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# EU Water Framework Directive: groundwater-dependent terrestrial ecosystems in Northern Ireland

Groundwater Systems and Water Quality Programme  
Commissioned Report CR/05/069N





BRITISH GEOLOGICAL SURVEY

GROUNDWATER SYSTEMS AND WATER QUALITY PROGRAMME  
COMMISSIONED REPORT CR/05/069N

# EU Water Framework Directive: groundwater-dependent terrestrial ecosystems in Northern Ireland

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## Summary

The EU Water Framework Directive (WFD) requires those terrestrial ecosystems dependent on groundwater be identified and the anthropogenic pressures acting on the ecosystems analysed. Where significant damage is occurring or could occur due to groundwater factors, then the associated groundwater body is considered to be at risk of not attaining ‘good status’ as defined in the Directive. This report describes the methodology for identifying and carrying out risk assessments for groundwater-dependent terrestrial ecosystems (GWDTEs) in Northern Ireland as part of the initial characterisation process of the WFD. The methodology is based on UK Technical Advisory Group (UKTAG) guidance. 22 designated sites, all Special Areas of Conservation (SACs), have been identified in Northern Ireland as GWDTEs.

The report details the level of risk to these GWDTEs from groundwater abstractions and potentially polluting point sources. With one exception, the occurrence of both types of groundwater pressure within the assessment zones of the GWDTEs set by the UKTAG guidance is negligible and hence Risk Category 2b has been determined for initial characterisation. Murlough SAC has been given a Risk Category of 2a for potentially polluting point sources, i.e. it is not at significant risk but confidence that the available information is comprehensive and reliable is low. This is because there are a number of controlled point sources on or close to the GWDTE, on geology that is likely to be in hydraulic connection with it, and some of these sources are concentrated in a small area. It is suggested that improved monitoring of this site would be advisable to increase confidence in the risk assessment.

The report highlights a number of aspects that could improve the methodology for identification and assessment of risk for GWDTEs.

# 1 Introduction

The EU Water Framework Directive (WFD) requires those terrestrial ecosystems dependent on groundwater be identified and the anthropogenic pressures acting on the ecosystems analysed. Where significant damage is occurring or could occur due to groundwater factors, then the associated groundwater body is considered to be at risk of not attaining ‘good status’ as defined in the Directive. This report describes the methodology for identifying and carrying out risk assessments for groundwater-dependent terrestrial ecosystems (GWDTEs) in Northern Ireland, as part of the initial characterisation process of the WFD. The methodology is based on UK Technical Advisory Group (UKTAG) guidance.

The report details those Natura 2000 designated sites (i.e. Special Protected Areas (SPAs) and Special Areas of Conservation (SACs) established under the EC Birds Directive (79/409/EEC) and Habitats Directive (92/43/EEC), respectively) identified as GWDTEs using the methodology, and assesses which of these are at risk of being significantly damaged as a result of groundwater abstractions and potentially polluting point sources; diffuse pollution is addressed elsewhere (McConvey and Donald, 2005). Those data limitations and gaps in knowledge affecting the process are detailed in Section 6.

The full initial characterisation process and the overall risk assessment for all water bodies can be found at <http://www.ehsni.gov.uk>.

This study has been undertaken for the Environment and Heritage Service (EHS) by the British Geological Survey. EHS is the competent body for Northern Ireland responsible for meeting the requirements of the WFD.

## 2 WFD requirements relating to GWDTEs

The UKTAG has defined a GWDTE as one which is ‘directly dependent on the *water level in or flow of water from* a groundwater body (that is, in or from the saturated zone). Such an ecosystem may also be dependent on the concentrations of substances (and potential pollutants) within that groundwater body, but to qualify as a groundwater-dependent terrestrial ecosystem there must be a direct hydraulic connection with the groundwater body.’ (UKTAG 2004a)

A purpose of the Water Framework Directive (WFD), as set out in Article 1 (a), is to establish a framework for the protection of inland surface waters, transitional waters, coastal waters and groundwater which prevents further deterioration and protects and enhances the status of aquatic ecosystems and, with regard to their water needs, terrestrial ecosystems and wetlands directly depending on the aquatic ecosystems. The specific requirements relating to GWDTEs are linked to the overall environmental objectives for groundwater (Article 4 (b)) and the aim of achieving good status of groundwater bodies by 2015.

Groundwater status covers both quantitative and chemical aspects. The definition of good quantitative status of a body (Annex V, 2.1.2) includes the statement that ‘...*the level of groundwater is not subject to anthropogenic alterations such as would result in significant damage to terrestrial ecosystems which depend directly on the groundwater body*’. For good chemical status, the equivalent definition (Annex V, 2.3.2) is that ‘*the chemical composition of the groundwater body is such that the concentrations of pollutants are not such as would result...in any significant damage to terrestrial ecosystems which depend directly on the groundwater body*’.

Therefore in defining the status of groundwater bodies, it is necessary to identify any associated GWDTEs and assess whether there is a risk of significant damage of these as a result of groundwater-related pressures.



### 3 UKTAG guidance on GWDTEs

Guidance has been developed by the UKTAG (UKTAG 2004a) on the identification and risk assessment of GWDTEs. Aspects of the UKTAG guidance on assessment of abstraction and recharge pressures (UKTAG 2004b) and pollution pressures (UKTAG 2004c) on groundwater bodies are also of relevance.

Given the number of statutory and non-statutory terrestrial ecosystems (TEs), prioritisation of the identification and risk assessment of GWDTEs has been necessary. The UKTAG has agreed that the first stage, to be completed by the end of 2004, should be limited to Natura 2000 sites.

#### 3.1 GUIDANCE ON IDENTIFICATION OF GWDTEs

Guidance on the identification of GWDTEs (UKTAG 2004a) describes a dual process in which identification is based on complementary ecological and hydrogeological assessments. The ecological assessment uses a vegetation typology system based around the likely source or nature of the water sustaining the vegetation; direct rainfall, surface water and/or groundwater. Some plant communities are highly dependent upon more mineralised groundwaters, others can use several irrigating sources. The guidance identifies those National Vegetation Classification (NVC) communities that have some dependence on groundwater and categorises the dependence as high (1), moderate (2) or low (3). Only those TEs that include at least one of these NVC communities are considered in the identification of GWDTEs. The hydrogeological setting is used to assess which of those NVC-categorised sites are likely to be significantly groundwater dependent. Note, for Northern Ireland, the UKTAG approach would benefit from being reviewed to ensure it incorporates all locally-present aquatic plant and animal communities that exist in environments defined as terrestrial ecosystems (see Chapter 2) and which may be groundwater dependent. This could be carried out under further characterisation.

The scheme used in Northern Ireland for classifying geology, on the basis of potential for interaction of groundwater with surface waters and TEs, is described in Macdonald et al (2005). The drift or solid geology at surface (1:250,000 scale) is categorised as having high, moderate or low groundwater interaction potential. The TEs are classified as significantly groundwater dependent (and therefore requiring a risk assessment) based on the degree of groundwater interaction and the categories of their NVC communities using the matrix described in the UKTAG GWDTE guidance (Table 1).

**Table 1 Matrix for classification of terrestrial ecosystems as groundwater-dependent and requiring assessment of risk from groundwater-related pressures (from UKTAG guidance - UKTAG (2004a))**

Groundwater interaction	NVC Category 1	NVC Category 2	NVC Category 3
<b>High</b>	GWDTE, assess risk	GWDTE, assess risk	GWDTE, assess risk
<b>Moderate</b>	GWDTE, assess risk	GWDTE, assess risk	do not assess risk
<b>Low</b>	GWDTE, assess risk <sup>1</sup>	do not assess risk	do not assess risk

<sup>1</sup> under suggested changes to the UKTAG guidance, made after the GWDTE identification for Northern Ireland had been undertaken, Natura 2000 sites with NVC Category 1 communities and low groundwater interaction potential would be classified as non groundwater dependent

#### 3.2 GUIDANCE ON ASSESSING RISK TO GWDTEs

The risk assessment refers to the risk that a groundwater body will not be at good status by 2015 (taking into account any likely derogations). In the context of TEs, this involves the assessment

of whether groundwater-related pressures are causing, or are likely to cause, significant damage. For statutory sites (as reported on here), damage is defined as significant if the GWDTE is in an 'unfavourable condition' as a result of a groundwater-related pressure.

The UKTAG GWDTE guidance sets out a methodology for undertaking the risk assessment in flowchart form (Figure 1). In this, a pressure analysis is not undertaken if the GWDTE is undamaged or if it is known to be damaged by a pressure that is not groundwater-related. This assumes that all pressures must already have an impact. The approach taken in Northern Ireland is to look at the pressures and the hydrogeological setting and identify where these indicate risk. This approach was taken as, to-date, there has not been sufficient monitoring and assessment of TEs to establish where unfavourable conditions are the result of groundwater-related pressures.

The UKTAG GWDTE guidance provides no methodology for analysing the risks from groundwater-related pressures. Elements are included in the guidance on assessing pressures from abstraction and pollution (UKTAG 2004b & c), although no specific guidance is given in either. In the guidance on assessment of abstraction and recharge pressures on bodies of groundwater, a number of approaches for risk screening are put forward (see Box 1). The initial screen used in the GWDTE risk assessment in Northern Ireland was to select only those groundwater abstractions located on the GWDTE or within 5 km from its boundary. These were then further sub-divided, with the number of abstractions and their abstraction rate from 1 to 5 km, 250 m to 1 km and on or within 250 m also tallied; smaller abstractions may still have an impact if are located close to the GWDTE. Very few significant abstractions were identified within any of these zones in Northern Ireland; these will be discussed in Section 5. Note, there are no locations in Northern Ireland where significant artificial recharge to groundwater bodies is undertaken and so this aspect of the pressure analysis is not necessary.

**Box 1 Approaches to screening risk to GWDTEs (UKTAG, 2004b)**

- Identify the simple presence or absence of any groundwater abstractions within a specified buffer distance (or distances) from the wetland or lake (e.g. 5 km would be consistent with Habitats Directive); or/and
- Estimate the total rates of groundwater abstraction present within the same specified buffer distances; or/and
- Estimate the proportion of the buffer areas occupied by the abstraction source centred equivalent recharge circles; or/and
- Estimate the cumulative drawdown at the wetland associated with groundwater abstraction based on 'no recharge' time period assumptions and T and S estimates specified by receptor or abstraction source or aquifer type where appropriate; or/and
- Identify known impacts or the results of existing detailed assessments: List and map those wetlands or lakes where groundwater abstraction impacts are considered to have been damaging to dependent ecologies or to groundwater quality. This could include the results of any more detailed investigations (e.g. results of Habitats Directive assessments).

In the case of pollution point sources, the recommended assessment or 'buffer' zone for GWDTEs in the UKTAG guidance (UKTAG, 2004c) is 2 km. As with groundwater abstractions, point sources on or within a buffer of 250 m of the GWDTE were also tallied, as lower risk pollutant sources may still have an impact if located close to the GWDTE. It is assumed GWDTEs will not be at risk from activities with discharges controlled by current legislation (UKTAG, 2004c) unless there is evidence of significant impact. The factors to be taken into account when assessing the risk from uncontrolled discharges are listed in Box 2. Again very few significant point pollution sources were identified within the buffer zones around the GWDTEs; these will be discussed in Section 5.

The risk to GWDTEs from diffuse pollution are not addressed in this report; this aspect can be found in McConvey and Donald (2005).

**Box 2 Factors to be taken into account when assessing the risk from uncontrolled discharges (UKTAG, 2004a)**

- Volume of discharge and contaminant concentrations (though data may be limited);
- Nature of type of soil and/or low permeability strata overlying the aquifer, although any allowance made for groundwater vulnerability should be related to the pathway as some point sources (e.g. landfill site, soakaways) may by-pass the soil layer of part of the unsaturated zone;
- The flow path including the distance to the receptor and aquifer properties, which when combined with an understanding of the contaminant allows an estimate to be made of the likely attenuation or persistence of the contaminant;
- Dilution in the dependent surface water body;
- Existing information on known impacts.

### 3.3 RISK CATEGORIES

The WFD requires Member States to assess whether groundwater bodies will be at risk of failing to achieve the environmental objectives, set out in Article 4, by December 2015. Guidance provided by the UKTAG has expanded the assessment required by the WFD, with sub-divisions for ‘at risk’ and ‘not at risk’ bodies of water, based on the degree of confidence in the risk assessment. These categories for groundwater bodies, based on the condition of GWDTEs, are given in Table 2. GWDTEs have been assigned a Risk Category for groundwater abstraction and potentially polluting point source Sections 5.1 and 5.2.

**Table 2 Categories of risk of groundwater bodies, based on the condition of associated GWDTEs (UKTAG, 2004a)**

Category	Risk assessment based on available information	Qualification
1a	may be at significant risk	dependent on scale and nature of the pressure
1b	probably at significant risk	partly dependent on scale and nature of the pressure - further information needed to improve confidence
2a	not at significant risk	confidence in the available information being comprehensive and reliable is low
2b	not at significant risk	confidence in the available information being comprehensive and reliable is high

### 3.4 AVAILABILITY OF MONITORING DATA

Risk assessments for groundwater bodies should be supported where possible, by monitoring data for groundwater levels and chemistry which will enable any trends to be identified. In Northern Ireland there is very limited groundwater-specific monitoring at TE sites. As a result it has not been possible to use monitoring data to support this risk assessment process.

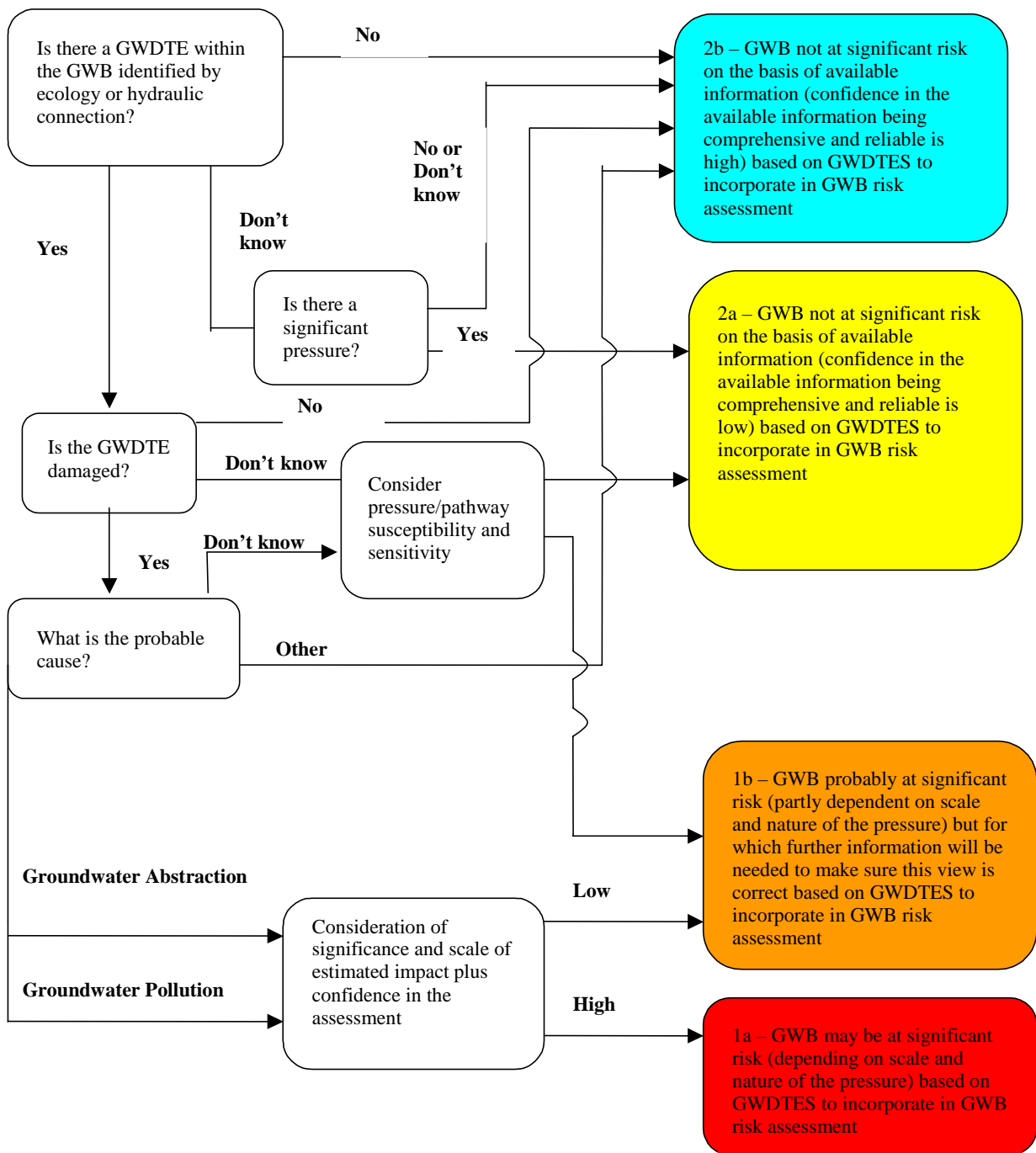


Figure 1 Risk assessment methodology for GWDTEs as devised by the UKTAG (2004a)

## 4 Identification of GWDTEs in Northern Ireland

Those SACs and SPAs that have NVC communities that are potentially groundwater-dependent are listed in Table 3; this list excludes those that are solely coastal waters, such as Strangford Lough and the waters surrounding Rathlin Island. Features within each of the sites were given NVC categories (see Table 3) by EHS ecologists. The NVC categories aquatic communities. Where there are SACs or SPAs with more than one NVC category, the highest category is shown with a '+' symbol. Note, only one of the 39 sites included is a SPA; the remainder are SACs.

The geology underlying each of the sites with an NVC category was identified using a Geographical Information System. The geology has been classified as having high, moderate or low potential for interaction of groundwater with surface waters and TEs using a scheme described in Macdonald et al (2005). The percentage of geology underlying the sites, falling into each category is shown in Table 3. The overall classification of the geology for each site uses the highest groundwater interaction class present with an area greater than 10%. (n.b. the geological data used is at 1:250,000 scale; the SACs and SPAs have been mapped at 1:10,000 scale.)

The sites were then identified as having a significant degree of groundwater dependence, and therefore requiring an assessment of the risk from groundwater-related pressures, based on a matrix of NVC category and groundwater interaction class (see Table 1). As mentioned in the footnote to Table 1, this matrix changed in later versions of the UKTAG GWDTE guidance; the version available at the time that this assessment was undertaken included all sites with an NVC Category 1 feature. With the later version, it is likely that seven NVC Category 1 sites with an overall **low** groundwater interaction would not have been classified as significantly groundwater dependent and therefore would not have gone through to risk assessment. A further three would also not have been classified as significantly groundwater dependent as they are raised bogs which generally use direct rainfall only; flexibility to remove these was planned for the later version of the guidance.

Twenty-one sites went forward to the risk assessment stage; these are all SACs. Their locations are shown in Figure 2

**Table 3 Identification of groundwater-dependent terrestrial ecosystems (GWDTE)**

Natura 2000 site <sup>1</sup>	Features	Area (km <sup>2</sup> )	River basin	Cross border?	NVC Category <sup>2</sup>	Groundwater interaction potential <sup>3</sup>				Classified as GWDTE? <sup>4</sup>
						high	moderate	low	overall	
Aughnadarragh	• Fens	13	North Eastern		2	0	0	100	low	no
Ballynahone Bog	• Raised bog	244	Neagh Bann		3	0	0	100	low	no
Black Bog	• Raised bog	194	North Western		3	0	0	100	low	no
Breen Wood	• Wet woodlands	36	North Eastern		2	30	0	70	high	yes
Carn - Glenshane Pass	• Blanket bog	1939	North Western/ Neagh Bann		3	3	11	86	low	no
Cranny Bogs	• Raised bog	79	North Western		2	65	0	35	high	yes
Cuilcagh Mountain	• Oligotrophic and dystrophic loughs • Wet heath • Blanket bog	2750	Shannon/North Western	✓	1+	0	1	99	low	yes <sup>5</sup>
Curran Bog	• Raised bog	183	Neagh Bann		3	15	0	85	high	no
Dead Island Bog	• Raised bog	55	Neagh Bann		3	11	0	89	high	no
Deroran Bog	• Raised bog	76	North Western		3	3	0	97	low	no
Derryleckagh	• Fens	50	Neagh Bann		1	16	0	84	high	yes
Eastern Mournes	• Wet heath • River • Blanket bog	7508	Neagh Bann/North Eastern		1+	1	0	99	low	yes <sup>5</sup>
Fardrum & Roosky Turloughs	• Turloughs	43	North Western		1	100	0	0	high	yes
Garron Plateau	• Oligotrophic and dystrophic loughs • Wet heath • Fens • Blanket bog	4650	Neagh Bann /North Eastern		1+	0	59	41	moderate	yes
Garry Bog	• Raised bog	155	North Eastern		3	0	0	100	low	no
Hollymount	• Wet woodlands	50	North Eastern		2	59	0	41	high	yes
Largalunny	• Upland mosaic	245	North Western		2/3	20	67	13	high	yes
Lecale Fens	• Fens	41	North Eastern		1+	24	0	76	high	yes
Lough Melvin	• Mesotrophic lough • Purple moor-grass and rush pastures	516	North Western	✓	1+	0	1	99	low	yes <sup>5</sup>
Lough Neagh and Lough Beg	• Wet woodlands • Reed beds and swamps • Fens • Purple moor-grass and rush pastures	41188	Neagh Bann		2+	7	1	92	low	no
Magheraveely Marl Loughs	• Fens • Marl lakes	59	North Western	✓	1+	1	0	99	low	yes <sup>5</sup>
Magilligan	• Coastal sand dune	1069	North Western		2+	100	0	0	high	yes

Natura 2000 site <sup>1</sup>	Features	Area (km <sup>2</sup> )	River basin	Cross border?	NVC Category <sup>2</sup>	Groundwater interaction potential <sup>3</sup>				Classified as GWDTE? <sup>4</sup>
						% of underlying geology high	moderate	low	overall	
Main Valley Bogs	<ul style="list-style-type: none"> <li>• Raised bog</li> </ul>	186	Neagh Bann		3	82	0	18	high	yes <sup>5</sup>
Moneygal Bog	<ul style="list-style-type: none"> <li>• Raised bog</li> </ul>	156	North Western		3	0	0	100	low	no
Moninea Bog	<ul style="list-style-type: none"> <li>• Raised bog</li> </ul>	45	North Western		3	0	0	100	low	no
Montiaghs Moss	<ul style="list-style-type: none"> <li>• Higher plant assemblage</li> </ul>	151	Neagh Bann		2/3	0	0	100	low	no
Murlough	<ul style="list-style-type: none"> <li>• Coastal sand dune</li> </ul>	11902	North Eastern		2	87	0	13	high	yes
Owenkillew River	<ul style="list-style-type: none"> <li>• Wet woodlands</li> </ul>	213	North Western		2+					
Peatlands Park	<ul style="list-style-type: none"> <li>• Wet woodlands</li> <li>• Raised bog</li> <li>• Fens</li> </ul>	207	Neagh Bann		2+	2	0	98	low	no
Pettigoe Plateau	<ul style="list-style-type: none"> <li>• Blanket bog</li> <li>• Oligotrophic and dystrophic loughs</li> <li>• Wet heath</li> </ul>	1270	North Western		2+	0	0	100	low	no
Rea's Wood and Farr's Bay	<ul style="list-style-type: none"> <li>• Wet woodland</li> </ul>	42	Neagh Bann		2+	0	0	100	low	no
Slieve Beagh	<ul style="list-style-type: none"> <li>• Blanket bog</li> <li>• Oligotrophic and dystrophic loughs</li> </ul>	1900	North Western/ Neagh Bann	✓	1+	0	3	97	low	yes <sup>5</sup>
Slieve Gullion	<ul style="list-style-type: none"> <li>• Fens</li> </ul>	612	Neagh Bann		2	0	0	100	low	no
Teal Lough	<ul style="list-style-type: none"> <li>• Blanket bog</li> </ul>	202	North Western/ Neagh Bann		3	3	0	97	low	no
Tonnagh Beg Bog	<ul style="list-style-type: none"> <li>• Raised bog</li> </ul>	56	North Western		3	0	0	100	low	no
Tully Bog	<ul style="list-style-type: none"> <li>• Raised bog</li> </ul>	36	North Western		3	53	0	47	high	yes
Turmennan	<ul style="list-style-type: none"> <li>• Fens</li> </ul>	15	North Eastern		1	0	0	100	low	yes <sup>5</sup>
Upper Ballinderry River	<ul style="list-style-type: none"> <li>• River</li> </ul>	59	Neagh Bann		1	53	0	47	high	yes
Upper Lough Erne	<ul style="list-style-type: none"> <li>• Reed beds and swamps</li> <li>• Purple moor-grass and rush pastures</li> <li>• Fens</li> <li>• Wet woodlands</li> <li>• Eutrophic lake</li> </ul>	5769	North Western	✓	1+	2	0	98	low	yes <sup>5</sup>
West Fermanagh Scarplands	<ul style="list-style-type: none"> <li>• Blanket bog</li> <li>• Cave system</li> <li>• Eutrophic lake</li> <li>• Purple moor-grass and rush pastures</li> <li>• Wet heath</li> </ul>	2270	North Western		1+	31	10	59	high	yes
Wolf Island Bog	<ul style="list-style-type: none"> <li>• Raised bog</li> </ul>	118	Neagh Bann		3	4	0	96	low	no

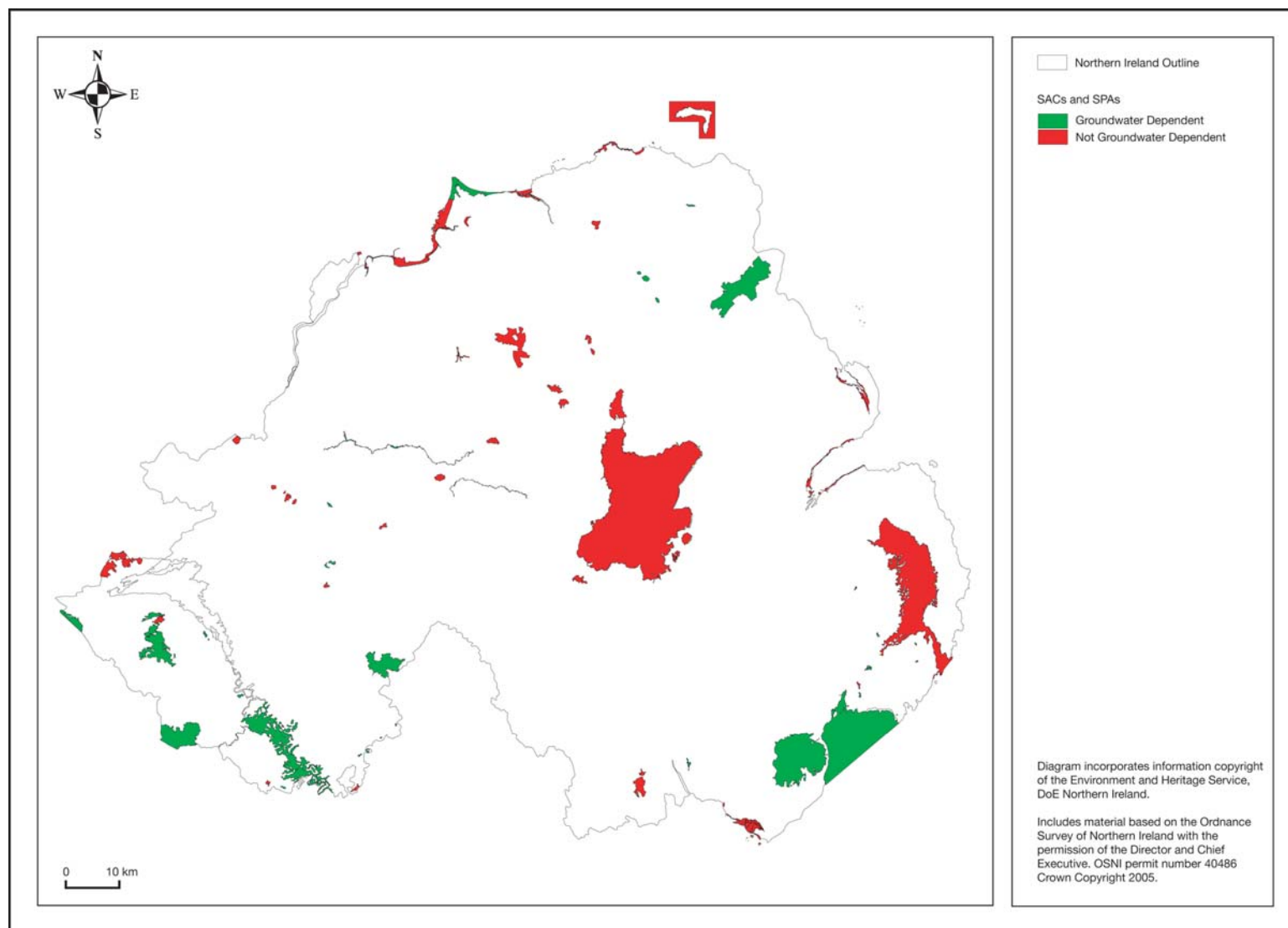
<sup>1</sup> potentially groundwater-dependent SACs/SPAs with NVC categories – all are SACs apart from Lough Neagh and Lough Beg

<sup>2</sup> highest NVC category feature within SAC given with '+' appended where more than one feature categorised

<sup>3</sup> groundwater interaction defined by permeability of underlying geology (drift and solid) at surface

<sup>4</sup> GWDTE classification based on the version of the UKTAG guidance available at the time

<sup>5</sup> based on suggested changes to UKTAG guidance these TEs would not be classified as groundwater dependent



**Figure 2** Natura 2000 sites classified on the basis of groundwater-dependency, using UKTAG guidance (UKTAG 2004a)



## 5 Assessment of risk to GWDTEs in Northern Ireland

### 5.1 RISK FROM GROUNDWATER ABSTRACTIONS

Northern Ireland does not presently have a system in place for regulating groundwater abstractions. However, a preliminary database of groundwater abstractions has been established by EHS using a variety of data sources. In the absence of knowledge of actual abstraction volumes, estimates of abstraction rates have been made by EHS. The data set has not been verified and can only be considered to be a first estimate of the location and yields of groundwater abstractions. Nevertheless, it is considered by EHS that most of the larger abstractions, for example public water supply boreholes, will have been captured. The vast majority of small abstractions (20 m<sup>3</sup>/d or less) are located on farms. All but one of the large abstractions (greater than 1000 m<sup>3</sup>/d) are public water supplies. Medium-sized abstractions are used for a range of activities, including food processing, light industry and smaller public water supplies. Groundwater abstractions were categorised to help with their display within the GIS and with the pressure analysis. The number of abstractions within each category is shown in Table 4.

**Table 4 Categories and numbers of groundwater abstractions**

<b>Abstraction (m<sup>3</sup>/d)</b>	<b>Number</b>
≤20	1577
21-100	35
101-1000	55
1001-2000	17
2001-5000	8
>5000	2

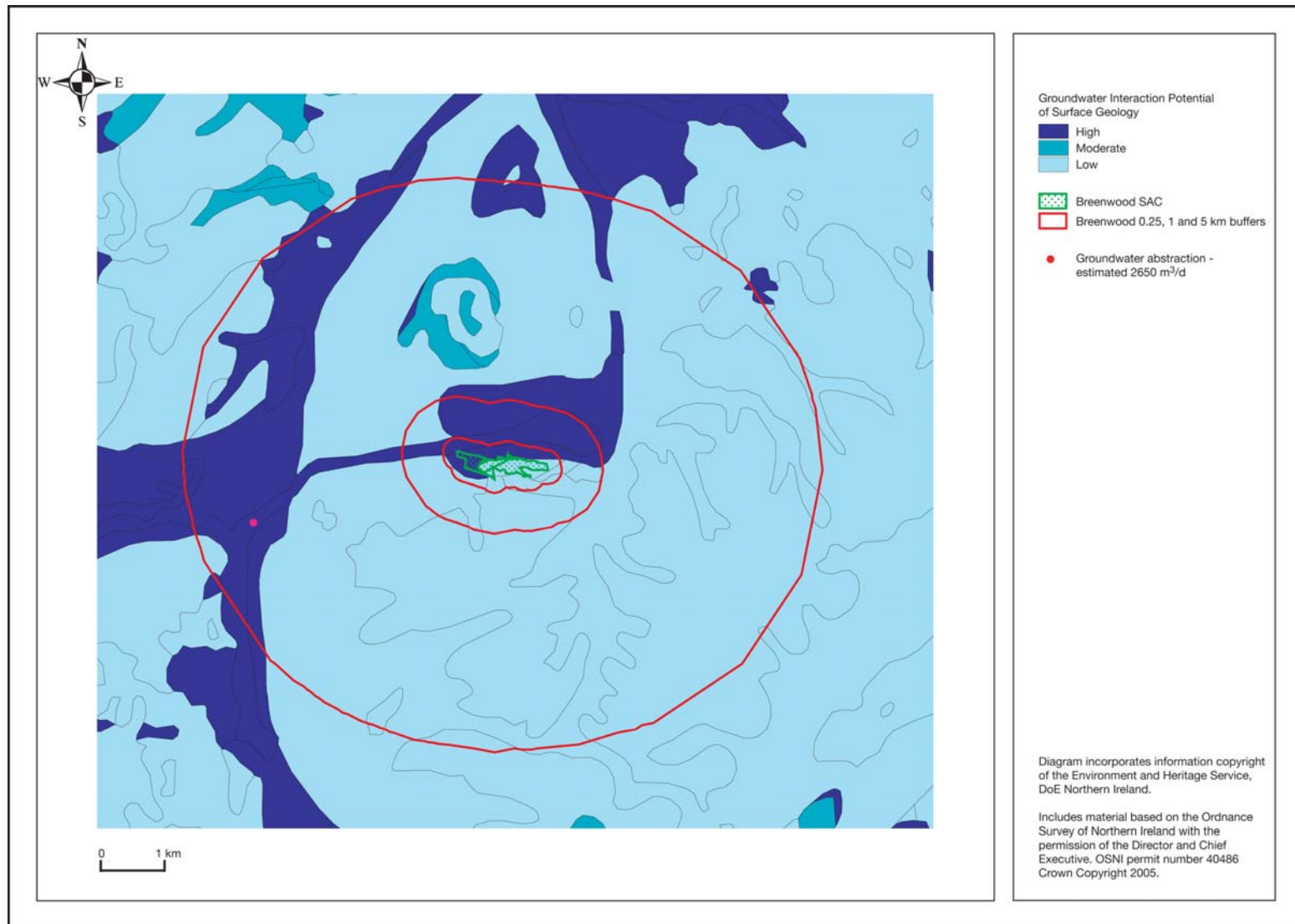
The initial screen employed for assessing the risk to GWDTEs from groundwater abstractions was simply summing the number of abstractions within each abstraction category for buffers of 250 m, 250 m to 1 km and 1 to 5 km (see Section 3.2) on and around the SACs identified as GWDTEs. These figures are listed in Table 5 for each GWDTE: abstractions of 20 m<sup>3</sup>/d or less were not included as this rate of abstraction poses a negligible risk to GWDTEs. Groundwater abstractions do not pose a risk of significant damage to any of the GWDTEs identified in Section 3. A short commentary is included within Table 5. In undertaking the assessment, criteria that were employed were: the connection between the formation within which the abstraction is located and that underlying the GWDTE; the size and location of abstractions (capture zone radii were calculated based on estimates of recharge (Robins, 1996)); where appropriate and known, the flow in river SACs; and the type of feature. A typical case, Breen Wood SAC, is shown in Figure 3 which shows the boundary of the GWDTE, the geology classified by groundwater interaction potential, the buffers and the single groundwater abstraction within the buffers.

**Table 5 Assessment of risk to GWDTEs from groundwater abstractions**

GWDTEs Zones <sup>1</sup> (km)	Abstraction categories (m <sup>3</sup> /d)															Commentary	Risk Category
	21-100			101-1000			1000-2001			2001-5000			>5000				
	≤0.25	0.25 -1	1 – 5	≤0.25	0.25 -1	1 – 5	≤0.25	0.25 -1	1 – 5	≤0.25	0.25 -1	1 – 5	≤0.25	0.25 -1	1 – 5		
Breen Wood												1				Hydraulic connection poor between the borehole and the GWDTE	2b
Cranny Bogs																	2b
Cuilcagh Mountain																	2b
Derryleckagh																	2b
Eastern Mourne																	2b
Fardrum & Roosky Turloughs																	2b
Garron Plateau												1				Down-gradient of the Plateau	2b
Hollymount																	2b
Largalinny																	2b
Lecale Fens																	2b
Lough Melvin																	2b
Magheraveely Marl Loughs																	2b
Magilligan																	2b
Main Valley Bogs						1			2			1				Raised bogs <sup>2</sup>	2b
Murlough																	2b
Owenkillew River										1						Abstraction rate very small compared with Q95 river flow (~0.5%)	2b
Slieve Beagh						1										Relatively small, distant and hydraulic connection poor	2b
Tully Bog					1	1										Raised bogs <sup>2</sup>	2b
Turmennan																	2b
Upper Ballinderry River					1	2										Small abstractions and a river with a relatively large flow	2b
Upper Lough Erne						1										Abstraction insignificant relative to the size of the lough	2b
West Fermanagh Scarplands																	2b

<sup>1</sup> ≤0.25 km zone includes abstractions within the boundary of the GWDTE

<sup>2</sup> Although these raised bogs include NVC communities that are categorised as groundwater dependent, these types of bogs are reliant solely on rainfall and not groundwater



**Figure 3 Breen Wood SAC – an example of a GWDTE, showing groundwater abstractions, 250 m, 1 km and 5 km buffers and geology classified according to potential groundwater interaction.**

## 5.2 RISK FROM POINT SOURCE POLLUTION PRESSURES

The risk from point source pollution pressures was assessed initially by looking at the occurrence of known potential sources within buffers of 250 m and 250 m to 2 km (see Section 3.2). EHS datasets used within the assessment are listed in Table 6.

**Table 6 Datasets used to assess risk to GWDTEs from pollution point sources**

Dataset	Comments
Flooded or discharging abandoned mines	location only
Groundwater Directive Part IIa consented discharges	Land parcel areas rather than points
Industrial Discharge Consents - discharging to ground	two classes available, < 5 and 5-100 m <sup>3</sup> /d
Industrial Pollution Controls (IPC)	may include uncontrolled discharges
Oil depots	location only
Potentially polluting activities, e.g. petrol stations	location and risk category - only high risk activities used

Apart from the abandoned mines and possibly the sites covered by IPCs, none of the datasets include uncontrolled discharges. None of the mine discharges proved to be an issue for GWDTEs. The vast majority of IPCs will be relevant to surface water sources only and details are not available of those that are likely to discharge to the ground.

The UK guidance (UKTAG 2004c) states that controlled discharges are not relevant if there is no evidence of significant impacts on the GWDTE. No such evidence currently exists.

Given these two factors, it would be inappropriate to classify any of the GWDTEs as ‘at risk’ and the associated groundwater bodies at poor status. However, it is appropriate to highlight where a significant number of sources from the EHS datasets in Table 6 are concentrated within the buffers. This information determines whether the GWDTEs are classified at Risk Category 2a or 2b (Section 3.3) and is relevant to the design of groundwater quality monitoring networks in the future. The number and type of the sources from the datasets in Table 6 were tallied for the two zones. These are listed in Table 7, including a short commentary on the risk plus the Risk Category for each GWDTE. This is based on the type and number of the sources within the buffers and the geological setting.

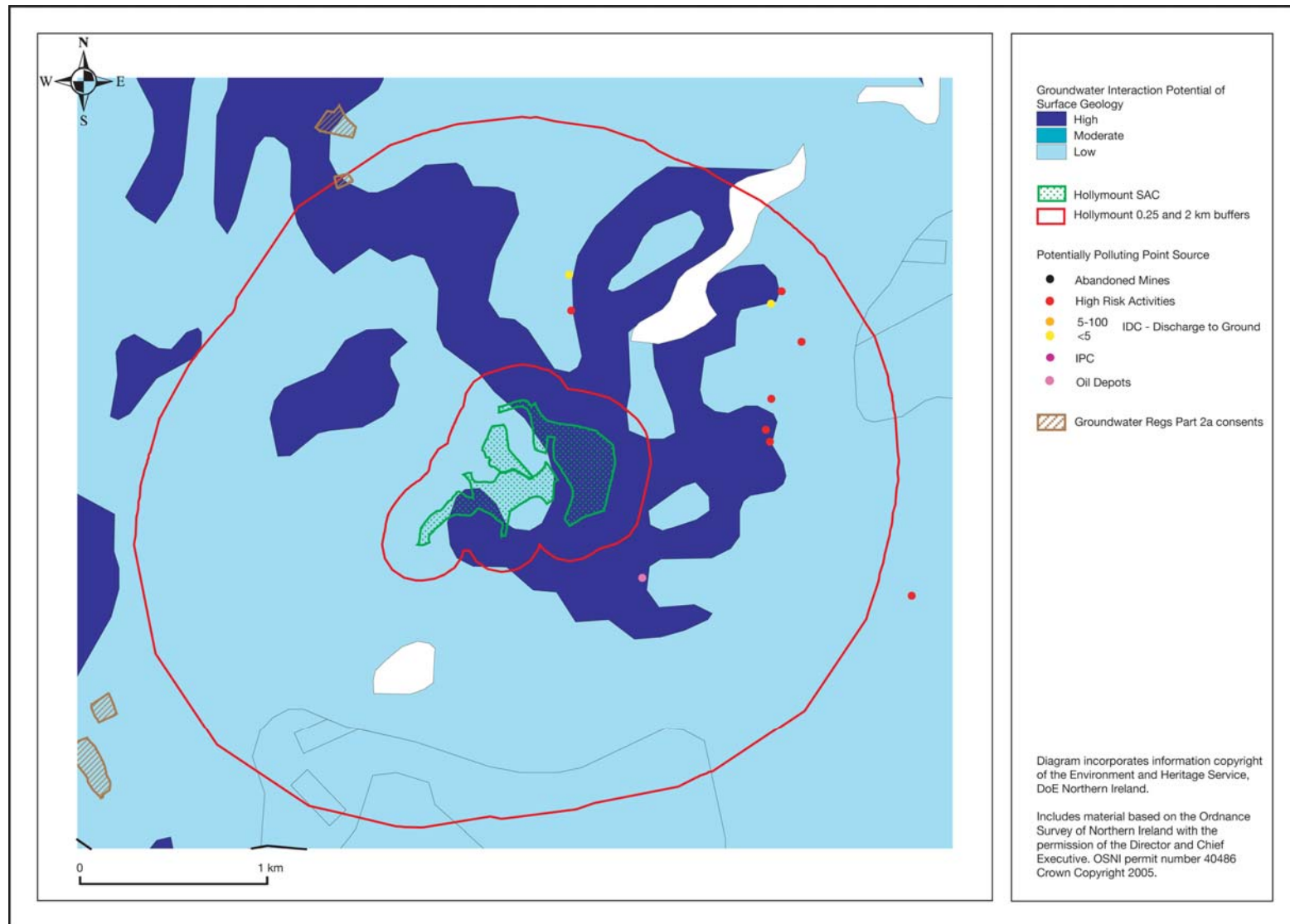
For the majority of GWDTEs, the number of potentially polluting point sources are not significant, resulting in a 2b Risk Category. A typical case, Hollymount SAC, is presented in Figure 4, which shows the boundary of the GWDTE, the geology classified by groundwater interaction potential, the buffers and the potentially polluting point source locations.

Only one GWDTE, Murlough (Figure 5), has been given a 2a Risk Category based on potentially polluting point sources. This is because there are number of point sources on or close to the GWDTE, on geology that is likely to be in hydraulic connection with it. Some of these are concentrated in a small area. It is suggested that improved monitoring of this site would be advisable to increase confidence in the risk assessment.

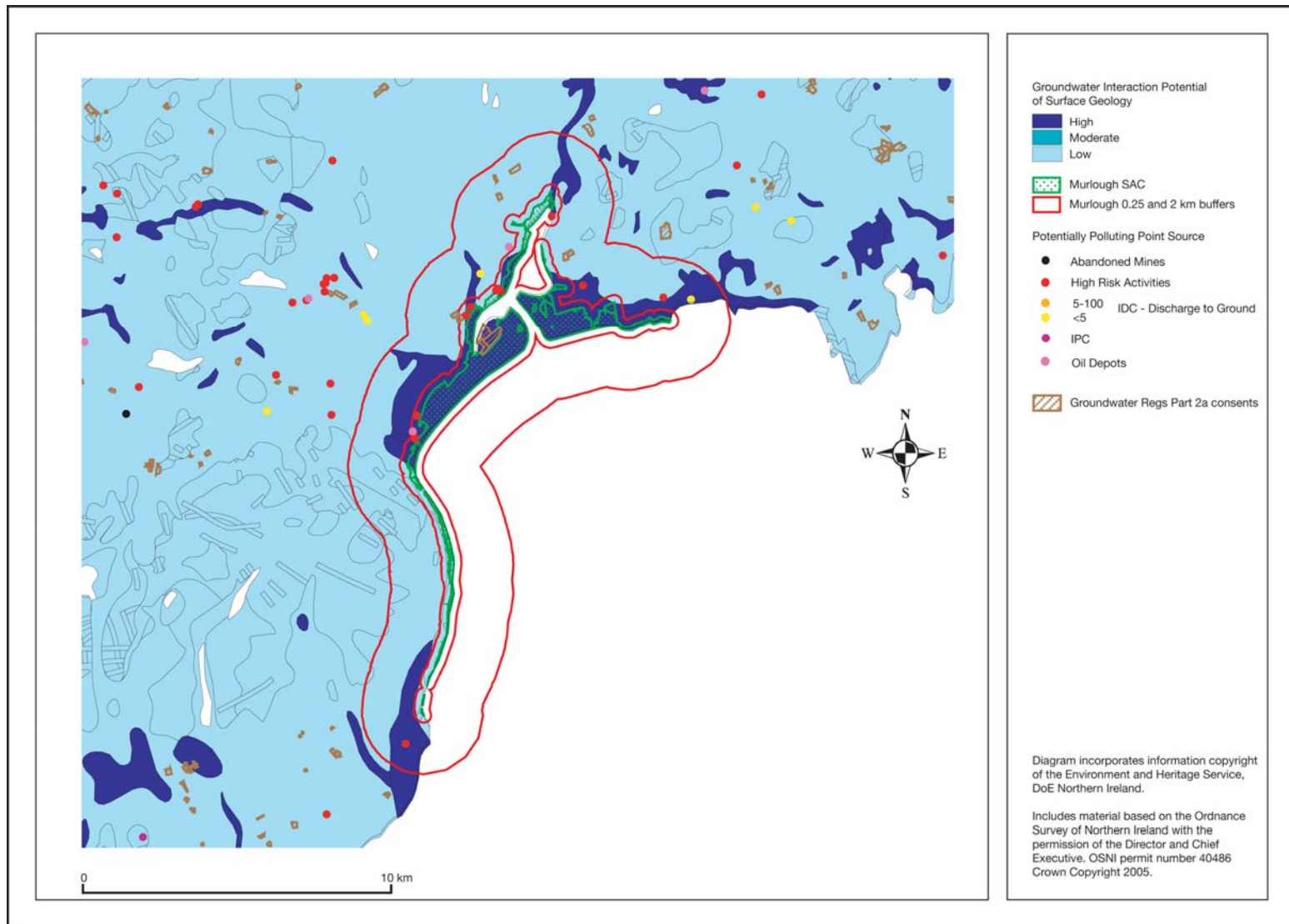
**Table 7 Assessment of risk to GWDTEs from potentially polluting point sources**

GWDTEs	Potentially polluting sources (zones – km)														Commentary	Risk Category
	Abandoned mines		Industrial Discharge Consents				Oil depots		Industrial Pollution Controls		High risk potentially polluting activities		Part IIa consents			
	≤0.25	0.25 – 2	< 5 m <sup>3</sup> /d		5 –100 m <sup>3</sup> /d		≤0.25	0.25 – 2	≤0.25	0.25 – 2	≤0.25	0.25 – 2	≤0.25	0.25 – 2		
			≤0.25	0.25 – 2	≤0.25	0.25 – 2										
Breen Wood											1		4	Location of Part IIa consents unlikely to be in hydraulic connection	2b	
Cranny Bogs											5	1	9	Location of Part IIa consents unlikely to be in hydraulic connection	2b	
Cuilcagh Mountain											1		1	Sources not significant	2b	
Derryleckagh							1				1		1	Sources not significant	2b	
Eastern Mournes				1			1						21	All sources down-gradient	2b	
Fardrum & Roosky Turloughs								1						Sources not significant	2b	
Garron Plateau	1	11		4							2	7	20	All sources down-gradient	2b	
Hollymount				2				1					1	Refuse tip 800 m away on land likely to be in hydraulic connection, nothing else significant	2b	
Largalunny														-	2b	
Lecale Fens				1									10	Two Part IIa consents located on land likely to be in hydraulic connection with Loughkeelan (one of the Fens) – assumed this addressed when consenting the discharges	2b	
Lough Melvin											1			Sources not significant	2b	
Magheraveely Marl Loughs							1				2			Sources not significant	2b	
Magilligan					3								5	Location of Part IIa consents unlikely to be in hydraulic connection. IDCs are spread out	2b	
Main Valley Bogs				1				1			4		5	Very few of these located on land likely to be in hydraulic connection	2b	
Murlough				2				2			7	3	5	A significant number of sources on or in the vicinity – some concentrated in a small area	2a	
Owenkillew River				1	1					1	1	11	5	20	A large number of sources but spread out over a large area	2b
Slieve Beagh														-	2b	
Tully Bog												5		Sources not significant	2b	
Turmennan				1									1	Sources not significant	2b	
Upper Ballinderry River				2				2		3	3	23	6	Although there are a number of sources this is because of a long buffer - sources mainly petrol stations	2b	
Upper Lough Erne				1					1		1	2	1	Sources not significant	2b	
West Fermanagh Scarplands														-	2b	

<sup>1</sup> ≤0.25 km zone includes abstractions within the boundary of the GWDTE



**Figure 4 Hollymount - a GWDTE with a typical range and number of potentially polluting point sources. Also shows geology, classified according to potential groundwater interaction and 250 m and 2 km buffers.**



**Figure 5 Murlough SAC, classified as Risk Category 2a for potentially polluting point sources, showing potentially polluting point sources, geology classified according to potential groundwater interaction and 250 m and 2 km buffers.**

### 5.3 SUMMARY OF RISK TO GWDTEs

Given that the risk from diffuse pollution is not included in this study, it is not possible to give an overall risk assessment for the GWDTEs. For ease of reference, the Risk Categories for the GWDTEs, in relation to groundwater abstractions and potentially polluting point sources, are given together in Table 8. Murlough SAC is the only GWDTE which has been assessed as having a Risk Category other than 2b.

**Table 8 Assessment of risk to GWDTEs from groundwater abstractions**

GWDTEs	Risk Category	
	Groundwater abstractions	Potentially polluting point sources
Breen Wood	2b	2b
Cranny Bogs	2b	2b
Cuilcagh Mountain	2b	2b
Derryleckagh	2b	2b
Eastern Mourne	2b	2b
Fardrum & Roosky Turloughs	2b	2b
Garron Plateau	2b	2b
Hollymount	2b	2b
Largalenny	2b	2b
Lecale Fens	2b	2b
Lough Melvin	2b	2b
Magheraveely Marl Loughs	2b	2b
Magilligan	2b	2b
Main Valley Bogs	2b	2b
Murlough	2b	2a
Owenkillew River	2b	2b
Slieve Beagh	2b	2b
Tully Bog	2b	2b
Turmennan	2b	2b
Upper Ballinderry River	2b	2b
Upper Lough Erne	2b	2b
West Fermanagh Scarplands	2b	2b

## 6 Improvements to the methodology

In applying the methodology for identification and assessment of risk for GWDTEs, a number of aspects have been highlighted that could improve results. These are listed below.

Whilst the points listed where improvements are possible, the context of the work done to date should be remembered. This was to undertake a first pass screening exercise to identify where pressures exist and impacts may occur and prioritise where further assessment would be beneficial. It is considered that this objective has been achieved, albeit with more work required to better understand the TEs assessed and the pressures on them.



- i. There would appear to be some misalignment between 1:250 000 scale geological digital data and other spatial data of up to 300 m in places. This has been identified during other WFD-related work. Hydrogeological assessments for helping to identify potentially groundwater-dependent TEs have relied solely on spatial data. The misalignment of geological data and the location of SACs and SPAs may have introduced some errors to the identification process. This also has implications for the pressure analysis as the hydraulic connection between the location of the pressure and the GWDTE is important.
- ii. This particular issue will need to be reviewed prior to beginning assessment of other statutory and non-statutory sites. The sites addressed in this report could be revisited as better data become available. The geological data and other spatial data used should be at a scale appropriate for the type and significance of the site. It is noted that 1:50 000 scale digital geological maps should shortly be available.
- iii. Mapping of exact locations of relevant features within designated sites is limited. With more site specific understanding and mapping the risk assessment can be improved. Where possible, local ecological knowledge of sites should be compiled to confirm, or otherwise, the presence/absence of indicators of groundwater dependency. Such knowledge will also be critical in determining the significance of the potential impact from nearby pressures.
- iv. During this first pass at identifying and carrying out risk assessments on GWDTEs it has been necessary to use a computer-based approach due to time limitations. At a later date, if these constraints are lifted, it would be advisable to look at each site in more detail, enabling a conceptual model of the hydrogeology to be developed and for this to be linked with the ecology.
- v. However, even with a better understanding of the hydrogeological setting of TEs, there is a knowledge gap in terms of the sensitivity of TEs to changes in groundwater level and quality. This has been identified by the UKTAG and it is hoped that research to address this knowledge gap will be progressed.
- vi. The pressures data used in the analysis could be improved. Groundwater abstraction rates are presently estimated and it is not clear if all large abstractions have been identified.
- vii. In addition, there is a lack of monitoring data to assess trends in groundwater levels and quality. This would help assess the impacts of these pressures on GWDTEs and could be extrapolated to similar hydrogeological/ecological/pressure settings. This should be addressed when developing the monitoring network required by the WFD.

## Glossary

EHS	Environment and Heritage Service, Northern Ireland
GIS	geographical information system
GWDTE	groundwater-dependent terrestrial ecosystem
IDC	Industrial Discharge Consent
IPC	Industrial Pollution Controls
NVC	National Vegetation Classification
SAC	Special Area of Conservation
SPA	Special Protected Area
TE	terrestrial ecosystem
UKTAG	UK Technical Advisory Group
WFD	Water Framework Directive

## References

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