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O'Callaghan Moran & Associates
ENVIRONMENTAL MANAGEMENT FOR BUSINESS

TIER 3

ENVIRONMENTAL RISK ASSESSMENT

OF A

FORMER MUNICIPAL LANDFILL

WHITEGATE

COUNTY CLARE

Prepared For: -

Clare County Council
Department of Physical Development (Environment)
Áras Contae an Chláir
New Road
Ennis
Co. Clare, V95 DXP2

Prepared By: -

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July 2021

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TABLE OF CONTENTS

LIST OF APPENDICES

1. INTRODUCTION

Clare County Council (the Council) completed a Tier 1 Assessment of the closed Whitegate landfill in early 2009 in accordance with the "Code of Practice Environmental risk Assessment for Unregulated Waste Disposal Sites (CoP)" published by the Environmental Protection Agency (the Agency).

The Tier 1 Assessment, which is included in Appendix 1, concluded that the site was provisionally a Class A – High Risk Site due to the risk of leachate migration to the Slieve Aughty Special Protection Area (SPR-9). All other pathways were deemed to be Low Risk.

Later in 2009 the Council completed a Tier 2 Site Investigation. The site investigation works included:-

- Trial pit survey to assess the thickness and nature of the capping material and the waste;
- Collection and analyses of groundwater, surface water and leachate samples;
- Ground gas monitoring;

Both the Tier 1 and Tier 2 assessment programmes were undertaken as part of a Pilot Project to Support the Waste Management (Certification of Historic Unlicensed Waste Disposal and Recovery Activity) Regulations 2008 and were supervised by Steering Committee comprising officers from the Environmental Protection Agency, The Department of the Environment and Local Government and an Environmental Consultant. Each phase of assessment was reviewed and approved by the Steering Committee.

The findings are discussed in Section 3 of this report.

Conservation Services, Ecological & Environmental Consultants (CSEE) completed an assessment of the ecological impacts from the landfill on the status of specieis and habitats in the Slieve Aughty Special Protection Area in December 2009. A copy of the survey is in Appendix 2.

1.1 Methodology

Mr Sean Moran MSc, P.Geol, was the OCM Project Manager with responsibility for the preparation of the Tier 3 Risk Assessment. Mr. Moran a hydrogeologist with more than 32 years' experience in hydrogeological assessment and is certified by the IGI as qualified person in accordance with Section 2.3 of Code of Practice: Environmental Risk Assessment for Unregulated Waste Disposal Sites (EPA, 2007).

Mr. Moran completed a site walk over with Mr Cathal Brodie of Clare County Council on March 4th 2021to assess the site conditions and the location and condition of nearby sensitive receptors.

2. ENVIRONMENTAL SETTING

2.1 Site Location

Whitegate landfill site is located approximately 800m to the north of Whitegate village, off the R352 Scariff to Portumna road (Figure 2.1) on lands owned by Clare County Council. The site is located c2.5km to the west of Lough Derg.

2.2 Site Layout

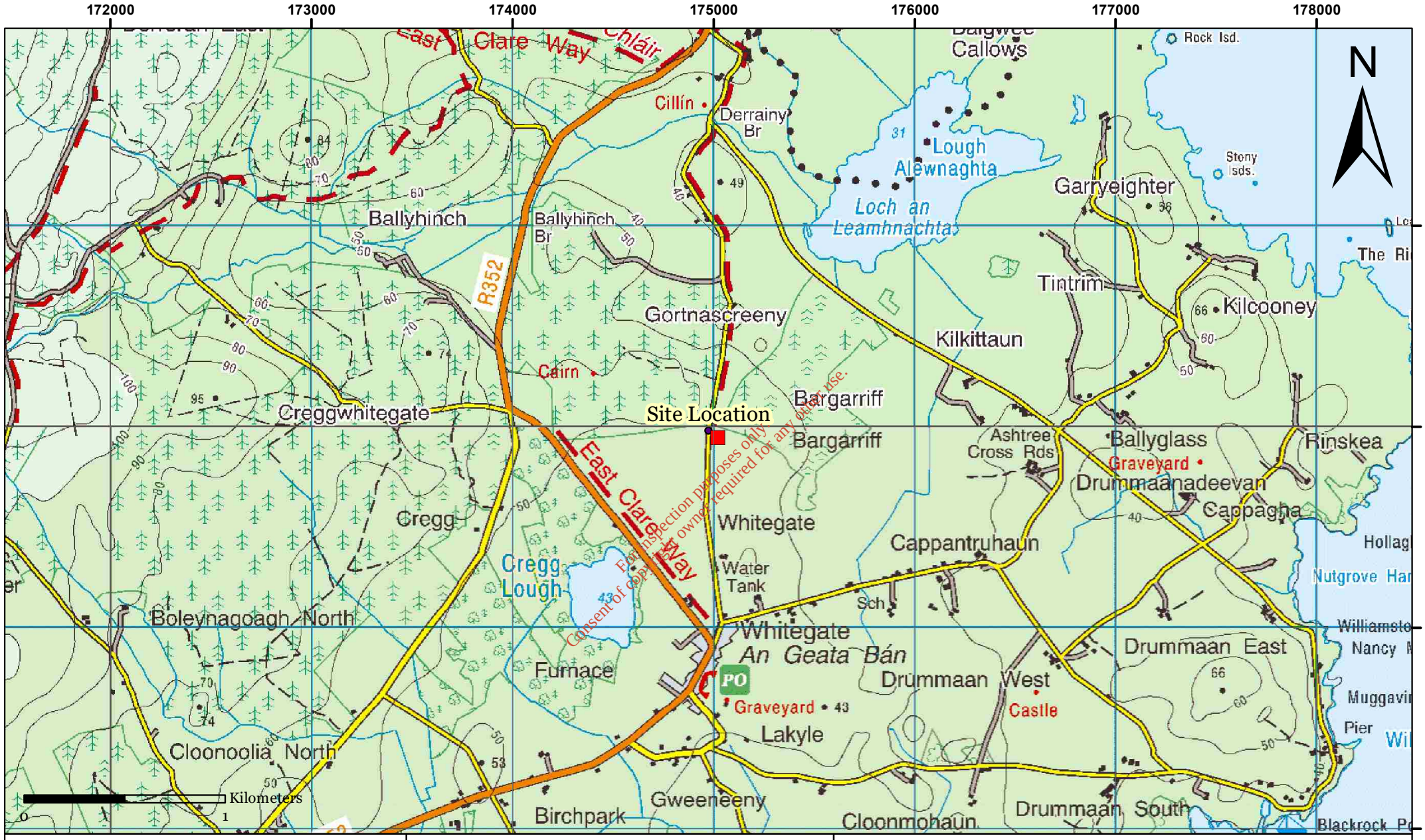
The site covers c8ha and is fenced off and are densely covered with gorse (Figure 2.2). The landfill is bound on all sides by forestry. On the western boundary of the site there is a local road access from Whitegate village. This road forms part of the East Clare Way, and re-joins the R352 approximately 2km to the north of the landfill. The landfill area is raised c4-5m above the surrounding natural ground and slopes from west to east across the site.

2.3 Surrounding Land Use

The site is located in a rural area and the surrounding land use which is predominantly forestry is shown on Figure 2.3. The closest dwelling is c600m north of the site.

2.4 Site History

The landfill operated from the 1960s and closed in 1998. While the site covers 8ha it is estimated based on site investigations that only c1.1ha was ever used for landfill.



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CLIENT
Starrus Eco Holdings Ltd

TITLE
Site Location

Details:
Site Location

Figure 2.1

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Title:

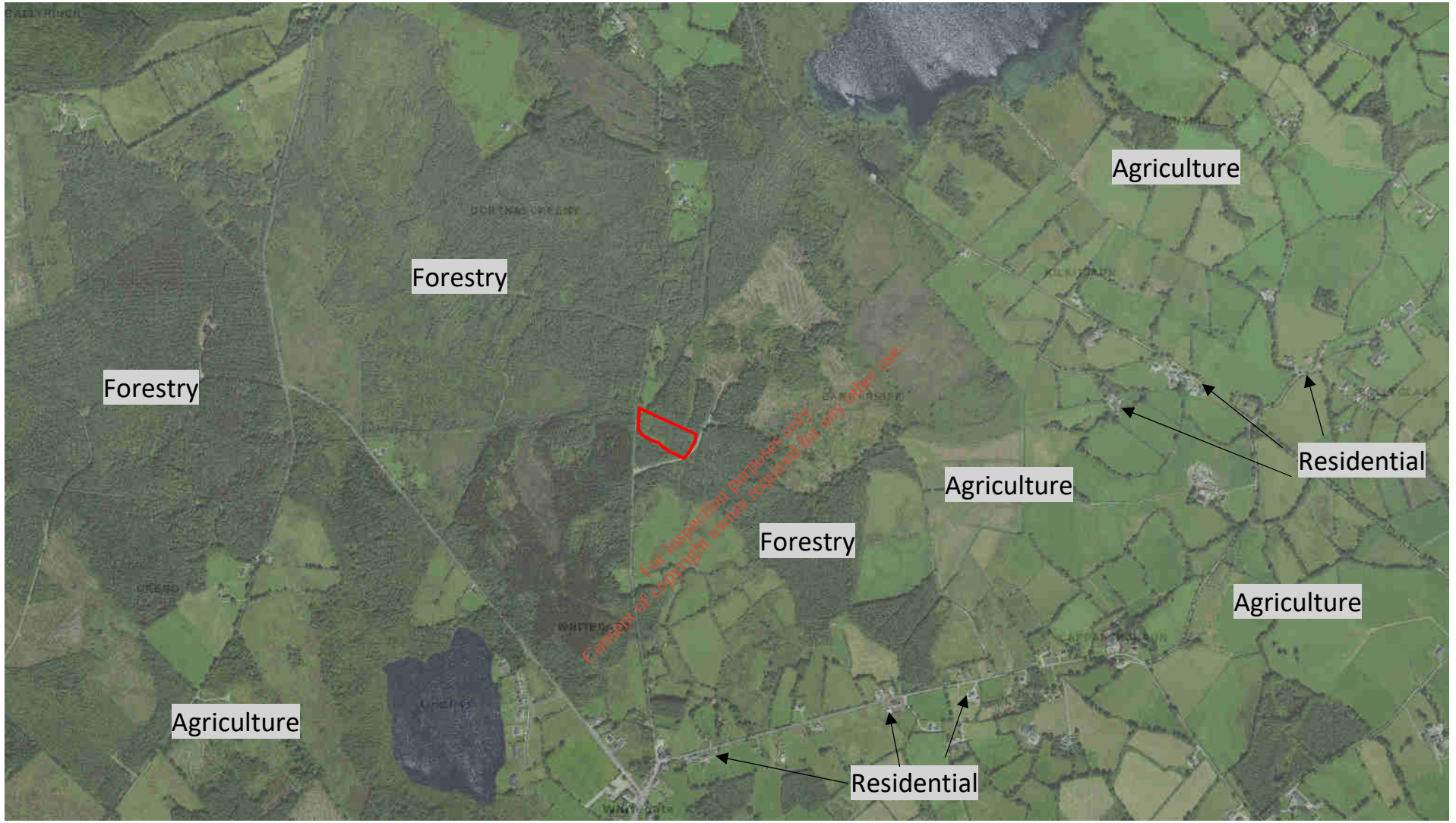
Figure 2.2 Site Layout

Legend

-Landfill Layout

Client:

Clare County Council



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Title:

Figure 2.3 Site Layout

Legend

-Landfill Layout

Client:

Clare County Council

2.5 Hydrology

The site is located in the catchment of Lough Allewnaghta. There is a land drain running west to east along the northern site boundary western boundary. This drain discharges to the Derrainy River to the northeast of the site which eventually discharges to Lough Allewnaghta c 1km northeast of the site. Cregg Lough is located c1.15km to the southwest of the site but there is no drains connecting to this Lough from the site and drainage out of Cregg Lough is to the southwest away from the site into Lough Derg (Figure 2.4).

The landfill is in the catchment of the Derrainy River which discharges into Lough Allewnaghta. Reports have been prepared on the 'Status' of each water body. Status means the condition of the water in a watercourse and is defined by its ecological and chemical status. Water bodies are ranked in one of five classes, High, Good, Moderate, Poor and Bad. The current status of the Derrainey River is Good however the Status of Lough Allewnaghta is Bad. This is based on pressures from agriculture and Invasive Species in the lake and is not associated with impacts from the landfill.

2.6 Geology & Hydrogeology

OCM established the local geological and hydrogeological conditions from a review of databases maintained by the Geological Survey of Ireland (GSI), Teagasc and the site investigation findings.

2.6.1 Soils and Subsoils

The Tier 2 site investigation established that the landfill is overlain by 200-700mm of subsoil.

Figure 2.5, which is derived from the Teagasc Maps, shows the subsoils beneath the site and in the surrounding area comprise cut over peat.

The 2009 Tier 2 investigations confirmed the presence of some peat underlying the waste across the site based on the excavation of 10 trial holes (T-1 to T-10). Bedrock was encountered in T-6 at 1.5m below ground level (bgl) and in TH-8 at 3mbgl but waste was not directly in contact with the bedrock. The thickness of the peat and underlying subsoil was not established.

2.6.2 Bedrock

The site is underlain entirely by a mudstone and siltstone conglomerate form the Ayle Rier Formation. (Figure 2.6).

2.6.3 Hydrogeology

Figure 2.7, which is derived from the GSI Aquifer Map, shows the aquifer characteristics. The Ayle River Formation is classified as a Poor Aquifer that is productive only in local zones (Pl). Groundwater flow paths are typically 10s to 100s of metres with discharge to local streams and rivers. Groundwater yields are usually very poor.

Vulnerability is defined by the GSI as the intrinsic geological and hydrogeological characteristics that determine the ease with which groundwater may be contaminated by human activities.

The vulnerability rating for the bedrock aquifer underlying the peat in the area is classified as Moderate indicating the presence of up to 5m of subsoils above the bedrock (Figure 2.8) however the harvesting of peat has reduced the vulnerability rating and the trial pit excavations indicates that the vulnerability in T-6 and T-8 is Extreme. .

OCM conducted a review of the GSI database to identify the location of any nearby wells or springs. The Whitegate public water supply well is located c3km to the southwest of the site in a separate hydrologic catchment. The closest down hydraulic gradient well identified by GSI is c1.5km to the east of the site in Killkittuan townland and is an agricultural and domestic well installed in 2002 with an abstraction rate of 32m^3/day. (Figure 2.9). This is also the closest well to the site identified by the Council during the Tier 2 investigations.

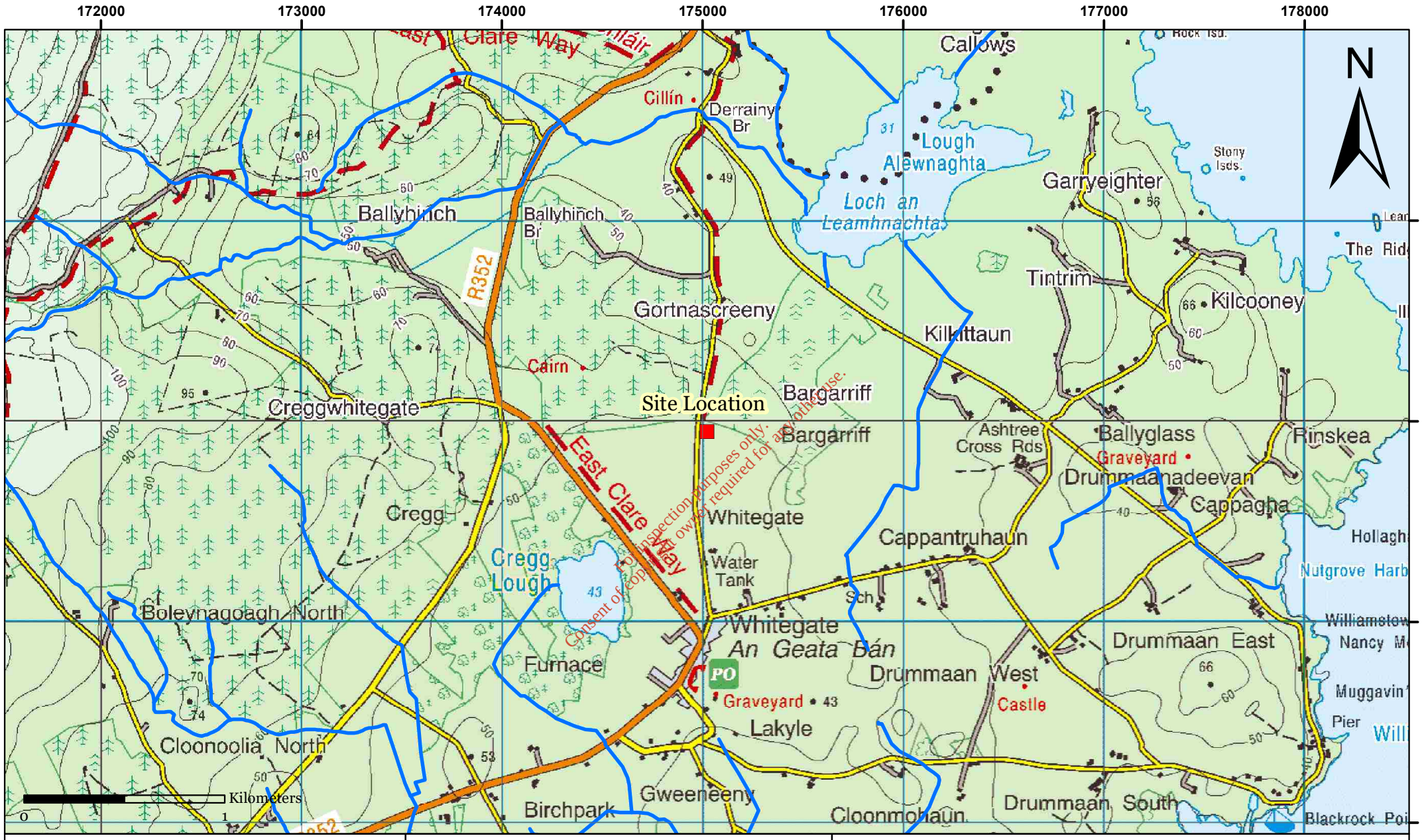
The site lies within the Tynagh Groundwater Body (GWB) IE_SH_G_236. The GWB status is rated as 'Good'.

It is likely that shallow groundwater beneath the site discharges to the stream to the northeast of the site.

2.7 Biodiversity

The site is not located in a Natura 2000 site. The Slieve Aughty Special Protection Area (SPA) is located on the western side of the public road to the site (Figure 2.10). It is up hydraulic gradient and upstream of the site. A Conservation Plan for the Slieve Aughty Mountains SPA has not yet been prepared by the Department of the Environment, Heritage & Local Government. However, it is understood that the principal nature conservation objectives for the site are to maintain the population of the species (hen harrier & merlin) for which the site is selected, and to maintain and, where possible, enhance, the habitats on which the harriers are dependant.

The desk study assessment by CSEE which is included in Appendix 2 concluded that based on a detailed consideration of the feeding habits of Merlins and Hen Harriers the proportion of the diet of these birds derived from aquatic/riparian food chains is insignificant, thereby ruling out any significant likelihood of a food chain impact on these species (or indeed any other element of the Slieve Aughty Mountains SPA biota) from the landfill.



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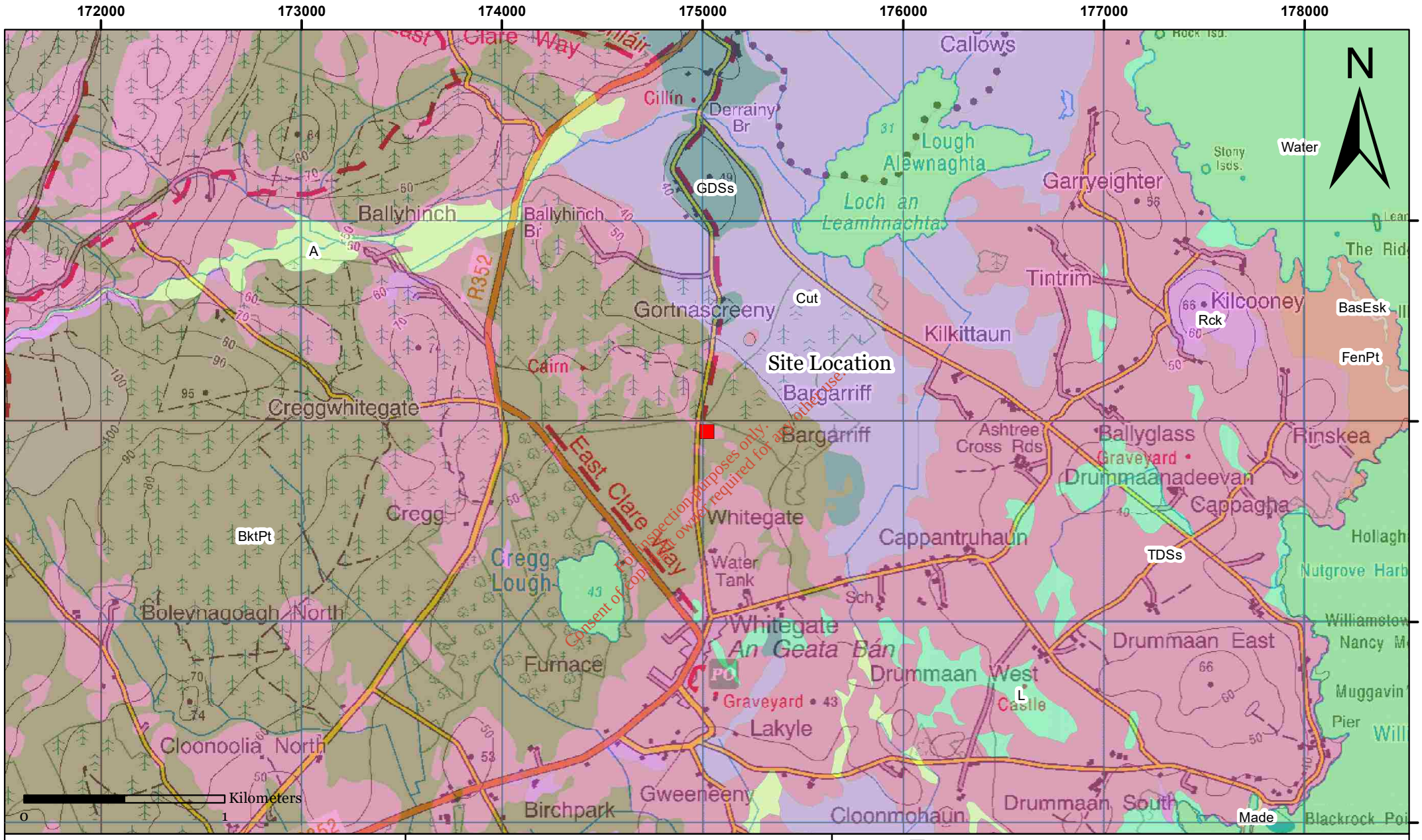
TITLE
Hydrology

Details:

Site Location
Rivers

Figure 2.4



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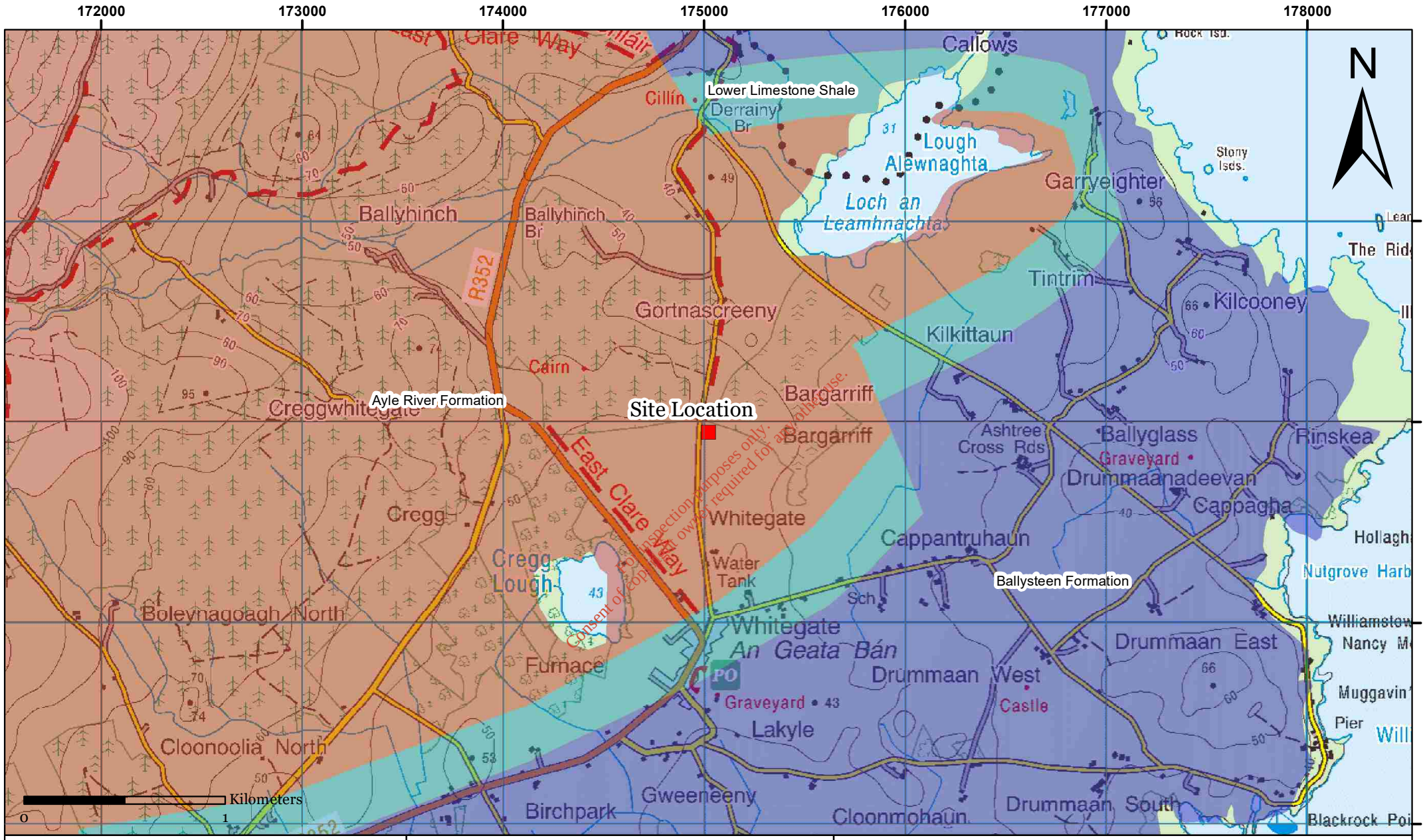
TITLE
Subsoils

Details:
- Site Location
- A - Alluvium
- BasEsk - Basic Esker
- BktPt - Blanket Peat
- Cut
- FenPt - Fen Peat
- GDSs - Sandstone Sands & Gravels
- L - Lake
- Made - Made Ground
- Rck - Bedrock at Surface
- TDSs - Sandstone Till
- Water

Figure 2.5



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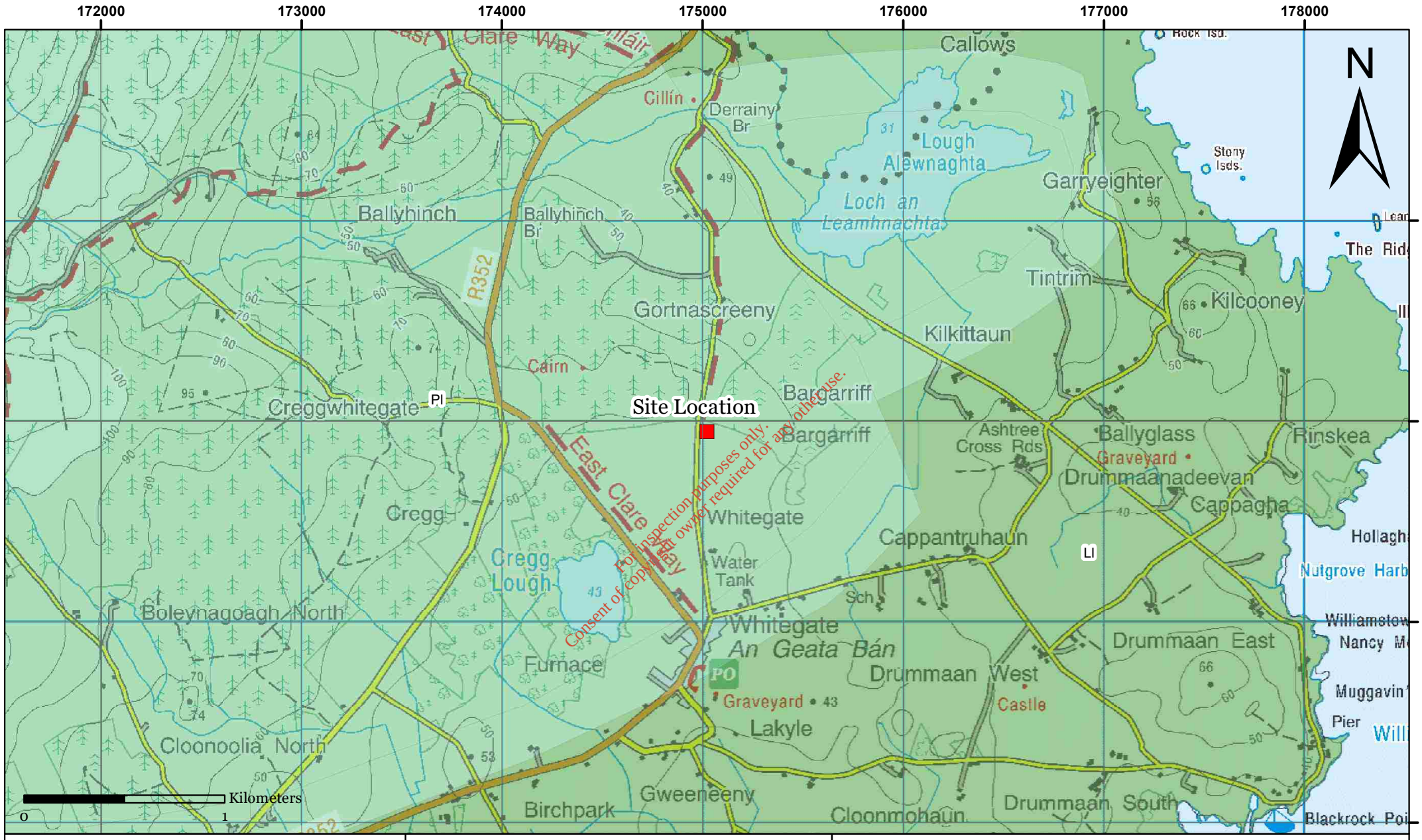
TITLE
Bedrock Geology

Details:
- Site Location
- Ayle River Formation - Mudstone, Siltstone, Conglomerate
- Ballysteen Formation - Dark, Muddy Limestone Shale
- Lower Limestone Shale - Sandstone, Mudstone and Thin Limestone

Figure 2.6



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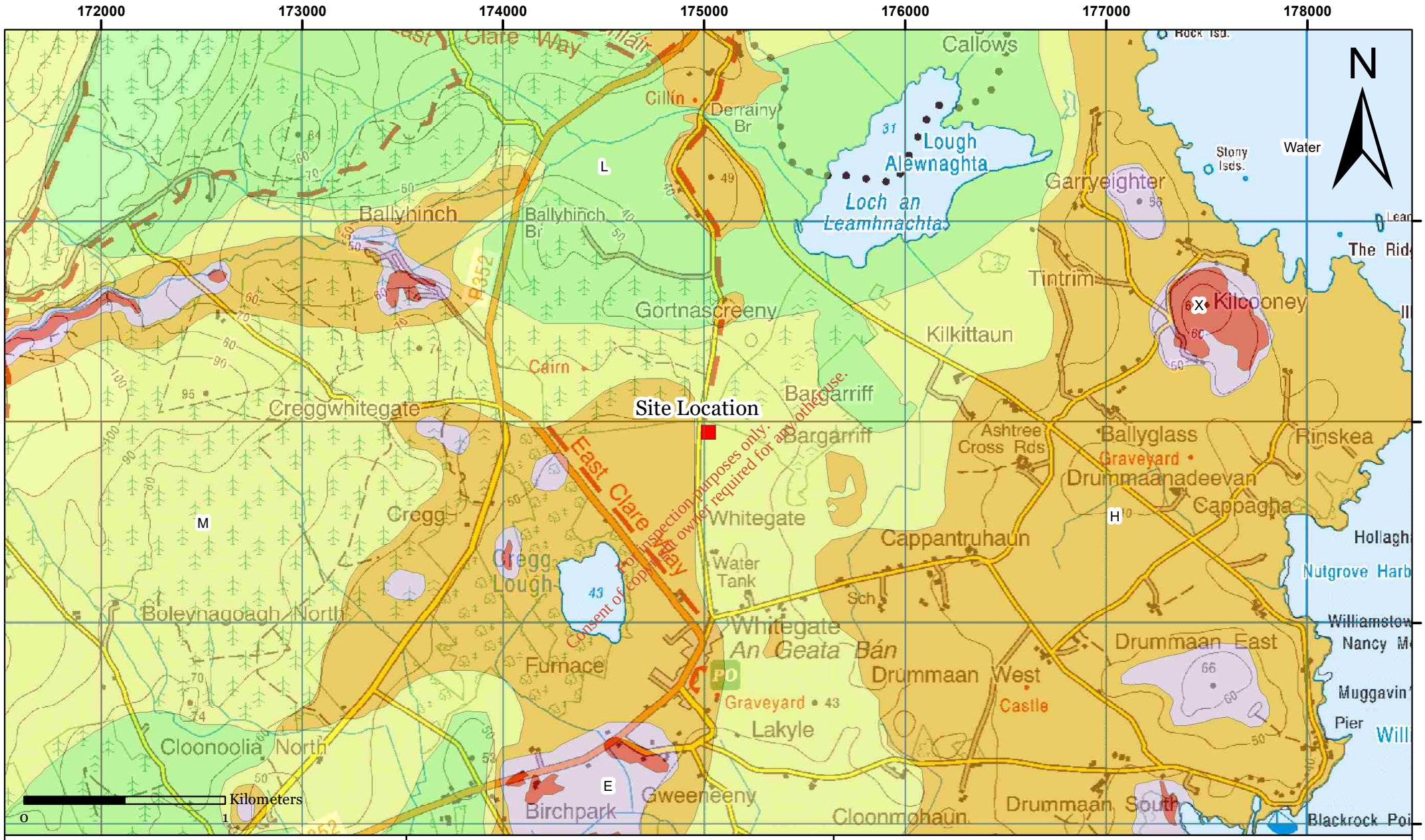
TITLE
Aquifer Classification

Details:
- Site Location
- LI - Locally Important Aquifer. Moderately Productive only in Local Zones
- PI - Poor Aquifer. Unproductive except for Local Zones

Figure 2.7



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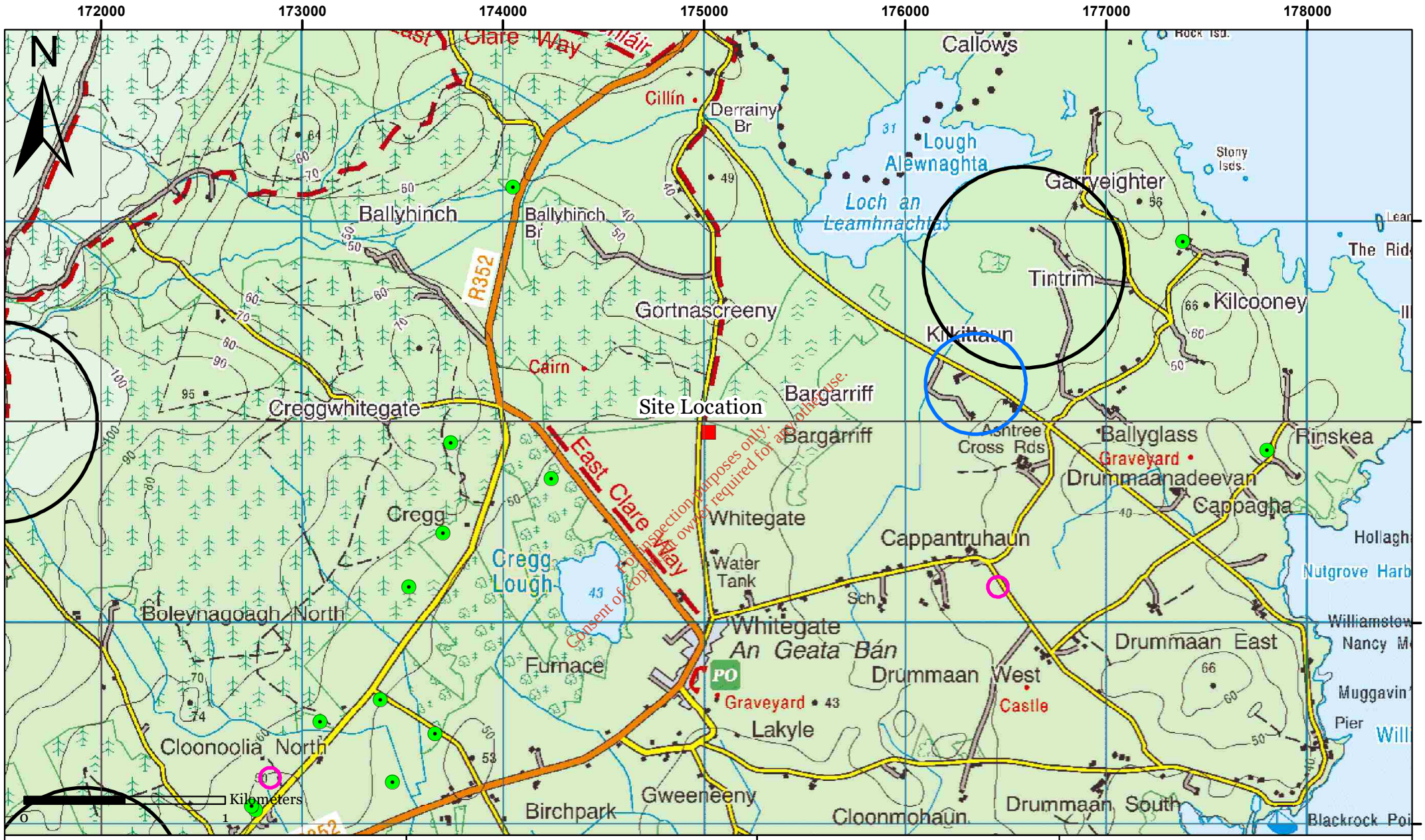
TITLE
Groundwater Vulnerability

Details:
- Site Location
- X - Bedrock near Surface
- E - Extreme
- H - High
- M - Moderate
- L - Low

Figure 2.8



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TITLE
GSI Well Location Data

Details:
Unfortunately many of the borehole logs in the GSI database do not contain accurate location information. The size of the circles shown above is inversely proportional to the accuracy of the well location (i.e. small circles represent high accuracy, where relatively larger circles represent lower accuracy).

- Site Location
- Well Accuracy 10m to 50m
- Well Accuracy 50m to 100m
- Well Accuracy 250m to 500m
- Well Accuracy 500m to 1km

Figure 2.9

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CLIENT
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TITLE
NPWS

Details:

- Site Location ING
- SAC
- SPA

Figure 2.10

3. TIER 2 SITE INVESTIGATION SUMMARY

3.1 Objectives

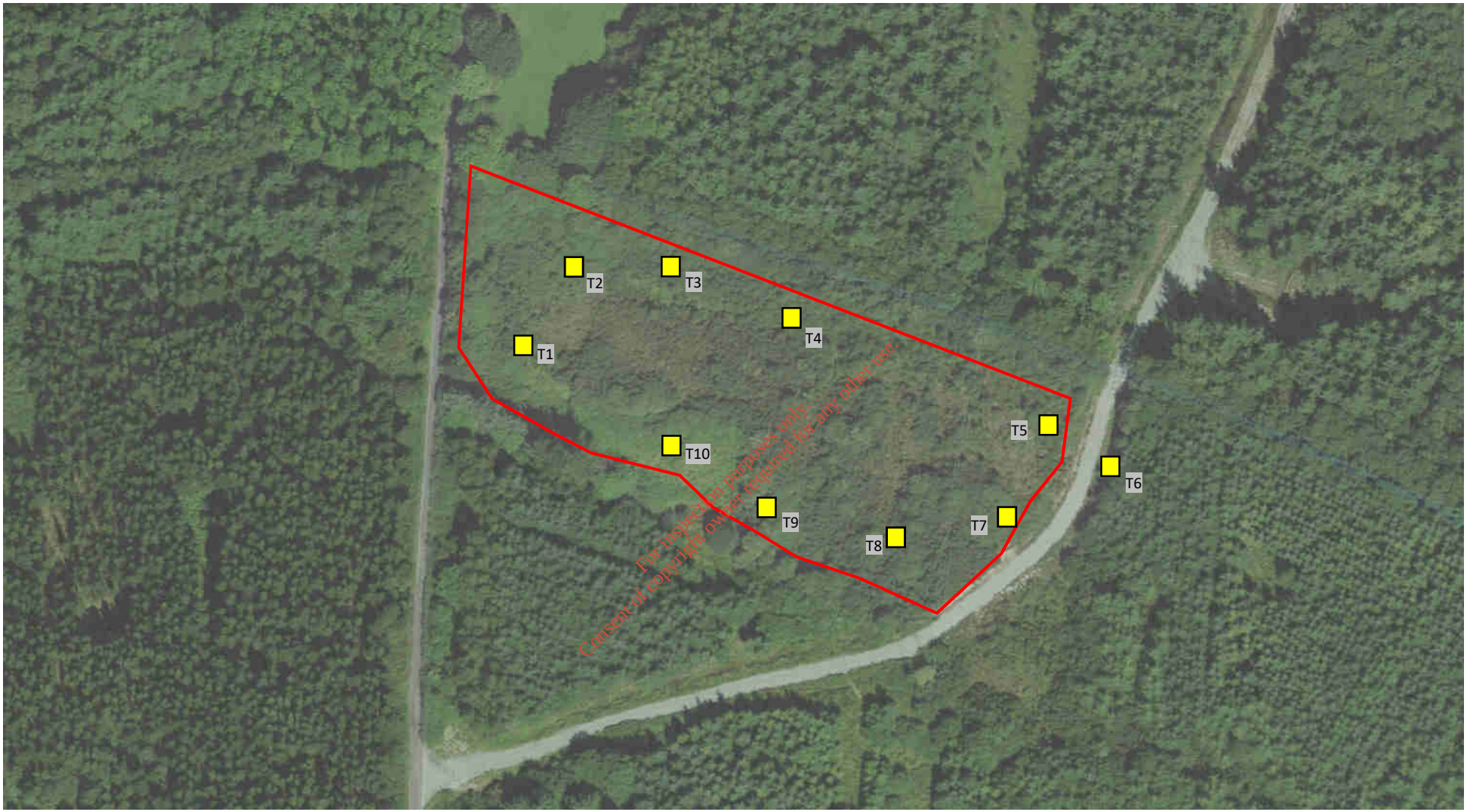
The objective of the Tier 2 assessment were to establish if the risk ranking assigned during the Tier 1 assessment was correct.

3.2 Site Investigation Scope

Clare County Council staff completed the Tier 2 Investigation in 2009. The full Tier 2 Report is in Appendix 3. The assessment included;

- Site and local area reconnaissance
- Trial pit survey to assess the thickness and nature of the capping material and the waste;
- Collection and analyses of groundwater, surface water, leachate and waste samples;
- Ground gas monitoring;

The locations of the trial pits are shown on Figure 3.1.



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Title:

Figure 3.1 Trial Pit Location

Legend

-Landfill Layout

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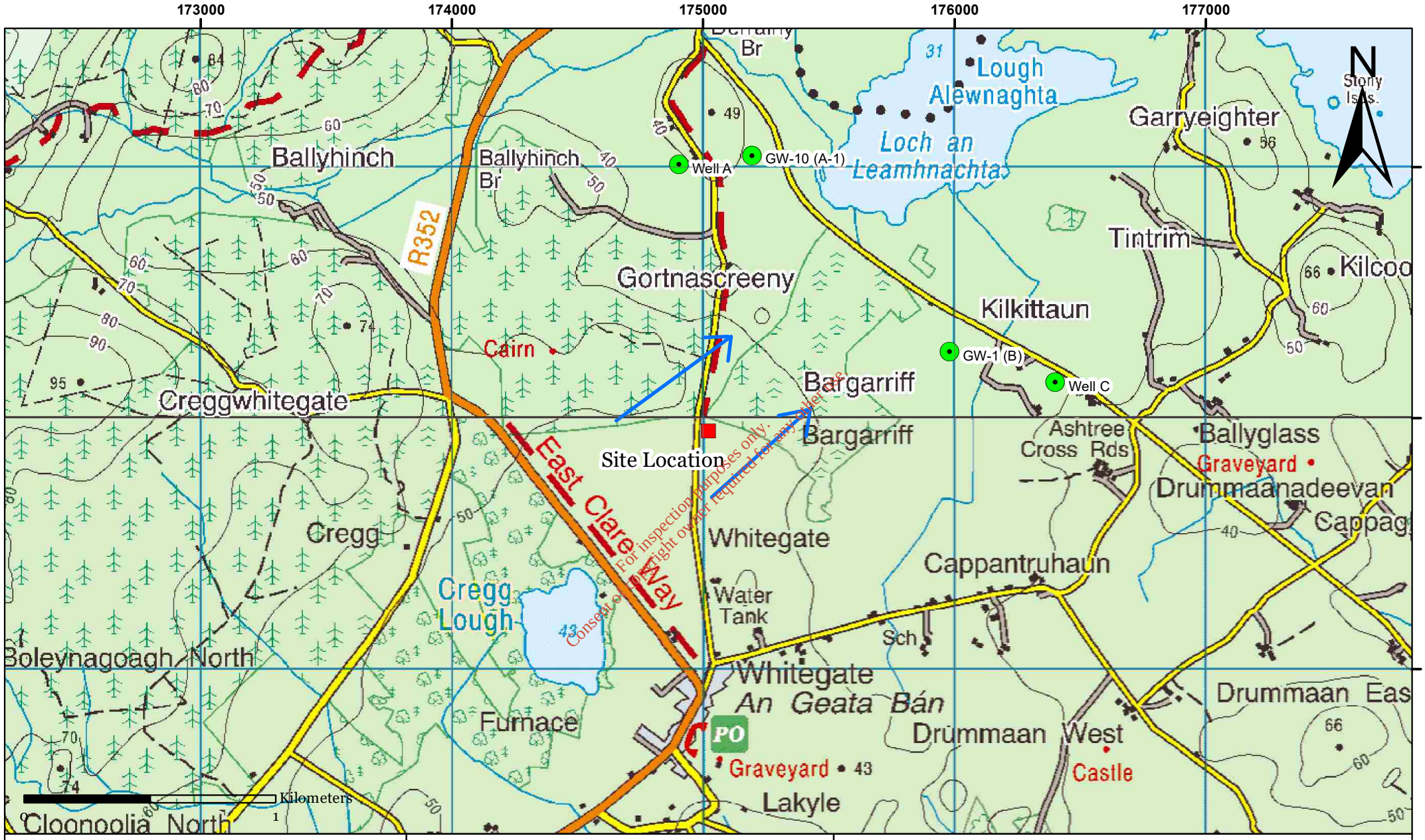

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TITLE
Sample Locations and Groundwater Flow

Details:
- Site Location
- Wells
- Inferred Groundwater Flow

Figure 3.2

3.3 Ground Conditions

Ten trial pits (T-1 T-10) were opened across the site which confirmed the presence of c200 – 700mm capping layer comprising top soil. Waste is present across the entire site with a thickness of between 4-5m. The waste footprint covered 1.19 ha. It is was underlain in all trial pit locations by peat. It is noted that water inflows were observed in the trial pit and is indicated as the water table. However given the nature of the site it is more likely that the water in the trial pits is perched water in the waste mass and not groundwater.

3.3.1 Waste Characterisation

Based on the trial pit logs the waste is predominantly municipal with c10% commercial/industrial waste. The waste is typical of what would be found in landfill in a rural area.

3.3.2 Extent of Waste Body

Based on a combination of the trial pits and some excavation along the boundaries the waste extends close to the site perimeters on the north, south and west of the site but not along the eastern site boundary. It is on averages 4.5m thick and is c5m at its deepest. The Tier 2 Investigation established that there is c59,500m^3 of waste present on the site and it is present across c1ha of the site footprint. Using a conversion ratio of 0.5 tonne/m3 this indicates the presence of 29,750 tonnes.

3.3.3 Leachate

Perched water/leachate was present in most of the trial pits with samples collected for laboratory analysis from T-3, T-4, T-5 and T-8 where sufficient water was present for the collection of leachate samples.

3.4 Groundwater

The Whitegate public water supply well is located c3km to the southwest of the site in a separate hydrologic catchment. The closest down hydraulic gradient well identified by GSI is c1.5km to the east of the site in Killkittuan townland and is an agricultural and domestic well installed in 2002 with an abstraction rate of 32m^3/day) (Well B). The Council identified a well c900m to the northeast of the site which was sampled as part of the Tier 2 investigations. Two other wells were also sampled by the Council, one up hydraulic gradient to the north (Well A) and one down hydraulic gradient to the north (Well C).

Based on the local topography and site drainage the groundwater flow direction is considered to be from the high ground to the west where the highest elevation locally is c95mOD to the east and north east toward Lough Alwenaghta c31mOD.

The well locations and groundwater flow direction is shown on Figure 3.2.

In 2021 The Council completed updated sampling at down hydraulic gradient Well B in April and May 2021 and at a new up gradient location (Well A-1). The previous upgradient well was no longer in use in 2021.

3.4.1 Laboratory Analysis

The 2009 samples were shipped to Alcontrol Laboratories in Dublin an ILAB accredited laboratory. The 2021 samples were shipped to Southern Scientific Laboratories in Co. Kerry also an ILAB accredited laboratory.

The samples were analysed for an indicator range of parameters which include some of the parameters specified in Table C2 of the EPA Manual on Landfill Monitoring (2003).

3.4.2 Groundwater Quality

The full laboratory test report is in the Tier 2 report in Appendix 3 and the results are presented in Table 4.1 -4.4. The table includes Interim Guideline Values (IGV) published by the EPA and the Groundwater Threshold Values (GTV) set out in the European Communities Environmental Objectives (Groundwater) Regulations (S.I. 9 of 2010).

The IGVs are not statutory, but were developed to assist in the assessment of impacts on groundwater quality. The IGVs are based on, but are more conservative than the Drinking Water quality standards. GTVs have only been established for core indicator parameters.

The results from 2009 shows elevated sulphate in the groundwater up and down hydraulic gradient of the landfill area. Elevated ammonium, arsenic, sulphate, manganese and iron was detected in Well B and elevated ammonium and sulphate in Well C. The Council observed that there were other sources of potential contamination downgradient of the landfill which include a piggery and intensive dairy farm, both of which are closer to the wells than the landfill. It is considered that the elevated parameters in the wells are more likely to originate from these sources than the landfill site.

The 2021 results continue to show elevated ammonium and manganese in GW-1 (Well B) down hydraulic gradient of the landfill. It is still considered that the sources of these

parameters are most likely to be associated with activities in the catchment such as the piggery and/or the dairy farm and not the landfill. Other indicator parameters for landfill leachate such as elevated metals, chloride, potassium, iron or pH were not detected in the groundwater in GW-1(Well B).

Table 4.1 Groundwater Monitoring Results 2009

Sample I.D. / Sample Date	Units	Well A Upgradient	Well B Downgradient (Before Treatment)	Well B Downgradient (After Treatment)	Well C Downgradient	IGV	GTV
Electrical Conductivity	uS/cm	357	595	772	465	1000	1,875
Chloride	mg/l	11.33	22.19	37.24	22.56	30	187.5
pH	units	6.85	7.07	7.66	7.97	>4>9	NE
Ammonium	mg/l	0.012	4.631	0.479	0.177	0.15	0.175
Nitrite	mg/l	<0.0025	<0.0025	<0.0025	<0.0025	NE	375
E.coli	cfu/100 ml	0	0	0	0	0	NE
Coliform Bacteria	cfu/100 ml	4	0	0	0	0	NE
Total Alkalinity as	mg/l	155	300	400	225	NE	NE
Fluoride	mg/l	<0.5	<0.5	<0.5	<0.5	NE	NE
Arsenic Dissolved	ug/l	1.24	489	461	1.1	NE	7.5
Boron Dissolved	ug/l	112	<9.4	<9.4	<9.4	NE	750
Cadmium Dissolved	ug/l	<10	<10	<10	<10	NE	3.75
Chromium Dissolved	ug/l	1	1.54	2.01	1.24	NE	37.5
Copper Dissolved	ug/l	1.23	4.54	3.15	22	NE	1500
Lead Dissolved	ug/l	0.14	2.35	0.673	1.51	10	18.75
Manganese Dissolved	ug/l	16.2	897	7.4	28	50	NE
Nickel Dissolved	ug/l	0.404	1.84	0.768	1.34	20	15
Selenium Dissolved	ug/l	<0.39	0.435	1.14	0.857	NE	NE
Zinc Dissolved	ug/l	2.26	16.6	6.79	42.9	100	75
Mercury	ug/l	<0.01	<0.01	<0.01	<0.01	NE	0.75
Sulphate (soluble)	ug/l	17000	6600	9100	15700	200	187.5
Chloride	mg/l	12.6	22.4	39	24.1	30	187.5
Phosphate (ortho as	mg/l	<0.08	<0.08	0.529	<0.08	30	NE
Chromium (Unfiltered)	ug/l	3.93	<3	<3	<3	NE	37.5
Phosphorus (Unfiltered)	ug/l	31.8	208	40.2	<18.3	NE	NE
Total Cyanide	mg/l	<50	<50	<50	<50	10	37.5
Calcium Dissolved	mg/l	23	118	1.26	69.1	NE	NE
Sodium Dissolved	mg/l	83.8	17	231	10.7	150	NE
Magnesium Dissolved	mg/l	7.57	6.75	<0.036	3.8	NE	NE
Potassium Dissolved	mg/l	4.92	<2.34	<2.34	3.78	5	NE
Iron Dissolved	ug/l	<19	7880	96.7	<19	200	NE

Table 4.2 Groundwater Results Anions and Cations

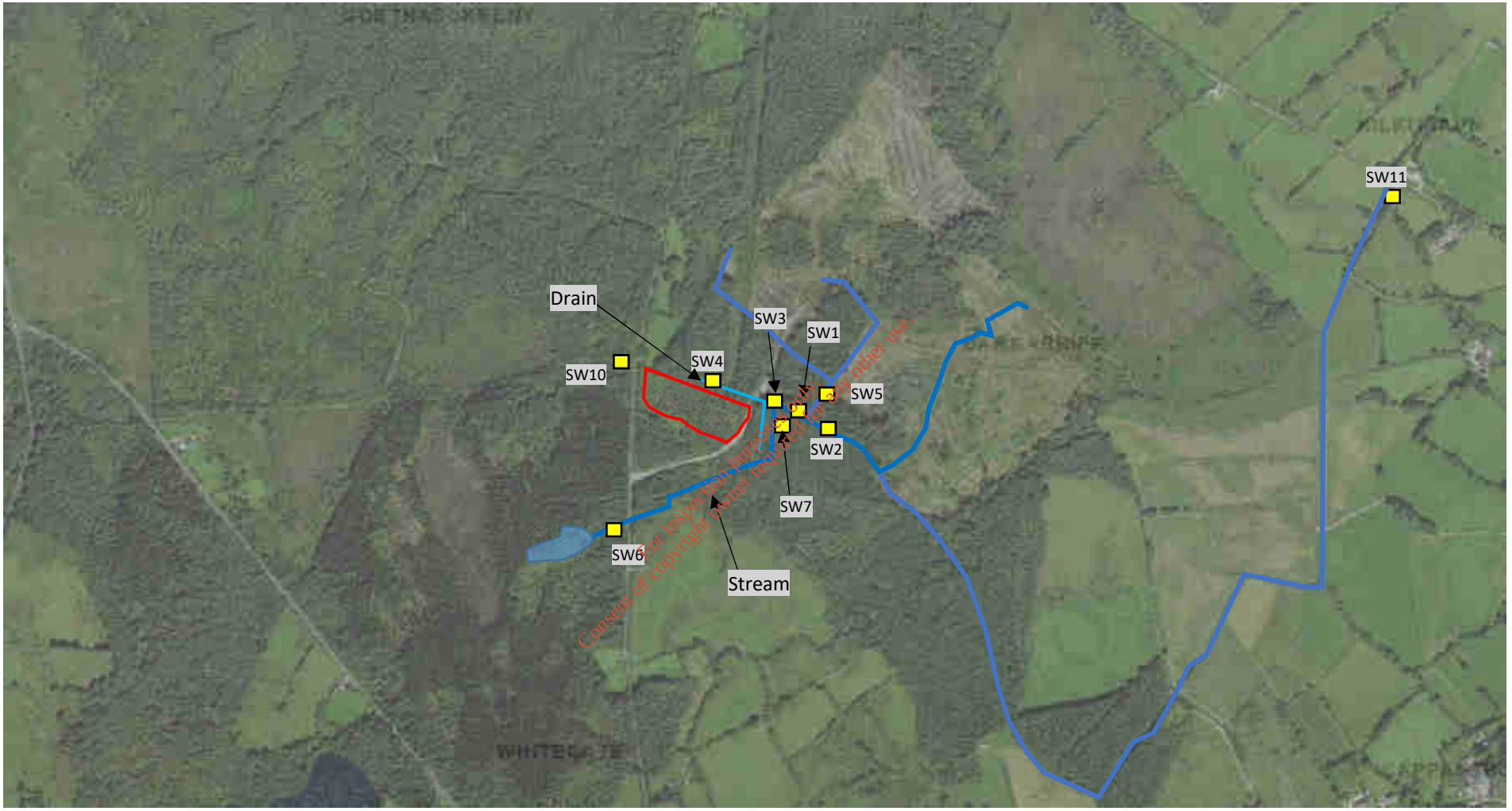
Sample I.D.	Units	GW10	GW10	GW1 (Well B)	GW1 (Well B	IGV	GTV
Sample Date		24/03/2021	24/04/2021	24/03/2021	24/04/2021		
Electrical Conductivity	uS/cm	465	469	581	585	1000	1,875
Chloride	mg/l	20.4	22.3	22.6	26.0	30	187.5
pH	units	7.7	7.6	7.3	7.2	>4>9	NE
Ammonium	mg/l	0.02	0.03	3.18	2.69	0.15	0.175
E.coli	cfu/100 ml	< 1	< 1	< 1	< 1	0	NE
Coliform Bacteria	cfu/100 ml	< 1	1	< 1	< 1	0	NE
Total Alkalinity as CaCO3	mg/l	228.3	238.4	327.9	340.4	NE	NE
Sulphate (soluble)	ug/l	29.0	30.1	7.3	1.7	200	187.5
Phosphorus (Unfiltered)	ug/l	0.05	0.06	0.15	0.17	NE	NE
Total Cyanide	mg/l	< 0.01	< 0.01	< 0.01	< 0.01	10	37.5
Calcium Dissolved	mg/l	67	77.3	94	105.0	NE	NE
Sodium Dissolved	mg/l	16	17.4	15	15.6	150	NE
Magnesium Dissolved	mg/l	< 10	< 10.0	< 10	< 10.0	NE	NE
Potassium Dissolved	mg/l	< 10	< 10.0	< 10	< 10.0	5	NE
Iron Dissolved	ug/l	23.47	< 5.00	9.47	< 5.00	200	NE
Total Dissolved Solid	mg/l	266	268	335	335	NE	NE
Total Suspended Solids	mg/l	< 4	< 4	17	15	NE	NE

Table 4.3 Metals

Sample I.D.	Units	GW10	GW10	GW1 Well B	GW1 Well B	IGV	GTV
Sample Date		24/03/2021	24/04/2021	24/03/2021	24/04/2021		
Fluoride	mg/l	< 0.1	< 0.1	0.1	0.1	NE	NE
Arsenic Dissolved	ug/l	< 1.00	< 1.00	6.78	6.44	NE	7.5
Boron Dissolved	ug/l	24.51	35.66	23.77	34.98	NE	750
Cadmium Dissolved	ug/l	< 0.45	< 0.45	< 0.45	< 0.45	NE	3.75
Chromium Dissolved	ug/l	2.35	< 1.00	2.37	< 1.00	NE	37.5
Copper Dissolved	ug/l	17.60	28.31	2.22	3.24	NE	1500
Lead Dissolved	ug/l	< 1.00	< 1.00	< 1.00	< 1.00	10	18.75
Manganese Dissolved	ug/l	8.34	21.48	781.01	784.00	50	NE
Nickel Dissolved	ug/l	2.55	< 1.00	3.03	< 1.00	20	15
Zinc Dissolved	ug/l	10.99	25.85	6.02	5.79	100	75
Mercury	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	NE	0.75

Table 4.4 Phenol, BTEX, Volatile and Semi-Volatile Organic Compounds and PAHs

Sample I.D.	Units	GW10	GW10	GW1 Well B	GW1 Well B	IGV	GTV
Sample Date		24/03/2021	24/04/2021	24/03/2021	24/04/2021		
Phenol	ug/l	< 0.01	< 0.01	< 0.01	< 0.01	NE	NE
BTEX	ug/l	ND	ND	ND	ND	NE	0.75
VOC's	ug/l	ND	ND	ND	ND	NE	NE
SVOC's	ug/l	ND	ND	ND	ND	NE	NE
PAH's	ug/l	ND	ND	ND	ND	NE	0.075



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Title:

Figure 3.3 Surface Water Sampling Points

Legend

-Landfill Layout

-Surface Water Sampling Point

Client:

Clare County Council

3.5 Surface Water

Surface water sampling locations are shown on Figure 3.3. In 2009 Surface water samples from locations SW-1, SW-2, SW-3, SW-4, SW-5, SW-6 and SW-7. SW-4 is on the drain that runs along the northern side of the landfill which connects to a stream further east. SW-3, SW-2 and SW-1 are sample points further downstream. SW-5 is a sample point on a stream further to the north that joins the stream which runs along the north of the landfill to the northeast of the landfill site. While SW-6 and SW-7 are sample points on a stream to the south of the landfill which drains land further to the southwest of the landfill area.

In 2021 two rounds of sampling was undertaken on 24th of March and 24th of April. Samples were collected from the same locations as 2009 for SW-1 and SW-6 and from two new locations SW-10 and SW-11. SW-10 was on a drain upstream to the northwest of the landfill which connects to the drain along the north of the landfill while SW-11 is on a stream into which the streams to the north and south of the landfill discharge into and to which run off from other lands to the east and south of the landfill also discharges.

3.5.1 Laboratory Analysis

The samples were placed in laboratory prepared containers and stored in coolers at below 4ºC prior to shipment to Southern Scientific laboratory. Chain of custody (C.O.C.) documentation was included with the samples.

3.5.2 Surface Water Quality

The samples analysed for List 1 and II substances and the parameters specified in Table C2 of the EPA Manual on Landfill Monitoring (2003) which included electrical conductivity, ammonia, nitrate, potassium, sodium, chloride, sulphate, fluoride, heavy metals to include (arsenic, boron, cadmium, chromium, copper, lead, mercury, manganese, nickel, lead and zinc), cyanide, Volatile Organic Compounds (VOC), Semi-Volatile Organic Compounds (SVOC) and coliforms.

The laboratory test report is contained in Appendix 4 and the results are presented in Table 4.5 and 4.6. The table includes for comparative purposes the 2009 Surface Water Regulations Environmental Quality Standards (EQS).

The 2009 sampling results show elevated ammonia in the drain and stream along the north of the landfill associated with leachate run off. Ammonia levels to the streams further north and south of the landfill also show elevated ammonia but less than at the landfill.

Elevated lead, arsenic and manganese are also seen but the levels of these parameters appear to be higher coming from run-off from lands upstream of the landfill area (SW-5 and SW-6).

For the 2021 results, ammonia exceeds the AA-EQS in SW-1 in April and May. Nickel exceeds the AA-EQS in SW-1 on the 24th of March 2021. Manganese exceeds the MAC EQS in SW-1, SW-6 and SW-11 on both days of sampling.

Total coliforms was elevated in all samples. E.coli was present in SW-1 and SW-11 on both days of sampling. Iron concentrations were elevated in all samples.

The 2021 monitoring results also indicate that the surface water along the north of the landfill is being impacted by leachate run-off but that there are other sources of contamination upstream of the landfill with very elevated arsenic at SW-6. The results for SW-11 shows that some attenuation is occurring downstream based on the significantly reduced ammonia levels. It is also possible that run off from other activities in the catchment such as forestry, intensive agriculture (dairy and piggery) to the east of the landfill may also be impacting on surface water quality at SW-11.

Table 4.5 Surface Water Monitoring Results – November 2009

Parameter	Units	SW-1	SW-2	SW-3	SW-4	SW-5	SW-6	SW-7	AA -EQS	EU MAC*
		05/11/2009	05/11/2009	05/11/2009	05/11/2009	05/11/2009	05/11/2009	05/11/2009		
Dissolved Oxygen	%	7.72	7.65	6.94	6.11	5.51	5.54	7.2	NE	NE
Dissolved Oxygen	mg/l	68.9	68	61.9	54.6	49.6	49.3	64.1	65	NE
pH	pH Units	6.07	6.05	6.89	6.72	4.13	5.19	5.63	4.5-9	NE
Electrical Conductivity	uS/cm	115	122	447	400	189	89	102	1000	NE
Total Suspended Solids	mg/l	5	4	15	3	< 2	< 2	9	NE	NE
Ammonia*	mg/l	0.288	0.349	4.233	2.725	0.339	0.12	0.044	0.065	NE
TON	mg/l	0.288	0.349	4.233	2.725	0.339	0.12	0.044	NE	NE
Nitrate	mg/l	<0.001	<0.001	0.068	<0.001	0.301	<0.001	<0.001	NE	NE
Nitite	mg/l	<0.001	<0.001	0.074	<0.001	0.317	<0.001	<0.001	NE	NE
BOD	mg/l	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	NE	NE
COD	mg/l	2	<2	4	<2	<2	<2	<2	NE	NE
Sulphate	mg/l	103	102	26	16	104	115	105	NE	NE
Chloride	mg/l	<0.5	<0.5	10.086	13.652	15.303	<0.5	<0.5	NE	NE
Total P	mg/l	< 3.0	54.8	58.6	35.3	21.5	30.1	30.7	NE	NE
Fluoride	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	500	NE
Calcium	mg/l	11.1	11.1	16.4	51.4	7.92	7.34	8.48	NE	NE
Sodium	mg/l	11.2	11.1	12.5	13.4	17.7	11.1	10.4	NE	NE
Potassium	mg/l	< 2.34	< 2.34	7.76	9.15	< 2.34	< 2.34	< 2.34	NE	NE
Arsenic	ug/l	10.6	12.6	8.95	5.45	17	18.1	13.3	25	10
Boron	ug/l	< 18	< 18	132	74.1	< 18	< 18	< 18	NE	NE
Cadmium	ug/l	< 0.220	< 0.220	< 0.220	< 0.220	< 0.220	< 0.220	< 0.220	0.08	0.45
Chromium	ug/l	< 0.7	< 0.7	< 0.7	< 0.7	2.86	< 0.7	< 0.7	4.7	32
Copper	ug/l	14.2	17.2	< 1.6	8.71	< 1.6	< 1.6	< 1.6	30	NE
Lead	ug/l	2.5	2.47	2.14	1.83	2.05	3.21	2.85	1.2	14
Manganese	ug/l	197	284	470	458	734	396	237	20	20
Nickel	ug/l	1.65	2.15	2.62	2.56	2.08	< 1.5	< 1.5	4	34
Selenium	ug/l	1.17	1.07	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	NE	NE
Magnesium	ug/l	2.16	2.11	11.8	10.6	1.83	1.62	1.49	NE	NE
Zinc	ug/l	9.18	17.7	15.8	20.6	11.9	12.7	12.2	100	NE
Mercury	ug/l	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.05	0.07
Iron	ug/l	1.63	1.96	-	3.26	3.49	2.23	1.69	NE	NE

NE Denotes Not Established

Table 4.6 Surface Water Monitoring Results – March 2021 – April 2021

Parameter	Units	SW1	SW1	SW6	SW6	SW10	SW10	SW11	SW11	AA -EQS	EU MAC*
		24/03/2021	24/04/2021	24/03/2021	24/04/2021	24/03/2021	24/04/2021	24/03/2021	24/04/2021		
Dissolved Oxygen	mg/L	8.0	4.3	6.7	3.3	7.2	NS	8.1	6.4	65	NE
Electrical Conductivity	uS/cm	340	551	86	99	65	NS	410	499	1000	NE
Chloride	mg/l	21.6	30.6	22.0	24.4	13.5	NS	17.2	17.2	NE	NE
pH	units	7.0	7.1	5.2	5.8	5.8	NS	7.5	7.6	NE	NE
Ammonium	mg/l	5.19	10.82	0.06	0.37	0.04	NS	0.34	0.08	0.065	NE
E.coli	cfu/100 ml	10	8	< 10	< 1	< 1	NS	7	59	NE	NE
Coliform Bacteria	cfu/100 ml	> 201	31	85	18	70	NS	> 201	> 201	NE	NE
Total Alkalinity as CaCO3	mg/l	166.4	314.4	16.4	28.2	8.4	NS	212.3	291.0	NE	NE
Fluoride	mg/l	< 0.1	< 0.1	< 0.1	< 0.1	0.1	NS	< 0.1	0.1	500	NE
Arsenic Dissolved	ug/l	14.68	7.47	20.83	30.29	< 1.00	NS	1.30	1.72	25	10
Boron Dissolved	ug/l	67.48	135.06	< 20.00	< 20.00	< 20.00	NS	< 20.00	24.55	NE	NE
Cadmium Dissolved	ug/l	< 0.45	< 0.45	< 0.45	< 0.45	< 0.45	NS	< 0.45	< 0.45	0.0015/0.0025	0.9/1.5
Chromium Dissolved	ug/l	2.60	< 1.00	2.17	< 1.00	2.08	NS	2.19	< 1.00	4.7	35
Copper Dissolved	ug/l	< 1.00	2.24	< 1.00	1.09	1.97	NS	6.16	4.21	30	NE
Lead Dissolved	ug/l	< 1.00	< 1.00	1.08	2.00	2.03	NS	< 1.00	< 1.00	7.5	NE
Manganese Dissolved	ug/l	529.20	1010.00	167.41	433.58	17.89	NS	120.68	759.78	20	20
Nickel Dissolved	ug/l	4.03	< 1.00	2.66	< 1.00	3.90	NS	3.43	< 1.00	4	34
Zinc Dissolved	ug/l	< 5.00	< 5.00	< 5.00	< 5.00	< 5.00	NS	< 5.00	< 5.00	100	NE
Mercury	ug/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	NS	< 0.50	< 0.50	0.05	0.07
Sulphate (soluble)	ug/l	5.3	< 0.5	< 0.5	< 0.5	3.1	NS	11.3	11.6	NE	NE
Phosphorus (Unfiltered)	ug/l	0.40	< 0.04	< 0.04	< 0.04	< 0.04	NS	0.15	0.10	NE	NE
Total Cyanide	mg/l	< 0.01	< 0.01	< 0.01	< 0.01	0.03	NS	< 0.01	< 0.01	NE	NE
Calcium Dissolved	mg/l	37	70.7	< 10	< 10.0	< 10	NS	71	102.0	NE	NE
Sodium Dissolved	mg/l	12	16.3	10	10.6	< 10	NS	< 10	11.0	NE	NE
Potassium Dissolved	mg/l	< 10	12.3	< 10	< 10.0	< 10	NS	< 10	< 10.0	NE	NE
Iron Dissolved	ug/l	3064.99	1938.00	1304.46	2038.00	243.04	NS	179.33	151.06	NE	NE
Total Dissolved Solid	mg/l	193	318	49	56	37	NS	234	287	NE	NE
Total Suspended Solids	mg/l	< 20	21	< 20	< 10	588	NS	< 10	< 4	NE	NE
Phenol	ug/l	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NS	< 0.01	< 0.01	NE	NE
BTEX	ug/l	ND	ND	ND	ND	ND	NS	ND	ND	NE	NE
VOC's	ug/l	ND	ND	ND	ND	ND	NS	ND	ND	NE	NE
SVOC's	ug/l	ND	ND	ND	ND	ND	NS	ND	ND	NE	NE
PAH's	ug/l	ND	ND	ND	ND	ND	NS	ND	ND	NA	NA

NE denotes Not established, NA Denotes Not Analysed

3.5.3 Leachate

Leachate samples were collected from trial pits T-3, T-4, T-5 and T-8 during the Tier 2 Site Investigations in 2009. The samples were sent for analysis to Alcontrol Laboratories in Dublin for analysis for the landfill parmeters outlined in the Landfill Manual. The full results are in the Tier 2 Report in Appendix 3 and the results are summarised below on Table 4.7. The results are indicative of an aged leachate.

Table 4.7 Landfill Leachate Samples 2009

Sample I.D. Sample Date	Units	Leachate 3	Leachate 4	Leachate 5	Leachate 8	EPA Landfill Design Manual Range
pH		6.89	6.78	6.88	6.86	NE
Conductivity	uS/cm	2400	2600	4000	2200	NE
Total Suspended Solids	mg/l	14,108	2,840	8,812	41,736	NE
Ammonia	mg/l	34.8	98.36	193.35	81.27	283 -- 2,040
Total Oxidised Nitrogen	mg/l	<0.001	<0.001	<0.001	<0.001	NE
Nitrate	mg/l	<0.001	<0.001	<0.001	<0.001	NE
Nitrite	mg/l	<0.00025	<0.00025	<0.00025	<0.00025	NE
BOD settled	mg/l	15	80	186	36	110 - 1,900
COD	mg/l	349	831	1333	659	622 - 8,000
Sulphate	mg/l	118	19.5	166	55.4	<5 - 322
Chloride	mg/l	75.3	72.4	213	43	570 - 4,710
Ortho-Phosphate	mg/l	<0.08	<0.08	<0.08	<0.08	NE
Fluoride	mg/l	0.03	0.027	0.5	0.025	NE
Total Alkalinity	mg/l	1210	2320	4300	1440	NE
Total Phospohorous	mg/l	1710	5720	11600	3640	NE
Calcium	mg/l	236	195	271	206	NE
Sodium	mg/l	60.8	76.9	133	37	NE
Potassium	mg/l	109	119	272	44	NE
Total Cyanide	µg/l	<0.05	<0.05	<0.05	<0.05	NE
Arsenic	µg/l	4.46	6.31	16.8	6.46	<1 - 6,700
Boron	µg/l	1090	939	776	618	NE
Cadmium	µg/l	<0.22	<0.22	<0.22	<0.22	<10 - 80
Copper	µg/l	2.27	<1.6	<1.6	<1.6	20 - 620
Mercury	µg/l	<0.01	<0.01	<0.01	<0.01	<0.1 - 0.8
Nickel	µg/l	<1	<1	<1	<1	<30 - 600
Lead	µg/l	2.35	2.1	1.64	1.88	<40 - 1,900
Zinc	µg/l	<0.01	<0.01	<0.01	<0.01	<30 - 6,700
Manganese	µg/l	1730	1380	2130	2230	40 - 3,590
Chromium	µg/l	8.9	22.3	38.5	11.1	NE
Selenium	µg/l	<1	<1	<1	<1	NE
Magnesium	mg/l	94.9	77.9	74.7	49.6	NE
Iron	mg/l	1.25	11.4	22.8	14.2	NE
Total Pesticide	mg/l	< 0.01	< 0.01	< 0.01	< 0.01	NE
SVOC's						
4-Methylphenol	µg/l	<1.00	46.5	159	2.62	NE
Bis (2-ethylhexyl) phthalate	µg/l	21.1	7.03	54.6	4.64	NE
Di-n-butyl phthalate	µg/l	<1.00	1.77	6.42	<1.00	NE
Fluorene	µg/l	1.11	<1	<1	<1	NE
Phenol	µg/l	<1.00	9.89	14.6	<1.00	NE
Naphthalene	µg/l	1.17	<1	1.12	<1.00	NE
Diethyl phthalate	µg/l	1.48	<1.00	<1.00	<1.00	NE
DI-n-Octyl phthalate	µg/l	<5	<5	<5	<5	NE
VOC's						
Benzene	µg/l	<1.30	<1.30	1.82	<1.30	NE
Chlorobenzene	µg/l	<3.50	<3.50	24.7	<3.50	NE
P/m-Xylene	µg/l	<2.50	4.76	19	24.5	NE
o-xylene	µg/l	<1.70	<1.70	2.99	<1.70	NE
1,3,5-Trimethyl-benzene	µg/l	<1.80	<1.80	4.78	<1.80	NE
1,2,4- Trimethyl-benzene	µg/l	<1.70	4.51	18.5	5.25	NE
4-Isopropyltoluene	µg/l	<2.60	<2.60	14.1	<2.60	NE

NE Denotes Not Established

3.5.4 Discussion

The surface water monitoring programme indicates that the landfill is having an impact on surface water quality downstream but that some attenuation is occurring further downstream. It also indicates that there are other activities in the catchment that are impacting on water quality locally. These activities include intensive dairy farming and piggery activities located to the east and southeast of the site.

3.6 Landfill Gas

As part of the Tier 1 assessment of the site landfill, gas monitoring was undertaking at location G-1 which was between trial pits TH-3 and TH-4. Attempts were made to use a gas probe in other locations but it was not possible to penetrate the surface. The monitoring included the measurement of methane, carbon dioxide, oxygen and atmospheric pressure and gas flow rate using a Gas Data LSMx gas analyser. The meter was calibrated before use. The detection limit is 0.1% for methane, carbon dioxide and oxygen. No methane was detected in any of the locations and carbon dioxide levels did not exceed 2.8%. It was noted however during the survey that the ground was very wet and further monitoring was not carried out because of potential damage to the gas meter by pulling water through the probe.

Table 4.6 Landfill Gas Monitoring Results – November 12th 2009

	Atmospheric Pressure	CH_4 (Peak)	CO_2	O_2
Location	Mb	%	%	%
G1	1000	12.2	4	0.0

NR denotes not recorded

Given the age and nature of the waste landfill gas generation is also likely to be substantially depleted in 2021.

4. TIER 3 RISK ASSESSMENT

4.1 Conceptual Site Model

The Tier 1 Risk scores are presented in Table 4.1, with the full Tier 1 Risk scores in Appendix 1. The assessments concluded initially that the site was a High Risk site due to the proximity of the site to the SAC to the west of the site and the risk of impact from leachate run-off. .

Table 4.1 Tier 1 Risk Assessment Scores

SPR Linkage	Linkage Score	Norm Score
SPR1	35.00	11.67
SPR2	105	35.00
SPR3	21.00	9.00
SPR4	63.00	26.00
SPR5	21.00	5.00
SPR6	0	0.0
SPR7	21.00	9.00
SPR8	14.00	23.00
SPR9	42.00	70.00
SPR10	3.50	2.00
SPR11	0	0

Risk Classification: A High

The Tier 1 Conceptual Site Model (CSM) is shown in Figure 4.1. It shows the waste mass on the underlying peat with waste filled close to the road to the west of the landfill with the Special Protection Area further west and the drain to the north of the landfill into which leachate is migrating.

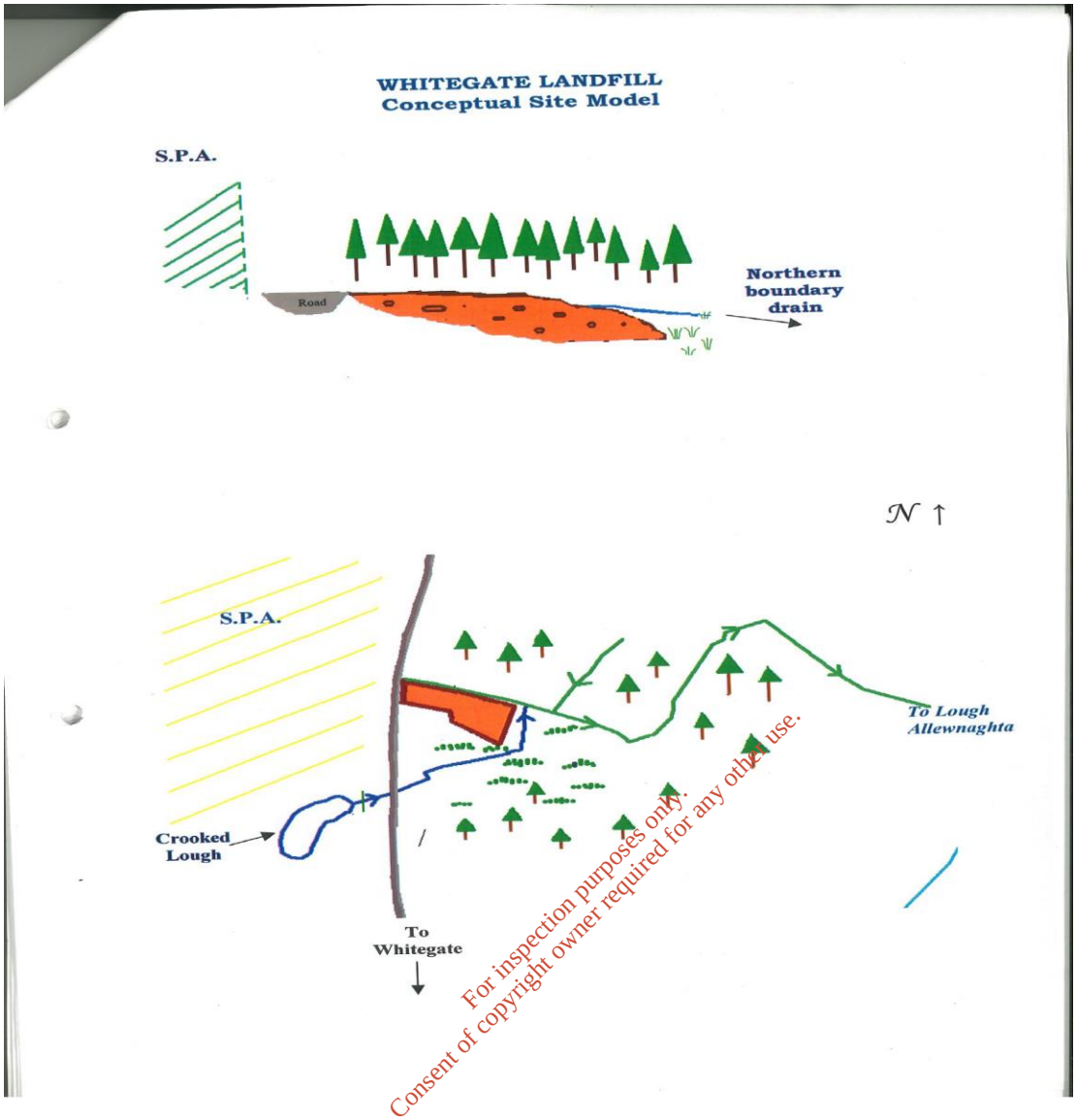

Figure 4.1 Tier 1 Conceptual Site Model

4.2 Revised CSM

The COP requires that the Conceptual Site Model (CSM) developed during Tier 1 be refined based on the findings of further site investigations. OCM refined the CSM based on the Tier 2 Investigations and the site inspection completed in May 2021. A schematic of the revised CSM is shown in Figure 4.2.

There is a thin layer of soils overlying the waste c200-700mm capping layer comprising top soil though it was not present continuously across the site. In some locations waste was visible at the surface. Waste is present across the entire 1.19Ha landfill area with a thickness of between 4-5m. It is was underlain by peat. It is likely that rainfall recharge infiltrates the waste to its base. Because of the compaction of the waste on the peat the underlying peat layer is essentially impervious resulting in preferential discharge of leachate to the surface water drains around the site. Leachate migrates laterally to the drain along the north side of the landfill. It is likely that in the winter months there is substantial dilution of the leachate in the surface water courses downstream but in the drier periods of the year impacts will be more noticeable.

Leachate migration to the underlying bedrock is considered to be insignificant because of the presence of compacted peat underlying the waste with preferential flow laterally to the surface water drainage system.

The SPA is upstream of the landfill and both hydrologically and ecologically has been established as not being at risk due to the presence of the landfill.

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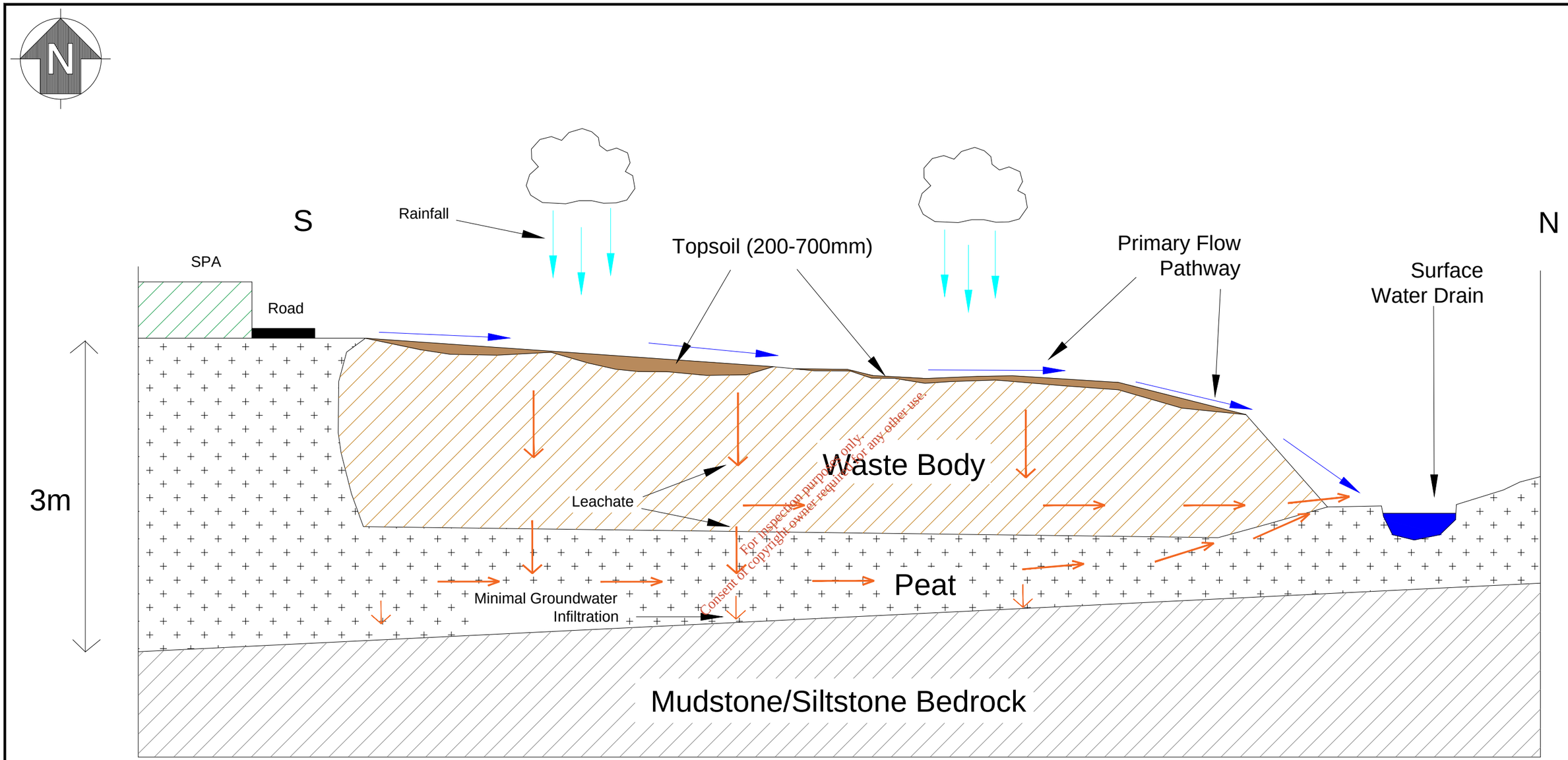

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FIGURE No.

4.2

TITLE

Conceptual Site Model

SCALE

SCALE

REV.

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4.3 Sources

The source is the municipal solid waste which is estimated to be in the region of c59,500m^3 (29,750 tonnes) which extend across c1ha of the site footprint.

Leachate

The results of the analysis of the leachate sample collected from the trial pits T-3, T-4, T-5 and T-8 in 2009 indicate the presence of a weak and aged leachate that is present in isolated pockets in the waste mass. It is likely that the leachate gradually discharges to the surface water drain to the north of the site particularly in the winter months when rainfall amounts result in the generation of more but leachate. Because the leachate is weak and rainfall amounts are high in the winter the impacts downstream are relatively low.

Landfill Gas

Low levels of Landfill gas is being generated in the waste body which is freely venting to atmosphere because of the lack of consistent landfill cover.

4.4 Pathways

4.4.1 Leachate Migration Pathways

Leachate migrates away from the landfill in the landfill drain to the north of the site and discharges with rainfall runoff to the downstream first order streams which eventually discharge to Lough Allewnaghta c1km downstream.

4.4.2 Landfill Gas Migration Pathways

Landfill gas is migrating through the waste at the surface and possibly toward the surface water drains surrounding the landfill. It is likely that the landfill gas is venting to atmosphere around the margins of the landfill.

4.5 Receptors

4.5.1 Leachate Migration Receptors

The first order streams downstream of the landfill and Lough Allewnaghta are the primary receptors. Given the presence of peat beneath the waste and the nature of the underlying bedrock the aquifer beneath the site or groundwater wells down hydraulic gradient of the site are not considered to be receptors.

Landfill Gas

Landfill gas migrates freely to atmosphere where the cover is thin and where there is cover it can migrate laterally to the surface water drain to the north of the site and to lower ground to the south and east of the site.

4.6 Revised Risk Scores

The revised Tier 3 risk scores are summarised on Table 5.2 and are included in full in Appendix 5. The overall risk for the site is High remains moderate due to leachate migration to the surface receptor.

Table 5.2 Tier 3 Risk Scores

Groundwater & Surface Water	Groundwater only	Surface water only	Lateral & Vertical	
Calculator	**SPR Values**	**Maximum Score**	**Linkages**	**Normalised Score**
SPR 1 =	105	300	**Leachate => surface water**	**35%**
SPR 2 =	35	300	**Leachate => SWDTE**	**12%**
SPR 3 =	21	240	**Leachate => human presence**	**9%**
SPR 4 =	21	240	**Leachate => GWDTE**	**9%**
SPR 5 =	21	400	**Leachate => Aquifer**	**5%**
SPR 6 =	0	560	**Leachate => Surface Water**	**0%**
SPR 7 =	63	240	**Leachate => SWDTE**	**26%**
SPR 8 =	42	60	**Leachate => Surface Water**	**70%**
SPR 9 =	14	60	**Leachate => SWDTE**	**23%**
SPR 10 =	3.5	150	**Landfill Gas => Human Presence**	**2%**
SPR 11 =	0	250	**Landfill Gas => Human Presence**	**0%**
Risk Classification		**Range of Risk Scores**		
Highest Risk (Class A)		**Greater than or equal to 70% for any individual SPR lingage**		
Moderate Risk (Class B)		**Between 40-70% for any individual SPR linkage**		
Lowest Risk (Class C)		**Less than or equal to 40% for any individual SPR linkage**		
TIER 3 RATING		**High Risk**		

The Tier 3 Risk remains high due to the pathway for leachate migration to downstream surface water courses.

5. REMEDIAL ACTION PLAN

The Risk Ranking for the site is High and is associated with leachate migration along the surface water pathway to a surface water receptor. The landfill gas risk is considered to be Low. In preparing this Remedial Action Plan (RAP) OCM has considered the proposed future end use for the site, which will be as retained closed landfill.

Given the age of the site i.e. closed for 23 years, the aged nature of the leachate and lack of landfill gas the landfill impacts are limited to weak leachate discharges to off site water courses.

To minimise the generation of leachate a landfill cap is required with surface water drainage along the boundaries to divert rainfall away from the waste mass. To prevent leachate break out along the sides the sides of the landfill will also have to be sealed with clay barrier.

The EPA Landfill Restoration and Aftercare Manual recommends that for Non-Inert Landfill a 1m clay cap but given the nature of the waste and low amenity use a lesser thickness of landfill capping may be sufficient.

Surface water drainage layer

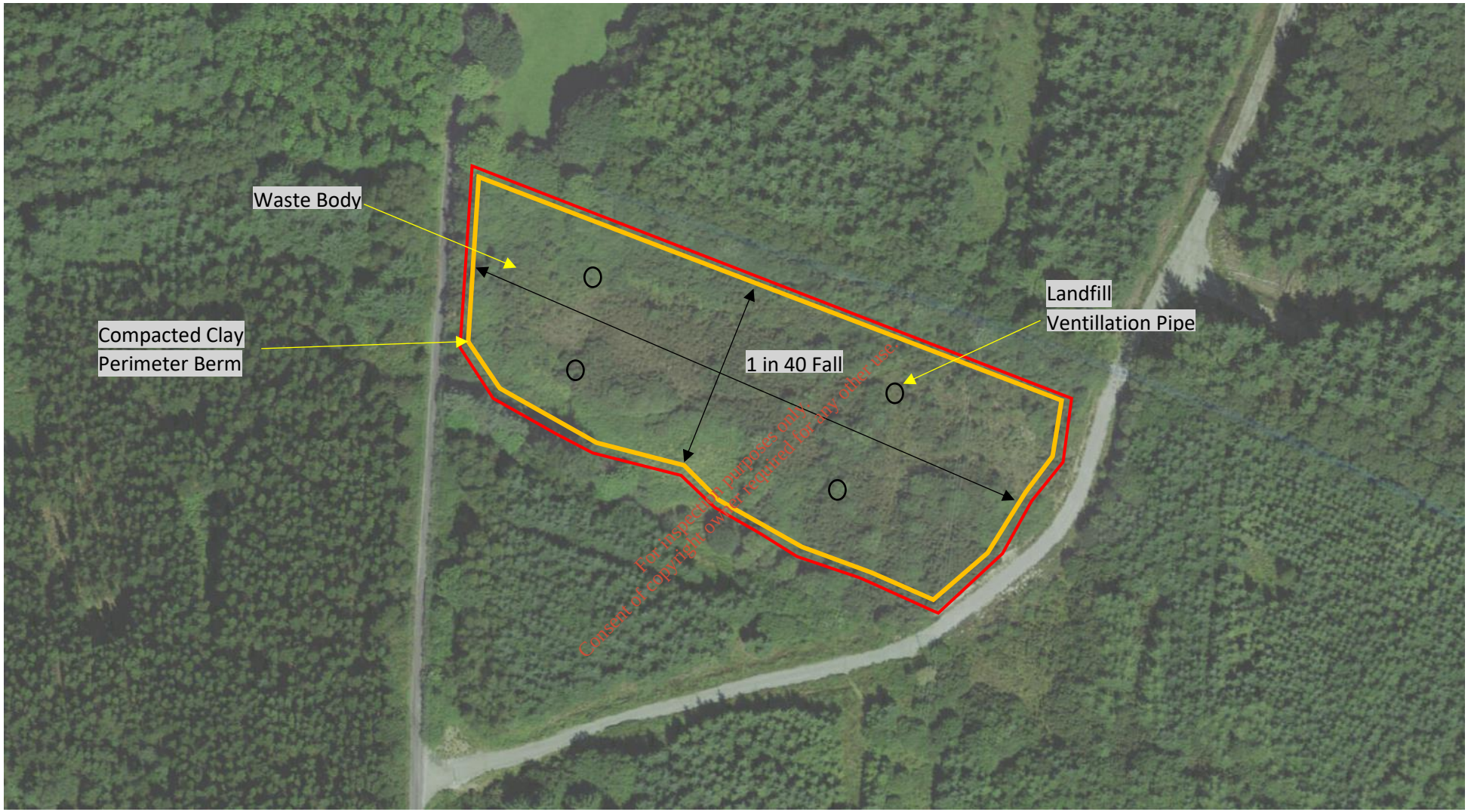
Figure 5.1 – 5.4 show an outline remedial design for the site to mitigate the environmental risk posed by the site, and to accommodate the proposed end use and EPA Landfill Restoration Manual requirements.

The waste around the sides of the landfill needs to be pulled back from the surface water drains. A low permeability clay retaining berm should be constructed in these areas between the edge of the waste and the drains.

There is currently a thin capping layer in some areas on the site but it is absent in some areas. Clean soil should be imported to site to build up the capping layer to 500mm thickness.

The capping layer should be integrated into the perimeter retaining berm and graded to achieve a fall from a central ridge running north to south to the sides of the capped site with a fall of 1:40. The finished cap should be grass seeded.

Four gas ventilation wells should be installed, one in each quadrant of the site to prevent landfill gas migration laterally once the cap has been placed. The well pipes should be 100mm slotted uPVC and should extend 150mm above the top soil layer. These wells should be fitted with cowls to prevent damage.



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Email: info@ocallaghanmoran.com

Title:

Figure 5.1 Remediation Measures

Legend

-Landfill Layout

Client:

Clare County Council

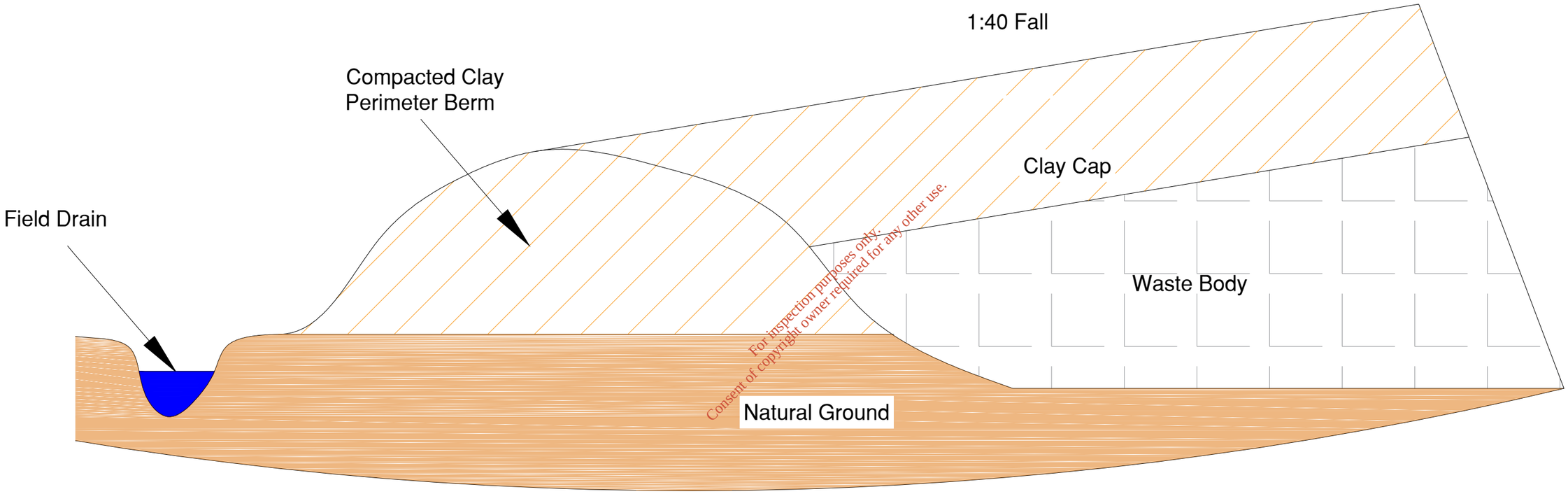

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FIGURE No.
5.2

TITLE

Clay Berm Detail

SCALE
NTS

REV.
A

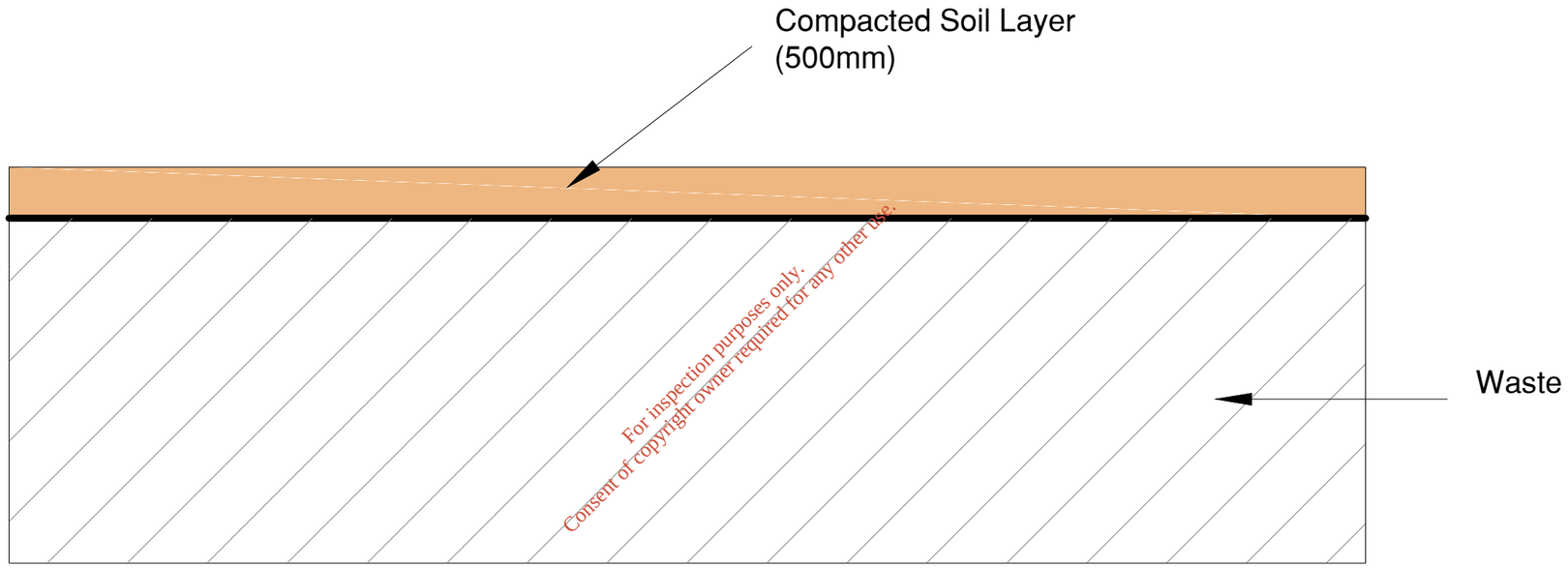

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FIGURE No.

5.3

TITLE

Landfill Capping Detail

SCALE

NTS

REV.

A

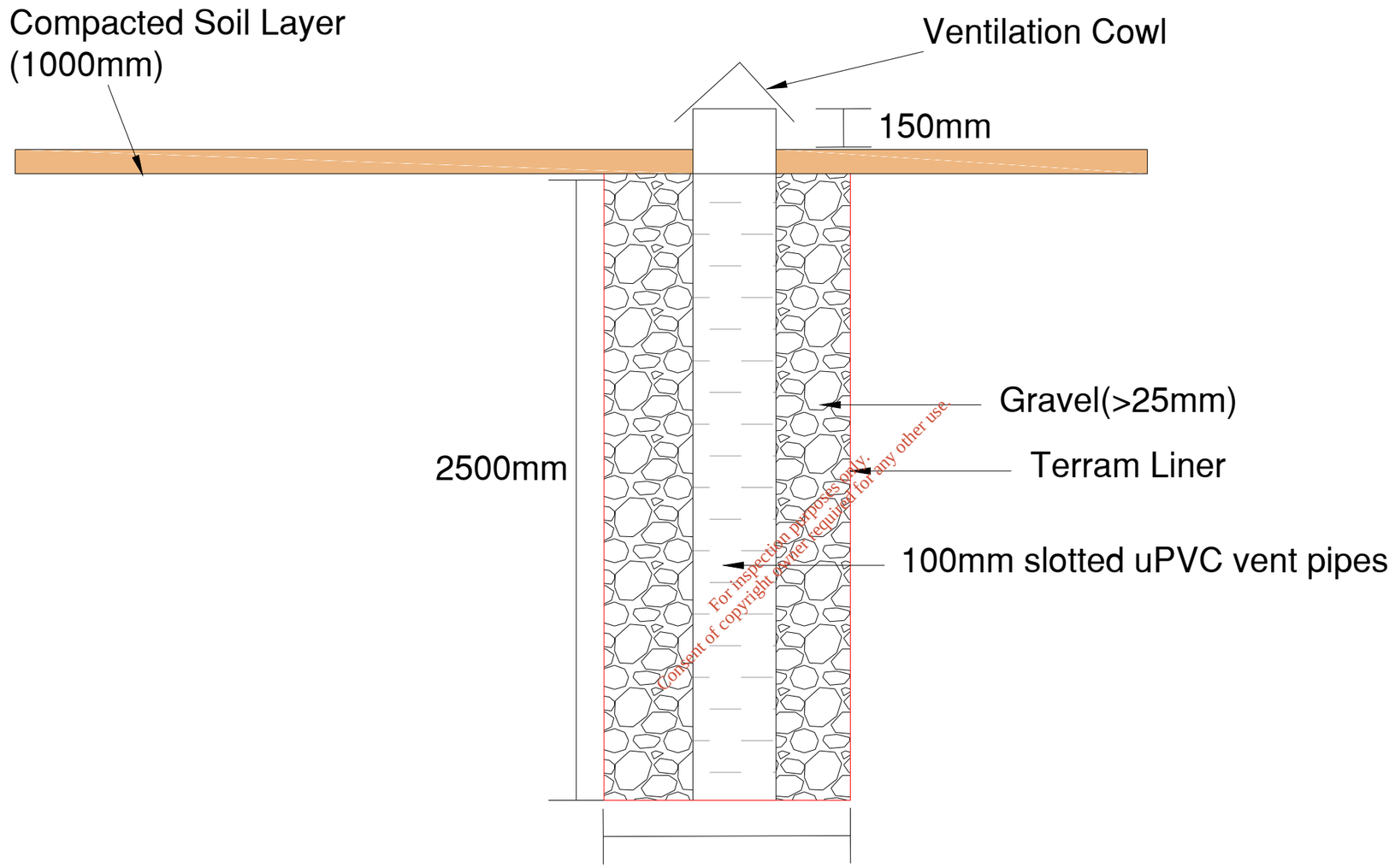

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FIGURE No.
5.4

TITLE

Landfill Gas Ventilation Pipe

SCALE
NTS

REV.
A

6. APPROPRIATE ASSESSMENT RISK SCREENING

6.1 AA Risk Screening Process

The Habitats Directive, which is implemented under the European Communities Birds and Natural Habitats) Regulations 2011 (S.I. No 477 of 2011) requires an "appropriate assessment" of the potential impacts any works may have on the conservation objectives of any Natura 2000 site.

Article 6(3) of the Directive stipulates that *any plan or project not directly connected with or necessary to the management of a Natura 2000 site, but likely to have a significant effect thereon…shall be subject to appropriate assessment of its implications for the site in view of the site's conservation objectives.*

Natura 2000 sites are those identified as sites of European Community importance and designated as such under the EU Habitats Directive (92/43/EC) (Special Area of Conservation) or the Birds Directive (Special Protection Areas).

Guidance documents issued by Department of Environment, Heritage and Local Government and the National Parks and Wildlife Services recommend that the assessment be completed in a series of Stages, which comprise:

Stage 1: Screening

The purpose of this Stage is to determine, on the basis of a preliminary assessment and objective criteria, whether a plan or project, alone and in combination with other plans or projects, could have significant effects on a Natura 2000 site in view of the site's conservation objectives.

Stage 2: Appropriate Assessment

This Stage is required if the Stage 1 Screening exercise identifies that the project is likely to have a significant impacts on a Natura 2000 site.

Stage 3: Assessment of Alternative Solutions.

If Stage 2 determines that the project will have an adverse impact upon the integrity of a Natura 2000 site, despite the implementation of mitigation measures, it must be objectively concluded that no alternative solutions exist before the plan can proceed.

Stage 4: Compensatory Measures:

Where no alternative solutions are feasible and where adverse impacts remain but imperative reasons of overriding public interest require the implementation of a project an assessment of compensatory measures that will effectively offset the damage to the Natura site 2000 is required.

The AA screening is required as it is proposed to undertake remedial measures incorporating the construction of retaining berms along the perimeter, the regarding and capping of the landfill.

6.2 Stage 1 Screening Methodology

The Stage 1 Screening was conducted in accordance with the guidance presented in the "Assessment of Plans and Projects significantly affecting Natura 2000 sites, Methodological Guidance on the provisions of Articles 6(3) and 6(4) of the Habitats Directive 92/43/EEC" (2001); The Department of Environment, Heritage and Local Government (2009, revised February 2010) Appropriate Assessment of Plans and Projects in Ireland and the National Parks and Wildlife Services (2010) Circular NPW 1/10 & PSSP 2/10 Appropriate Assessment under Article 6 of the Habitats Directive: Guidance for Planning Authorities.

Special Areas of Conservation (SAC) are selected for the conservation and protection of habitats listed on Annex I and species (other than birds) listed on Annex II of the Habitats Directive, and their habitats. The habitats on Annex I require special conservation measures. Special Protection Areas (SPA) are selected for the conservation and protection of bird species listed on Annex I of the Birds Directive and regularly occurring migratory species, and their habitats, particularly wetlands.

The closest designated sites are the Slieve Aughty Mountains SPA immediately to the west and the Lough Derg (Shannon) Special Area of Conservation (SAC) which is located c1km to the east of the site (Figure 2.11?).

The limited remedial works have the potential to general dust emissions, and potentially surface water emissions in the immediate vicinity of the site when the remedial works are being undertaken.

While the Slieve Aughty SPA is not likely to be at risk during the remedial works programme there is potential for impacts on the Lough Derg SAC because of the direct surface water connection between the landfill and the SAC.

6.3 Stage 1 Conclusion

As the remedial measures could potentially impact on the SAC a Stage 2 Appropriate Assessment will be required.

7. CONCLUSIONS AND RECOMMENDATIONS

7.1 Conclusions

Risk Category

The results of the Tier 3 assessment and the refined SPR conceptual model confirm that the site remains a Class A – High Risk due to the risk posed by leachate migration to surface water. Leachate migration risk to groundwater is considered to be insignificant. The landfill gas migration risk to offsite receptors is Low.

Surface Water

The 2009 and 2021 surface water monitoring indicates that the landfill is impacting on surface water quality downstream of the landfill however some attenuation is occurring downstream. There are also other potential sources of surface water impacts in the catchment associated with intensive agricultural practices.

Groundwater

The groundwater quality at the closest wells to the site (900m 1.5km to the northeast) indicates that the site is not impacting on groundwater quality but that other activities closer to these wells may be impacting on water quality. The presence of a compacted peat layer beneath the waste means that any leachate generated in the waste will discharge laterally preferentially along the surface water pathway rather than vertically to the groundwater

There are no public supply wells within 3km of the site.

Landfill Gas

The landfill gas risk is low and the remedial measures proposed will mitigate the residual risk

Ecological Sensitive Sites

The desk study assessment by CSEE concluded that based on a detailed consideration of the feeding habits of Merlins and Hen Harriers the proportion of the diet of these birds derived from aquatic/riparian food chains is insignificant, thereby ruling out any significant likelihood of a food chain impact on these species (or indeed any other element of the Slieve Aughty Mountains SPA biota) from the landfill.

A risk screening for the proposed remedial measures indicates that a Stage 2 Appropriate Assessment would be required to assess the risk posed to the Lough Derg (Shannon) SAC.

7.2 Recommendations

The remedial measures described in Section 5 of the report should be implemented to mitigate the environmental risk posed by the landfill.

Following the implementation of the remedial measures surface water monitoring should be undertaken at SW-10 upstream and SW-4, SW-2 and SW-11 downstream annually to establish their effectiveness. Monitoring should be undertaken for ammonia, sodium, chloride, potassium, manganese, electrical conductivity and heavy metal suite (cadmium, chromium copper, lead, mercury nickel zinc).

APPENDICES

APPENDIX 1

Tier 1 Report

See Separate Volume

APPENDIX 2

Ecology Report

See Separate Volume

APPENDIX 3

Tier 2 Report

See Separate Volume

APPENDIX 4

Surface Water Laboratory Results

See Separate Volume

APPENDIX 5

Tier 3 Risk Scores

See Separate Volume