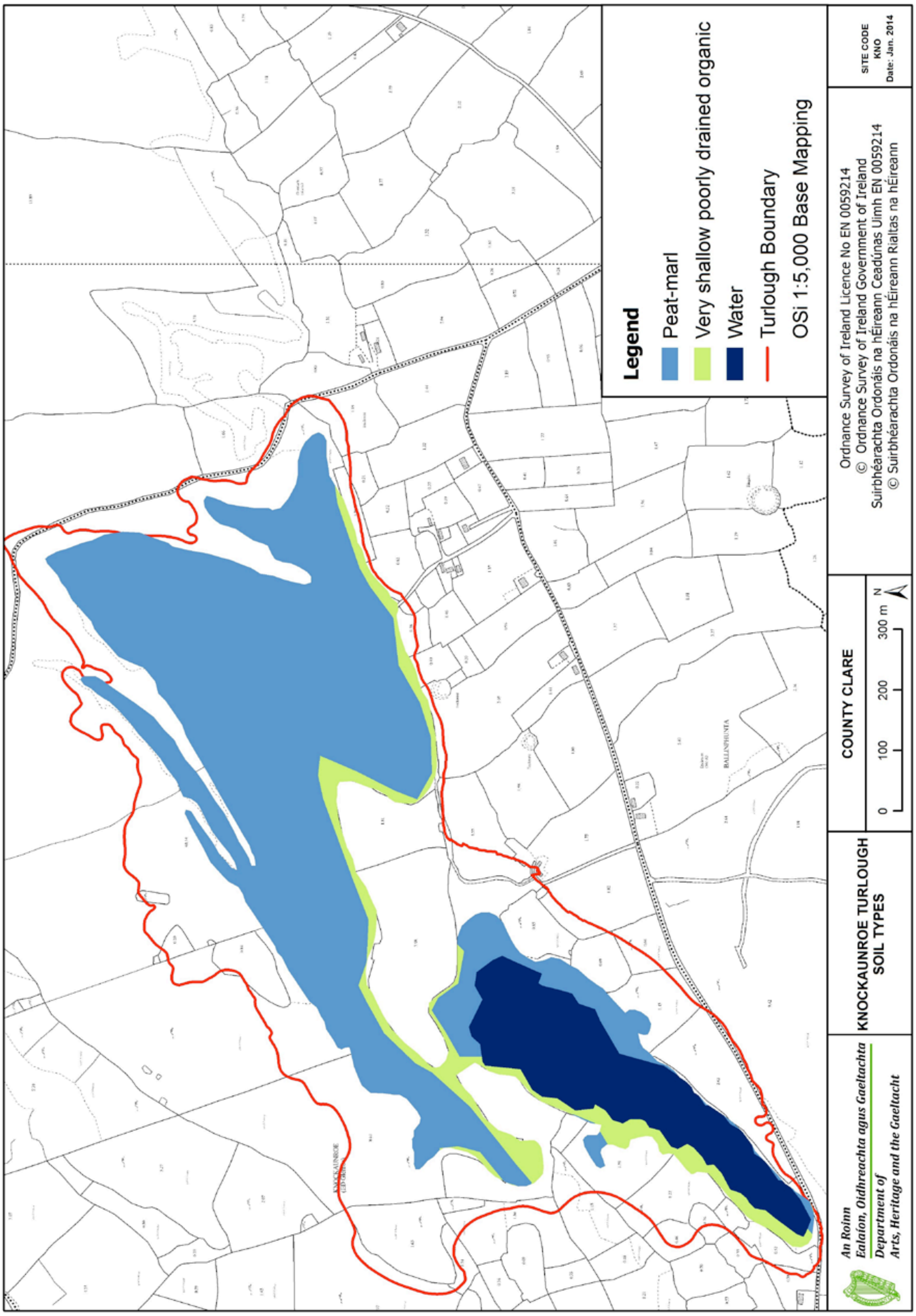
SITE CODE
KNO
Date: Jan. 2014
COUNTY CLARE
0 100 200 300 m
N
KNOCKAUNROE TURLOUGH
SOIL TYPE
SAMPLING POINTS
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht


Legend
Peat-marl
Very shallow poorly drained organic
Water
Turlough Boundary
OSi 1:5,000 Base Mapping
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SITE CODE
KNO
Date: Jan. 2014
COUNTY CLARE
0 100 200 300 m
N
KNOCKAUNROE TURLOUGH
SOIL TYPES
An Roinn
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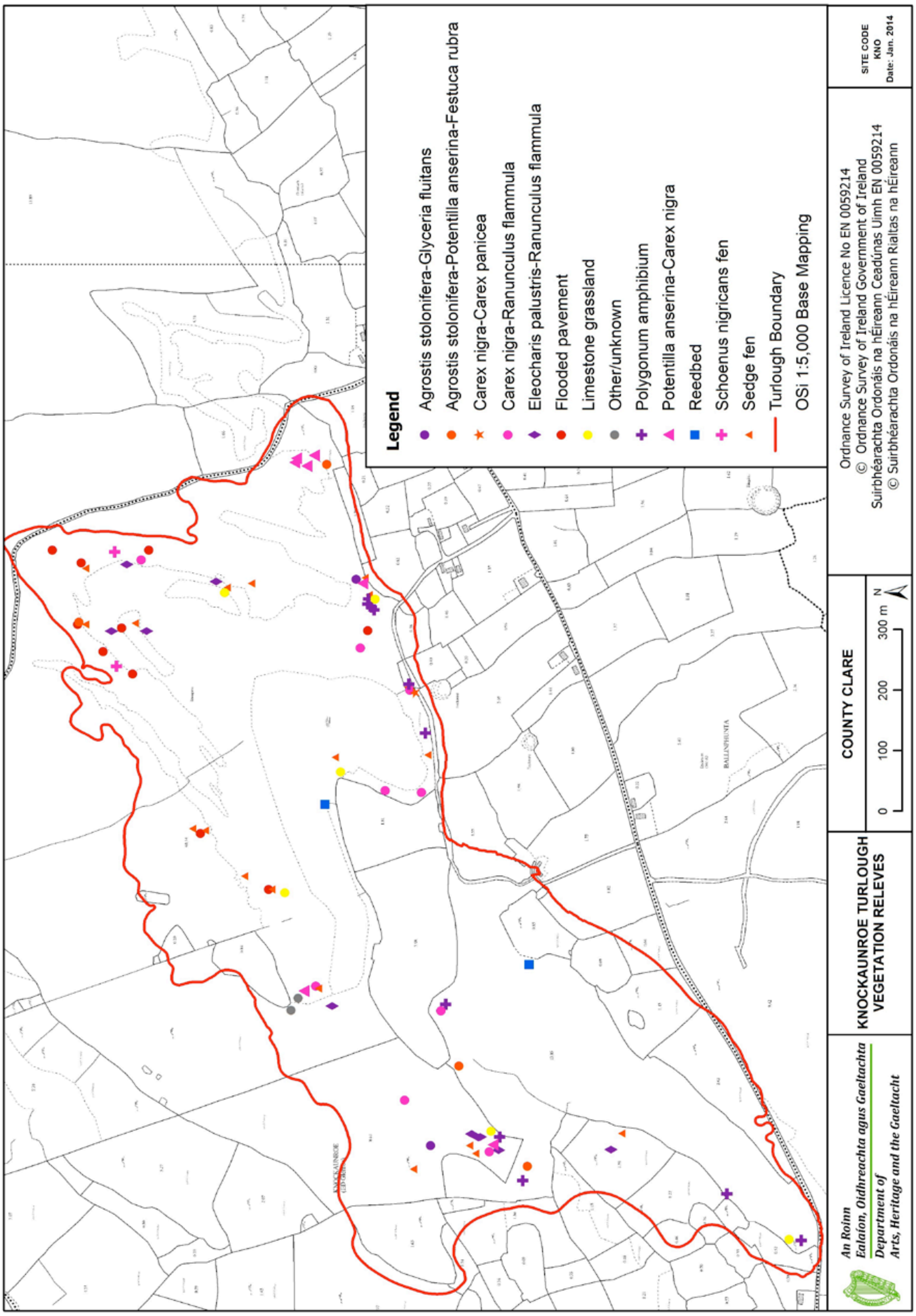
Department of
Arts, Heritage and the Gaeltacht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Agrostis stolonifera-Glyceria fluitans
Agrostis stolonifera-Potentilla anserina-Festuca rubra
Carex nigra-Carex panicea
Carex nigra-Ranunculus flammula
Eleocharis palustris-Ranunculus flammula
Flooded pavement
Limestone grassland
Other/unknown
Polygonum amphibium
Potentilla anserina-Carex nigra
Reedbed
Schoenus nigricans fen
Sedge fen
Turlough Boundary
OSi 1:5,000 Base Mapping
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht
KNOCKAUNROE TURLOUGH
VEGETATION RELEVES
COUNTY CLARE
0
100
200
300 m
N
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© Suirbhéarachta Ordonáis na hÉireann Rialtas na hÉireann
SITE CODE
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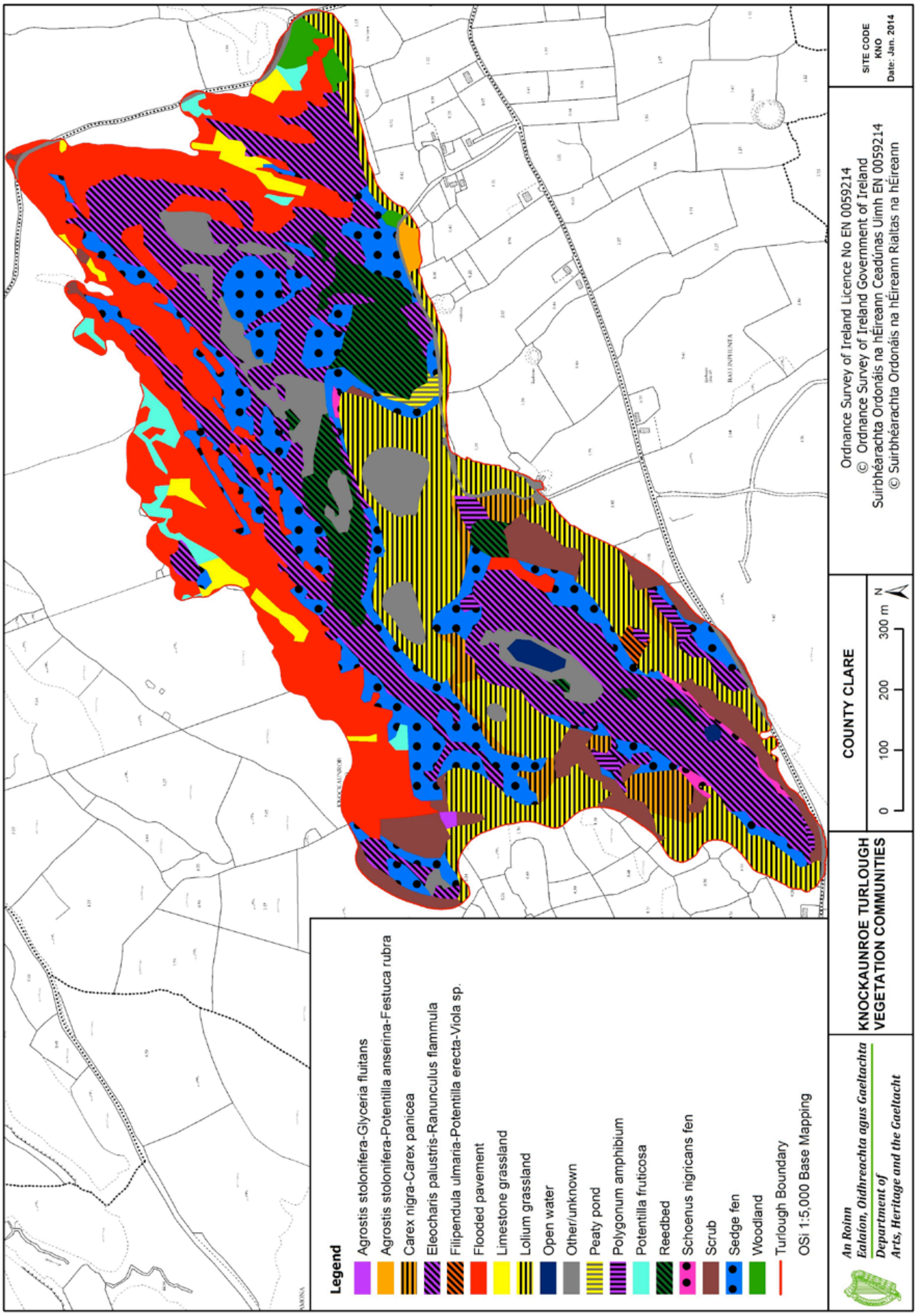
Date: Jan. 2014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Agrostis stolonifera-Glyceria fluitans
Agrostis stolonifera-Potentilla anserina-Festuca rubra
Carex nigra-Carex panicea
Eleocharis palustris-Ranunculus flammula
Filipendula ulmaria-Potentilla erecta-Viola sp.
Flooded pavement
Limestone grassland
Lolium grassland
Open water
Other/unknown
Peaty pond
Polygonum amphibium
Potentilla fruticosa
Reedbed
Schoenus nigricans fen
Scrub
Sedge fen
Woodland
Turlough Boundary
OSi 1:5,000 Base Mapping
An Roinn Ealaíon, Oidhreachta agus Gaeltachta
Department of Arts, Heritage and the Gaeltacht
KNOCKAUNROE TURLOUGH
VEGETATION COMMUNITIES
COUNTY CLARE
0 100 200 300 m
N
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SITE CODE
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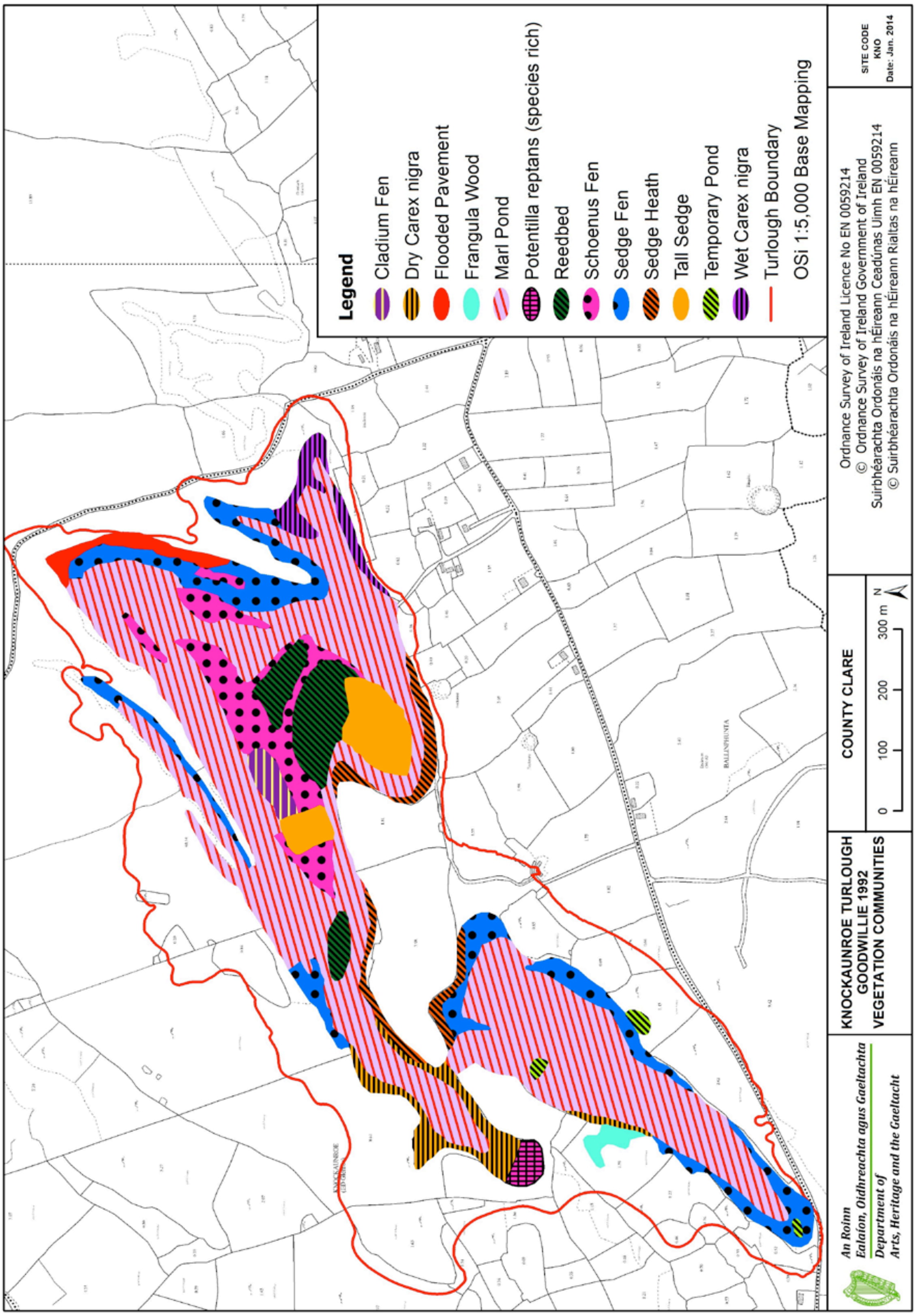
Date: Jan. 2014


Legend
Cladium Fen
Dry Carex nigra
Flooded Pavement
Frangula Wood
Marl Pond
Potentilla reptans (species rich)
Reedbed
Schoenus Fen
Sedge Fen
Sedge Heath
Tall Sedge
Temporary Pond
Wet Carex nigra
Turlough Boundary
OSi 1:5,000 Base Mapping
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht
KNOCKAUNROE TURLOUGH
GOODWILLIE 1992
VEGETATION COMMUNITIES
COUNTY CLARE
0
100
200
300 m
N
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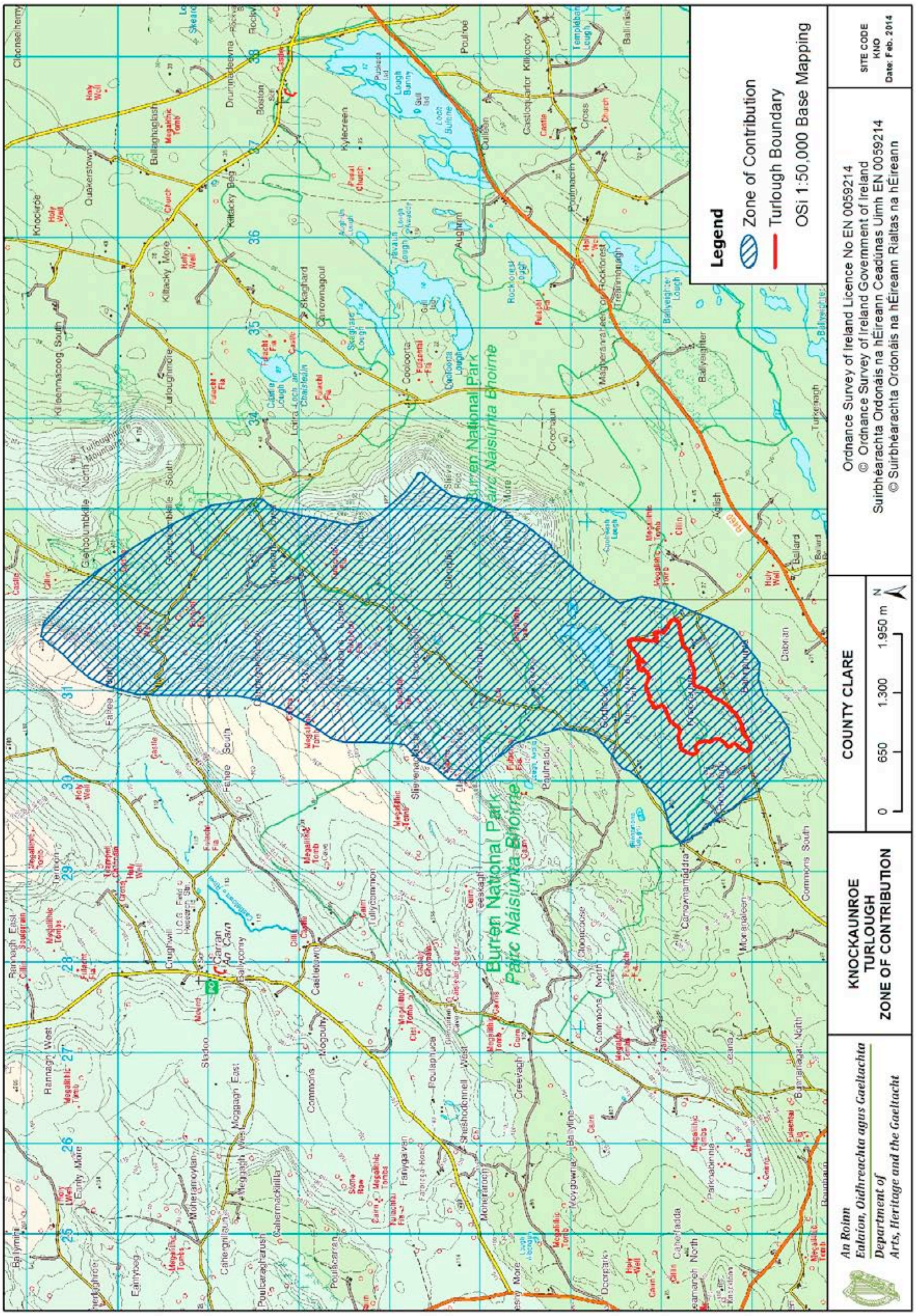
Date: Jan. 2014



Legend
Zone of Contribution
Turlough Boundary
OSi 1:50,000 Base Mapping
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SITE CODE
KNO
Date: Feb. 2014
COUNTY CLARE
0 650 1,300 1,950 m
N
KNOCKAUNROE
TURLOUGH
ZONE OF CONTRIBUTION
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht
Burren National Park
Páirc Náisiúnta Bhoirne

Site Report: Lisduff Turlough
TCD Turlough Research project 2006-2011

Turlough Project Code	SAC Name	SAC/NHA No.	County	Townland	RBD	Easting	Northing	Area (ha)
LIS	Lisduff Turlough	000609	Roscommon	Lisduff	SHANNON	184250	255500	54

File update: July 2015 (S. Waldren)

Site Description

Lisduff turlough, which has SAC status, is situated to the south of Athleague in south-central Co. Roscommon. This medium-sized turlough is shallow and flat and lacks any distinguishing topographic features. Thirteen vegetation communities were recorded; the dominant vegetation types were *Eleocharis palustris-Ranunculus flammula* and *Molinia caerulea-Carex panicea.* Lisduff soils are alkaline and organic with significant amounts of calcium carbonate. The site has extensive areas of 'Fen Peat', with a limited expanse of the 'Shallow poorly-drained organic' soil type. Approximately half of the turlough area (53%) is under rotational grazing. This turlough is relatively slow to fill and drain and typically there is one major flood event per annum. Lisduff shows several characteristics of the more oligotrophic turloughs, which is unusual within its regional setting.

Lisduff – photo: S. Kimberley

Phytoplankton

Phytoplankton analysis was conducted on sub-samples of monthly spot samples collected for hydrochemical analysis between October 2006 and June 2007. Phytoplankton composition varies significantly over time and data from autumn, mid-winter and spring/early summer are presented below. Taxa were identified to species level where possible. Some taxa were not discriminated beyond general groupings (i.e. small centric diatoms, dinoflagellates and pinnate diatoms). The term non-identifiable alone (or n.i.) was reserved for cases where specimens were not identifiable. Discrimination between n.i. filament, n.i. flagellate, n.i. colony, n.i. green filament was made when applicable. Biovolume ($mm^3 m^{-3}$) was used as the measure of algal biomass.

October 2006		January 2007		May 2007	
Biovolume (mm^3/m^3)	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*
Phacotus	24107	*Chroomonas acuta*	27908	*n.i. dinoflagellate*	45024
Fragilaria/Synedra	7409	*Achnanthidium minutissima*	24213	*Monoraphidium*	13657
Ankistrodesmus	6524	*Cryptomonas*	9198	*Fragilaria/Synedra*	10496
Oocystis solitaria	3057	*Dinobryon*	5435	*Pandorina*	5894
Monoraphidium	2601	*n.i. pennates*	3800	*Gomphonema*	5519

Benthic Algae

Turloughs were inspected for algal mats during the emptying phase in 2007, 2008 and 2009. Turloughs were visited in the first two weeks of March to June 2007 as part of the monthly monitoring of turloughs. Dedicated trips to inspect for algal mats were conducted in 2008 on the 4th of March, the 1st of April, and the 26th, 27th and 28th of May, and in 2009 on the 15th and 16th of June and on the 24th and 25th of July. The presence of both living floating mats and dead drying mats was noted, as well as their extent in the turlough basins. Occurrence of visible filamentous algal mats in the three years of observation is presented below. Y = visible occurrence; * = "extensive cover" (estimated to be 2 to 8% of total area of basin); † = negligible quantity observed; • = turlough was too flooded to permit full observation. No algal mats were observed in Lisduff.

Year of Observation		
2007	**2008**	**2009**
N	N	N

Hydrochemistry

Data shown are the mean ± SD of monthly spot samples collected between October 2006 and June 2007. Mean seasonal Total P and Chlorophyll *a* were used to determine the trophic status of the floodwaters based on OECD trophic categories. The median and range of <u>mean values</u> across all turloughs are also provided.

Hydrochemical Variable	Lisduff Values		Turlough Summary Stats (n=22)		
	Mean±SD	OECD Trophic Category	Median	Min	Max
pH	8.1±0.1		8.1	7.7	8.3
Alkalinity mg l^{-1} $CaCO_3$	227.8±43.8		204.0	112.4	236.4
Colour mg l^{-1} PtCo	20.6±9.1		26.9	7.9	85.1
Molybdate Reactive Phosphorus µg l^{-1}	1.5±0.5		3.4	0.7	42.1
Total Phosphorus µg l^{-1}	7.4±2.0	Oligotrophic	24.8	4.0	82.1
Chlorophyll *a* µg l^{-1}	1.4±0.5	Oligotrophic	4.9	1.1	33.5
Nitrate-N mg l^{-1}	1.8±0.8		0.7	0.1	1.9
Total Nitrogen mg l^{-1}	1.9±0.8		1.2	0.6	2.3

Aquatic Invertebrates

22 turloughs were sampled for littoral aquatic macroinvertebrates using sweep nets during November 2006 and April 2007. Zooplankton samples were collected in April 2007. Open-water cladocerans and littoral chydorids were sampled using a zooplankton net and perspex tube respectively.

Aquatic Macroinvertebrates			
November 2006	**Count**	**April 2007**	**Count**
Agabus sp. (larva)	2	*Agabus* sp. (larva)	49
Asellus aquaticus	68	*Agyroneta aquatica*	2
Berosus signaticollis	25	*Asellus aquaticus*	44
Chironomidae	1	*Berosus signaticollis*	7
Euconulus alderi	3	Chironomidae	6
Graptodytes bilineatus	17	*Cloeon simile*	5
Helophorus brevipalpis	6	Culicidae	1
Hydrachnidia (Mite)	7	Diptera Pupae	2
Hygrotus parallelogramus	1	*Dryops* sp.	1
Ilybius sp. (larva)	4	*Dryops* sp (larva)	2
Limnephilus auricula	4	*Euconulus alderi*	5
Limnephilus lunatus	34	*Glossiphonia complanata*	1
Limnephilus marmoratus	23	*Graptodytes bilineatus*	15
Lymnaea peregra	1	*Haliplus variegatus*	1
*Lymnaea truncula*ta	22	*Helophorus brevipalpis*	5
Notonecta glauca	4	*Hydrachnidia* (Mite)	13
Oligochaeta	3	*Hydroporus erythrocephalus*	1
Pisidium/Sphaerium spp.	39	*Hydroporus palustris*	1
Planorbis carinatus	1	*Hygrotus inaequalis*	1
Polycelis nigra/tenuis	1	*Ilybius* sp. (larva)	1
Rhantus sp. (larva)	1	*Laccophilus* sp. (larva)	2
Succinea sp.	2	*Lestes* sp.	6
Tipulidae	5	*Limnephilus centralis*	21
Valvata cristata	23	*Limnephilus lunatus*	1
		Limnephilus marmoratus	1
		*Lymnaea truncula*ta	2
		Oligochaeta	2
		Porhydrus lineatus	2
		Psychodidae	1
		Rhantus sp. (larva)	8
		Succinea sp.	2
		Sympetrum sanguinem	12
		Valvata macrostoma	1

Aquatic Macroinvertebrates: Presence of high abundances (> 50 individuals) of in November 2006 suggests nutrient poor conditions.

Aquatic Macroinvertebrate Taxa	**Presence of high abundances**	
	November 2006	**April 2007**
Diptera	N	N
Ostracoda	N	N
Odonata	N	N
Trichoptera	Y	N

Zooplankton species
Alonella excisa
Chydorus globosus
Chydorus sphaericus
Daphnia pulex
Eurycercus lamellatus
Lathurona rectirostris
Simocephalus vetulus

Vegetation

Vegetation description and classification yielded 25 vegetation communities suitable for mapping. Thirteen vegetation communities were mapped in Lisduff, the dominant vegetation types were the oligotrophic *Eleocharis palustris-Ranunculus flammula* and *Molinia caerulea-Carex panicea* communities. High conservation value communities are denoted by *. Fifty-two plant species were recorded.

Vegetation Community	Area (Ha)
A. stolonifera-Glyceria fluitans	0.07
A. stolonifera-P. anserina - F. rubra	1.39
Carex nigra-C. panicea	4.01
E. palustris-P. arundinacea	0.84
Eleocharis palustris-R. flammula	20.22
Lolium grassland	2.99
**Molinia caerulea-Carex panicea*	19.56
Other/unknown	0.77
P. anserina-Carex nigra	3.04
Polygonum amphibium	0.3
Tall herb	0.36
Woodland/scrub	0.35
Number of vegetation communities	13
Number of plant species	59

Vascular Plant Species

Nomenclature follows Parnell, J & Curtis, T. (2012) *Webb's An Irish Flora*, University of Cork Press.

Achillea ptarmica	*Eleocharis palustris*	*Phalaris arundinacea*
Agrostis stolonifera	*Equisetum fluviatile*	*Plantago lanceolata*
Agrostis vinealis	*Festuca arundinacea*	*Plantago maritima*
Anagallis tenella	*Festuca rubra*	*Polygonum amphibium*
Baldellia ranunculoides	*Filipendula ulmaria*	*Polygonum persicaria*
Bellis perennis	*Galium palustre*	*Potamogeton natans*
Briza media	*Glyceria fluitans*	*Potentilla anserina*
Cardamine pratensis	*Hippuris vulgaris*	*Potentilla erecta*
Carex aquatilis	*Holcus lanatus*	*Potentilla reptans*
Carex flacca	*Hydrocotyle vulgaris*	*Prunella vulgaris*
Carex hirta	*Juncus acutiflorus*	*Ranunculus flammula*
Carex hostiana	*Juncus articulatus*	*Ranunculus repens*
Carex nigra	*Juncus bulbosus*	*Rorippa amphibia*
Carex panicea	*Leontodon autumnalis*	*Schoenoplectus lacustris*
Carex pulicaris	*Littorella uniflora*	*Schoenus nigricans*
Carex vesicaria	*Lotus corniculatus*	*Succisa pratensis*
Carex viridula agg.	*Mentha aquatica*	*Taraxacum officinale* agg.
Carex viridula ssp. *oedocarpa*	*Menyanthes trifoliata*	*Trifolium repens*
Centaurea nigra	*Molinia caerulea*	*Vicia cracca*
Cirsium dissectum	*Parnassia palustris*	

Soils and Grazing

Soils were classified using a modified version of soil categories generated by the Teagasc/EPA Soils and Subsoils Mapping project (Fealy *et al.*, 2009). The classification scheme principally uses parent material (calcareous/non-calcareous), depth class (shallow/deep) and drainage class (well drained/poorly drained) to assign soils to one of nine broad categories. The mean ± SD of a range of soil properties are also provided, in addition to the median and range of each variable across turloughs. Lisduff has extensive areas of Fen Peat. The mean ± SD of a range of soil properties are also provided, in addition to the median and range of each variable across turloughs. Lisduff soils are alkaline and organic with very high amounts of calcium carbonate.

Soil Types/Grazing Extent	% Turlough Area
Very shallow poorly drained organic	14.3
Fen Peat	85.7
Extent of rotationally grazed area	53

Soil Property (n=6)	Lisduff	Turlough Summary Stats (n=22)		
	Mean ± SD	Median	Min	Max
pH	8.03 ± 0.2	7.20	5.94	8.29
% Organic Matter content	23.7 ± 5.6	25.8	10.2	69.1
% Inorganic content	33.8 ± 31.1	43.2	25.7	85.0
% Calcium carbonate content	42.5 ± 26.9	11.3	2.48	43.7
Total Nitrogen mg kg^{-1}	9234 ± 2204	11142	4983	24233
Total Phosphorus mg kg^{-1}	432 ± 187	905	245	1594

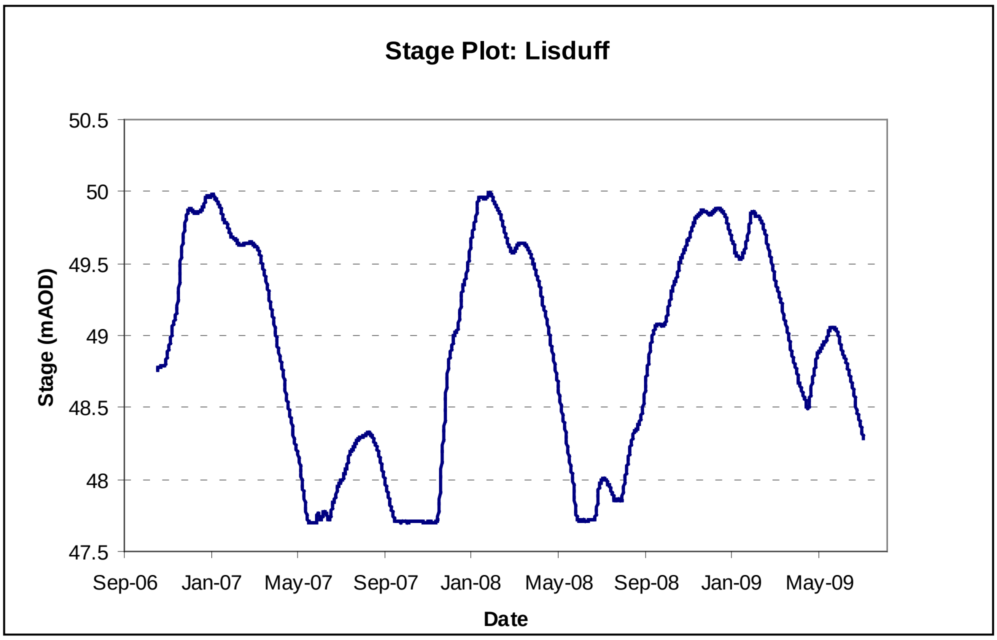
Hydrology

Water levels were recorded at hourly intervals using a variety of Schlumberger Divers® (Marton Geotechnical Ltd, Suffolk, UK) placed at or near the lowest point in each turlough. Divers measure the pressure of the water and air column above them, and from this the depth of water can be calculated. GPS surveys were carried out on 21 monitoring sites (Tullynafrankagh omitted) in order to develop digital terrain models (DTMs) from which contour maps, stage-volume and stage-surface area relationships are produced. The inflow magnitude is indicative of the properties of a turlough's catchment area and flow capacity, while outflow is a function of the drainage capacity of the system.

Lisduff is relatively slow to fill and drain, and typically there is one major flood event per annum.

Hydrological Information	Lisduff Values	Turlough Summary Stats (n=21)		
		Median	Min	Max
Start of Hydrological Recording	05/11/2006	-	-	-
End of Hydrological Recording	08/07/2009	-	-	-
Days Recorded	976	-	-	-
Equipment Failure	None recorded	-	-	-
Hydroperiod (days)	234	213	135	348
Maximum Floodwater Depth (m)	3	4.9	3	15.4
Maximum Floodwater Volume ('000 m^3)	771.3	877.9	355.6	4008.1
Maximum Flooded Area	53.74	38.61	13.71	78.12
Average Basin Depth (m)	1.44	2.28	0.85	6.76
Average Daily Inflow ($m^3 s^{-1}$)	0.341	0.684	0.254	10.253
Average Daily Outflow ($m^3 s^{-1}$)	0.157	0.271	0.086	2.018
Drainage Capacity ($m^3 s^{-1}$)	0.132	0.154	0.069	1.156
Recession Duration (days)	67.5	57.3	11	142.5

Stage plot for Lisduff turlough



Zone of Groundwater Contribution (ZOC) Risk Assessments

GIS based risk assessments were conducted with a view to identifying turloughs at risk of failing to meet WFD water quality objectives. These risk assessments were conducted by Compass Informatics Ltd and were based on Risk Assessment Sheet GWDTERA2a (Guidance Document No. GW9) on assessing risks to turloughs from phosphate (Working Group on Groundwater 2004) and Pathway Susceptibilities and Pressure Magnitudes were integrated to produce Impact Potential maps and predicted Risk Categories for the turlough ZOC. The TCD Risk Category is derived from a revised Impact Potential matrix. The predicted Risk Categories were adjusted using mean seasonal floodwater Total P ($\mu g\ l^{-1}$) (see Section 4.5.4 of the Risk Assessment Sheet GWDTERA2a). The risk categories include 1A: at significant risk; 1B: probably at significant risk; 2A: Not at significant risk (low confidence); 2B: Not at significant risk (higher confidence).

ZOC Area (Km^2)	Predicted WFD Risk Category	Adjusted WFD Risk Category	Predicted TCD Risk Category	Adjusted TCD Risk Category
11	1B	1B	1B	1B

ZOC Pressure Variable	
CORINE BARE ROCK %	0
CORINE PEAT BOGS%	0
CORINE ALL NATURAL AND SEMI-NATURAL AREAS%	5
CORINE IMPROVED PASTURE%	79
CORINE UNIMPROVED PASTURE%	8
CORINE ALL PASTURE%	87
CORINE OTHER AGRICULTURAL LANDS%	8
TEAGASC/EPA HABITATS ROCK%	1
TEAGASC/EPA HABITATS BOGS/PEATS%	1
TEAGASC/EPA HABITATS FORESTS/SCRUBS%	1
TEAGASC/EPA HABITATS WATER%	0
TEAGASC/EPA HABITATS DRY GRASSLAND%	89
TEAGASC/EPA HABITATS WET GRASSLAND%	8
TEAGASC TOTAL GRASSLAND%	97
TOTAL LIVESTOCK UNIT/ha of ZOC	1
TILLAGE%	1
No. SEPTIC TANKS km^{-2} ZOC	6
No. SEPTIC TANKS km^{-2} EXTREME PATHWAY SUSCEPTIBILITY	6
HIGH PATHWAY SUSCEPTIBILITY%	0
EXTR+HIGH PATHWAY SUSCEPTIBILITY%	43
WELL DRAINED SOIL %	86
POORLY DRAINED SOIL%	14

Site Conservation Assessment

The following site conservation assessment was undertaken to feed into the national reporting structure for assessing conservation status as required under Article 17 of the Habitats Directive. A suite of indicators and associated targets were derived to assess ecological structure and function. Future prospects were assessed through the evaluation of the impact of current and recent pressures and likely future threats to the site. The assessment follows a rules based approach to determine whether Structures & functions and Future Prospects should be assessed as good (green), inadequate (amber) or bad (red). For further details, see Chapter 10 (Conservation Status Assessment).

Please note an updated approach to assessing site condition has been proposed and is outlined in Chapter 12 (Monitoring Methods for Turloughs).

Conservation Condition Summary

Structure & Function	**Favourable**
Future Prospects	**Favourable**
Site Conservation Condition	**Favourable**

Structure and Function Status:

Indicator	*Comments*
Hydrological Function: *Good*	Evidence of drainage in the ZOC but unlikely to have much impact
Water Quality: *Very Good*	7.4 µg P l^{-1}
Biological Responses: *Very Good*	
Algal communities: 0	No algal mats recorded, low max CHL
Vegetation communities: 2	High cover of positive indicator communities typical of oligotrophic turloughs, low cover of negative indicators
***Rumex* cover: 0**	Absent
Important plants: 1	*Plantago maritima*; surprisingly few
Important aquatic invertebrates: 2	*Alonella exisa, Agabus labiatus, Berosus signaticollis, Graptodytes bilineatus, Sympetrum sanguineum*
Overall Structure & Function: *Good*	

Pressures:

Code	*Impact*	*Notes*
A04.01.01 Intensive cattle grazing (turlough)	L	Low grazing impact, just under 50% of turlough ungrazed
H02.07 Diffuse groundwater pollution due to non-sewered population (ZOC)	L	Fairly low number of dwellings in high susceptibility pathways

Threats:

Code	Impact	Notes
A10.02 Removal of stone walls and embankments (in turlough)	L	
M01.03 Flooding and rising precipitations	L	
A02.03 Grassland removal for arable land (ZOC)	L	Potential threat in ZOC
H02.07 Diffuse groundwater pollution due to non-sewered population (ZOC)	L	Continuing low impact pressure
A02.01 Agricultural intensification (ZOC)	L	Low level intensification possible in part of ZOC
H02.06 Diffuse groundwater pollution due to agricultural and forestry activities (ZOC)	L	Likely a low threat
A04.01.01 Intensive cattle grazing (turlough)	L	Continuing low impact pressure

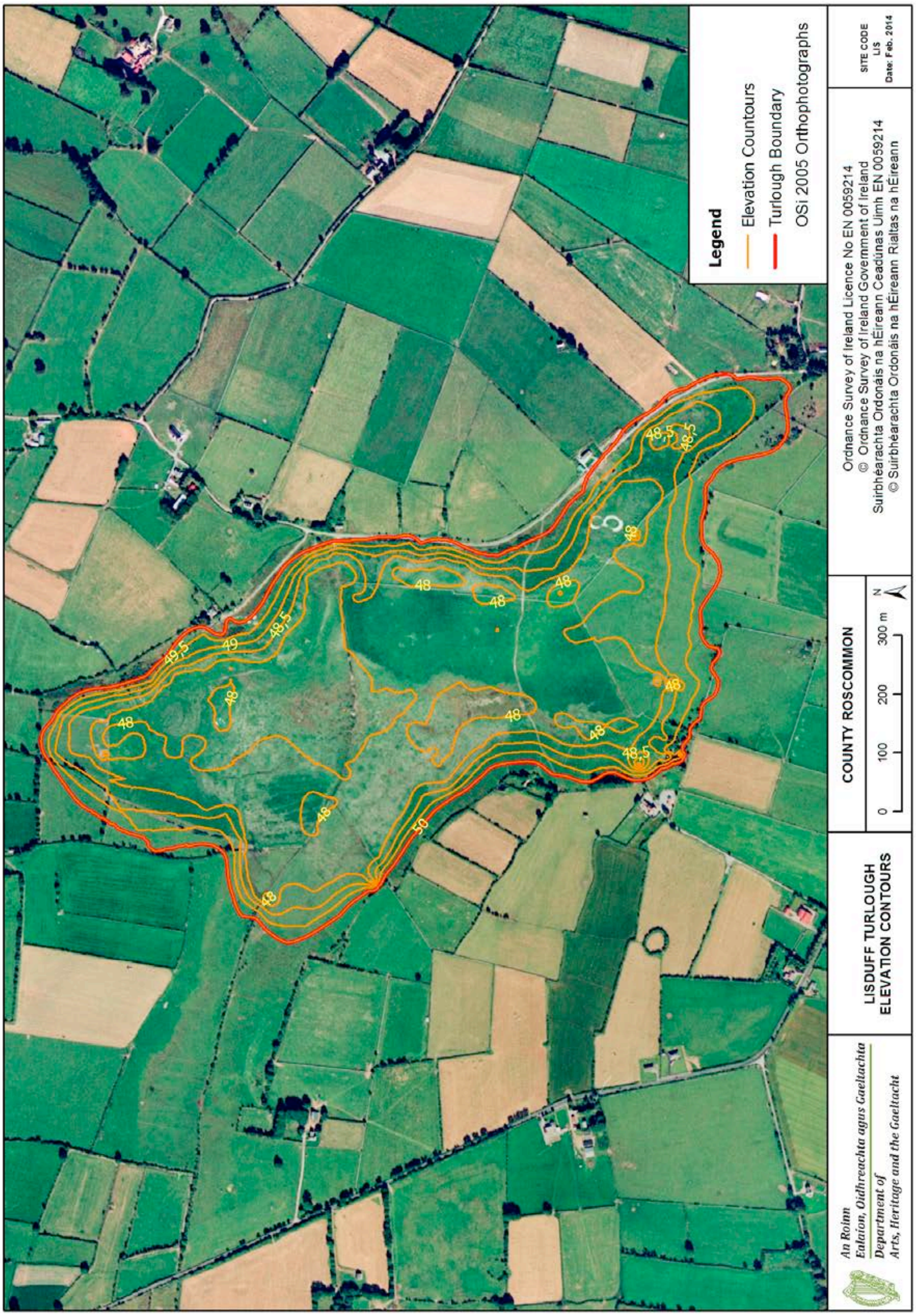
Future Prospects: **Favourable** – low impact threats unlikely to have a major influence on the current favourable ecological condition of the turlough.

Overall Assessment: **Favourable** – favourable ecological structure and function combined with a low threat level. Would probably benefit from reduced grazing; reduction in grazing does not seem to impact significantly on the more oligotrophic turloughs. Lisduff is remarkable among the Roscommon turloughs in having very low nutrient status and vegetation characteristic of the more oligotrophic turloughs; it is therefore of considerable conservation interest.

Maps

Maps are provided of:

1. Elevation contours, based on GIS digital terrain models from points by differential GPS topographic survey (for further details, see *Chapter 3: Hydrology*)
2. Grazing in land parcels
3. Approximate sampling points for water chemistry and aquatic invertebrates
4. Soil nutrient sampling points
5. Points for soil survey (note: soils were surveyed to the turlough boundary defined by Goodwillie, 1992; see map 9)
6. Soils (note: soils were mapped by combining the EPA Subsoils base map with the point soil descriptions; for further details see *Chapter 6: Soils and Landuse*)
7. Vegetation relevés
8. Vegetation communities (note: relevés do not always match to mapped communities due to small scale variation; for further details of mapping see *Chapter 7: Turlough Vegetation: Description, Mapping and Ecology*)
9. Vegetation maps digitised from Goodwillie, R. (1992) *Turlough's Over 50 Hectares*. Report to NPWS
10. Estimated zone of groundwater contribution (ZOC)


Legend
Elevation Countours
Turlough Boundary
OSi 2005 Orthophotographs
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SITE CODE
LIS
Date: Feb. 2014
COUNTY ROSCOMMON
0 100 200 300 m
N
LISDUFF TURLOUGH
ELEVATION CONTOURS
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
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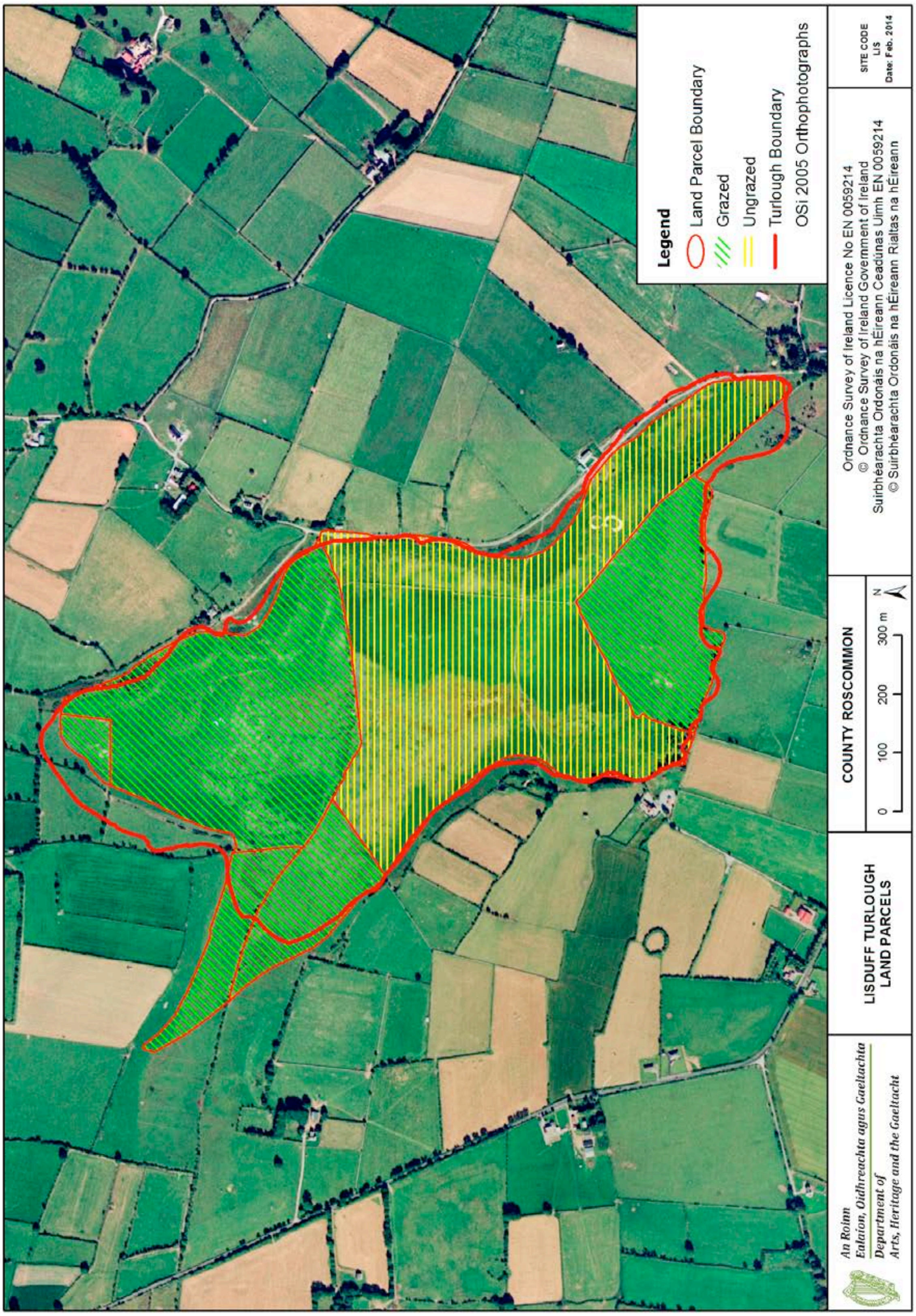
Arts, Heritage and the Gaeltacht


Legend
Land Parcel Boundary
Grazed
Ungrazed
Turlough Boundary
OSi 2005 Orthophotographs
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LIS
Date: Feb. 2014
COUNTY ROSCOMMON
0 100 200 300 m
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LISDUFF TURLOUGH
LAND PARCELS
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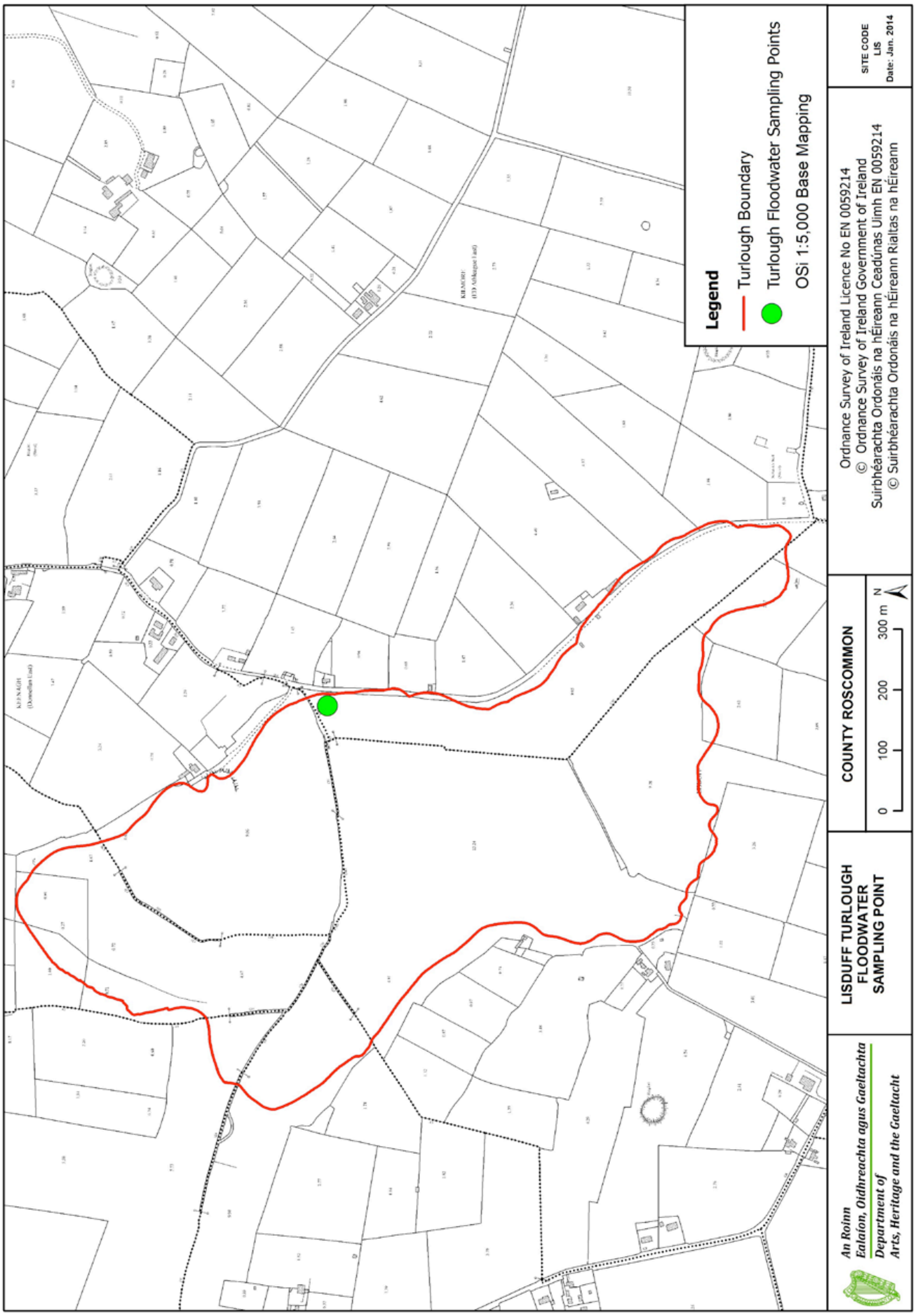
Legend
Turlough Boundary
Turlough Floodwater Sampling Points
OSi 1:5,000 Base Mapping
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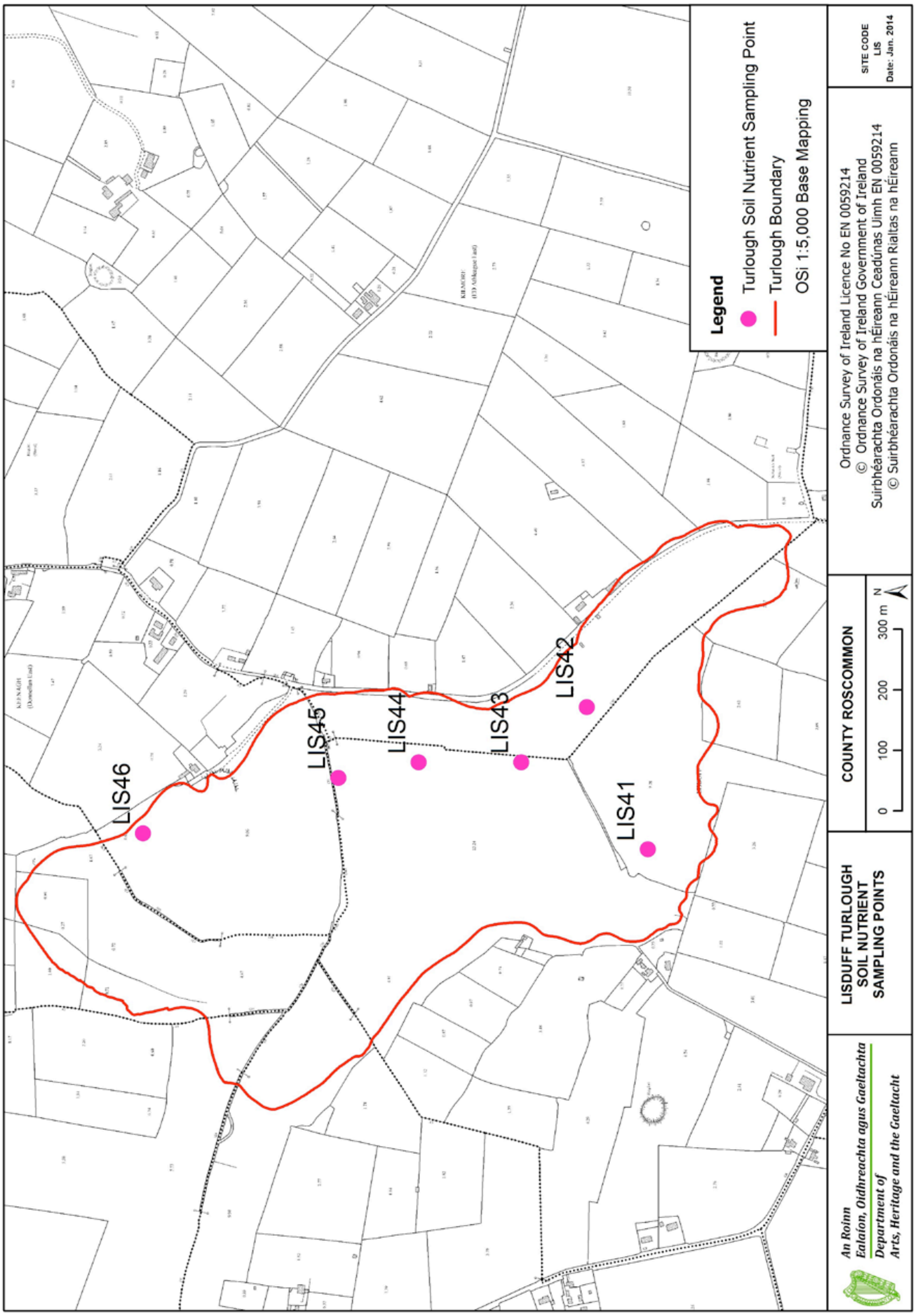
SITE CODE
LIS
Date: Jan. 2014
COUNTY ROSCOMMON
0 100 200 300 m
N
LISDUFF TURLOUGH
FLOODWATER
SAMPLING POINT
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht


LIS46
LIS45
LIS44
LIS43
LIS42
LIS41
Legend
Turlough Soil Nutrient Sampling Point
Turlough Boundary
OSi 1:5,000 Base Mapping
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SITE CODE
LIS
Date: Jan. 2014
COUNTY ROSCOMMON
0 100 200 300 m
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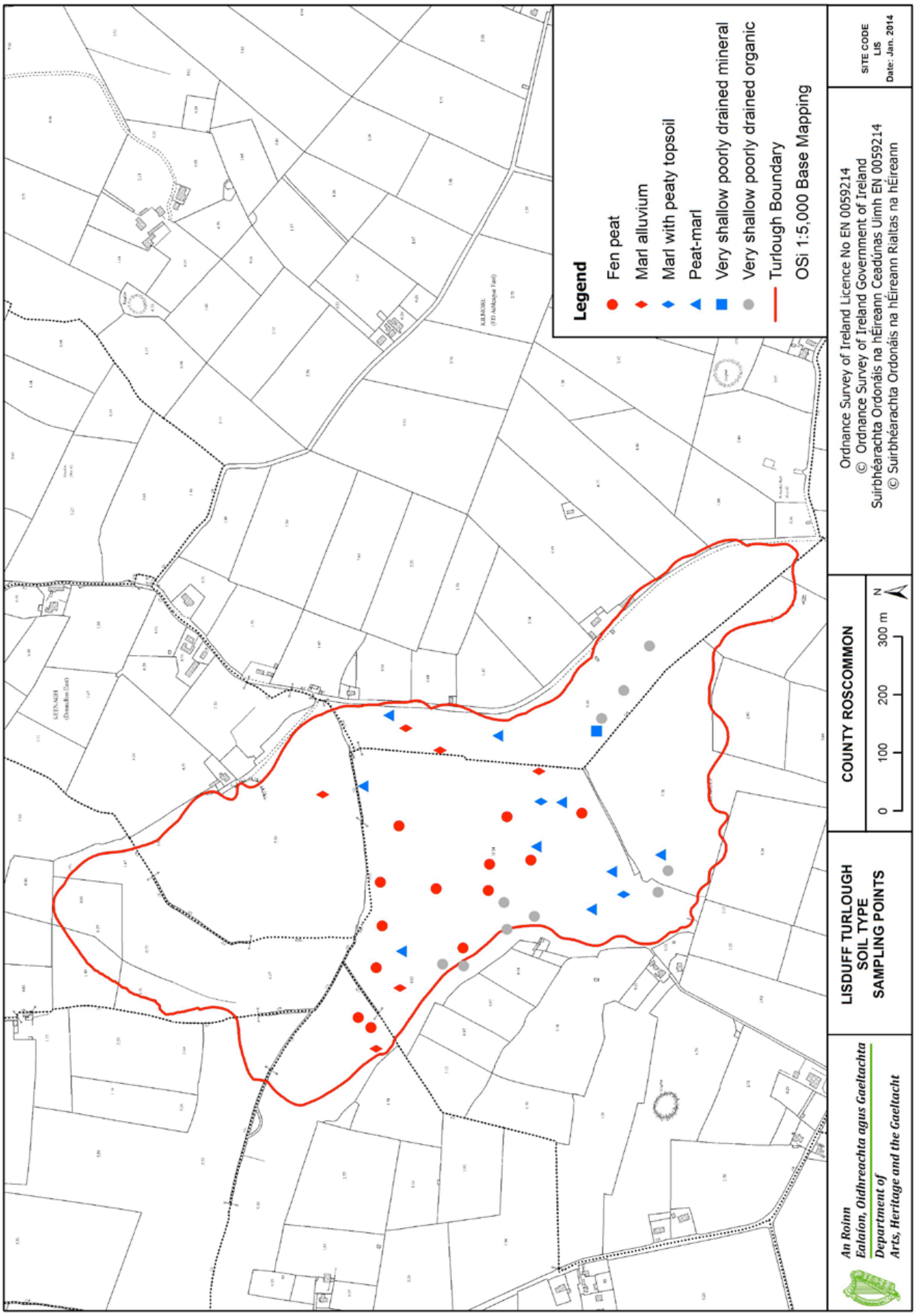
LISDUFF TURLOUGH SOIL NUTRIENT SAMPLING POINTS
An Roinn Ealaíon, Oidhreachta agus Gaeltachta
Department of Arts, Heritage and the Gaeltacht



Legend
Fen peat
Marl alluvium
Marl with peaty topsoil
Peat-marl
Very shallow poorly drained mineral
Very shallow poorly drained organic
Turlough Boundary
OSi 1:5,000 Base Mapping
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SITE CODE
LIS
Date: Jan. 2014
COUNTY ROSCOMMON
0 100 200 300 m
N
LISDUFF TURLOUGH
SOIL TYPE
SAMPLING POINTS
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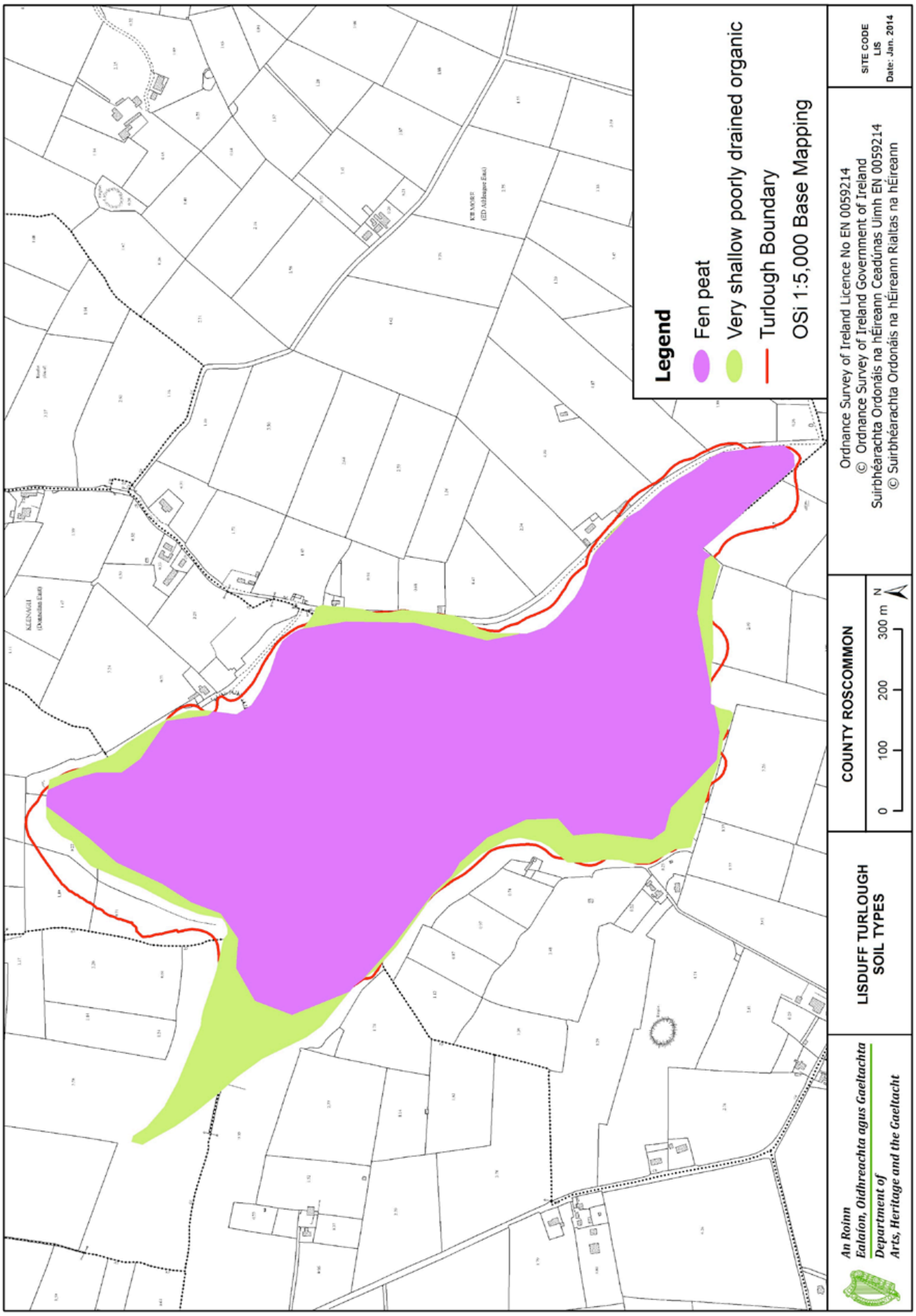
Legend
Fen peat
Very shallow poorly drained organic
Turlough Boundary
OSi 1:5,000 Base Mapping
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COUNTY ROSCOMMON
0 100 200 300 m
N
LISDUFF TURLOUGH
SOIL TYPES
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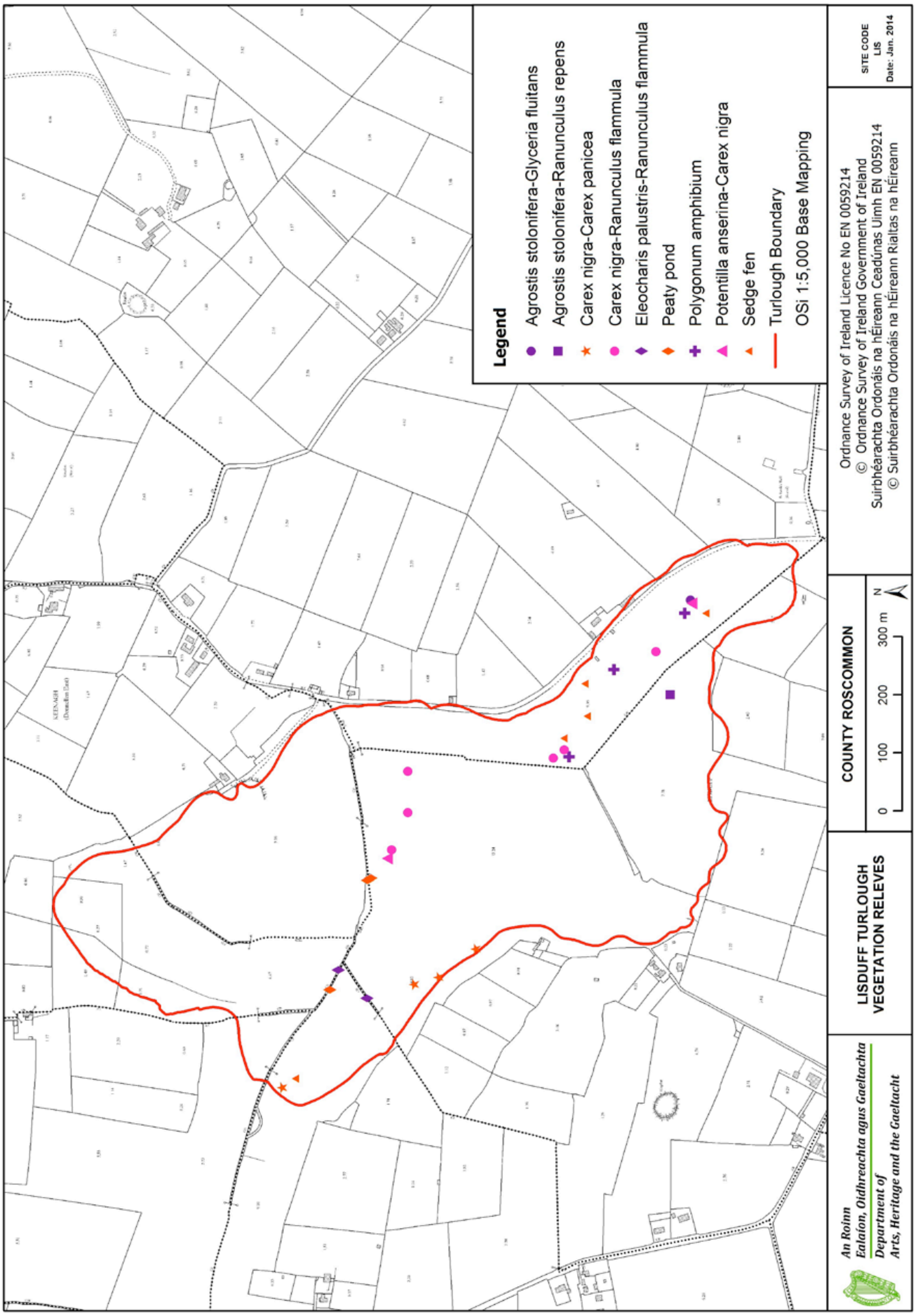
Legend
Agrostis stolonifera-Glyceria fluitans
Agrostis stolonifera-Ranunculus repens
Carex nigra-Carex panicea
Carex nigra-Ranunculus flammula
Eleocharis palustris-Ranunculus flammula
Peaty pond
Polygonum amphibium
Potentilla anserina-Carex nigra
Sedge fen
Turlough Boundary
OSi 1:5,000 Base Mapping
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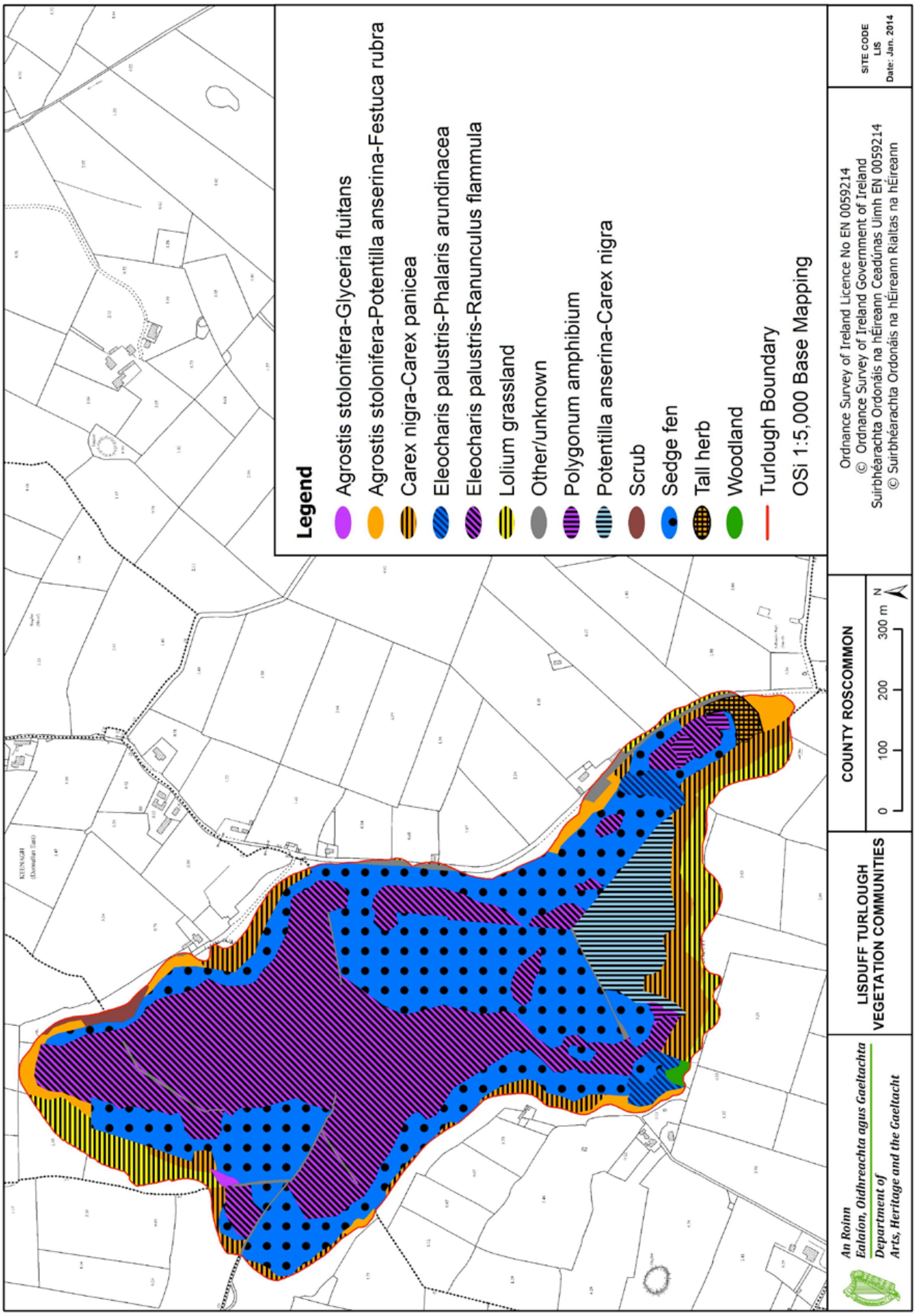
LIS
Date: Jan. 2014
COUNTY ROSCOMMON
0 100 200 300 m
N
LISDUFF TURLOUGH
VEGETATION RELEVES
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht


Legend
Agrostis stolonifera-Glyceria fluitans
Agrostis stolonifera-Potentilla anserina-Festuca rubra
Carex nigra-Carex panicea
Eleocharis palustris-Phalaris arundinacea
Eleocharis palustris-Ranunculus flammula
Lolium grassland
Other/unknown
Polygonum amphibium
Potentilla anserina-Carex nigra
Scrub
Sedge fen
Tall herb
Woodland
Turlough Boundary
OSi 1:5,000 Base Mapping
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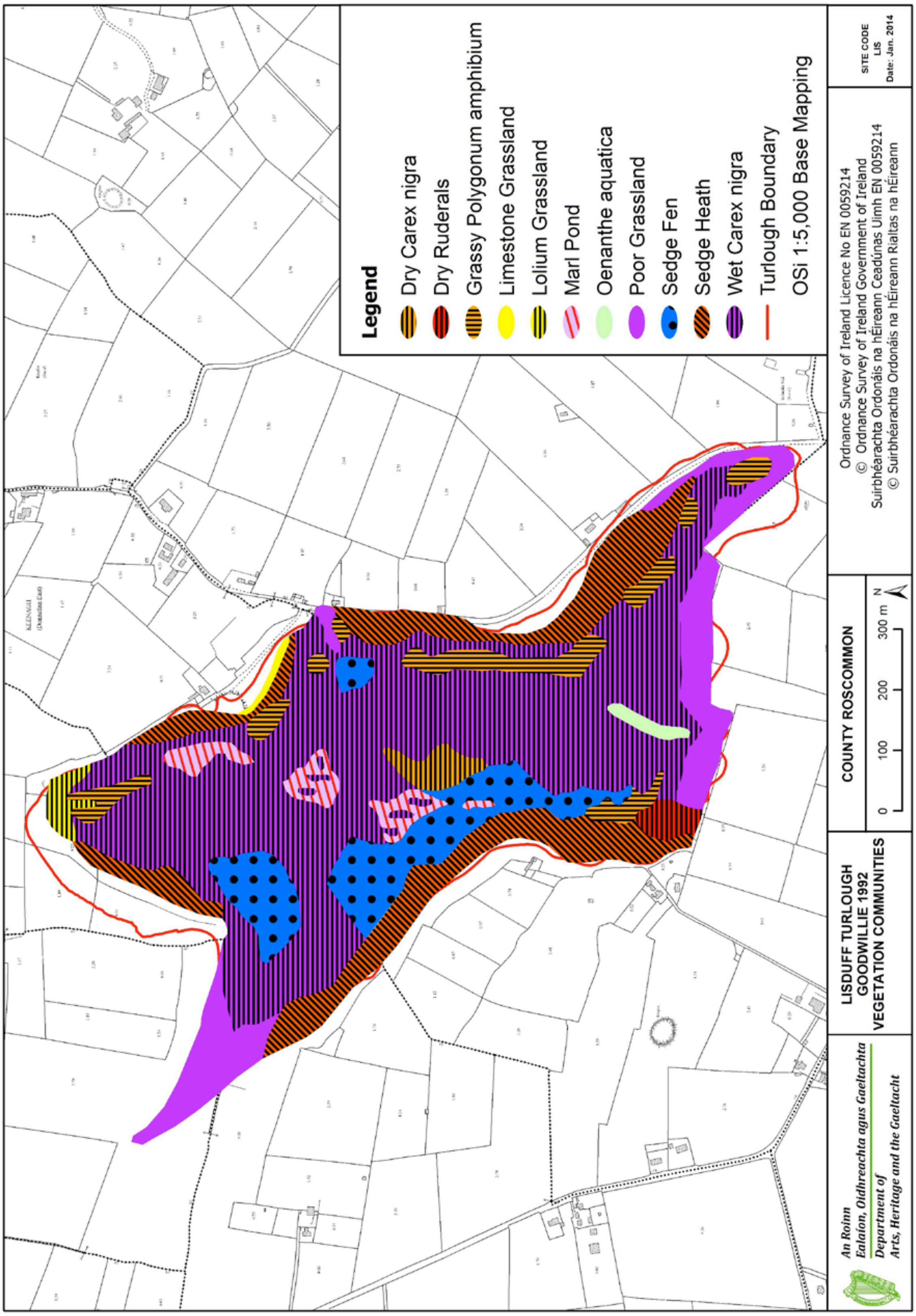
SITE CODE
LIS
Date: Jan. 2014
COUNTY ROSCOMMON
0 100 200 300 m
N
LISDUFF TURLOUGH
VEGETATION COMMUNITIES
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht


Legend
Dry Carex nigra
Dry Ruderals
Grassy Polygonum amphibium
Limestone Grassland
Lolium Grassland
Marl Pond
Oenanthe aquatica
Poor Grassland
Sedge Fen
Sedge Heath
Wet Carex nigra
Turlough Boundary
OSi 1:5,000 Base Mapping
SITE CODE
LIS
Date: Jan. 2014
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COUNTY ROSCOMMON
0 100 200 300 m
N
LISDUFF TURLOUGH
GOODWILLIE 1992
VEGETATION COMMUNITIES
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
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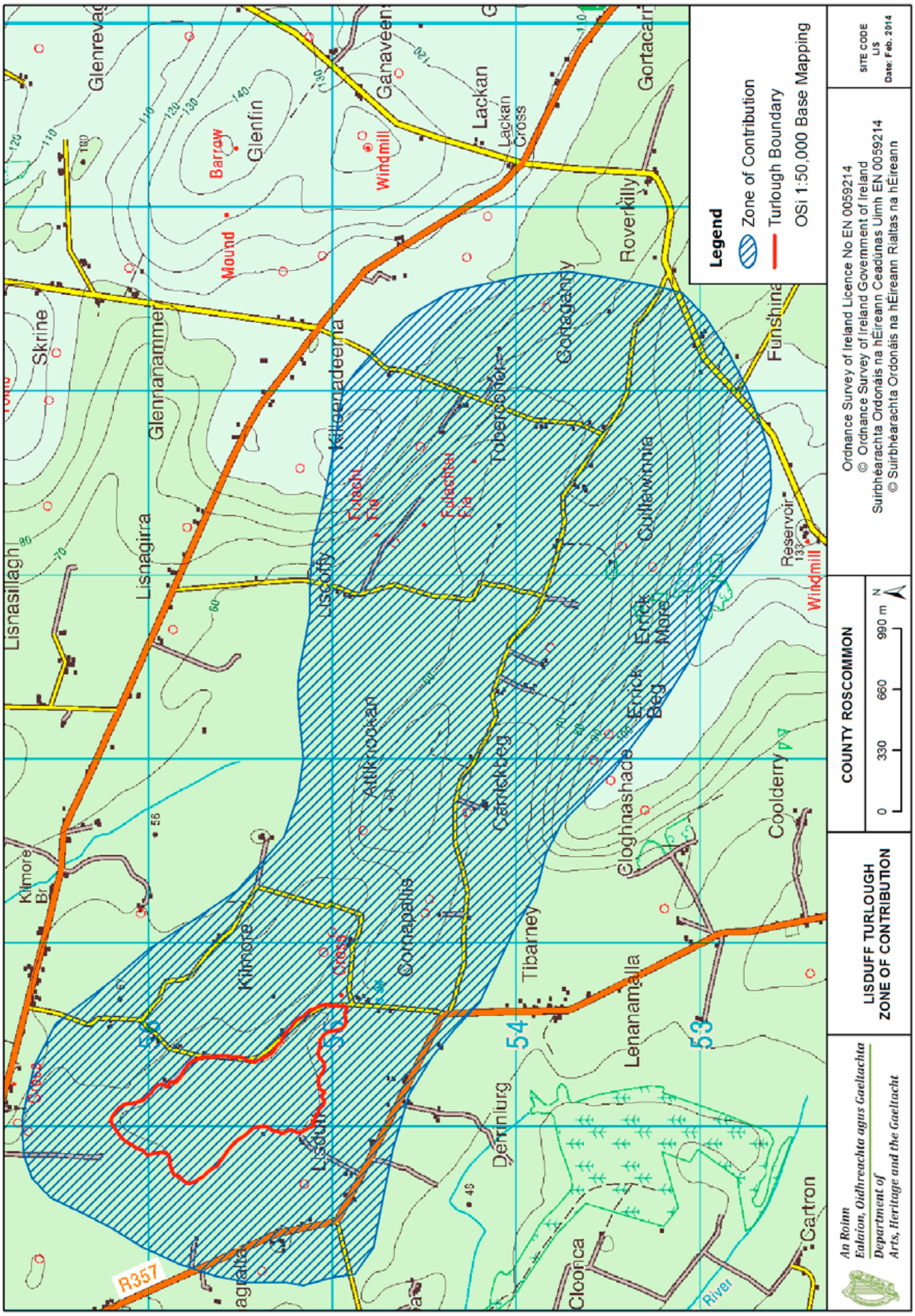

Legend
Zone of Contribution
Turlough Boundary
OSi 1:50,000 Base Mapping
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SITE CODE
LIS
Date: Feb. 2014
COUNTY ROSCOMMON
0
330
660
990 m
N
LISDUFF TURLOUGH
ZONE OF CONTRIBUTION
An Roinn
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Site Report: Lough Aleenaun Turlough
TCD Turlough Research project 2006-2011

Turlough Project Code	SAC Name	SAC/NHA No.	County	Townland	RBD	Easting	Northing	Area (ha)
ALE	East Burren Complex	001926	Clare	Sheshymore	SHANNON	124740	195440	14

File update: July 2014 (S. Waldren)

Site Description

Lough Aleenaun occurs in the East Burren Complex SAC, off the Ballyvaughan-Kilnaboy road. This is one of the smaller turloughs included in the study, at 13.7 ha. A large hollow is evident, presumably a result of collapse. The turlough is surrounded by scrub-covered pavement and drift-filled fields. The northern end of the turlough is bounded by a steep 4m cliff. Only six vegetation communities were mapped in Lough Aleenaun; the *Agrostis stolonifera-Glyceria fluitans* community was the most abundant. Lough Aleenaun soils are moderately alkaline and organic, with significant amounts of calcium carbonate. Fen peat is the dominant soil type (64.9% of the area). Rotational grazing occurs throughout the turlough. The hydrological regime of this turlough is characterised by many flooding events throughout the year, with rapid filling and draining. In addition, it is known that part of the turlough has been bulldozed in the past (Goodwillie, 1992) resulting in highly degraded biological communities.

Lough Aleenaun – photo: S. Kimberley

Phytoplankton

Phytoplankton analysis was conducted on sub-samples of monthly spot samples collected for hydrochemical analysis between October 2006 and June 2007. Phytoplankton composition varies significantly over time and data from autumn, mid-winter and spring/early summer are presented below. Taxa were identified to species level where possible. Some taxa were not discriminated beyond general groupings (i.e. small centric diatoms, dinoflagellates and pinnate diatoms). The term non-identifiable alone (or n.i.) was reserved for cases where specimens were not identifiable. Discrimination between n.i. filament, n.i. flagellate, n.i. colony, n.i. green filament was made when applicable. Biovolume (mm^3 m^{-3}) was used as the measure of algal biomass.

October 2006		January 2007		May 2007	
Biovolume (mm^3/m^3)	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*
n.i. green colonies	300092	*Fragilaria capucina*	82974	*Achnanthidium minutissima*	57600
Scenedesmus	270677	*Oscillatoria*	57507	*Phacus*	41823
Monoraphidium	28635	*n.i. pennates*	49371	*n.i.*	26797
Nitzchia acicularis	19891	*Cryptomonas*	41938	*n.i. flagellates*	22299
n.i. centrics	17424	*Synedra*	39118	*Navicula capitata*	21092

Benthic Algae

Turloughs were inspected for algal mats during the emptying phase in 2007, 2008 and 2009. Turloughs were visited in the first two weeks of March to June 2007 as part of the monthly monitoring of turloughs. Dedicated trips to inspect for algal mats were conducted in 2008 on the 4th of March, the 1st of April, and the 26th, 27th and 28th of May, and in 2009 on the 15th and 16th of June and on the 24th and 25th of July. The presence of both living floating mats and dead drying mats was noted, as well as their extent in the turlough basins. Occurrence of visible filamentous algal mats in the three years of observation is presented below. Y = visible occurrence; * = "extensive cover" (estimated to be 2 to 8% of total area of basin); † = negligible quantity observed; • = turlough was too flooded to permit full observation. Extensive algal mats were observed in Lough Aleenaun in each year, despite extensive flooding during visits.

Year of Observation		
2007	2008	2009
Y*	Y*	Y*

Hydrochemistry

Data shown are the mean ± SD of monthly spot samples collected between October 2006 and June 2007. Mean seasonal Total P and Chlorophyll *a* were used to determine the trophic status of the floodwaters based on OECD trophic categories. The median and range of mean values across all turloughs are also provided.

Hydrochemical Variable	Lough Aleenaun Values		Turlough Summary Stats (n=22)		
	Mean±SD	OECD Trophic Category	Median	Min	Max
pH	8.0	-	8.1	7.7	8.3
Alkalinity mg l^{-1} $CaCO_3$	160.2	-	204.0	112.4	236.4
Colour mg l^{-1} PtCo	13.5	-	26.9	7.9	85.1
Molybdate Reactive Phosphorus µg l^{-1}	9.1	-	3.4	0.7	42.1
Total Phosphorus µg l^{-1}	30.7	Mesotrophic	24.8	4.0	82.1
Chlorophyll *a* µg l^{-1}	9.2	Eutrophic	4.9	1.1	33.5
Nitrate-N mg l^{-1}	1.0		0.7	0.1	1.9
Total Nitrogen mg l^{-1}	1.2		1.2	0.6	2.3

Aquatic Invertebrates

22 turloughs were sampled for littoral aquatic macroinvertebrates using sweep nets during November 2006 and April 2007. Zooplankton samples were collected in April 2007. Open-water cladocerans and littoral chydorids were sampled using a zooplankton net and perspex tube respectively.

Aquatic Macroinvertebrates			
November 2006	**Count**	**April 2007**	**Count**
Agabus sp. (larva)	29	*Agabus nebulosus*	2
Chironomidae	937	*Agabus* sp. (larva)	6
Diptera Pupae	18	Ceratopogonidae	11
Haliplus sp. (larva)	8	Chironomidae	43
Lymnaea palustris	2	*Cloeon dipterum*	8
Lymnaea peregra	4	*Corixinae* Instar I & II	8
Lymnaea trunculata	4	Diptera Pupae	23
Oligochaeta	8	*Helobdella stagnalis*	6
Ostracoda	69	*Helophorus brevipalpis*	11
Phacopteryx brevipennis	2	*Hydrobius fuscipes*	2
Pisidium/Sphaerium spp.	14	*Hydroporus palustris*	2
Planorbis contortus	2	*Hygrotus confluens*	2
Succinea sp.	4	*Lymnaea peregra*	113
Tipulidae	2	Oligochaeta	476
Valvata cristata	2	Ostracoda	64
		Planorbis leucostoma	6
		Polycelis nigra/tenuis	2
		Sigara lateralis	2

Aquatic Macroinvertebrates: Presence of high abundances (> 50 individuals) of Diptera and Ostracoda recorded in November 2006 and April 2007 indicates nutrient enrichment.

Aquatic Macroinvertebrate Taxa	**Presence of high abundances**	
	November 2006	**April 2007**
Diptera	Y	Y
Ostracoda	Y	Y
Odonata	N	N
Trichoptera	N	N

Zooplankton species
Alona affinis
Chydorus sphaericus
Daphnia pulex
Eurycercus lamellatus
Graptoleberis testudinaria
Leydigia leydigi
Simocephalus vetulus

Vegetation

Vegetation description and classification yielded 25 vegetation communities suitable for mapping. Only six vegetation communities were mapped in Lough Aleenaun, reflecting the highly disturbed nature of the site; the vegetation was dominated by *A. stolonifera-Glyceria fluitans* which tends to indicate heavy grazing in wet, eutrophic turloughs. High conservation value communities are denoted by *. 65 plant species were recorded.

Vegetation Community	Area (Ha)
A. stolonifera-Glyceria fluitans	7.48
A. stolonifera-P. anserina - F. rubra	0.33
*Flooded pavement	0.04
Lolium grassland	1.5
Open water	0.02
Other/unknown	1.03
Woodland/scrub	3.85
Number of vegetation communities	6
Number of plant species	66

Vascular Plant Species

Nomenclature follows Parnell, J & Curtis, T. (2012) *Webb's An Irish Flora*, University of Cork Press.

Achillea millefolium	*Galium boreale*	*Potentilla anserina*
Agrostis capillaris	*Galium palustre*	*Prunella vulgaris*
Agrostis stolonifera	*Glyceria fluitans*	*Ranunculus acris*
Alchemilla filicaulis	*Hippuris vulgaris*	*Ranunculus aquatilis*
Alopecurus geniculatus	*Holcus lanatus*	*Ranunculus flammula*
Apium nodiflorum	*Juncus acutiflorus*	*Ranunculus repens*
Bellis perennis	*Juncus articulatus*	*Ranunculus species*
Callitriche sp	*Juncus bufonius*	*Rorippa amphibia*
Caltha palustris	*Leontodon autumnalis*	*Rorippa islandica*
Cardamine pratensis	*Lolium perenne*	*Rorippa nasturtium-aquaticum*
Carex hirta	*Lotus corniculatus*	*Rorippa palustris*
Carex nigra	*Luzula species*	*Rumex acetosa*
Cerastium fontanum	*Mentha aquatica*	*Rumex crispus*
Cirsium arvense	*Myosotis scorpioides*	*Rumex obtusifolius*
Cirsium dissectum	*Phalaris arundinacea*	*Senecio aquaticus*
Cirsium vulgare	*Phleum pratense*	*Stellaria media*
Cynosurus cristatus	*Plantago lanceolata*	*Taraxacum officinale* agg.
Eleocharis acicularis	*Plantago major*	*Trifolium pratense*
Eleocharis palustris	*Poa trivialis*	*Trifolium repens*
Elymus repens	*Polygonum amphibium*	*Veronica arvensis*
Festuca rubra	*Polygonum aviculare*	*Veronica catenata*
Filipendula ulmaria	*Polygonum persicaria*	*Veronica serpyllifolia*

Soils and Grazing

Soils were classified using a modified version of soil categories generated by the Teagasc/EPA Soils and Subsoils Mapping project (Fealy *et al*., 2009). The classification scheme principally uses parent material (calcareous/non-calcareous), depth class (shallow/deep) and drainage class (well drained/poorly drained) to assign soils to one of nine broad categories. L. Aleenaun has extensive areas of Fen Peats and very shallow well-drained organic soils occupy the upper slopes. The mean ± SD of a range of soil properties are also provided, in addition to the median and range of each variable across turloughs. L. Aleenaun soils are moderately alkaline and organic, with significant amounts of calcium carbonate.

Soil Types/Grazing Extent	% Turlough Area
Very shallow well drained organic	35.5
Fen Peat	64.9
Extent of rotationally grazed area	100

Soil Property (n=6)	Lough Aleenaun	Turlough Summary Stats (n=22)		
	Mean ± SD	Median	Min	Max
pH	7.57 ± 0.5	7.20	5.94	8.29
% Organic Matter content	24.1 ± 9.8	25.8	10.2	69.1
% Inorganic content	38.2 ± 25.8	43.2	25.7	85.0
% Calcium carbonate content	37.7 ± 30.3	11.3	2.48	43.7
Total Nitrogen mg kg^{-1}	12077 ± 5042	11142	4983	24233
Total Phosphorus mg kg^{-1}	1594 ± 670	905	245	1594

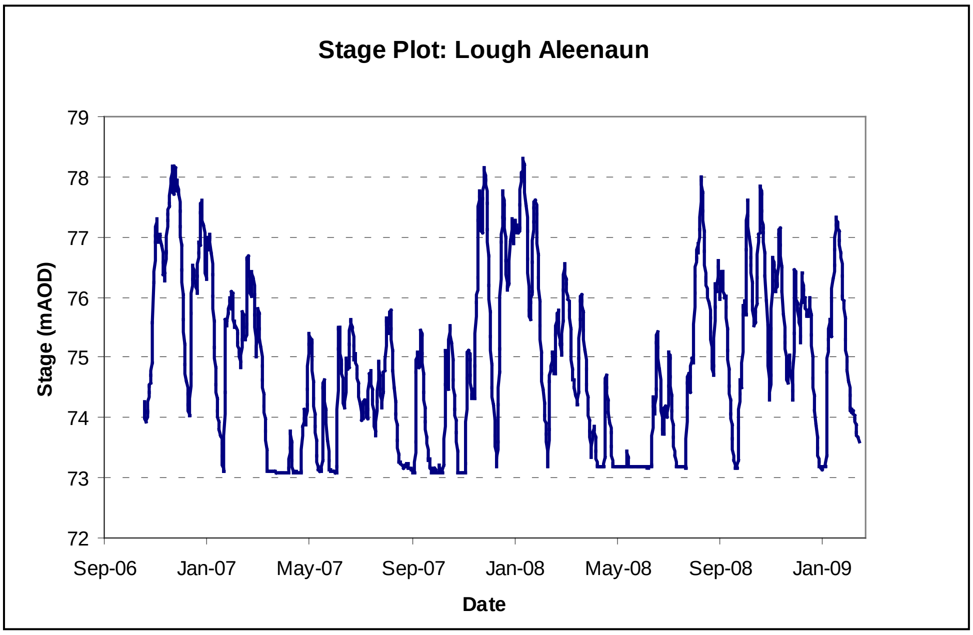
Hydrology

Water levels were recorded at hourly intervals using a variety of Schlumberger Divers® (Marton Geotechnical Ltd, Suffolk, UK) placed at or near the lowest point in each turlough. Divers measure the pressure of the water and air column above them, and from this the depth of water can be calculated. GPS surveys were carried out on 21 monitoring sites (Tullynafrankagh omitted) in order to develop digital terrain models (DTMs) from which contour maps, stage-volume and stage-surface area relationships are produced. The inflow magnitude is indicative of the properties of a turlough's catchment area and flow capacity, while outflow is a function of the drainage capacity of the system.

The hydrological regime of this turlough is characterised by many flooding events throughout the year, with very rapid filling and draining. It has the shortest recession duration of any of the turloughs studied.

Hydrological Information	Lough Aleenaun Values	Turlough Summary Stats (n=21)		
		Median	**Min**	**Max**
Start of Hydrological Recording	06/11/2006	-	-	-
End of Hydrological Recording	19/02/2009	-	-	-
Days Recorded	836	-	-	-
Equipment Failure	19/2/2009 onwards	-	-	-
Hydroperiod (days)	158	213	135	348
Maximum Floodwater Depth (m)	5.9	4.9	3	15.4
Maximum Floodwater Volume ('000 m^3)	355.6	877.9	355.6	4008.1
Maximum Flooded Area	13.71	38.61	13.71	78.12
Average Basin Depth (m)	2.59	2.28	0.85	6.76
Average Daily Inflow ($m^3 s^{-1}$)	1.548	0.684	0.254	10.253
Average Daily Outflow ($m^3 s^{-1}$)	0.555	0.271	0.086	2.018
Drainage Capacity ($m^3 s^{-1}$)	0.374	0.154	0.069	1.156
Recession Duration (days)	11	57.3	11	142.5

Stage plot for Lough Aleenaun



Zone of Groundwater Contribution (ZOC) Risk Assessments

GIS based risk assessments were conducted with a view to identifying turloughs at risk of failing to meet WFD water quality objectives. These risk assessments were conducted by Compass Informatics Ltd and were based on Risk Assessment Sheet GWDTERA2a (Guidance Document No. GW9) on assessing risks to turloughs from phosphate (Working Group on Groundwater 2004) and Pathway Susceptibilities and Pressure Magnitudes were integrated to produce Impact Potential maps and predicted Risk Categories for the turlough ZOC. The TCD Risk Category is derived from a revised Impact Potential matrix. The predicted Risk Categories were adjusted using mean seasonal floodwater Total P (μg l^{-1}) (see Section 4.5.4 of the Risk Assessment Sheet GWDTERA2a). The risk categories include 1A: at significant risk; 1B: probably at significant risk; 2A: Not at significant risk (low confidence); 2B: Not at significant risk (higher confidence).

ZOC Area (Km^2)	Predicted WFD Risk Category	Adjusted WFD Risk Category	Predicted TCD Risk Category	Adjusted TCD Risk Category
5	2B	1A	1B	1A

ZOC Pressure Variable	
CORINE BARE ROCK %	0
CORINE PEAT BOGS%	0
CORINE ALL NATURAL AND SEMI-NATURAL AREAS%	73
CORINE IMPROVED PASTURE%	16
CORINE UNIMPROVED PASTURE%	0
CORINE ALL PASTURE%	16
CORINE OTHER AGRICULTURAL LANDS%	11
TEAGASC/EPA HABITATS ROCK%	39
TEAGASC/EPA HABITATS BOGS/PEATS%	0
TEAGASC/EPA HABITATS FORESTS/SCRUBS%	4
TEAGASC/EPA HABITATS WATER%	0
TEAGASC/EPA HABITATS DRY GRASSLAND%	45
TEAGASC/EPA HABITATS WET GRASSLAND%	12
TEAGASC TOTAL GRASSLAND%	57
TOTAL LIVESTOCK UNIT/ha of ZOC	0
TILLAGE%	0
No. SEPTIC TANKS km^{-2} ZOC	1
No. SEPTIC TANKS km^{-2} EXTREME PATHWAY SUSCEPTIBILITY	1
HIGH PATHWAY SUSCEPTIBILITY%	0
EXTR+HIGH PATHWAY SUSCEPTIBILITY%	96
WELL DRAINED SOIL %	94
POORLY DRAINED SOIL%	6

Site Conservation Assessment

The following site conservation assessment was undertaken to feed into the national reporting structure for assessing conservation status as required under Article 17 of the Habitats Directive. A suite of indicators and associated targets were derived to assess ecological structure and function. Future prospects were assessed through the evaluation of the impact of current and recent pressures and likely future threats to the site. The assessment follows a rules based approach to determine whether Structures & functions and Future Prospects should be assessed as good (green), inadequate (amber) or bad (red). For further details, see Chapter 10 (Conservation Status Assessment).

Please note an updated approach to assessing site condition has been proposed and is outlined in Chapter 12 (Monitoring Methods for Turloughs).

Conservation Condition Summary

Structure & Function	**Inadequate/Bad**
Future Prospects	**Inadequate**
Site Conservation Condition	**Bad**

Structure and Function Status:

Indicator	*Comments*
Hydrological Function: *Good*	
Water Quality: *Intermediate*	30.7 µg P l^{-1}
Biological Responses: *Bad*	
Algal communities: -2	Extensive algal mats were regularly recorded, high max CHL
Vegetation communities: -1	High cover of negative indicator communities, moderate cover of positive indicators
***Rumex* cover: -1**	60.9% frequency
Important plants: 1	*Rorippa islandica*
Important aquatic invertebrates: 0	None present
Overall Structure & Function: *Inadequate/Bad*	

Pressures:

Code	*Impact*	*Notes*
A04.01.01 Intensive cattle grazing (turlough)	M	Moderate grazing impact over the whole of the turlough
H02.06 Diffuse groundwater pollution due to agricultural and forestry activities (ZOC)	M	

Threats:

Code	Impact	Notes
A02.01 Agricultural intensification (ZOC)	M	Likely increase in ZOC
H02.06 Diffuse groundwater pollution due to agricultural and forestry activities (ZOC)	M	Continuing medium impact pressure
A04.01.01 Intensive cattle grazing (turlough)	M	Continuing medium impact pressure
A10.02 Removal of stone walls and embankments (in turlough)	L	
M01.03 Flooding and rising precipitations	L	
H02.07 Diffuse groundwater pollution due to non-sewered population (ZOC)	L	

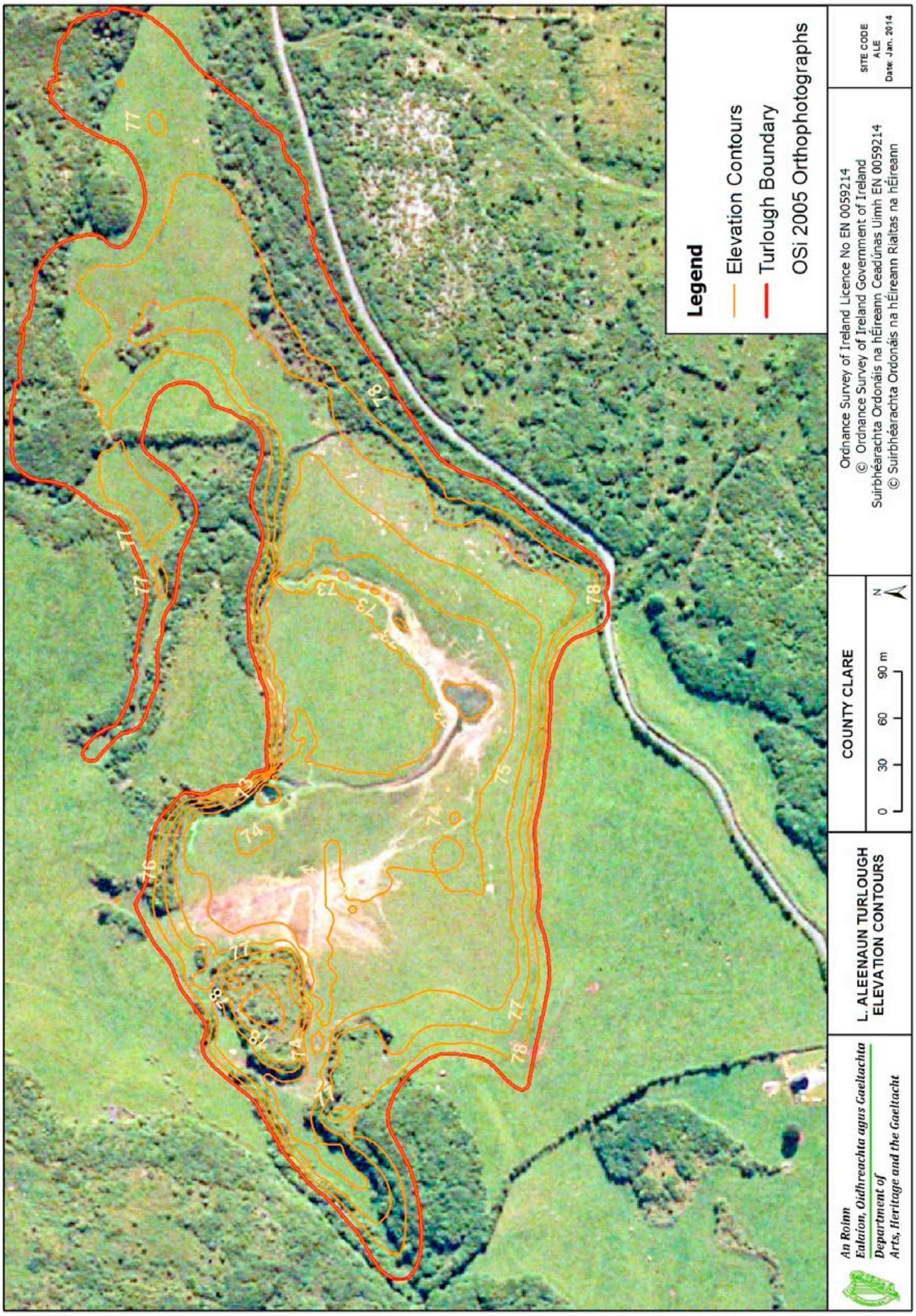
Future Prospects: **Inadequate** – medium level threats are unlikely to allow any improvement of the highly disturbed biological communities.

Overall Assessment: **Bad** – although hydrologically Lough Aleenaun functions well, its communities are highly disturbed even though there appear to be relatively few pressures; this is the likely result of extreme disturbance within the turlough thought to be due to previous bulldozing of the basin. Conservation status is assessed as Bad given the Inadequate to Bad structure and function and Inadequate future prospects, coupled with highly degraded biological communities. Conservation action should reduce (but not entirely eliminate) the grazing pressure, and also reduce the nutrient inputs; given the apparently good hydrological functioning, this may facilitate recovery of the biological communities in the medium to long term, improving the conservation status.

Maps

Maps are provided of:

1. Elevation contours, based on GIS digital terrain models from points by differential GPS topographic survey (for further details, see *Chapter 3: Hydrology*)
2. Grazing in land parcels
3. Approximate sampling points for water chemistry and aquatic invertebrates
4. Soil nutrient sampling points
5. Points for soil survey (note: soils were surveyed to the turlough boundary defined by Goodwillie, 1992; see map 9)
6. Soils (note: soils were mapped by combining the EPA Subsoils base map with the point soil descriptions; for further details see *Chapter 6: Soils and Landuse*)
7. Vegetation relevés
8. Vegetation communities (note: relevés do not always match to mapped communities due to small scale variation; for further details of mapping see *Chapter 7: Turlough Vegetation: Description, Mapping and Ecology*)
9. Vegetation maps digitised from Goodwillie, R. (1992) *Turlough's Over 50 Hectares*. Report to NPWS
10. Estimated zone of groundwater contribution (ZOC)


Legend
Elevation Contours
Turlough Boundary
OSi 2005 Orthophotographs
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SITE CODE
ALE
Date: Jan. 2014
COUNTY CLARE
0 30 60 90 m
N
L. ALEENAUN TURLOUGH
ELEVATION CONTOURS
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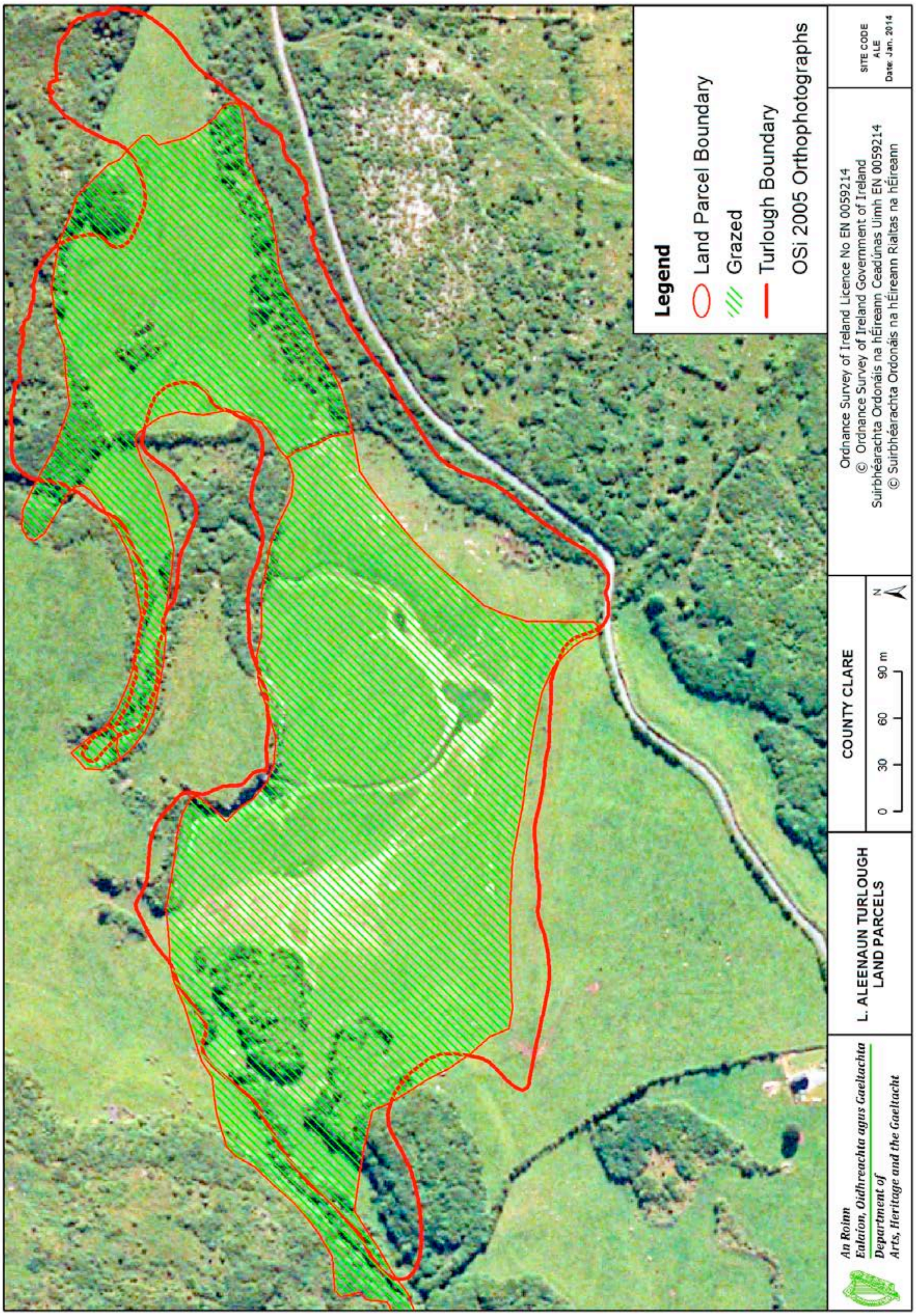
Legend
Land Parcel Boundary
Grazed
Turlough Boundary
OSi 2005 Orthophotographs
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ALE
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COUNTY CLARE
0 30 60 90 m
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LAND PARCELS
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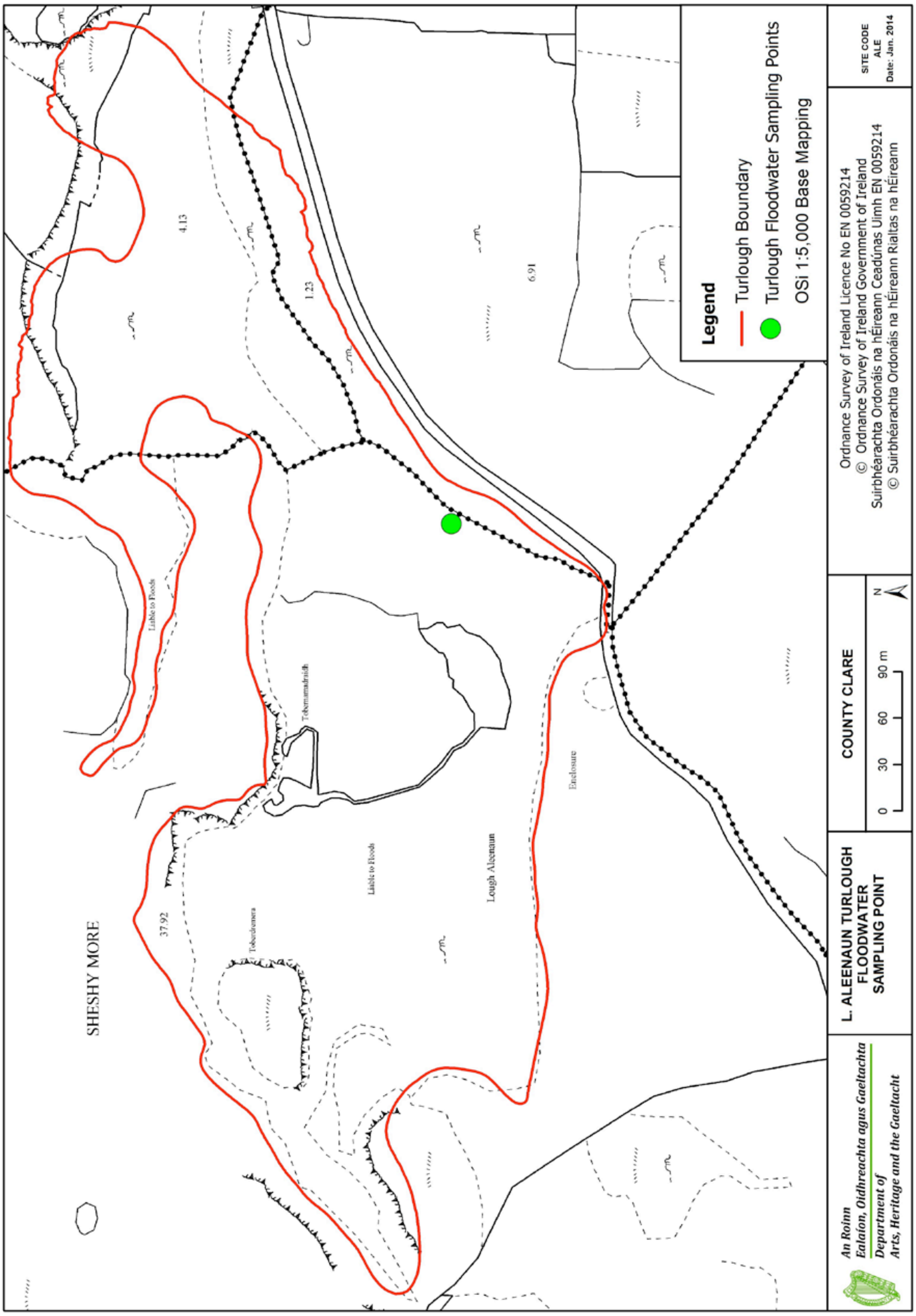
Legend
Turlough Boundary
Turlough Floodwater Sampling Points
OSi 1:5,000 Base Mapping
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ALE
Date: Jan. 2014
COUNTY CLARE
0 30 60 90 m
N
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FLOODWATER
SAMPLING POINT
An Roinn
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Department of
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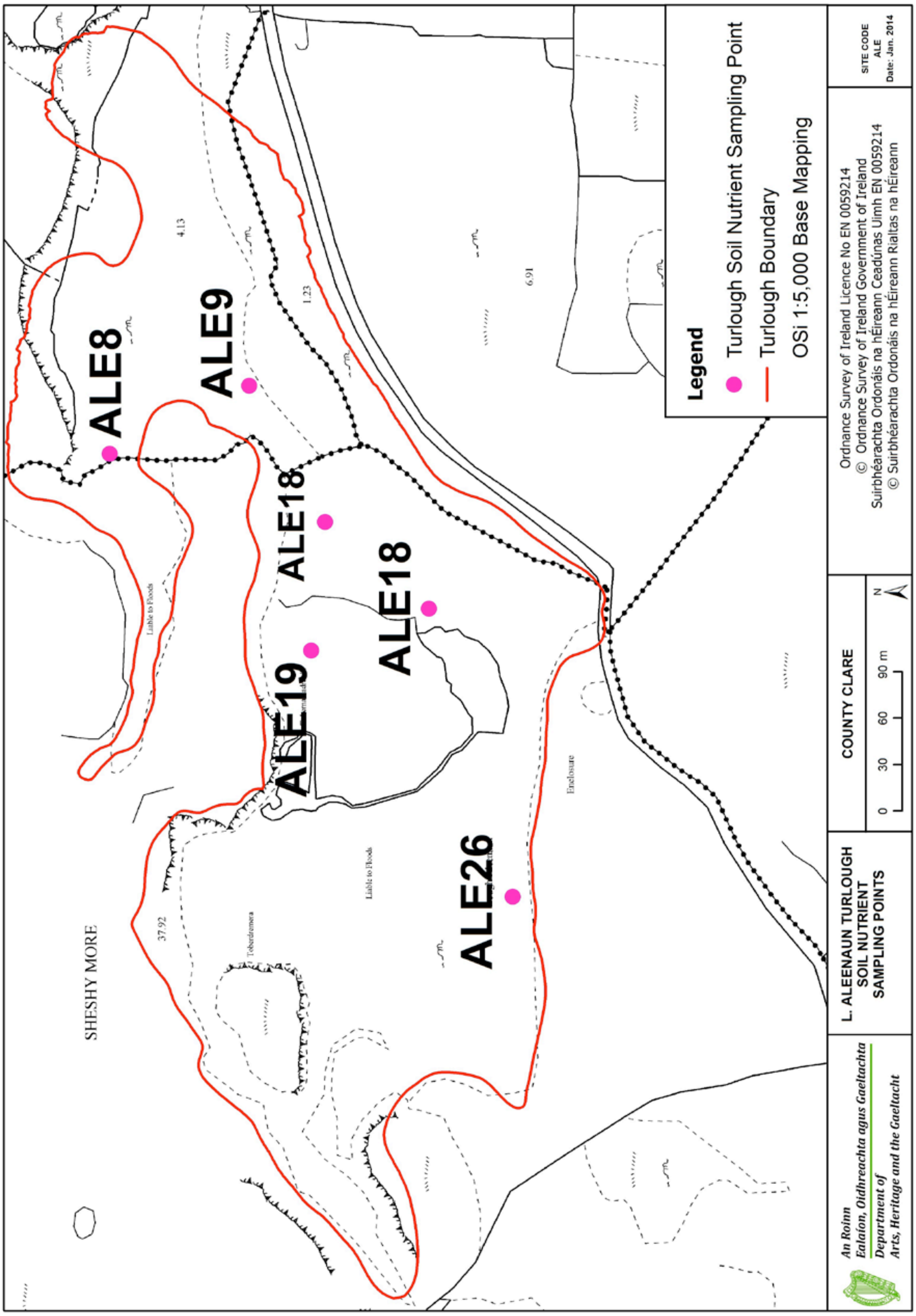
SHESHY MORE
Lough Aleenaun
Liable to Floods
Liable to Floods
Enclosure
37.92
4.13
1.23
6.91


Legend
Turlough Soil Nutrient Sampling Point
Turlough Boundary
OSi 1:5,000 Base Mapping
ALE8
ALE9
ALE18
ALE18
ALE19
ALE26
SHESHY MORE
Liable to Floods
Liable to Floods
Enclosure
4.13
1.23
6.91
37.92
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ALE
Date: Jan. 2014
L. ALEENAUN TURLOUGH
SOIL NUTRIENT
SAMPLING POINTS
COUNTY CLARE
0 30 60 90 m
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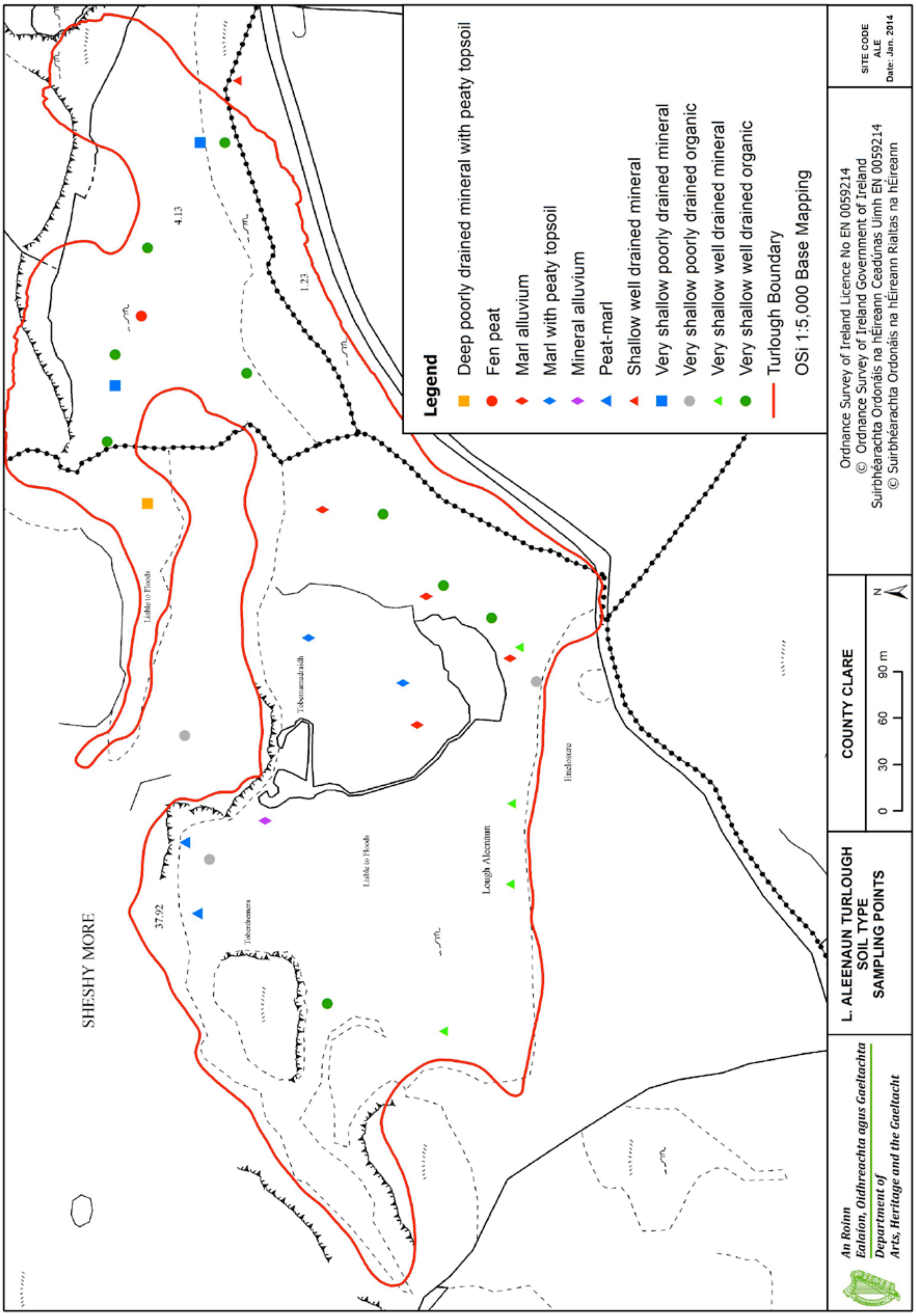

Legend
Deep poorly drained mineral with peaty topsoil
Fen peat
Marl alluvium
Marl with peaty topsoil
Mineral alluvium
Peat-marl
Shallow well drained mineral
Very shallow poorly drained mineral
Very shallow poorly drained organic
Very shallow well drained mineral
Very shallow well drained organic
Turlough Boundary
OSi 1:5,000 Base Mapping
SHESHY MORE
Lough Aleenaun
Liable to Floods
Liable to Floods
Enclosure
4.13
1.23
37.92
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SOIL TYPE
SAMPLING POINTS
COUNTY CLARE
0 30 60 90 m
N
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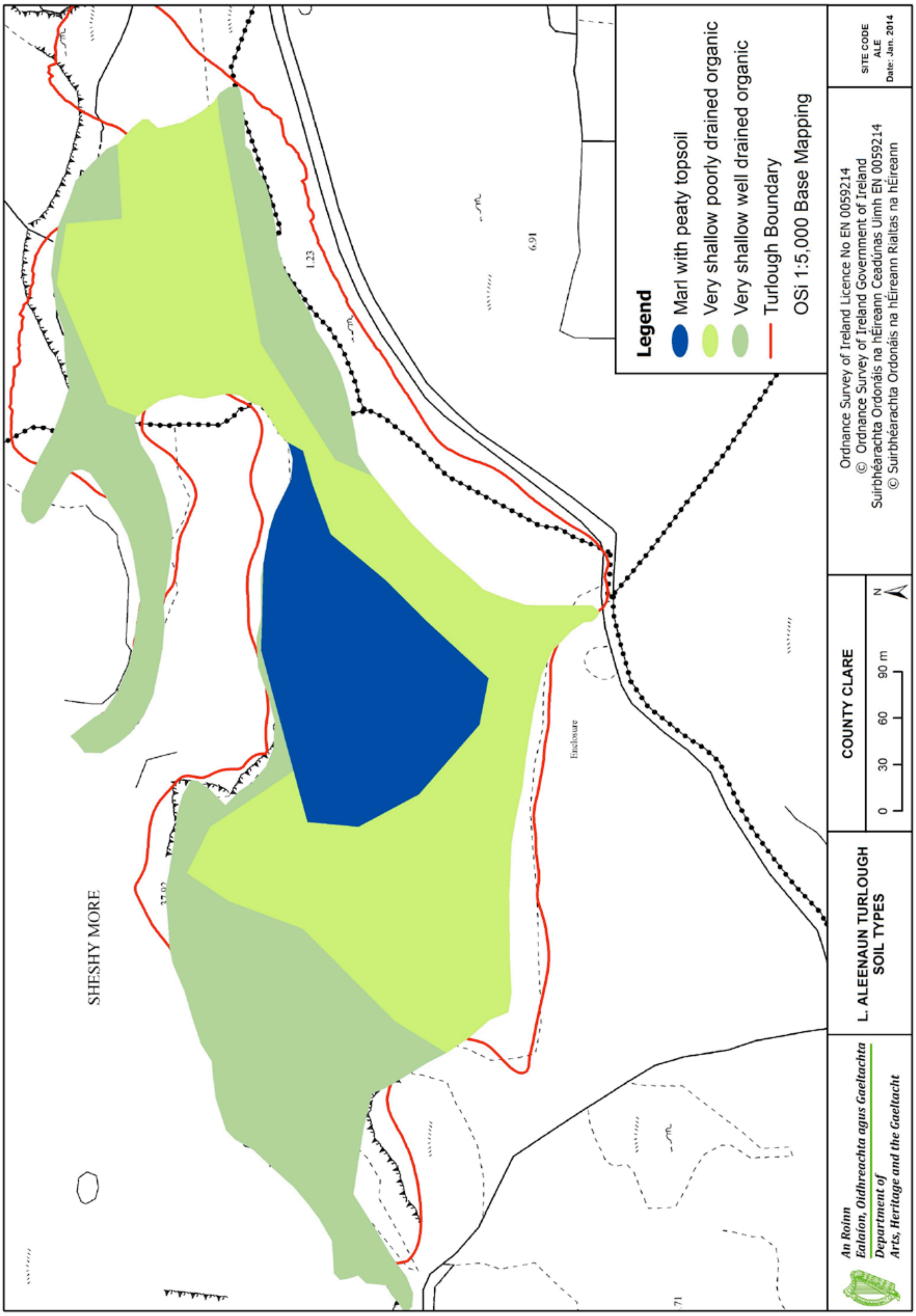
SHESHY MORE
Enclosure
1.23
6.91
37.02
71
Legend
Marl with peaty topsoil
Very shallow poorly drained organic
Very shallow well drained organic
Turlough Boundary
OSi 1:5,000 Base Mapping
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SOIL TYPES
COUNTY CLARE
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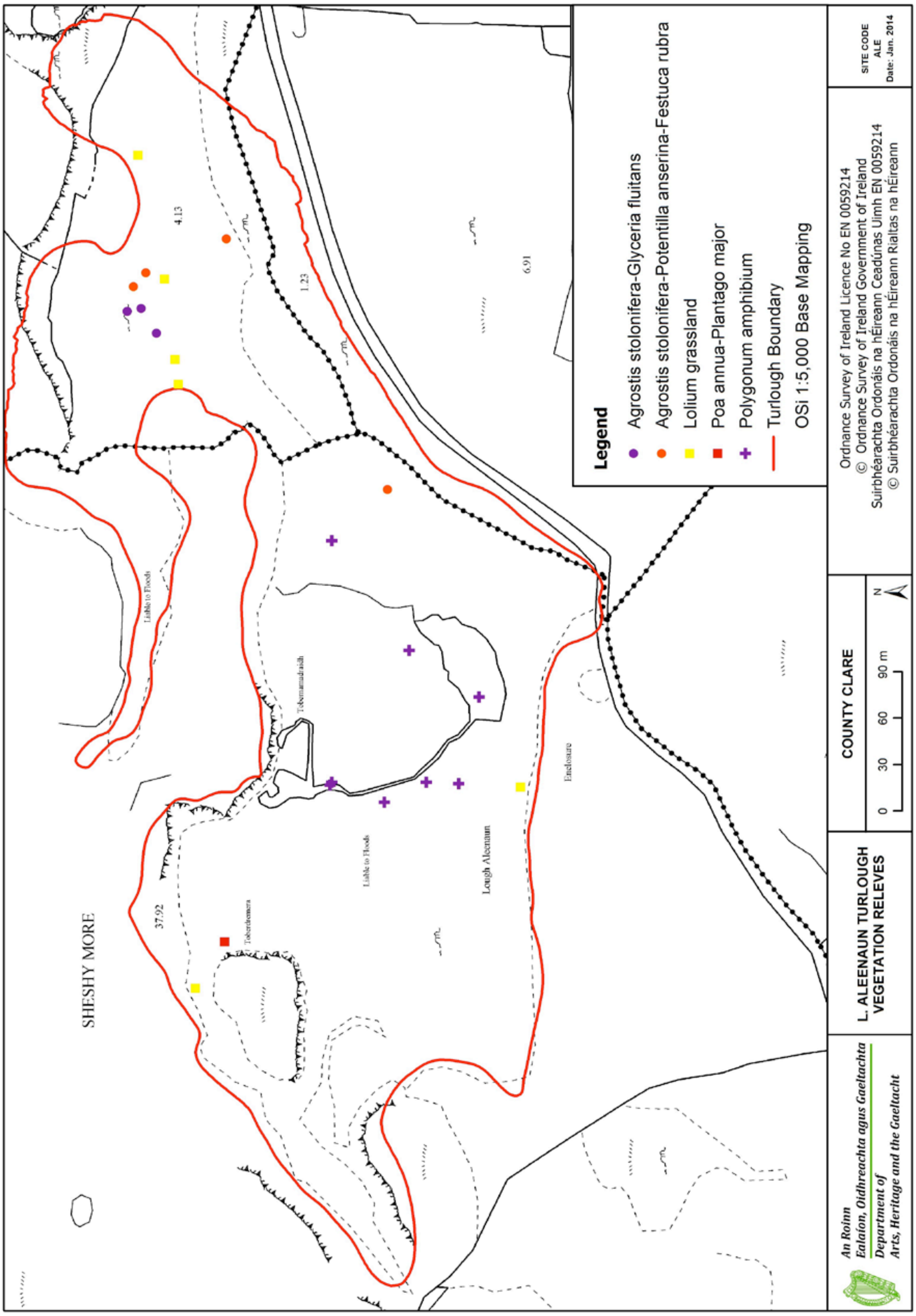

Legend
Agrostis stolonifera-Glyceria fluitans
Agrostis stolonifera-Potentilla anserina-Festuca rubra
Lolium grassland
Poa annua-Plantago major
Polygonum amphibium
Turlough Boundary
OSi 1:5,000 Base Mapping
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ALE
Date: Jan. 2014
COUNTY CLARE
0 30 60 90 m
N
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VEGETATION RELEVES
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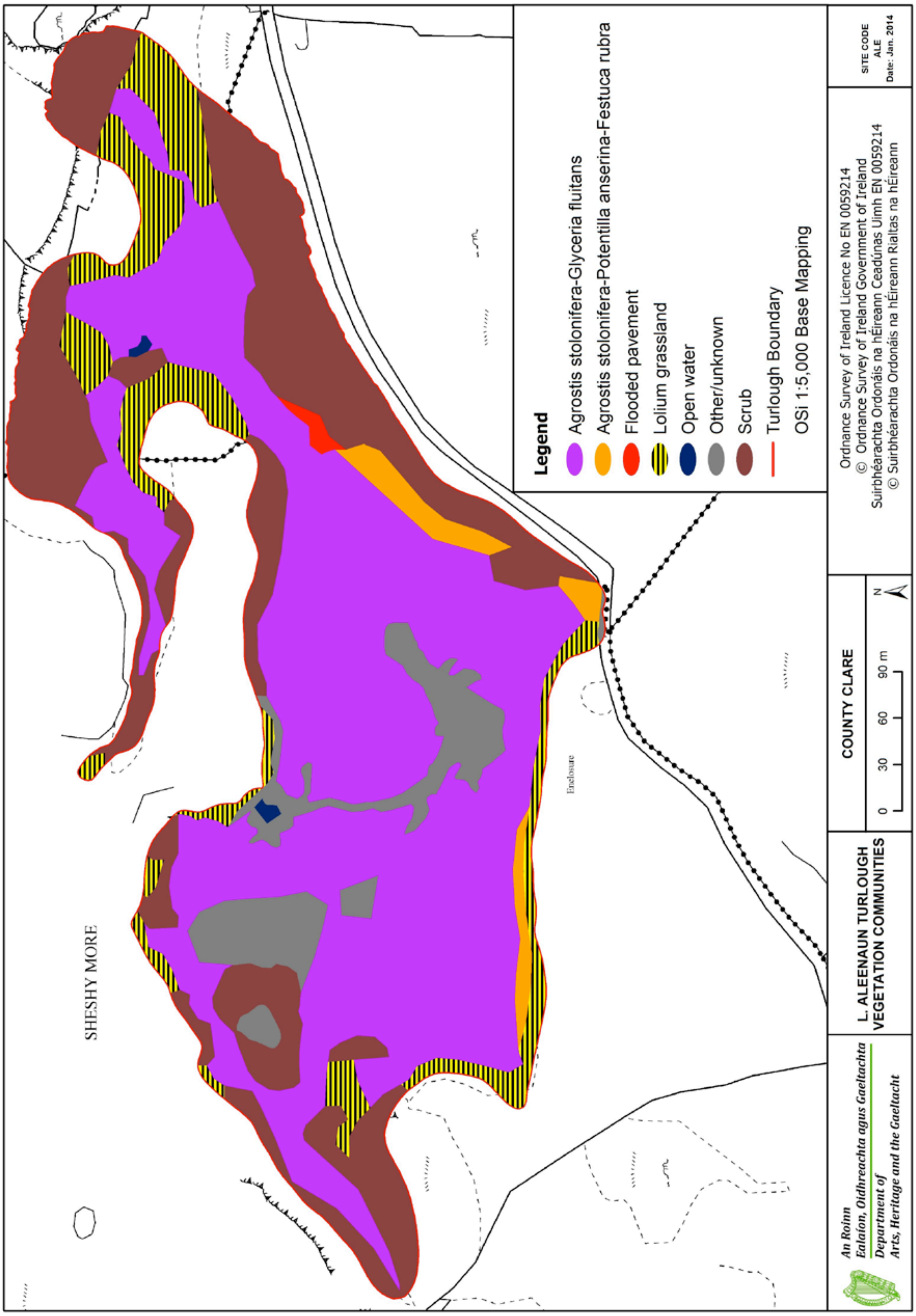
Department of
Arts, Heritage and the Gaeltacht
SHESHY MORE
Liable to Floods
Lough Aleenaun
Enclosure
4.13
1.23
6.91
37.92


SHESHY MORE
Enclosure
Legend
Agrostis stolonifera-Glyceria fluitans
Agrostis stolonifera-Potentilla anserina-Festuca rubra
Flooded pavement
Lolium grassland
Open water
Other/unknown
Scrub
Turlough Boundary
OSi 1:5,000 Base Mapping
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SITE CODE
ALE
Date: Jan. 2014
COUNTY CLARE
0 30 60 90 m
N
L. ALEENAUN TURLOUGH
VEGETATION COMMUNITIES
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Department of
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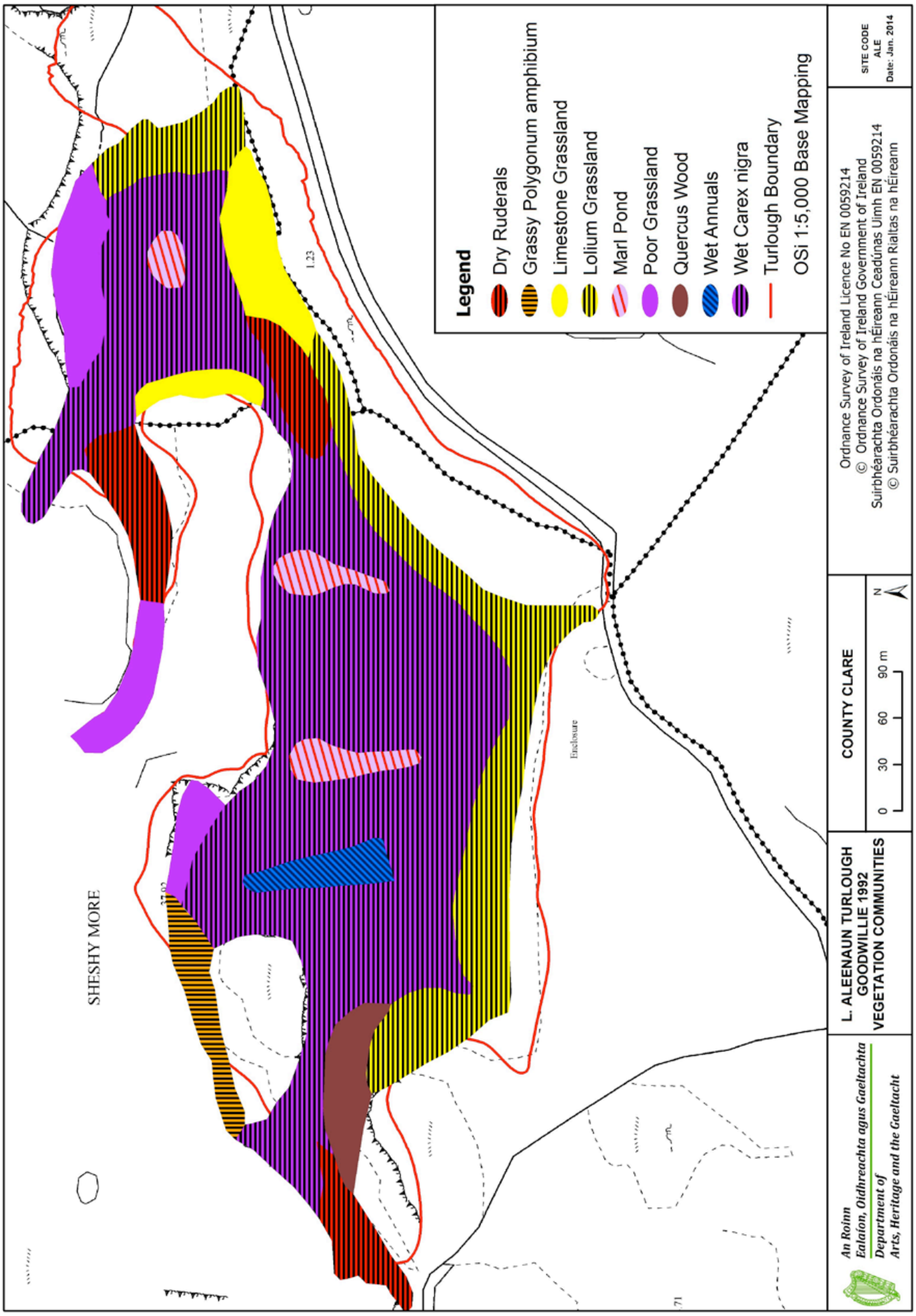
Legend
Dry Ruderals
Grassy Polygonum amphibium
Limestone Grassland
Lolium Grassland
Marl Pond
Poor Grassland
Quercus Wood
Wet Annuals
Wet Carex nigra
Turlough Boundary
OSi 1:5,000 Base Mapping
SHESHY MORE
Enclosure
SITE CODE
ALE
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COUNTY CLARE
0 30 60 90 m
N
L. ALEENAUN TURLOUGH
GOODWILLIE 1992
VEGETATION COMMUNITIES
An Roinn
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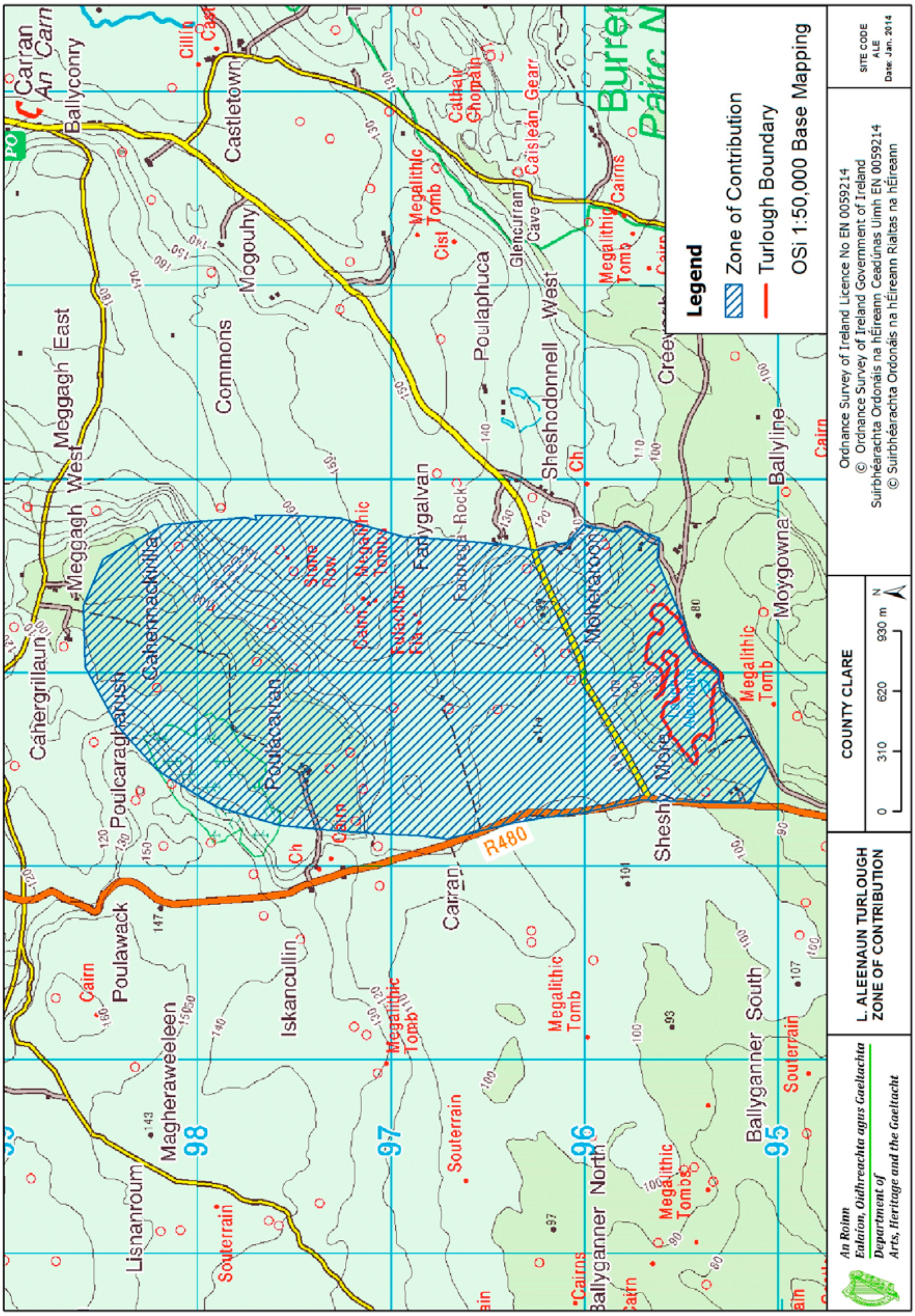

Legend
Zone of Contribution
Turlough Boundary
OSi 1:50,000 Base Mapping
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SITE CODE
ALE
Date: Jan. 2014
COUNTY CLARE
0
310
620
930 m
N
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ZONE OF CONTRIBUTION
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Department of
Arts, Heritage and the Gaeltacht
R480
Carran
Ballyconry
Castletown
Mogouhy
Commons
Meggagh East
Meggagh West
Cahergrillaun
Poulcaragharush
Cahermackirilla
Poulacarran
Fahygalvan
Poulaphuca
Sheshodonnell West
Moneratoon
Sheshy More
Moygowna
Ballyline
Creevagh
Poulawack
Magheraweeleen
Lisnanroum
Iskancullin
Ballyganner North
Ballyganner South
Megalithic Tomb
Souterrain
Cairn
Stone Row
Fulachta Fia
Glencurran Cave

Site Report: Lough Coy Turlough
TCD Turlough Research project 2006-2011

Turlough Project Code	SAC Name	SAC/NHA No.	County	Townland	RBD	Easting	Northing	Area (ha)
COY	Lough Coy	002117	Galway	Shanvally	WESTERN	149000	207500	26

File update: July 2015 (S. Waldren)

Site Description

Lough Coy is situated within the Shanvally townland near Gort in south-east County Galway. This turlough is one of four study sites within the Gort lowlands turlough complex, the associated three study turloughs within the complex are Blackrock, Caherglassan and Garryland. Lough Coy is a relatively deep, compact (26 ha), bowl-shaped turlough where often steep, grassy slopes surround a semi-permanent lake. Boulders are peppered throughout the site. Eight vegetation types were mapped within the site; the dominant vegetation types were *Filipendula ulmaria-Potentilla erecta-Viola sp.* and *Agrostis stolonifera-Potentilla anserina-Festuca rubra*. Lough Coy soils are moderately acidic and mineral, with low amounts of calcium carbonate. The dominant soil types were 'Very shallow poorly-drained mineral' and 'Alluvial mineral'. All of the turlough is under rotational grazing. The hydrological data indicate that Lough Coy has a flashy hydrological regime, with more than one significant flood event occurring on an annual basis. The site has a high inflow rate and large drainage capacity.

Lough Coy – photo: S. Kimberley

Phytoplankton

Phytoplankton analysis was conducted on sub-samples of monthly spot samples collected for hydrochemical analysis between October 2006 and June 2007. Phytoplankton composition varies significantly over time and data from autumn, mid-winter and spring/early summer are presented below. Taxa were identified to species level where possible. Some taxa were not discriminated beyond general groupings (i.e. small centric diatoms, dinoflagellates and pinnate diatoms). The term non-identifiable alone (or n.i.) was reserved for cases where specimens were not identifiable. Discrimination between n.i. filament, n.i. flagellate, n.i. colony, n.i. green filament was made when applicable. Biovolume (mm^3 m^{-3}) was used as the measure of algal biomass.

October 2006		January 2007		May 2007	
Biovolume (mm^3/m^3)	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*
Didymocystis	*77216*	*Nitzchia*	*68371*	*n.i.'strange flagellate'*	*50818*
Monoraphidium	*71754*	*n.i. pennates*	*35259*	*n.i. pennates*	*34272*
Lagerheimia wratislaviensis	*60354*	*Eunotia faba*	*30496*	*n.i. centrics*	*24920*
Scenedesmus	*57725*	*n.i.*	*24179*	*Diatoma moniliformis*	*6803*
n.i. flagellates	*50400*	*n.i. 'strange flagellate'*	*21840*	*Eunotia faba*	*6586*

Benthic Algae

Turloughs were inspected for algal mats during the emptying phase in 2007, 2008 and 2009. Turloughs were visited in the first two weeks of March to June 2007 as part of the monthly monitoring of turloughs. Dedicated trips to inspect for algal mats were conducted in 2008 on the 4th of March, the 1st of April, and the 26th, 27th and 28th of May, and in 2009 on the 15th and 16th of June and on the 24th and 25th of July. The presence of both living floating mats and dead drying mats was noted, as well as their extent in the turlough basins. Occurrence of visible filamentous algal mats in the three years of observation is presented below. Y = visible occurrence; * = "extensive cover" (estimated to be 2 to 8% of total area of basin); † = negligible quantity observed; • = turlough was too flooded to permit full observation. No algal mats were observed in Lough Coy in any year.

Year of Observation		
2007	2008	2009
N	N	N

Hydrochemistry

Data shown are the mean ± SD of monthly spot samples collected between October 2006 and June 2007. Mean seasonal Total P and Chlorophyll *a* were used to determine the trophic status of the floodwaters based on OECD trophic categories. The median and range of <u>mean values</u> across all turloughs are also provided.

Hydrochemical Variable	Ardkill Values		Turlough Summary Stats (n=22)		
	Mean±SD	OECD Trophic Category	Median	Min	Max
pH	7.9±0.2		8.1	7.7	8.3
Alkalinity mg l^{-1} $CaCO_3$	142.7±26.1		204.0	112.4	236.4
Colour mg l^{-1} PtCo	71.6±47.9		26.9	7.9	85.1
Molybdate Reactive Phosphorus µg l^{-1}	20.6±9.9		3.4	0.7	42.1
Total Phosphorus µg l^{-1}	43.3±15.9	Eutrophic	24.8	4.0	82.1
Chlorophyll *a* µg l^{-1}	5.2±5.6	Mesotrophic	4.9	1.1	33.5
Nitrate-N mg l^{-1}	1.0±0.2		0.7	0.1	1.9
Total Nitrogen mg l^{-1}	1.4±0.3		1.2	0.6	2.3

Aquatic Invertebrates

22 turloughs were sampled for littoral aquatic macroinvertebrates using sweep nets during November 2006 and April 2007. Zooplankton samples were collected in April 2007. Open-water cladocerans and littoral chydorids were sampled using a zooplankton net and perspex tube respectively.

Aquatic Macroinvertebrates			
November 2006	**Count**	**April 2007**	**Count**
Agabus sp. (larva)	3	*Asellus aquaticus*	4
Asellus aquaticus	1	*Callicorixa praeusta*	1
Curculionidae	1	*Chironomidae*	5
Gammarus lacustris	1	*Cloeon dipterum*	3
Hydrachnidia (Mite)	3	*Corixa panzeri*	2
Lymnaea trunculata	9	*Gammarus lacustris*	9
Ostracoda	1	*Haliplus* sp. *ruficollis* group (females)	1
Sigara concinna	4	*Hydroporus palustris*	12
Sigara dorsalis	1	*Hygrotus inaequalis*	1
Sigara falleni	1	*Ischnura elegans*	1
Sigara fallenoidea	1	*Laccophilus minutus*	1
Sigara lateralis	1	*Notonecta glauca*	1
Sigara nigrolineata	3	Oligochaeta	4
Succinea sp.	1	Ostracoda	69
Zonitoides sp.	3	*Phacopteryx brevipennis*	1
		Pisidium/Sphaerium spp.	1
		Porhydrus lineatus	2
		Sigara concinna	2
		Sigara dorsalis	8
		Valvata macrostoma	5

Aquatic Macroinvertebrates: Presence of high abundances (> 50 individuals) of Ostracoda recorded in April 2007 indicates nutrient enrichment.

Aquatic Macroinvertebrate Taxa	Presence of high abundances	
	November 2006	April 2007
Diptera	N	N
Ostracoda	N	Y
Odonata	N	N
Trichoptera	N	N

Zooplankton species
Alona quadrangularis
Alonella excisa
Chydorus sphaericus
Daphnia pulex
Eurycercus lamellatus
Graptoleberis testudinaria

Vegetation

Vegetation description and classification yielded 25 vegetation communities suitable for mapping. Eight vegetation types were mapped within Lough Coy; the dominant vegetation types were *Filipendula ulmaria-Potentilla erecta-Viola sp.* and *Agrostis stolonifera-Potentilla anserina-Festuca rubra*, as with most other turloughs in the Gort chain (Blackrock, Coole-Garryland, Caherglassan), Lough Coy also contains the important *Eleocharis acicularis* community. High conservation value communities are denoted by *. Thirty-seven plant species were recorded, including the notable *Eleocharis acicularis* and *Viola persicfolia*.

Vegetation Community	**Area (Ha)**
A. stolonifera-P. anserina - F. rubra	0.61
A. stolonifera-R. repens	4.12
**Eleocharis acicularis*	2.55
**F. ulmaria-P. erecta-Viola sp*	4.38
Lolium grassland	2.19
Open water	8
Other/unknown	0.74
P. anserina-P. reptans	0.18
Woodland/scrub	2.68
Number of vegetation communities	8
Number of plant species	37

Vascular Plant Species

Nomenclature follows Parnell, J & Curtis, T. (2012) *Webb's An Irish Flora*, University of Cork Press.

Agrostis stolonifera	*Festuca rubra*	*Polygonum amphibium*
Briza media	*Filipendula ulmaria*	*Potentilla anserina*
Carex flacca	*Galium boreale*	*Potentilla erecta*
Carex hirta	*Galium palustre*	*Potentilla reptans*
Carex hostiana	*Galium verum*	*Ranunculus repens*
Carex nigra	*Leontodon autumnalis*	*Rumex acetosa*
Carex panicea	*Lotus corniculatus*	*Rumex crispus*
Carex viridula agg.	*Mentha aquatica*	*Stellaria media*
Carex viridula ssp. *oedocarpa*	*Molinia caerulea*	*Succisa pratensis*
Cerastium fontanum	*Phalaris arundinacea*	*Trifolium repens*
Eleocharis acicularis	*Phleum pratense*	*Viola canina*
Elymus repens	*Plantago lanceolata*	*Viola persicifolia*
Euphrasia species	*Plantago major*	

Soils and Grazing

Soils were classified using a modified version of soil categories generated by the Teagasc/EPA Soils and Subsoils Mapping project (Fealy *et al.*, 2009). The classification scheme principally uses parent material (calcareous/non-calcareous), depth class (shallow/deep) and drainage class (well drained/poorly drained) to assign soils to one of nine broad categories. Lough Coy has extensive areas of mineral soil types. The mean ± SD of a range of soil properties are also provided, in addition to the median and range of each variable across turloughs. Lough Coy soils are moderately acidic and mineral, with low amounts of calcium carbonate. All of the land parcels were grazed, though some were also partially flooded at the time of mapping.

Soil Types/Grazing Extent	% Turlough Area
Very shallow well drained mineral	12.2
Very shallow poorly drained mineral	46.1
Alluvial mineral	41.7
Extent of rotationally grazed area	100

Soil Property (n=6)	Lough Coy	Turlough Summary Stats (n=22)		
	Mean ± SD	Median	Min	Max
pH	6.62 ± 0.6	7.20	5.94	8.29
% Organic Matter content	14.5 ± 4.6	25.8	10.2	69.1
% Inorganic content	81.5 ± 5.6	43.2	25.7	85.0
% Calcium carbonate content	4.00 ± 1.1	11.3	2.48	43.7
Total Nitrogen mg kg^{-1}	7069 ± 2234	11142	4983	24233
Total Phosphorus mg kg^{-1}	1163 ± 402	905	245	1594

Hydrology

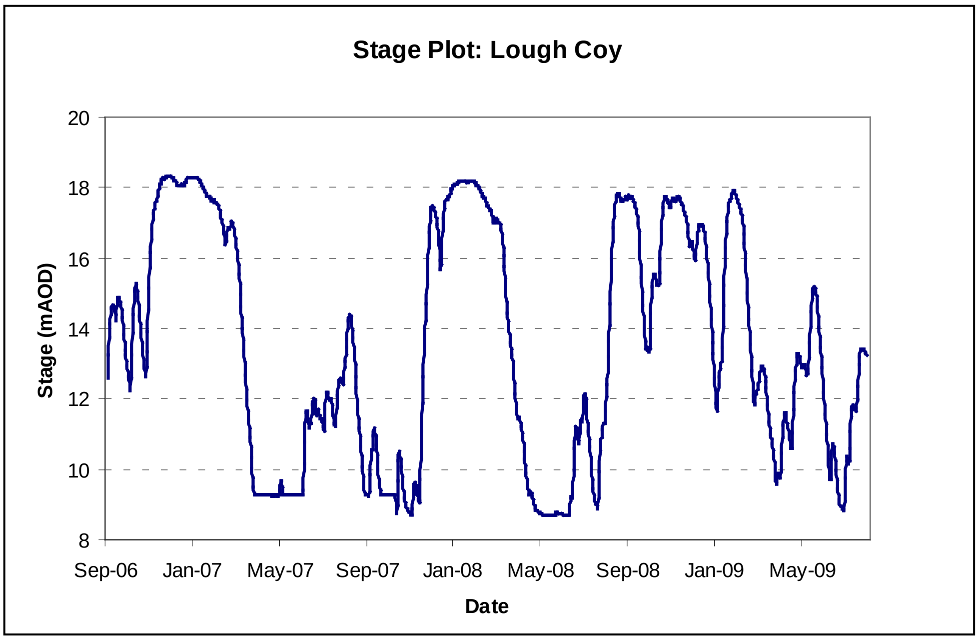
Water levels were recorded at hourly intervals using a variety of Schlumberger Divers® (Marton Geotechnical Ltd, Suffolk, UK) placed at or near the lowest point in each turlough. Divers measure the pressure of the water and air column above them, and from this the depth of water can be calculated. GPS surveys were carried out on 21 monitoring sites (Tullynafrankagh omitted) in order to develop digital terrain models (DTMs) from which contour maps, stage-volume and stage-surface area relationships are produced. The inflow magnitude is indicative of the properties of a turlough's catchment area and flow capacity, while outflow is a function of the drainage capacity of the system.

The hydrological data indicate that Lough Coy has a flashy hydrological regime, with more than one significant flood event occurring on an annual basis. The site has a high inflow rate and large drainage capacity. The recession duration is very short.

Lough Coy forms part of a series of conduit fed turloughs which includes Blackrock (also known as Peterswell), Coole/Garryland, and Caherglassan. Blackrock, the first in the series, is partly fed by the Owenshree river which drains from the Slieve Aughty mountains, which have acidic bedrock. This system consequently has a very large zone of groundwater contribution.

Hydrological Information	Lough Coy Values	Turlough Summary Stats (n=21)		
		Median	Min	Max
Start of Hydrological Recording	24/09/2006	-	-	-
End of Hydrological Recording	05/08/2009	-	-	-
Days Recorded	1046	-	-	-
Equipment Failure	None recorded	-	-	-
Hydroperiod (days)	187	213	135	348
Maximum Floodwater Depth (m)	10.6	4.9	3	15.4
Maximum Floodwater Volume ('000 m^3)	1479.1	877.9	355.6	4008.1
Maximum Flooded Area	25.26	38.61	13.71	78.12
Average Basin Depth (m)	5.86	2.28	0.85	6.76
Average Daily Inflow ($m^3\ s^{-1}$)	1.331	0.684	0.254	10.253
Average Daily Outflow ($m^3\ s^{-1}$)	0.842	0.271	0.086	2.018
Drainage Capacity ($m^3\ s^{-1}$)	0.535	0.154	0.069	1.156
Recession Duration (days)	32	57.3	11	142.5

Stage plot for Lough Coy



Zone of Groundwater Contribution (ZOC) Risk Assessments

GIS based risk assessments were conducted with a view to identifying turloughs at risk of failing to meet WFD water quality objectives. These risk assessments were conducted by Compass Informatics Ltd and were based on Risk Assessment Sheet GWDTERA2a (Guidance Document No. GW9) on assessing risks to turloughs from phosphate (Working Group on Groundwater 2004) and Pathway Susceptibilities and Pressure Magnitudes were integrated to produce Impact Potential maps and predicted Risk Categories for the turlough ZOC. The TCD Risk Category is derived from a revised Impact Potential matrix. The predicted Risk Categories were adjusted using mean seasonal floodwater Total P ($\mu g\ l^{-1}$) (see Section 4.5.4 of the Risk Assessment Sheet GWDTERA2a). The risk categories include 1A: at significant risk; 1B: probably at significant risk; 2A: Not at significant risk (low confidence); 2B: Not at significant risk (higher confidence).

ZOC Area (Km^2)	Predicted WFD Risk Category	Adjusted WFD Risk Category	Predicted TCD Risk Category	Adjusted TCD Risk Category
83	2A	1A	1B	1A

ZOC Pressure Variable	
CORINE BARE ROCK %	0
CORINE PEAT BOGS%	16
CORINE ALL NATURAL AND SEMI-NATURAL AREAS%	16
CORINE IMPROVED PASTURE%	29
CORINE UNIMPROVED PASTURE%	28
CORINE ALL PASTURE%	57
CORINE OTHER AGRICULTURAL LANDS%	11
TEAGASC/EPA HABITATS ROCK%	0
TEAGASC/EPA HABITATS BOGS/PEATS%	14
TEAGASC/EPA HABITATS FORESTS/SCRUBS%	13
TEAGASC/EPA HABITATS WATER%	0
TEAGASC/EPA HABITATS DRY GRASSLAND%	63
TEAGASC/EPA HABITATS WET GRASSLAND%	10
TEAGASC TOTAL GRASSLAND%	73
TOTAL LIVESTOCK UNIT/ha of ZOC	1
TILLAGE%	0
No. SEPTIC TANKS km^{-2} ZOC	8
No. SEPTIC TANKS km^{-2} EXTREME PATHWAY SUSCEPTIBILITY	7
HIGH PATHWAY SUSCEPTIBILITY%	57
EXTR+HIGH PATHWAY SUSCEPTIBILITY%	74
WELL DRAINED SOIL %	58
POORLY DRAINED SOIL%	41

Site Conservation Assessment

The following site conservation assessment was undertaken to feed into the national reporting structure for assessing conservation status as required under Article 17 of the Habitats Directive. A suite of indicators and associated targets were derived to assess ecological structure and function. Future prospects were assessed through the evaluation of the impact of current and recent pressures and likely future threats to the site. The assessment follows a rules based approach to determine whether Structures & functions and Future Prospects should be assessed as good (green), inadequate (amber) or bad (red). For further details, see Chapter 10 (Conservation Status Assessment).

Please note an updated approach to assessing site condition has been proposed and is outlined in Chapter 12 (Monitoring Methods for Turloughs).

Conservation Condition Summary

Structure & Function	**Inadequate**
Future Prospects	**Inadequate**
Site Conservation Condition	**Inadequate**

Structure and Function Status:

Indicator	*Comments*
Hydrological Function: *Good*	Some drainage work evident in the ZOC but unlikely to have significant impact on the turlough hydrology
Water Quality: *Intermediate*	43.3 µg P l^{-1}. Towards the high end of this category
Biological Responses: *intermediate*	
Algal communities: -1	No algal mats recorded, likely due to the highly coloured water due to runoff from the Slieve Aughty forestry activity; however, high max CHL
Vegetation communities: 1	Moderately high cover of positive indicator communities, low cover of negative indicators
***Rumex* cover: 0**	27.3% frequency
Important plants: 1	*Viola persicifolia*
Important aquatic invertebrates: 1	*Alonella excisa*
Overall Structure & Function: *Inadequate*	

Pressures:

Code	Impact	Notes
A04.01.01 Intensive cattle grazing (turlough)	H	All of the turlough grazed, and some land parcels with very high stocking levels
H02.06 Diffuse groundwater pollution due to agricultural and forestry activities (ZOC)	M	Agricultural runoff and runoff from forestry in the Slieve Aughty mountains
H02.07 Diffuse groundwater pollution due to non-sewered population (ZOC)	L	Relatively low dwelling number in areas of high and extreme pathway susceptibility
B01 Forest planting on open ground (ZOC)	L	But major impact will be on groundwater nutrient enrichment

Threats:

Code	Impact	Notes
A02.01 Agricultural intensification (ZOC)	M	Agricultural intensification in ZOC likely
H02.06 Diffuse groundwater pollution due to agricultural and forestry activities (ZOC)	M	Continuing pressure
A04.01.01 Intensive cattle grazing (turlough)	M	Continuing pressure
A02.03 Grassland removal for arable land (ZOC)	L	Some evidence of shift to maize production locally
A10.02 Removal of stone walls and embankments (in turlough)	L	
H02.07 Diffuse groundwater pollution due to non-sewered population (ZOC)	L	
M01.03 Flooding and rising precipitations	L	
A04.03 Abandonment of pastoral systems, lack of grazing (ZOC)	L	Possible pressure, given productivity of site

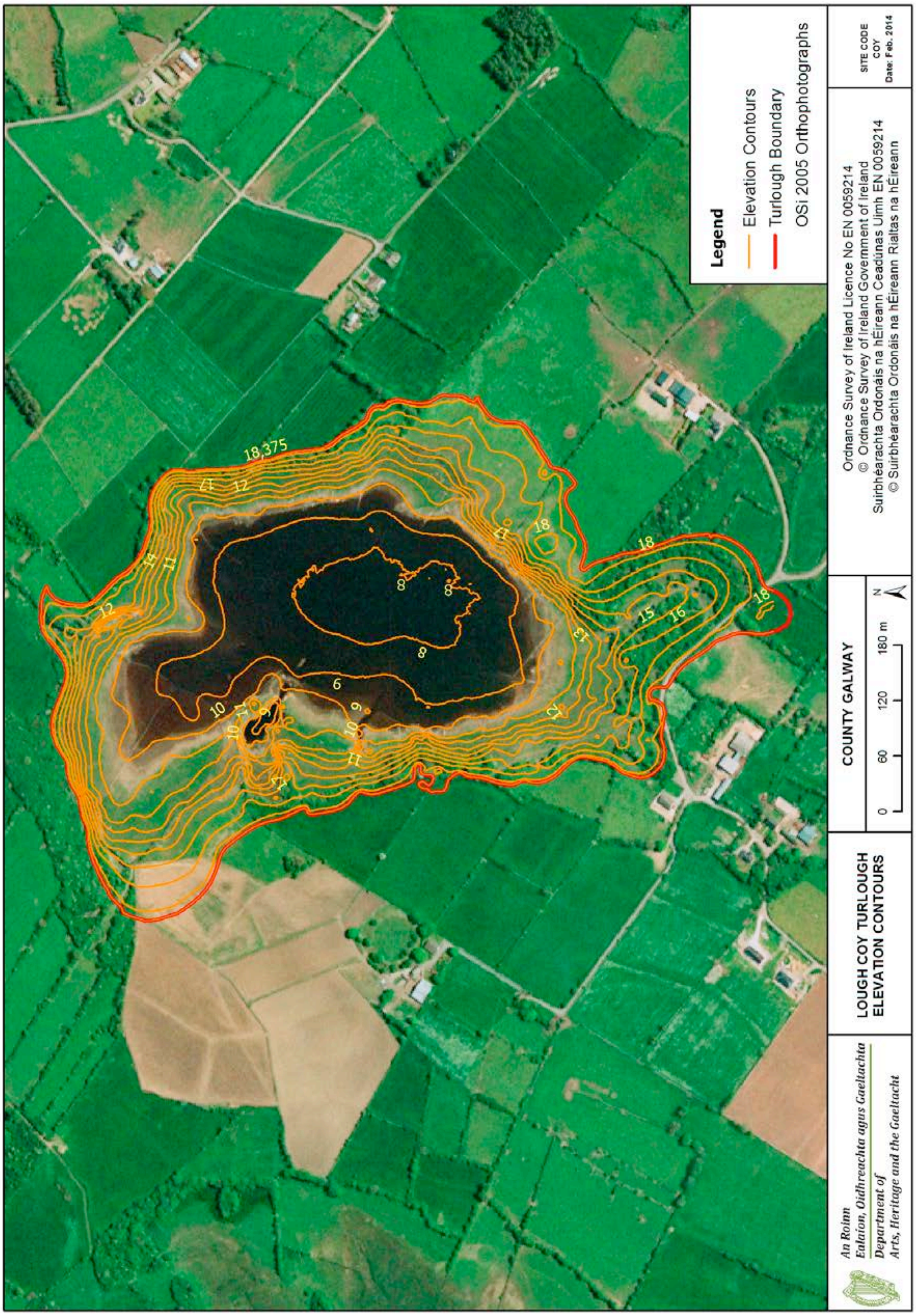
Future Prospects: **Inadequate** – several moderate impacts which are unlikely to improve structure and functions to favourable.

Overall Assessment: **Inadequate** – due to intermediate structure and function and intermediate future prospects.

Maps

Maps are provided of:

1. Elevation contours, based on GIS digital terrain models from points by differential GPS topographic survey (for further details, see *Chapter 3: Hydrology*)
2. Grazing in land parcels
3. Approximate sampling points for water chemistry and aquatic invertebrates
4. Soil nutrient sampling points
5. Points for soil survey (note: soils were surveyed to the turlough boundary digitised from Tynan, S., M. Gill & P. Johnston, 2006. *Development of a methodology for the characterisation of a karstic groundwater body with particular emphasis on the linkage with associated ecosystems such as the turlough ecosystem.* Environmental Protection Agency, Ireland.)
6. Soils (note: soils were mapped by combining the EPA Subsoils base map with the point soil descriptions; for further details see *Chapter 6: Soils and Landuse*)
7. Vegetation relevés
8. Vegetation communities (note: relevés do not always match to mapped communities due to small scale variation; for further details of mapping see *Chapter 7: Turlough Vegetation: Description, Mapping and Ecology*)
9. Estimated zone of groundwater contribution (ZOC)


Legend
Elevation Contours
Turlough Boundary
OSi 2005 Orthophotographs
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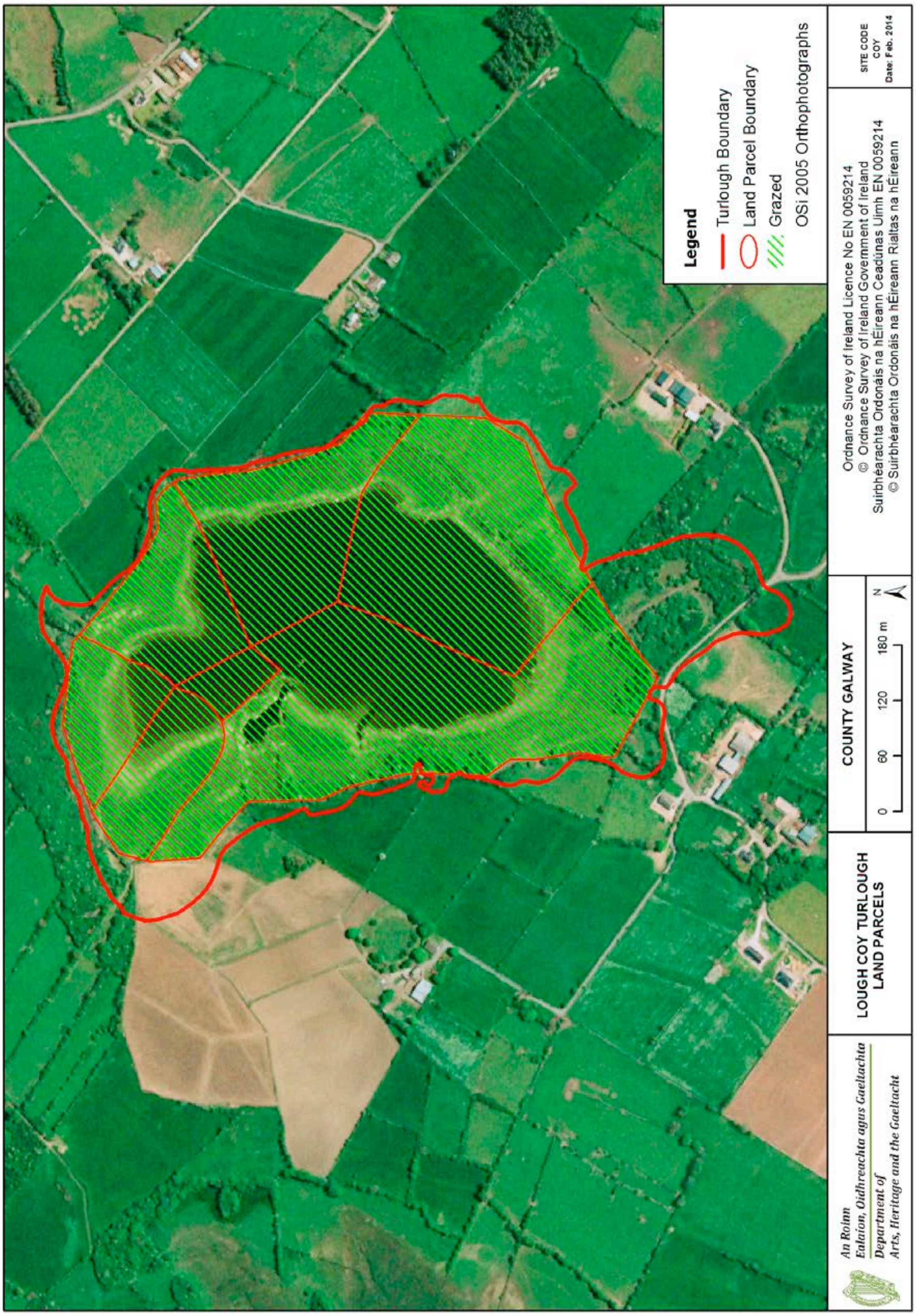
SITE CODE
COY
Date: Feb. 2014
COUNTY GALWAY
0 60 120 180 m
N
LOUGH COY TURLOUGH
ELEVATION CONTOURS
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht



Legend
Turlough Boundary
Land Parcel Boundary
Grazed
OSi 2005 Orthophotographs
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Date: Feb. 2014
COUNTY GALWAY
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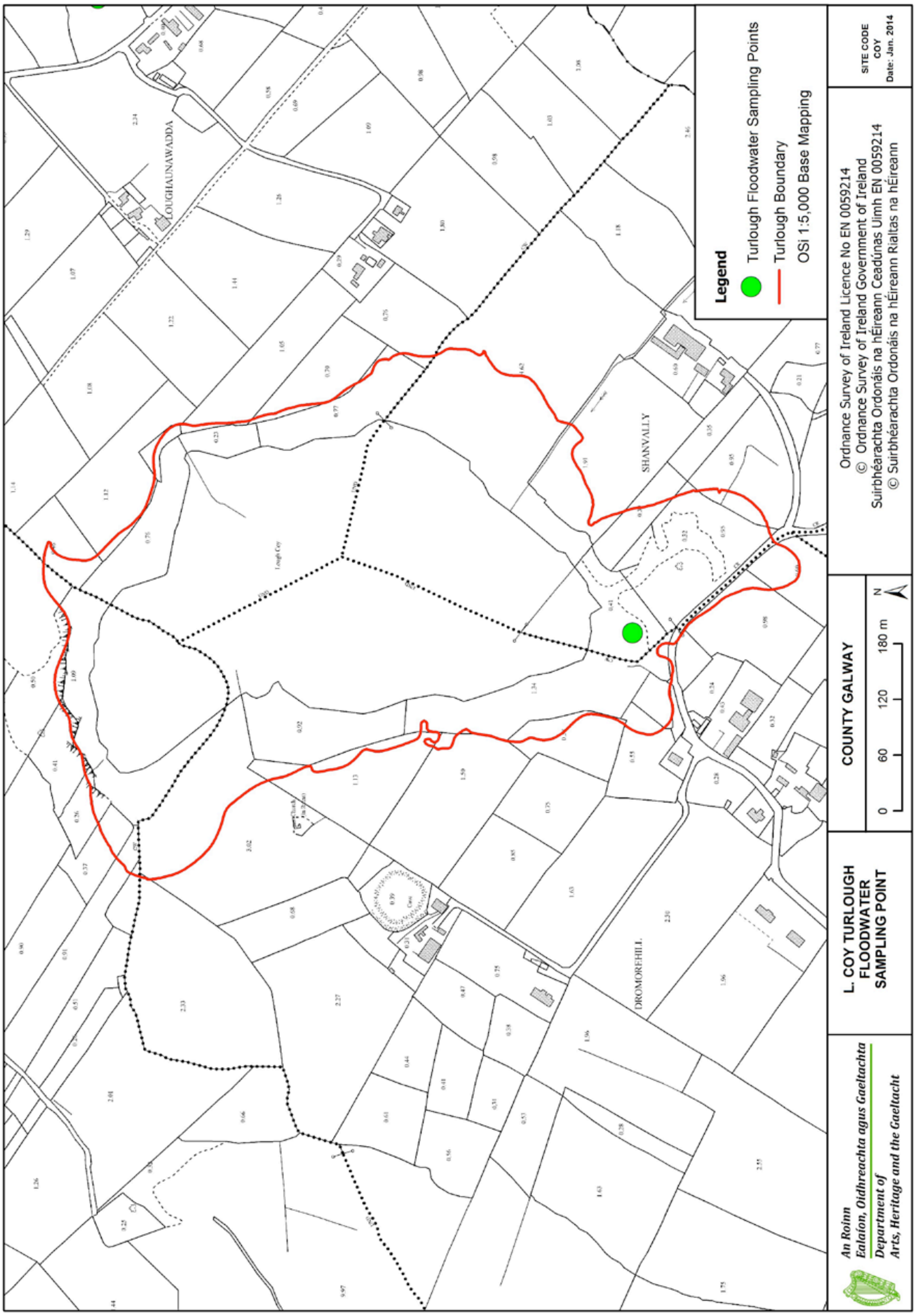
LOUGH COY TURLOUGH
LAND PARCELS
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht



Legend
Turlough Floodwater Sampling Points
Turlough Boundary
OSi 1:5,000 Base Mapping
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COY
Date: Jan. 2014
COUNTY GALWAY
0 60 120 180 m
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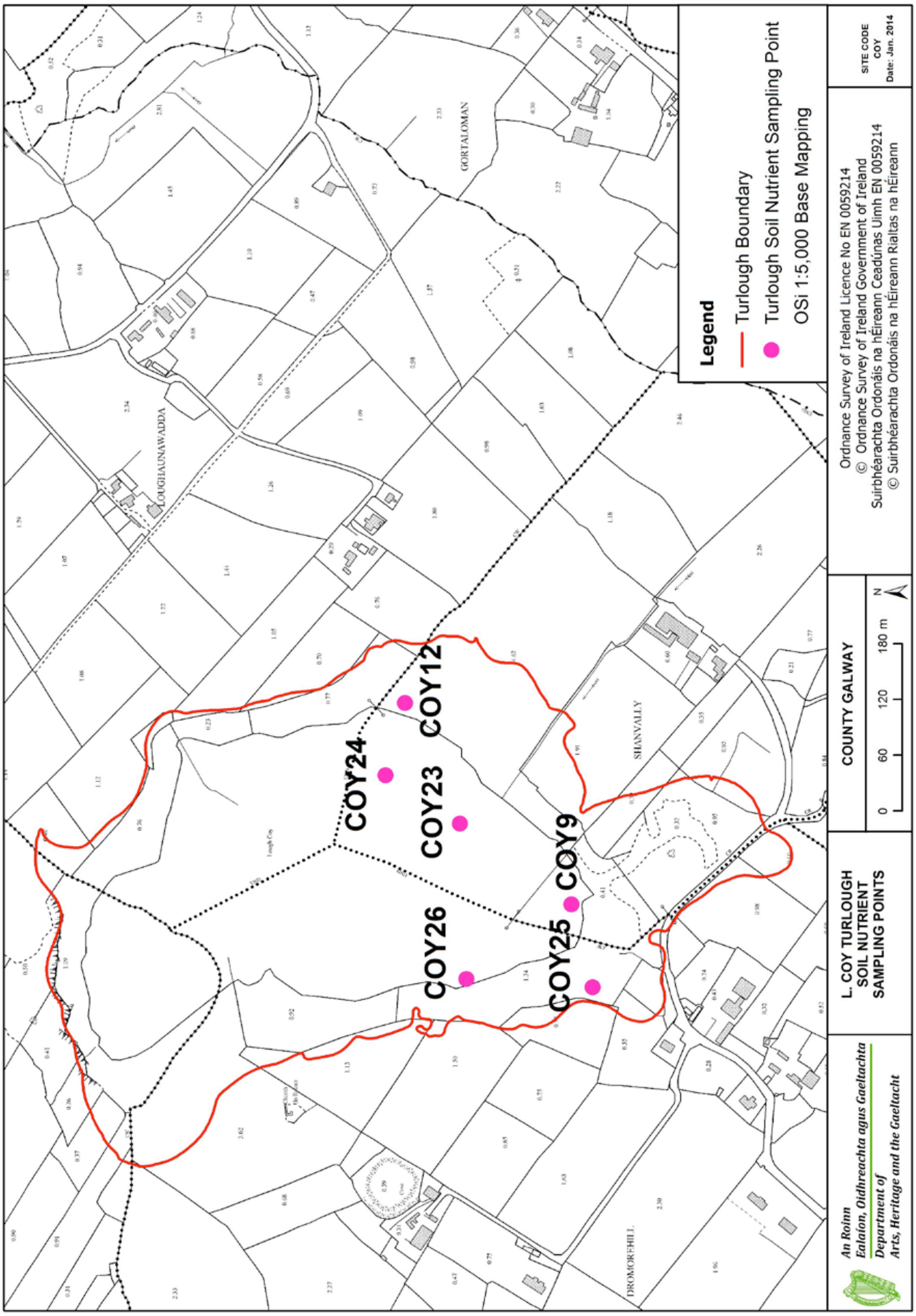
L. COY TURLOUGH FLOODWATER SAMPLING POINT
An Roinn Ealaíon, Oidhreachta agus Gaeltachta
Department of Arts, Heritage and the Gaeltacht
LOUGHAUNAWADDA
SHANVALLY
DROMOREHILL
Lough Coy



L. COY TURLOUGH
SOIL NUTRIENT
SAMPLING POINTS
COUNTY GALWAY
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SITE CODE
COY
Date: Jan. 2014
Legend
Turlough Boundary
Turlough Soil Nutrient Sampling Point
OSi 1:5,000 Base Mapping
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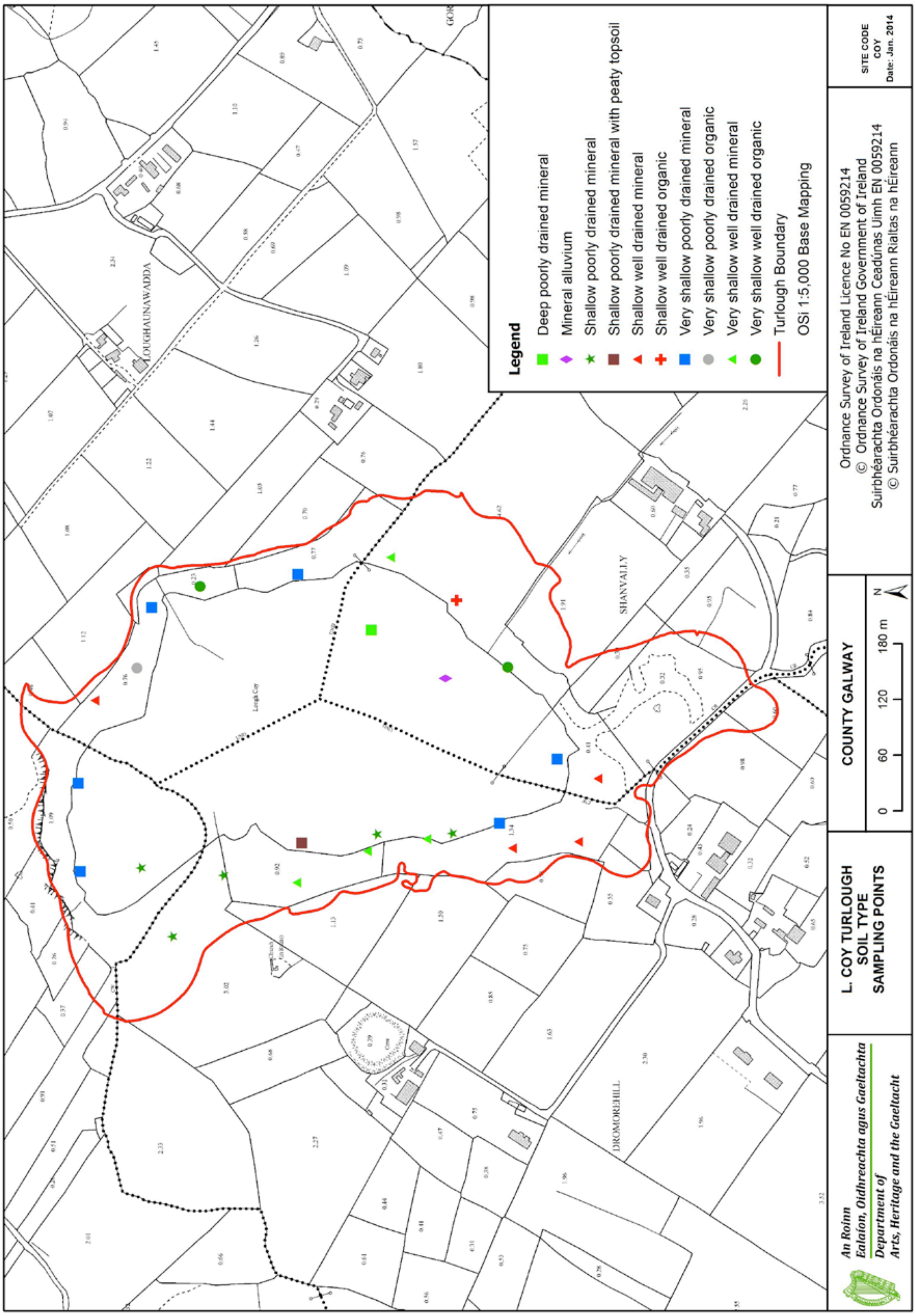
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht
COY12
COY24
COY23
COY9
COY26
COY25
GORTALOMAN
LOUGHAUNAWADDA
SHANVALLY
DROMOREHILL


Legend
Deep poorly drained mineral
Mineral alluvium
Shallow poorly drained mineral
Shallow poorly drained mineral with peaty topsoil
Shallow well drained mineral
Shallow well drained organic
Very shallow poorly drained mineral
Very shallow poorly drained organic
Very shallow well drained mineral
Very shallow well drained organic
Turlough Boundary
OSi 1:5,000 Base Mapping
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SITE CODE
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Date: Jan. 2014
COUNTY GALWAY
0 60 120 180 m
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L. COY TURLOUGH
SOIL TYPE
SAMPLING POINTS
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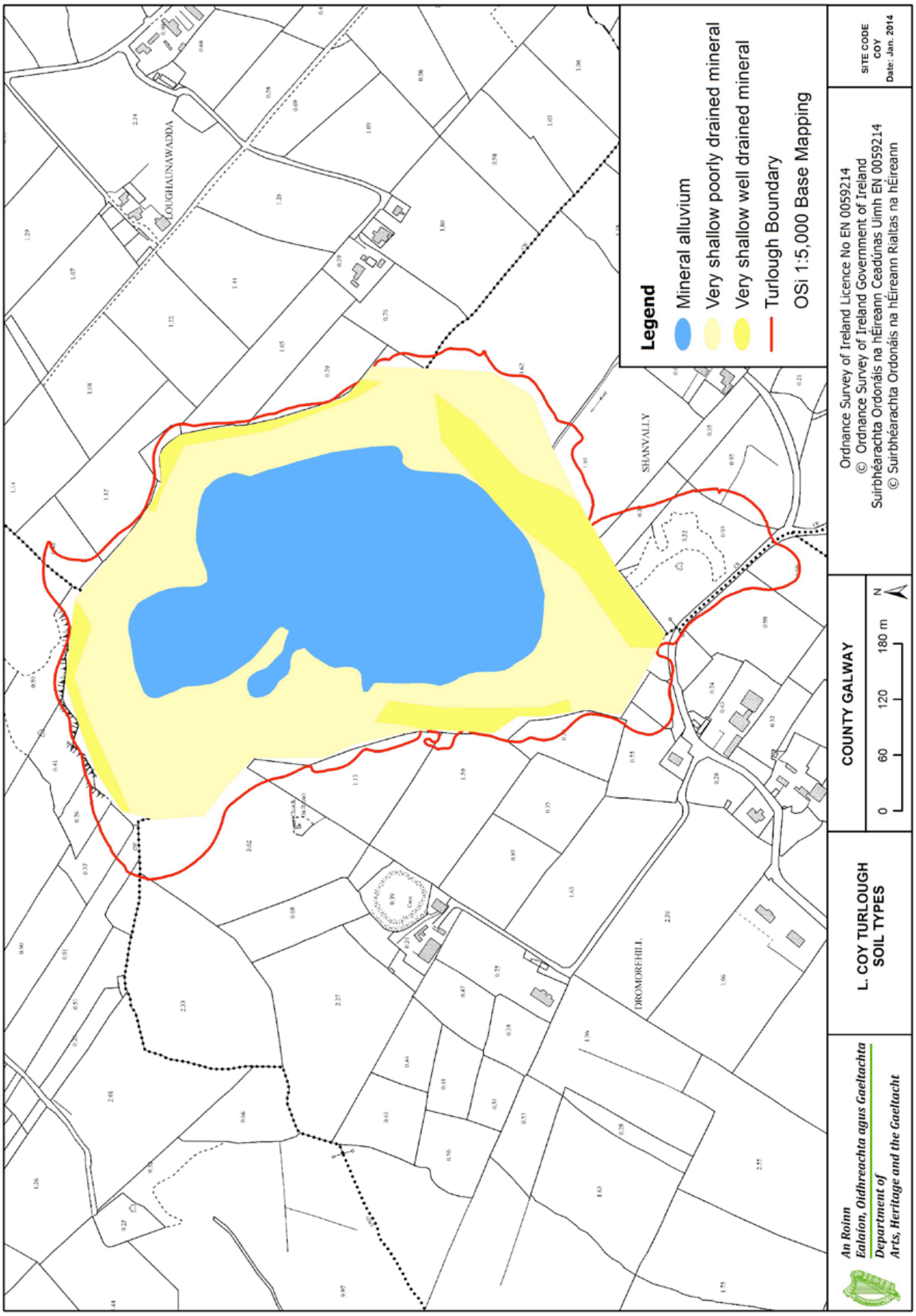
Department of
Arts, Heritage and the Gaeltacht
LOUGHAUNAWADDA
SHANVALLY
DROMOREHILL
Lough Coy


Legend
Mineral alluvium
Very shallow poorly drained mineral
Very shallow well drained mineral
Turlough Boundary
OSi 1:5,000 Base Mapping
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SITE CODE
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Date: Jan. 2014
COUNTY GALWAY
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L. COY TURLOUGH
SOIL TYPES
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Department of
Arts, Heritage and the Gaeltacht
LOUGHAUNAWADDA
SHANVALLY
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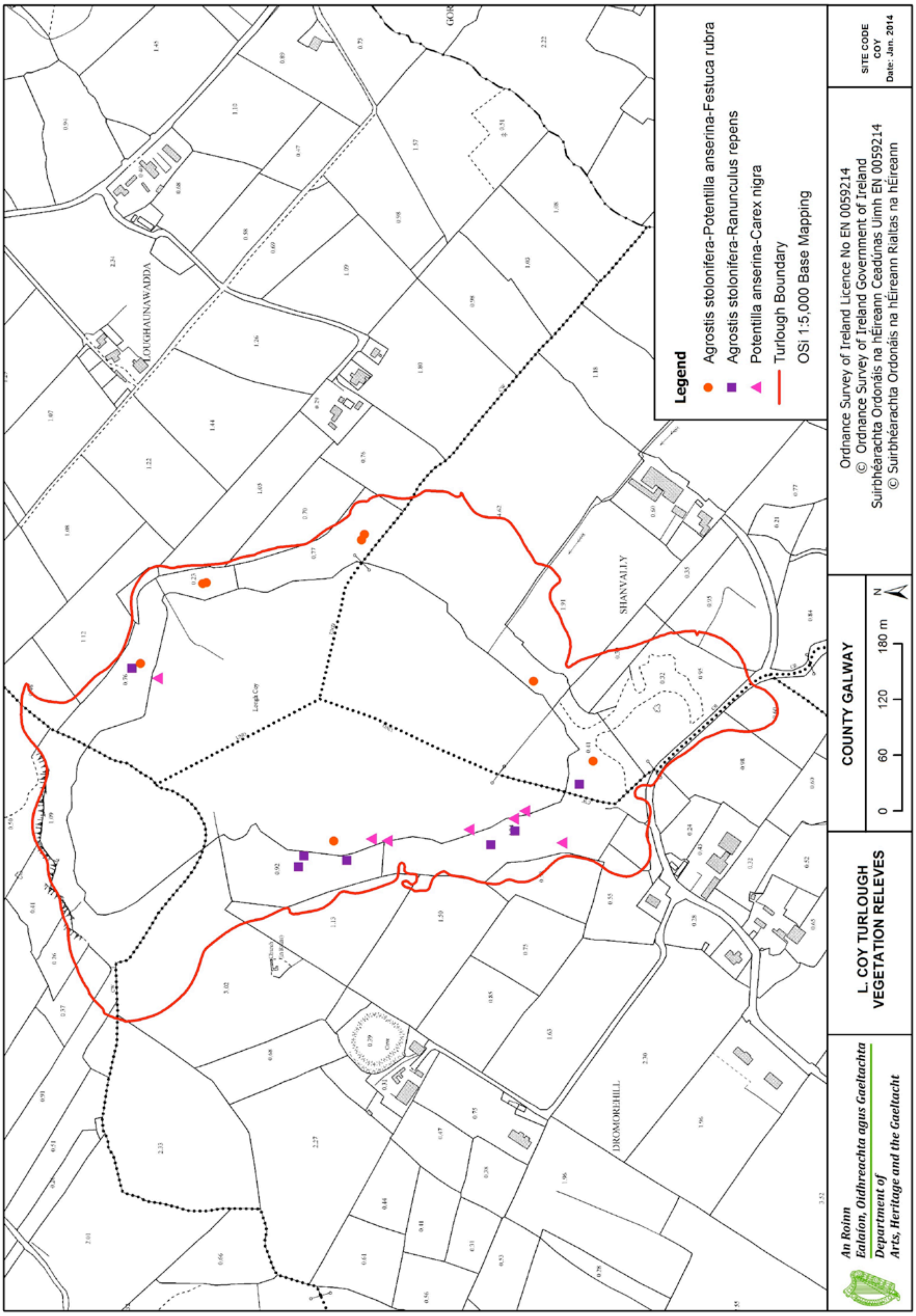
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Agrostis stolonifera-Potentilla anserina-Festuca rubra
Agrostis stolonifera-Ranunculus repens
Potentilla anserina-Carex nigra
Turlough Boundary
OSi 1:5,000 Base Mapping
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SITE CODE
COY
Date: Jan. 2014
COUNTY GALWAY
0 60 120 180 m
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L. COY TURLOUGH
VEGETATION RELEVES
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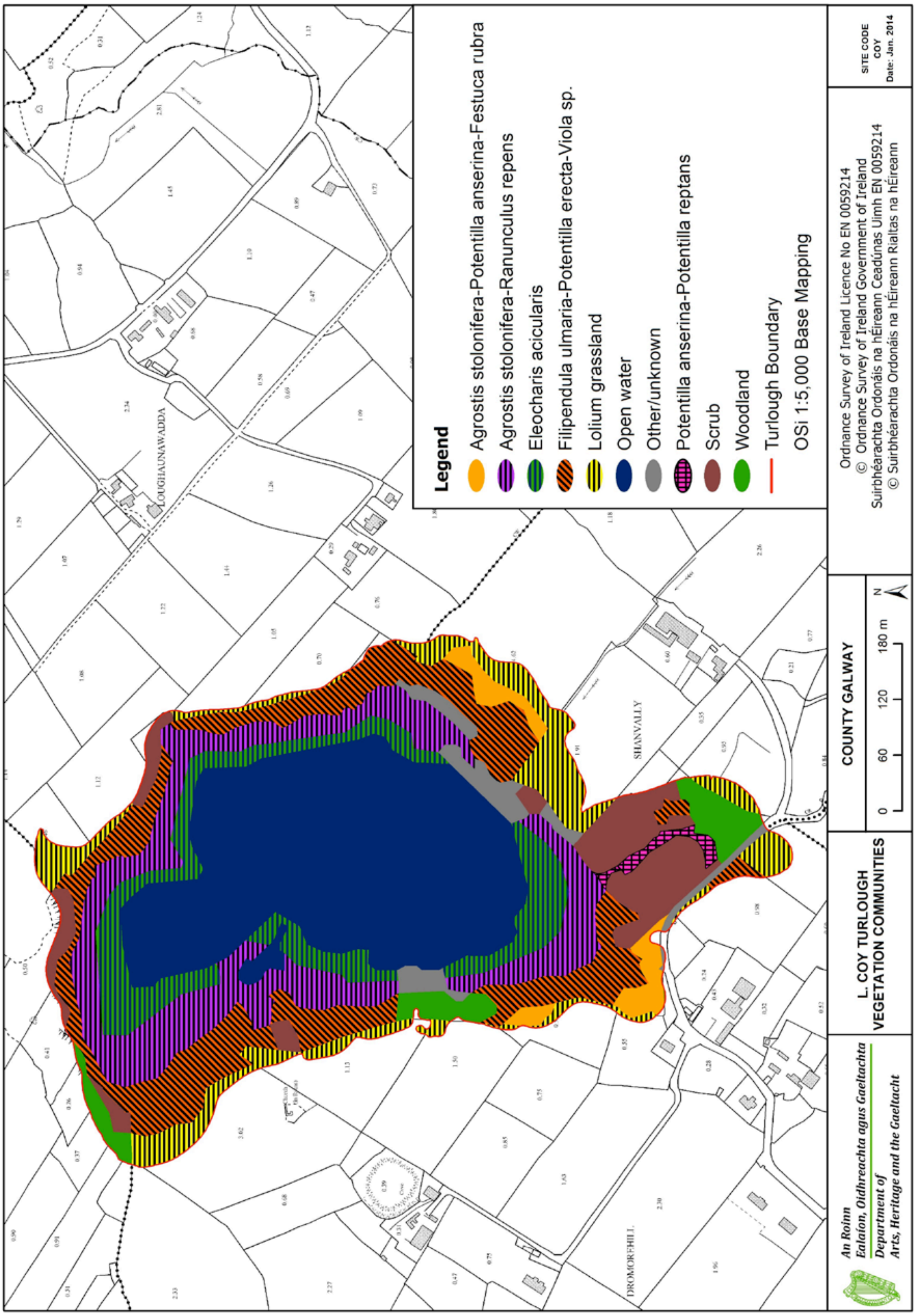
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht
LOUGHAUNAWADDA
SHANVALLY
DROMOREHILL
Lough Coy



Legend
Agrostis stolonifera-Potentilla anserina-Festuca rubra
Agrostis stolonifera-Ranunculus repens
Eleocharis acicularis
Filipendula ulmaria-Potentilla erecta-Viola sp.
Lolium grassland
Open water
Other/unknown
Potentilla anserina-Potentilla reptans
Scrub
Woodland
Turlough Boundary
OSi 1:5,000 Base Mapping
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SITE CODE
COY
Date: Jan. 2014
COUNTY GALWAY
0 60 120 180 m
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L. COY TURLOUGH
VEGETATION COMMUNITIES
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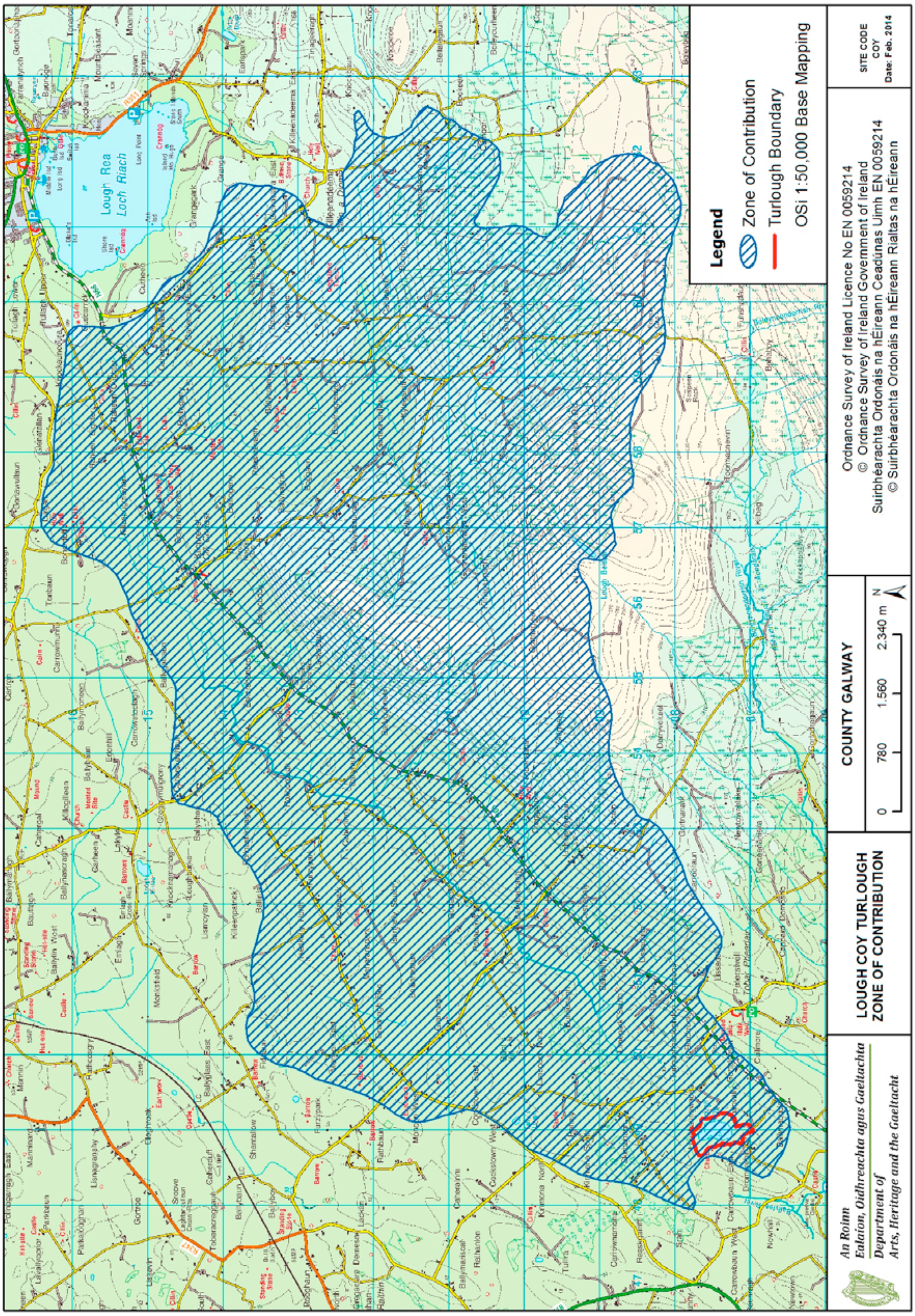
Department of
Arts, Heritage and the Gaeltacht
LOUGHAUNAWADDA
SHANVALLY
DROMOREHILL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Zone of Contribution
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SITE CODE
COY
Date: Feb. 2014
COUNTY GALWAY
0 780 1,560 2,340 m
N
LOUGH COY TURLOUGH
ZONE OF CONTRIBUTION
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht
Lough Rea
Loch Riach

Site Report: Lough Gealain Turlough
TCD Turlough Research project 2006-2011

Turlough Project Code	SAC Name	SAC/NHA No.	County	Townland	RBD	Easting	Northing	Area (ha)
GEA	East Burren Complex	001926	Clare	Gortlecka	SHANNON	131450	194730	37

File update: July 2015 (S. Waldren)

Site Description

Lough Gealain lies adjacent and to the north of Knockaunroe turlough, close to the base of Mullach Mor, Co. Clare. This turlough extends to 35.8 ha. The basin is very flat and lacks drift deposits, it is extremely calcareous with extensive marl. The northern area of the turlough retains permanent water and turlough area occurs along the southern end of the basin. Nine vegetation communities were mapped in Lough Gealain; the largest area was occupied by open water, and the flooded pavement community was the most abundant vegetation type. Some of the open water communities are dominated by very open *Phragmites australis* stands with a ground cover of *Littorella uniflora*. Stands of *Cladium mariscus* are also frequent. Lough Gealain soils are moderately alkaline and highly organic, with significant amounts of calcium carbonate. There are extensive areas of alluvial marl, and very shallow poorly-drained organic soils occupy the fringing areas. The hydrological data suggest that Lough Gealain has one major flooding event per annum, but many smaller peaks are also evident. This appears to be one of the most pristine turloughs, with no obvious pressures, and little if any nutrient enrichment.

Lough Gealain – photo: S. Waldren

Phytoplankton

Phytoplankton analysis was conducted on sub-samples of monthly spot samples collected for hydrochemical analysis between October 2006 and June 2007. Phytoplankton composition varies significantly over time and data from autumn, mid-winter and spring/early summer are presented below. Taxa were identified to species level where possible. Some taxa were not discriminated beyond general groupings (i.e. small centric diatoms, dinoflagellates and pinnate diatoms). The term non-identifiable alone (or n.i.) was reserved for cases where specimens were not identifiable. Discrimination between n.i. filament, n.i. flagellate, n.i. colony, n.i. green filament was made when applicable. Biovolume (mm^3 m^{-3}) was used as the measure of algal biomass.

October 2006		**January 2007**		**May 2007**	
Biovolume (mm^3/m^3)	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*
Dinobryon	7000	*n.i.*	35564	*Gomphonema*	134220
Cymbella/Encyonema	2723	*n.i. 'strange flagellate'*	20572	*n.i. green colonies*	24192
Oocystis solitaria	1916	*Cryptomonas*	3856	*Mougeotia*	22709
n.i. pennates	1361	*n.i. centrics*	1402	*Dinobryon*	19169
Chroomonas acuta	1164	*Cymbella/Encyonema*	889	*n.i. pennates*	18828

Benthic Algae

Turloughs were inspected for algal mats during the emptying phase in 2007, 2008 and 2009. Turloughs were visited in the first two weeks of March to June 2007 as part of the monthly monitoring of turloughs. Dedicated trips to inspect for algal mats were conducted in 2008 on the 4th of March, the 1st of April, and the 26th, 27th and 28th of May, and in 2009 on the 15th and 16th of June and on the 24th and 25th of July. The presence of both living floating mats and dead drying mats was noted, as well as their extent in the turlough basins. Occurrence of visible filamentous algal mats in the three years of observation is presented below. Y = visible occurrence; * = "extensive cover" (estimated to be 2 to 8% of total area of basin); † = negligible quantity observed; • = turlough was too flooded to permit full observation. No algal mats were observed in Lough Gealain between 2007 and 2009.

Year of Observation		
2007	**2008**	**2009**
N	N	N

Hydrochemistry

Data shown are the mean ± SD of monthly spot samples collected between October 2006 and June 2007. Mean seasonal Total P and Chlorophyll *a* were used to determine the trophic status of the floodwaters based on OECD trophic categories. The median and range of mean values across all turloughs are also provided.

Hydrochemical Variable	Lough Gealain Values		Turlough Summary Stats (n=22)		
	Mean±SD	OECD Trophic Category	Median	Min	Max
pH	8.2±0.1		8.1	7.7	8.3
Alkalinity mg l^{-1} $CaCO_3$	134.9±4.9		204.0	112.4	236.4
Colour mg l^{-1} PtCo	7.9±3.2		26.9	7.9	85.1
Molybdate Reactive Phosphorus µg l^{-1}	0.8±0.4		3.4	0.7	42.1
Total Phosphorus µg l^{-1}	4.0±1.2	Oligotrophic	24.8	4.0	82.1
Chlorophyll *a* µg l^{-1}	1.1±0.7	Oligotrophic	4.9	1.1	33.5
Nitrate-N mg l^{-1}	0.4±0.1		0.7	0.1	1.9
Total Nitrogen mg l^{-1}	0.6±0.2		1.2	0.6	2.3

Aquatic Invertebrates

22 turloughs were sampled for littoral aquatic macroinvertebrates using sweep nets during November 2006 and April 2007. Zooplankton samples were collected in April 2007. Open-water cladocerans and littoral chydorids were sampled using a zooplankton net and perspex tube respectively.

Aquatic Macroinvertebrates			
November 2006	**Count**	**April 2007**	**Count**
Agabus sp. (larva)	5	*Agabus* sp. (larva)	2
Anisoptera sp. (larva)	2	*Agyroneta aquatica*	2
Asellus aquaticus	1	*Caenis horaria*	3
Caenis horaria	3	Chironomidae	4
Culicidae	1	*Cloeon dipterum*	1
Euconulus alderi	1	*Cloeon simile*	32
Graptodytes bilineatus	3	Diptera Pupae	3
Hydroporus palustris	1	*Hydroporus obscurus*	1
Limnephilidae sp. Instar II	3	*Hydroporus palustris*	2
Limnephilidae sp. Instar III	4	*Hygrotus impressopunctatus*	1
Limnephilus lunatus	1	*Hygrotus inaequalis*	1
Lymnaea glabra	3	*Lymnaea trunculata*	1
Lymnaea trunculata	2	*Polycelis nigra/tenuis*	1
Oligochaeta	2	*Porhydrus lineatus*	11
Phacopteryx brevipennis	4	*Rhantus* sp. (larva)	1
		Succinea sp.	1
		Sympetrum sanguinem	2

Aquatic Macroinvertebrates:

Aquatic Macroinvertebrate Taxa	Presence of high abundances (>50)	
	November 2006	**April 2007**
Diptera	N	N
Ostracoda	N	N
Odonata	N	N
Trichoptera	N	N

Zooplankton species
Alona affinis
Alonella excisa
Alonopsis elongata
Chydorus globosus
Chydorus sphaericus
Daphnia pulex
Eurycercus lamellatus
Lathurona rectirostris
Pleuroxus laevis
Polyphemus pediculus
Simocephalus vetulus

Vegetation

Vegetation description and classification yielded 25 vegetation communities suitable for mapping. Nine vegetation communities were mapped in Lough Gealain, with flooded pavement being the major component, and good representation of important oligotrophic communities such as *Molinia caerulea-Carex panicea*, *Eleocharis palustris-Ranunculus flammula* and *Schoenus* fen. Some of the shallow water areas are dominated by very open *Phragmites australis* stands with a ground cover of *Littorella uniflora*. Stands of *Cladium mariscus* are also frequent. Several important species occur, including important stands of *Potentilla fruticosa*. High conservation value communities are denoted by *. 52 plant species were recorded; relatively few releves were recorded from Lough Gealain, but the species list has been supplemented with records from a brief site visit in July 2014.

Vegetation Community	Area (Ha)
**M. caerulea-C. panicea*	4.52
Carex nigra-R. flammula	0.23
Eleocharis palustris-R. flammula	3.41
*Flooded pavement	6.56
Limestone grassland	1.37
Open water	8.11
Other/unknown	4.83
Reedbed	0.41
Schoenus nigricans fen	2.37
Tall herb	0.2
Woodland/scrub	4.79
Number of vegetation communities	9
Number of plant species	52

Vascular Plant Species

Nomenclature follows Parnell, J & Curtis, T. (2012) *Webb's An Irish Flora*, University of Cork Press.

Agrostis stolonifera	*Festuca rubra*	*Potentilla erecta*
Angelica sylvatica	*Frangula alnus*	*Potentilla fruticosa*
Briza media	*Galium boreale*	*Prunella vulgaris*
Calluna vulgaris	*Galium palustre*	*Prunus spinosa*
Caltha palustris	*Galium verum*	*Ranunculus flammula*
Campanula rotundifolia	*Geranium sanguineum*	*Rhamnus cathartica*
Carex elata	*Juncus articulatus*	*Rhinanthus minor*
Carex flacca	*Juncus* cf. *subnodulosus*	*Rubus fruticosus* agg.
Carex hostiana	*Leontodon autumnalis*	*Rubus saxatilis*
Carex panicea	*Littorella uniflora*	*Salix repens*
Carex viridula agg.	*Lotus corniculatus*	*Samolus valerandi*
Cirsium dissectum	*Lythrum salicaria*	*Schoenus nigricans*
Cladium mariscus	*Mentha aquatica*	*Succisa pratensis*
Corylus avellana	*Molinia caerulea*	*Thymus praecox*
Dactylorhiza incarnata	*Parnassia palustris*	*Viburnum opulus*
Eleocharis cf multicaulis	*Phragmites australis*	*Viola* sp.
Eleocharis palustris	*Plantago maritima*	
Euphrasia sp.	*Potamageton natans*	

Soils and Grazing

Soils were classified using a modified version of soil categories generated by the Teagasc/EPA Soils and Subsoils Mapping project (Fealy *et al.*, 2009). The classification scheme principally uses parent material (calcareous/non-calcareous), depth class (shallow/deep) and drainage class (well drained/poorly drained) to assign soils to one of nine broad categories. L. Gealain has extensive areas of alluvial marl, with very shallow poorly-drained organic soils occupy the fringing areas. The mean ± SD of a range of soil properties are also provided, in addition to the median and range of each variable across turloughs. L. Gealain soils are moderately alkaline and highly organic, with significant amounts of calcium carbonate. Mean Total Nitrogen is towards the high end of the range for turloughs, while mean Total Phosphorus is towards the low end of the range. There was no grazing of this site by domestic livestock.

Soil Types/Grazing Extent	**% Turlough Area**
Very shallow poorly drained organic	48.7
Alluvial Marl	50.5
Extent of rotationally grazed area	0

Soil Property (n=6)	**Lough Gealain**	**Turlough Summary Stats (n=22)**		
	Mean ± SD	**Median**	**Min**	**Max**
pH	7.48 ± 0.8	7.20	5.94	8.29
% Organic Matter content	38.1 ± 18.3	25.8	10.2	69.1
% Inorganic content	41.9 ± 23.6	43.2	25.7	85.0
% Calcium carbonate content	20.0 ± 28.4	11.3	2.48	43.7
Total Nitrogen mg kg^{-1}	21917 ± 8630	11142	4983	24233
Total Phosphorus mg kg^{-1}	578 ± 220	905	245	1594

Hydrology

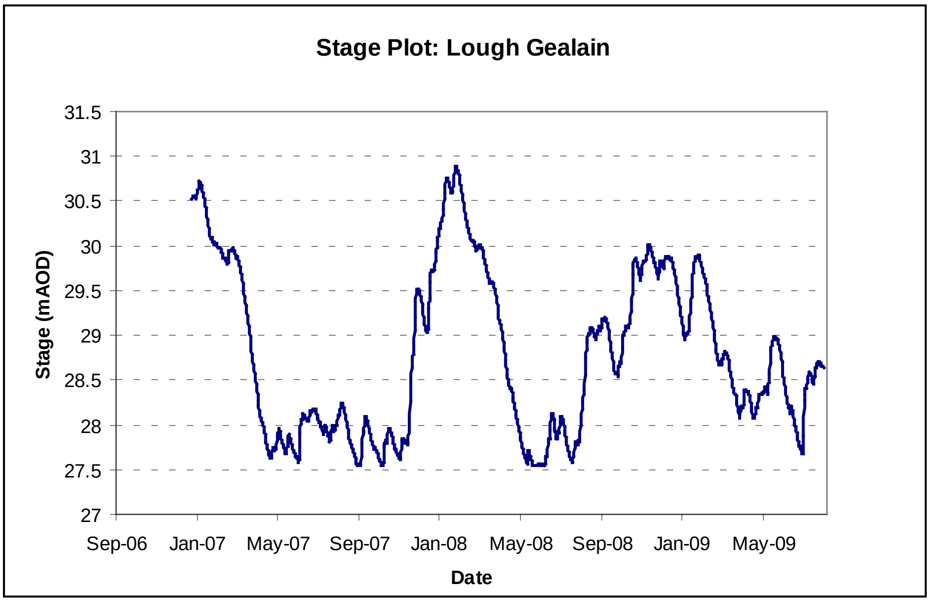
Water levels were recorded at hourly intervals using a variety of Schlumberger Divers® (Marton Geotechnical Ltd, Suffolk, UK) placed at or near the lowest point in each turlough. Divers measure the pressure of the water and air column above them, and from this the depth of water can be calculated. GPS surveys were carried out on 21 monitoring sites (Tullynafrankagh omitted) in order to develop digital terrain models (DTMs) from which contour maps, stage-volume and stage-surface area relationships are produced. The inflow magnitude is indicative of the properties of a turlough's catchment area and flow capacity, while outflow is a function of the drainage capacity of the system.

The hydrological data suggest that Lough Gealain has one major flooding event per annum, but many smaller peaks are also evident. Depths, inflow, outflow, drainage and recession duartion are all fairly average. There is permanent water at this site.

Lough Gealain is hydrologically linked with Knockaunroe, the base of which is slightly lower in elevation; water level changes at Knockaunroe lag about 24 hrs behind those in Lough Gealain (see *Chapter 2: Hydrology* for further details).

Hydrological Information	Lough Gealain Values	Turlough Summary Stats (n=21)		
		Median	Min	Max
Start of Hydrological Recording	11/01/2007	-	-	-
End of Hydrological Recording	05/08/2009	-	-	-
Days Recorded	937	-	-	-
Equipment Failure	None recorded	-	-	-
Hydroperiod (days)	212	213	135	348
Maximum Floodwater Depth (m)	4.9	4.9	3	15.4
Maximum Floodwater Volume ('000 m^3)	919.9	877.9	355.6	4008.1
Maximum Flooded Area (ha)	35.79	38.61	13.71	78.12
Average Basin Depth (m)	2.57	2.28	0.85	6.76
Average Daily Inflow (m^3 s^{-1})	0.844	0.684	0.254	10.253
Average Daily Outflow (m^3 s^{-1})	0.222	0.271	0.086	2.018
Drainage Capacity (m^3 s^{-1})	0.154	0.154	0.069	1.156
Recession Duration (days)	69.1	57.3	11	142.5

Stage plot for Lough Gealain



Zone of Groundwater Contribution (ZOC) Risk Assessments

GIS based risk assessments were conducted with a view to identifying turloughs at risk of failing to meet WFD water quality objectives. These risk assessments were conducted by Compass Informatics Ltd and were based on Risk Assessment Sheet GWDTERA2a (Guidance Document No. GW9) on assessing risks to turloughs from phosphate (Working Group on Groundwater 2004) and Pathway Susceptibilities and Pressure Magnitudes were integrated to produce Impact Potential maps and predicted Risk Categories for the turlough ZOC. The TCD Risk Category is derived from a revised Impact Potential matrix. The predicted Risk Categories were adjusted using mean seasonal floodwater Total P (μg l^{-1}) (see Section 4.5.4 of the Risk Assessment Sheet GWDTERA2a). The risk categories include 1A: at significant risk; 1B: probably at significant risk; 2A: Not at significant risk (low confidence); 2B: Not at significant risk (higher confidence).

ZOC Area (Km^2)	Predicted WFD Risk Category	Adjusted WFD Risk Category	Predicted TCD Risk Category	Adjusted TCD Risk Category
14	1B	1B	1B	1B

ZOC Pressure Variable	
CORINE BARE ROCK %	62
CORINE PEAT BOGS%	0
CORINE ALL NATURAL AND SEMI-NATURAL AREAS%	7
CORINE IMPROVED PASTURE%	25
CORINE UNIMPROVED PASTURE%	0
CORINE ALL PASTURE%	25
CORINE OTHER AGRICULTURAL LANDS%	4
TEAGASC/EPA HABITATS ROCK%	60
TEAGASC/EPA HABITATS BOGS/PEATS%	0
TEAGASC/EPA HABITATS FORESTS/SCRUBS%	2
TEAGASC/EPA HABITATS WATER%	1
TEAGASC/EPA HABITATS DRY GRASSLAND%	36
TEAGASC/EPA HABITATS WET GRASSLAND%	1
TEAGASC TOTAL GRASSLAND%	0
TOTAL LIVESTOCK UNIT/ha of ZOC	0
TILLAGE%	2
No. SEPTIC TANKS km^{-2} ZOC	2
No. SEPTIC TANKS km^{-2} EXTREME PATHWAY SUSCEPTIBILITY	0
HIGH PATHWAY SUSCEPTIBILITY%	83
EXTR+HIGH PATHWAY SUSCEPTIBILITY%	98
WELL DRAINED SOIL %	1
POORLY DRAINED SOIL%	62

Site Conservation Assessment

The following site conservation assessment was undertaken to feed into the national reporting structure for assessing conservation status as required under Article 17 of the Habitats Directive. A suite of indicators and associated targets were derived to assess ecological structure and function. Future prospects were assessed through the evaluation of the impact of current and recent pressures and likely future threats to the site. The assessment follows a rules based approach to determine whether Structures & functions and Future Prospects should be assessed as good (green), inadequate (amber) or bad (red). For further details, see Chapter 10 (Conservation Status Assessment).

Please note an updated approach to assessing site condition has been proposed and is outlined in Chapter 12 (Monitoring Methods for Turloughs).

Conservation Condition Summary

Structure & Function	**Favourable**
Future Prospects	**Favourable**
Site Conservation Condition	**Favourable**

Structure and Function Status:

Indicator	*Comments*
Hydrological Function: *Good*	
Water Quality: *Very Good*	4.0 µg P l^{-1}. Extremely low mean water TP, bordering on ultra-oligotrophic
Biological Responses: *Very Good*	
Algal communities: 0	No algal mats recorded, low max CHL
Vegetation communities: 2	Exceptionally high cover of positive indictors (over 96%), no negative indicators
***Rumex* cover: 1**	Absent
Important plants: 2	*Potentilla fruticosa, Frangula alnus, Plantago maritima*
Important aquatic invertebrates: 2	*Alonella exisa, Alanopsis elongata, Graptodytes bilineatus*
Overall Structure & Function: *Good*	

Pressures: exceptionally, no recorded pressures were identified for this site. It is not grazed by domestic stock, and has exceptionally good water quality.

Threats:

Code	*Impact*	*Notes*
A02.01 Agricultural intensification (ZOC)	L	Possible threat in ZOC, but likely to be very limited
H02.06 Diffuse groundwater pollution due to agricultural and forestry activities (ZOC)	L	Likely low impact pressure
M01.03 Flooding and rising precipitations	L	
H02.07 Diffuse groundwater pollution due to non-sewered population (ZOC)	L	Likely low impact pressure

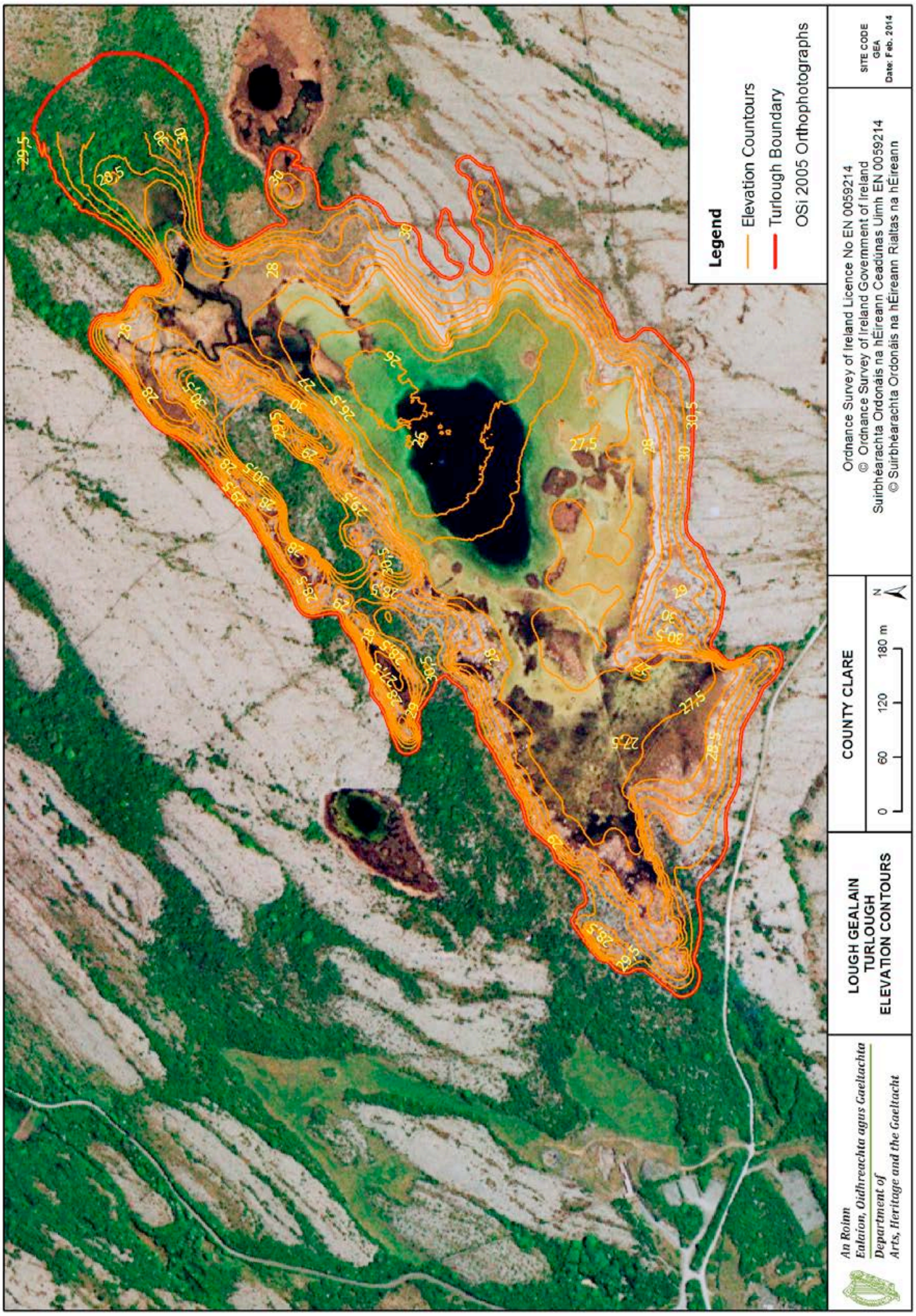
Future Prospects: **Favourable** – some low impact threats are possible, some of these are generic across all turloughs

Overall Assessment: **Favourable** – appears to be in excellent ecological condition and is of outstanding conservation importance, of international significance. However, any increase in groundwater nutrients is likely to affect ecological function and therefore groundwater nutrients should be monitored regularly.

Maps

Maps are provided of:

1. Elevation contours, based on GIS digital terrain models from points by differential GPS topographic survey (for further details, see *Chapter 3: Hydrology*)
2. Grazing in land parcels
3. Approximate sampling points for water chemistry and aquatic invertebrates
4. Soil nutrient sampling points
5. Points for soil survey (note: soils were surveyed to the turlough boundary defined by the maximum recorded flood level; see hydrology above and *Chapter 3: Hydrology*)
6. Soils (note: soils were mapped by combining the EPA Subsoils base map with the point soil descriptions; for further details see *Chapter 6: Soils and Landuse*)
7. Vegetation relevés
8. Vegetation communities (note: relevés do not always match to mapped communities due to small scale variation; for further details of mapping see *Chapter 7: Turlough Vegetation: Description, Mapping and Ecology*)
9. Estimated zone of groundwater contribution (ZOC)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Elevation Countours
Turlough Boundary
OSi 2005 Orthophotographs
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GEA
Date: Feb. 2014
COUNTY CLARE
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N
LOUGH GEALAIN
TURLOUGH
ELEVATION CONTOURS
An Roinn
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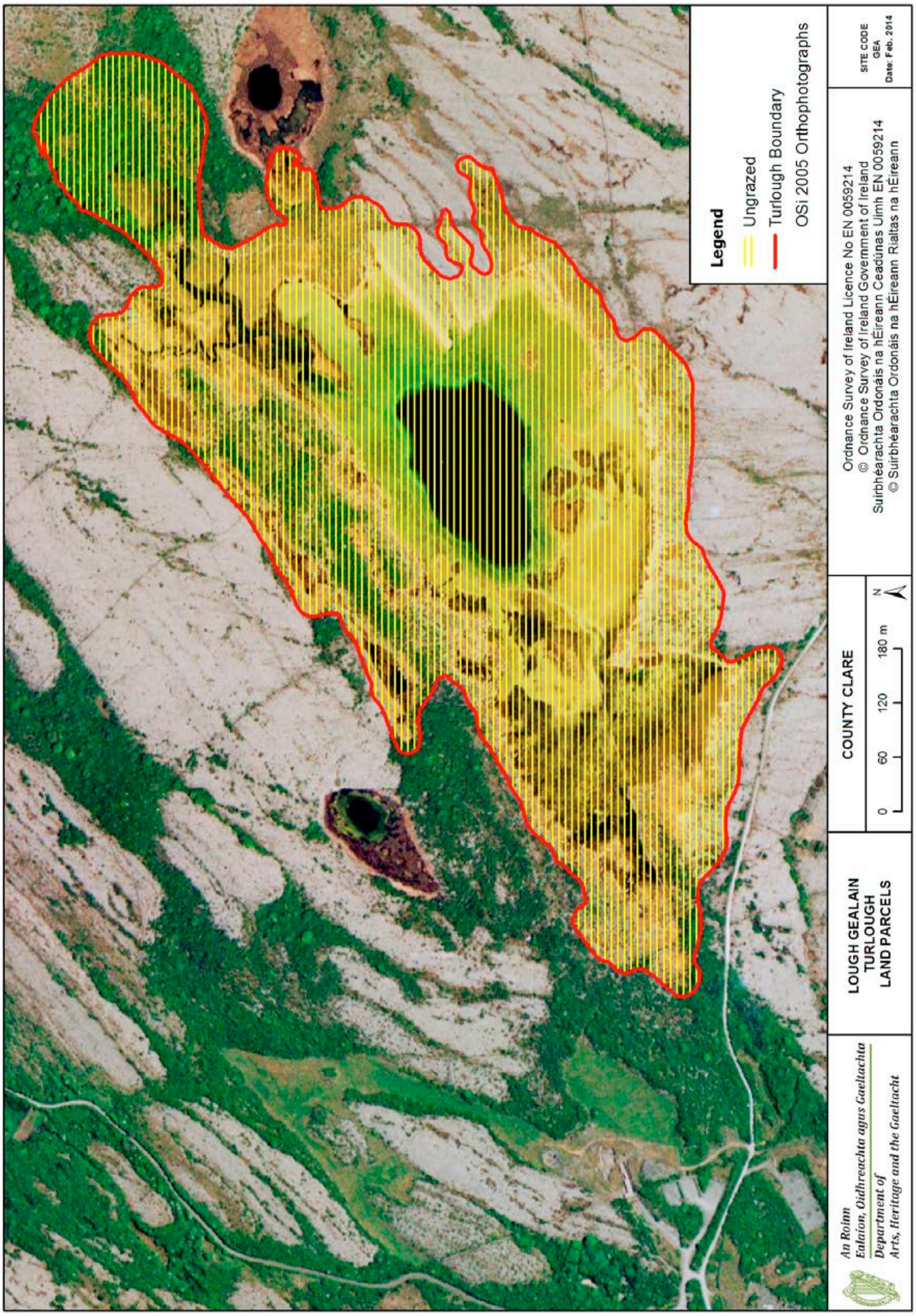
Department of
Arts, Heritage and the Gaeltacht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Turlough Boundary
OSi 2005 Orthophotographs
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Date: Feb. 2014
COUNTY CLARE
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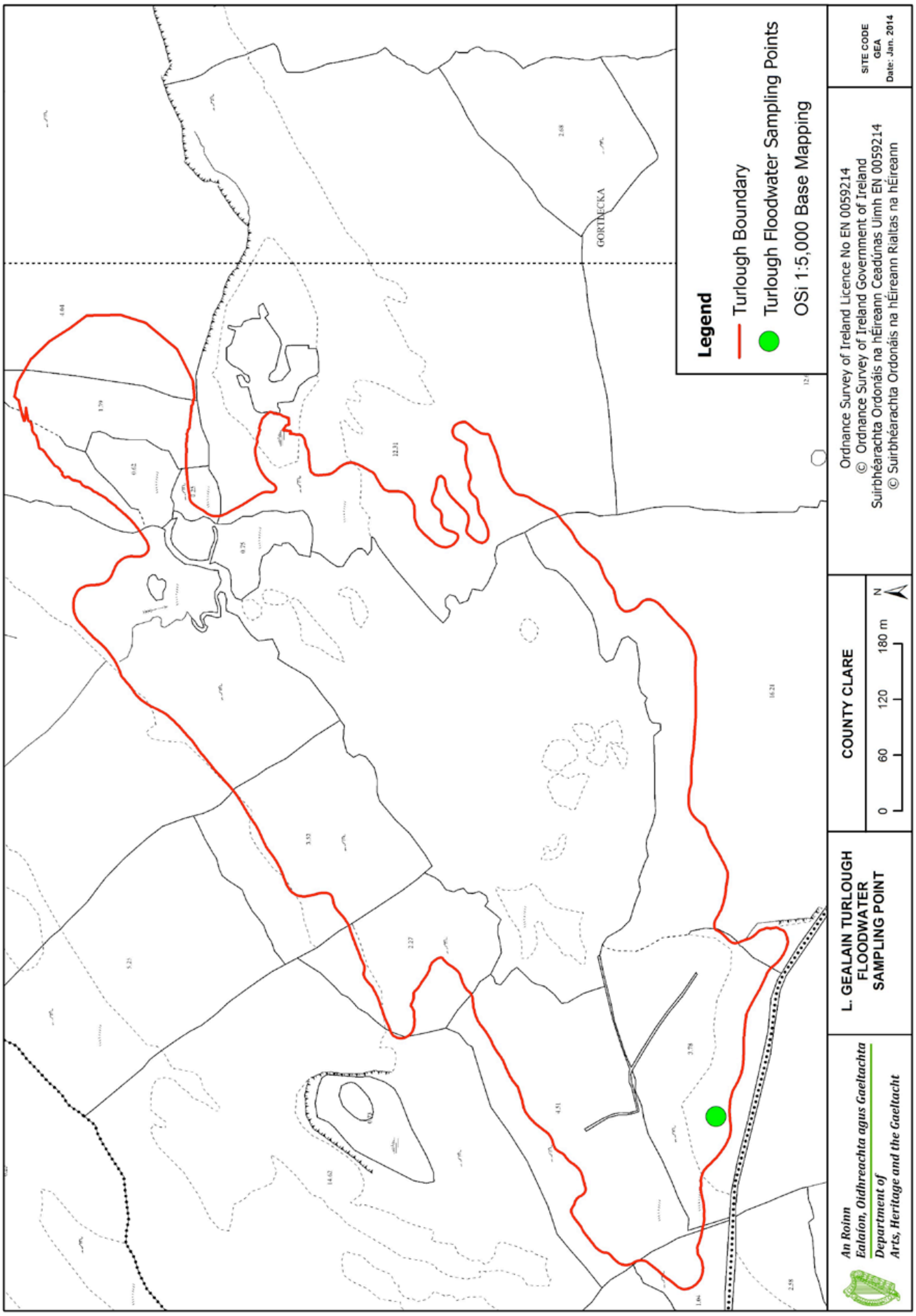
TURLOUGH
LAND PARCELS
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht



L. GEALAIN TURLOUGH FLOODWATER SAMPLING POINT
COUNTY CLARE
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N
SITE CODE GEA
Date: Jan. 2014
Legend
Turlough Boundary
Turlough Floodwater Sampling Points
OSi 1:5,000 Base Mapping
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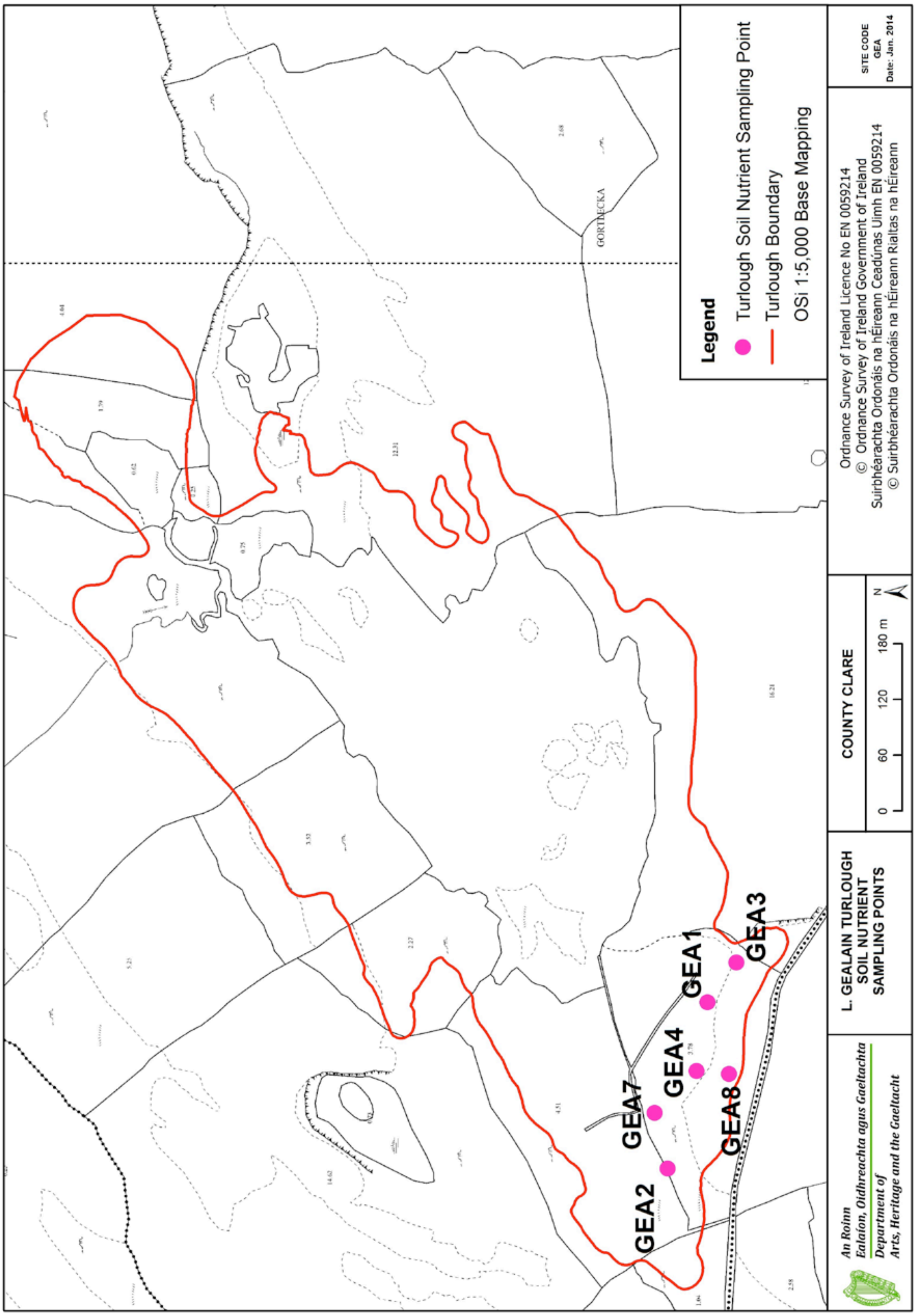
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Turlough Soil Nutrient Sampling Point
Turlough Boundary
OSi 1:5,000 Base Mapping
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SITE CODE
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Date: Jan. 2014
COUNTY CLARE
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L. GEALAIN TURLOUGH
SOIL NUTRIENT
SAMPLING POINTS
An Roinn
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Arts, Heritage and the Gaeltacht
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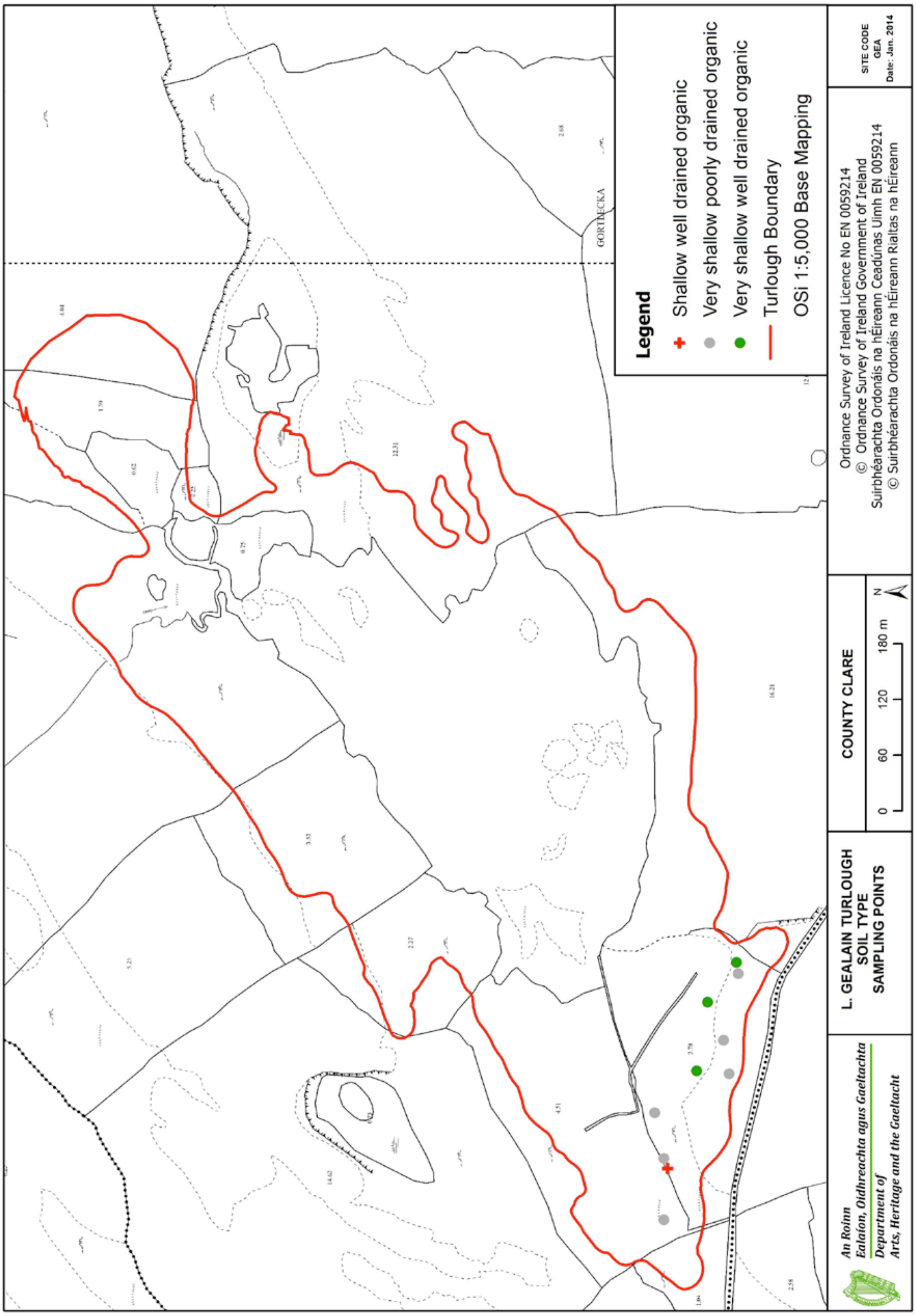
Legend
Shallow well drained organic
Very shallow poorly drained organic
Very shallow well drained organic
Turlough Boundary
OSi 1:5,000 Base Mapping
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Date: Jan. 2014
COUNTY CLARE
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L. GEALAIN TURLOUGH
SOIL TYPE
SAMPLING POINTS
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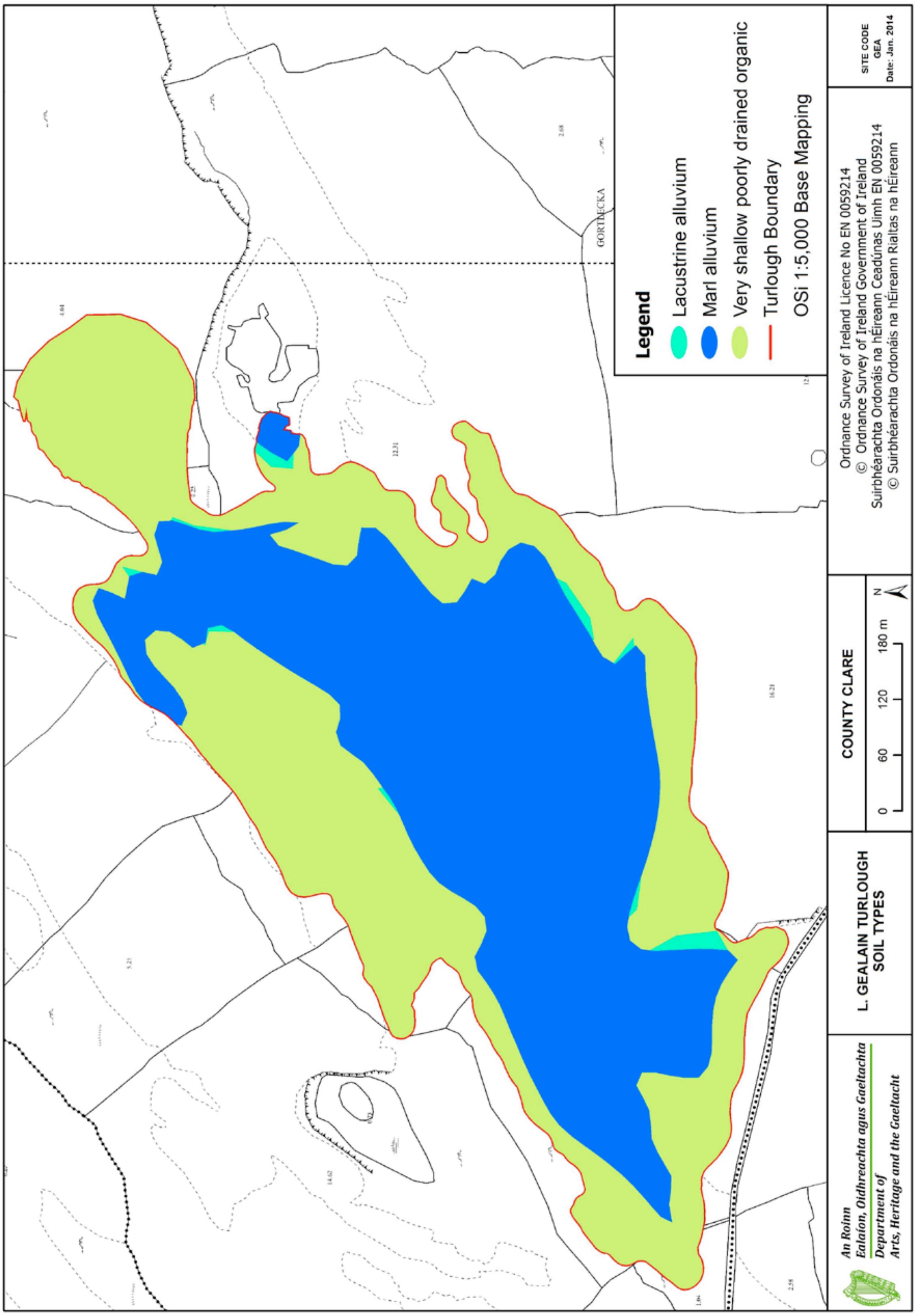
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Lacustrine alluvium
Marl alluvium
Very shallow poorly drained organic
Turlough Boundary
OSi 1:5,000 Base Mapping
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COUNTY CLARE
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L. GEALAIN TURLOUGH
SOIL TYPES
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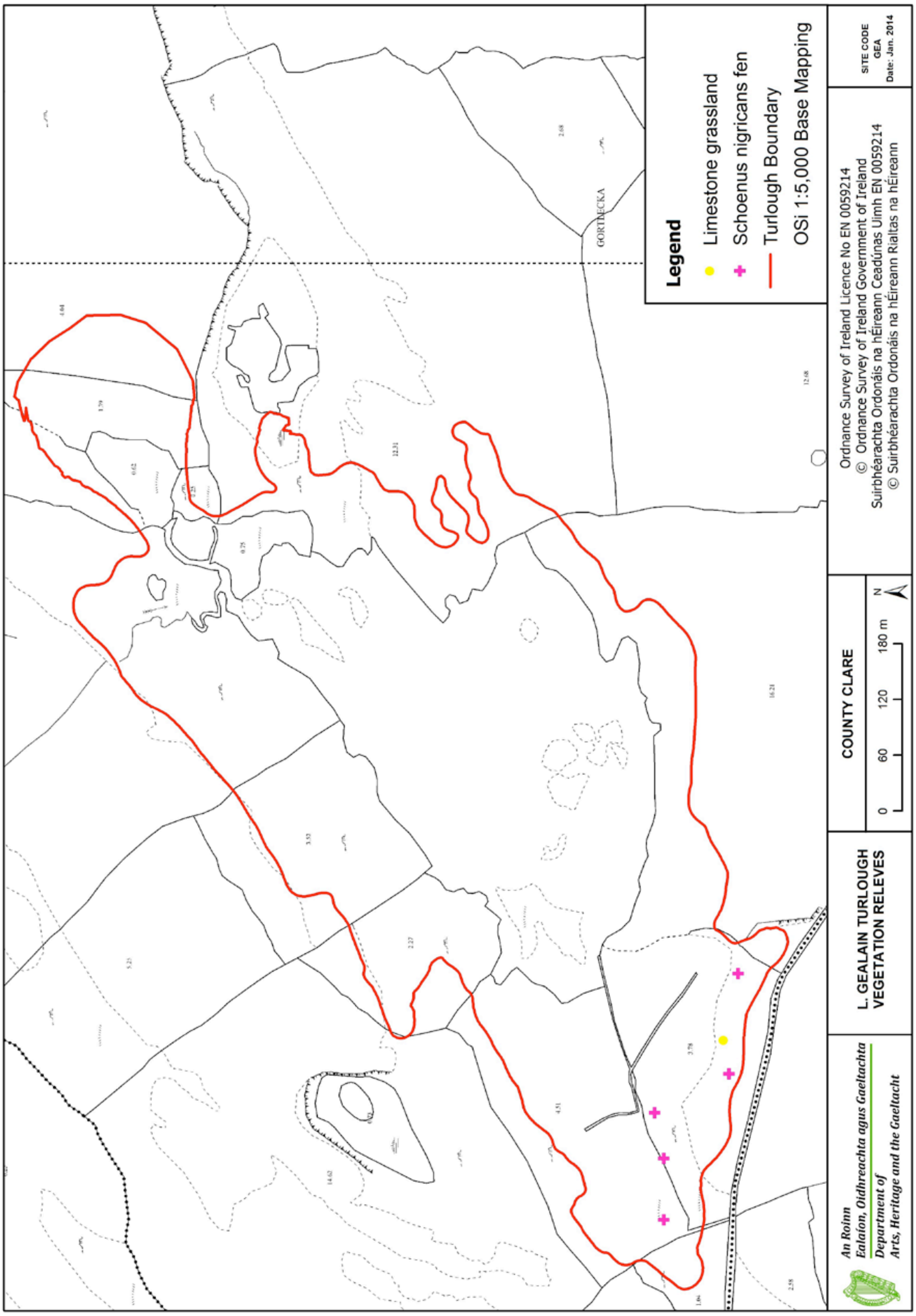
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Limestone grassland
Schoenus nigricans fen
Turlough Boundary
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GEA
Date: Jan. 2014
COUNTY CLARE
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L. GEALAIN TURLOUGH
VEGETATION RELEVES
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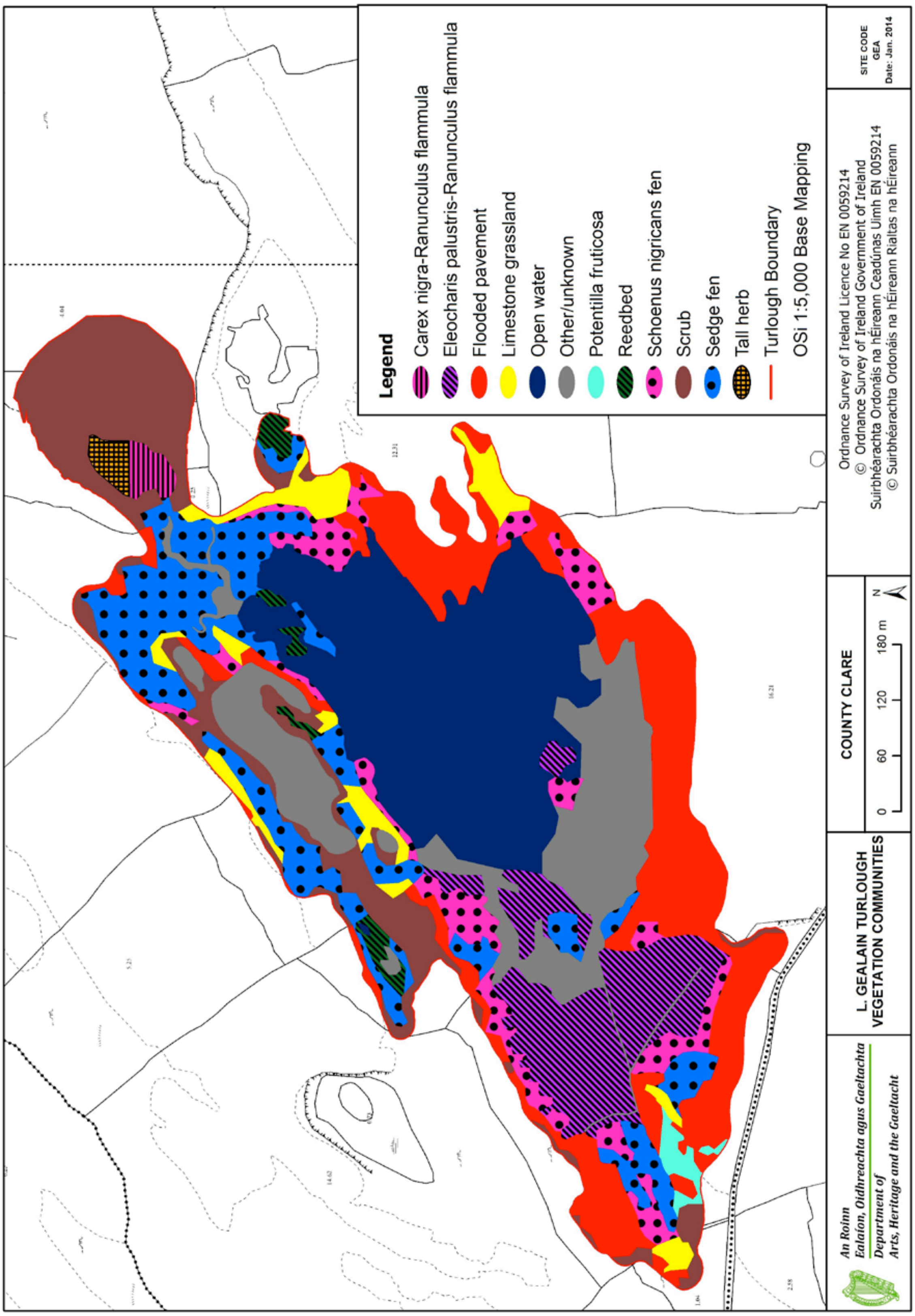
Legend
Carex nigra-Ranunculus flammula
Eleocharis palustris-Ranunculus flammula
Flooded pavement
Limestone grassland
Open water
Other/unknown
Potentilla fruticosa
Reedbed
Schoenus nigricans fen
Scrub
Sedge fen
Tall herb
Turlough Boundary
OSi 1:5,000 Base Mapping
SITE CODE
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COUNTY CLARE
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L. GEALAIN TURLOUGH
VEGETATION COMMUNITIES
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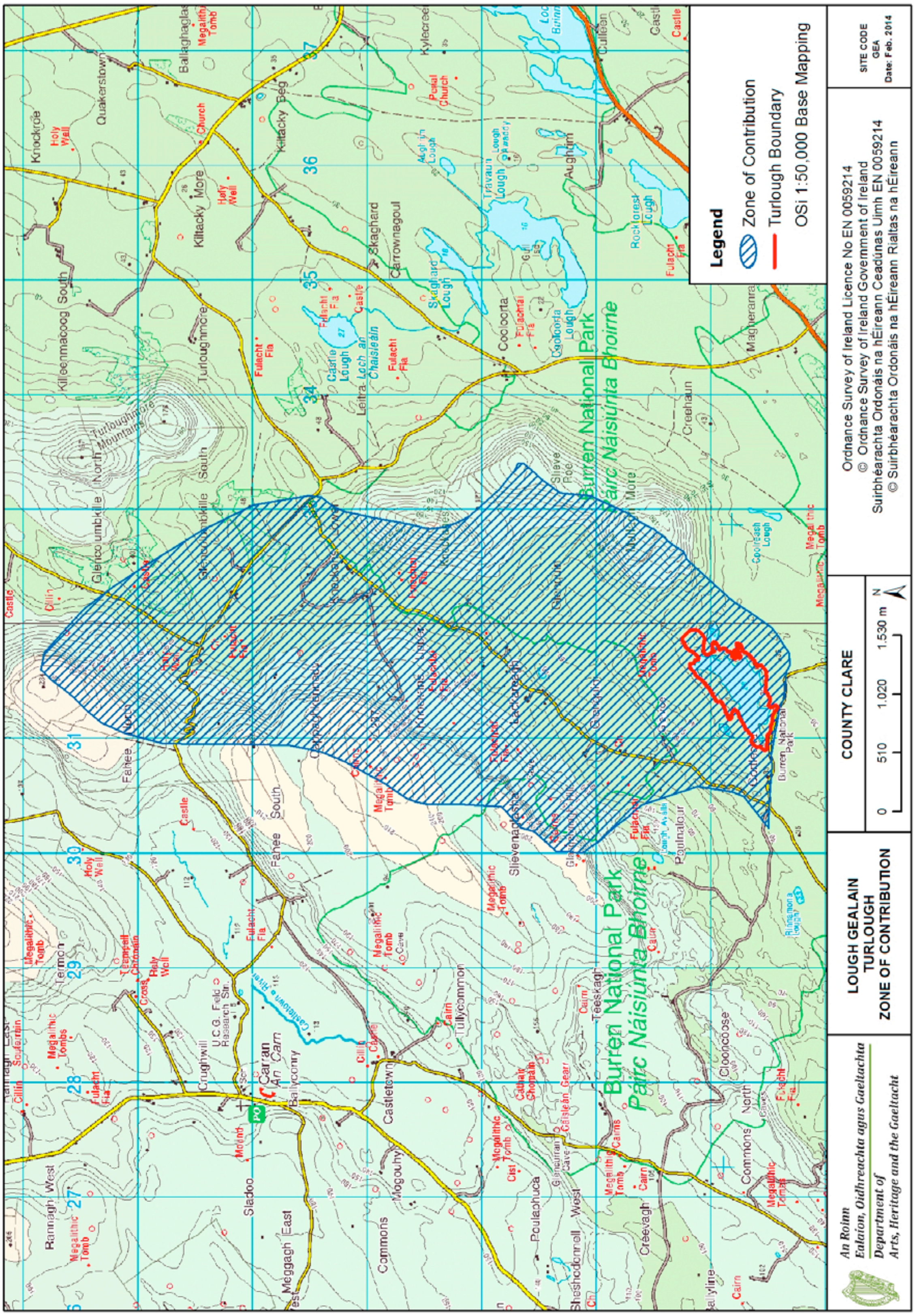
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Zone of Contribution
Turlough Boundary
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Date: Feb. 2014
COUNTY CLARE
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LOUGH GEALAIN
TURLOUGH
ZONE OF CONTRIBUTION
An Roinn
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Department of
Arts, Heritage and the Gaeltacht
Burren National Park
Pairc Naisiunta Bhoirne

Site Report: Rathnalulleagh Turlough
TCD Turlough Research project 2006-2011

Turlough Project Code	SAC Name	SAC/NHA No.	County	Townland	RBD	Easting	Northing	Area (ha)
RAT	Non-SAC	000613	Roscommon	Rathnalulleagh	SHANNON	177710	273760	46

File update: June 2015 (S. Waldren)

Site Description

Rathnalluleagh turlough, which has NHA rather than SAC status, occurs in central Co. Roscommon just south of Carrowreagh and Brierfield turloughs. The flat-floored basin is surrounded by grassy ridges. A narrow arm extends to the north-west from the main basin area. Only six vegetation types were mapped at the site; *Filipendula ulmaria-Potentilla erecta-Viola* sp. was the predominant vegetation type. Rathnalluleagh has extensive areas of mineral soil types. The soils are moderately acidic with low amounts of calcium carbonate. 'Shallow well drained mineral' and 'Shallow poorly drained mineral' were the two dominant soil types. All of the turlough area is under rotational grazing. The hydrological data indicate that this turlough is relatively quick to flood and drain and there may be more than one major flood event per annum. There is evidence of heavy grazing or agricultural improvement having altered the vegetation since Goodwillie's survey (1992).

Rathnalulleagh – photo: S. Kimberley

Phytoplankton

Phytoplankton analysis was conducted on sub-samples of monthly spot samples collected for hydrochemical analysis between October 2006 and June 2007. Phytoplankton composition varies significantly over time and data from autumn, mid-winter and spring/early summer are presented below. Taxa were identified to species level where possible. Some taxa were not discriminated beyond general groupings (i.e. small centric diatoms, dinoflagellates and pinnate diatoms). The term non-identifiable alone (or n.i.) was reserved for cases where specimens were not identifiable. Discrimination between n.i. filament, n.i. flagellate, n.i. colony, n.i. green filament was made when applicable. Biovolume (mm^3 m^{-3}) was used as the measure of algal biomass.

October 2006		**January 2007**		**May 2007**	
Biovolume (mm^3/m^3)	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*
Tribonema	*2983709*	*Cryptomonas*	*630627*	*Dinobryon*	*8715892*
Synedra	*2101491*	*Eunotia bilunaris*	*138741*	*Oedogonium*	*771435*
Chlamydomonas	*839174*	*n.i. centrics*	*107899*	*Eunotia faba*	*382052*
Staurastrum punctulatum	*289863*	*Eunotia faba*	*100061*	*Oedogonium*	*330132*
Cryptomonas	*179403*	*n.i. dinoflagellate*	*60960*	*n.i. pennates*	*224175*

Benthic Algae

Turloughs were inspected for algal mats during the emptying phase in 2007, 2008 and 2009. Turloughs were visited in the first two weeks of March to June 2007 as part of the monthly monitoring of turloughs. Dedicated trips to inspect for algal mats were conducted in 2008 on the 4th of March, the 1st of April, and the 26th, 27th and 28th of May, and in 2009 on the 15th and 16th of June and on the 24th and 25th of July. The presence of both living floating mats and dead drying mats was noted, as well as their extent in the turlough basins. Occurrence of visible filamentous algal mats in the three years of observation is presented below. Y = visible occurrence; * = "extensive cover" (estimated to be 2 to 8% of total area of basin); † = negligible quantity observed; • = turlough was too flooded to permit full observation. Algal mats were observed in Rathnalulleagh in 2007.

Year of Observation		
2007	**2008**	**2009**
Y	N	N

Hydrochemistry

Data shown are the mean ± SD of monthly spot samples collected between October 2006 and June 2007. Mean seasonal Total P and Chlorophyll *a* were used to determine the trophic status of the floodwaters based on OECD trophic categories. The median and range of <u>mean values</u> across all turloughs are also provided.

Hydrochemical Variable	Ardkill Values		Turlough Summary Stats (n=22)		
	Mean±SD	OECD Trophic Category	Median	Min	Max
pH	8.1±0.1		8.1	7.7	8.3
Alkalinity mg l^{-1} $CaCO_3$	236.4±38.9		204.0	112.4	236.4
Colour mg l^{-1} PtCo	28.3±6.5		26.9	7.9	85.1
Molybdate Reactive Phosphorus µg l^{-1}	3.4±1.9		3.4	0.7	42.1
Total Phosphorus µg l^{-1}	44.6±22.0	Eutrophic	24.8	4.0	82.1
Chlorophyll *a* µg l^{-1}	33.5±36.5	Hypereutrophic	4.9	1.1	33.5
Nitrate-N mg l^{-1}	0.7±0.5		0.7	0.1	1.9
Total Nitrogen mg l^{-1}	1.3±0.5		1.2	0.6	2.3

Aquatic Invertebrates

22 turloughs were sampled for littoral aquatic macroinvertebrates using sweep nets during November 2006 and April 2007. Zooplankton samples were collected in April 2007. Open-water cladocerans and littoral chydorids were sampled using a zooplankton net and perspex tube respectively.

Aquatic Macroinvertebrates			
November 2006	**Count**	**April 2007**	**Count**
Agabus nebulosus	1	*Agabus* sp. (larva)	12
Agabus sp. (larva)	5	Chironomidae	12
Agyroneta aquatica	1	*Cloeon dipterum*	2
Chironomidae	5	*Corixa iberica*	3
Lymnaea truncúlata	24	Diptera Pupae	6
Oligochaeta	21	*Dryops* sp (larva)	1
Ostracoda	37	*Hydrachnidia* (Mite)	1
		Laccophilus sp (larva)	1
		Lymnaea peregra	1
		Lymnaea trunculata	6
		Nemoura cinerea	5
		Notonecta glauca	1
		Oligochaeta	54
		Planorbis planorbis	6
		Polycelis nigra/tenuis	2
		Psychodidae	1
		Rhantus sp. (larva)	2
		Succinea sp.	2
		Tipulidae	5

Aquatic Macroinvertebrates:

Aquatic Macroinvertebrate Taxa	Presence of high abundances (>50)	
	November 2006	**April 2007**
Diptera	N	N
Ostracoda	N	N
Odonata	N	N
Trichoptera	N	N

Zooplankton species
Chydorus sphaericus
Daphnia pulex
Peracantha truncata

Vegetation

Vegetation description and classification yielded 25 vegetation communities suitable for mapping. Six vegetation communities were mapped in Rathnalulleagh, with the *Filipendula ulmaria-Potentilla erecta-Viola* sp. community the predominant vegetation type; though widespread, this community may only occur in turloughs. There was also a high proportion of *Lolium* grassland. High conservation value communities are denoted by *. Seventy-nine vascular plant species were recorded.

Vegetation Community	Area (Ha)
Agrostis stolonifera-Potentilla anserina-Festuca rubra	2.1
Carex nigra-Carex panicea	0.84
**Filipendula ulmaria-P. erecta-Viola sp.*	17.5
Lolium grassland	6.4
Open water	0.01
Potentilla anserina-P. reptans	0.31
Tall herb	1.8
Number of vegetation communities	6
Number of plant species	79

Vascular Plant Species

Nomenclature follows Parnell, J & Curtis, T. (2012) *Webb's An Irish Flora*, University of Cork Press.

Achillea millefolium	*Filipendula ulmaria*	*Poa pratensis*
Agrostis capillaris	*Galium palustre*	*Polygonum aviculare*
Agrostis stolonifera	*Galium verum*	*Polygonum persicaria*
Alopecurus geniculatus	*Geum rivale*	*Potentilla anserina*
Bellis perennis	*Glyceria fluitans*	*Potentilla erecta*
Caltha palustris	*Gnaphalium uliginosum*	*Potentilla reptans*
Cardamine flexuosa	*Holcus lanatus*	*Prunella vulgaris*
Cardamine pratensis	*Hypochaeris radicata*	*Ranunculus acris*
Carex disticha	*Iris pseudacorus*	*Ranunculus repens*
Carex flacca	*Juncus acutiflorus*	*Ranunculus trichophyllus*
Carex hirta	*Juncus articulatus*	*Rorippa amphibia*
Carex nigra	*Juncus conglomeratus*	*Rorippa palustris*
Carex panicea	*Juncus effusus*	*Rumex acetosa*
Carex viridula ssp. viridula	*Leontodon autumnalis*	*Rumex crispus*
Centaurea nigra	*Leontodon hispidus*	*Senecio aquaticus*
Cerastium fontanum	*Leontodon saxatilis*	*Stellaria graminea*
Cirsium arvense	*Lolium perenne*	*Stellaria media*
Cirsium palustre	*Lotus corniculatus*	*Stellaria palustris*
Cynosurus cristatus	*Molinia caerulea*	*Succisa pratensis*
Dactylis glomerata	*Myosotis scorpioides*	*Trifolium pratense*
Deschampsia cespitosa	*Phalaris arundinacea*	*Trifolium repens*
Eleocharis palustris	*Phleum bertolonii*	*Urtica dioica*
Elymus repens	*Phleum pratense*	*Valeriana officinalis*
Festuca arundinacea	*Plantago lanceolata*	*Veronica catenata*
Festuca ovina	*Plantago major*	*Veronica scutellata*
Festuca pratensis	*Poa annua*	*Vicia cracca*
Festuca rubra		

Soils and Grazing

Soils were classified using a modified version of soil categories generated by the Teagasc/EPA Soils and Subsoils Mapping project (Fealy *et al.*, 2009). The classification scheme principally uses parent material (calcareous/non-calcareous), depth class (shallow/deep) and drainage class (well drained/poorly drained) to assign soils to one of nine broad categories. Rathnalulleagh has extensive areas of mineral soil types. The mean ± SD of a range of soil properties are also provided, in addition to the median and range of each variable across turloughs. Rathnalulleagh soils are moderately acidic and mineral, with low amounts of calcium carbonate.

Soil Types/Grazing Extent	% Turlough Area
Very shallow well drained mineral	2
Shallow well drained mineral	35.6
Shallow poorly drained mineral	62.4
Extent of rotationally grazed area	100

Soil Property (n=6)	Rathnalulleagh	Turlough Summary Stats (n=22)		
	Mean ± SD	Median	Min	Max
pH	6.23 ± 0.6	7.20	5.94	8.29
% Organic Matter content	18.4 ± 6.8	25.8	10.2	69.1
% Inorganic content	78.0 ± 8.3	43.2	25.7	85.0
% Calcium carbonate content	3.55 ± 1.5	11.3	2.48	43.7
Total Nitrogen mg kg^{-1}	7958 ± 3572	11142	4983	24233
Total Phosphorus mg kg^{-1}	713 ± 352	905	245	1594

Hydrology

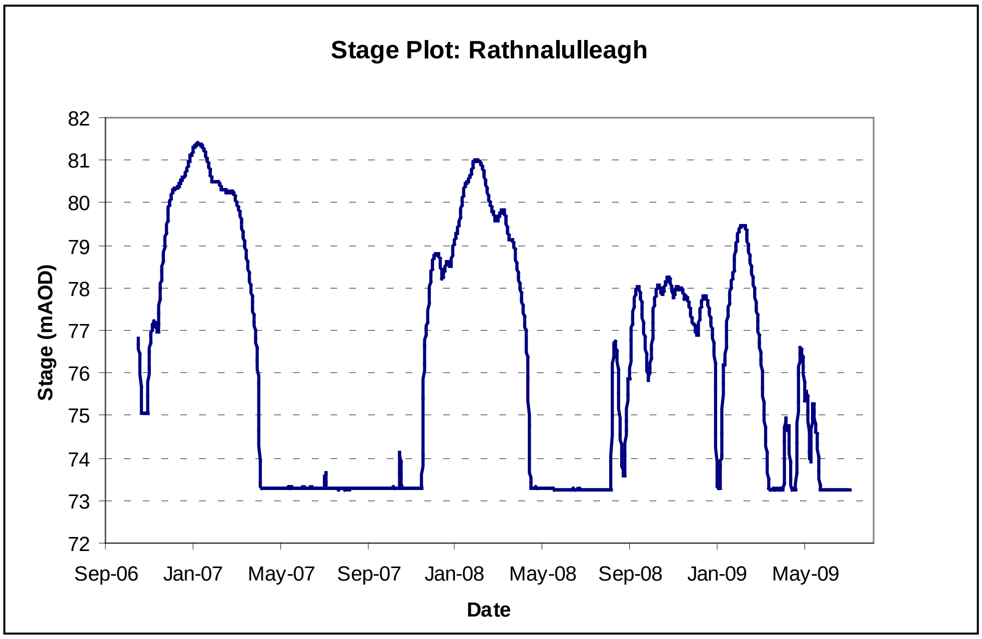
Water levels were recorded at hourly intervals using a variety of Schlumberger Divers® (Marton Geotechnical Ltd, Suffolk, UK) placed at or near the lowest point in each turlough. Divers measure the pressure of the water and air column above them, and from this the depth of water can be calculated. GPS surveys were carried out on 21 monitoring sites (Tullynafrankagh omitted) in order to develop digital terrain models (DTMs) from which contour maps, stage-volume and stage-surface area relationships are produced. The inflow magnitude is indicative of the properties of a turlough's catchment area and flow capacity, while outflow is a function of the drainage capacity of the system.

The hydrological data indicate that this turlough is relatively quick to flood and drain and there may be more than one major flood event per annum. The turlough is relatively deep.

Rathnalulleagh shows close hydrological linkage with Carrowreagh and to some extent Brierfield. Brierfield is the upper-most turlough of the three, with Rathnalulleagh at the lowest elevation. Carrowreagh and Rathnalulleagh show very similar water level profiles, with Rathnalulleagh lagging Carrowreagh; the much shallower Brierfield shows similar peak flood times to Carrowreagh but is likely to belong to a different system.

Hydrological Information	Rathnalulleagh	Turlough Summary Stats (n=21)		
		Median	Min	Max
Start of Hydrological Recording	04/11/2006	-	-	-
End of Hydrological Recording	08/07/2009	-	-	-
Days Recorded	977	-	-	-
Equipment Failure	None recorded	-	-	-
Hydroperiod (days)	175	213	135	348
Maximum Floodwater Depth (m)	8.2	4.9	3	15.4
Maximum Floodwater Volume ('000 m^3)	877.9	877.9	355.6	4008.1
Maximum Flooded Area (ha)	29.46	38.61	13.71	78.12
Average Basin Depth (m)	2.98	2.28	0.85	6.76
Average Daily Inflow ($m^3 s^{-1}$)	0.461	0.684	0.254	10.253
Average Daily Outflow ($m^3 s^{-1}$)	0.325	0.271	0.086	2.018
Drainage Capacity ($m^3 s^{-1}$)	0.239	0.154	0.069	1.156
Recession Duration (days)	42.4	57.3	11	142.5

Stage plot for Rathnalulleagh turlough



Zone of Groundwater Contribution (ZOC) Risk Assessments

GIS based risk assessments were conducted with a view to identifying turloughs at risk of failing to meet WFD water quality objectives. These risk assessments were conducted by Compass Informatics Ltd and were based on Risk Assessment Sheet GWDTERA2a (Guidance Document No. GW9) on assessing risks to turloughs from phosphate (Working Group on Groundwater 2004) and Pathway Susceptibilities and Pressure Magnitudes were integrated to produce Impact Potential maps and predicted Risk Categories for the turlough ZOC. The TCD Risk Category is derived from a revised Impact Potential matrix. The predicted Risk Categories were adjusted using mean seasonal floodwater Total P (μg l^{-1}) (see Section 4.5.4 of the Risk Assessment Sheet GWDTERA2a). The risk categories include 1A: at significant risk; 1B: probably at significant risk; 2A: Not at significant risk (low confidence); 2B: Not at significant risk (higher confidence).

ZOC Area (Km^2)	Predicted WFD Risk Category	Adjusted WFD Risk Category	Predicted TCD Risk Category	Adjusted TCD Risk Category
20	2B	1A	1B	1A

ZOC Pressure Variable	
CORINE BARE ROCK %	0
CORINE PEAT BOGS%	0
CORINE ALL NATURAL AND SEMI-NATURAL AREAS%	0
CORINE IMPROVED PASTURE%	48
CORINE UNIMPROVED PASTURE%	48
CORINE ALL PASTURE%	96
CORINE OTHER AGRICULTURAL LANDS%	4
TEAGASC/EPA HABITATS ROCK%	0
TEAGASC/EPA HABITATS BOGS/PEATS%	1
TEAGASC/EPA HABITATS FORESTS/SCRUBS%	0
TEAGASC/EPA HABITATS WATER%	0
TEAGASC/EPA HABITATS DRY GRASSLAND%	89
TEAGASC/EPA HABITATS WET GRASSLAND%	11
TEAGASC TOTAL GRASSLAND%	1
TOTAL LIVESTOCK UNIT/ha of ZOC	0
TILLAGE%	6
No. SEPTIC TANKS km^{-2} ZOC	6
No. SEPTIC TANKS km^{-2} EXTREME PATHWAY SUSCEPTIBILITY	0
HIGH PATHWAY SUSCEPTIBILITY%	36
EXTR+HIGH PATHWAY SUSCEPTIBILITY%	62
WELL DRAINED SOIL %	38
POORLY DRAINED SOIL%	0

Site Conservation Assessment

The following site conservation assessment was undertaken to feed into the national reporting structure for assessing conservation status as required under Article 17 of the Habitats Directive. A suite of indicators and associated targets were derived to assess ecological structure and function. Future prospects were assessed through the evaluation of the impact of current and recent pressures and likely future threats to the site. The assessment follows a rules based approach to determine whether Structures & functions and Future Prospects should be assessed as good (green), inadequate (amber) or bad (red). For further details, see Chapter 10 (Conservation Status Assessment).

Please note an updated approach to assessing site condition has been proposed and is outlined in Chapter 12 (Monitoring Methods for Turloughs).

Conservation Condition Summary

Structure & Function	**Inadequate**
Future Prospects	**Inadequate**
Site Conservation Condition	**Inadequate**

Structure and Function Status:

Indicator	***Comments***
Hydrological Function: *Good*	
Water Quality: *Intermediate*	44.6 µg P l^{-1}. High within this category, approaching bad status
Biological Responses: *Intermediate*	
Algal communities: -1	Algal mats were recorded only n 207 though they were not extensive, but max CHL was high
Vegetation communities: 1	High cover of positive indictors (mainly the *Filipendula/Potentilla/Viola community*), moderate cover of negative indicators (mostly *Lolium* grassland); relatively uniform
***Rumex* cover: 0**	30.7%
Important plants: 1	*Viola persicifolia*
Important aquatic invertebrates: 0	None recorded
Overall Structure & Function: *Inadequate*	

Pressures:

Code	Impact	Notes
H02.06 Diffuse groundwater pollution due to agricultural and forestry activities (ZOC)	M	Moderate to high nutrient levels in groundwater likely due to agricultural inputs
A04.01.01 Intensive cattle grazing (turlough)	M	Moderate grazing levels over the whole of the turlough
A05.02 Stock feeding (within and adjacent to turlough)	L	Some evidence of stock feeding adjacent to the turlough
H02.07 Diffuse groundwater pollution due to non-sewered population (ZOC)	L	Relatively low level of septic tanks on high vulnerability pathways

Threats:

Code	Impact	Notes
H02.06 Diffuse groundwater pollution due to agricultural and forestry activities (ZOC)	M	Ongoing pressure
A04.01.01 Intensive cattle grazing (turlough)	M	Ongoing pressure
J02.05 Modification of hydrographic functioning, general (=drainage in turlough)	M	Likely threat as Rathnalulleagh not in a designated SAC
A02.03 Grassland removal for arable land (ZOC)	L	Likely threat in the ZOC due to pasture/grassland cover in ZOC
A05.02 Stock feeding (turlough and immediately adjacent)	L	Lack of SAC designation likely means that this will continue
A02.01 Agricultural intensification (ZOC)	L	Likely threat in the ZOC due to pasture/grassland cover in ZOC
M01.03 Flooding and rising precipitations	L	
A10.02 Removal of stone walls and embankments (in turlough)	L	
A04.03 Abandonment of pastoral systems, lack of grazing (ZOC)	L	Possible threat given the high productivity of the system and the communities present; fairly unlikely given the current grazing level

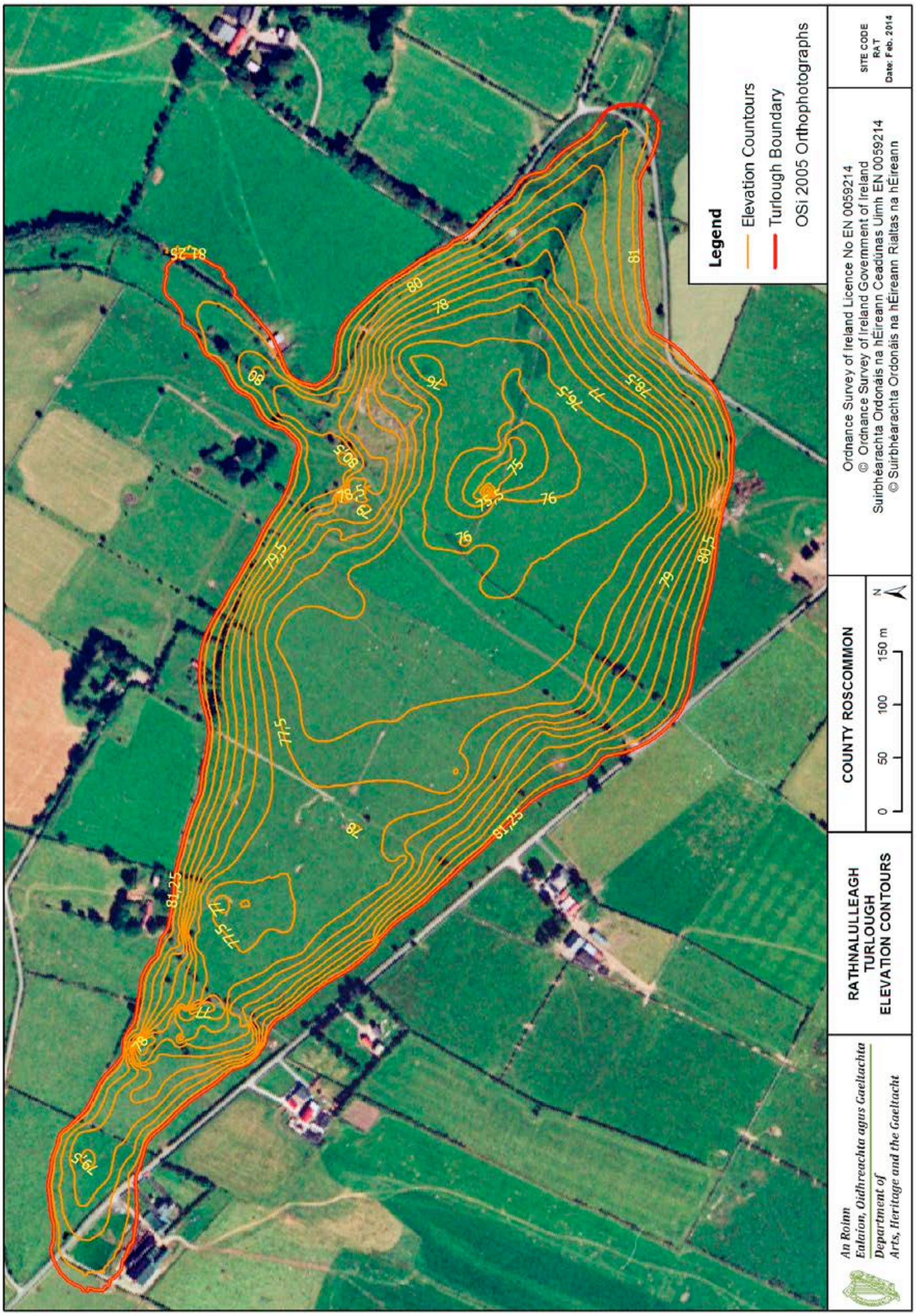
Future Prospects: **Inadequate –** moderate levels of threat. Lack of SAC designation may mean limited mitigation of these threats.

Overall Assessment: **Inadequate** – while the ecological conditions are average, the current pressures are moderate; however, lack of SAC designation means that many pressures will continue or will likely increase. Designation within an SAC and management of grazing and nutrient inputs could help improve the status of the turlough; however, the relative lack of biological interest probably places the site on a lower conservation priority.

Maps

Maps are provided of:

1. Elevation contours, based on GIS digital terrain models from points by differential GPS topographic survey (for further details, see *Chapter 3: Hydrology*)
2. Grazing in land parcels
3. Approximate sampling points for water chemistry and aquatic invertebrates
4. Soil nutrient sampling points
5. Points for soil survey (note: soils were surveyed to the turlough boundary defined by Goodwillie, 1992; see map 9)
6. Soils (note: soils were mapped by combining the EPA Subsoils base map with the point soil descriptions; for further details see *Chapter 6: Soils and Landuse*)
7. Vegetation relevés
8. Vegetation communities (note: relevés do not always match to mapped communities due to small scale variation; for further details of mapping see *Chapter 7: Turlough Vegetation: Description, Mapping and Ecology*)
9. Vegetation maps digitised from Goodwillie, R. (1992) *Turlough's Over 50 Hectares*. Report to NPWS
10. Estimated zone of groundwater contribution (ZOC)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Elevation Countours
Turlough Boundary
OSi 2005 Orthophotographs
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SITE CODE
RAT
Date: Feb. 2014
COUNTY ROSCOMMON
0
50
100
150 m
N
RATHNALULLEAGH
TURLOUGH
ELEVATION CONTOURS
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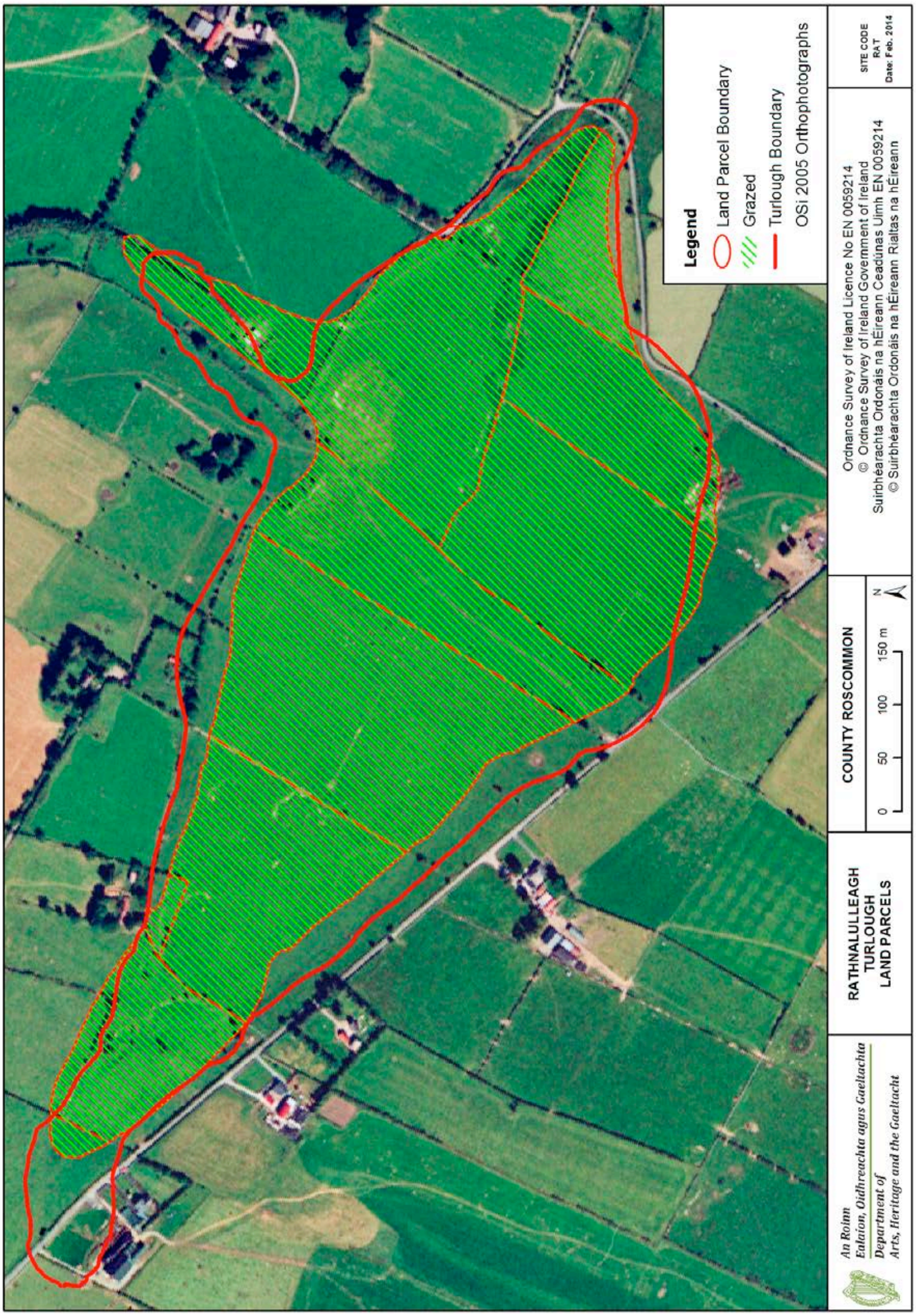
Legend
Land Parcel Boundary
Grazed
Turlough Boundary
OSi 2005 Orthophotographs
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Date: Feb. 2014
COUNTY ROSCOMMON
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RATHNALULLEAGH
TURLOUGH
LAND PARCELS
An Roinn
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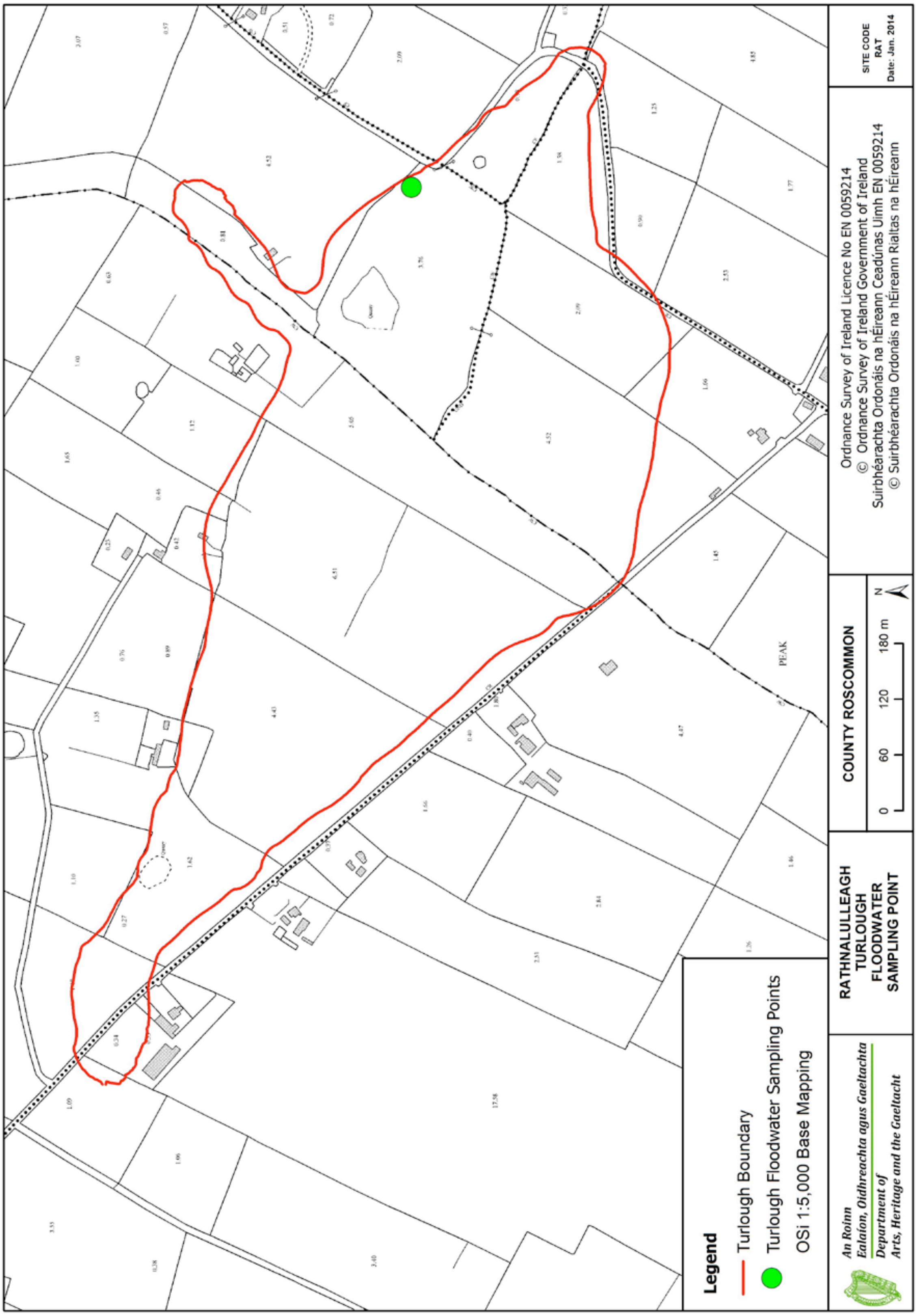

Legend
Turlough Boundary
Turlough Floodwater Sampling Points
OSi 1:5,000 Base Mapping
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RATHNALULLEAGH
TURLOUGH
FLOODWATER
SAMPLING POINT
COUNTY ROSCOMMON
0 60 120 180 m
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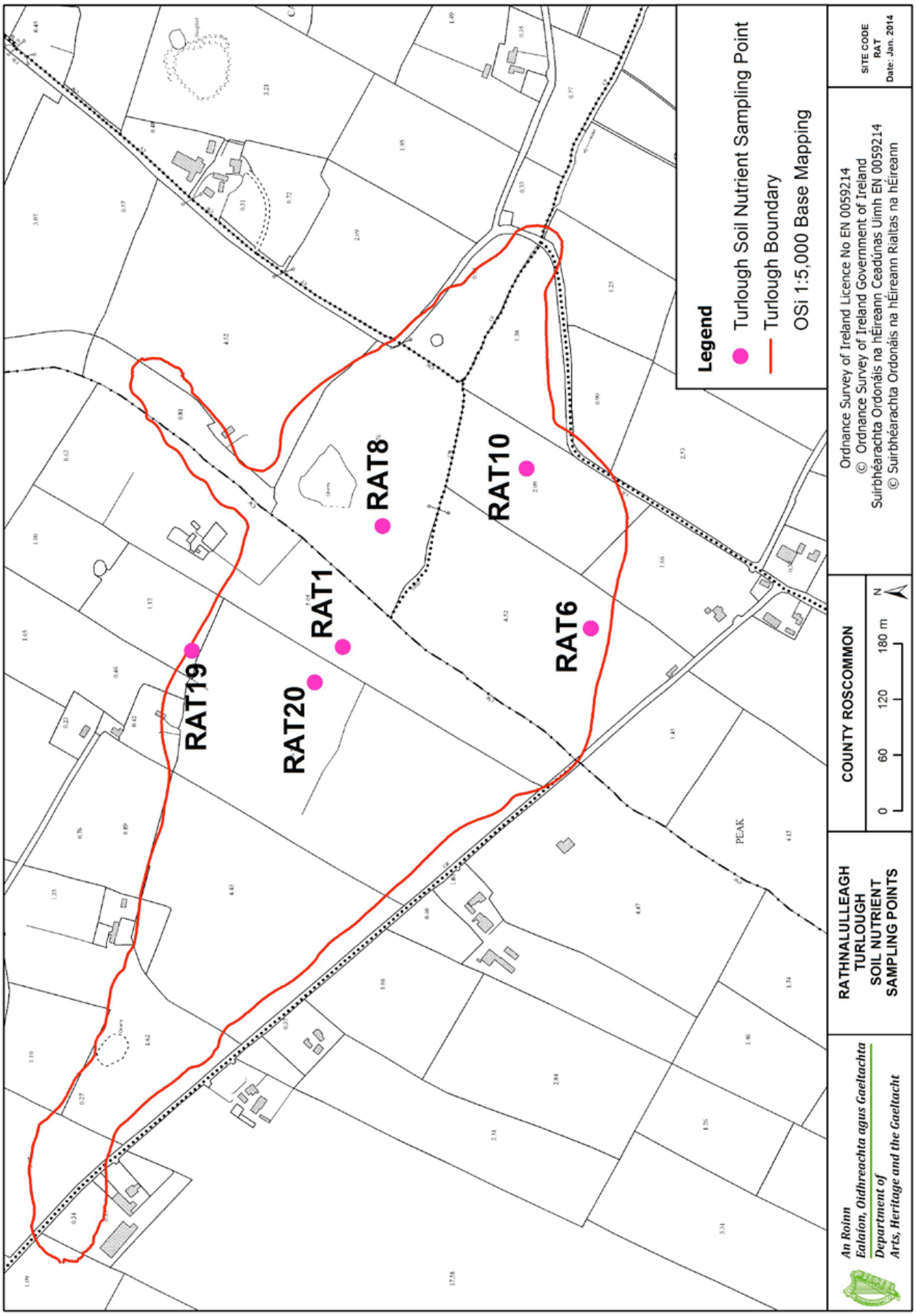
Legend
Turlough Soil Nutrient Sampling Point
Turlough Boundary
OSi 1:5,000 Base Mapping
RAT8
RAT10
RAT1
RAT6
RAT19
RAT20
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RAT
Date: Jan. 2014
COUNTY ROSCOMMON
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RATHNALULLEAGH
TURLOUGH
SOIL NUTRIENT
SAMPLING POINTS
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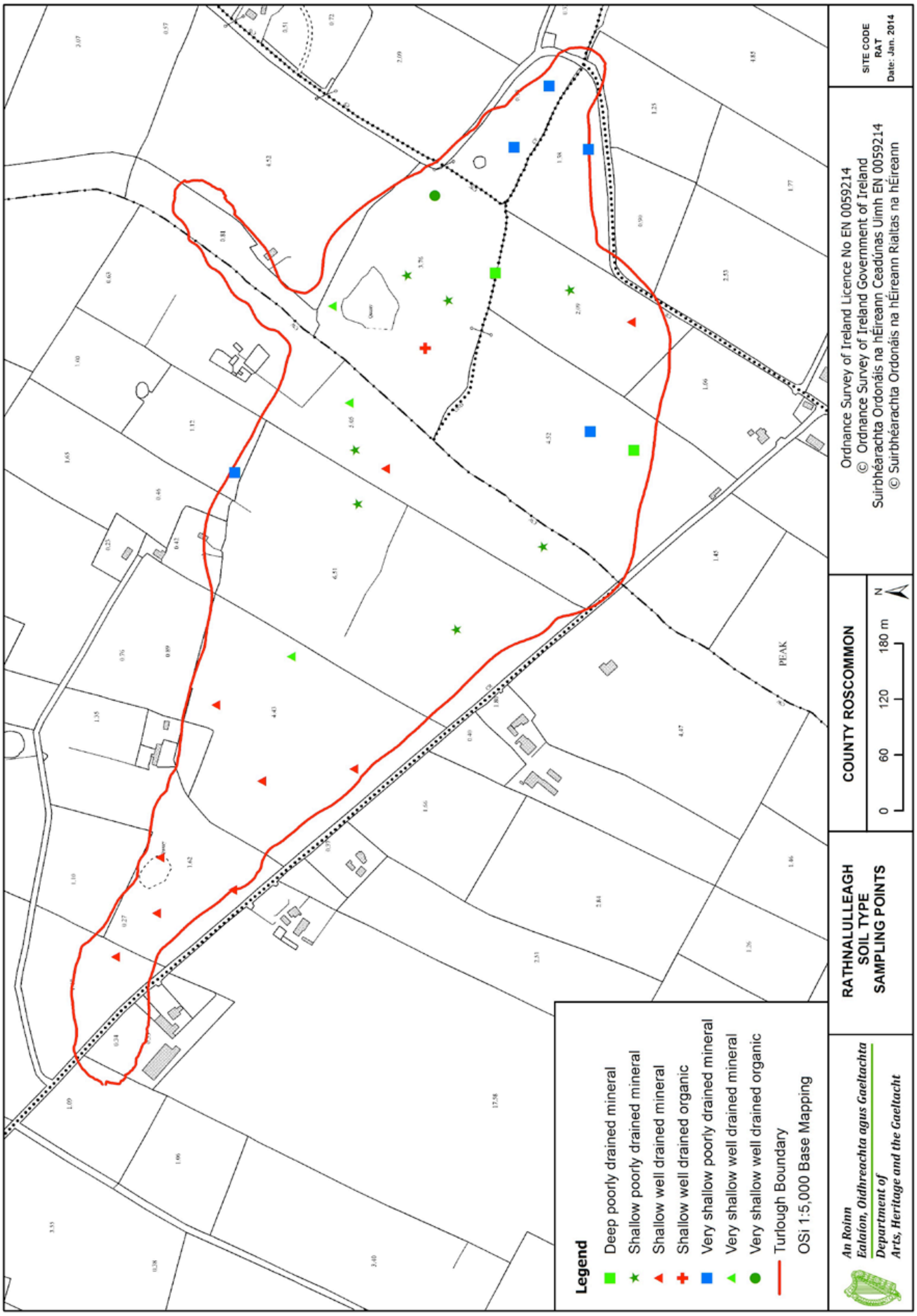

Legend
Deep poorly drained mineral
Shallow poorly drained mineral
Shallow well drained mineral
Shallow well drained organic
Very shallow poorly drained mineral
Very shallow well drained mineral
Very shallow well drained organic
Turlough Boundary
OSi 1:5,000 Base Mapping
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RATHNALULLEAGH
SOIL TYPE
SAMPLING POINTS
COUNTY ROSCOMMON
0 60 120 180 m
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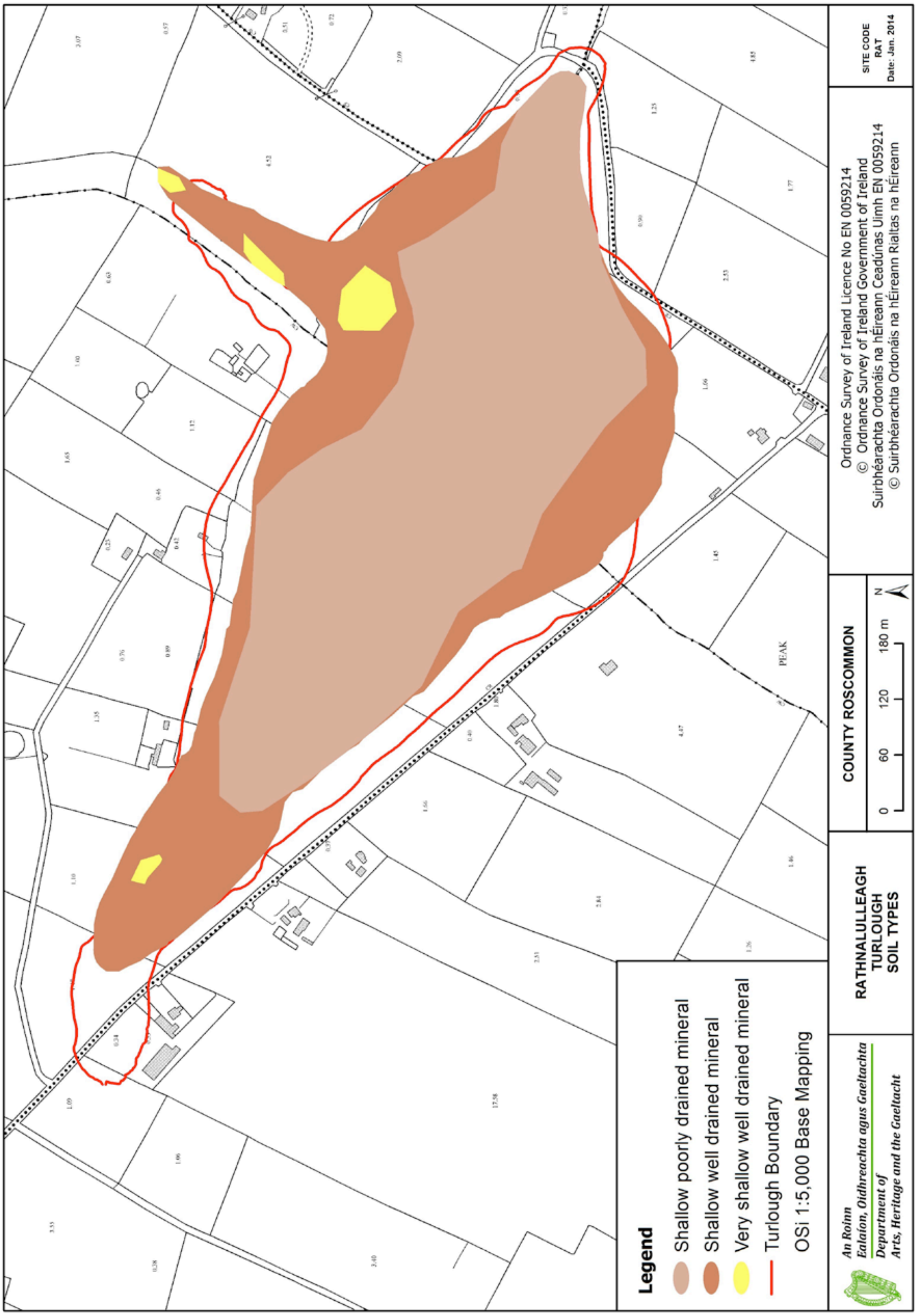
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Shallow poorly drained mineral
Shallow well drained mineral
Very shallow well drained mineral
Turlough Boundary
OSi 1:5,000 Base Mapping
RATHNALULLEAGH TURLOUGH SOIL TYPES
COUNTY ROSCOMMON
0 60 120 180 m
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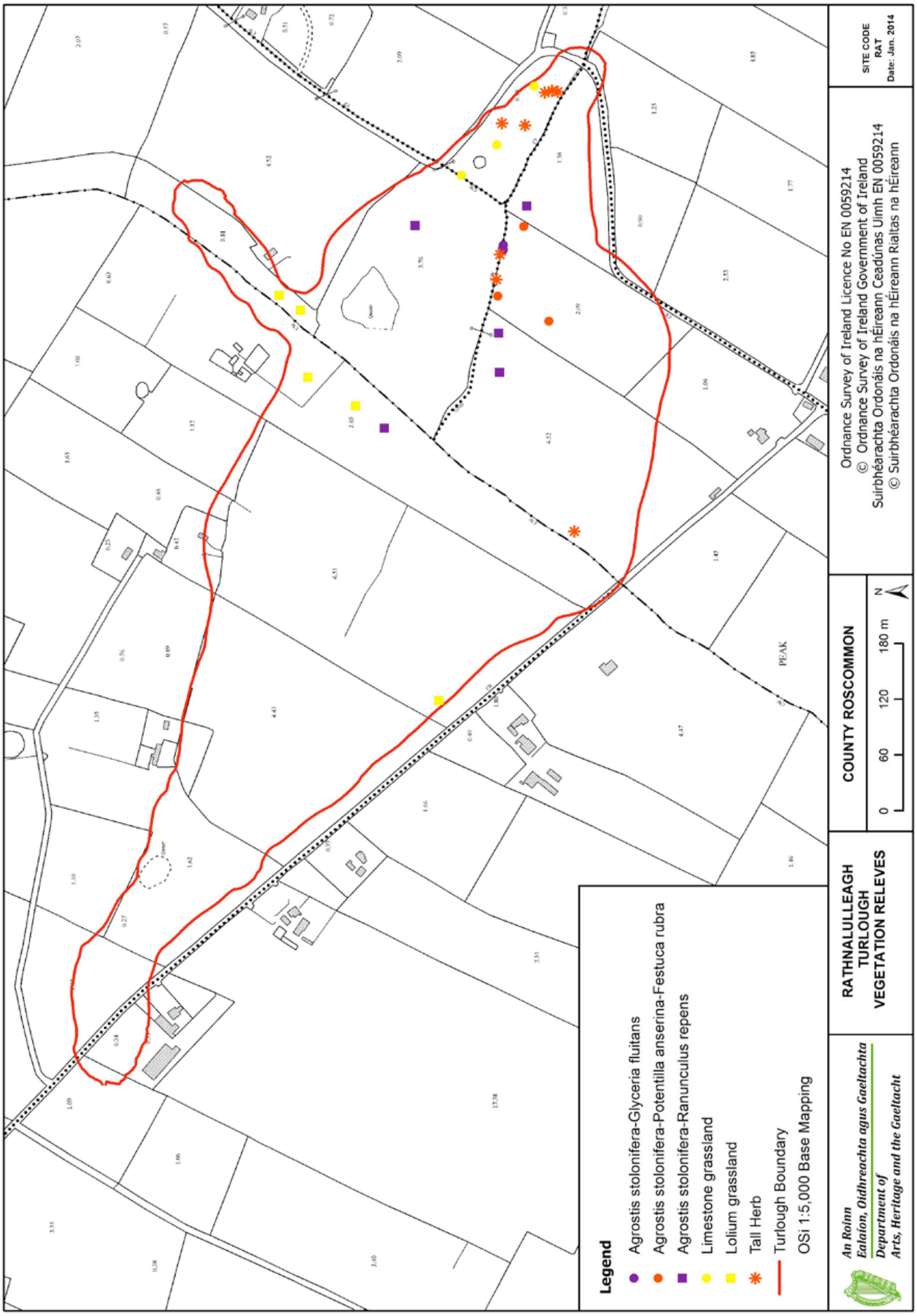
PEAK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Agrostis stolonifera-Glyceria fluitans
Agrostis stolonifera-Potentilla anserina-Festuca rubra
Agrostis stolonifera-Ranunculus repens
Limestone grassland
Lolium grassland
Tall Herb
Turlough Boundary
OSi 1:5,000 Base Mapping
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RATHNALULLEAGH
TURLOUGH
VEGETATION RELEVES
COUNTY ROSCOMMON
0 60 120 180 m
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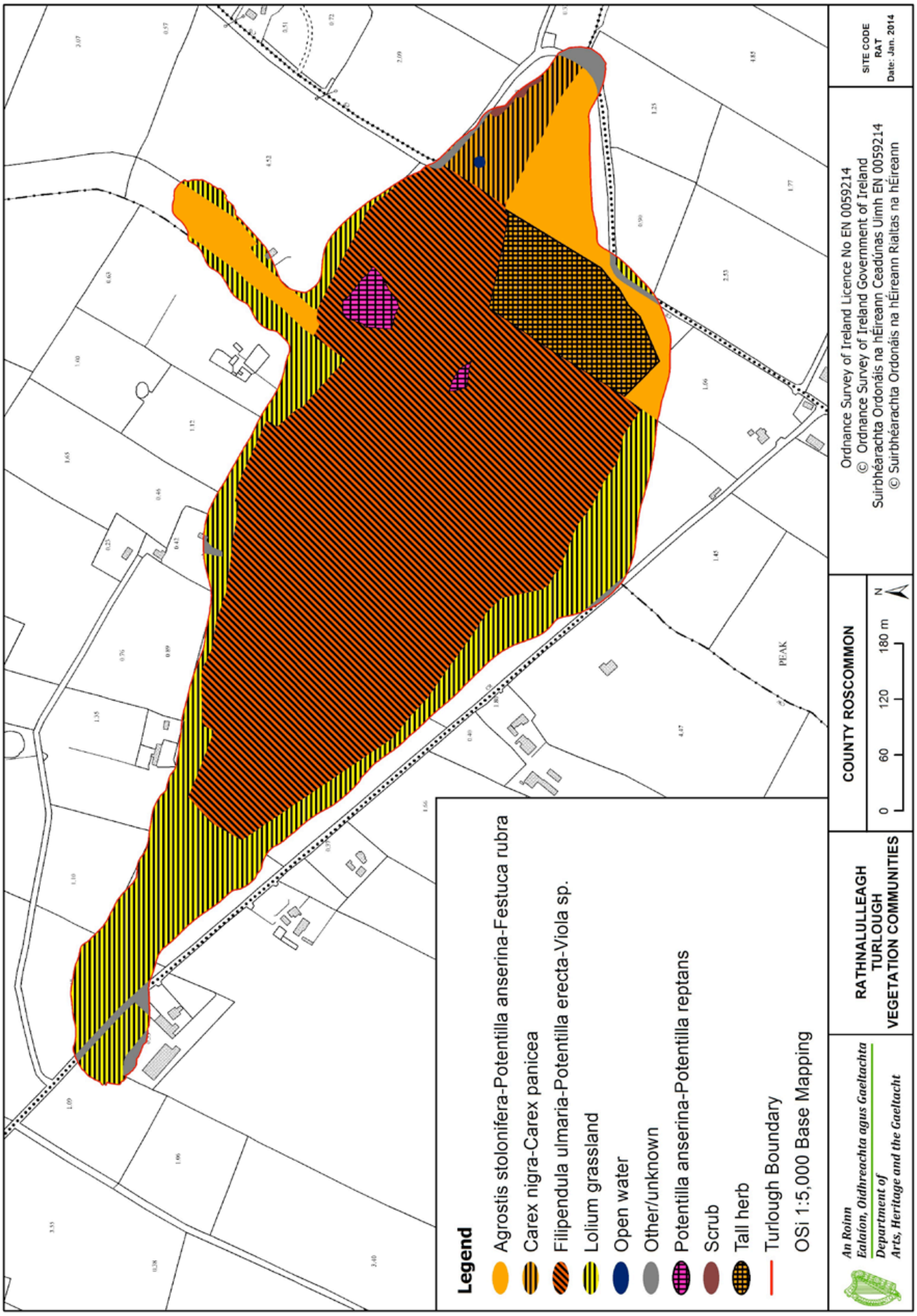
Legend
Agrostis stolonifera-Potentilla anserina-Festuca rubra
Carex nigra-Carex panicea
Filipendula ulmaria-Potentilla erecta-Viola sp.
Lolium grassland
Open water
Other/unknown
Potentilla anserina-Potentilla reptans
Scrub
Tall herb
Turlough Boundary
OSi 1:5,000 Base Mapping
An Roinn
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RATHNALULLEAGH
TURLOUGH
VEGETATION COMMUNITIES
COUNTY ROSCOMMON
0 60 120 180 m
N
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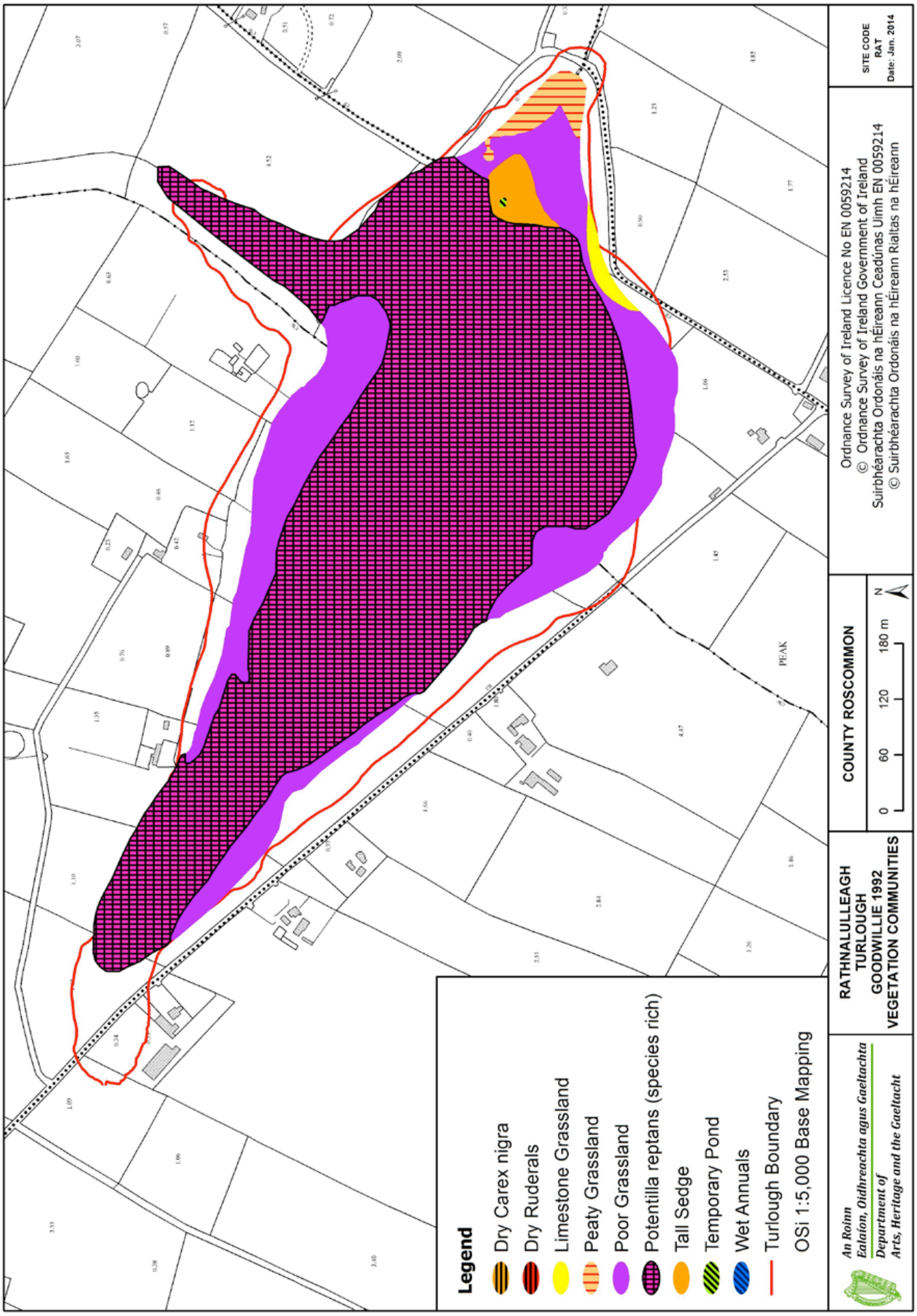
RAT
Date: Jan. 2014
PEAK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Dry Carex nigra
Dry Ruderals
Limestone Grassland
Peaty Grassland
Poor Grassland
Potentilla reptans (species rich)
Tall Sedge
Temporary Pond
Wet Annuals
Turlough Boundary
OSi 1:5,000 Base Mapping
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
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Arts, Heritage and the Gaeltacht
RATHNALULLEAGH
TURLOUGH
GOODWILLIE 1992
VEGETATION COMMUNITIES
COUNTY ROSCOMMON
0 60 120 180 m
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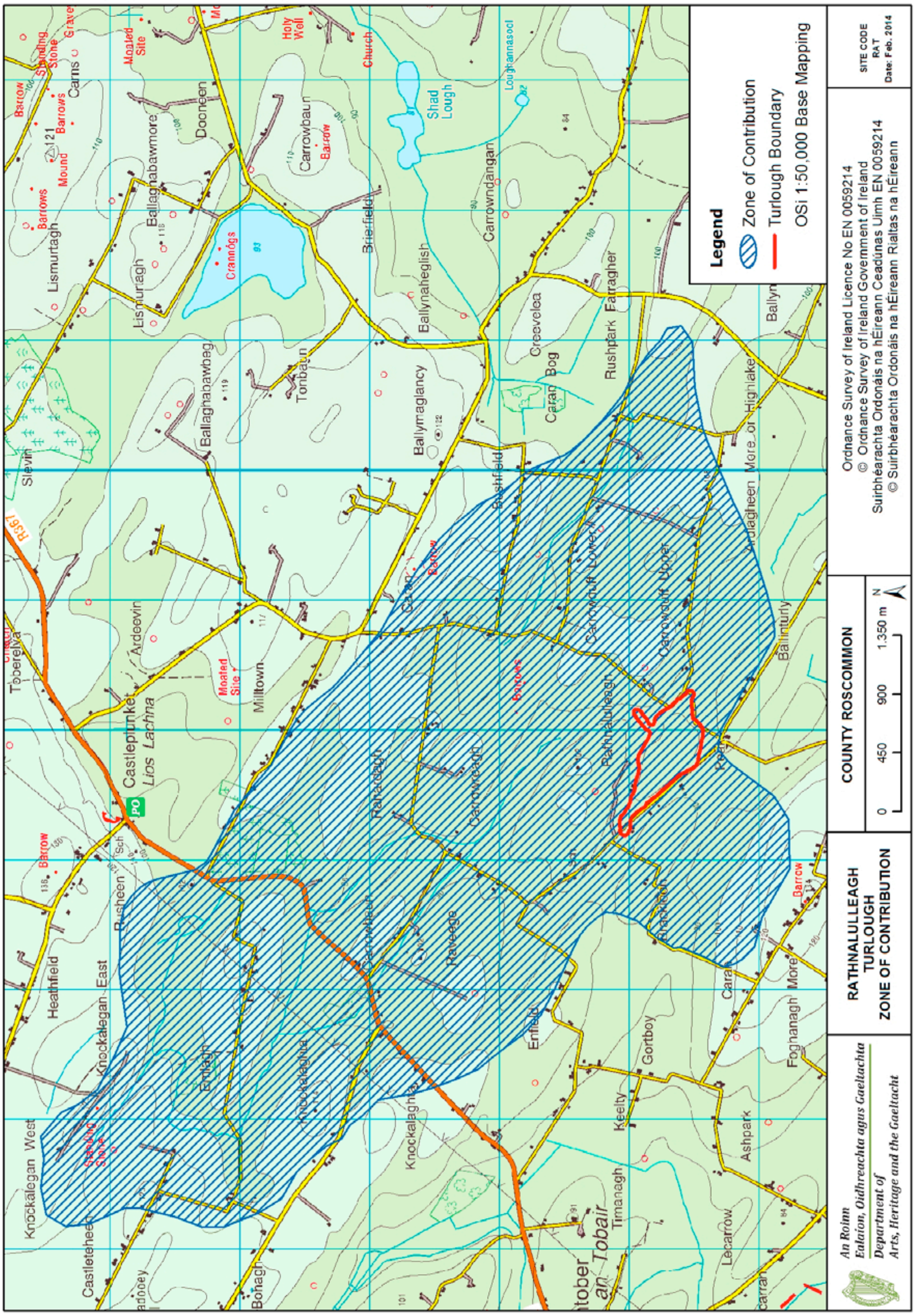
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Zone of Contribution
Turlough Boundary
OSi 1:50,000 Base Mapping
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SITE CODE
RAT
Date: Feb. 2014
COUNTY ROSCOMMON
0 450 900 1,350 m
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RATHNALULLEAGH
TURLOUGH
ZONE OF CONTRIBUTION
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht

Site Report: Roo West Turlough
TCD Turlough Research project 2006-2011

Turlough Project Code	SAC Name	SAC/NHA No.	County	Townland	RBD	Easting	Northing	Area (ha)
ROO	East Burren Complex	001930	Galway	Roo West	WESTERN	138630	202210	43

File update: July 2015 (S. Waldren)

Site Description

Roo West turlough occurs in the East Burren SAC, approximately 5km inland from Kinvara, and 5km from Gort (Co. Galway). The turlough is surrounded on all sides by limestone pavement, and the basin forms a neat depression rather than a sprawling complex. Eleven vegetation communities were recorded in the turlough; the *Eleocharis palustris-Ranunculus flammula* community was the most abundant. The soils in Roo West are moderately alkaline and organic. There are extensive areas of alluvial marl, with very shallow well-drained organic soils in the upper slopes. Hydrological data indicate that this site typically experiences one major flood event per annum, however the turlough may not drain to residual pools every year. The site has a relatively low inflow rate and an average drainage capacity.

Roo West – photo: S. Kimberley

Phytoplankton

Phytoplankton analysis was conducted on sub-samples of monthly spot samples collected for hydrochemical analysis between October 2006 and June 2007. Phytoplankton composition varies significantly over time and data from autumn, mid-winter and spring/early summer are presented below. Taxa were identified to species level where possible. Some taxa were not discriminated beyond general groupings (i.e. small centric diatoms, dinoflagellates and pinnate diatoms). The term non-identifiable alone (or n.i.) was reserved for cases where specimens were not identifiable. Discrimination between n.i. filament, n.i. flagellate, n.i. colony, n.i. green filament was made when applicable. Biovolume (mm^3 m^{-3}) was used as the measure of algal biomass.

October 2006		January 2007		May 2007	
Biovolume (mm^3/m^3)	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*
Cryptomonas	78285	*Cryptomonas*	212353	*Achnanthidium minutissima*	56320
Chroomonas acuta	20512	*Chroomonas acuta*	83298	*Fragilaria/Synedra*	34512
Fragilaria/Synedra	12081	*Fragilaria/Synedra*	37167	*n.i. pennates*	31909
n.i. pennates	6623	*Synedra*	25656	*Chroomonas acuta*	23351
Klebsormidium	6422	*Achnanthidium minutissima*	22346	*n.i. pennates*	15579

Benthic Algae

Turloughs were inspected for algal mats during the emptying phase in 2007, 2008 and 2009. Turloughs were visited in the first two weeks of March to June 2007 as part of the monthly monitoring of turloughs. Dedicated trips to inspect for algal mats were conducted in 2008 on the 4th of March, the 1st of April, and the 26th, 27th and 28th of May, and in 2009 on the 15th and 16th of June and on the 24th and 25th of July. The presence of both living floating mats and dead drying mats was noted, as well as their extent in the turlough basins. Occurrence of visible filamentous algal mats in the three years of observation is presented below. Y = visible occurrence; * = "extensive cover" (estimated to be 2 to 8% of total area of basin); † = negligible quantity observed; • = turlough was too flooded to permit full observation. Algal mats were observed in Roo West in every year, though often in very small quantity.

Year of Observation		
2007	**2008**	**2009**
Y	Y†	Y†

Hydrochemistry

Data shown are the mean ± SD of monthly spot samples collected between October 2006 and June 2007. Mean seasonal Total P and Chlorophyll *a* were used to determine the trophic status of the floodwaters based on OECD trophic categories. high .

Hydrochemical Variable	Roo West Values		Turlough Summary Stats (n=22)		
	Mean±SD	OECD Trophic Category	Median	Min	Max
pH	8.3±0.1		8.1	7.7	8.3
Alkalinity mg l^{-1} $CaCO_3$	141.0±26.3		204.0	112.4	236.4
Colour mg l^{-1} PtCo	13.6±7.1		26.9	7.9	85.1
Molybdate Reactive Phosphorus µg l^{-1}	1.1±0.5		3.4	0.7	42.1
Total Phosphorus µg l^{-1}	9.8±4.1	Oligotrophic	24.8	4.0	82.1
Chlorophyll *a* µg l^{-1}	2.1±1.1	Oligotrophic	4.9	1.1	33.5
Nitrate-N mg l^{-1}	0.2±0.2		0.7	0.1	1.9
Total Nitrogen mg l^{-1}	0.6±0.3		1.2	0.6	2.3

Aquatic Invertebrates

22 turloughs were sampled for littoral aquatic macroinvertebrates using sweep nets during November 2006 and April 2007. Zooplankton samples were collected in April 2007. Open-water cladocerans and littoral chydorids were sampled using a zooplankton net and perspex tube respectively.

Aquatic Macroinvertebrates			
November 2006	**Count**	**April 2007**	**Count**
Agabus labiatus	1	*Agabus* sp. (larva)	14
Agabus nebulosus	1	*Berosus signaticollis*	1
Agabus sp. (larva)	46	Chironomidae	8
Chironomidae	3	*Cloeon dipterum*	12
Dryops sp. (larva)	4	*Cloeon simile*	2
Graptodytes bilineatus	3	Corixinae Instar I & II	2
Hydrachnidia (Mite)	1	Diptera Pupae	8
Limnephilidae sp. Instar III	2	*Dryops* sp. (larva)	1
Lymnaea palustris	8	*Graptodytes bilineatus*	2
Lymnaea peregra	11	*Halticinae* sp.	1
Lymnaea trunculata	4	*Hydrachnidia* (Mite)	1
Oligochaeta	3	*Hygrotus* sp. (larva)	1
Ostracoda	36	*Ilybius* sp. (larva)	1
Phacopteryx brevipennis	1	*Lestes* sp.	1
Planorbis leucostoma	3	*Lymnaea peregra*	7
		Oligochaeta	1
		Phacopteryx brevipennis	1
		Planorbis leucostoma	4
		Planorbis planorbis	12
		Porhydrus lineatus	1
		Rhantus sp. (larva)	1
		Sympetrum sanguinem	23
		Tipulidae	1

Aquatic Macroinvertebrates:

Aquatic Macroinvertebrate Taxa	Presence of high abundances (>50)	
	November 2006	**April 2007**
Diptera	N	N
Ostracoda	N	N
Odonata	N	N
Trichoptera	N	N

Zooplankton species
Acroperus angustatus
Alona affinis
Alona rustica
Alonella excisa
Chydorus sphaericus
Daphnia pulex
Eurycercus lamellatus
Graptoleberis testudinaria
Lathurona rectirostris
Pleuroxus laevis
Pleuroxus trigonellus
Simocephalus vetulus

Vegetation

Vegetation description and classification yielded 25 vegetation communities suitable for mapping. Eleven vegetation communities were recorded in Roo West; the *Eleocharis palustris-Ranunculus flammula* community was the most extensive, with important amounts of Flooded Pavement and *Molinia caerulea-Carex panciea*. High conservation value communities are denoted by *. Fifty plant species were recorded.

Vegetation Community	**Area (Ha)**
A. stolonifera-P. anserina-F. rubra	2.04
A. stolonifera-R. repens	1.38
Carex nigra-C. panicea	3.66
Carex nigra-Equisetum fluviatile	1
Eleocharis palustris-R. flammula	11.6
*Flooded pavement	5.33
Limestone grassland	2.84
Lolium grassland	2.38
**Molinia caerulea-Carex panicea*	3.69
Open water	5.33
Other/unknown	4.86
Schoenus nigricans fen	0.37
Woodland/scrub	3.32
Number of vegetation communities	11
Number of plant species	49

Vascular Plant Species

Nomenclature follows Parnell, J & Curtis, T. (2012) *Webb's An Irish Flora*, University of Cork Press.

Achillea ptarmica	*Filipendula vulgaris*	*Plantago lanceolata*
Agrostis stolonifera	*Galium boreale*	*Plantago major*
Alopecurus geniculatus	*Galium palustre*	*Plantago maritima*
Calluna vulgaris	*Galium verum*	*Potentilla anserina*
Campanula rotundifolia	*Hydrocotyle vulgaris*	*Potentilla erecta*
Cardamine pratensis	*Juncus acutiflorus*	*Potentilla reptans*
Carex flacca	*Leontodon autumnalis*	*Prunella vulgaris*
Carex hostiana	*Leontodon hispidus*	*Prunus spinosa*
Carex nigra	*Leontodon saxatilis*	*Ranunculus flammula*
Carex panicea	*Linum catharticum*	*Ranunculus repens*
Carex viridula agg.	*Littorella uniflora*	*Salix repens*
Carex viridula ssp. *oedocarpa*	*Lotus corniculatus*	*Schoenus nigricans*
Centaurea nigra	*Mentha aquatica*	*Succisa pratensis*
Danthonia decumbens	*Molinia caerulea*	*Trifolium repens*
Euphrasia species	*Parnassia palustris*	*Viola riviniana*
Festuca rubra	*Phalaris arundinacea*	*Viola* sp.
Filipendula ulmaria		

Soils and Grazing

Soils were classified using a modified version of soil categories generated by the Teagasc/EPA Soils and Subsoils Mapping project (Fealy *et al.*, 2009). The classification scheme principally uses parent material (calcareous/non-calcareous), depth class (shallow/deep) and drainage class (well drained/poorly drained) to assign soils to one of nine broad categories. Roo West has extensive areas of alluvial marl, and very shallow well-drained organic soils occupy the upper slopes. The mean ± SD of a range of soil properties are also provided, in addition to the median and range of each variable across turloughs. Roo West soils are moderately alkaline and organic. The calcium carbonate contents do not reflect the expanse of alluvial marl in this turlough as persistent flooding restricted sampling to the upper levels. All of the land parcels were grazed, though parts of some of them were inundated at the time of mapping.

Soil Types/Grazing Extent	% Turlough Area
Deep well drained mineral	0.6
Very shallow well drained organic	23.8
Alluvial marl	75.6
Extent of rotationally grazed area	100

Soil Property (n=6)	Roo West	Turlough Summary Stats (n=22)		
	Mean ± SD	Median	Min	Max
pH	7.20 ± 0.7	7.20	5.94	8.29
% Organic Matter content	29.1 ± 10.5	25.8	10.2	69.1
% Inorganic content	55.1 ± 19.4	43.2	25.7	85.0
% Calcium carbonate content	15.8 ± 21.0	11.3	2.48	43.7
Total Nitrogen mg kg^{-1}	14000 ± 2945	11142	4983	24233
Total Phosphorus mg kg^{-1}	716 ± 193	905	245	1594

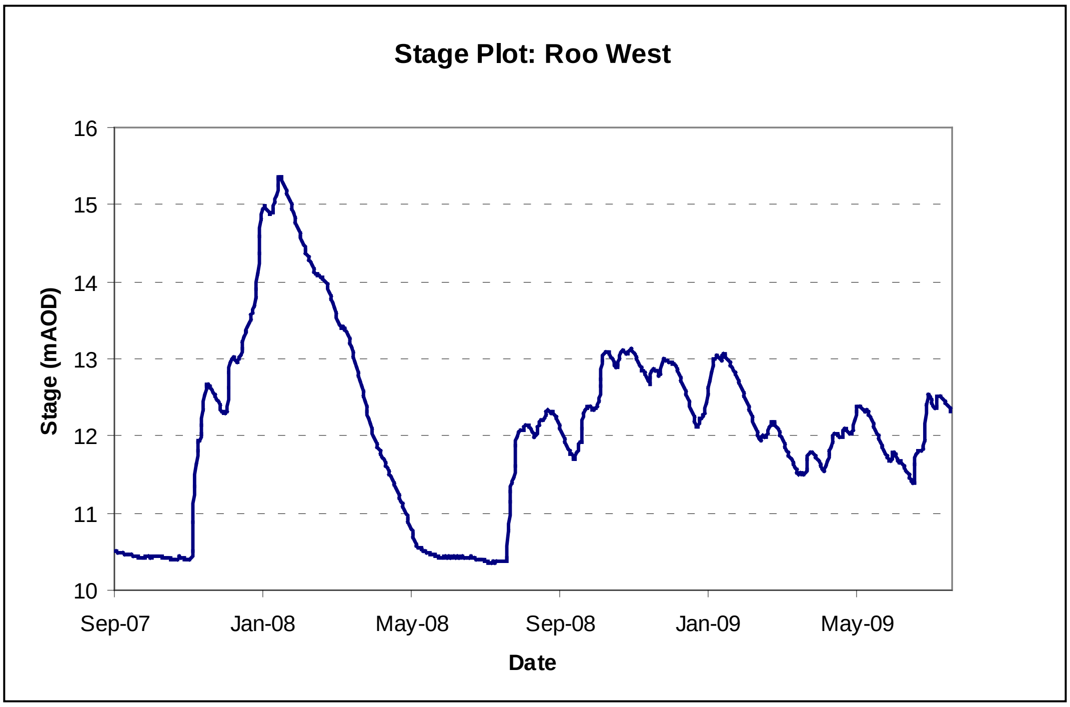
Hydrology

Water levels were recorded at hourly intervals using a variety of Schlumberger Divers® (Marton Geotechnical Ltd, Suffolk, UK) placed at or near the lowest point in each turlough. Divers measure the pressure of the water and air column above them, and from this the depth of water can be calculated. GPS surveys were carried out on 21 monitoring sites (Tullynafrankagh omitted) in order to develop digital terrain models (DTMs) from which contour maps, stage-volume and stage-surface area relationships are produced. The inflow magnitude is indicative of the properties of a turlough's catchment area and flow capacity, while outflow is a function of the drainage capacity of the system.

Roo West has a relatively low inflow rate and an average drainage capacity, there appears to be a single major flood with often consderable oscillations in water depth and the turlough may not drain to residual pools every year.

Hydrological Information	Roo West Values	Turlough Summary Stats (n=21)		
		Median	Min	Max
Start of Hydrological Recording	27/09/2007	-	-	-
End of Hydrological Recording	05/08/2009	-	-	-
Days Recorded	678	-	-	-
Equipment Failure	Before 27/9/2007	-	-	-
Hydroperiod (days)	213	213	135	348
Maximum Floodwater Depth (m)	5.5	4.9	3	15.4
Maximum Floodwater Volume ('000 m^3)	1077.3	877.9	355.6	4008.1
Maximum Flooded Area (ha)	40.99	38.61	13.71	78.12
Average Basin Depth (m)	2.63	2.28	0.85	6.76
Average Daily Inflow (m^3 s^{-1})	0.995	0.684	0.254	10.253
Average Daily Outflow (m^3 s^{-1})	0.275	0.271	0.086	2.018
Drainage Capacity (m^3 s^{-1})	0.218	0.154	0.069	1.156
Recession Duration (days)	57.3	57.3	11	142.5

Stage plot for Roo West turlough



Zone of Groundwater Contribution (ZOC) Risk Assessments

GIS based risk assessments were conducted with a view to identifying turloughs at risk of failing to meet WFD water quality objectives. These risk assessments were conducted by Compass Informatics Ltd and were based on Risk Assessment Sheet GWDTERA2a (Guidance Document No. GW9) on assessing risks to turloughs from phosphate (Working Group on Groundwater 2004) and Pathway Susceptibilities and Pressure Magnitudes were integrated to produce Impact Potential maps and predicted Risk Categories for the turlough ZOC. The TCD Risk Category is derived from a revised Impact Potential matrix. The predicted Risk Categories were adjusted using mean seasonal floodwater Total P (μg l^{-1}) (see Section 4.5.4 of the Risk Assessment Sheet GWDTERA2a). The risk categories include 1A: at significant risk; 1B: probably at significant risk; 2A: Not at significant risk (low confidence); 2B: Not at significant risk (higher confidence).

ZOC Area (Km^2)	Predicted WFD Risk Category	Adjusted WFD Risk Category	Predicted TCD Risk Category	Adjusted TCD Risk Category
15	1B	1A	1B	1A

ZOC Pressure Variable	
CORINE BARE ROCK %	48
CORINE PEAT BOGS%	0
CORINE ALL NATURAL AND SEMI-NATURAL AREAS%	2
CORINE IMPROVED PASTURE%	37
CORINE UNIMPROVED PASTURE%	1
CORINE ALL PASTURE%	38
CORINE OTHER AGRICULTURAL LANDS%	13
TEAGASC/EPA HABITATS ROCK%	44
TEAGASC/EPA HABITATS BOGS/PEATS%	1
TEAGASC/EPA HABITATS FORESTS/SCRUBS%	0
TEAGASC/EPA HABITATS WATER%	0
TEAGASC/EPA HABITATS DRY GRASSLAND%	55
TEAGASC/EPA HABITATS WET GRASSLAND%	0
TEAGASC TOTAL GRASSLAND%	1
TOTAL LIVESTOCK UNIT/ha of ZOC	0
TILLAGE%	2
No. SEPTIC TANKS km^{-2} ZOC	2
No. SEPTIC TANKS km^{-2} EXTREME PATHWAY SUSCEPTIBILITY	0
HIGH PATHWAY SUSCEPTIBILITY%	81
EXTR+HIGH PATHWAY SUSCEPTIBILITY%	92
WELL DRAINED SOIL %	3
POORLY DRAINED SOIL%	48

Site Conservation Assessment

The following site conservation assessment was undertaken to feed into the national reporting structure for assessing conservation status as required under Article 17 of the Habitats Directive. A suite of indicators and associated targets were derived to assess ecological structure and function. Future prospects were assessed through the evaluation of the impact of current and recent pressures and likely future threats to the site. The assessment follows a rules based approach to determine whether Structures & functions and Future Prospects should be assessed as good (green), inadequate (amber) or bad (red). For further details, see Chapter 10 (Conservation Status Assessment).

Please note an updated approach to assessing site condition has been proposed and is outlined in Chapter 12 (Monitoring Methods for Turloughs).

Conservation Condition Summary

Structure & Function	**Favourable**
Future Prospects	**Favourable/Inadequate**
Site Conservation Condition	**Favourable**

Structure and Function Status:

Indicator	*Comments*
Hydrological Function: *Good*	
Water Quality: *Very Good/Good*	9.8 µg P l^{-1}. Borderline good/very good
Biological Responses: *Very Good*	
Algal communities: 0	Although algal mats were recorded they were never extensive, low max CHL
Vegetation communities: 2	High cover of positive indictors, low negative indicator cover
***Rumex* cover: 1**	Absent
Important plants: 1	*Plantago maritima*
Important aquatic invertebrates: 2	*Alona rustica, Alonella exisa, Agabus labiatus, Berosus signaticollis, Graptodytes bilineatus, Sympetrum sanguineum*
Overall Structure & Function: *Good*	

Pressures:

Code	*Impact*	*Notes*
A04.01.01 Intensive cattle grazing (turlough)	M	Moderate grazing levels over the whole of the turlough
H02.06 Diffuse groundwater pollution due to agricultural and forestry activities	L	Fairly low water TP but elevated compared to other turloughs surrounded by limestone pavement; may reflect local inputs from grazing in addition to ZOC

Threats:

Code	Impact	Notes
H02.06 Diffuse groundwater pollution due to agricultural and forestry activities (ZOC)	M	Ongoing pressure, which might increase due to agricultural intensification
A04.01.01 Intensive cattle grazing (turlough)	M	Ongoing pressure
A02.01 Agricultural intensification (ZOC)	M	Likely threat as the ZOC contains large amount of pasture
M01.03 Flooding and rising precipitations	L	
A10.02 Removal of stone walls and embankments (in turlough)	L	
H02.07 Diffuse groundwater pollution due to non-sewered population (ZOC)	L	Low level threat due to relatively low numbers of septic tanks in ZOC

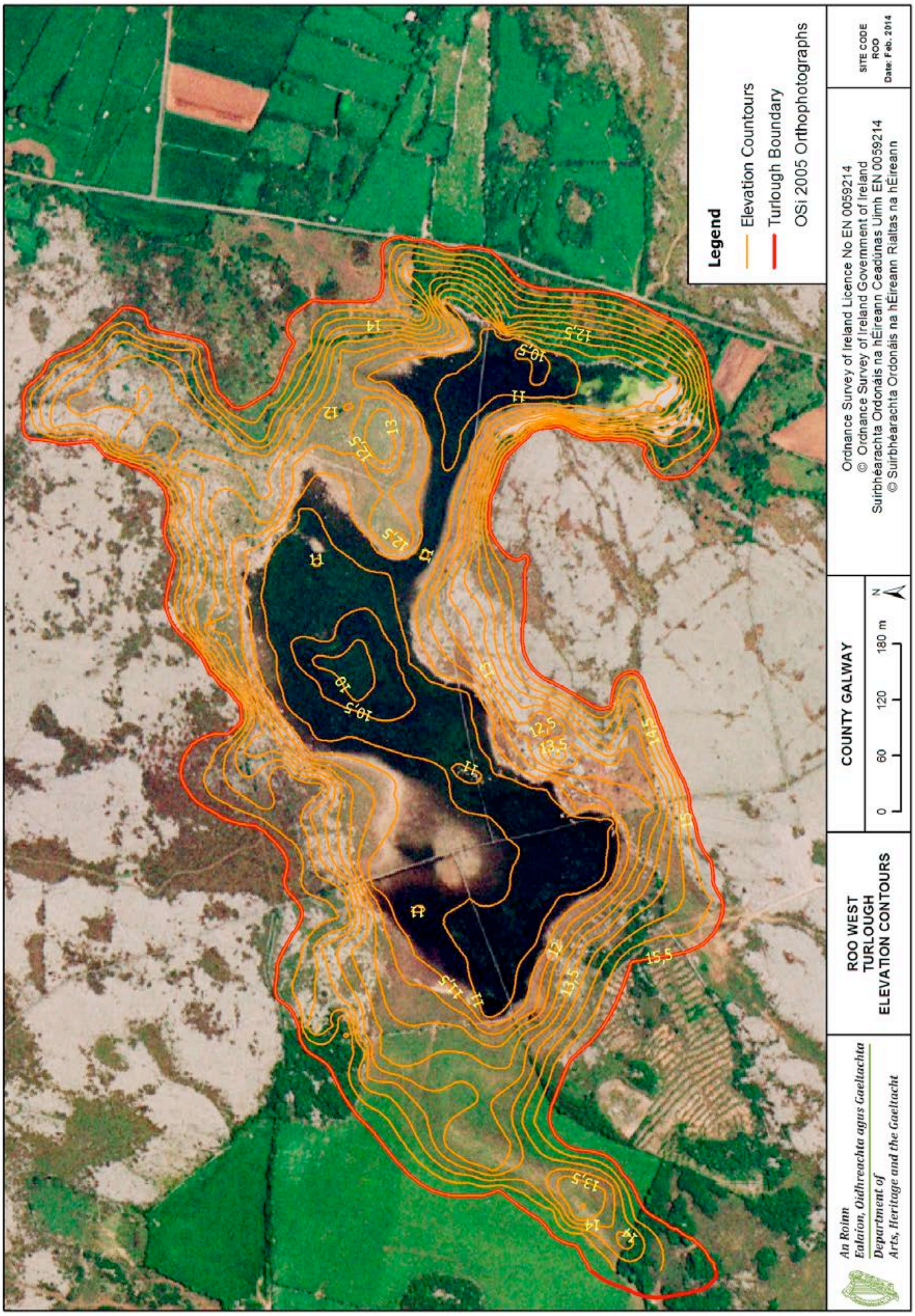
Future Prospects: **Favourable/Inadequate** – borderline: an increase in some of the current pressures seems likely, the main impacts would be on groundwater quality due to nutrient enrichment. Water quality in Roo already is poorer than in many other Burren turloughs.

Overall Assessment: **Favourable** – only just about in favourable conservation status, but there is a potential problem of grazing compared to other oligotrophic turloughs locally in the Burren region (e.g. Knockaunroe, Lough Gealain). Efforts should be made to determine the relative contributions of nutrient inputs from domestic grazing within the turlough and from the ZOC. A reduction in grazing would be desireable; the more oligotrophic turloughs seem capable of withstanding very low levels of grazing without altering ecological function, probably because of low productivity. Reduced grazing may help lower the nutrient status.

Maps

Maps are provided of:

1. Elevation contours, based on GIS digital terrain models from points by differential GPS topographic survey (for further details, see *Chapter 3: Hydrology*)
2. Grazing in land parcels
3. Approximate sampling points for water chemistry and aquatic invertebrates
4. Soil nutrient sampling points
5. Points for soil survey (note: soils were surveyed to the turlough boundary digitised from maps in van Ravensberg, M. & van der Wijngaart, R. 2000. *Syntaxonomy and Synecology of two turloughs Roo West and Roo East in West Ireland*. Department of Nature Conservation and Plant Ecology, Wageningen University).
6. Soils (note: soils were mapped by combining the EPA Subsoils base map with the point soil descriptions; for further details see *Chapter 6: Soils and Landuse*)
7. Vegetation communities (note: relevés do not always match to mapped communities due to small scale variation; for further details of mapping see *Chapter 7: Turlough Vegetation: Description, Mapping and Ecology*)
8. Estimated zone of groundwater contribution (ZOC)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Elevation Countours
Turlough Boundary
OSi 2005 Orthophotographs
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SITE CODE
ROO
Date: Feb. 2014
COUNTY GALWAY
0 60 120 180 m
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TURLOUGH
ELEVATION CONTOURS
An Roinn
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Department of
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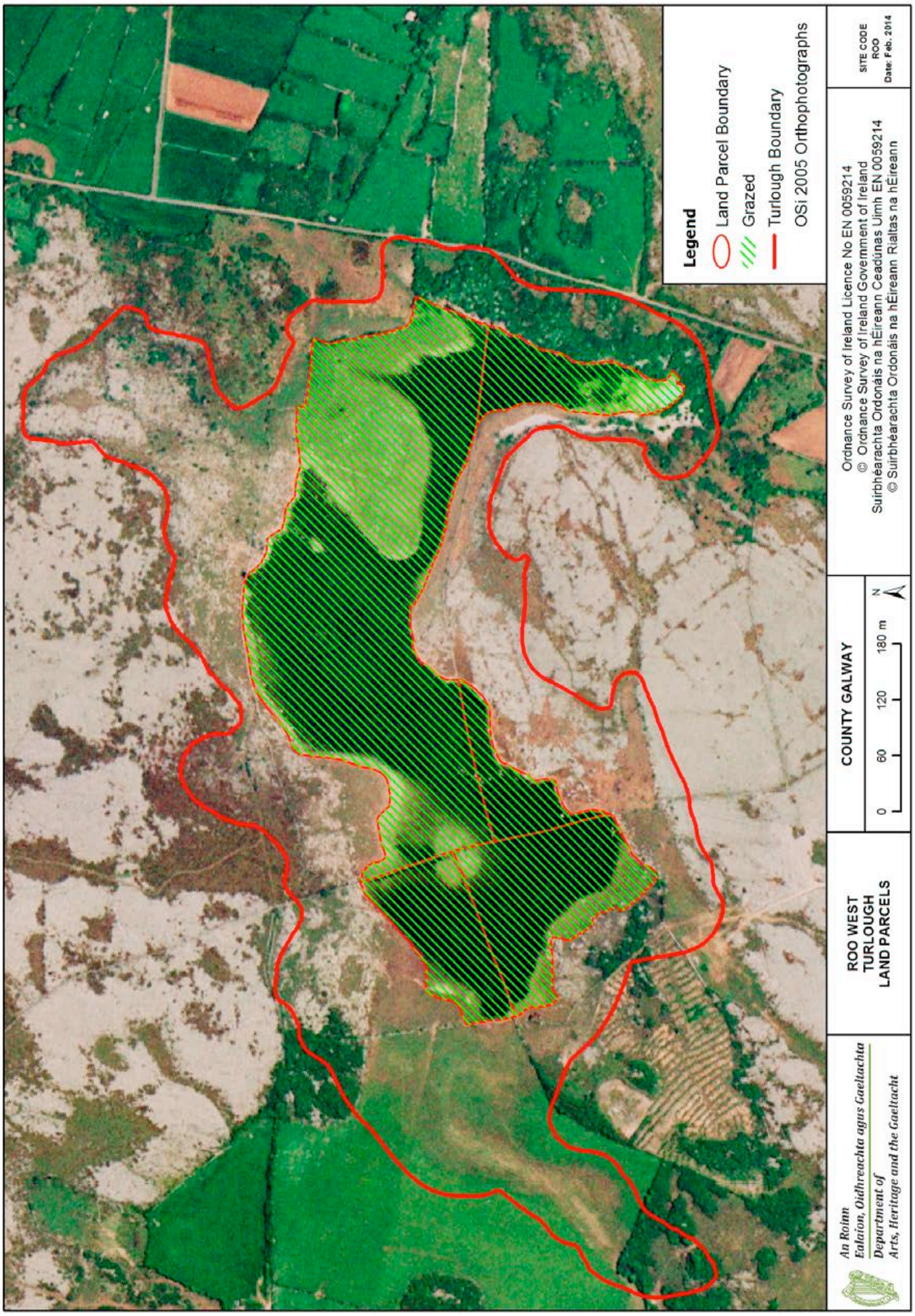
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Land Parcel Boundary
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OSi 2005 Orthophotographs
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Department of
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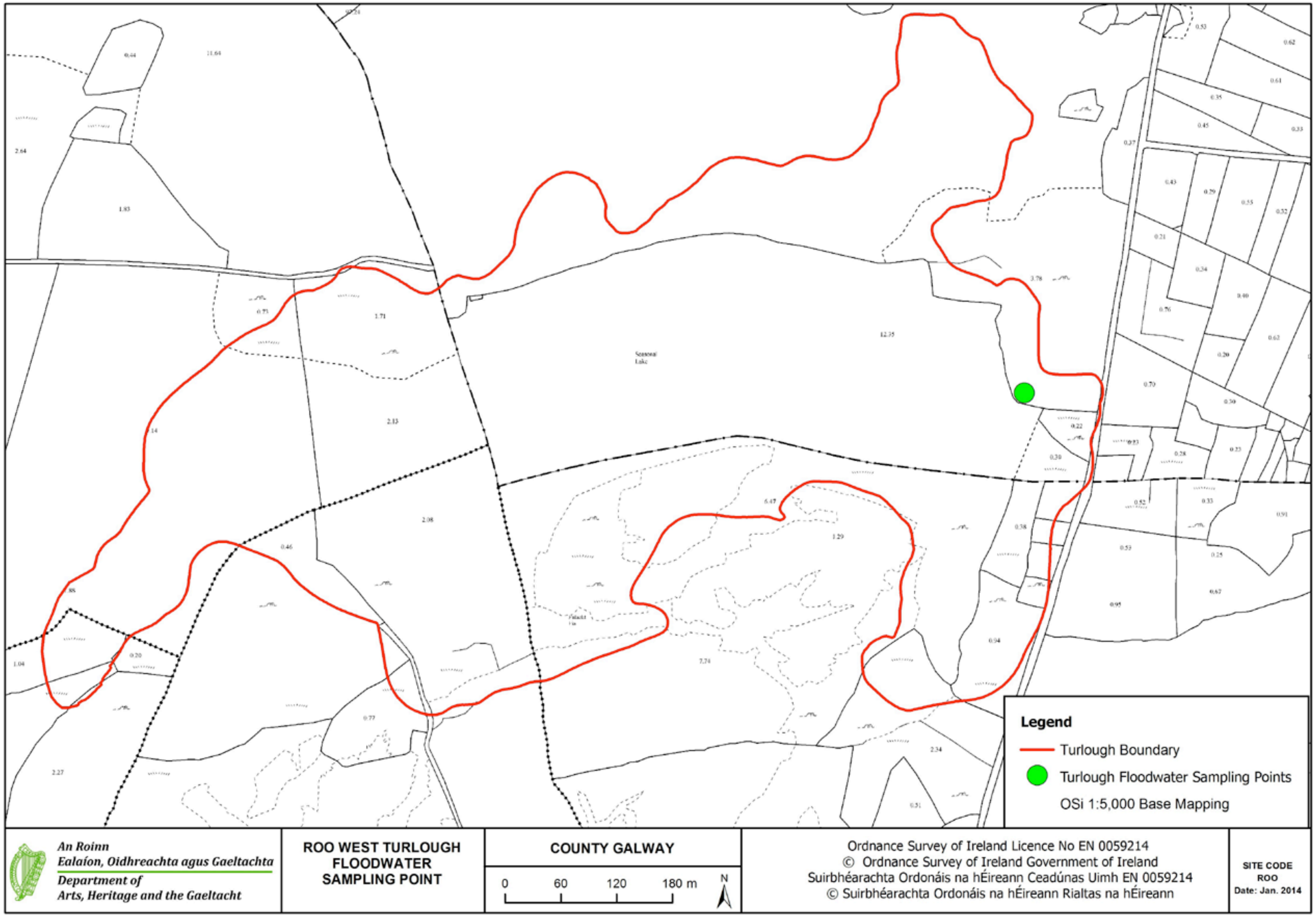
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Turlough Boundary
Turlough Floodwater Sampling Points
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Ealaíon, Oidhreachta agus Gaeltachta
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Arts, Heritage and the Gaeltacht
ROO WEST TURLOUGH
FLOODWATER
SAMPLING POINT
COUNTY GALWAY
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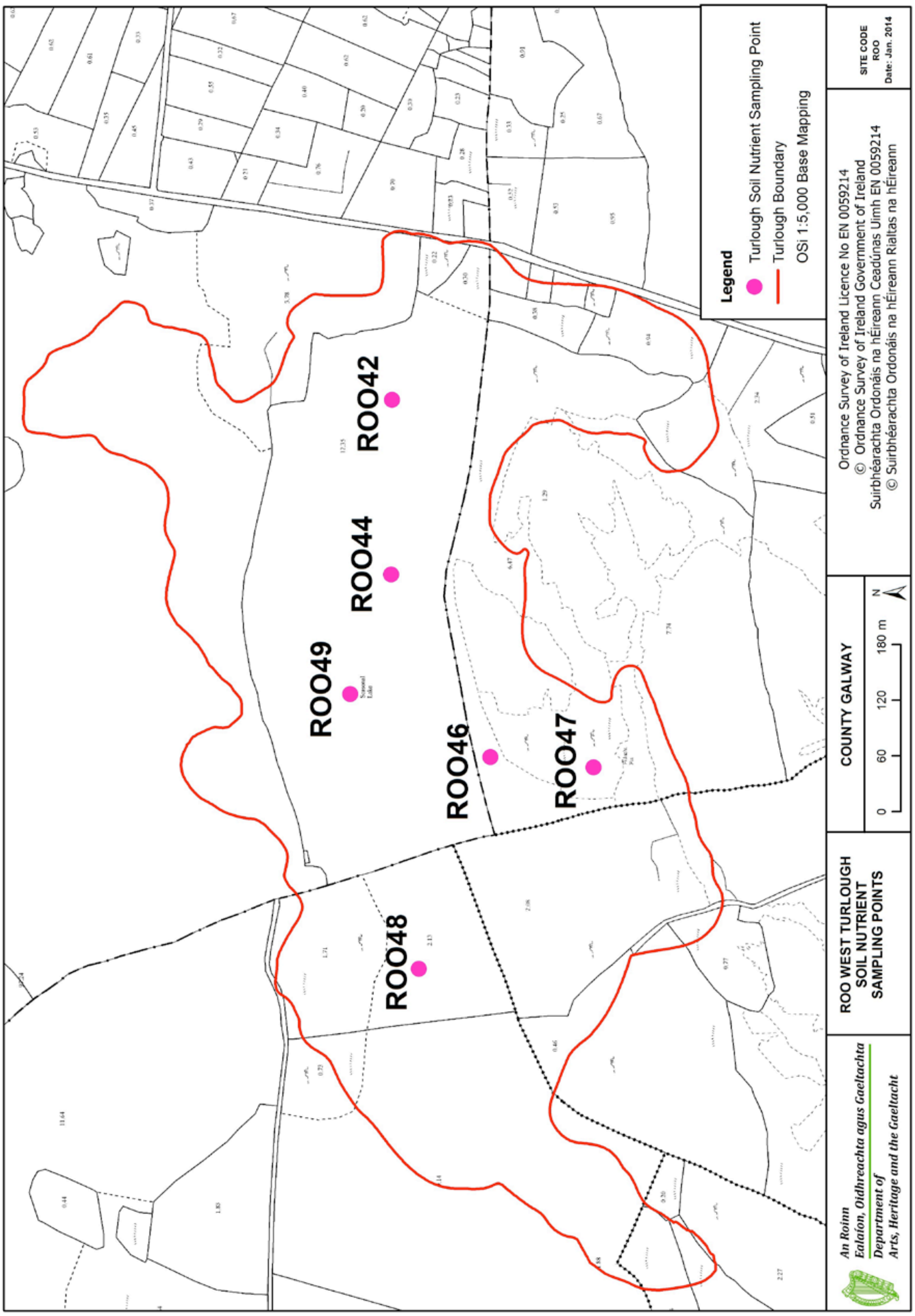
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Turlough Soil Nutrient Sampling Point
Turlough Boundary
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Date: Jan. 2014
COUNTY GALWAY
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ROO WEST TURLOUGH
SOIL NUTRIENT
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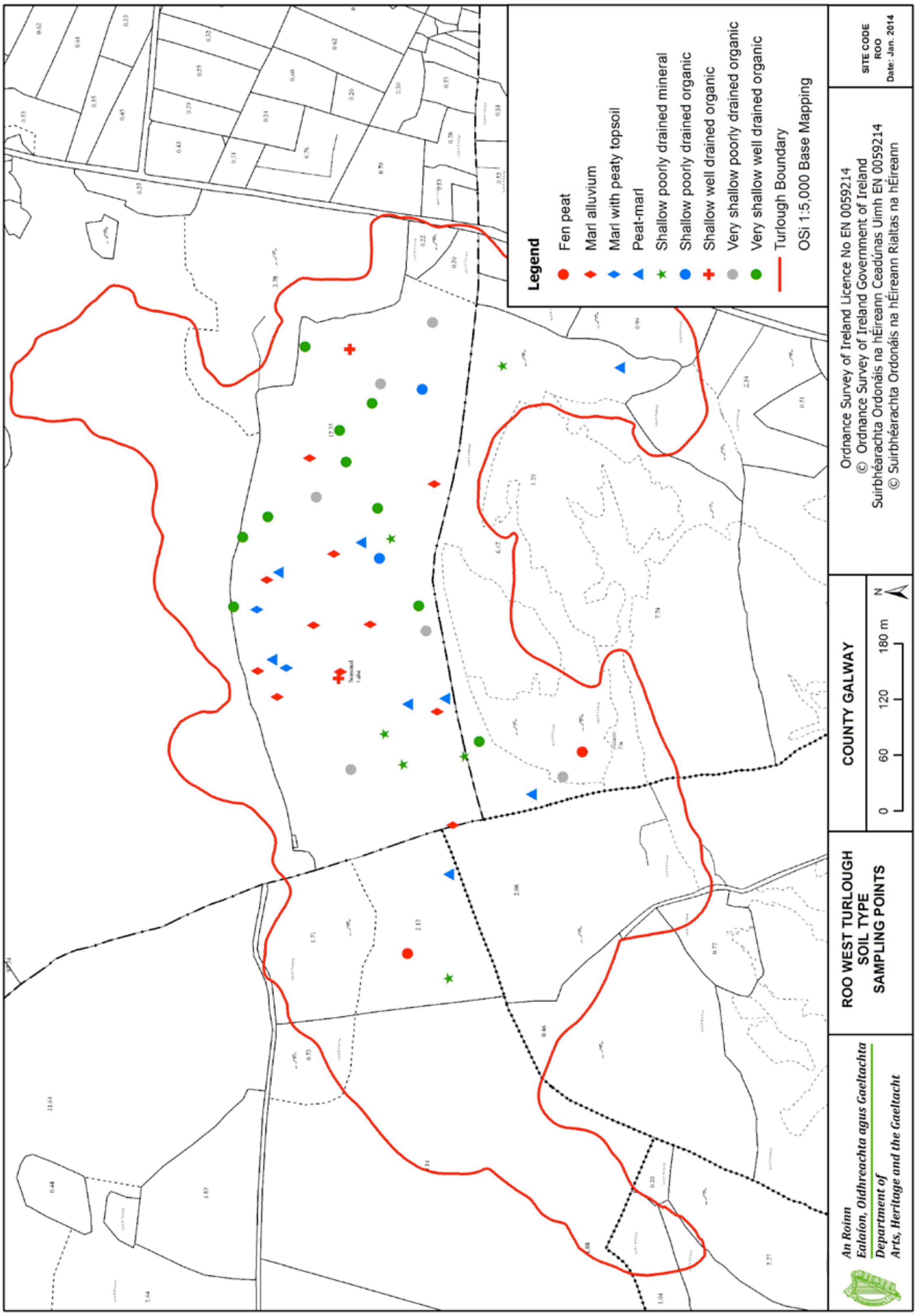
Legend
Fen peat
Marl alluvium
Marl with peaty topsoil
Peat-marl
Shallow poorly drained mineral
Shallow poorly drained organic
Shallow well drained organic
Very shallow poorly drained organic
Very shallow well drained organic
Turlough Boundary
OSi 1:5,000 Base Mapping
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COUNTY GALWAY
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ROO WEST TURLOUGH
SOIL TYPE
SAMPLING POINTS
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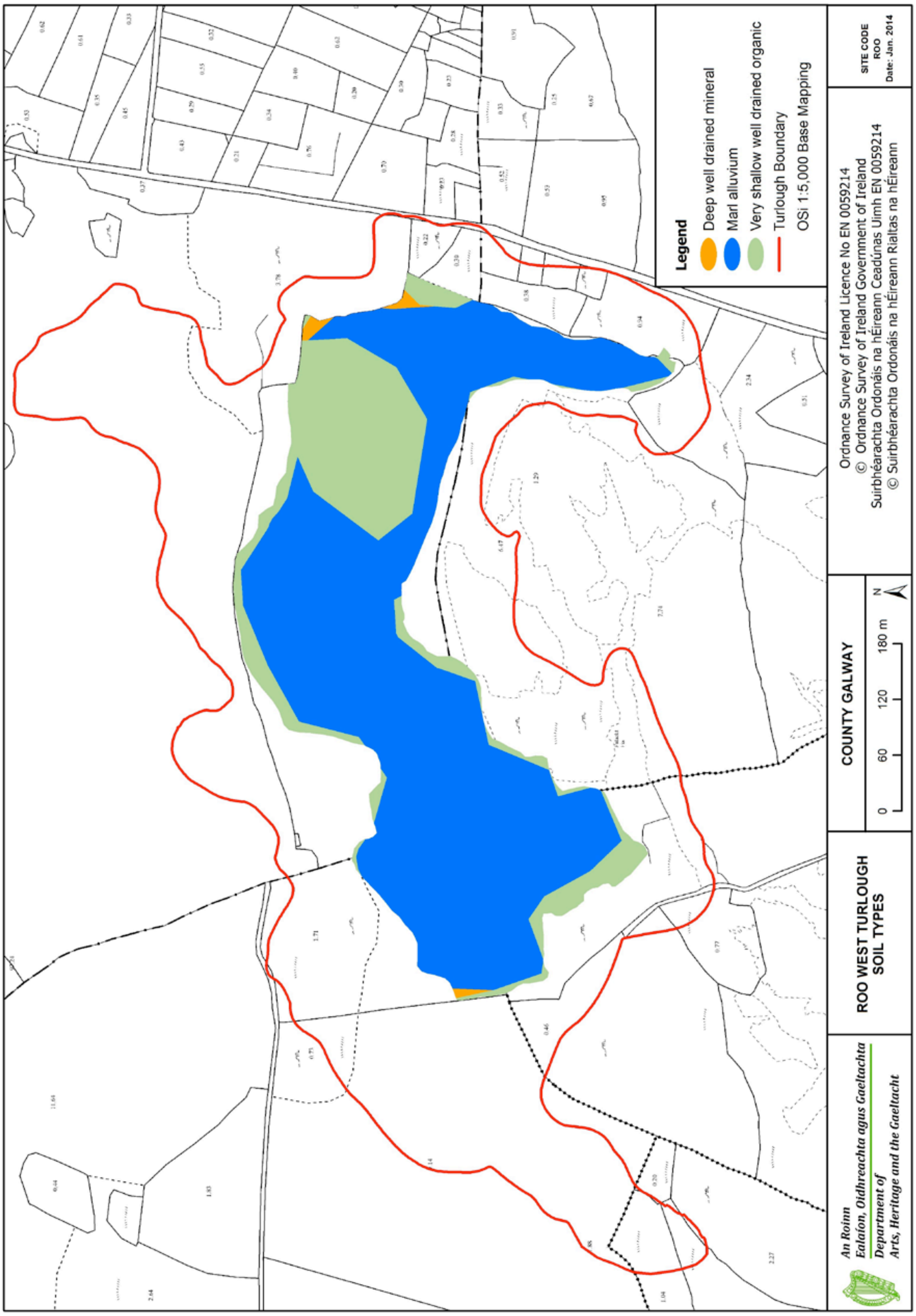
Legend
Deep well drained mineral
Marl alluvium
Very shallow well drained organic
Turlough Boundary
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COUNTY GALWAY
0 60 120 180 m
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ROO WEST TURLOUGH
SOIL TYPES
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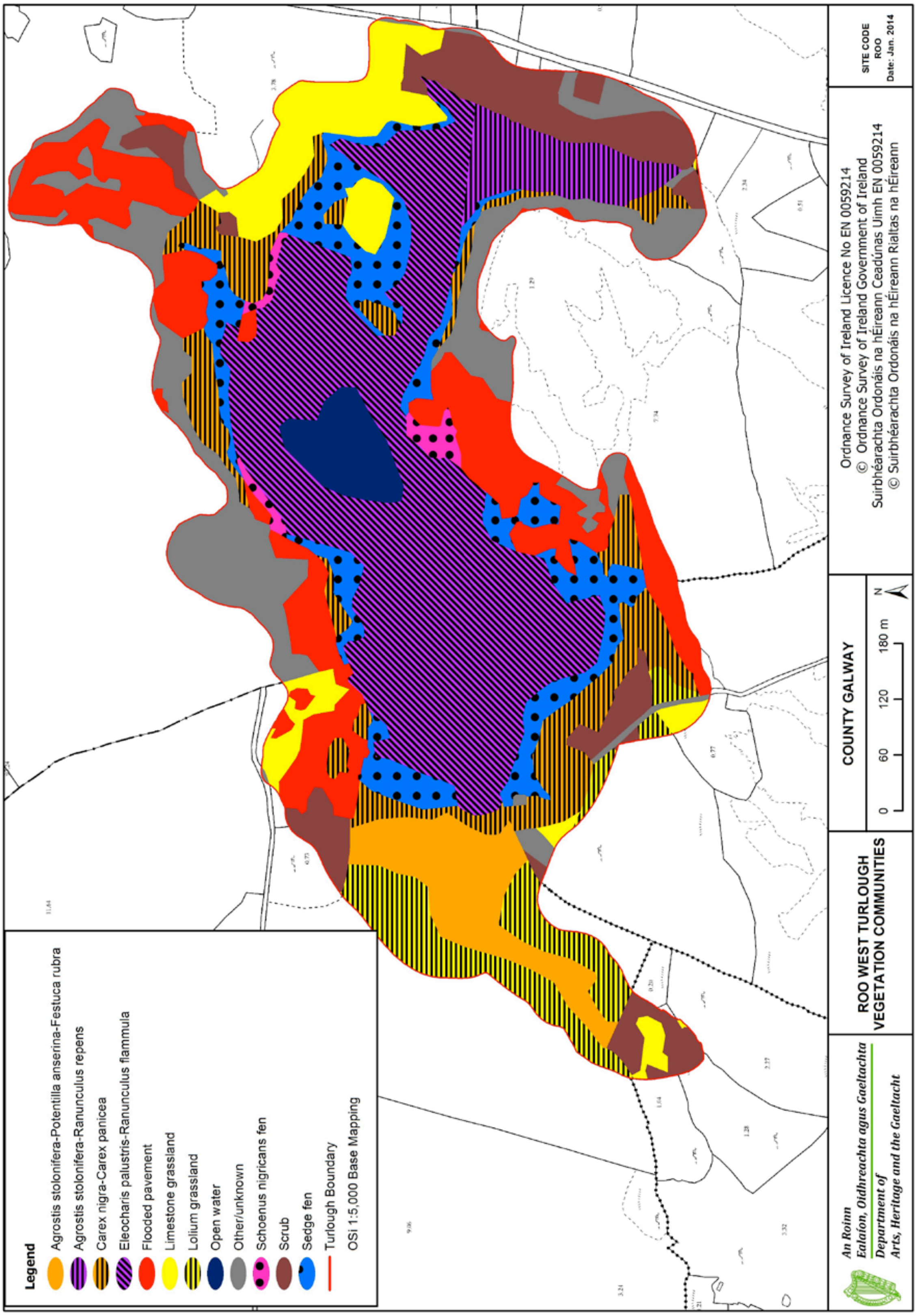
Arts, Heritage and the Gaeltacht



Legend
Agrostis stolonifera-Potentilla anserina-Festuca rubra
Agrostis stolonifera-Ranunculus repens
Carex nigra-Carex panicea
Eleocharis palustris-Ranunculus flammula
Flooded pavement
Limestone grassland
Lolium grassland
Open water
Other/unknown
Schoenus nigricans fen
Scrub
Sedge fen
Turlough Boundary
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Department of
Arts, Heritage and the Gaeltacht
ROO WEST TURLOUGH
VEGETATION COMMUNITIES
COUNTY GALWAY
0 60 120 180 m
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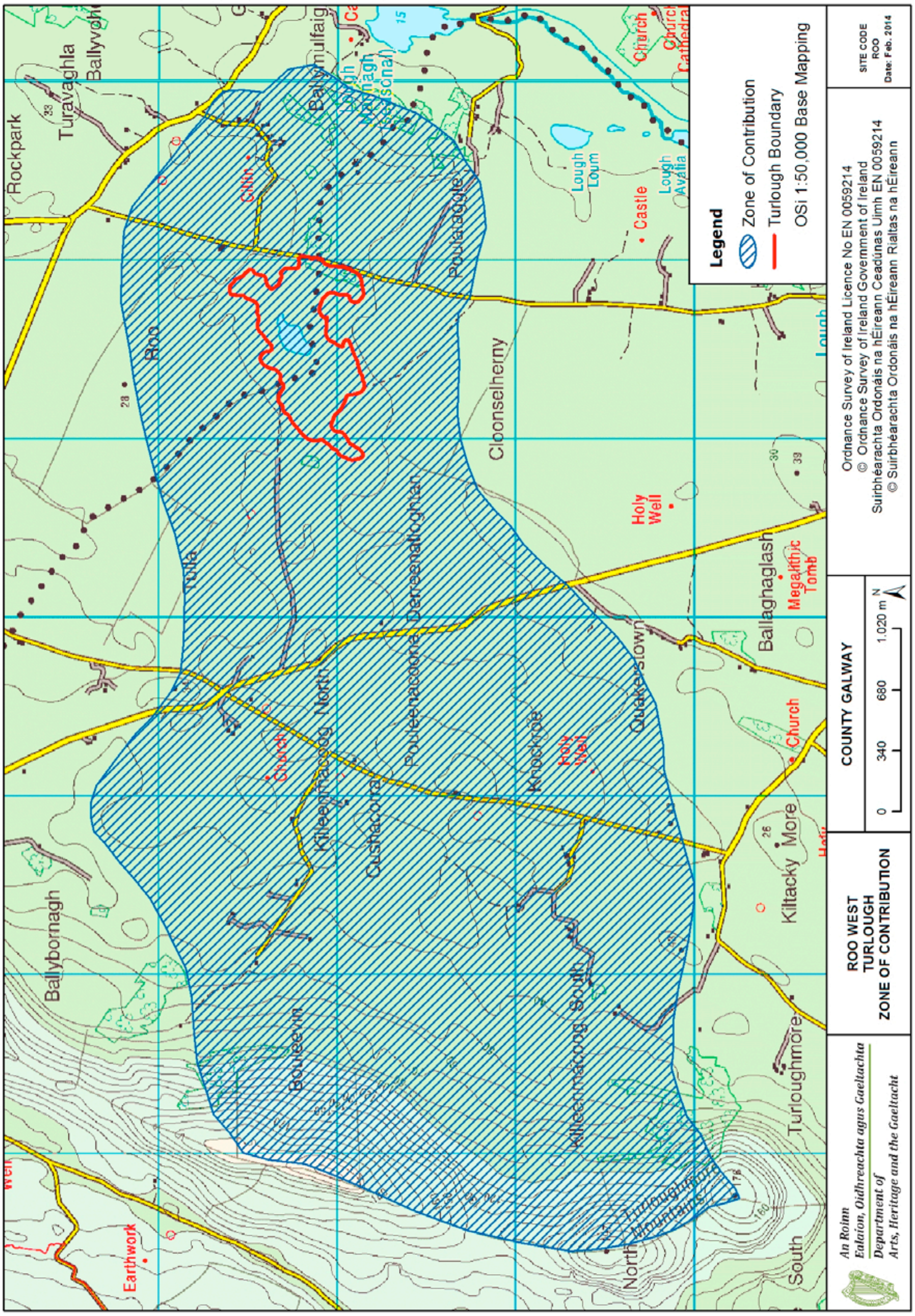
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ROO
Date: Feb. 2014
COUNTY GALWAY
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ROO WEST
TURLOUGH
ZONE OF CONTRIBUTION
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Department of
Arts, Heritage and the Gaeltacht
Rockpark
Turavaghla
Roo
Tulla
Cloonselherny
Poulataggle
Ballymulfaig
Lough Loum
Lough Avalia
Castle
Holy Well
Megalithic Tomb
Ballaghaglash
Quakerstown
Knockroe
Church
Kiltacky More
Killeenmacoog North
Killeenmacoog South
Cushacorra
Pouleenacoona Dereenatloghan
Ballybornagh
Bouleevin
Turloughmore
Turloughmore Mountains
Earthwork
North
South

Site Report: Skealoghan Turlough
TCD Turlough Research project 2006-2011

Turlough Project Code	SAC Name	SAC/NHA No.	County	Townland	RBD	Easting	Northing	Area (ha)
SKE	Skealoghan Turlough	000541	Mayo	Skealoghan	WESTERN	124750	262900	33

File update: July 2014 (S. Waldren)

Site Description

Skealoghan turlough, which has SAC status, is situated near Ballinrobe, south County Mayo not far from Kilglassan and Ardkill turloughs. This site generally has a broad, flat topography, with limestone out-crops occurring within the central, north and north-eastern areas. Twelve vegetation types were mapped within this site; the most extensive vegetation types were *Potentilla anserina-Carex nigra*, *Carex nigra-Carex-panicea* and *Lolium* grassland. Almost all of the turlough (87%) is under rotational grazing. Skealoghan soils are circumneutral and peaty, with low amounts of calcium carbonate. Skealoghan has extensive areas of 'Fen Peats' throughout the basin floor. 'Very shallow well drained organic soils' occur on the upper slopes. The turlough typically has one major flood event per annum, however the water level can vary markedly during the flooded period.

Skealoghan – photo: S. Kimberley

Phytoplankton

Phytoplankton analysis was conducted on sub-samples of monthly spot samples collected for hydrochemical analysis between October 2006 and June 2007. Phytoplankton composition varies significantly over time and data from autumn, mid-winter and spring/early summer are presented below. Taxa were identified to species level where possible. Some taxa were not discriminated beyond general groupings (i.e. small centric diatoms, dinoflagellates and pinnate diatoms). The term non-identifiable alone (or n.i.) was reserved for cases where specimens were not identifiable. Discrimination between n.i. filament, n.i. flagellate, n.i. colony, n.i. green filament was made when applicable. Biovolume (mm^3 m^{-3}) was used as the measure of algal biomass.

October 2006		January 2007		May 2007	
Biovolume (mm^3/m^3)	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*
Chlamydomonas	*916252*	*Fragilaria/Synedra*	*301441*	*Chroomonas acuta*	*39458*
Cryptomonas	*182664*	*Cryptomonas*	*97856*	*Cryptomonas*	*33600*
n.i. pennates	*32607*	*n.i. pennates*	*30569*	*Eunotia bilunaris*	*10208*
n.i.	*24051*	*Chroomonas acuta*	*9063*	*n.i. pennates*	*4498*
Mallomonas akrokomos	*16703*	*Achnanthidium minutissima*	*7874*	*Monoraphidium*	*3590*

Benthic Algae

Turloughs were inspected for algal mats during the emptying phase in 2007, 2008 and 2009. Turloughs were visited in the first two weeks of March to June 2007 as part of the monthly monitoring of turloughs. Dedicated trips to inspect for algal mats were conducted in 2008 on the 4th of March, the 1st of April, and the 26th, 27th and 28th of May, and in 2009 on the 15th and 16th of June and on the 24th and 25th of July. The presence of both living floating mats and dead drying mats was noted, as well as their extent in the turlough basins. Occurrence of visible filamentous algal mats in the three years of observation is presented below. Y = visible occurrence; * = "extensive cover" (estimated to be 2 to 8% of total area of basin); † = negligible quantity observed; • = turlough was too flooded to permit full observation. Algal mats were observed in Skealoghan in 2007 and 2008, these were extensive in 2007.

Year of Observation		
2007	2008	2009
Y*	Y	N

Hydrochemistry

Data shown are the mean ± SD of monthly spot samples collected between October 2006 and June 2007. Mean seasonal Total P and Chlorophyll *a* were used to determine the trophic status of the floodwaters based on OECD trophic categories. The median and range of <u>mean values</u> across all turloughs are also provided.

Hydrochemical Variable	Skealoghan Values		Turlough Summary Stats (n=22)		
	Mean±SD	OECD Trophic Category	Median	Min	Max
pH	8.1±0.2		8.1	7.7	8.3
Alkalinity mg l^{-1} $CaCO_3$	197.8±26.6		204.0	112.4	236.4
Colour mg l^{-1} PtCo	26.0±10.1		26.9	7.9	85.1
Molybdate Reactive Phosphorus µg l^{-1}	5.8±5.9		3.4	0.7	42.1
Total Phosphorus µg l^{-1}	20.4±6.2	Mesotrophic	24.8	4.0	82.1
Chlorophyll *a* µg l^{-1}	6.9±4.2	Mesotrophic	4.9	1.1	33.5
Nitrate-N mg l^{-1}	0.5±0.7		0.7	0.1	1.9
Total Nitrogen mg l^{-1}	0.9±0.7		1.2	0.6	2.3

Aquatic Invertebrates

22 turloughs were sampled for littoral aquatic macroinvertebrates using sweep nets during November 2006 and April 2007. Zooplankton samples were collected in April 2007. Open-water cladocerans and littoral chydorids were sampled using a zooplankton net and perspex tube respectively.

Aquatic Macroinvertebrates			
November 2006	**Count**	**April 2007**	**Count**
Agabus bipustulatus	1	*Asellus aquaticus*	28
Agabus sp. (larva)	7	*Cercyon tristis*	2
Anisoptera sp. (larva)	9	Chironomidae	6
Chaoboridae	1	*Cloeon dipterum*	97
Chironomidae	1	*Corixinae* Instar I & II	32
Cloeon dipterum	4	Curculionidae	2
Corixa punctata	1	Diptera Pupae	13
Culicidae	7	*Halticinae* sp.	6
Glossiphonia heteroclita	2	*Helophorus brevipalpis*	3
Haliplus lineatocollis	1	*Hydrachnidia* (Mite)	45
Haliplus sp. (larva)	1	*Hydroporus erythrocephalus*	6
Hydaticus sp. (larva)	12	*Hygrotus impressopunctatus*	2
Hydrachnidia (Mite)	5	*Hygrotus inaequalis*	16
Hydroporus obscurus	1	*Hyphydrus ovatus*	9
Ilybius sp. (larva)	13	*Ilybius* sp. (larva)	4
Limnephilidae sp. Instar II	38	*Laccobius biguttatus*	2
Limnephilidae sp. Instar III	15	*Laccophilus minutus*	2
Limnephilus auricula	1	*Lestes* sp.	13
Limnephilus decipiens	1	*Limnephilus centralis*	2
Limnephilus lunatus	3	*Lymnaea peregra*	2
Limnephilus marmoratus	17	*Lymnaea stagnalis*	9
Lymnaea peregra	1	*Lymnaea trunculata*	2
*Lymnaea truncula*ta	3	*Notonecta glauca*	2
Oligochaeta	27	Notonectidae sp. (larva)	47
Ostracoda	4	Ostracoda	24
Phacopteryx brevipennis	5	*Pisidium/Sphaerium* spp.	9
Physa fontinalis	2	*Planorbis crista*	28
Pisidium/Sphaerium spp.	2	*Polycelis nigra/tenuis*	28
Planorbis crista	11	*Porhydrus lineatus*	4
Polycelis nigra/tenuis	29	*Rhantus* sp. (larva)	6
Psychodidae	1	*Sigara limitata*	2
Rhantus sp. (larva)	7	*Sympetrum sanguinem*	82
Sigara nigrolineata	1	*Triaenodes bicolor*	39
Succinea sp.	1		
Tipulidae	1		
Valvata cristata	5		

Aquatic Macroinvertebrates: Presence of high abundances (> 50 individuals) of Odonata and Trichoptera (> 50 individuals) indicates nutrient poor conditions.

Aquatic Macroinvertebrate Taxa	**Presence of high abundances**	
	November 2006	**April 2007**
Diptera	N	N
Ostracoda	N	N
Odonata	N	Y
Trichoptera	Y	Y

Zooplankton species
Alona affinis
Alona excisa
Alona quadrangularis
Alonella excisa
Chydorus latus
Chydorus sphaericus
Daphnia pulex
Eurycercus glacialis
Eurycercus lamellatus
Graptoleberis testudinaria
Lathurona rectirostris
Pleuroxus laevis
Pleuroxus trigonellus
Simocephalus vetulus

Vegetation

Vegetation description and classification yielded 25 vegetation communities suitable for mapping. Twelve vegetation communities were recorded in Skealoghan, the most extensive vegetation types was *Potentilla anserina-Carex nigra*, with large amounts of *Carex nigra-Carex-panicea* and *Lolium* grassland. High conservation value communities are denoted by *. Eighty plant species were recorded.

Vegetation Community	**Area (Ha)**
A. stolonifera-P. anserina - F. rubra	0.6
Carex nigra-C. panicea	4.62
Carex nigra-Equisetum fluviatile	1.02
Carex nigra-R. flammula	2.72
E. palustris-P. arundinacea	0.17
Limestone grassland	1.88
Lolium grassland	3.43
**Molinia caerulea-Carex panicea*	1.86
Open water	0.08
Other/unknown	0.6
P. anserina-Carex nigra	13.57
Polygonum amphibium	0.82
Reedbed	1.08
Woodland/scrub	0.7
Number of vegetation communities	12
Number of plant species	80

Vascular Plant Species

Nomenclature follows Parnell, J & Curtis, T. (2012) *Webb's An Irish Flora*, University of Cork Press.

Achillea millefolium	*Equisetum arvense*	*Polygonum persicaria*
Agrostis stolonifera	*Equisetum fluviatile*	*Potamogeton natans*
Alisma plantago-aquatica	*Eriophorum angustifolium*	*Potentilla anserina*
Alopecurus geniculatus	*Euphrasia* species	*Potentilla erecta*
Apium nodiflorum	*Festuca arundinacea*	*Potentilla palustris*
Baldellia ranunculoides	*Festuca rubra*	*Prunella vulgaris*
Bellis perennis	*Filipendula ulmaria*	*Ranunculus acris*
Briza media	*Galium palustre*	*Ranunculus flammula*
Callitriche sp.	*Galium verum*	*Ranunculus fluitans*
Cardamine pratensis	*Glyceria fluitans*	*Ranunculus repens*
Carex disticha	*Hydrocotyle vulgaris*	*Ranunculus species*
Carex flacca	*Hypochaeris radicata*	*Rhinanthus minor*
Carex hirta	*Juncus articulatus*	*Rumex conglomeratus*
Carex hostiana	*Leontodon autumnalis*	*Rumex crispus*
Carex nigra	*Leontodon hispidus*	*Schoenoplectus lacustris*
Carex panicea	*Leontodon saxatilis*	*Senecio aquaticus*
Carex pulicaris	*Lolium perenne*	*Sparganium emersum*
Carex rostrata	*Lotus corniculatus*	*Stellaria palustris*
Carex vesicaria	*Mentha aquatica*	*Succisa pratensis*
Centaurea nigra	*Menyanthes trifoliata*	*Taraxacum officinale* agg.
Chara species	*Molinia caerulea*	*Trifolium repens*
Cirsium dissectum	*Nardus stricta*	*Veronica scutellata*
Cynosurus cristatus	*Parnassia palustris*	*Veronica serpyllifolia*
Dactylorhiza incarnata	*Phalaris arundinacea*	*Veronica species*
Daucus carota	*Plantago lanceolata*	*Vicia cracca*
Deschampsia cespitosa	*Plantago maritima*	*Zannichellia palustris*
Eleocharis palustris	*Polygonum amphibium*	

Soils and Grazing

Soils were classified using a modified version of soil categories generated by the Teagasc/EPA Soils and Subsoils Mapping project (Fealy *et al.*, 2009). The classification scheme principally uses parent material (calcareous/non-calcareous), depth class (shallow/deep) and drainage class (well drained/poorly drained) to assign soils to one of nine broad categories. Skealoghan has extensive areas of Fen Peats, while very shallow well-drained organic soils occupy the upper slopes. The mean ± SD of a range of soil properties are also provided, in addition to the median and range of each variable across turloughs. Skealoghan soils are circumneutral and peaty, with low amounts of calcium carbonate.

Soil Types/Grazing Extent	% Turlough Area
Very shallow well drained organic	35.1
Fen peat	64.9
Extent of rotationally grazed area	87

Soil Property (n=6)	Skealoghan	Turlough Summary Stats (n=22)		
	Mean ± SD	Median	Min	Max
pH	7.03 ± 0.7	7.20	5.94	8.29
% Organic Matter content	53.4 ± 25.4	25.8	10.2	69.1
% Inorganic content	39.9 ± 26.2	43.2	25.7	85.0
% Calcium carbonate content	6.72 ± 6.2	11.3	2.48	43.7
Total Nitrogen mg kg^{-1}	22383 ± 10719	11142	4983	24233
Total Phosphorus mg kg^{-1}	1059 ± 288	905	245	1594

Hydrology

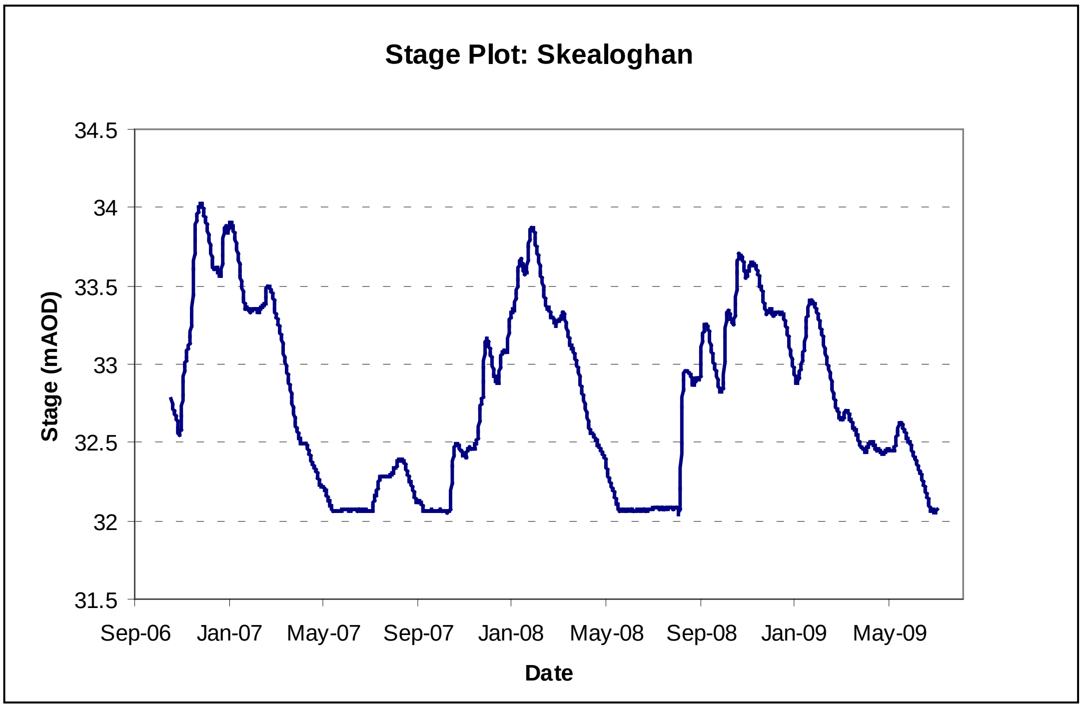
Water levels were recorded at hourly intervals using a variety of Schlumberger Divers® (Marton Geotechnical Ltd, Suffolk, UK) placed at or near the lowest point in each turlough. Divers measure the pressure of the water and air column above them, and from this the depth of water can be calculated. GPS surveys were carried out on 21 monitoring sites (Tullynafrankagh omitted) in order to develop digital terrain models (DTMs) from which contour maps, stage-volume and stage-surface area relationships are produced. The inflow magnitude is indicative of the properties of a turlough's catchment area and flow capacity, while outflow is a function of the drainage capacity of the system.

Despite being relatively shallow, Skeaoghan typically has one major flood event per annum, however the water level can vary markedly during the flooded period. The drainage capacity is very low.

Skealoghan is hydrologically linked with Kilglassan, and to a lesser degree with Ardkill. Kilglassan and Skealoghan show very similar profiles of water depth, albeit with time lags which vary throughout the year (for further details see *Chapter 2: Hydrology*).

Hydrological Information	Skealoghan Values	Turlough Summary Stats (n=21)		
		Median	Min	Max
Start of Hydrological Recording	06/11/2006	-	-	-
End of Hydrological Recording	08/07/2009	-	-	-
Days Recorded	975	-	-	-
Equipment Failure	None recorded	-	-	-
Hydroperiod (days)	213	213	135	348
Maximum Floodwater Depth (m)	3.2	4.9	3	15.4
Maximum Floodwater Volume ('000 m^3)	382.2	877.9	355.6	4008.1
Maximum Flooded Area (ha)	32.68	38.61	13.71	78.12
Average Basin Depth (m)	1.17	2.28	0.85	6.76
Average Daily Inflow (m^3 s^{-1})	0.5	0.684	0.254	10.253
Average Daily Outflow (m^3 s^{-1})	0.166	0.271	0.086	2.018
Drainage Capacity (m^3 s^{-1})	0.069	0.154	0.069	1.156
Recession Duration (days)	64.1	57.3	11	142.5

Stage plot for Skealoghan turlough



Zone of Groundwater Contribution (ZOC) Risk Assessments

GIS based risk assessments were conducted with a view to identifying turloughs at risk of failing to meet WFD water quality objectives. These risk assessments were conducted by Compass Informatics Ltd and were based on Risk Assessment Sheet GWDTERA2a (Guidance Document No. GW9) on assessing risks to turloughs from phosphate (Working Group on Groundwater 2004) and Pathway Susceptibilities and Pressure Magnitudes were integrated to produce Impact Potential maps and predicted Risk Categories for the turlough ZOC. The TCD Risk Category is derived from a revised Impact Potential matrix. The predicted Risk Categories were adjusted using mean seasonal floodwater Total P (µg l^{-1}) (see Section 4.5.4 of the Risk Assessment Sheet GWDTERA2a). The risk categories include 1A: at significant risk; 1B: probably at significant risk; 2A: Not at significant risk (low confidence); 2B: Not at significant risk (higher confidence).

ZOC Area (Km^2)	Predicted WFD Risk Category	Adjusted WFD Risk Category	Predicted TCD Risk Category	Adjusted TCD Risk Category
9	2A	1A	1B	1A

ZOC Pressure Variable	
CORINE BARE ROCK %	0
CORINE PEAT BOGS%	0
CORINE ALL NATURAL AND SEMI-NATURAL AREAS%	4
CORINE IMPROVED PASTURE%	75
CORINE UNIMPROVED PASTURE%	15
CORINE ALL PASTURE%	90
CORINE OTHER AGRICULTURAL LANDS%	7
TEAGASC/EPA HABITATS ROCK%	0
TEAGASC/EPA HABITATS BOGS/PEATS%	0
TEAGASC/EPA HABITATS FORESTS/SCRUBS%	1
TEAGASC/EPA HABITATS WATER%	1
TEAGASC/EPA HABITATS DRY GRASSLAND%	97
TEAGASC/EPA HABITATS WET GRASSLAND%	2
TEAGASC TOTAL GRASSLAND%	99
TOTAL LIVESTOCK UNIT/ha of ZOC	1
TILLAGE%	1
No. SEPTIC TANKS km^{-2} ZOC	7
No. SEPTIC TANKS km^{-2} EXTREME PATHWAY SUSCEPTIBILITY	3
HIGH PATHWAY SUSCEPTIBILITY%	0
EXTR+HIGH PATHWAY SUSCEPTIBILITY%	12
WELL DRAINED SOIL %	96
POORLY DRAINED SOIL%	4

Site Conservation Assessment

The following site conservation assessment was undertaken to feed into the national reporting structure for assessing conservation status as required under Article 17 of the Habitats Directive. A suite of indicators and associated targets were derived to assess ecological structure and function. Future prospects were assessed through the evaluation of the impact of current and recent pressures and likely future threats to the site. The assessment follows a rules based approach to determine whether Structures & functions and Future Prospects should be assessed as good (green), inadequate (amber) or bad (red). For further details, see Chapter 10 (Conservation Status Assessment).

Please note an updated approach to assessing site condition has been proposed and is outlined in Chapter 12 (Monitoring Methods for Turloughs).

Conservation Condition Summary

Structure & Function	**Inadequate**
Future Prospects	**Inadequate**
Site Conservation Condition	**Inadequate**

Structure and Function Status:

Indicator	*Comments*
Hydrological Function: *Good*	
Water Quality: *Good/Intermediate*	20.4 µg P l^{-1}. Borderline good/intermediate
Biological Responses: *Intermediate*	Mixed – algal communities reflecting enrichment, but otherwise contains important species
Algal communities: -2	Extensive algal mats were recorded, and max CHL is high
Vegetation communities: 0	Relatively low cover of both positive and negative indicators
***Rumex* cover: 1**	6.9%
Important plants: 1	*Plantago maritima*
Important aquatic invertebrates: 1	*Alonella exisa, Eurycercus glacialis*
Overall Structure & Function: *Inadequate*	Rather mixed

Pressures:

Code	*Impact*	*Notes*
H02.06 Diffuse groundwater pollution due to agricultural and forestry activities (ZOC)	M	Moderate to high nutrient levels in groundwater likely due to agricultural inputs
A04.01.01 Intensive cattle grazing (turlough)	M	Moderate grazing levels over the majority of the turlough
A05.02 Stock feeding (within and adjacent to turlough)	L	Some evidence of stock feeding adjacent to the turlough
A08 Fertilisation (within turlough)	L	Some evidence of fertilizer inputs directly into the turlough

Threats:

Code	Impact	Notes
H02.06 Diffuse groundwater pollution due to agricultural and forestry activities (ZOC)	M	Ongoing pressure, which might increase due to agricultural intensification
A04.01.01 Intensive cattle grazing (turlough)	M	Ongoing pressure
A02.03 Grassland removal for arable land (ZOC)	M	Likely threat as the ZOC contains large amount of pasture
A02.01 Agricultural intensification (ZOC)	L	Potential agricultural intensification in ZOC; major impacts likely to be via groundwater nutrient levels. May counter any attempts to address nutrients within the turlough
M01.03 Flooding and rising precipitations	L	
A10.02 Removal of stone walls and embankments (in turlough)	L	

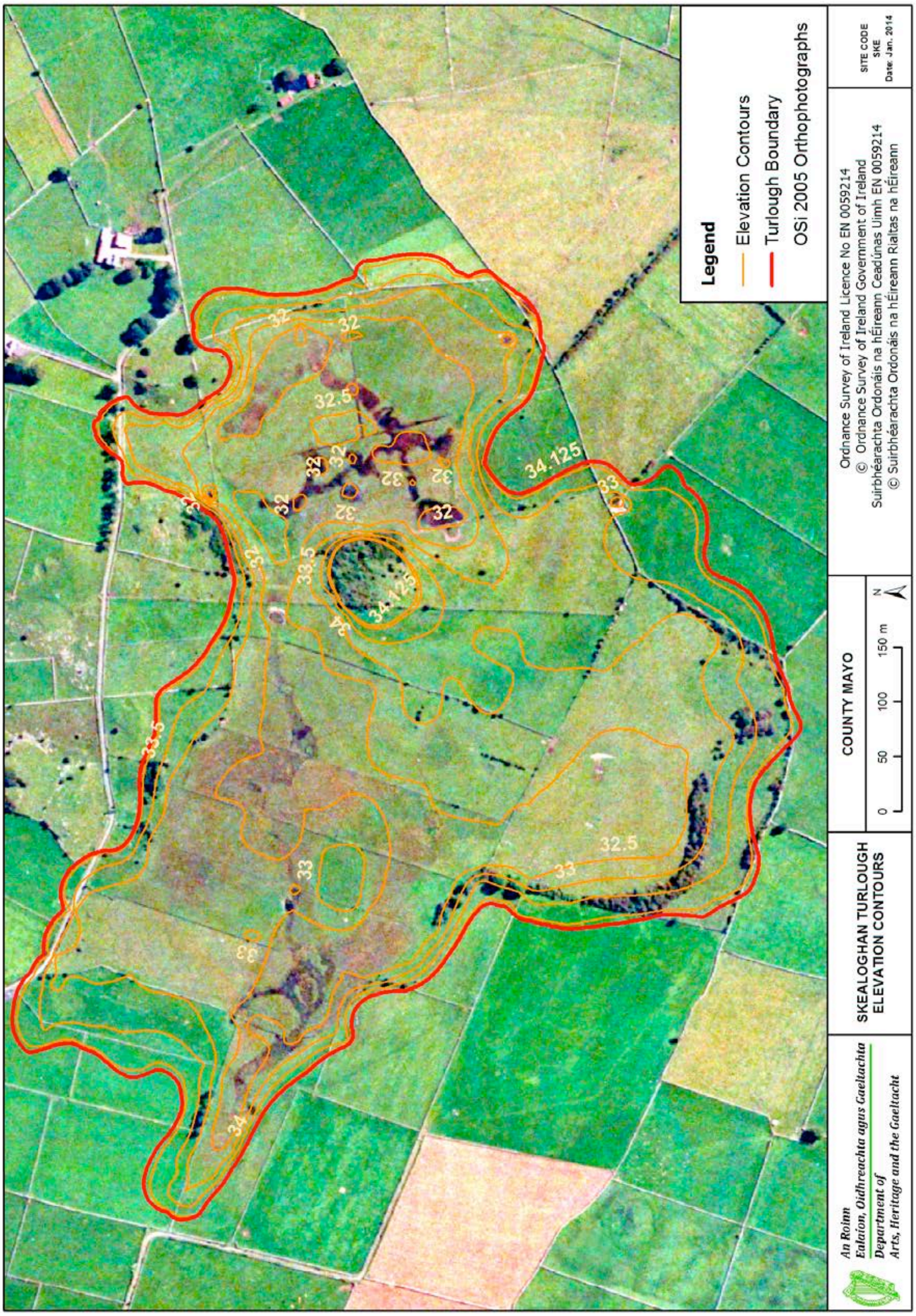
Future Prospects: **Inadequate** – the main problem is relatively high levels of grazing and agricultural inputs that are likely to persist. Direct fertiliser input to the turlough should cease through effective management of the SAC, but the relative contributions of local and ZOC agricultural inputs needs to be determined in order for effective methods to be devised to mitigate the threats.

Overall Assessment: **Inadequate** – Skealoghan faces pressures which have impacted on the ecological functioning of the turlough and most of which are likely to persist as threats. These impacts are mainly from agriculture both locally and within the ZOC; as mentioned above the relative contributions of these need to be assessed to help devise prescriptive conservation management to improve the conservation status. Despite these impacts, Skealoghan retains consdierable biological interest.

Maps

Maps are provided of:

1. Elevation contours, based on GIS digital terrain models from points by differential GPS topographic survey (for further details, see *Chapter 3: Hydrology*)
2. Grazing in land parcels
3. Approximate sampling points for water chemistry and aquatic invertebrates
4. Soil nutrient sampling points
5. Points for soil survey (note: soils were surveyed to the turlough boundary defined by Goodwillie, 1992; see map 9)
6. Soils (note: soils were mapped by combining the EPA Subsoils base map with the point soil descriptions; for further details see *Chapter 6: Soils and Landuse*)
7. Vegetation relevés
8. Vegetation communities (note: relevés do not always match to mapped communities due to small scale variation; for further details of mapping see *Chapter 7: Turlough Vegetation: Description, Mapping and Ecology*)
9. Vegetation maps digitised from Goodwillie, R. (1992) *Turlough's Over 50 Hectares*. Report to NPWS
10. Estimated zone of groundwater contribution (ZOC)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Turlough Boundary
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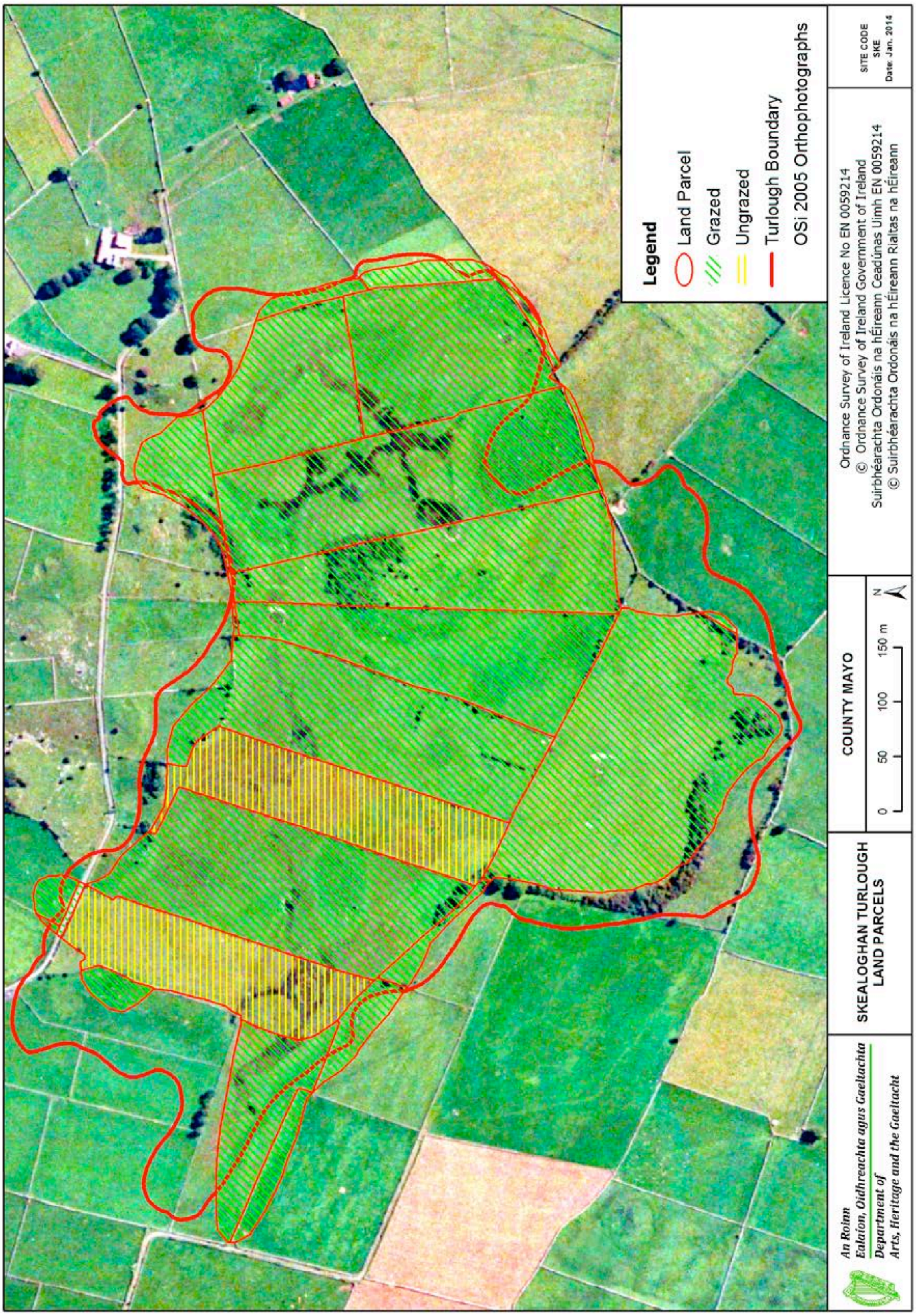
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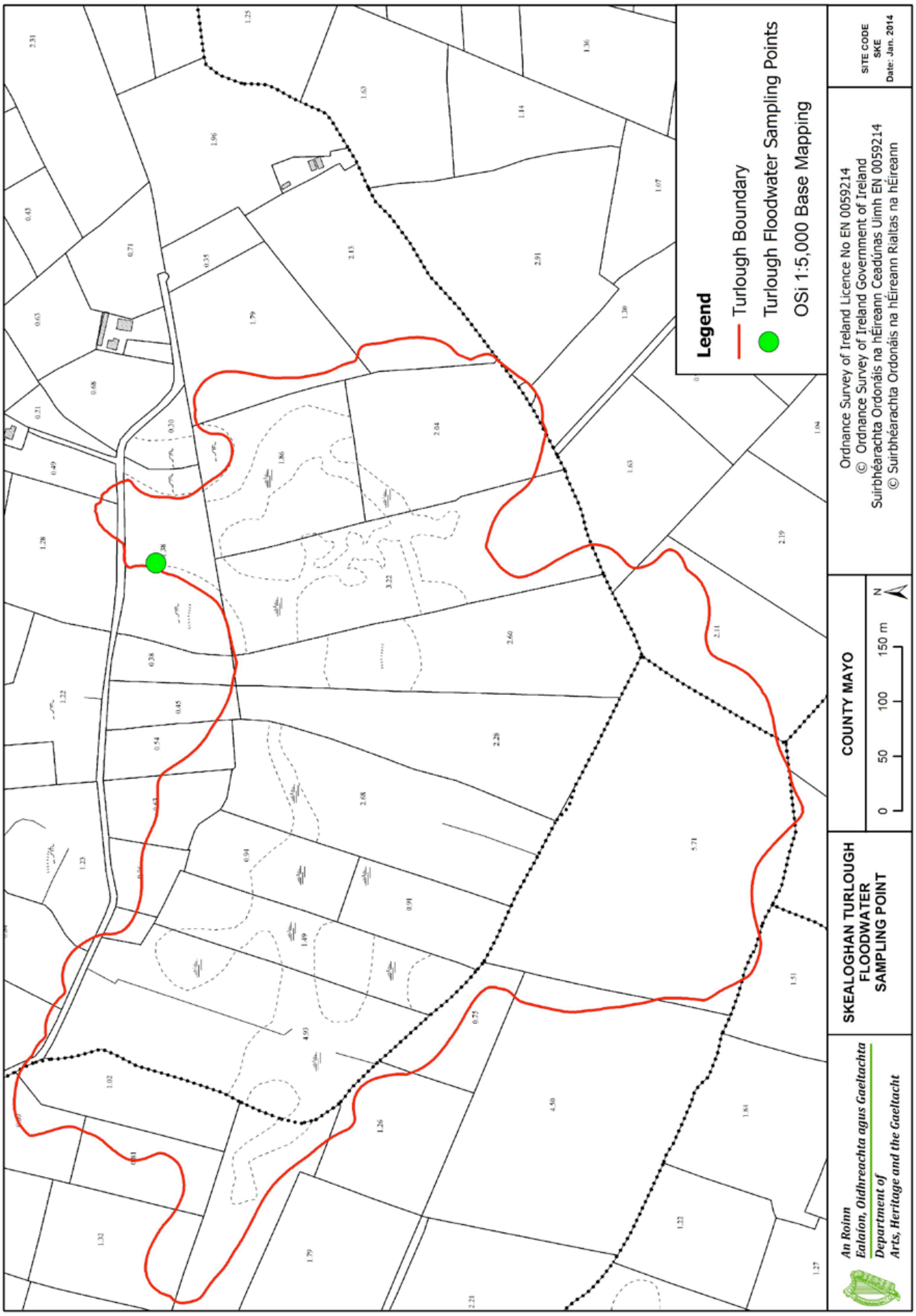

Legend
Turlough Boundary
Turlough Floodwater Sampling Points
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COUNTY MAYO
0 50 100 150 m
N
SKEALOGHAN TURLOUGH
FLOODWATER
SAMPLING POINT
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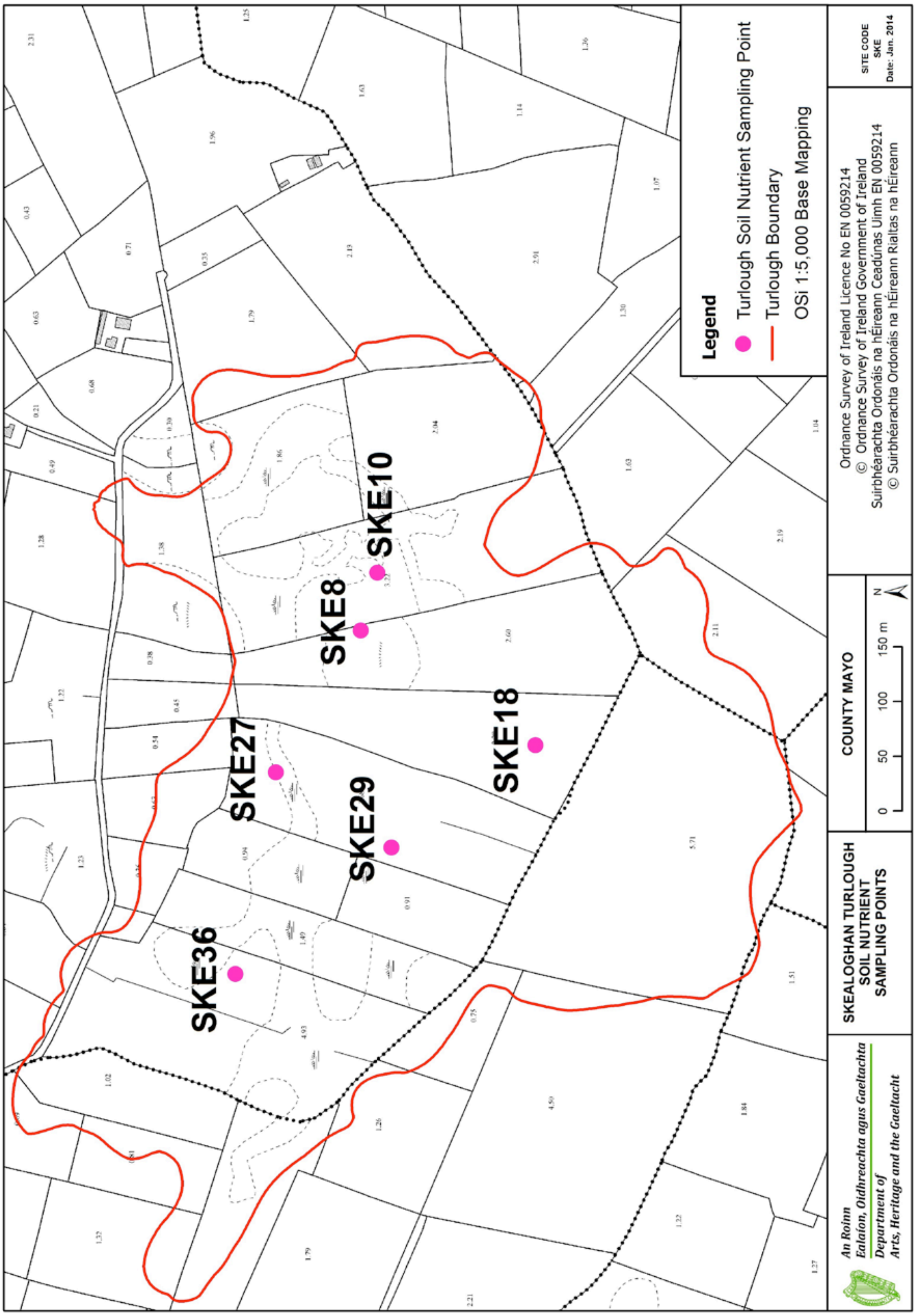
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Turlough Soil Nutrient Sampling Point
Turlough Boundary
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SITE CODE
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Date: Jan. 2014
COUNTY MAYO
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SKEALOGHAN TURLOUGH
SOIL NUTRIENT
SAMPLING POINTS
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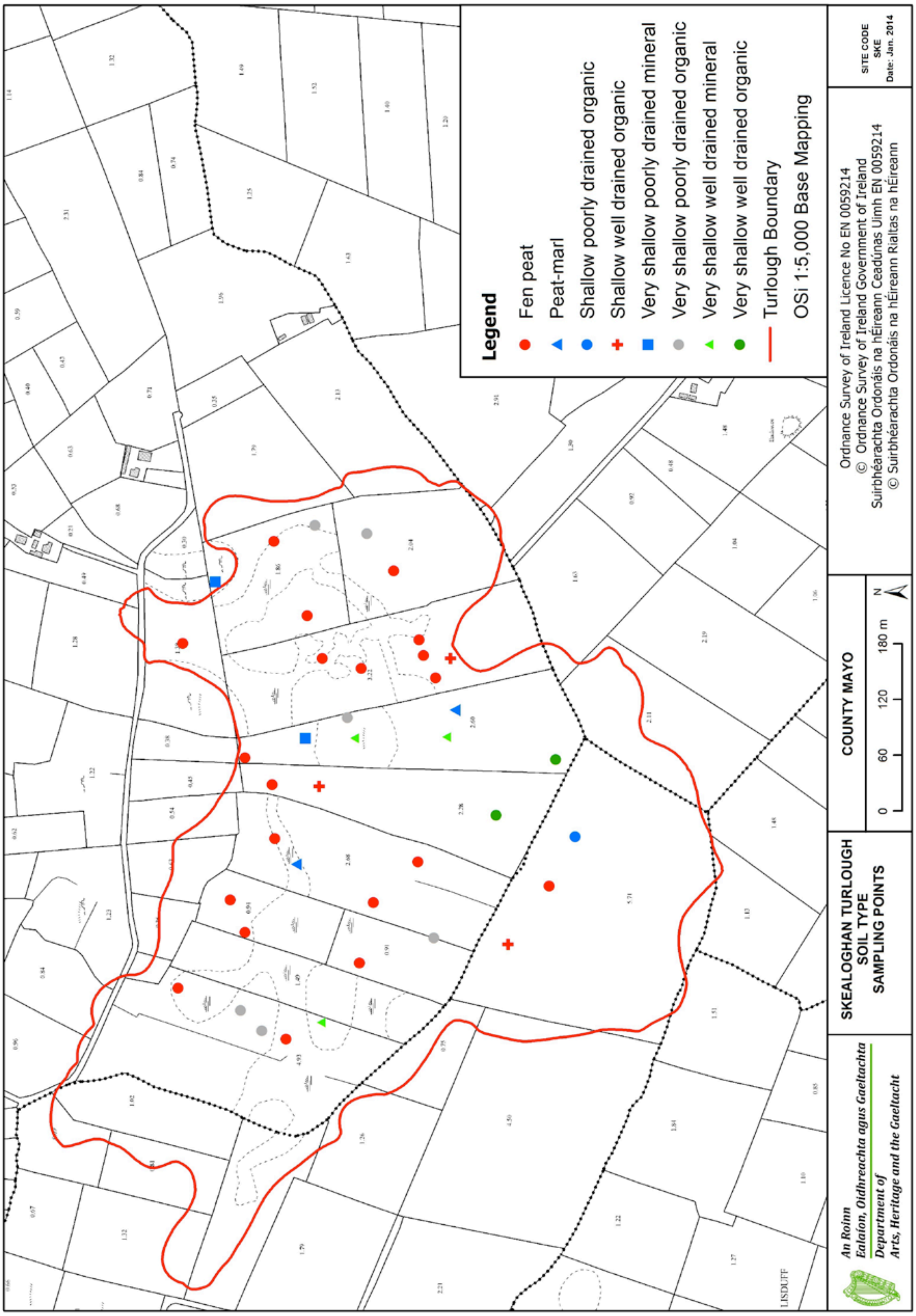
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Fen peat
Peat-marl
Shallow poorly drained organic
Shallow well drained organic
Very shallow poorly drained mineral
Very shallow poorly drained organic
Very shallow well drained mineral
Very shallow well drained organic
Turlough Boundary
OSi 1:5,000 Base Mapping
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SKEALOGHAN TURLOUGH
SOIL TYPE
SAMPLING POINTS
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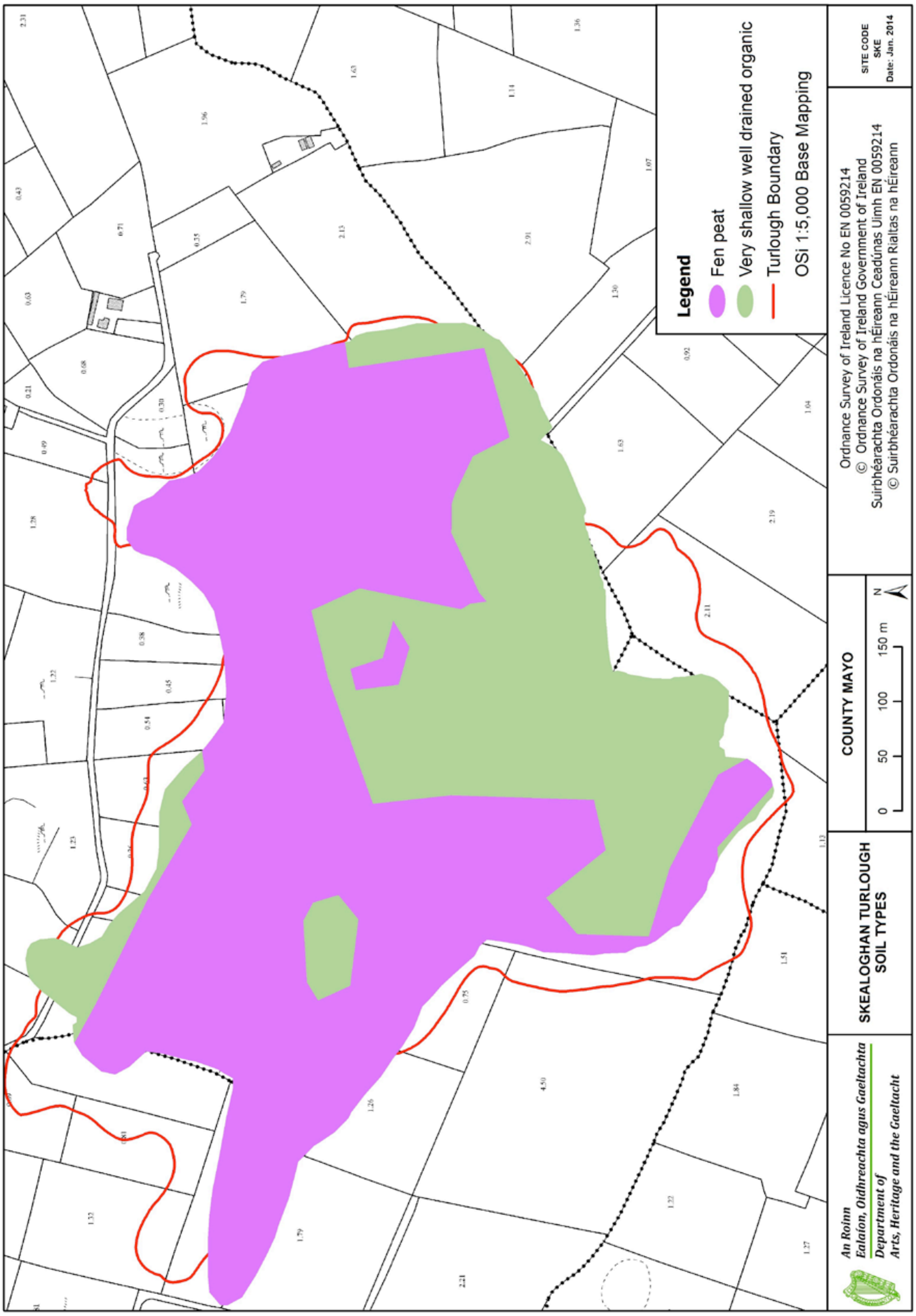
Legend
Fen peat
Very shallow well drained organic
Turlough Boundary
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COUNTY MAYO
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SKEALOGHAN TURLOUGH
SOIL TYPES
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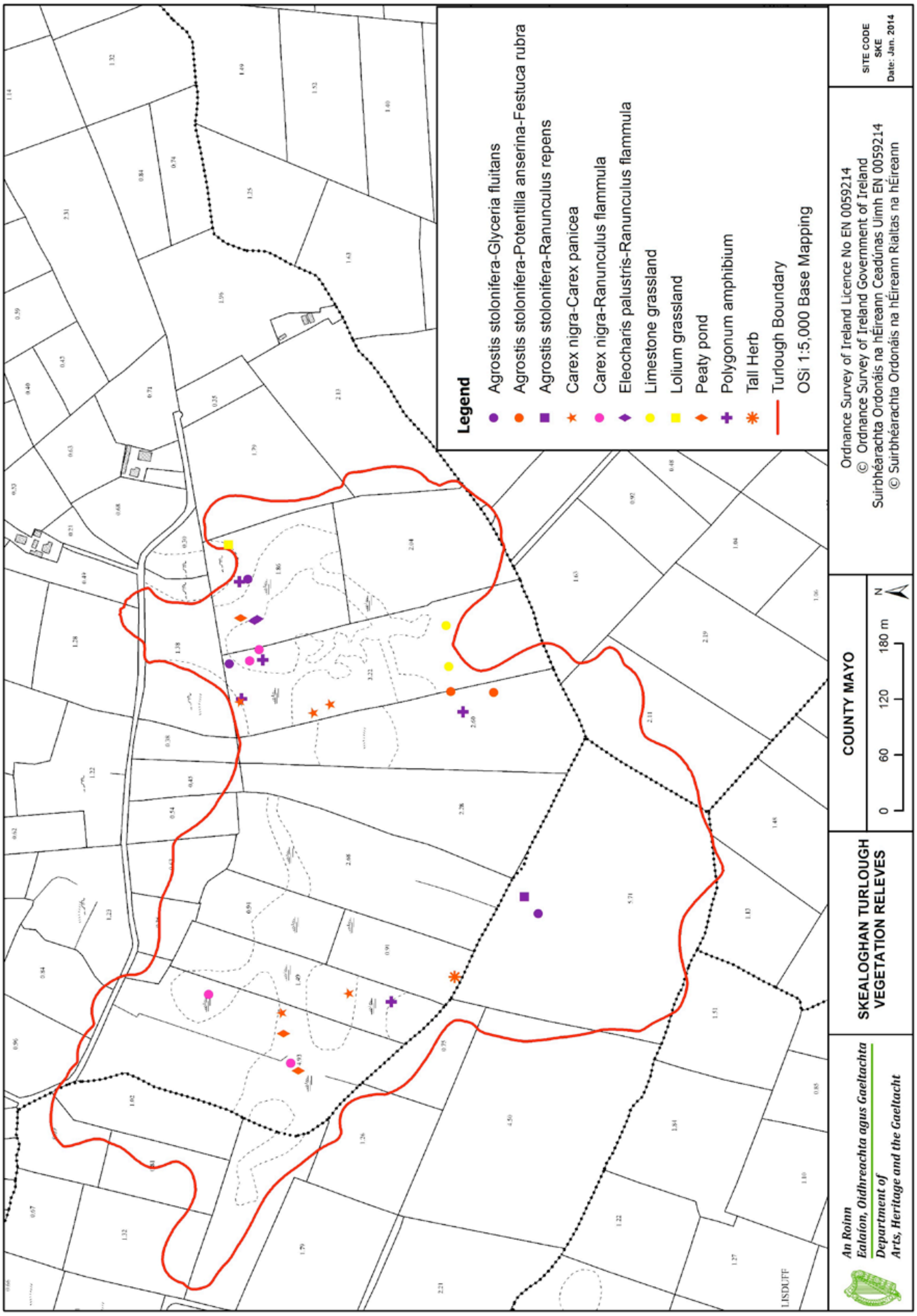
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Agrostis stolonifera-Glyceria fluitans
Agrostis stolonifera-Potentilla anserina-Festuca rubra
Agrostis stolonifera-Ranunculus repens
Carex nigra-Carex panicea
Carex nigra-Ranunculus flammula
Eleocharis palustris-Ranunculus flammula
Limestone grassland
Lolium grassland
Peaty pond
Polygonum amphibium
Tall Herb
Turlough Boundary
OSi 1:5,000 Base Mapping
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Date: Jan. 2014
COUNTY MAYO
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SKEALOGHAN TURLOUGH
VEGETATION RELEVES
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht
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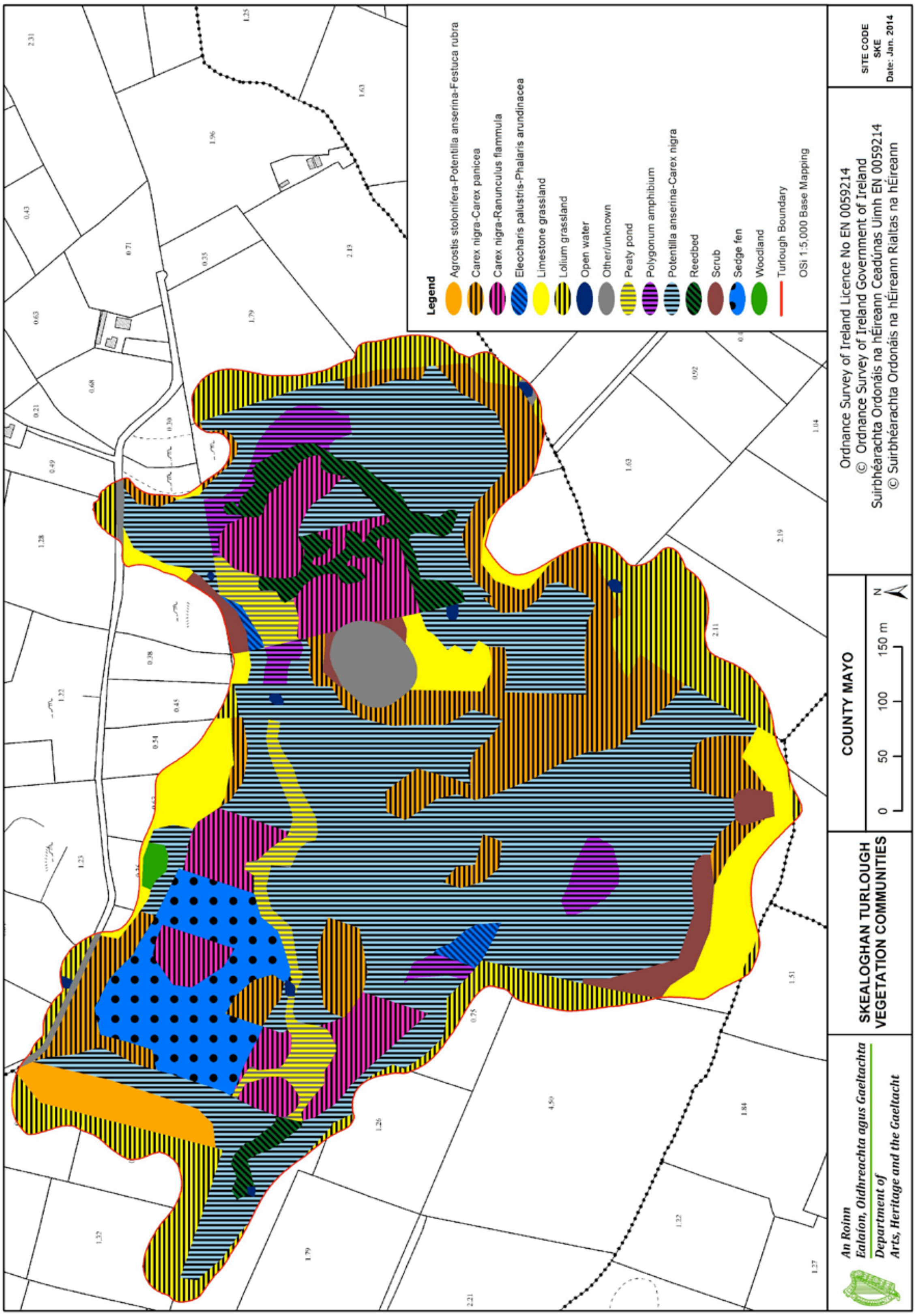
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Agrostis stolonifera-Potentilla anserina-Festuca rubra
Carex nigra-Carex panicea
Carex nigra-Ranunculus flammula
Eleocharis palustris-Phalaris arundinacea
Limestone grassland
Lolium grassland
Open water
Other/unknown
Peaty pond
Polygonum amphibium
Potentilla anserina-Carex nigra
Reedbed
Scrub
Sedge fen
Woodland
Turlough Boundary
OSi 1:5,000 Base Mapping
SITE CODE
SKE
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COUNTY MAYO
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SKEALOGHAN TURLOUGH
VEGETATION COMMUNITIES
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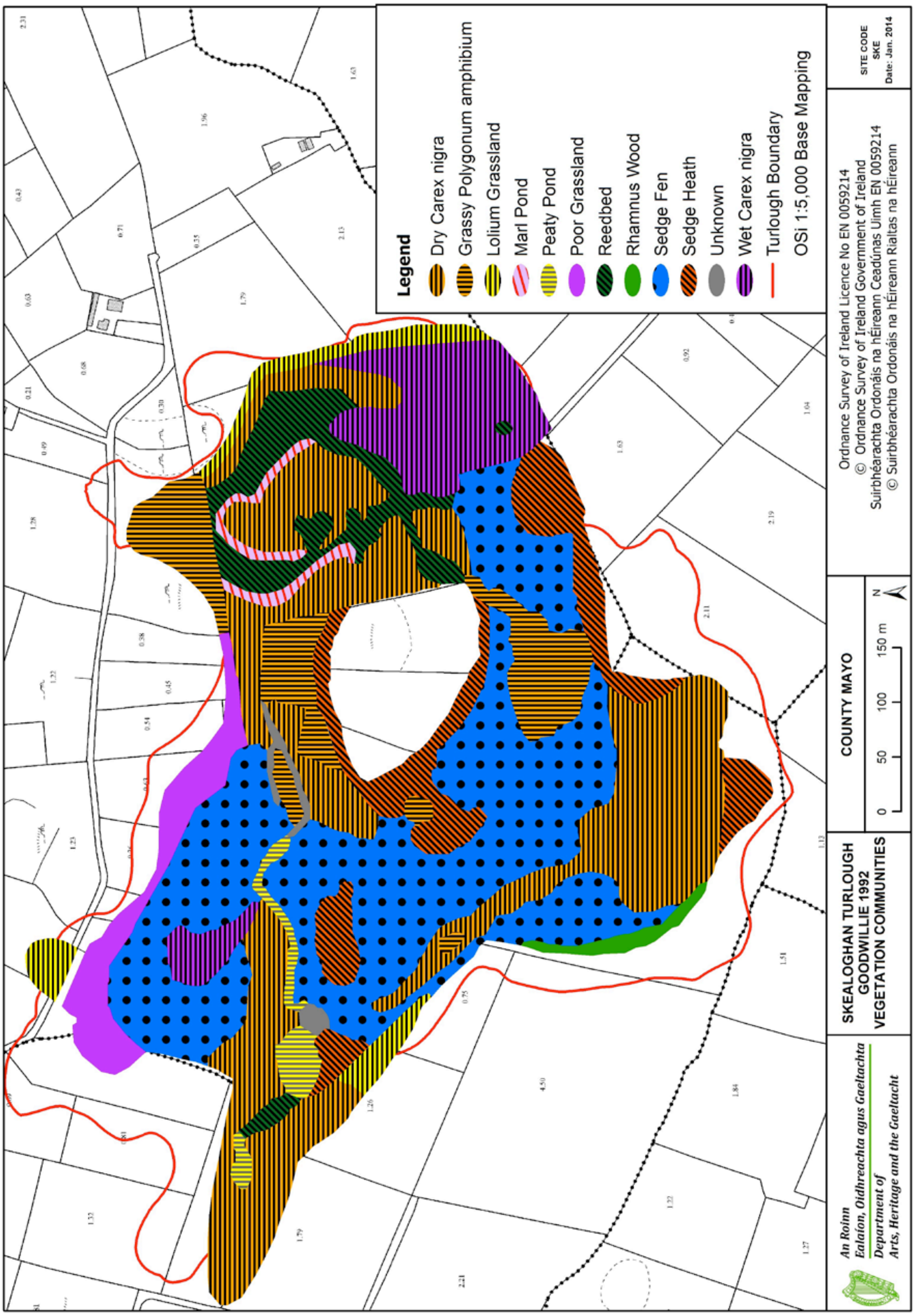
Legend
Dry Carex nigra
Grassy Polygonum amphibium
Lolium Grassland
Marl Pond
Peaty Pond
Poor Grassland
Reedbed
Rhamnus Wood
Sedge Fen
Sedge Heath
Unknown
Wet Carex nigra
Turlough Boundary
OSi 1:5,000 Base Mapping
SITE CODE
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SKEALOGHAN TURLOUGH
GOODWILLIE 1992
VEGETATION COMMUNITIES
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
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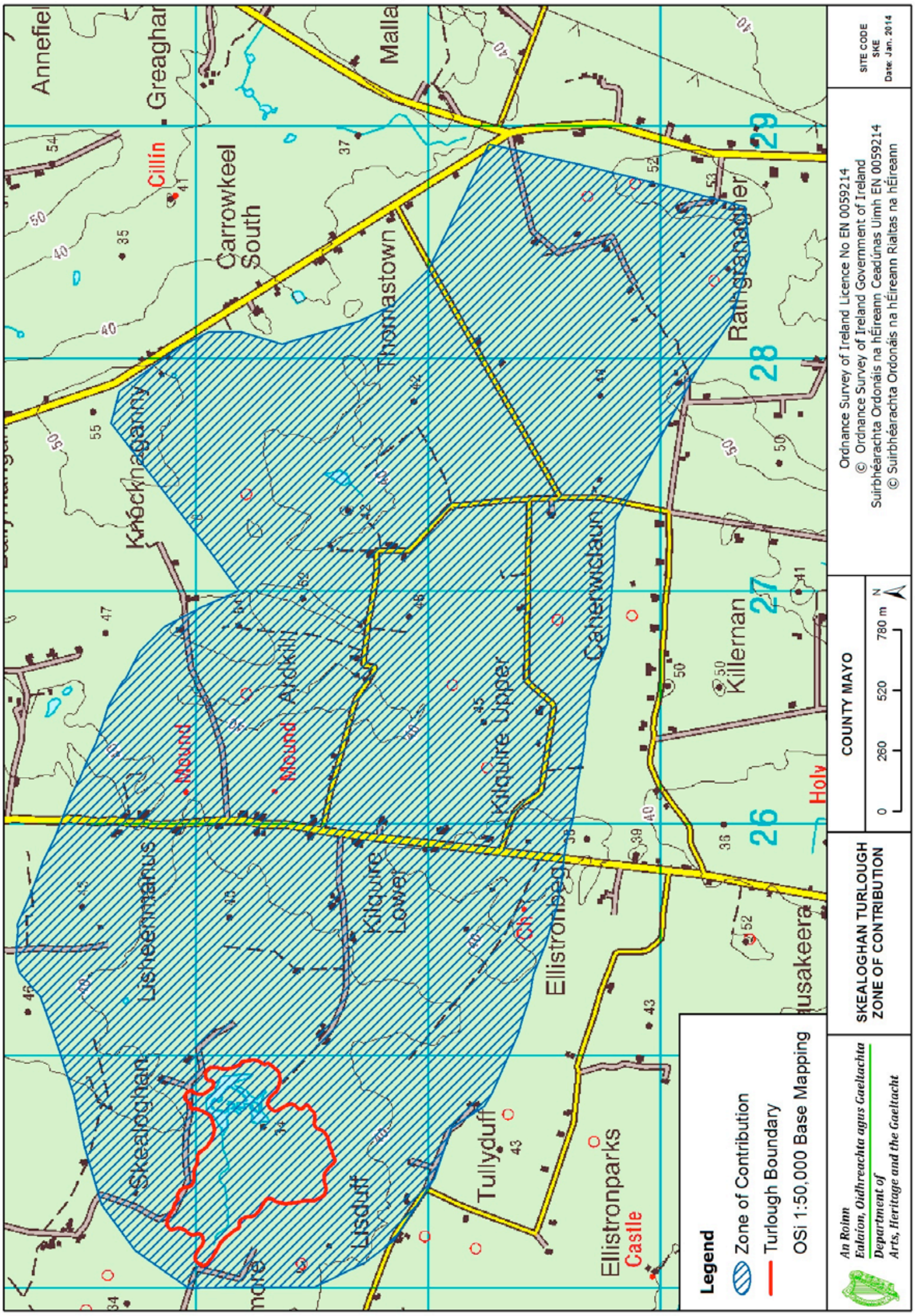
Legend
Zone of Contribution
Turlough Boundary
OSi 1:50,000 Base Mapping
SKEALOGHAN TURLOUGH
ZONE OF CONTRIBUTION
COUNTY MAYO
0 260 520 780 m
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SITE CODE
SKE
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Skealoghan
Lisduff
Tullyduff
Ellistronparks
Castle
Ellistronbeg
Kilquire Lower
Kilquire Upper
Caherwalaun
Killernan
Ardkill
Mound
Knocknagarny
Thomastown
Rathgranagher
Carrowkeel South
Cillín
Greaghan
Annefiel
Malla
Usheenmanus
Ch
Holy
26
27
28
29

Site Report: Termon Turlough
TCD Turlough Research project 2006-2011

Turlough Project Code	SAC Name	SAC/NHA No.	County	Townland	RBD	Easting	Northing	Area (ha)
TER	Termon	001321	Galway	Termon	WESTERN	140920	197350	42

File update: July 2015 (S. Waldren)

Site Description

Termon turlough, a designated SAC, lies to the east of Lough Bunny (Co. Galway). It consists of a relatively flat basin, surrounded by drift-covered slopes and a limestone outcrop to the northern end. The extent of the turlough is 42.0 ha. This turlough rarely dries out, and of the eight vegetation communities mapped here, by far the most dominant was the Reedbed community. Termon soils are alkaline and organic, with significant amounts of calcium carbonate. The dominant soil type is alluvial marl. Rotational grazing is carried out on a small proportion of the turlough (12%). While this turlough does not dry out, the hydrological data show that there is an annual peak in water levels over the winter months, with a gradual lowering of the water level until it starts to slowly rise again.

Termon – photo: S. Kimberley

Phytoplankton

Phytoplankton analysis was conducted on sub-samples of monthly spot samples collected for hydrochemical analysis between October 2006 and June 2007. Phytoplankton composition varies significantly over time and data from autumn, mid-winter and spring/early summer are presented below. Taxa were identified to species level where possible. Some taxa were not discriminated beyond general groupings (i.e. small centric diatoms, dinoflagellates and pinnate diatoms). The term non-identifiable alone (or n.i.) was reserved for cases where specimens were not identifiable. Discrimination between n.i. filament, n.i. flagellate, n.i. colony, n.i. green filament was made when applicable. Biovolume (mm^3 m^{-3}) was used as the measure of algal biomass.

October 2006		**January 2007**		**May 2007**	
Biovolume (mm^3/m^3)	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*
Chroomonas acuta	518	*Chroomonas acuta*	214562	*Dinobryon*	754535
n.i. pennates	205	*Achnanthidium minutissima*	35995	*Achnanthidium minutissima*	203250
Cryptomonas	119	*Cryptomonas*	30240	*Chroomonas acuta*	104558
Oocystis solitaria	85	*n.i. pennates*	23092	*n.i. pennates*	55106
Eunotia bilunaris	63	*Eunotia minor*	6829	*Cryptomonas*	50400

Benthic Algae

Turloughs were inspected for algal mats during the emptying phase in 2007, 2008 and 2009. Turloughs were visited in the first two weeks of March to June 2007 as part of the monthly monitoring of turloughs. Dedicated trips to inspect for algal mats were conducted in 2008 on the 4th of March, the 1st of April, and the 26th, 27th and 28th of May, and in 2009 on the 15th and 16th of June and on the 24th and 25th of July. The presence of both living floating mats and dead drying mats was noted, as well as their extent in the turlough basins. Occurrence of visible filamentous algal mats in the three years of observation is presented below. Y = visible occurrence; * = "extensive cover" (estimated to be 2 to 8% of total area of basin); † = negligible quantity observed; • = turlough was too flooded to permit full observation. Algal mats were observed in Termon in 2008, water levels were too high in 2008 to make a meaningful observation.

Year of Observation		
2007	**2008**	**2009**
N	Y	•

Hydrochemistry

Data shown are the mean ± SD of monthly spot samples collected between October 2006 and June 2007. Mean seasonal Total P and Chlorophyll *a* were used to determine the trophic status of the floodwaters based on OECD trophic categories. The median and range of <u>mean values</u> across all turloughs are also provided.

Hydrochemical Variable	Ardkill Values		Turlough Summary Stats (n=22)		
	Mean±SD	OECD Trophic Category	Median	Min	Max
pH	8.1±0.1		8.1	7.7	8.3
Alkalinity mg l^{-1} $CaCO_3$	225.6±30.7		204.0	112.4	236.4
Colour mg l^{-1} PtCo	21.1±9.3		26.9	7.9	85.1
Molybdate Reactive Phosphorus µg l^{-1}	2.3±1.1		3.4	0.7	42.1
Total Phosphorus µg l^{-1}	15.0±7.9	Mesotrophic	24.8	4.0	82.1
Chlorophyll *a* µg l^{-1}	3.1±2.4	Mesotrophic	4.9	1.1	33.5
Nitrate-N mg l^{-1}	0.3±0.3		0.7	0.1	1.9
Total Nitrogen mg l^{-1}	0.6±0.3		1.2	0.6	2.3

Aquatic Invertebrates

22 turloughs were sampled for littoral aquatic macroinvertebrates using sweep nets during November 2006 and April 2007. Zooplankton samples were collected in April 2007. Open-water cladocerans and littoral chydorids were sampled using a zooplankton net and perspex tube respectively.

Aquatic Macroinvertebrates			
November 2006	**Count**	**April 2007**	**Count**
Agabus bipustulatus	1	*Agabus* sp. (larva)	25
Agabus sp. (larva)	1	Ceratopogonidae	1
Agyroneta aquatica	5	Chironomidae	147
Anisoptera sp. (larva)	46	*Cloeon dipterum*	2
Asellus aquaticus	3	*Cloeon simile*	5
Bithynia leachi	62	*Corixinae* Instar I & II	5
Bithynia tentaculata	84	Diptera Pupae	2
Chironomidae	1	*Dryops* sp. (larva)	1
Culicidae	12	*Gammarus lacustris*	1
Curculionidae	1	*Haliplus confinis*	1
Hydaticus sp. (larva)	3	*Hydrachnidia* (Mite)	4
Hydrachnidia (Mite)	2	*Hygrotus impressopunctatus*	4
Hygrotus inaequalis	1	*Hygrotus quinquelineatus*	2
Hygrotus quinquelineatus	2	*Ilybius* sp. (larva)	8
Ilybius sp. (larva)	1	*Laccophilus* sp. (larva)	4
Lestes sp.	3	*Limnephilus centralis*	1
Limnephilidae sp. Instar II	182	*Notonecta glauca*	2
Limnephilidae sp. Instar III	35	Oligochaeta	56
Limnephilus lunatus	8	Ostracoda	48
Limnephilus marmoratus	7	*Porhydrus lineatus*	2
Lymnaea peregra	1	*Rhantus* sp. (larva)	4
Lymnaea trunculata	46	*Succinea* sp.	2
Noterus clavicornis	7	Tabanidae	6
Oligochaeta	1	Tipulidae	11
Pisidium/Sphaerium spp.	79		
Planorbis contortus	1		
Planorbis planorbis	6		
Polycelis nigra/tenuis	23		
Porhydrus lineatus	7		
Scritidae	1		
Tipulidae	1		
Triaenodes bicolor	2		
Valvata cristata	2		
Ylodes reuteri	6		

Aquatic Macroinvertebrates: Presence of high abundances (> 50 individuals) of Diptera in April 2007 indicates nutrient enrichment; however, the presence of high abundances of Odonata and Trichoptera (> 50 individuals) in November 2006 indicates nutrient poor conditions. Hydrochemistry (above) suggests oligotrophic conditions.

Aquatic Macroinvertebrate Taxa	**Presence of high abundances**	
	November 2006	**April 2007**
Diptera	N	Y
Ostracoda	N	N
Odonata	Y	N
Trichoptera	Y	N

Zooplankton species
Alona affinis
Alona guttata
Chydorus latus
Chydorus sphaericus
Daphnia pulex
Eurycercus lamellatus
Lathurona rectirostris
Leydigia leydigi
Simocephalus vetulus

Vegetation

Vegetation description and classification yielded 25 vegetation communities suitable for mapping. This turlough rarely dries out, and of the eight vegetation communities mapped here, by far the most dominant was the Reedbed community, dominated by *Phragmites australis* but with abundant *Schoenoplectus lacustris*. Other important communities included the *Eleocharis palustris-Ranunculus flammula* community. High conservation value communities are denoted by *. Fifty-five vascular plant species were recorded, the most notable of which was *Teucrium scordium*.

Vegetation Community	Area (Ha)
A. stolonifera-Glyceria fluitans	1.41
A. stolonifera-P. anserina - F. rubra	0.84
Eleocharis palustris-R. flammula	8.27
Lolium grassland	1.33
Open water	2.16
Other/unknown	1.04
P. anserina-Carex nigra	0.14
Polygonum amphibium	1.03
Reedbed	21.65
Woodland/scrub	3.72
Number of vegetation communities	8
Number of plant species	55

Vascular Plant Species

Nomenclature follows Parnell, J & Curtis, T. (2012) *Webb's An Irish Flora*, University of Cork Press.

Agrostis stolonifera	*Glyceria fluitans*	*Phalaris arundinacea*
Alisma plantago-aquatica	*Hippuris vulgaris*	*Phragmites australis*
Baldellia ranunculoides	*Hydrocotyle vulgaris*	*Polygonum amphibium*
Cardamine flexuosa	*Iris pseudacorus*	*Potamogeton gramineus*
Cardamine pratensis	*Juncus acutiflorus*	*Potamogeton natans*
Carex elata	*Juncus articulatus*	*Potentilla anserina*
Carex hirta	*Juncus bulbosus*	*Potentilla erecta*
Carex hostiana	*Lathyrus pratensis*	*Potentilla reptans*
Carex nigra	*Lemna minor*	*Prunus spinosa*
Carex panicea	*Leontodon autumnalis*	*Ranunculus flammula*
Carex viridula agg.	*Littorella uniflora*	*Ranunculus repens*
Carex viridula ssp. viridula	*Lotus corniculatus*	*Schoenoplectus lacustris*
Chara species	*Lysimachia vulgaris*	*Senecio aquaticus*
Cirsium dissectum	*Lythrum salicaria*	*Sparganium emersum*
Eleocharis multicaulis	*Mentha aquatica*	*Teucrium scordium*
Eleocharis palustris	*Molinia caerulea*	*Veronica scutellata*
Equisetum fluviatile	*Myosotis scorpioides*	*Vicia cracca*
Filipendula ulmaria	*Nuphar lutea*	*Zannichellia palustris*
Galium palustre	*Oenanthe aquatica*	

Soils and Grazing

Soils were classified using a modified version of soil categories generated by the Teagasc/EPA Soils and Subsoils Mapping project (Fealy *et al.*, 2009). The classification scheme principally uses parent material (calcareous/non-calcareous), depth class (shallow/deep) and drainage class (well drained/poorly drained) to assign soils to one of nine broad categories. Termon has extensive areas of alluvial marl. The mean ± SD of a range of soil properties are also provided, in addition to the median and range of each variable across turloughs. Termon soils are alkaline and organic, with high amounts of calcium carbonate.

Soil Types/Grazing Extent	% Turlough Area
Shallow well drained mineral	0.1
Very shallow poorly drained organic	7
Alluvial marl	92.6
Extent of rotationally grazed area	12

Soil Property (n=6)	Termon	Turlough Summary Stats (n=22)		
	Mean ± SD	Median	Min	Max
pH	8.29 ± 0.1	7.20	5.94	8.29
% Organic Matter content	23.0 ± 5.1	25.8	10.2	69.1
% Inorganic content	34.6 ± 27.8	43.2	25.7	85.0
% Calcium carbonate content	42.4 ± 26.3	11.3	2.48	43.7
Total Nitrogen mg kg^{-1}	8217 ± 2785	11142	4983	24233
Total Phosphorus mg kg^{-1}	476 ± 165	905	245	1594

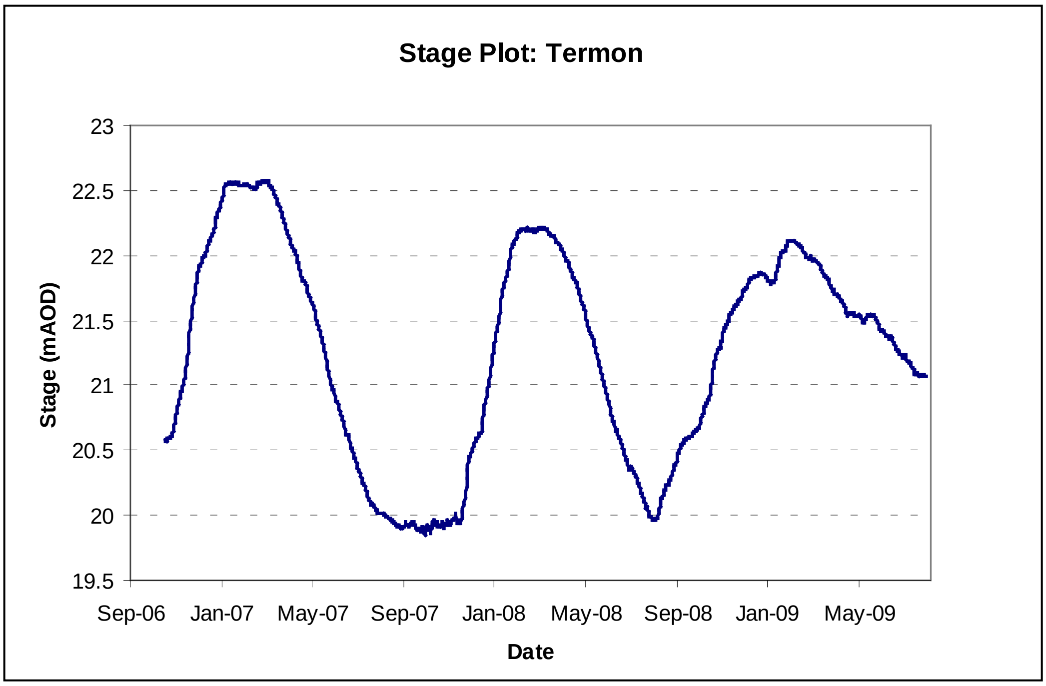
Hydrology

Water levels were recorded at hourly intervals using a variety of Schlumberger Divers® (Marton Geotechnical Ltd, Suffolk, UK) placed at or near the lowest point in each turlough. Divers measure the pressure of the water and air column above them, and from this the depth of water can be calculated. GPS surveys were carried out on 21 monitoring sites (Tullynafrankagh omitted) in order to develop digital terrain models (DTMs) from which contour maps, stage-volume and stage-surface area relationships are produced. The inflow magnitude is indicative of the properties of a turlough's catchment area and flow capacity, while outflow is a function of the drainage capacity of the system.

While this turlough does not dry out, the hydrological data show that there is an annual peak in water levels over the winter months, with a gradual lowering of the water level until it starts to slowly rise again. It has a very low drainage capacity and the longest recession duration of any of the turloughs studied.

Hydrological Information	Termon Values	Turlough Summary Stats (n=21)		
		Median	Min	Max
Start of Hydrological Recording	05/11/2006	-	-	-
End of Hydrological Recording	05/08/2009	-	-	-
Days Recorded	1004	-	-	-
Equipment Failure	None recorded	-	-	-
Hydroperiod (days)	304	213	135	348
Maximum Floodwater Depth (m)	3.7	4.9	3	15.4
Maximum Floodwater Volume ('000 m^3)	956	877.9	355.6	4008.1
Maximum Flooded Area (ha)	42.0	38.61	13.71	78.12
Average Basin Depth (m)	2.28	2.28	0.85	6.76
Average Daily Inflow (m^3 s^{-1})	0.254	0.684	0.254	10.253
Average Daily Outflow (m^3 s^{-1})	0.149	0.271	0.086	2.018
Drainage Capacity (m^3 s^{-1})	0.078	0.154	0.069	1.156
Recession Duration (days)	142.5	57.3	11	142.5

Stage plot for Termon turlough



Zone of Groundwater Contribution (ZOC) Risk Assessments

GIS based risk assessments were conducted with a view to identifying turloughs at risk of failing to meet WFD water quality objectives. These risk assessments were conducted by Compass Informatics Ltd and were based on Risk Assessment Sheet GWDTERA2a (Guidance Document No. GW9) on assessing risks to turloughs from phosphate (Working Group on Groundwater 2004) and Pathway Susceptibilities and Pressure Magnitudes were integrated to produce Impact Potential maps and predicted Risk Categories for the turlough ZOC. The TCD Risk Category is derived from a revised Impact Potential matrix. The predicted Risk Categories were adjusted using mean seasonal floodwater Total P ($\mu g\ l^{-1}$) (see Section 4.5.4 of the Risk Assessment Sheet GWDTERA2a). The risk categories include 1A: at significant risk; 1B: probably at significant risk; 2A: Not at significant risk (low confidence); 2B: Not at significant risk (higher confidence).

ZOC Area (Km^2)	Predicted WFD Risk Category	Adjusted WFD Risk Category	Predicted TCD Risk Category	Adjusted TCD Risk Category
6	1B	1A	1B	1A

ZOC Pressure Variable	
CORINE BARE ROCK %	0
CORINE PEAT BOGS%	0
CORINE ALL NATURAL AND SEMI-NATURAL AREAS%	14
CORINE IMPROVED PASTURE%	42
CORINE UNIMPROVED PASTURE%	21
CORINE ALL PASTURE%	62
CORINE OTHER AGRICULTURAL LANDS%	18
TEAGASC/EPA HABITATS ROCK%	0
TEAGASC/EPA HABITATS BOGS/PEATS%	1
TEAGASC/EPA HABITATS FORESTS/SCRUBS%	0
TEAGASC/EPA HABITATS WATER%	7
TEAGASC/EPA HABITATS DRY GRASSLAND%	91
TEAGASC/EPA HABITATS WET GRASSLAND%	1
TEAGASC TOTAL GRASSLAND%	92
TOTAL LIVESTOCK UNIT/ha of ZOC	1
TILLAGE%	0
No. SEPTIC TANKS km^{-2} ZOC	13
No. SEPTIC TANKS km^{-2} EXTREME PATHWAY SUSCEPTIBILITY	13
HIGH PATHWAY SUSCEPTIBILITY%	0
EXTR+HIGH PATHWAY SUSCEPTIBILITY%	19
WELL DRAINED SOIL %	87
POORLY DRAINED SOIL%	7

Site Conservation Assessment

The following site conservation assessment was undertaken to feed into the national reporting structure for assessing conservation status as required under Article 17 of the Habitats Directive. A suite of indicators and associated targets were derived to assess ecological structure and function. Future prospects were assessed through the evaluation of the impact of current and recent pressures and likely future threats to the site. The assessment follows a rules based approach to determine whether Structures & functions and Future Prospects should be assessed as good (green), inadequate (amber) or bad (red). For further details, see Chapter 10 (Conservation Status Assessment).

Please note an updated approach to assessing site condition has been proposed and is outlined in Chapter 12 (Monitoring Methods for Turloughs).

Conservation Condition Summary

Structure & Function	**Favourable**
Future Prospects	**Inadequate**
Site Conservation Condition	**Inadequate/Favourable**

Structure and Function Status:

Indicator	*Comments*
Hydrological Function: ***Intermediate***	There is a drain at the SW end which likely had an affect on the hydrological functioning, but the resulting alteration to ecology has probably by this stage stabilised.
Water Quality: ***Good***	15 µg P l^{-1}.
Biological Responses: ***Good***	
Algal communities: 0	Algal mats were recorded in 2008 but were not extensive, and max CHL is low
Vegetation communities: 1	Relatively low cover of positive indicators, marginally good
Rumex **cover: 1**	Absent
Important plants: 1	*Teucrium scordium*
Important aquatic invertebrates: 2	*Agabus labiatus, Lestes dryas, Sympetrum sanguineum*
Overall Structure & Function: ***Good***	

Pressures:

Code	*Impact*	*Notes*
H02.07 Diffuse groundwater pollution due to non-sewered population (ZOC)	L	Moderately high number of septic tanks in areas with high pathway susceptibility, but likely limited impact
A04.02.03 Non-intensive horse grazing (turlough)	L	Very light grazing by horses
H02.06 Diffuse groundwater pollution due to agricultural and forestry activities (ZOC)	L	
E01.03 Dispersed habitation (ZOC)	L	Moderately high number of dwellings in the ZOC. Likely impacts will be through nutrient enrichment of groundwater
J02.05 Modification of hydrographic functioning, general (=drainage in turlough)	L	As mentioned, drainage will have impacted on the hydrological functioning, though the drains were pre-1990; however, the effect of the drains may still be altering the ecology slightly
A04.01.01 Intensive cattle grazing (turlough)	L	Relatively light grazing with a small percentage of the turlough grazed, likely due to the long period of flooding

Threats:

Code	*Impact*	*Notes*
J02.05 Modification of hydrographic functioning, general (=drainage in turlough)	H	The high level of flooding has resulted in increasing calls for further drainage of this turlough
H02.07 Diffuse groundwater pollution due to non-sewered population (ZOC)	L	Ongoing pressure
H02.06 Diffuse groundwater pollution due to agricultural and forestry activities (ZOC)	L	Ongoing low level pressure
A04.01.01 Intensive cattle grazing (turlough)	L	
A02.01 Agricultural intensification (ZOC)	L	Likely threat in the ZOC due to pasture/grassland cover in ZOC
M01.03 Flooding and rising precipitations	L	
A10.02 Removal of stone walls and embankments (in turlough)	L	

Future Prospects: **Inadequate** – threats are mostly low impact; however the calls for further drainage of the turlough would have significant negative impacts on the structure and function of this important turlough

Overall Assessment: **Inadequate/Favourable** – Termon has generally good ecological functioning, with limited pressures and interesting biological communities. However, renewed proposals for drainage are a serious threat. Drainage that removed exceptionally high, very occasional flooding would be beneficial to local communities (the turlough is adjacent to a road) while also ensuring that the general ecological functions prevail – all efforts should be made to ensure that any drainage work addresses the extreme and not the regular flooding events in this turlough.

Maps

Maps are provided of:

1. Elevation contours, based on GIS digital terrain models from points by differential GPS topographic survey (for further details, see *Chapter 3: Hydrology*)
2. Grazing in land parcels
3. Approximate sampling points for water chemistry and aquatic invertebrates
4. Soil nutrient sampling points
5. Points for soil survey (note: soils were surveyed to the turlough boundary defined by Goodwillie, 1992; see map 9)
6. Soils (note: soils were mapped by combining the EPA Subsoils base map with the point soil descriptions; for further details see *Chapter 6: Soils and Landuse*)
7. Vegetation relevés
8. Vegetation communities (note: relevés do not always match to mapped communities due to small scale variation; for further details of mapping see *Chapter 7: Turlough Vegetation: Description, Mapping and Ecology*)
9. Vegetation maps digitised from Goodwillie, R. (1992) *Turlough's Over 50 Hectares*. Report to NPWS
10. Estimated zone of groundwater contribution (ZOC)

Legend
Elevation Contours
Turlough Boundary
OSi 2005 Orthophotographs
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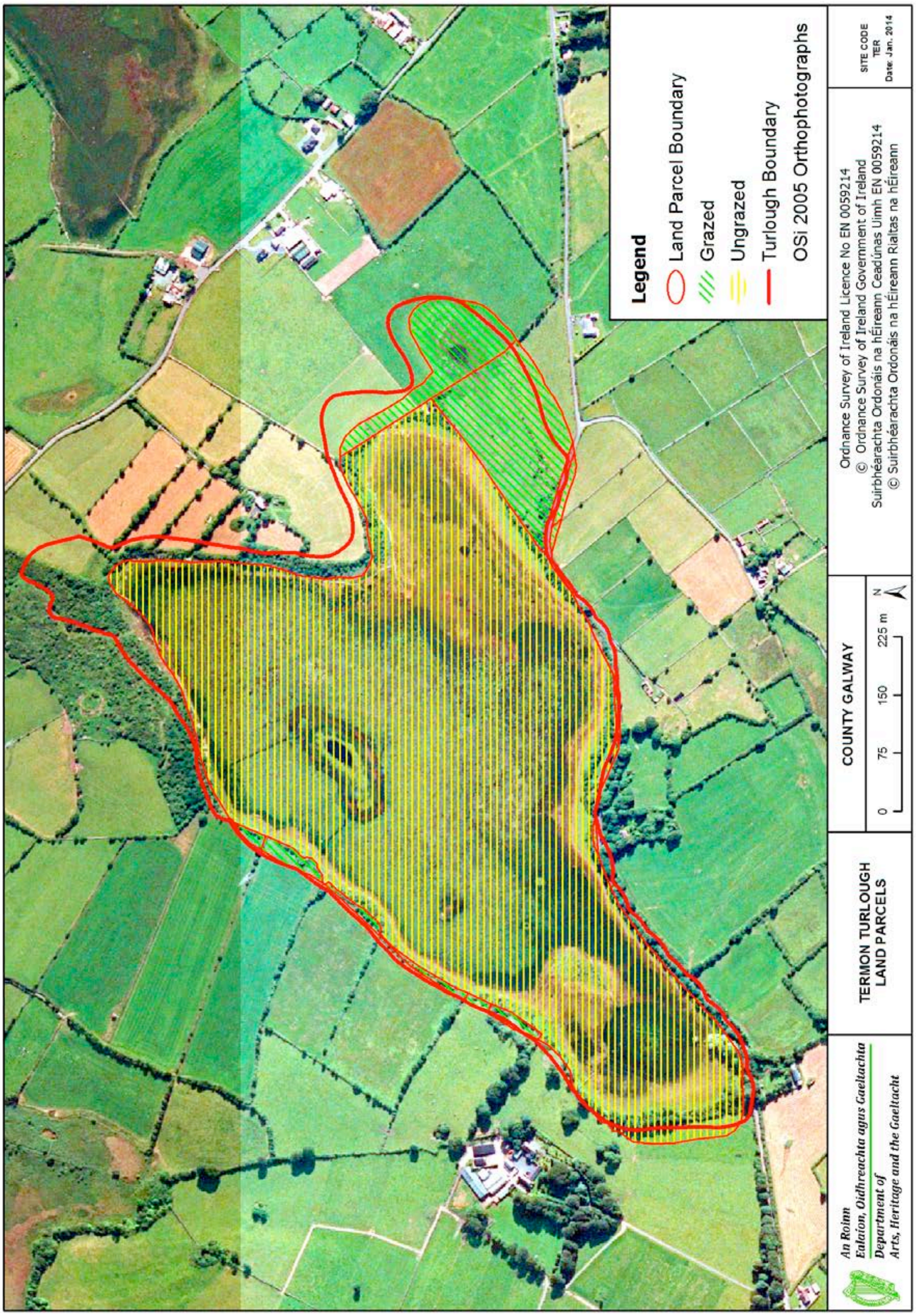
SITE CODE
TER
Date: Jan. 2014
COUNTY GALWAY
0 75 150 225 m
N
TERMON TURLOUGH
ELEVATION CONTOURS
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht


Legend
Land Parcel Boundary
Grazed
Ungrazed
Turlough Boundary
OSi 2005 Orthophotographs
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COUNTY GALWAY
0 75 150 225 m
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TERMON TURLOUGH
LAND PARCELS
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Department of
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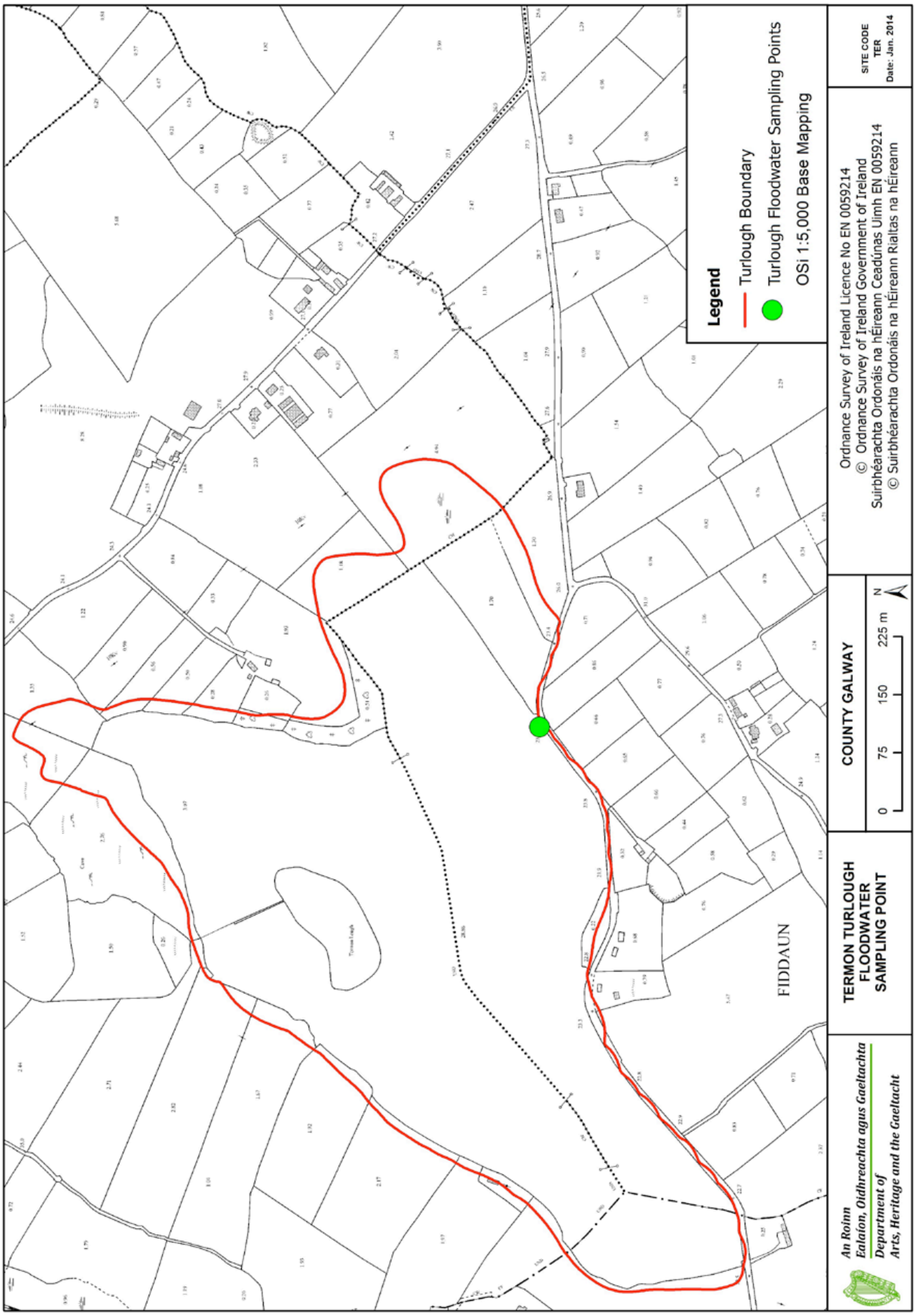
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Turlough Boundary
Turlough Floodwater Sampling Points
OSi 1:5,000 Base Mapping
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COUNTY GALWAY
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TERMON TURLOUGH
FLOODWATER
SAMPLING POINT
FIDDAUN
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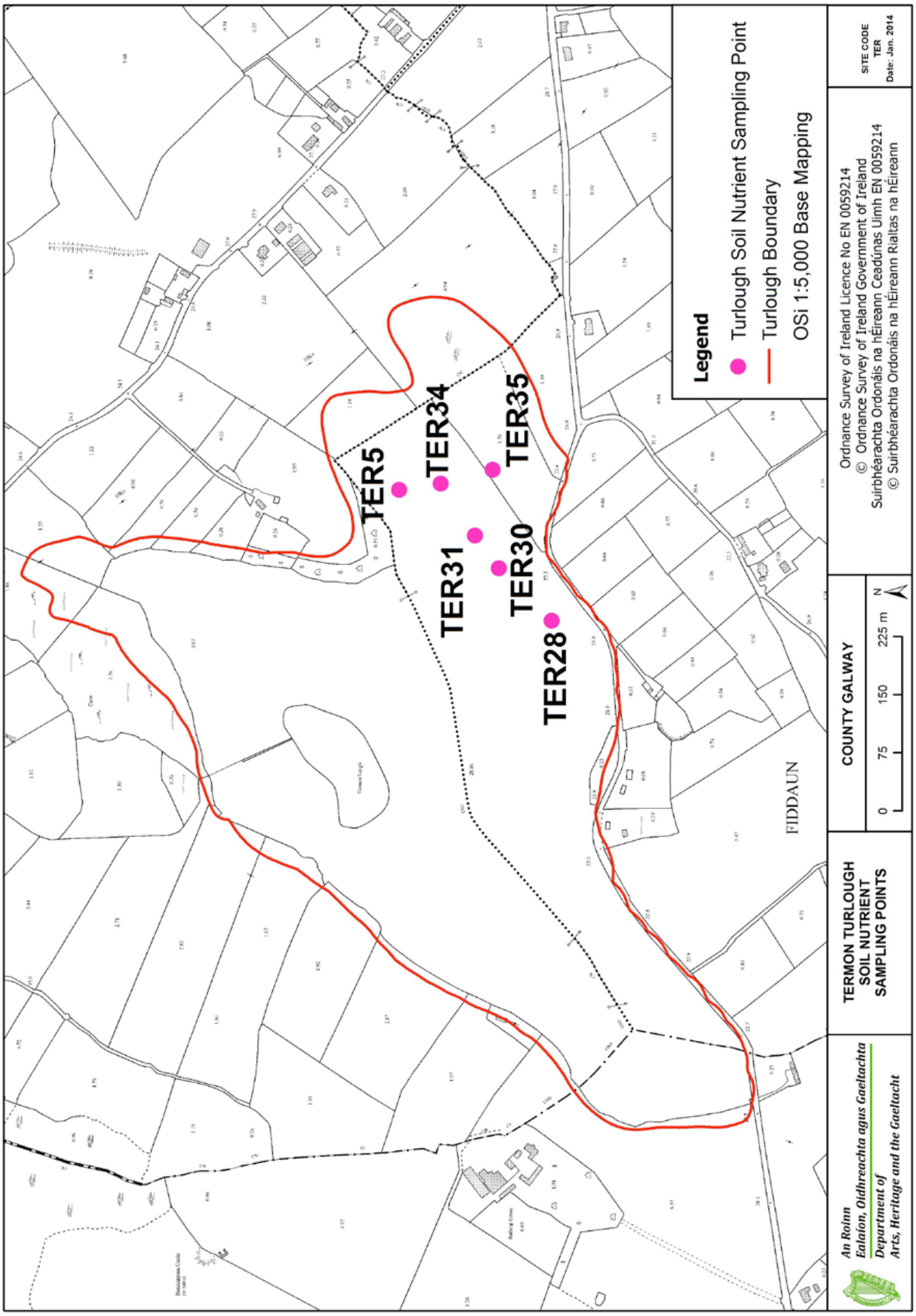
TER5
TER34
TER35
TER31
TER30
TER28
FIDDAUN
Legend
Turlough Soil Nutrient Sampling Point
Turlough Boundary
OSi 1:5,000 Base Mapping
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Date: Jan. 2014
TERMON TURLOUGH
SOIL NUTRIENT
SAMPLING POINTS
COUNTY GALWAY
0 75 150 225 m
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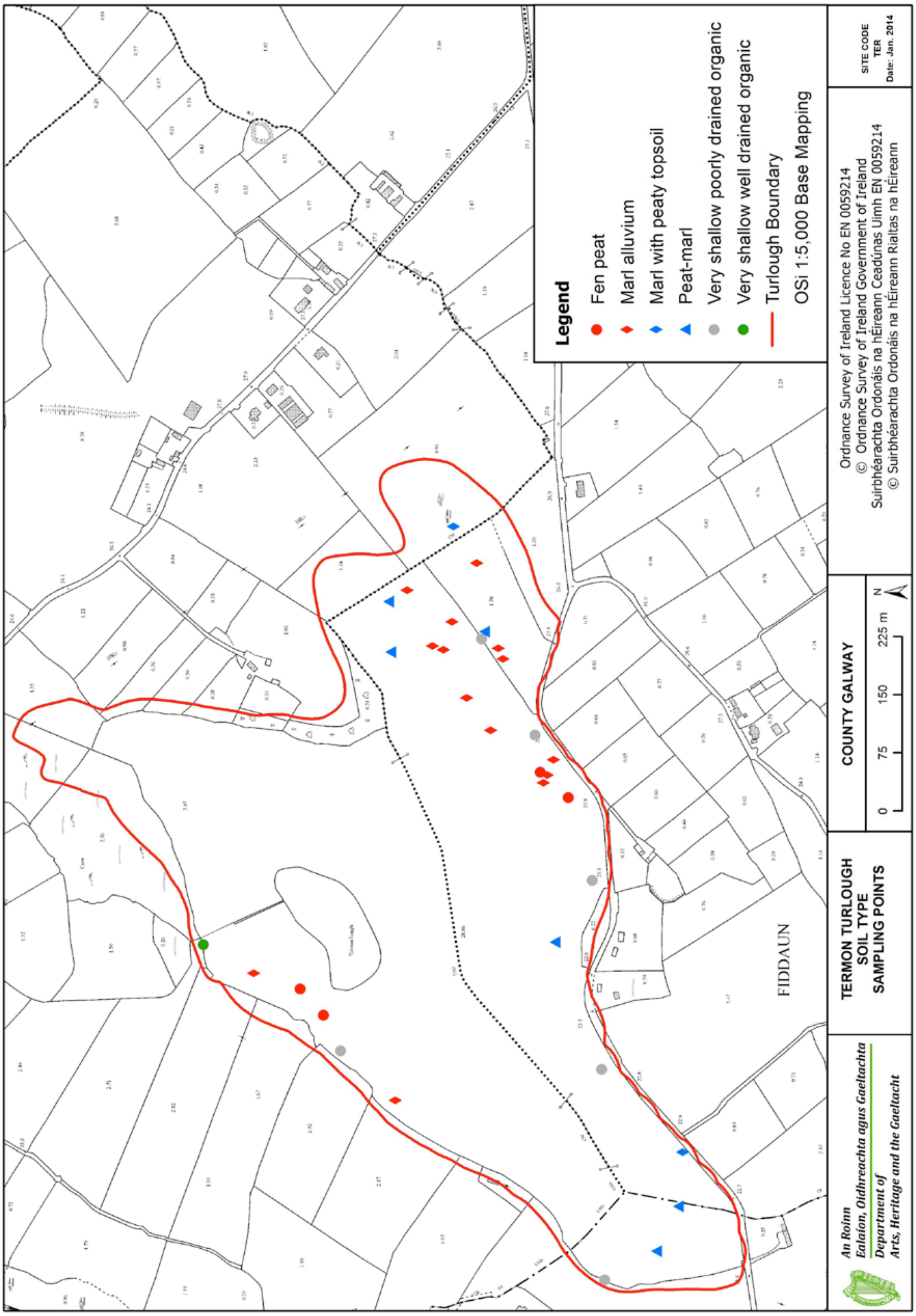
Legend
Fen peat
Marl alluvium
Marl with peaty topsoil
Peat-marl
Very shallow poorly drained organic
Very shallow well drained organic
Turlough Boundary
OSi 1:5,000 Base Mapping
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COUNTY GALWAY
0 75 150 225 m
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TERMON TURLOUGH
SOIL TYPE
SAMPLING POINTS
FIDDAUN
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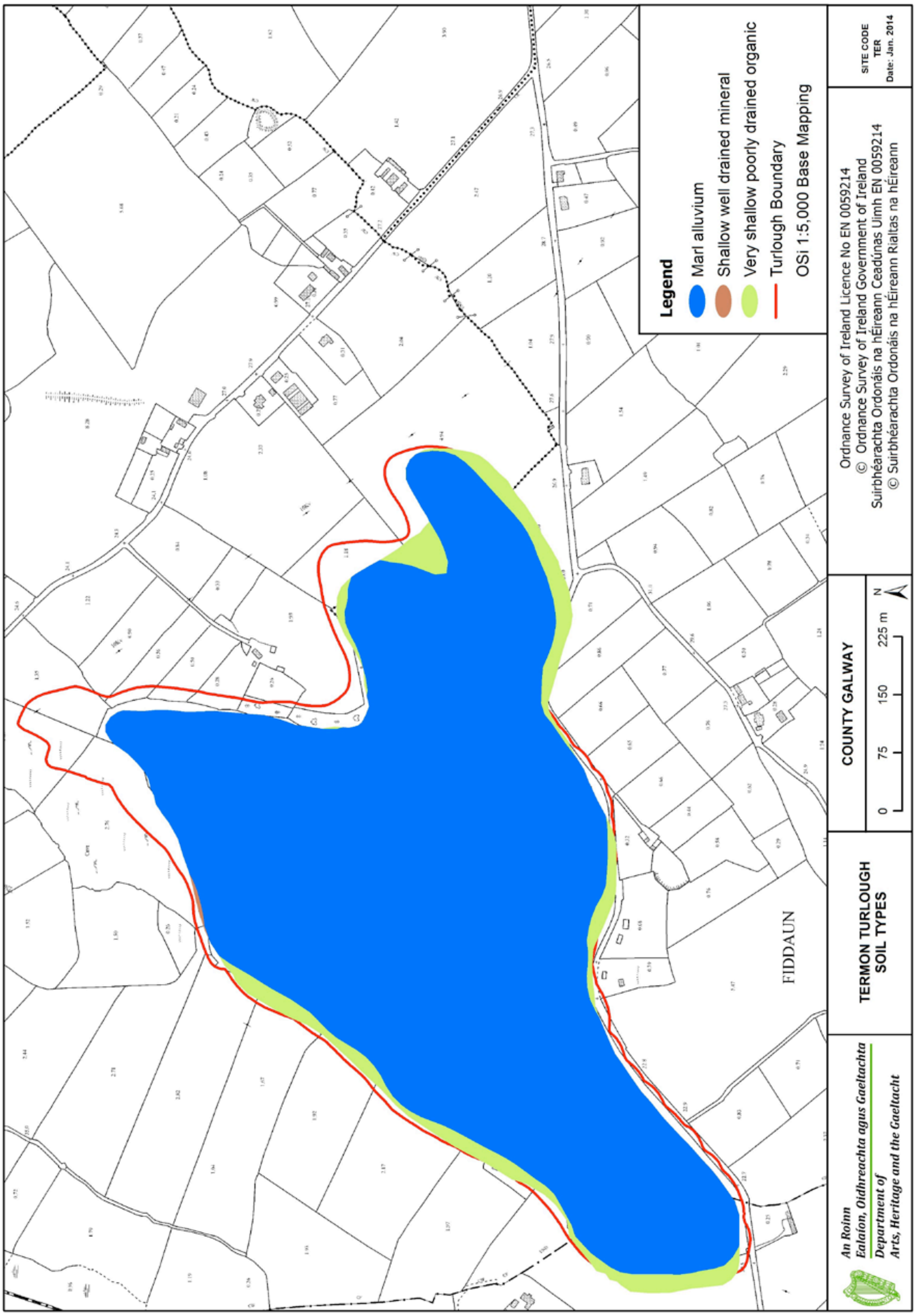

Legend
Marl alluvium
Shallow well drained mineral
Very shallow poorly drained organic
Turlough Boundary
OSi 1:5,000 Base Mapping
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COUNTY GALWAY
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TERMON TURLOUGH
SOIL TYPES
FIDDAUN
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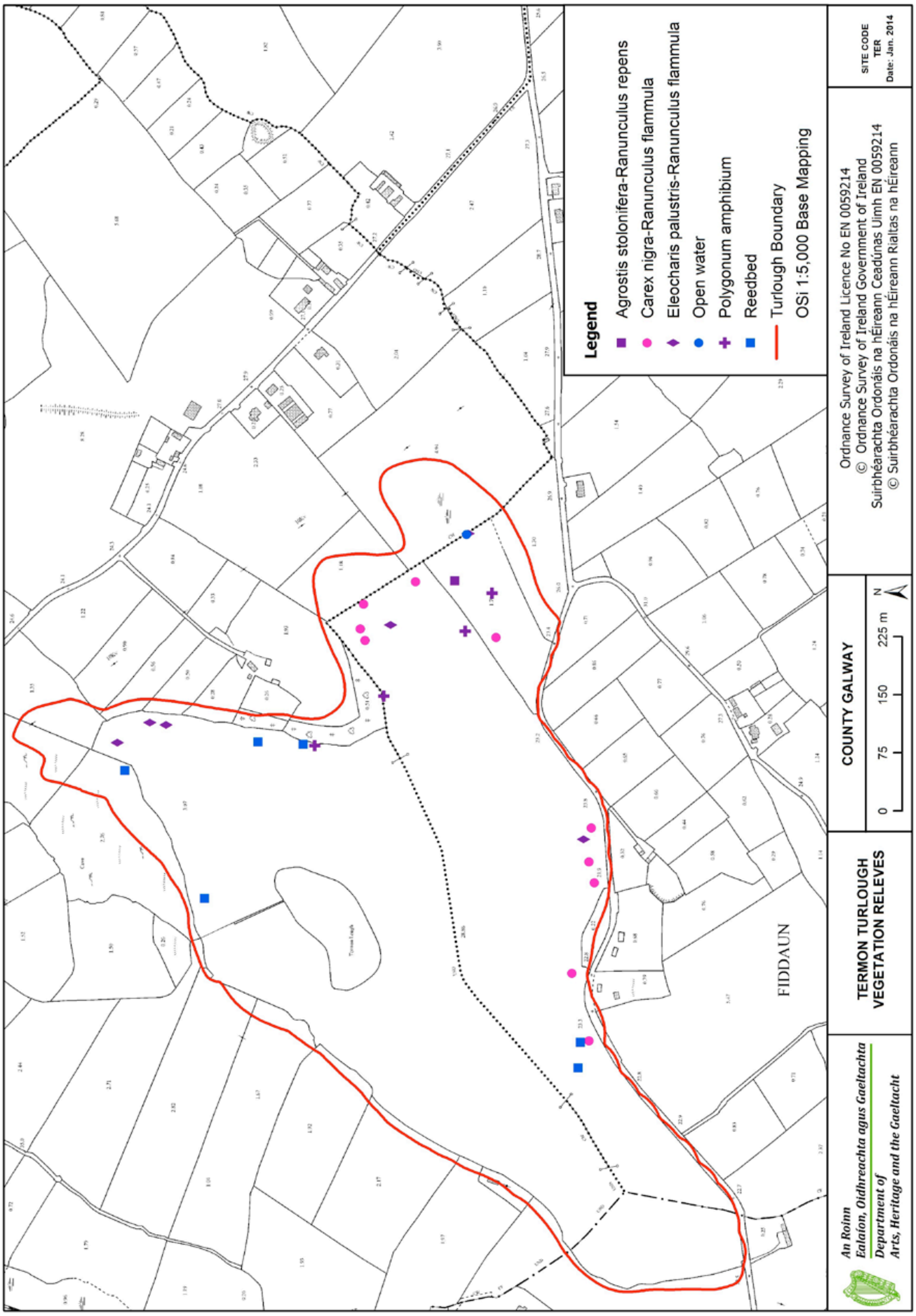
Legend
Agrostis stolonifera-Ranunculus repens
Carex nigra-Ranunculus flammula
Eleocharis palustris-Ranunculus flammula
Open water
Polygonum amphibium
Reedbed
Turlough Boundary
OSi 1:5,000 Base Mapping
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COUNTY GALWAY
0 75 150 225 m
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TERMON TURLOUGH
VEGETATION RELEVES
FIDDAUN
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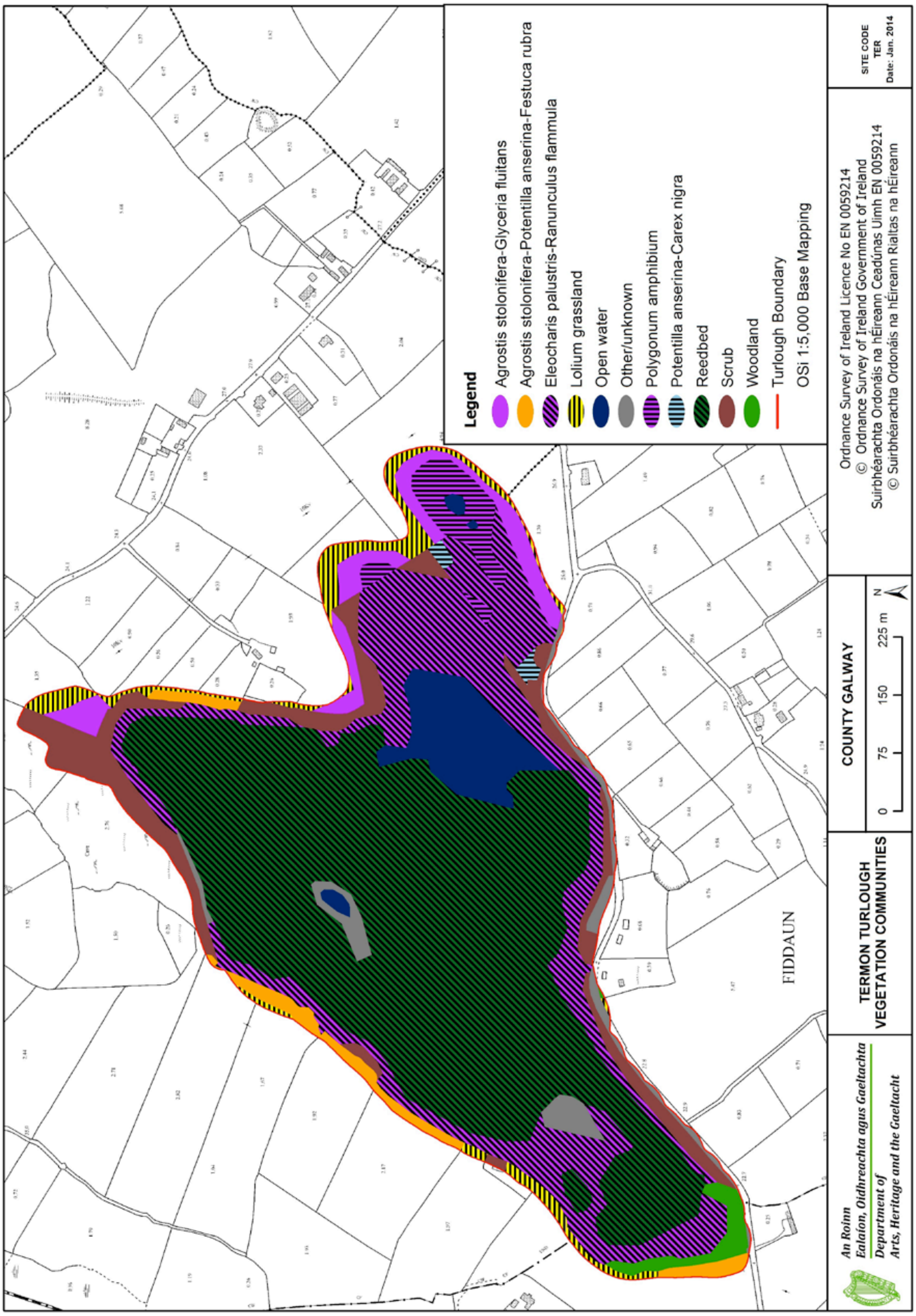
Legend
Agrostis stolonifera-Glyceria fluitans
Agrostis stolonifera-Potentilla anserina-Festuca rubra
Eleocharis palustris-Ranunculus flammula
Lolium grassland
Open water
Other/unknown
Polygonum amphibium
Potentilla anserina-Carex nigra
Reedbed
Scrub
Woodland
Turlough Boundary
OSi 1:5,000 Base Mapping
FIDDAUN
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht
TERMON TURLOUGH
VEGETATION COMMUNITIES
COUNTY GALWAY
0 75 150 225 m
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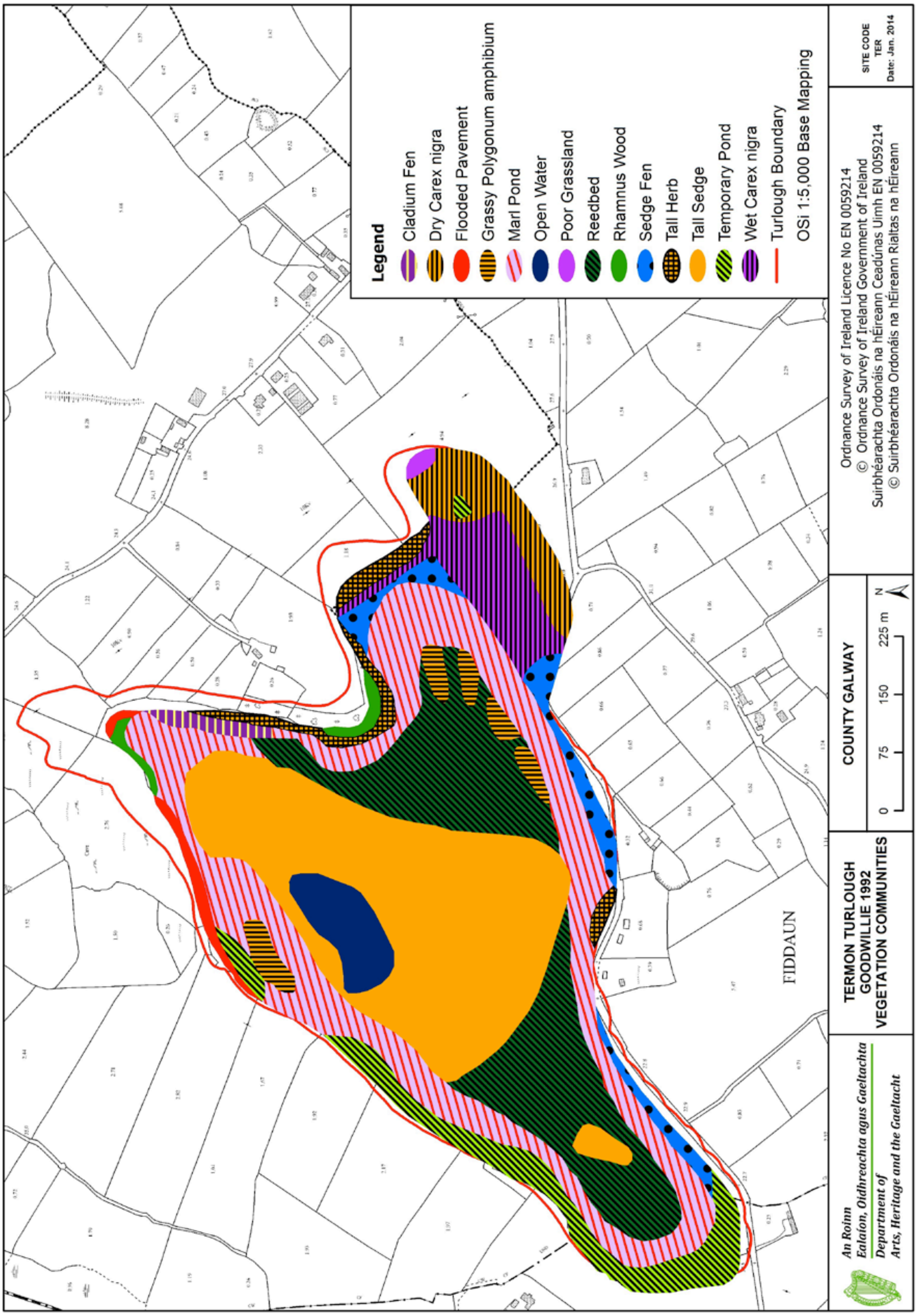
Legend
Cladium Fen
Dry Carex nigra
Flooded Pavement
Grassy Polygonum amphibium
Marl Pond
Open Water
Poor Grassland
Reedbed
Rhamnus Wood
Sedge Fen
Tall Herb
Tall Sedge
Temporary Pond
Wet Carex nigra
Turlough Boundary
OSi 1:5,000 Base Mapping
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Date: Jan. 2014
COUNTY GALWAY
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TERMON TURLOUGH
GOODWILLIE 1992
VEGETATION COMMUNITIES
FIDDAUN
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
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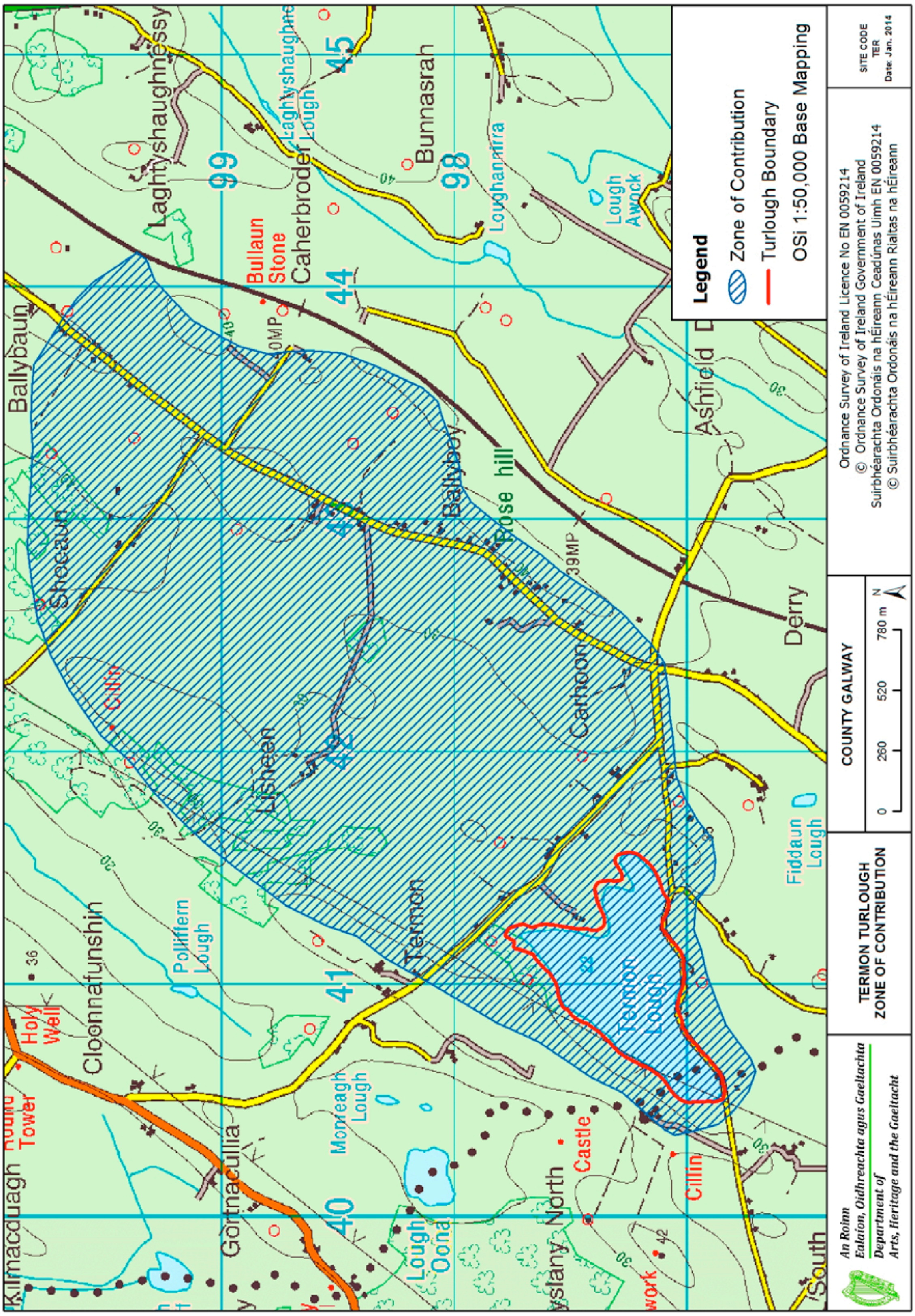
TERMON TURLOUGH
ZONE OF CONTRIBUTION
COUNTY GALWAY
0 260 520 780 m
N
Legend
Zone of Contribution
Turlough Boundary
OSi 1:50,000 Base Mapping
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Date: Jan. 2014
An Roinn
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Department of
Arts, Heritage and the Gaeltacht
Termon Lough
Termon
Lisheen
Carhoon
Ballyboy
Rose hill
Shocaun
Ballybaun
Caherbroder
Bullaun Stone
Laghtyshaughnessy
Laghtyshaughnessy Lough
Bunnasran
Loughannirra
Lough Awock
Ashfield D
Derry
Fiddaun Lough
Cloonnafunshin
Polliffern Lough
Monreagh Lough
Gortnacullia
Kilmacduagh
Holy Well
Round Tower
Castle
Cillin
Lough Oona
North
South
39MP
40MP

Site Report: Tullynafrankagh Turlough
TCD Turlough Research project 2006-2011

Turlough Project Code	SAC Name	SAC/NHA No.	County	Townland	RBD	Easting	Northing	Area (ha)
TUL	Lough Fingal complex	000606	Galway	Caherpeak West	WESTERN	143210	215340	15

File update: July 2015 (S. Waldren)

Site Description

Tullynafrankagh turlough occurs in the Lough Fingall Complex SAC and lies between Ballindereen turlough and Caranavoodaun turlough (Co. Galway). This was the smallest turlough included in the study, with an extent of just 12.0 ha. The turlough has a fen-like appearance, and the south-western areas retain water throughout the year. Ten vegetation communities were recorded at Tullynafrankagh; the dominant communities were the Reedbed community and the *Molinia caerulea-Carex panicea* community. Tullynafrankagh soils are moderately alkaline and highly organic, with significant amounts of calcium carbonate. There are extensive areas of fen peats and peat-marl soils. Almost 20% of the turlough area is under rotational grazing. Detailed hydrological monitoring was not conducted at this site, but water level data suggest rapid filling and emptying.

Tullynafrankagh – photo: N. Sharkey

Phytoplankton

Phytoplankton analysis was conducted on sub-samples of monthly spot samples collected for hydrochemical analysis between October 2006 and June 2007. Phytoplankton composition varies significantly over time and data from autumn, mid-winter and spring/early summer are presented below. Taxa were identified to species level where possible. Some taxa were not discriminated beyond general groupings (i.e. small centric diatoms, dinoflagellates and pinnate diatoms). The term non-identifiable alone (or n.i.) was reserved for cases where specimens were not identifiable. Discrimination between n.i. filament, n.i. flagellate, n.i. colony, n.i. green filament was made when applicable. Biovolume (mm^3 m^{-3}) was used as the measure of algal biomass.

October 2006		January 2007		May 2007	
Biovolume (mm^3/m^3)	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*
Fragilaria capucina	*83381*	*n.i. centrics*	*5126926*	*Spirogyra*	*663675*
Mougeotia	*66386*	*Synedra*	*778330*	*Mougeotia*	*647994*
Synedra	*37022*	*Cryptomonas*	*652373*	*Oedogonium*	*414377*
Cymbella/Encyonema	*34261*	*n.i. pennates*	*203795*	*Tribonema*	*174049*
n.i. pennates	*30572*	*Fragilaria/Synedra*	*201345*	*Cryptomonas*	*125038*

Benthic Algae

Turloughs were inspected for algal mats during the emptying phase in 2007, 2008 and 2009. Turloughs were visited in the first two weeks of March to June 2007 as part of the monthly monitoring of turloughs. Dedicated trips to inspect for algal mats were conducted in 2008 on the 4th of March, the 1st of April, and the 26th, 27th and 28th of May, and in 2009 on the 15th and 16th of June and on the 24th and 25th of July. The presence of both living floating mats and dead drying mats was noted, as well as their extent in the turlough basins. Occurrence of visible filamentous algal mats in the three years of observation is presented below. Y = visible occurrence; * = "extensive cover" (estimated to be 2 to 8% of total area of basin); † = negligible quantity observed; • = turlough was too flooded to permit full observation. Algal mats were observed in Tullynafrankagh each year, though in limited amounts in 2009; however, water levels were very high during the 2009 visit.

Year of Observation		
2007	**2008**	**2009**
Y	Y	Y†

Hydrochemistry

Data shown are the mean ± SD of monthly spot samples collected between October 2006 and June 2007. Mean seasonal Total P and Chlorophyll *a* were used to determine the trophic status of the floodwaters based on OECD trophic categories. The median and range of <u>mean values</u> across all turloughs are also provided.

Hydrochemical Variable	Tullynafrankagh Values		Turlough Summary Stats (n=22)		
	Mean±SD	**OECD Trophic Category**	**Median**	**Min**	**Max**
pH	7.9±0.2		8.1	7.7	8.3
Alkalinity mg l^{-1} $CaCO_3$	233.8±22.2		204.0	112.4	236.4
Colour mg l^{-1} PtCo	36.4±13.0		26.9	7.9	85.1
Molybdate Reactive Phosphorus µg l^{-1}	3.3±1.8		3.4	0.7	42.1
Total Phosphorus µg l^{-1}	33.0±17.9	Mesotrophic	24.8	4.0	82.1
Chlorophyll *a* µg l^{-1}	18.4±20.0	Eutrophic	4.9	1.1	33.5
Nitrate-N mg l^{-1}	1.5±1.3		0.7	0.1	1.9
Total Nitrogen mg l^{-1}	2.1±1.2		1.2	0.6	2.3

Aquatic Invertebrates

22 turloughs were sampled for littoral aquatic macroinvertebrates using sweep nets during November 2006 and April 2007. Zooplankton samples were collected in April 2007. Open-water cladocerans and littoral chydorids were sampled using a zooplankton net and perspex tube respectively.

Aquatic Macroinvertebrates			
November 2006	**Count**	**April 2007**	**Count**
Agabus sp. (larva)	3	*Agabus* sp. (larva)	7
Argyroneta aquatica	17	Anisoptera sp. (larva)	4
Anisoptera sp. (larva)	53	*Asellus aquaticus*	2
Berosus signaticollis	3	*Athripsodes aterrimus*	1
Bithynia leachi	37	*Callicorixa praeusta*	1
Bithynia tentaculata	7	Ceratopogonidae	1
Culicidae	8	Chironomidae	53
Diptera Pupae	3	*Cloeon simile*	2
Glossiphonia complanata	3	*Corixa punctata/iberica*	1
Haliplus fulvus	3	Diptera Pupae	15
Haliplus sp. (larva)	1	*Glossiphonia complanata*	2
Haliplus sp. *ruficollis* group (females)	1	*Helobdella stagnalis*	1
Helobdella stagnalis	3	*Helophorus brevipalpis*	1
Helophorus brevipalpis	13	*Holocentropus picicornis*	3
Hydrachnidia (Mite)	3	*Hydaticus* sp. (larva)	1
Hygrotus quinquelineatus	3	*Hydrachnidia* (Mite)	18
Ilybius sp. (larva)	3	*Ilybius* sp. (larva)	2
Laccobius biguttatus	23	*Laccobius* sp. (larva)	1
Lestes sp.	3	*Lestes* sp.	6
Limnephilidae sp. Instar II	53	*Limnephilus marmoratus*	5
Limnephilidae sp. Instar III	1	*Lymnaea peregra*	1
Limnephilus lunatus	47	*Oecetis testacea*	1
Limnephilus marmoratus	1	Oligochaeta	81
Lymnaea peregra	3	Ostracoda	1
Ochthebius minimus	13	*Planorbis contortus*	3
Oligochaeta	7	*Planorbis crista*	1
Phacopteryx brevipennis	3	*Polycelis nigra/tenuis*	13
Physa fontinalis	3	*Segmentina complanata*	1
Pisidium/Sphaerium spp.	3	*Sympetrum sanguinem*	14
Planorbis carinatus	13	Tipulidae	1
Planorbis contortus	7	Zygoptera sp. (larva)	1
Plea leachi	3		
Polycelis nigra/tenuis	26		
Porhydrus lineatus	3		
Tabanidae	3		
Triaenodes bicolor	3		

Aquatic Macroinvertebrates: Presence of high abundances (> 50 individuals) of Diptera recorded in April 2007 indicates nutrient enrichment. However, the presence of high abundances of Odonata and Trichoptera (> 50 individuals) in November 2006 suggests nutrient poor conditions. The hydrochemistry (above) indicates meso- to eutrophic conditions.

Aquatic Macroinvertebrate Taxa	Presence of high abundances	
	November 2006	April 2007
Diptera	N	Y
Ostracoda	N	N
Odonata	Y	N
Trichoptera	Y	N

Zooplankton species
Chydorus globosus
Chydorus sphaericus
Daphnia pulex
Eurycercus lamellatus
Pleuroxus laevis
Simocephalus vetulus

Vegetation

Vegetation description and classification yielded 25 vegetation communities suitable for mapping. Ten vegetation communities were recorded at Tullynafrankagh; the dominant communities were the Reedbed community and the *Molinia caerulea-Carex panicea* community. High conservation value communities are denoted by *. Seventy-five plant species were recorded.

Vegetation Community	Area (Ha)
A. stolonifera-Glyceria fluitans	0.24
A. stolonifera-P. anserina - F. rubra	0.04
Carex nigra-C. panicea	1.45
Carex nigra-Equisetum fluviatile	0.63
Lolium grassland	1.37
**Molinia caerulea-Carex panicea*	3.99
Open water	0.35
Other/unknown	0.3
Polygonum amphibium	0.4
Reedbed	4.57
Schoenus nigricans fen	0.99
Woodland/scrub	0.76
Number of vegetation communities	10
Number of plant species	75

Vascular Plant Species

Nomenclature follows Parnell, J & Curtis, T. (2012) *Webb's An Irish Flora*, University of Cork Press.

Agrostis capillaris	*Festuca arundinacea*	*Phleum bertolonii*
Agrostis stolonifera	*Festuca rubra*	*Phragmites australis*
Apium nodiflorum	*Filipendula ulmaria*	*Plantago lanceolata*
Blackstonia perfoliata	*Fraxinus excelsior*	*Plantago major*
Briza media	*Galium palustre*	*Polygonum amphibium*
Cardamine flexuosa	*Galium verum*	*Potentilla anserina*
Cardamine pratensis	*Glyceria fluitans*	*Potentilla erecta*
Carex disticha	*Hydrocotyle vulgaris*	*Potentilla reptans*
Carex flacca	*Iris pseudacorus*	*Primula species*
Carex hirta	*Juncus acutiflorus*	*Prunella vulgaris*
Carex hostiana	*Juncus articulatus*	*Prunus spinosa*
Carex nigra	*Juncus bulbosus*	*Ranunculus acris*
Carex panicea	*Lathyrus pratensis*	*Ranunculus flammula*
Carex viridula agg.	*Leontodon autumnalis*	*Ranunculus repens*
Centaurea nigra	*Leontodon hispidus*	*Rhinanthus minor*
Cirsium arvense	*Leucanthemum vulgare*	*Rubus fruticosus* agg.
Cirsium dissectum	*Linum catharticum*	*Salix cinerea ssp. oleifolia*
Dactylorhiza incarnata	*Lolium perenne*	*Schoenus nigricans*
Danthonia decumbens	*Lotus corniculatus*	*Senecio aquaticus*
Deschampsia cespitosa	*Mentha aquatica*	*Succisa pratensis*
Eleocharis palustris	*Menyanthes trifoliata*	*Taraxacum officinale* agg.
Elymus repens	*Molinia caerulea*	*Trifolium pratense*
Epilobium species	*Myosotis scorpioides*	*Trifolium repens*
Equisetum fluviatile	*Parnassia palustris*	*Triglochin palustris*
Equisetum palustre	*Phalaris arundinacea*	*Vicia cracca*

Soils and Grazing

Soils were classified using a modified version of soil categories generated by the Teagasc/EPA Soils and Subsoils Mapping project (Fealy et al., 2009). The classification scheme principally uses parent material (calcareous/non-calcareous), depth class (shallow/deep) and drainage class (well drained/poorly drained) to assign soils to one of nine broad categories. Tullynafrankagh has extensive areas of fen peats and peat-marl soils. The mean ± SD of a range of soil properties are also provided, in addition to the median and range of each variable across turloughs. Tullynafrankagh soils are moderately alkaline and organic, with high amounts of calcium carbonate.

Soil Types/Grazing Extent	% Turlough Area
Shallow well drained mineral	8.1
Fen peat	36.9
Peat-marl	55.1
Extent of rotationally grazed area	19

Soil Property (n=6)	Tullynafrankagh	Turlough Summary Stats (n=22)		
	Mean ± SD	Median	Min	Max
pH	7.8 ± 0.3	7.20	5.94	8.29
% Organic Matter content	36.2 ± 10.3	25.8	10.2	69.1
% Inorganic content	31.0 ± 4.4	43.2	25.7	85.0
% Calcium carbonate content	32.8 ± 12.3	11.3	2.48	43.7
Total Nitrogen mg kg^{-1}	15400 ± 4042	11142	4983	24233
Total Phosphorus mg kg^{-1}	844 ± 121	905	245	1594

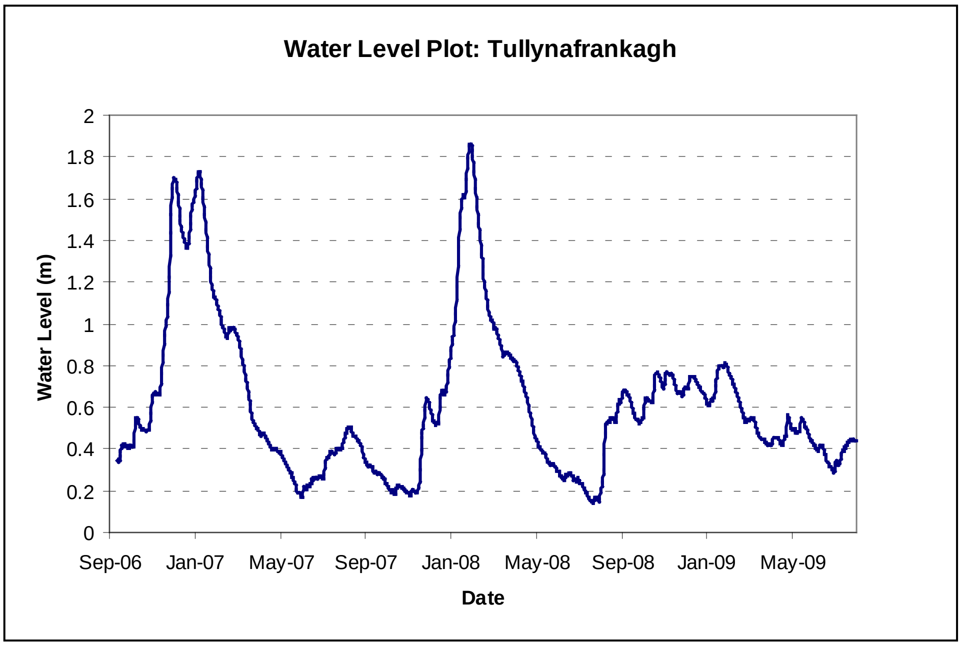
Hydrology

Water levels were recorded at hourly intervals using a variety of Schlumberger Divers® (Marton Geotechnical Ltd, Suffolk, UK) placed at or near the lowest point in each turlough. Divers measure the pressure of the water and air column above them, and from this the depth of water can be calculated. GPS surveys were carried out on 21 monitoring sites in order to develop digital terrain models (DTMs) from which contour maps, stage-volume and stage-surface area relationships are produced; this was not completed for Tullynafrankagh. The inflow magnitude is indicative of the properties of a turlough's catchment area and flow capacity, while outflow is a function of the drainage capacity of the system.

The water level data suggest short periods of maximum flooding with rapid filling and emptying. Lack of topographic survey at Tullynafrankagh precludes more detailed assessment of hydrological variables.

Hydrological Information	Tulynafrankagh Values	Turlough Summary Stats (n=21)		
		Median	Min	Max
Start of Hydrological Recording	01/10/2006	-	-	-
End of Hydrological Recording	04/08/2009	-	-	-
Days Recorded	1038	-	-	-
Equipment Failure	None recorded	-	-	-
Hydroperiod (days)	246	213	135	348
Maximum Floodwater Depth (m)	Not Available	4.9	3	15.4
Maximum Floodwater Volume ('000 m^3)	Not Available	877.9	355.6	4008.1
Maximum Flooded Area	Not Available	38.61	13.71	78.12
Average Basin Depth (m)	Not Available	2.28	0.85	6.76
Average Daily Inflow ($m^3 s^{-1}$)	Not Available	0.684	0.254	10.253
Average Daily Outflow ($m^3 s^{-1}$)	Not Available	0.271	0.086	2.018
Drainage Capacity ($m^3 s^{-1}$)	Not Available	0.154	0.069	1.156
Recession Duration (days)	Not Available	57.3	11	142.5

Water level plot for Tullynafrankagh turlough



Zone of Groundwater Contribution (ZOC) Risk Assessments

GIS based risk assessments were conducted with a view to identifying turloughs at risk of failing to meet WFD water quality objectives. These risk assessments were conducted by Compass Informatics Ltd and were based on Risk Assessment Sheet GWDTERA2a (Guidance Document No. GW9) on assessing risks to turloughs from phosphate (Working Group on Groundwater 2004) and Pathway Susceptibilities and Pressure Magnitudes were integrated to produce Impact Potential maps and predicted Risk Categories for the turlough ZOC. The TCD Risk Category is derived from a revised Impact Potential matrix. The predicted Risk Categories were adjusted using mean seasonal floodwater Total P (µg l^{-1}) (see Section 4.5.4 of the Risk Assessment Sheet GWDTERA2a). The risk categories include 1A: at significant risk; 1B: probably at significant risk; 2A: Not at significant risk (low confidence); 2B: Not at significant risk (higher confidence).

ZOC Area (Km^2)	Predicted WFD Risk Category	Adjusted WFD Risk Category	Predicted TCD Risk Category	Adjusted TCD Risk Category
1	1B	1A	1B	1A

ZOC Pressure Variable	
CORINE BARE ROCK %	0
CORINE PEAT BOGS%	0
CORINE ALL NATURAL AND SEMI-NATURAL AREAS%	17
CORINE IMPROVED PASTURE%	27
CORINE UNIMPROVED PASTURE%	34
CORINE ALL PASTURE%	60
CORINE OTHER AGRICULTURAL LANDS%	22
TEAGASC/EPA HABITATS ROCK%	0
TEAGASC/EPA HABITATS BOGS/PEATS%	0
TEAGASC/EPA HABITATS FORESTS/SCRUBS%	0
TEAGASC/EPA HABITATS WATER%	10
TEAGASC/EPA HABITATS DRY GRASSLAND%	84
TEAGASC/EPA HABITATS WET GRASSLAND%	6
TEAGASC TOTAL GRASSLAND%	90
TOTAL LIVESTOCK UNIT/ha of ZOC	1
TILLAGE%	1
No. SEPTIC TANKS km^{-2} ZOC	18
No. SEPTIC TANKS km^{-2} EXTREME PATHWAY SUSCEPTIBILITY	18
HIGH PATHWAY SUSCEPTIBILITY%	0
EXTR+HIGH PATHWAY SUSCEPTIBILITY%	53
WELL DRAINED SOIL %	88
POORLY DRAINED SOIL%	2

Site Conservation Assessment

The following site conservation assessment was undertaken to feed into the national reporting structure for assessing conservation status as required under Article 17 of the Habitats Directive. A suite of indicators and associated targets were derived to assess ecological structure and function. Future prospects were assessed through the evaluation of the impact of current and recent pressures and likely future threats to the site. The assessment follows a rules based approach to determine whether Structures & functions and Future Prospects should be assessed as good (green), inadequate (amber) or bad (red). For further details, see Chapter 10 (Conservation Status Assessment).

Please note an updated approach to assessing site condition has been proposed and is outlined in Chapter 12 (Monitoring Methods for Turloughs).

Conservation Condition Summary

Structure & Function	**Inadequate**
Future Prospects	**Inadequate**
Site Conservation Condition	**Inadequate**

Structure and Function Status:

Indicator	*Comments*
Hydrological Function: ***Intermediate***	Water is abstracted for a private water scheme from a borehole adjacent to the turlough, and is likely to have some impact on the hydrological function.
Water Quality: ***Intermediate***	33 µg P l^{-1}.
Biological Responses: ***Intermediate***	
Algal communities: -1	Algal mats were regularly recorded but were never extensive, however max CHL was high
Vegetation communities: 1	Intermediate cover of positive indicators, moderate cover of negative indicators. Just makes the good category
***Rumex* cover: 1**	Absent
Important plants: 0	None recorded
Important aquatic invertebrates: 0	None recorded
Overall Structure & Function: ***Intermediate***	

Pressures:

Code	Impact	Notes
H02.07 Diffuse groundwater pollution due to non-sewered population (ZOC)	M	High level of septic tanks in high risk groundwater pathway
H02.06 Diffuse groundwater pollution due to agricultural and forestry activities (ZOC)	M	Moderate agricultural activity within ZOC
J02.07.02 Groundwater abstractions for public water supply (ZOC)	L	Water abstraction likely to have an impact on hydrological function, probably fairly limited impacts although amount of abstraction recently increased
A04.03 Abandonment of pastoral systems, lack of grazing (turlough)	L	Possible impact of low grazing density on the prevalence of taller herb type communities, which may be important here given the relatively high nutrient loading
A04.01.01 Intensive cattle grazing (turlough)	L	Relatively low proportion of the turlough is grazed
A08 Fertilisation (within turlough)	L	Some evidence of fertilizer inputs
E01.03 Dispersed habitation (ZOC)	L	Significant dispersed habitation in ZOC, though impacts most likely through groundwater pollution

Threats:

Code	Impact	Notes
H02.06 Diffuse groundwater pollution due to agricultural and forestry activities (ZOC)	H	Likely to be a continuing and increasing impact
A02.01 Agricultural intensification (ZOC)	M	Moderate agricultural intensification likely within ZOC and linked with extreme pathway susceptibility
J02.07.02 Groundwater abstractions for public water supply (ZOC)	M	Continuing pressure, possibly with calls to increase abstraction
H02.07 Diffuse groundwater pollution due to non-sewered population (ZOC)	M	Continuing pressure
M01.03 Flooding and rising precipitations	L	
A10.02 Removal of stone walls and embankments (in turlough)	L	
A04.03 Abandonment of pastoral systems, lack of grazing	L	Possibly the grazing level is too low within the turlough, promoting tall and rather uniform vegetation.

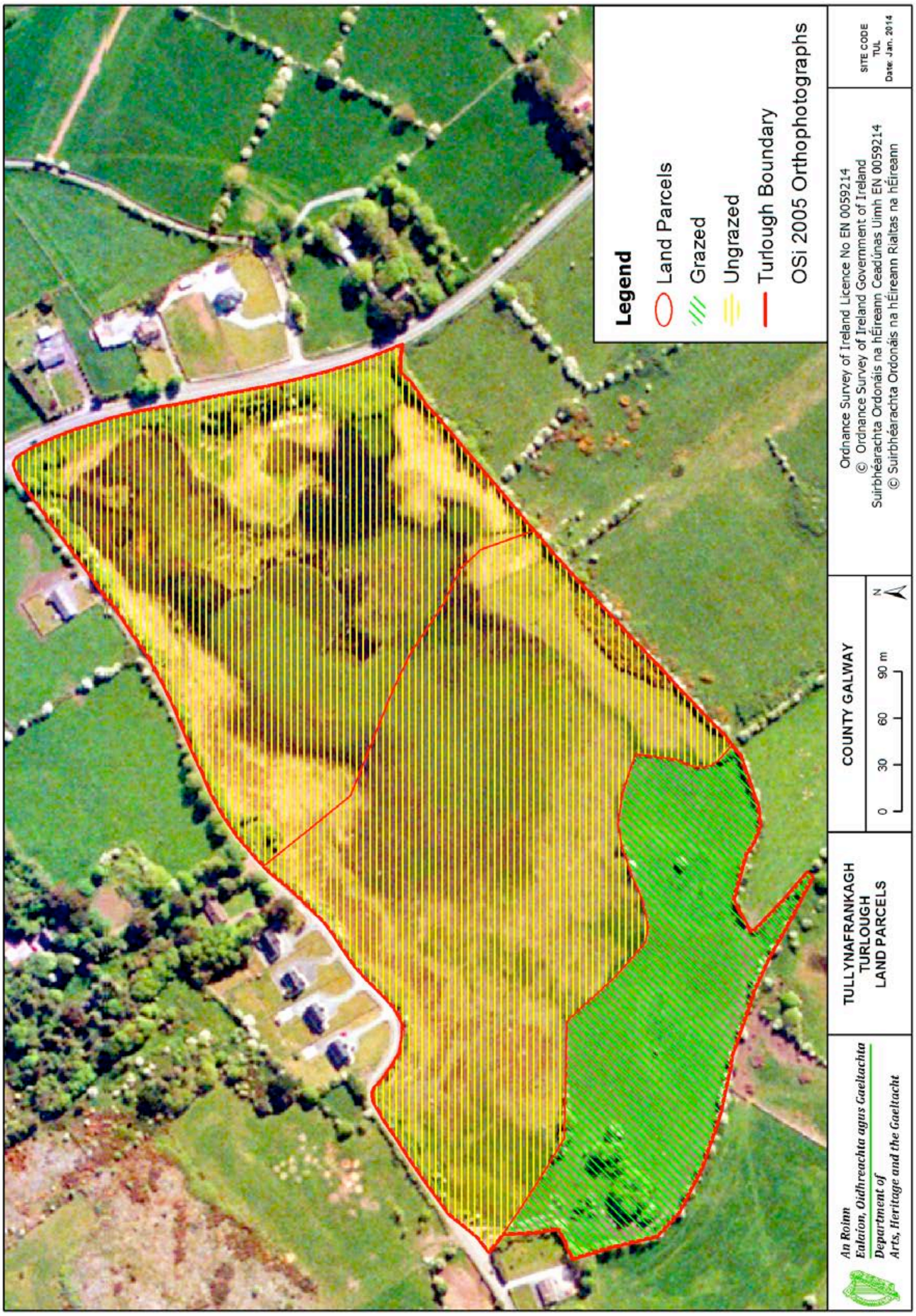
Future Prospects: **Inadequate** – several medium and high impact threats suggest that ecological condition is likely to deteriorate

Overall Assessment: **Inadequate** – structure and function not very good, and coupled with poor prospects suggest unfavourable conservation status. The impact of the group water scheme needs to be determined, more to provide evidence to support or refute similar actions in other turloughs. Water quality is moderately poor and likely worsen due to the high number of septic tanks and agricultural inputs, coupled with large area of extreme pathway susceptibility. A slight increase in grazing level may help increase diversity within the turlough, which is currently rather uniform.

Maps

Maps are provided of:

1. Grazing in land parcels
2. Approximate sampling points for water chemistry and aquatic invertebrates
3. Soil nutrient sampling points
4. Points for soil survey (note: soils were surveyed to the turlough boundary defined by Goodwillie, 1992; see map 9)
5. Soils (note: soils were mapped by combining the EPA Subsoils base map with the point soil descriptions; for further details see *Chapter 6: Soils and Landuse*)
6. Vegetation communities (note: relevés do not always match to mapped communities due to small scale variation; for further details of mapping see *Chapter 7: Turlough Vegetation: Description, Mapping and Ecology*)
7. Estimated zone of groundwater contribution (ZOC)


Legend
Land Parcels
Grazed
Ungrazed
Turlough Boundary
OSi 2005 Orthophotographs
Ordnance Survey of Ireland Licence No EN 0059214
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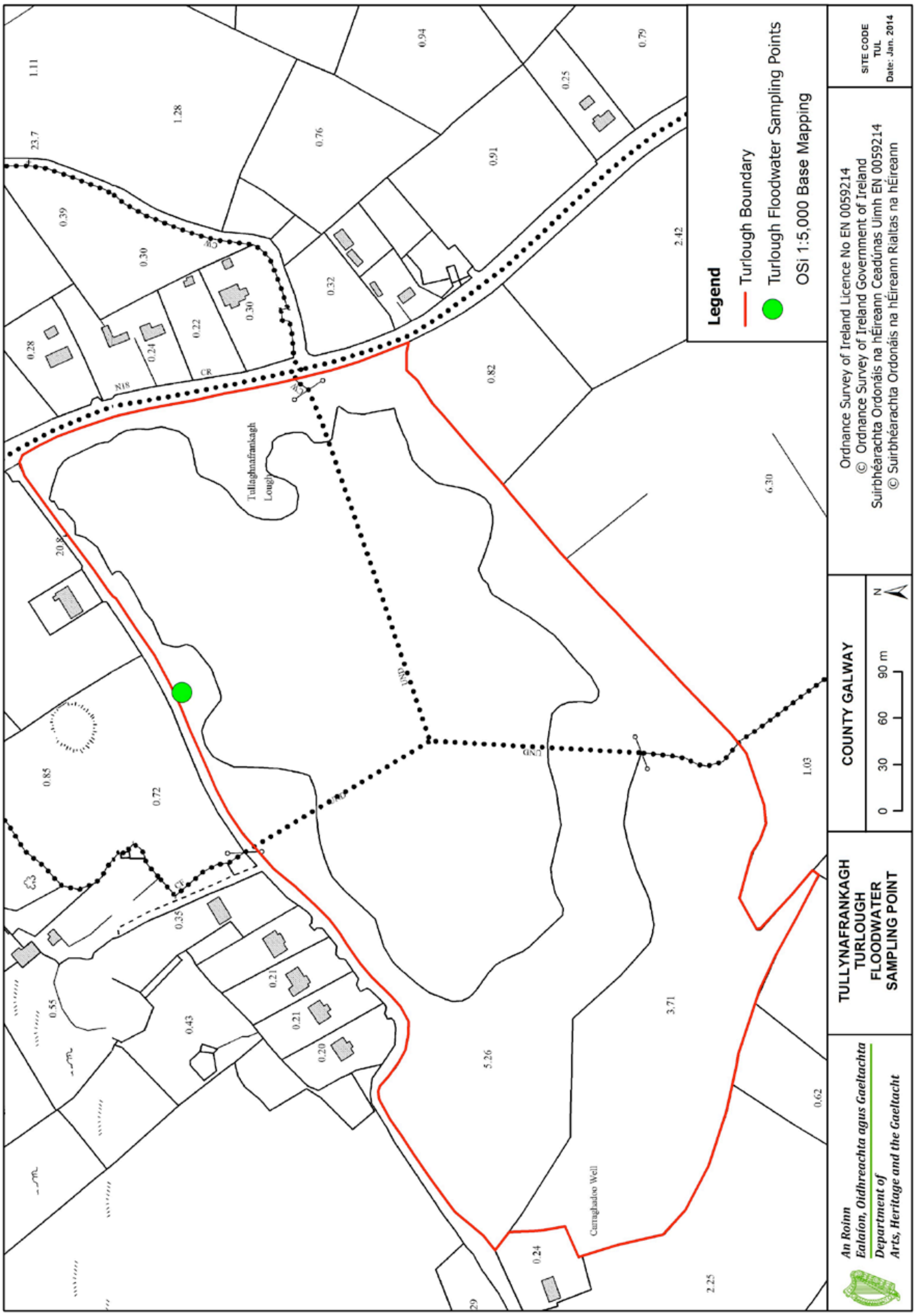
© Suirbhéarachta Ordonáis na hÉireann Rialtas na hÉireann
SITE CODE
TUL
Date: Jan. 2014
COUNTY GALWAY
0 30 60 90 m
N
TULLYNAFRANKAGH
TURLOUGH
LAND PARCELS
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht


Legend
Turlough Boundary
Turlough Floodwater Sampling Points
OSi 1:5,000 Base Mapping
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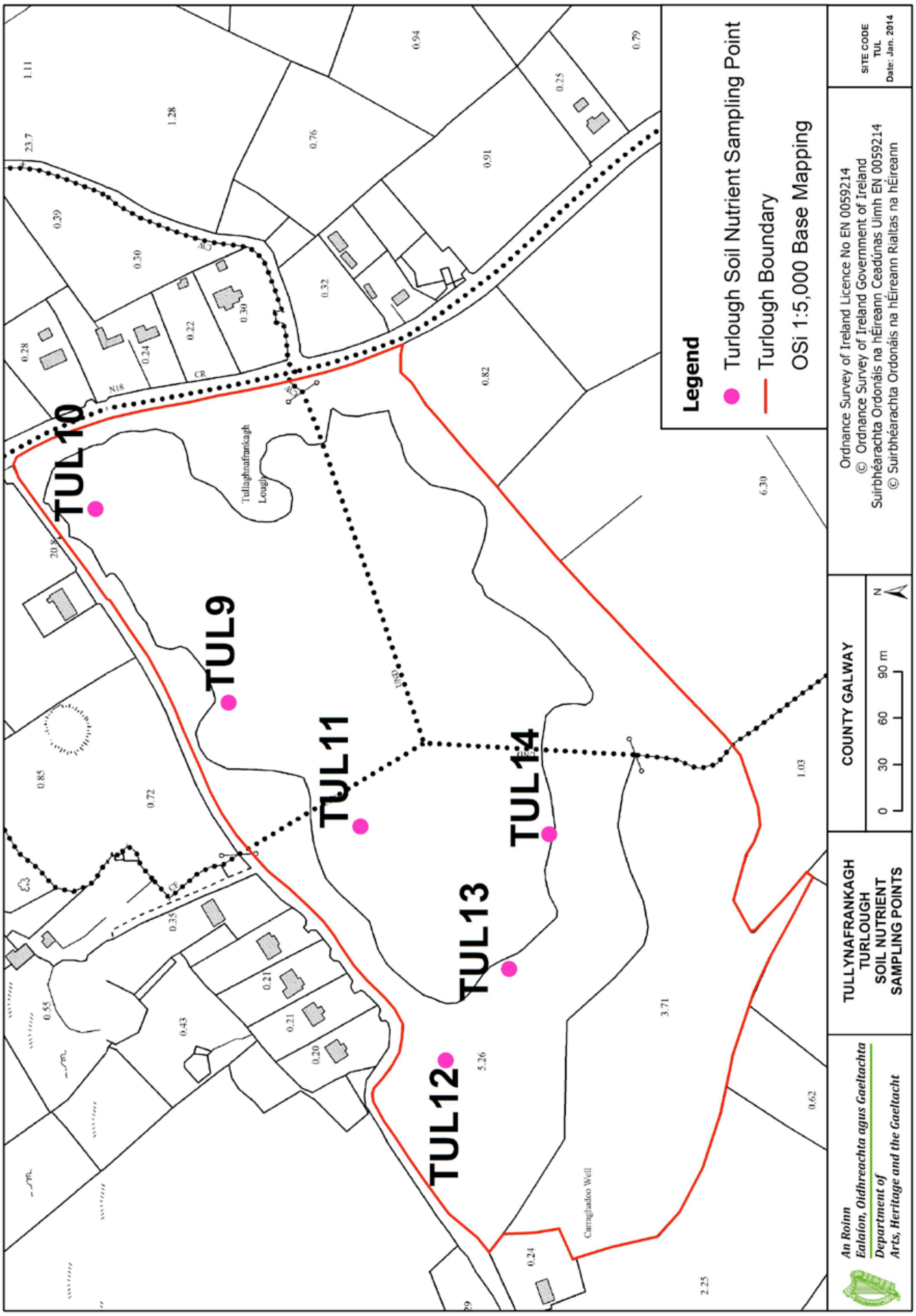
SITE CODE
TUL
Date: Jan. 2014
COUNTY GALWAY
0 30 60 90 m
N
TULLYNAFRANKAGH
TURLOUGH
FLOODWATER
SAMPLING POINT
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht
Tullaghnafrankagh Lough
Curraghadoo Well
N18


Legend
Turlough Soil Nutrient Sampling Point
Turlough Boundary
OSi 1:5,000 Base Mapping
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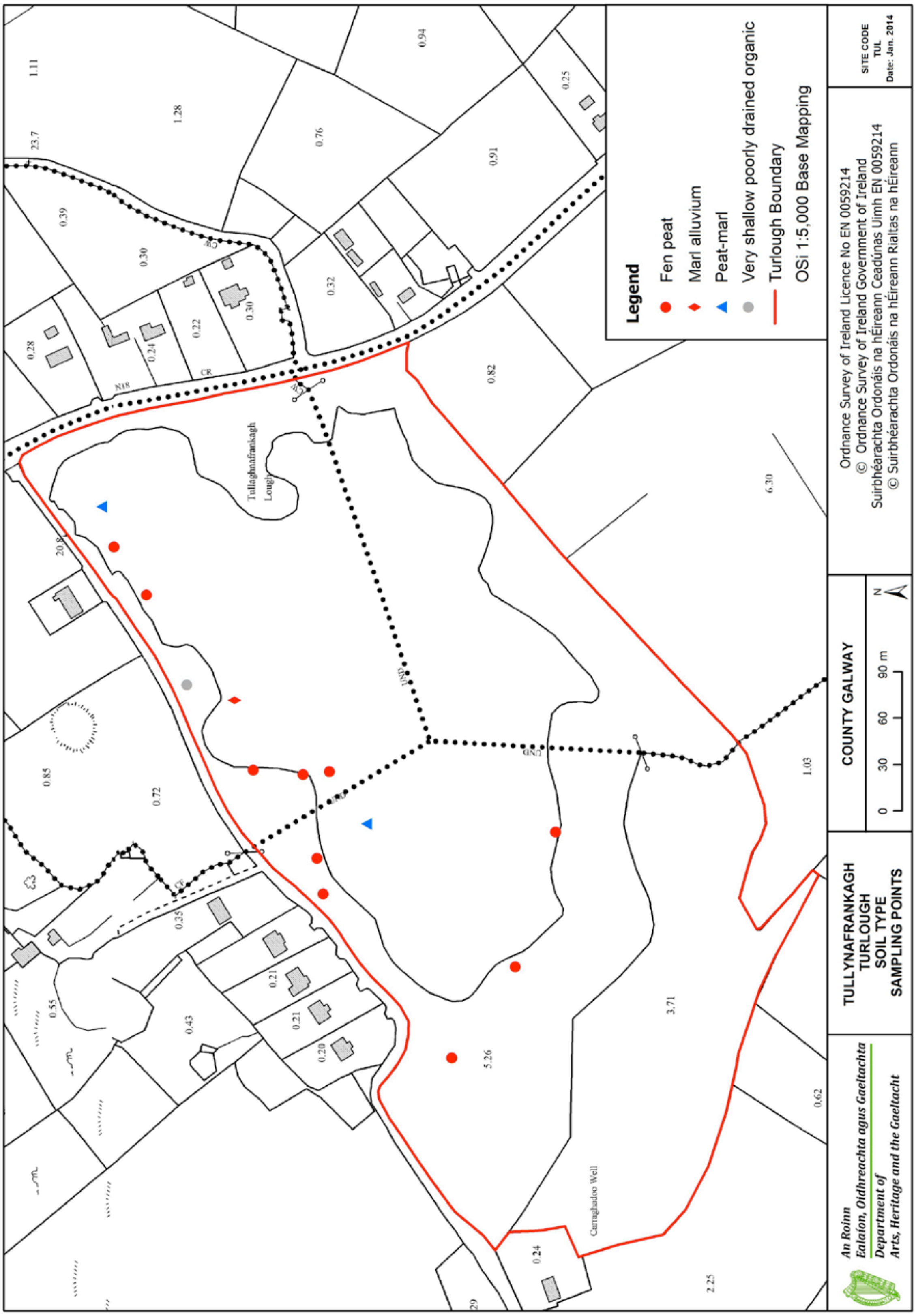
© Suirbhéaracht Ordonáis na hÉireann Rialtas na hÉireann
SITE CODE
TUL
Date: Jan. 2014
COUNTY GALWAY
0 30 60 90 m
N
TULLYNAFRANKAGH
TURLOUGH
SOIL NUTRIENT
SAMPLING POINTS
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht
TUL10
TUL9
TUL11
TUL14
TUL13
TUL12
Tullaghnafrankagh Lough
Carraghadoo Well
N18


Legend
Fen peat
Marl alluvium
Peat-marl
Very shallow poorly drained organic
Turlough Boundary
OSi 1:5,000 Base Mapping
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SITE CODE
TUL
Date: Jan. 2014
COUNTY GALWAY
0 30 60 90 m
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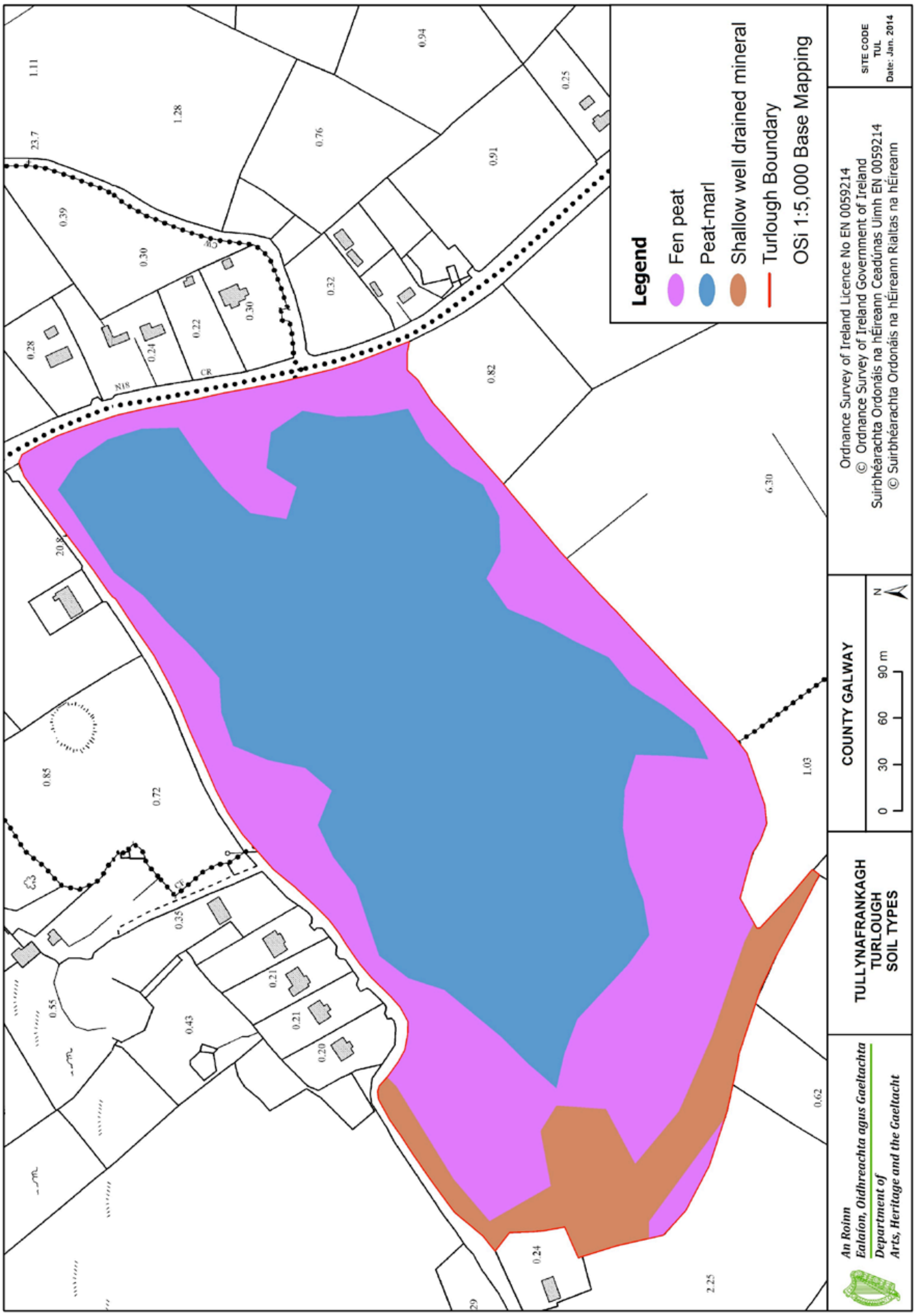
TULLYNAFRANKAGH
TURLOUGH
SOIL TYPE
SAMPLING POINTS
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht
Tullaghnafrankagh Lough
Curraghadoo Well


Legend
Fen peat
Peat-marl
Shallow well drained mineral
Turlough Boundary
OSi 1:5,000 Base Mapping
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SITE CODE
TUL
Date: Jan. 2014
TULLYNAFRANKAGH
TURLOUGH
SOIL TYPES
COUNTY GALWAY
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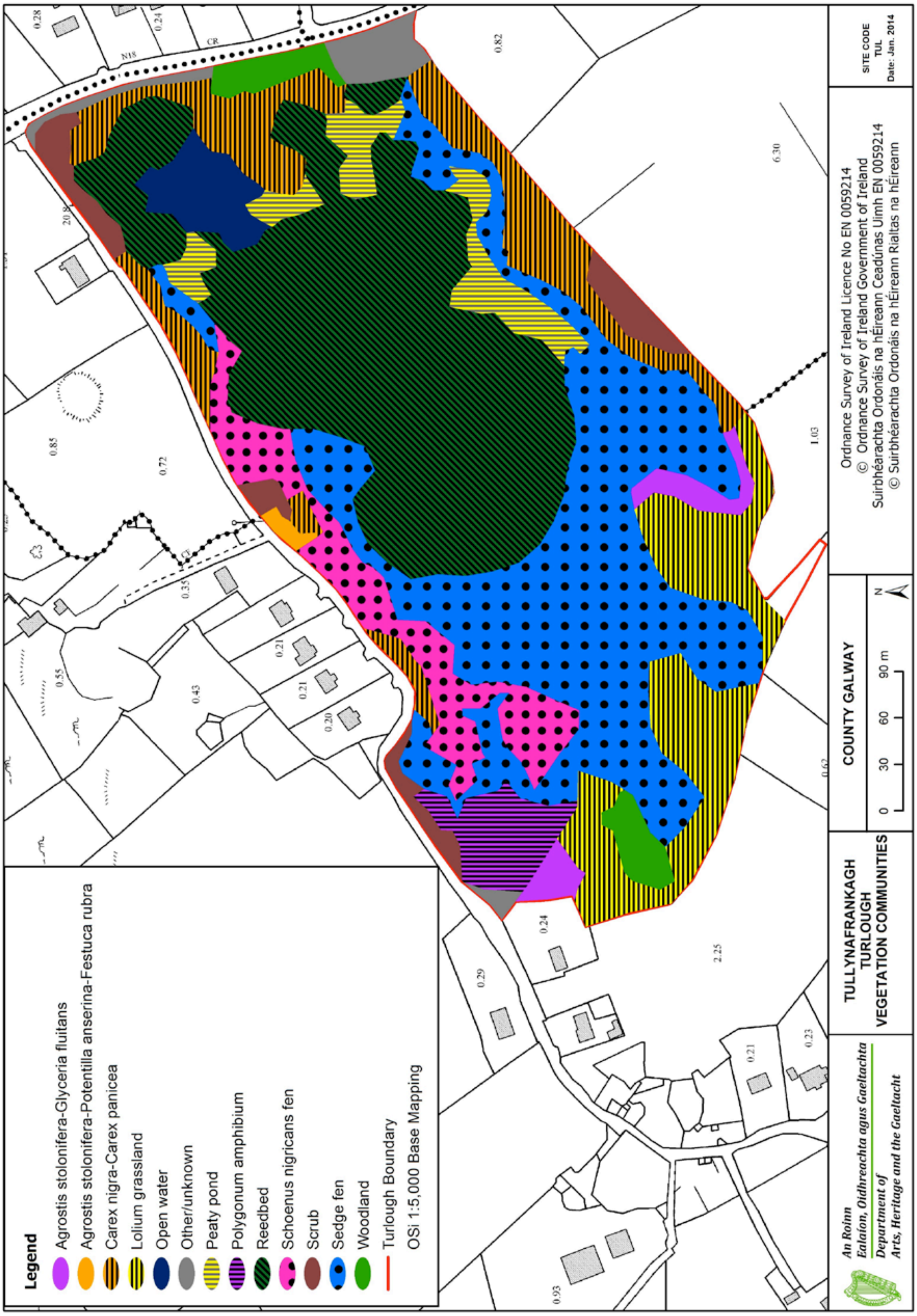
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht


Legend
Agrostis stolonifera-Glyceria fluitans
Agrostis stolonifera-Potentilla anserina-Festuca rubra
Carex nigra-Carex panicea
Lolium grassland
Open water
Other/unknown
Peaty pond
Polygonum amphibium
Reedbed
Schoenus nigricans fen
Scrub
Sedge fen
Woodland
Turlough Boundary
OSi 1:5,000 Base Mapping
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht
TULLYNAFRANKAGH
TURLOUGH
VEGETATION COMMUNITIES
COUNTY GALWAY
0 30 60 90 m
N
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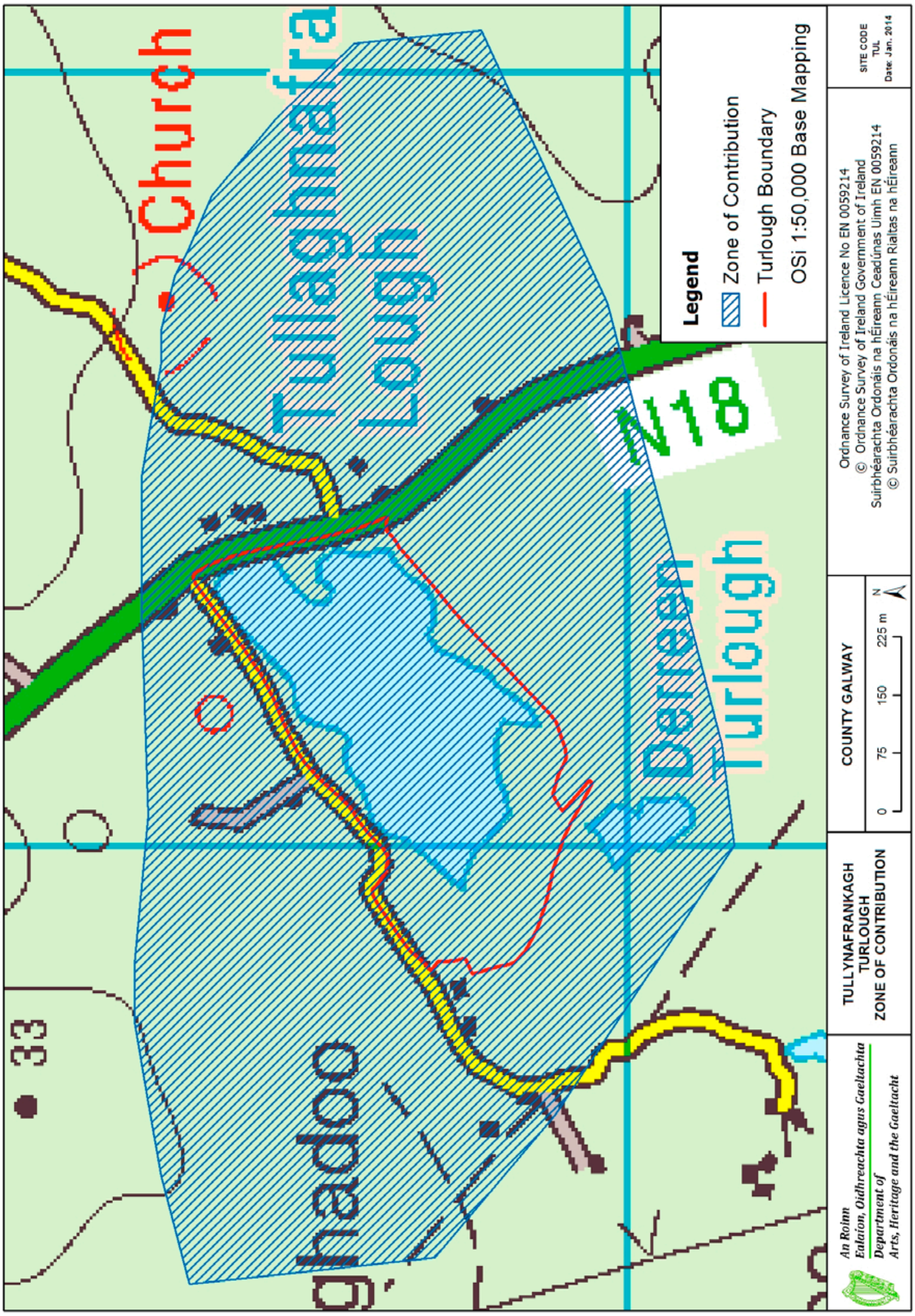
SITE CODE
TUL
Date: Jan. 2014


Church
Tullaghnafra
Lough
N18
Derreen
Turlough
33
ghadoo
Legend
Zone of Contribution
Turlough Boundary
OSi 1:50,000 Base Mapping
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TULLYNAFRANKAGH
TURLOUGH
ZONE OF CONTRIBUTION
COUNTY GALWAY
0 75 150 225 m
N
SITE CODE
TUL
Date: Jan. 2014
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht

Site Report: Turloughmore Turlough
TCD Turlough Research project 2006-2011

Turlough Project Code	SAC Name	SAC/NHA No.	County	Townland	RBD	Easting	Northing	Area (ha)
TUR	East Burren Complex	001926	Clare	Turloughmore	SHANNON	134950	199480	34

File update: July 2015 (S. Waldren)

Site Description

Turloughmore lies along the eastern fringe of the sprawling East Burren SAC complex in north Co. Clare. Surrounding drift ridges distinguish this site from other turloughs within the East Burren complex which are typically surrounded by limestone pavement. The site consists of a long, narrow basin with a gently sloping, undulating topography. Only six vegetation types were recorded at this site; *Lolium grassland* and *Agrostis stolonifera-Potentilla anserina-Festuca rubra* are by far the most extensive. Turloughmore soils are moderately acidic with low amounts of calcium carbonate. The soils are pre-dominantly comprised of the 'Shallow poorly drained mineral' soil type. This turlough has a very flashy hydrological regime, with multiple significant flood events occurring within a single year. The turlough is heavily grazed by sheep and cattle, and there is evidence of agricultural improvement (improved grassland, woodland and scrub clearance) at this site.

Turloughmore – photo: S. Kimberley

Phytoplankton

Phytoplankton analysis was conducted on sub-samples of monthly spot samples collected for hydrochemical analysis between October 2006 and June 2007. Phytoplankton composition varies significantly over time and data from autumn, mid-winter and spring/early summer are presented below. Taxa were identified to species level where possible. Some taxa were not discriminated beyond general groupings (i.e. small centric diatoms, dinoflagellates and pinnate diatoms). The term non-identifiable alone (or n.i.) was reserved for cases where specimens were not identifiable. Discrimination between n.i. filament, n.i. flagellate, n.i. colony, n.i. green filament was made when applicable. Biovolume (mm^3 m^{-3}) was used as the measure of algal biomass.

October 2006		January 2007		May 2007	
Biovolume (mm^3/m^3)	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*	*Biovolume (mm^3/m^3)*
Cryptomonas	*122320*	*Navicula*	*3619*	*n.i. centrics*	*22667*
Chlamydomonas	*25624*	*n.i. filament*	*2703*	*Navicula*	*19067*
Chroomonas acuta	*19384*	*Nitzchia*	*2684*	*n.i. pennates*	*10496*
Nitzchia	*18998*	*Fragilaria/Synedra*	*2323*	*Chlamydomonas*	*7541*
n.i. pennates	*15285*	*n.i.* pennates (colonial)	*1611*	*Cryptomonas*	*5760*

Benthic Algae

Turloughs were inspected for algal mats during the emptying phase in 2007, 2008 and 2009. Turloughs were visited in the first two weeks of March to June 2007 as part of the monthly monitoring of turloughs. Dedicated trips to inspect for algal mats were conducted in 2008 on the 4th of March, the 1st of April, and the 26th, 27th and 28th of May, and in 2009 on the 15th and 16th of June and on the 24th and 25th of July. The presence of both living floating mats and dead drying mats was noted, as well as their extent in the turlough basins. Occurrence of visible filamentous algal mats in the three years of observation is presented below. Y = visible occurrence; * = "extensive cover" (estimated to be 2 to 8% of total area of basin); † = negligible quantity observed; • = turlough was too flooded to permit full observation. No algal mats were observed in Turloughmore.

Year of Observation		
2007	**2008**	**2009**
N	N	N

Hydrochemistry

Data shown are the mean ± SD of monthly spot samples collected between October 2006 and June 2007. Mean seasonal Total P and Chlorophyll *a* were used to determine the trophic status of the floodwaters based on OECD trophic categories. The median and range of <u>mean values</u> across all turloughs are also provided.

Hydrochemical Variable	Turloughmore Values		Turlough Summary Stats (n=22)		
	Mean±SD	OECD Trophic Category	Median	Min	Max
pH	8.1±0.3		8.1	7.7	8.3
Alkalinity mg l^{-1} $CaCO_3$	167.5±19.1		204.0	112.4	236.4
Colour mg l^{-1} PtCo	11.0±7.0		26.9	7.9	85.1
Molybdate Reactive Phosphorus µg l^{-1}	3.3±1.8		3.4	0.7	42.1
Total Phosphorus µg l^{-1}	19.4±10.9	Mesotrophic	24.8	4.0	82.1
Chlorophyll *a* µg l^{-1}	4.8±4.6	Mesotrophic	4.9	1.1	33.5
Nitrate-N mg l^{-1}	0.3±0.4		0.7	0.1	1.9
Total Nitrogen mg l^{-1}	0.6±0.4		1.2	0.6	2.3

Aquatic Invertebrates

22 turloughs were sampled for littoral aquatic macroinvertebrates using sweep nets during November 2006. There was no floodwater present in April 2007.

Aquatic Macroinvertebrates			
November 2006	**Count**	**April 2007**	**Count**
Agabus sp. (larva)	42		
Chironomidae	1		
Hydrachnidia (Mite)	2		
Ilybius sp. (larva)	7		
Limnephilidae sp. Instar III	1		
Lymnaea peregra	1		
Ostracoda	7719		
Rhantus sp. (larva)	1		
Tipulidae	3		

Aquatic Macroinvertebrates: Presence of exceptionally high abundances (> 50 individuals) of Ostracoda in November 2006 indicates nutrient enrichment.

Aquatic Macroinvertebrate Taxa	Presence of high abundances	
	November 2006	**April 2007**
Diptera	N	
Ostracoda	Y	
Odonata	N	
Trichoptera	N	

Zooplankton species
No floodwater in 2007

Vegetation

Vegetation description and classification yielded 25 vegetation communities suitable for mapping. Five vegetation communities were mapped in Turloughmore. High conservation value communities are denoted by *. 52 plant species were recorded, including the notable *Teucrium scordium*.

Vegetation Community	Area (Ha)
A. stolonifera-P. anserina - F. rubra	10.66
Limestone grassland	0.19
Lolium grassland	19.94
Other/unknown	0.83
Poa annua-Plantago major	1.17
Woodland/scrub	1.35
Number of vegetation communities	5
Number of plant species	52

Vascular Plant Species

Nomenclature follows Parnell, J & Curtis, T. (2012) *Webb's An Irish Flora*, University of Cork Press.

Achillea millefolium	*Filipendula ulmaria*	*Polygonum amphibium*
Agrostis stolonifera	*Filipendula vulgaris*	*Polygonum aviculare*
Alopecurus geniculatus	*Galium palustre*	*Potentilla anserina*
Antennaria dioica	*Galium verum*	*Potentilla erecta*
Bellis perennis	*Glechoma hederacea*	*Prunella vulgaris*
Briza media	*Holcus lanatus*	*Ranunculus acris*
Campanula rotundifolia	*Leontodon autumnalis*	*Ranunculus repens*
Cardamine pratensis	*Leontodon hispidus*	*Rumex acetosa*
Carex flacca	*Leucanthemum vulgare*	*Rumex crispus*
Carex hirta	*Lolium perenne*	*Rumex obtusifolius*
Carex nigra	*Lotus corniculatus*	*Stellaria media*
Cerastium fontanum	*Matricaria discoidea*	*Succisa pratensis*
Cirsium arvense	*Plantago lanceolata*	*Taraxacum officinale* agg.
Cynosurus cristatus	*Plantago major*	*Teucrium scordium*
Dactylis glomerata	*Poa annua*	*Trifolium pratense*
Elymus repens	*Poa pratensis*	*Trifolium repens*
Festuca arundinacea	*Poa trivialis*	*Veronica serpyllifolia*
Festuca rubra		

Soils and Grazing

Soils were classified using a modified version of soil categories generated by the Teagasc/EPA Soils and Subsoils Mapping project (Fealy *et al.*, 2009). The classification scheme principally uses parent material (calcareous/non-calcareous), depth class (shallow/deep) and drainage class (well drained/poorly drained) to assign soils to one of nine broad categories. Turloughmore has extensive areas of shallow poorly drained mineral soils. The mean ± SD of a range of soil properties are also provided, in addition to the median and range of each variable across turloughs. Turloughmore soils are moderately acidic and mineral, with low amounts of calcium carbonate.

Soil Types/Grazing Extent	% Turlough Area
Shallow poorly drained mineral	85.3
Very shallow well drained organic	11
Extent of rotationally grazed area	100

Soil Property (n=6)	Turloughmore	Turlough Summary Stats (n=22)		
	Mean ± SD	Median	Min	Max
pH	6.58 ± 0.5	7.20	5.94	8.29
% Organic Matter content	18.8 ± 2.6	25.8	10.2	69.1
% Inorganic content	78.7 ± 2.8	43.2	25.7	85.0
% Calcium carbonate content	2.48 ± 0.4	11.3	2.48	43.7
Total Nitrogen mg kg^{-1}	8233 ± 1725	11142	4983	24233
Total Phosphorus mg kg^{-1}	915 ± 328	905	245	1594

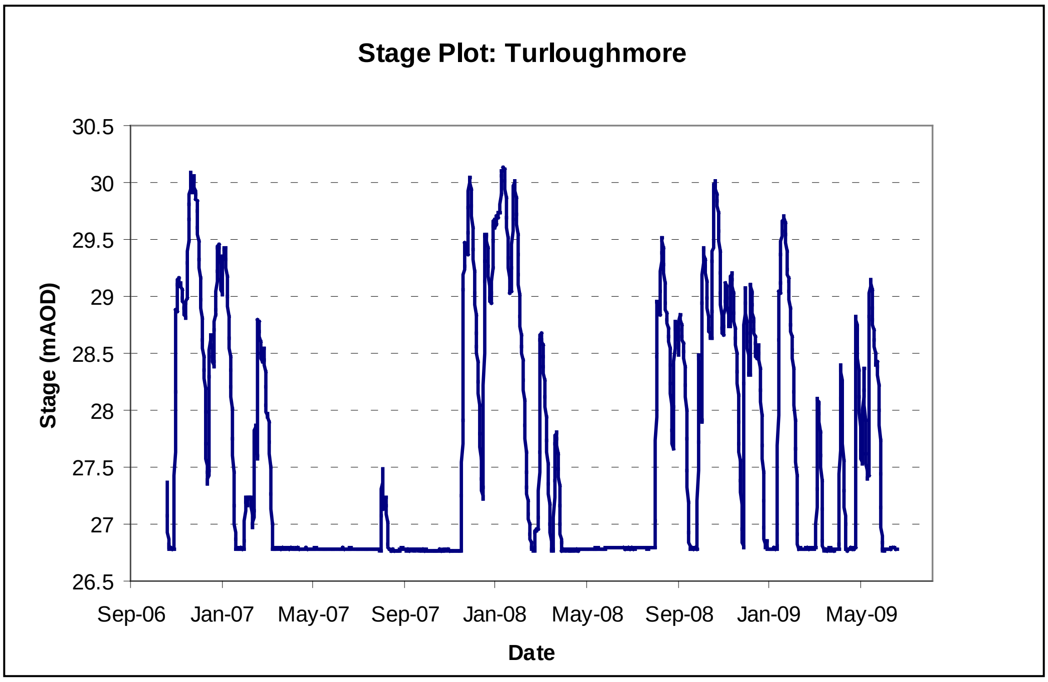
Hydrology

Water levels were recorded at hourly intervals using a variety of Schlumberger Divers® (Marton Geotechnical Ltd, Suffolk, UK) placed at or near the lowest point in each turlough. Divers measure the pressure of the water and air column above them, and from this the depth of water can be calculated. GPS surveys were carried out on 21 monitoring sites (Tullynafrankagh omitted) in order to develop digital terrain models (DTMs) from which contour maps, stage-volume and stage-surface area relationships are produced. The inflow magnitude is indicative of the properties of a turlough's catchment area and flow capacity, while outflow is a function of the drainage capacity of the system.

Turloughmore has a very flashy hydrological regime, with multiple significant flood events occurring within a single year. It is a shallow turlough, with moderate inflow and outflow, a fairly high drainage capacity but a very short recession duration

Hydrological Information	Turloughmore Values	Turlough Summary Stats (n=21)		
		Median	Min	Max
Start of Hydrological Recording	06/11/2006	-	-	-
End of Hydrological Recording	24/06/2009	-	-	-
Days Recorded	961	-	-	-
Equipment Failure	None recorded	-	-	-
Hydroperiod (days)	135	213	135	348
Maximum Floodwater Depth (m)	3.5	4.9	3	15.4
Maximum Floodwater Volume ('000 m^3)	416.5	877.9	355.6	4008.1
Maximum Flooded Area	30.79	38.61	13.71	78.12
Average Basin Depth (m)	1.35	2.28	0.85	6.76
Average Daily Inflow ($m^3 s^{-1}$)	1.746	0.684	0.254	10.253
Average Daily Outflow ($m^3 s^{-1}$)	0.585	0.271	0.086	2.018
Drainage Capacity ($m^3 s^{-1}$)	0.39	0.154	0.069	1.156
Recession Duration (days)	12.4	57.3	11	142.5

Stage plot for Turloughmore



Zone of Groundwater Contribution (ZOC) Risk Assessments

GIS based risk assessments were conducted with a view to identifying turloughs at risk of failing to meet WFD water quality objectives. These risk assessments were conducted by Compass Informatics Ltd and were based on Risk Assessment Sheet GWDTERA2a (Guidance Document No. GW9) on assessing risks to turloughs from phosphate (Working Group on Groundwater 2004) and Pathway Susceptibilities and Pressure Magnitudes were integrated to produce Impact Potential maps and predicted Risk Categories for the turlough ZOC. The TCD Risk category derived from a revised Impact Potential matrix. The predicted Risk Categories were adjusted using mean seasonal floodwater Total P (µg l^{-1}) (see Section 4.5.4 of the Risk Assessment Sheet GWDTERA2a). The risk categories include 1A: at significant risk; 1B: probably at significant risk; 2A: Not at significant risk (low confidence); 2B: Not at significant risk (higher confidence).

ZOC Area (Km^2)	Predicted WFD Risk Category	Adjusted WFD Risk Category	Predicted TCD Risk Category	Adjusted TCD Risk Category
4.5	2B	1B	1B	1B

ZOC Pressure Variable	
CORINE BARE ROCK %	45
CORINE PEAT BOGS%	0
CORINE ALL NATURAL AND SEMI-NATURAL AREAS%	0
CORINE IMPROVED PASTURE%	55
CORINE UNIMPROVED PASTURE%	0
CORINE ALL PASTURE%	55
CORINE OTHER AGRICULTURAL LANDS%	0
TEAGASC/EPA HABITATS ROCK%	44
TEAGASC/EPA HABITATS BOGS/PEATS%	0
TEAGASC/EPA HABITATS FORESTS/SCRUBS%	0
TEAGASC/EPA HABITATS WATER%	0
TEAGASC/EPA HABITATS DRY GRASSLAND%	56
TEAGASC/EPA HABITATS WET GRASSLAND%	0
TEAGASC TOTAL GRASSLAND%	56
TOTAL LIVESTOCK UNIT/ha of ZOC	1
TILLAGE%	0
No. SEPTIC TANKS km^{-2} ZOC	2
No. SEPTIC TANKS km^{-2} EXTREME PATHWAY SUSCEPTIBILITY	2
HIGH PATHWAY SUSCEPTIBILITY%	0
EXTR+HIGH PATHWAY SUSCEPTIBILITY%	70
WELL DRAINED SOIL %	97
POORLY DRAINED SOIL%	3

Site Conservation Assessment

The following site conservation assessment was undertaken to feed into the national reporting structure for assessing conservation status as required under Article 17 of the Habitats Directive. A suite of indicators and associated targets were derived to assess ecological structure and function. Future prospects were assessed through the evaluation of the impact of current and recent pressures and likely future threats to the site. The assessment follows a rules based approach to determine whether Structures & functions and Future Prospects should be assessed as good (green), inadequate (amber) or bad (red). For further details, see Chapter 10 (Conservation Status Assessment).

Please note an updated approach to assessing site condition has been proposed and is outlined in Chapter 12 (Monitoring Methods for Turloughs).

Conservation Condition Summary

Structure & Function	**Inadequate/Bad**
Future Prospects	**Bad**
Site Conservation Condition	**Bad**

Structure and Function Status:

Indicator	***Comments***
Hydrological Function: *Good*	
Water Quality: *Good/intermediate*	19.4 µg P l^{-1}. Borderline intermediate
Biological Responses: *Bad*	
Algal communities: -1	No algal mats were recorded, but max CHL was high
Vegetation communities: -1	High cover of negative indicators (mostly *Lolium* grassland), very low cover of positive indicators. Lacking in diversity
***Rumex* cover: -1**	60%
Important plants: 1	*Teucrium scordium*
Important aquatic invertebrates: 0	None recorded
Overall Structure & Function: *Inadequate/Bad*	Rather poor biological condition despite good hydrological function and moderately good water chemistry status

Pressures:

Code	***Impact***	***Notes***
A04.01.01 Intensive cattle grazing (turlough)	H	The whole of the turlough is grazed and some land parcels had very heavy livestock use
A02.01 Agricultural intensification	M	Moderate agricultural intensification seems likely to have occurred within the turlough – fertilisation, establishment of rye grass sward, woodland clearance
H02.06 Diffuse groundwater pollution due to agricultural and forestry activities (ZOC)	M	Moderate nutrient enrichment in groundwater likely from agriculture as few dwellings in ZOC; might also be influenced by inputs directly into turlough

Threats:

Code	Impact	Notes
A04.01.01 Intensive cattle grazing (turlough)	H	Continuing pressure
H02.06 Diffuse groundwater pollution due to agricultural and forestry activities (ZOC)	M	Likely to be a continuing and increasing impact
A02.01 Agricultural intensification (ZOC)	M	Moderate agricultural intensification likely within ZOC and linked with extreme pathway susceptibility
M01.03 Flooding and rising precipitations	L	
A10.02 Removal of stone walls and embankments (in turlough	L	

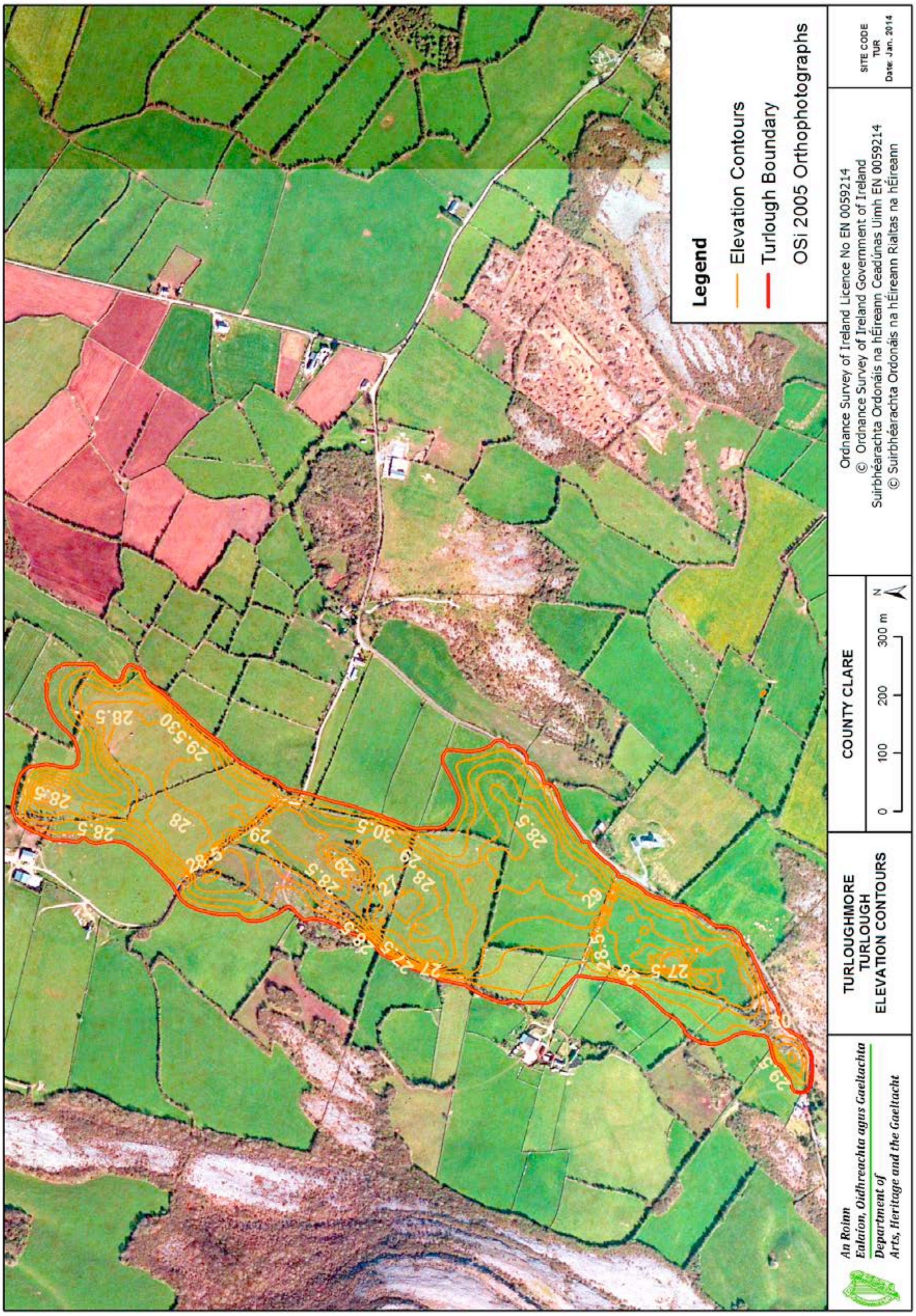
Future Prospects: **Bad** – current pressures are considered to have large impacts, and are likely to continue, and agricultural intensification is likely in the ZOC.

Overall Assessment: **Bad** – Turloughmore has reasonably good hydrological function and water chemistry, but poor biological communities. There are a number of potentially high impact pressures, many linked with agricultural improvement to support grazing. Though no evidence of fertiliser input was found, the high prevalence of *Lolium* grassland suggests reseeding, perhaps facilitated by the comparatively shallow flooding). This supports a relatively high density of cattle grazing, and this in turn may help to explain the fairly high water TP for a Burren turlough. Any fertiliser input to this turlough needs to be stopped, and the grazing pressure reduced; this may in time allow vegetation communities to recover, but this would be a long-term effect and only if the threats identified can be mitigated.

Maps

Maps are provided of:

1. Elevation contours, based on GIS digital terrain models from points by differential GPS topographic survey (for further details, see *Chapter 3: Hydrology*)
2. Grazing in land parcels
3. Approximate sampling points for water chemistry and aquatic invertebrates
4. Soil nutrient sampling points
5. Points for soil survey (note: soils were surveyed to the turlough boundary defined by Goodwillie, 1992; see map 9)
6. Soils (note: soils were mapped by combining the EPA Subsoils base map with the point soil descriptions; for further details see *Chapter 6: Soils and Landuse*)
7. Vegetation relevés
8. Vegetation communities (note: relevés do not always match to mapped communities due to small scale variation; for further details of mapping see *Chapter 7: Turlough Vegetation: Description, Mapping and Ecology*)
9. Vegetation maps digitised from Goodwillie, R. (1992) *Turlough's Over 50 Hectares*. Report to NPWS
10. Estimated zone of groundwater contribution (ZOC)


Legend
Elevation Contours
Turlough Boundary
OSi 2005 Orthophotographs
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SITE CODE
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Date: Jan. 2014
COUNTY CLARE
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ELEVATION CONTOURS
An Roinn
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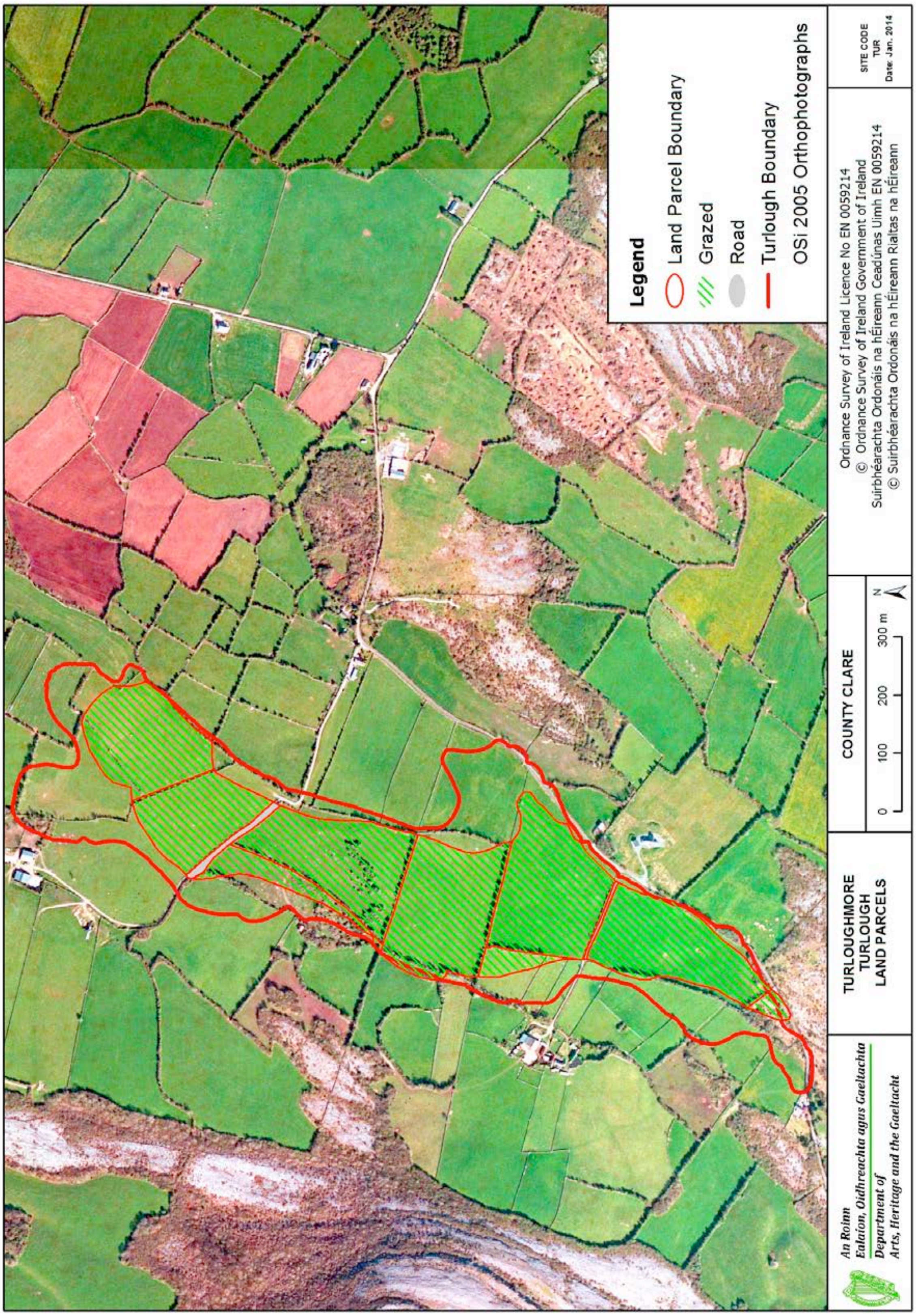
Legend
Land Parcel Boundary
Grazed
Road
Turlough Boundary
OSi 2005 Orthophotographs
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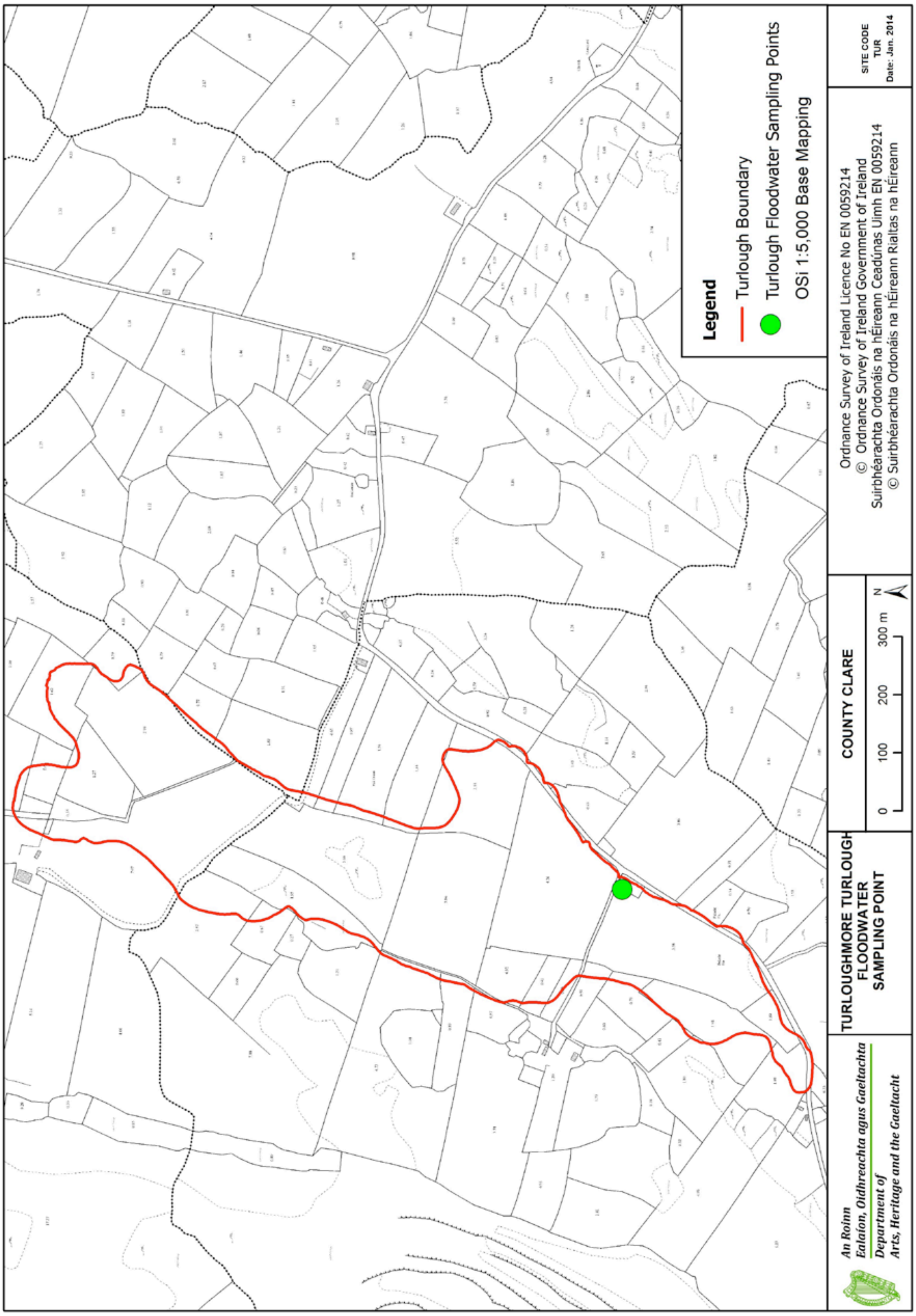

Legend
Turlough Boundary
Turlough Floodwater Sampling Points
OSi 1:5,000 Base Mapping
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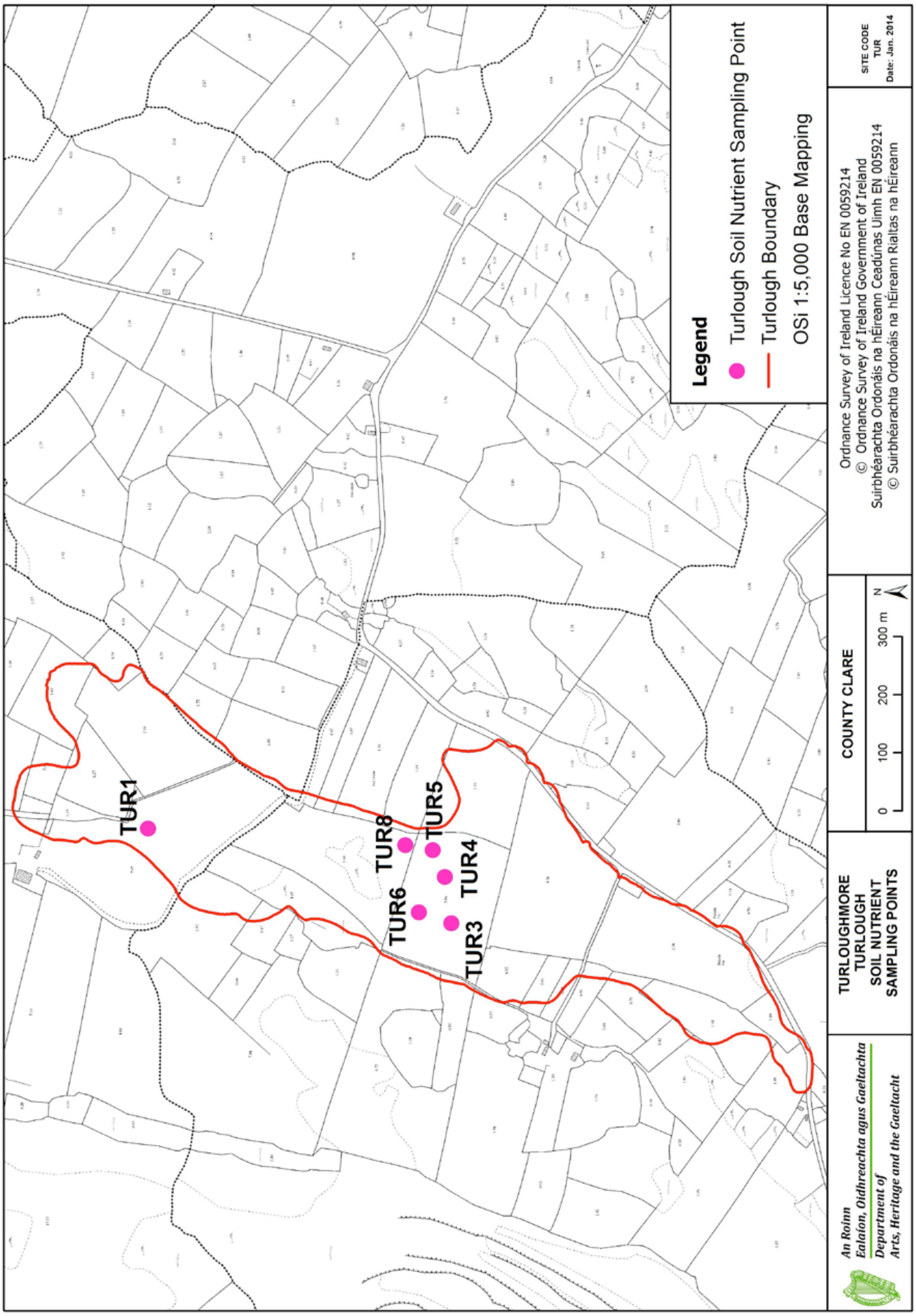
TUR1
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TUR4
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TUR3
Legend
Turlough Soil Nutrient Sampling Point
Turlough Boundary
OSi 1:5,000 Base Mapping
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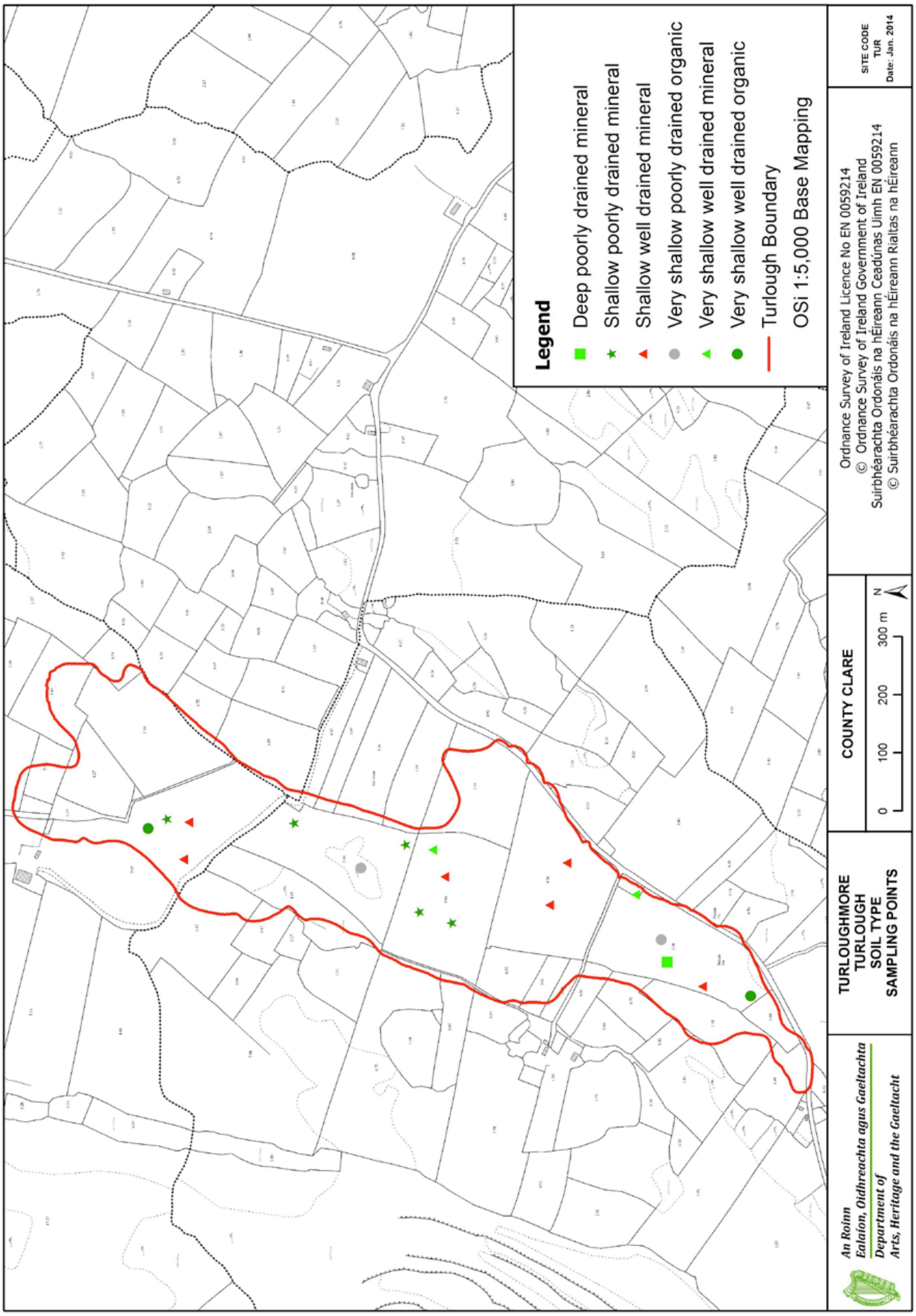
Legend
Deep poorly drained mineral
Shallow poorly drained mineral
Shallow well drained mineral
Very shallow poorly drained organic
Very shallow well drained mineral
Very shallow well drained organic
Turlough Boundary
OSi 1:5,000 Base Mapping
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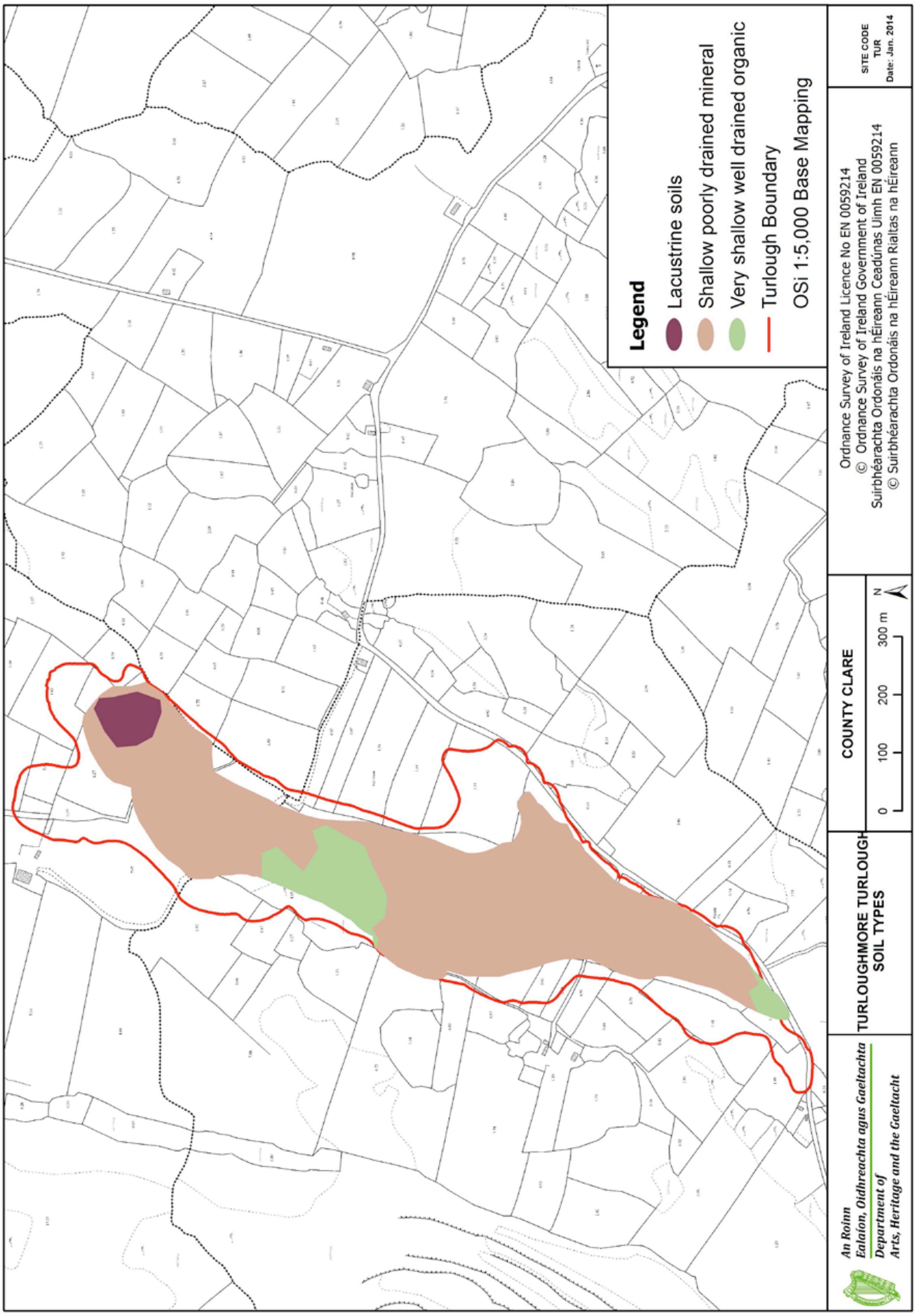
Legend
Lacustrine soils
Shallow poorly drained mineral
Very shallow well drained organic
Turlough Boundary
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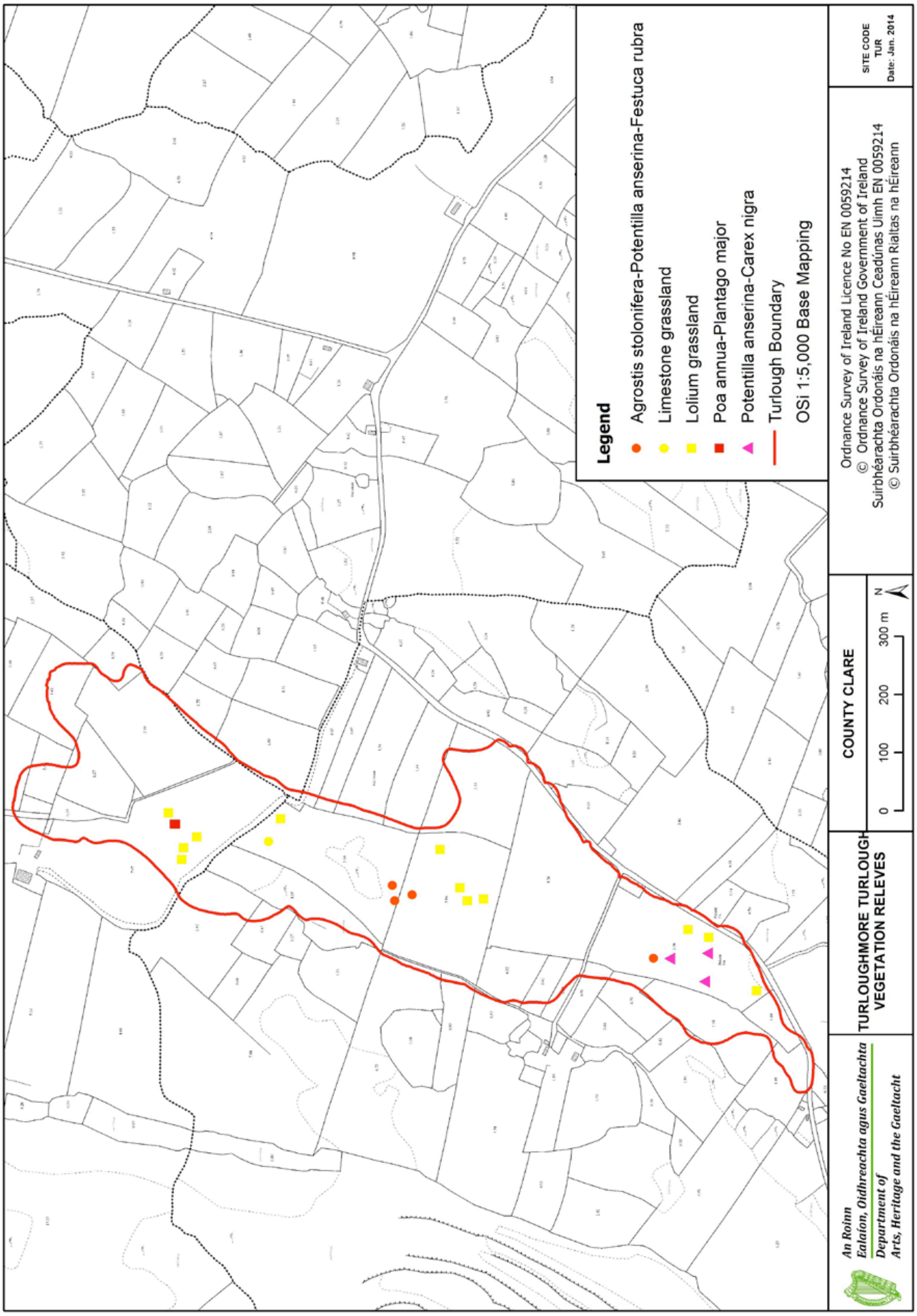
Legend
Agrostis stolonifera-Potentilla anserina-Festuca rubra
Limestone grassland
Lolium grassland
Poa annua-Plantago major
Potentilla anserina-Carex nigra
Turlough Boundary
OSi 1:5,000 Base Mapping
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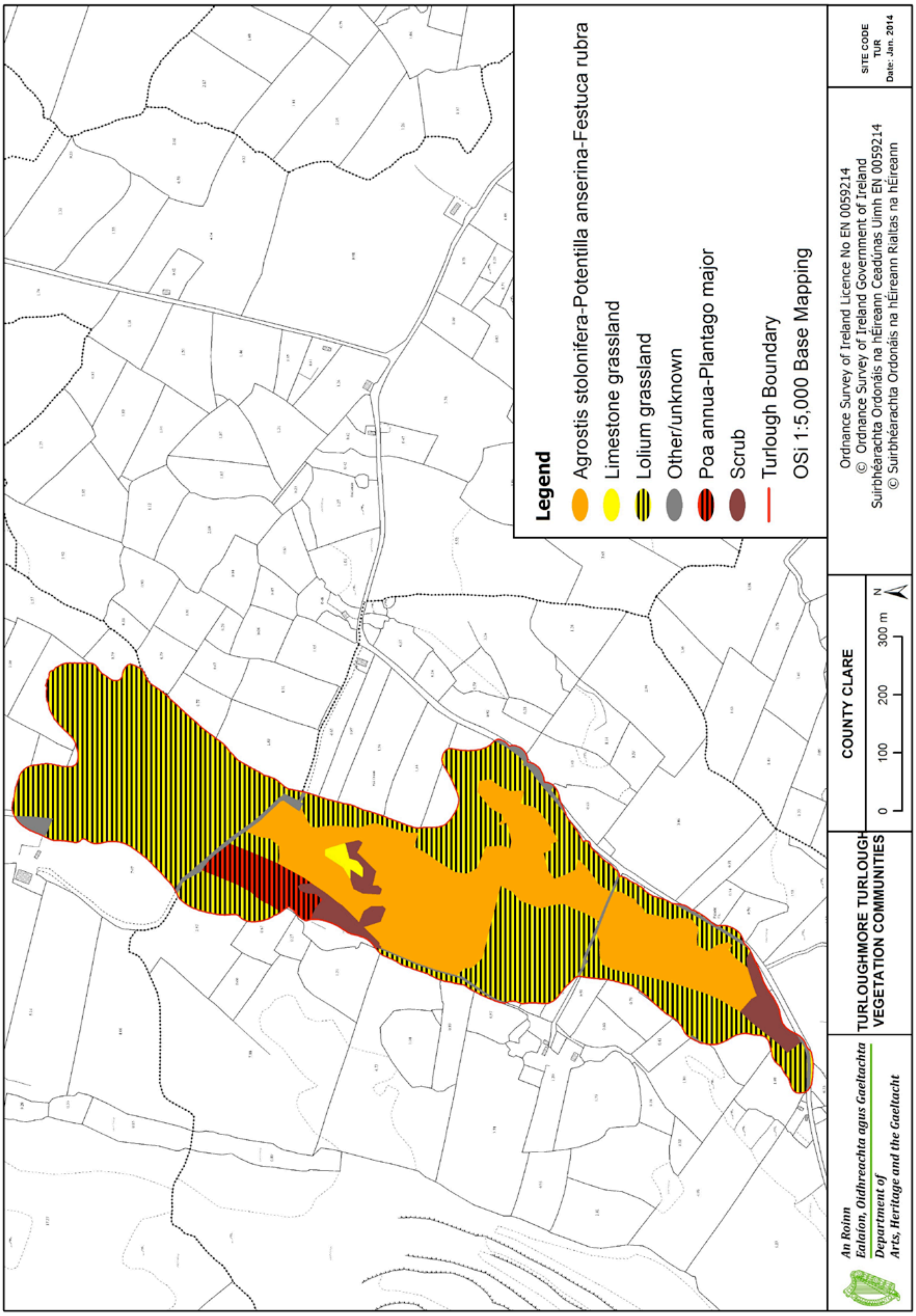
Legend
Agrostis stolonifera-Potentilla anserina-Festuca rubra
Limestone grassland
Lolium grassland
Other/unknown
Poa annua-Plantago major
Scrub
Turlough Boundary
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TURLOUGHMORE TURLOUGH
VEGETATION COMMUNITIES
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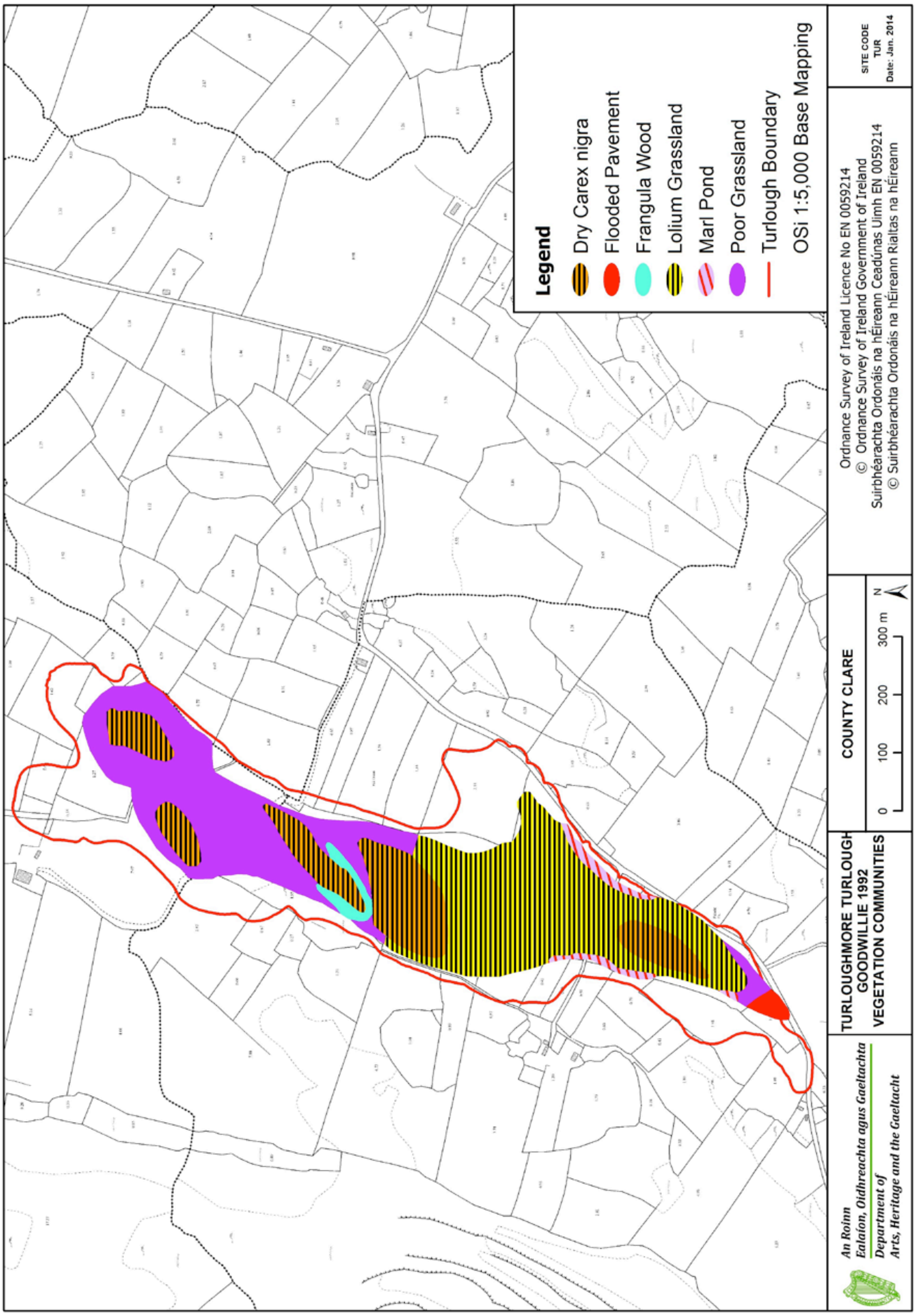

Legend
Dry Carex nigra
Flooded Pavement
Frangula Wood
Lolium Grassland
Marl Pond
Poor Grassland
Turlough Boundary
OSi 1:5,000 Base Mapping
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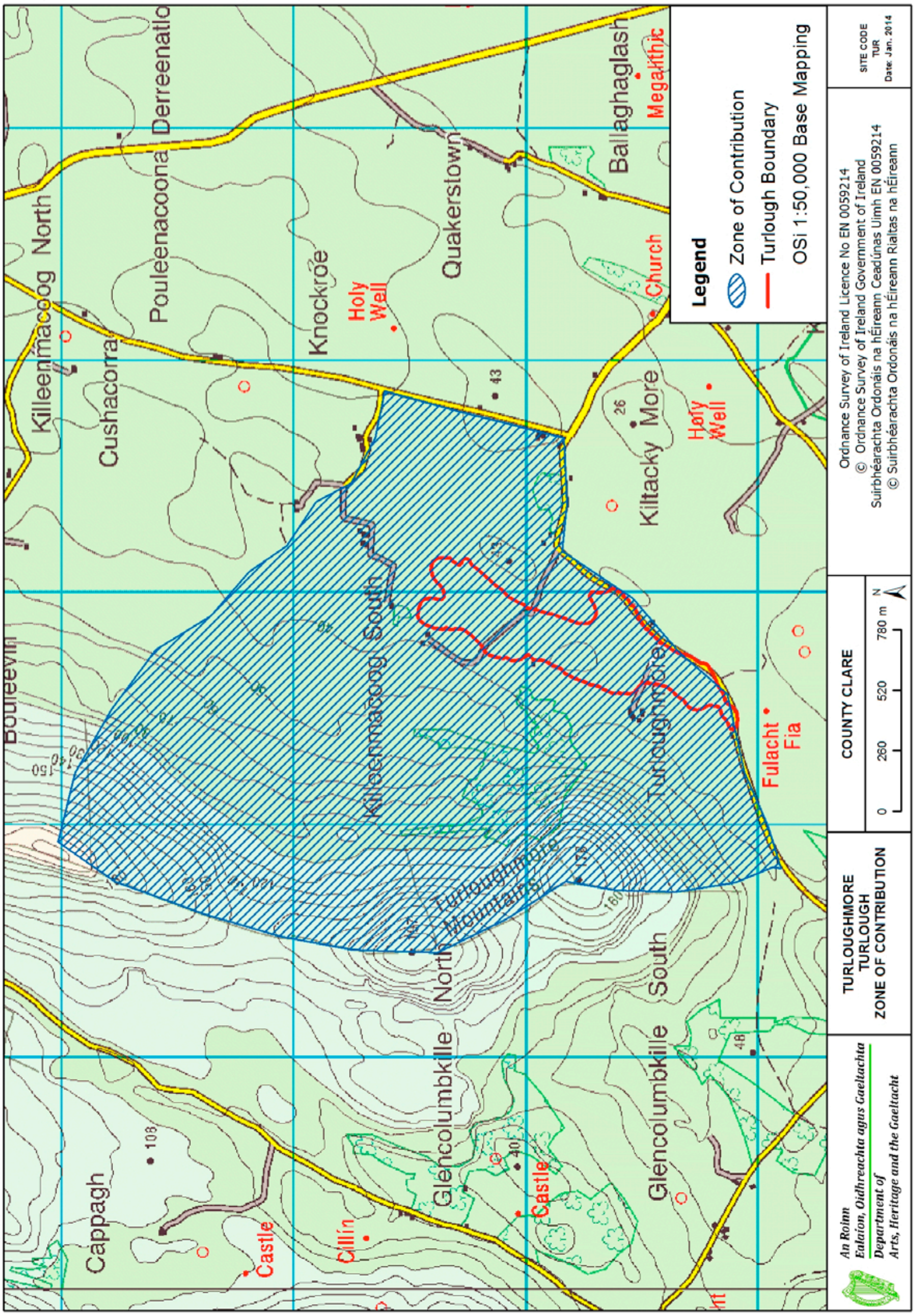
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Zone of Contribution
Turlough Boundary
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ZONE OF CONTRIBUTION
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Department of
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Killeenmacoog North
Cushacorra
Pouleenacoona
Derreenatlo
Knockroe
Holy Well
Quakerstown
Ballaghaglash
Megalithic
Church
Kiltacky More
Boleevin
Killeenmacoog South
Turloughmore
Fulacht Fia
Turloughmore Mountains
Glencolumbkille North
Glencolumbkille South
Cappagh
Castle
Cillín