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UPDATED TIER 2 AND TIER 3

ENVIRONMENTAL RISK ASSESSMENT

OF A

FORMER MUNICIPAL LANDFILL

CASTLEREA,

COUNTY ROSCOMMON

Prepared For: -

Roscommon County Council,
Roscommon,
Co. Roscommon

Prepared By: -

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September 2019

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1. INTRODUCTION

Roscommon County Council (the Council) completed a Tier 1 Assessment of the closed Castlerea landfill in 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 a Class A – High Risk Site due to the risk of leachate migration to surface water (SPR-8). Moderate Risks were linked to leachate migration to groundwater (SPR-5) and to Surface Water Dependant Ecosystems (SPR-7).

The Tier 1 assessment was informed by an environmental assessment of the site completed by Entec Consultants in 1998.

In 2017 the Council commissioned O'Callaghan Moran & Associates (OCM) to complete a Tier 2 Site Investigation and Tier 3 Environmental Risk Assessment in accordance with the CoP.

The assessment included a review of the Tier 1 Report compiled by the Council and the site investigation information in the Entec Report to guide the design of the further investigation programme.

The site investigation works included:-

- Trial pit survey to assess the thickness and nature of the capping material,
- Collection and analyses of samples of capping material for permeability testing,
- Installation of groundwater and leachate monitoring wells,
- Collection and analyses of groundwater, surface water and leachate samples,
- Ground gas monitoring
- Monitoring well level survey

The Council requested that the 2017 assessment be updated following the completion of a further round of surface water, groundwater and landfill gas monitoring. The current report includes the 2019 monitoring results and the updated landfill risk assessment.

1.1 Methodology

The 2017 site investigations were undertaken in accordance with BS 10175:2001and 2011 Investigation of Potentially Contaminated Sites-Code of Practice. The Risk Assessment was completed in accordance with the Code of Practice: Environmental Risk Assessment for Unregulated Waste Disposal Sites (EPA, 2007). The landfill gas risk assessment was completed in accordance with CIRIA 663.

The trial pitting and the installation of leachate and groundwater monitoring wells were undertaken by Ground Investigations Ireland Ltd. (GII) under the supervision of OCM. The collection of the leachate, groundwater and surface water samples, the ground gas monitoring and the borehole level survey was carried out by an OCM Environmental Scientist.

National Materials Testing Laboratory Ltd carried out the permeability testing on the capping material samples.

The leachate, groundwater and surface water samples were analysed by Exova Jones Environmental Forensics analytical laboratory in the UK. Microbiological parameters were analysed by CLS Laboratory in Galway.

Mr Sean Moran MSc, P.Geol, was the OCM Project Manager with responsibility for the delivery of the project. Mr. Moran a hydrogeologist with more than 28 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).

2. ENVIRONMENTAL SETTING

2.1 Site Location

The site is located 1.5 km to the south of Castlerea c250 m to the west of the N60 Castlerea to Ballymoe Road (Figure 2.1).

2.2 Site Layout

The landfill occupies 4.05 hectares (ha) and is covered in grass and scrub. It was developed in two phases (Figure 2.2). Phase A1 (1.35 ha) was the original waste disposal area and operated between 1960 and 1988. Phase A2 comprises 2.7 ha of which only 1.8 ha was used for landfilling between 1988 until 1999 when the site closed.

There are surface water drains running along the western boundary of Phase 2 and the eastern boundary of Phase 1, both of which discharge to a tributary stream of the River Suck (Harristown Stream) located c40 m north of the site.

2.3 Surrounding Land Use

The site is located in a rural area and the surrounding land use is shown on Figure 2.3. The landfill is in an area dominated by extensively cut over peat, most of which is now used for agriculture and forestry. The lands to the north, east and south east are in pasture, while the lands to the west and south west are forested. The closest dwelling is approximately 280 m to the north.

2.4 Site History

Landfilling was undertaken in the eastern area (A1) between 1960 and 1988 and in the western area (A2) between 1988 and 1999. The landfill closed in 1999 after the deposition area was capped.

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CLIENT
Roscommon County Council

TITLE
Site Location

Details:
Site Location

Figure 2.1

168000

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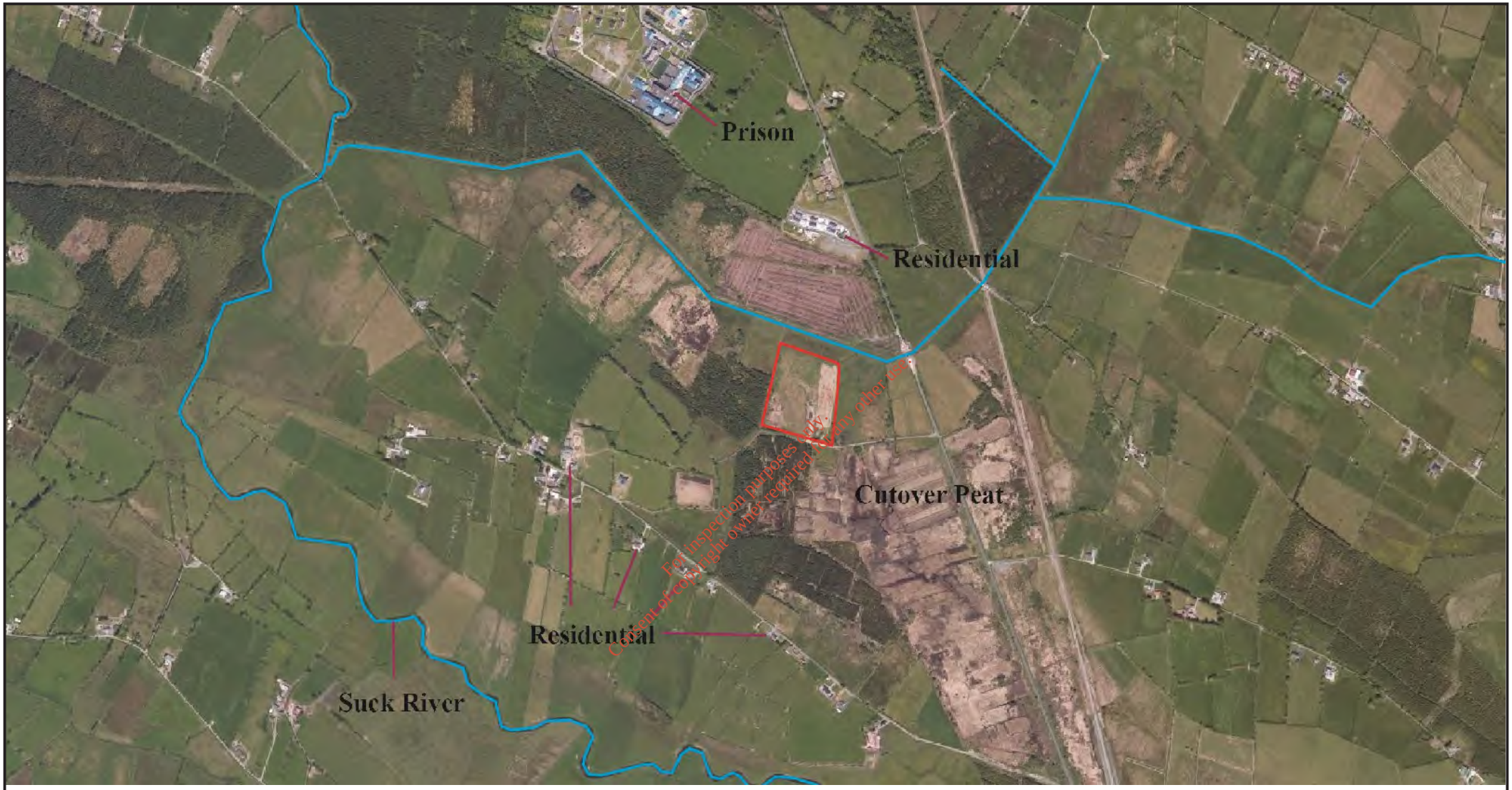
TITLE
Site Layout

Details:
- Site Boundary
- Extent of Infilled Area
- Streams/drains
- Overgrown drain

Figure 2.2



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Title: Surrounding Land Use

Legend

Site Boundary

Client: Roscommon County Council

Figure 2.3

2.5 Hydrology

The closest surface water course is the Harristown Stream, approximately 40 m north of the site. This stream flows in a westerly direction and meets the River Suck approximately 1.25 km northwest of the site (Figure 2.4).

The landfill is in the catchment of the Suck Water Management Unit (WMU) as designated in the Shannon River Basin District Management Plan prepared under the EU Water Framework Directive (WFD). The WMU comprises a number of different Water Bodies and the site is in the Castlerea Trib of Suck Water Body (IE_SH_26_2900).

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 WFD requires measures to ensure waters achieve at least 'Good Status' by 2015, and that their current 'Status' does not deteriorate. Where necessary, for example in heavily impacted or modified watercourses, extended deadlines (2021 and 2027) can be set.

The Castlerea Trib of Suck Water Body is ranked as being of Good Status based on the overall ecological status. A copy of the Surface Water Body Report is in Appendix 2.

The local drainage pattern consists of perimeter drainage ditches on the western, northern and eastern sides of the landfill (Figure 2.5).

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 2017 Tier 2 site investigation established there was a layer of variable capping material comprising brown sandy gravelly clay, peaty clay or clayey peat over the entire site. This ranges in thickness from 0.1 m in the north of Area A1, to 2.6 m in the centre-east of area A2.

Figure 2.6, which is derived from the Teagasc Maps, shows the subsoils across the site which comprise cut over peat. The map indicates that there is an area of hummocky sand and gravel glacial deposits on the site surrounded by cutover raised peat. However, this map was derived using topographical and aerial photography and it is highly likely that the raised area of the landfill has been misinterpreted as hummocky sand and gravel. This was confirmed through correspondence with staff at the GSI Land Mapping Unit. No sand and gravel deposits were encountered during well installation at the site.

The 1999 and 2016 investigations confirmed the presence of peat underlying the waste across the majority of the site. Peat was encountered in every borehole except one (CBH4 at the northern end of Area A1), where peat may have been removed to allow more space for filling and waste directly overlies boulder clay. Peat thicknesses encountered in the other boreholes ranged from ranged from 2.3 m to 5.3 m.

A layer of brown gravelly sandy clay with boulders (boulder clay) ranging from 2.2 to 3.7 m thick underlies the peat. This is underlain by a water-bearing, clayey sand and gravel layer to approximately 12 m.

2.6.2 Bedrock

The site is underlain entirely by the Visean Limestone Formation, which comprises undifferentiated Carboniferous limestone (Figure 2.7). The 2017 investigation confirmed the presence of competent limestone bedrock at 11.5.0m below ground level (MW1).

2.6.3 Hydrogeology

Shallow groundwater was encountered in the peat and underlying till in CBH3 and CBH6 at 0.9m below ground level and 2.2m below ground level respectively. A water-bearing, sand and gravel layer up to 4 m thick was encountered at 7.0 to 8.5 m below ground level. This water bearing formation is confined by the overlying peat and glacial till and an upward hydraulic gradient is present based on the water levels recorded in two monitoring wells installed in this formation.

Figure 2.8, which is derived from the GSI Aquifer Map, shows the aquifer characteristics. The limestone bedrock is classified as a Regionally Important Aquifer - Karstic (conduit) (Rkc). Groundwater flow in this type of aquifer is primarily through solution enhanced conduits. Groundwater flow paths can range from 100s of metres to kilometres, however groundwater yields are variable and dependant on the presence of karstified flow channels to provide storage and transmissivity of the groundwater.

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.

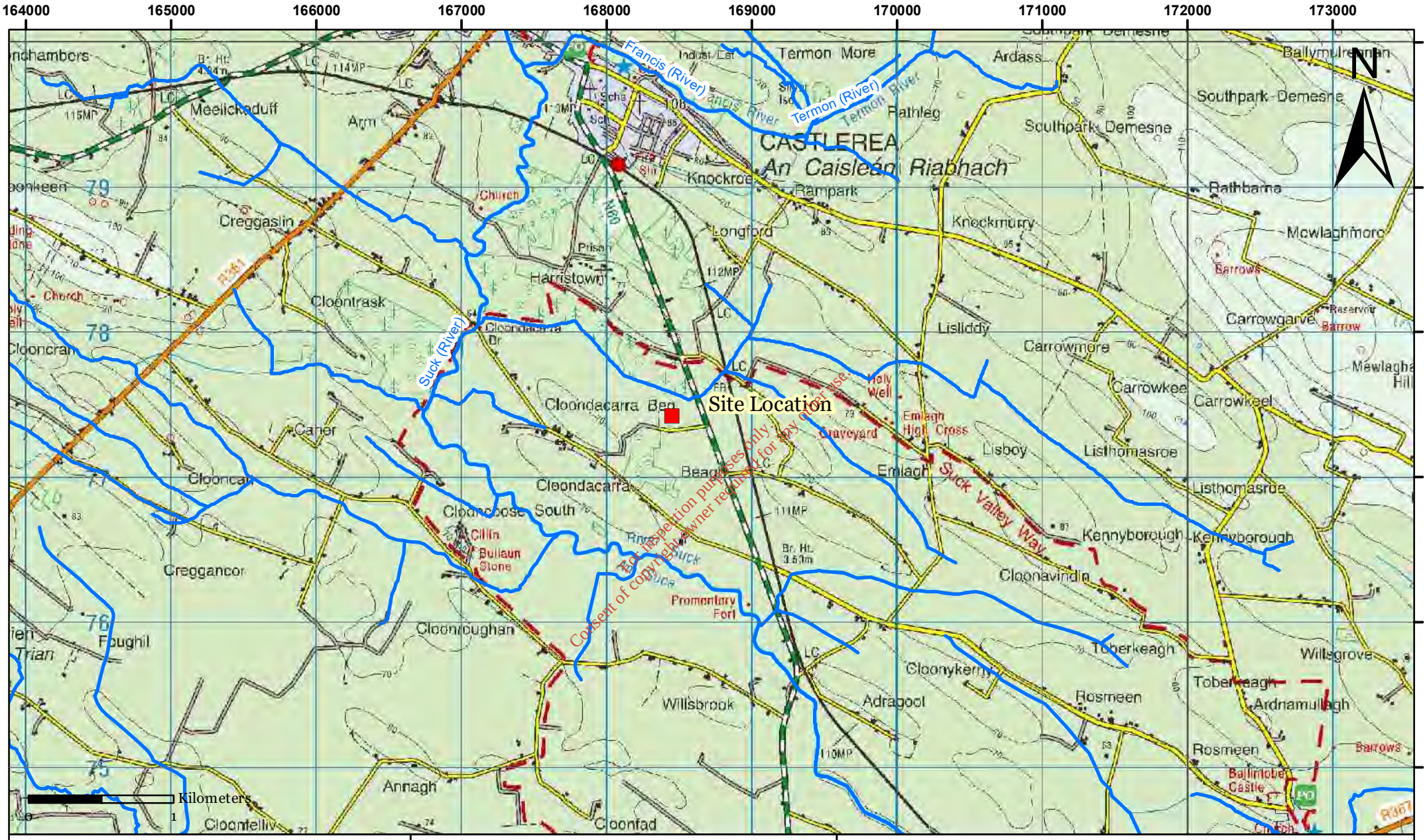
The vulnerability rating for the bedrock aquifer underlying the peat in the area is classified as Low – indicating the presence of over 10 m of low permeability subsoils. However, the presence of the sand and gravel layer at 7m below ground level indicates that the vulnerability in the vicinity of the site is likely to be Moderate. The GSI has classified the vulnerability in the vicinity of the hummocky sand and gravel deposits as High (Figure 2.9). However, it has been demonstrated that these deposits are not present on the site and this vulnerability rating may be ignored.

OCM conducted a review of the GSI database to identify the location of any nearby wells or springs. The Castlerea Water Supply is derived from the Sliver/Longford Spring which is located c2km northeast of the site. The GSI has delineated a Source Protection Area (SPA) for the spring and the landfill is not located within the area.

There are no wells or springs within a 1 km radius of the site (Figure 2.10). The nearest private well is located approximately 1.6 km west of the site. According to the GSI database this is a dug well 4.3 m deep, with a poor yield class, and is used for agricultural and domestic purposes.

The site lies within the Suck South Groundwater Body (GWB) (IE_SH_G_225). The GWB status is rated as 'Poor'. The GWB Report is in Appendix 3.

It is likely that shallow groundwater beneath the site discharges to the Harristown Stream. The deeper groundwater flow in the bedrock is also to the north-north west with discharge to the larger River Suck likely c1.5km to the northwest of the site.



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TITLE
Hydrology

Details:
- Site Location
- Rivers

Figure 2.4

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CLIENT
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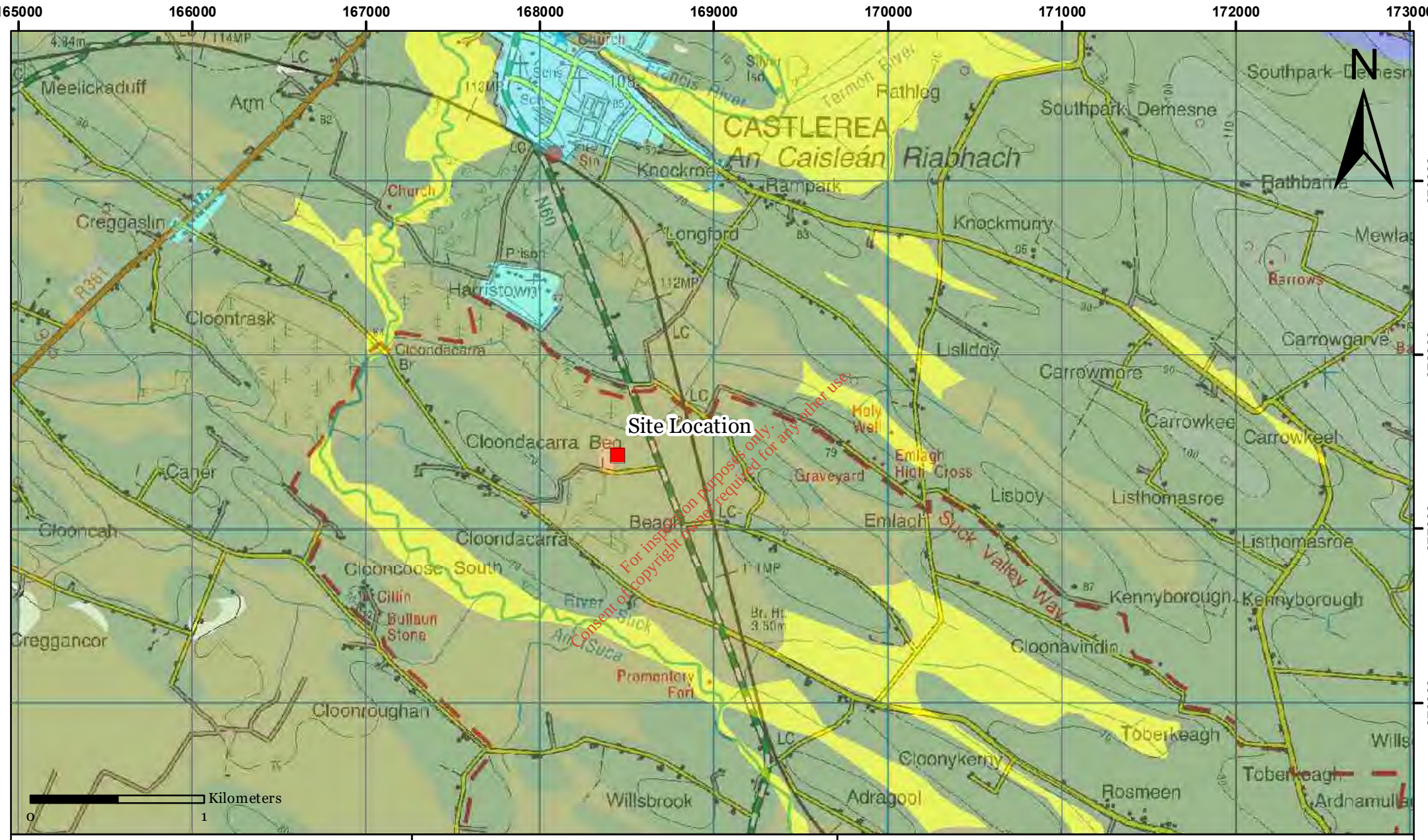
TITLE
Local Hydrology

Details:
- Site Boundary
- Streams/drains
- Overgrown drain

Figure 2.5



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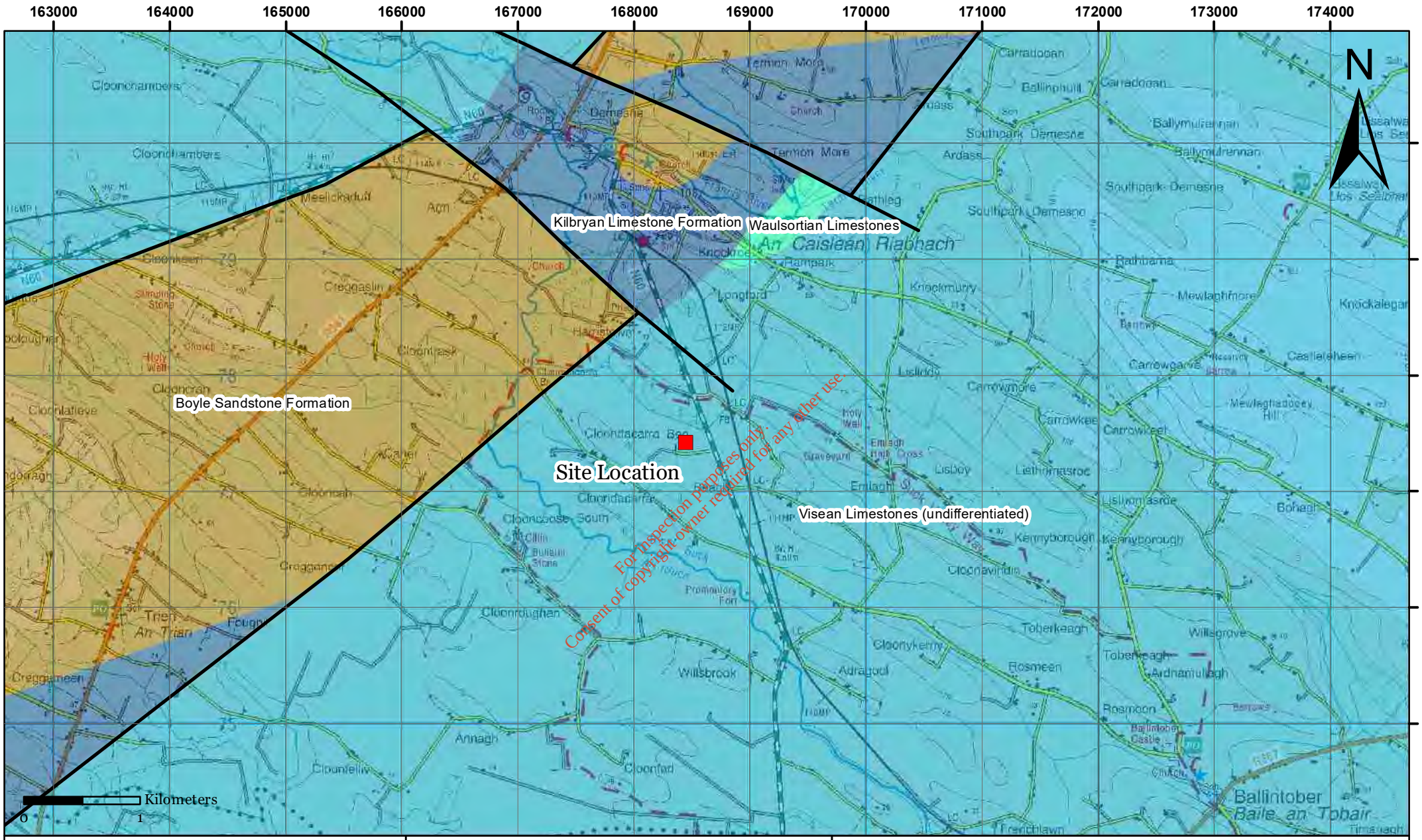
TITLE
Subsoils

Details:

- Site Location
- A - Alluvium undifferentiated
- BktPt - Blanket peat
- Cut-Cut Peat
- FenPt-Fen Peat
- GLs - Limestone sands and gravels (Carboniferous)
- KaRck-Karstified Rock
- Made - Made Ground
- TDCSs-Sandstone till (Devonian/Carboniferous)
- TDCSsS-Sandstone and shales till (Devonian/Carboniferous)
- TDSs - Sandstone till (Devonian)
- TLPSs - Sandstone till (Lower Palaeozoic)

Figure 2.6



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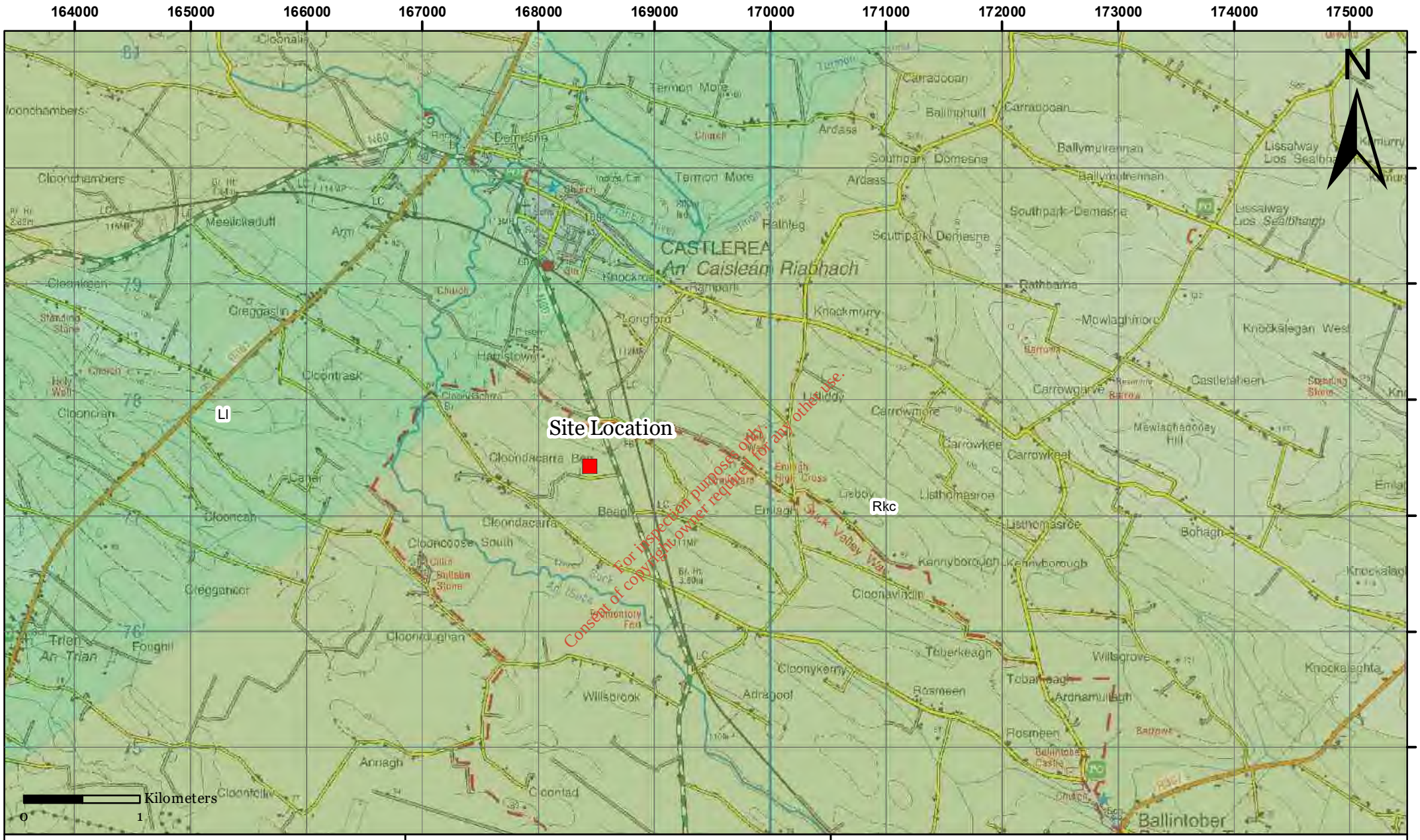
TITLE
Bedrock Geology

Details:
- Site Location
- Faults
- Boyle Sandstone Formation-Sandstone,siltstone,black mudstone
- Kilbryan Limestone Formation-Dark nodular calcarenite & shale
- Visean Limestones (undifferentiated)-Undifferentiated limestone
- Waulsortian Limestones-Massive unbedded lime-mudstone

Figure 2.7



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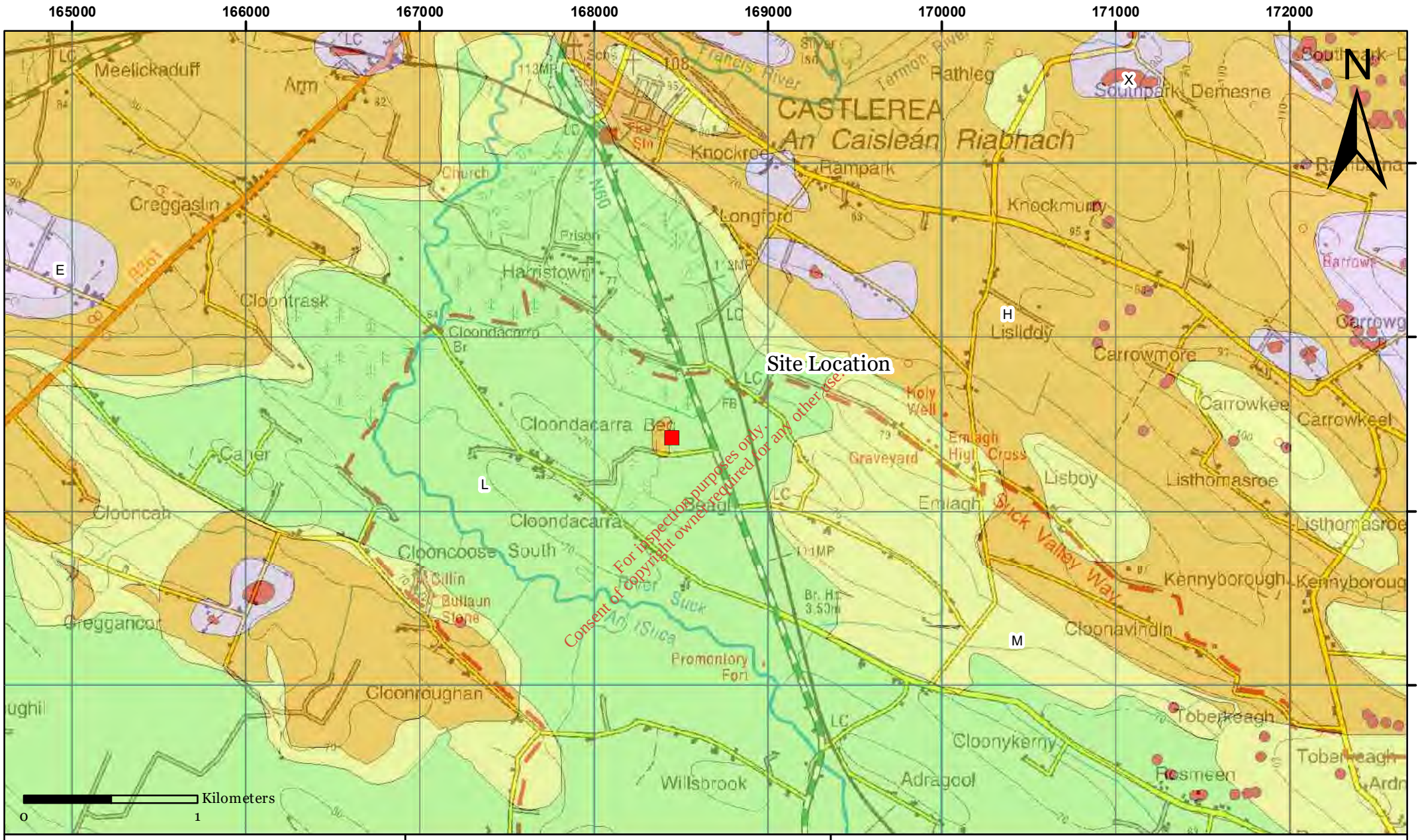
TITLE
Aquifer Classification

Details:

- Site Location
- Ll - Locally Important Aquifer. Mod. Productive only in Local Zones
- Rkc - Regionally Important Aquifer. Karstified Bedrock dominated by conduit flow

Figure 2.8



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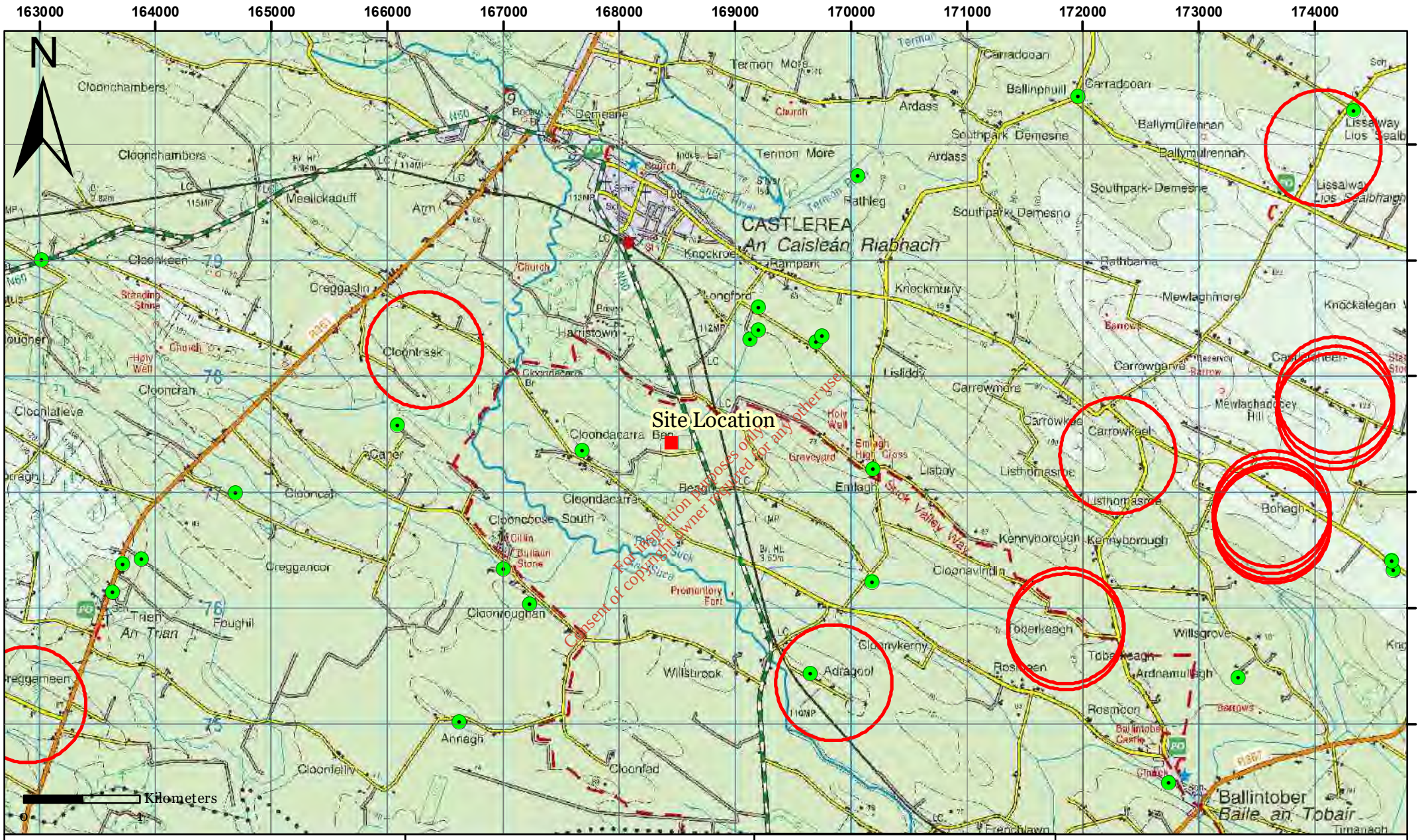
TITLE
Groundwater Vulnerability

Details:

Site Location	High
Bedrock near Surface	Moderate
Extreme	Low

Figure 2.9



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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: 500m to 1km

Figure 2.10

3. TIER 2 SITE INVESTIGATIONS

3.1 Objectives

Two phases of site investigation have been carried out at the site with the objective of collecting sufficient information to allow an assessment of the environmental risk posed by the landfill.

The first phase was carried out in 1998 by Entec prior to the closure and capping of the landfill in 1999. The findings of this investigation were used by the Council to compile the Tier 1 Risk assessment which was completed in 2009.

The second phase of investigation was undertaken in November/December 2017 by OCM, with the aim of updating and rrefining the Tier 1 Conceptual Site Model (CSM) and to collect sufficient additional information to complete the Tier 3 assessment of the environmental risk posed by the landfill.

3.2 Site Investigation Scope

The Entec site investigation comprised:

- Installation of three groundwater monitoring boreholes:
  - CBH3 – NW corner of the site to the north of the then current tipping point
  - CBH4 – NE corner of the site between the northern limit of Area A1 and the perimeter drainage ditch
  - CBH6 – southern site boundary
- Installation of three leachate/gas monitoring boreholes (CBH1, CBH2 and CBH5)
- Characterisation of waste during drilling
- Collection of groundwater surface water and leachate samples
- Ground gas monitoring

The locations of the Entec monitoring wells and surface water sampling points are shown on Figure 3.1.

The OCM investigation undertaken in 2017 comprised:

- Excavation of a series of trial pits to characterise the capping material used and to delineate the final post-closure lateral extent of the waste
- Installation of two groundwater monitoring wells
- Installation of one leachate/gas monitoring well
- Collection of leachate, groundwater and surface water samples
- Ground gas monitoring

The locations of the OCM site investigation trial pits, monitoring wells and surface water sampling points are also shown on Figure 3.1.

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Roscommon County Council

TITLE

Site Layout

Details:

- SW Sampling Locations
- 2017 Borehole Locations
- Trial Pits
- Site Boundary
- Waste Extent
- Entec Borehole Locations

Figure 3.1

3.3 Ground Conditions

The OCM trial pit investigation confirmed the presence of a capping layer comprising peat, clayey peat or peaty clay overlying the waste across in Area A1. The layer ranged from 10 to 40 cm thick, layer thinning northward.

The thickness and nature of the capping layer in Area A2 is variable. The entire waste body appears to have been covered with a clay layer comprising light brown to dark brown gravelly sandy clay with cobbles covered by a dark brown to black peat or clayey peat layer ranging from 0.68 to 3.1 m thick over much of the area.

Based on the borehole logs for MW-1 and MW-2 the waste is underlain by c3-4m of peat and glacial till in the south of the site which grades into alluvium/silt in the north of the site closer to the stream. The silt layer in the north of the site is at least 3m thick beneath the waste and is underlain by gravels.

Approximately 0.3 ha in the south-west of Area A2 has not been infilled and the natural ground here comprises c3m of peat overlying glacial tills.

3.3.1 Waste Characterisation

Details of the waste deposited in the landfill are included in the Entec report. Based on the waste accepted at the landfill in 1994 the waste in the landfill typically comprises 80% comprised domestic waste, 19% commercial waste and 1% road sweeping. Typical contents of the domestic waste comprised organic material (46%), paper (21%), plastics (9%), cinders (9%), and minor components including glass, metal, nappies, textiles and other materials. The landfill was also known to have accepted dog carcasses from the local dog pound.

3.3.2 Extent of Waste Body

The 1999 investigation established that the maximum thickness of the waste body in Area A1 was 3.8 m. The average thickness across area A1 was estimated to be 3.5 m. The average thickness in Area A2 was estimated to be 2m. In 1998 the total waste present was estimated to be 70 000 m^3 in 1998.

OCM excavated 14 trial pits in 2017 to establish the lateral extent of the waste and the thickness of the capping layer. The trial pits were logged by an OCM Environmental Scientist who logged the pits in accordance with BS5930. The trial pit logs are in Appendix 4. The 2017 investigation confirmed that the waste body extends over the entire footprint of Area A1. The final extent of the waste body in Area A2 was found to extend beyond the boundary defined in the 1999 investigation and it covers c. 1.8 ha (Figure 3.1).

In 2017 A waste thickness of 4.3 m was logged during the during the installation of the leachate well L1 in Area A2, with the thickness reducing to approximately 1 m to the north and west of this point. An area of approximately 0.3 ha in the south west of Area A2 has not been infilled and the natural ground here comprises cutover peat.

Assuming an estimated average thickness of the waste of 2 m in the area landfilled in the period between the issue of the Entec report and the final closure of the landfill, gives a final estimated volume of waste of 83,000 m^3. This equates to c41.500 tonnes.

3.4 2017 Monitoring Well Installation

The six wells installed in 1999 were in the peat and boulder clay subsoil. CBH2 extends to 4m below ground level (bgl): CBH1, CBH3 and CBH5 extend to 5m bgl), and CBH-4 extends to 6m bgl. OCM could not find these wells and it is likely that they were covered over by the capping material.

Two new wells (MW1 and MW2) were installed OCM in 2017 to monitor groundwater levels and quality up and down hydraulic gradient of the landfill respectively. One leachate well (L-1) was installed in the waste body to monitor landfill gas and leachate quality.

The wells were installed by Ground Investigations Ireland Ltd (GII) using a rotary percussive drilling rig with a 100 mm drilling bit. The drilling was supervised by an OCM Environmental scientist who logged the borings in accordance with BS 5930 as amended by the Geological Survey of Ireland (GSI), and ensured the wells were installed in accordance with OCM's specification. The borehole logs are in Appendix 4.

3.4.1 Well Design and Construction

MW1 is located to the south, up-hydraulic-gradient of the landfill. Made ground comprising brown gravelly sandy clay was encountered to a depth of 0.7 m bgl. This was underlain by peat down to 6.7 m bgl followed by gravelly clay till (boulder clay) to 8.5 m BGL where a sand and gravel layer was encountered. Weathered rock was encountered at 11.5m bgl and competent limestone bedrock as encountered at 14.5 m bgl and the borehole was terminated 15.5 m bgl. However, it was not possible to install to this depth due to the collapse of the borehole sidewall back to just below the casing 11.0 m bgl. The well screen section was therefore located in the gravels immediately above the bedrock.

MW2 was installed on the northern margins of the landfill footprint. Because of the very soft ground conditions further north it was not possible to install a monitoring well outside the landfill footprint to the north. Waste was encountered down to 3 m bgl and this was underlain by c5.5m of silt. A sand and gravel layer was encountered at 8.3mbgl. This was followed by the sand and gravel layer to 10.7m Limestone bedrock was encountered at this depth. The borehole was terminated at 10.3 m bgl due to the difficulty of keeping the borehole open in the gravel zone above the bedrock.

Prior to the installation of the well pipes, the boring was cleaned out by airlifting to remove rock chippings and fine silts. A gravel filter pack was inserted in the annular space between the boring and the standpipe. Above the gravel filter, the annular space was filled with a 1 m bentonite seal. The annular space above the bentonite seal was filled with borehole cuttings or pea gravel, and another 1 m bentonite seal was placed at the surface to prevent ingress of surface water. The solid section of the well pipes was brought above the ground level and was fitted with a steel protective well casing. Details of the well construction are in Appendix 4.

The leachate monitoring well extended through the waste and into the top of the underlying peat to depth of 5.2 m bgl. This was installed with slotted standpipe through the waste material, with 1 m of plain pipe at the top. A gravel filter pack was inserted in the annular space between the boring and the standpipe. Above the gravel filter, the annular space was filled with a 1m bentonite seal.

3.4.2 Groundwater

Water strikes were encountered during the drilling at 8.2 m bg) in MW1, and 7.5 m in MW2.

3.4.3 Visual and Olfactory Evidence of Contamination

There was no visual or olfactory evidence of contamination in any in the groundwater wells.

3.4.4 Borehole Development

The drilling of the groundwater wells ended with a short phase of airlift pumping. Discharge from each borehole was completely clear of sediment after airlift pumping and further airlift surging and development was not necessary.

3.4.5 Permeability Testing of the Capping Material

Two samples of the capping material were collected for permeability testing. Sample 1 from the A1 area and Sample 2 from the A2 area. The samples were sent to National Materials Testing Laboratory Ltd in Carlow for Constant Head Triaxial permeability Testing. The laboratory report is in Appendix 5. Sample 1 had a permeability of 1.002×10^{-9}m/s while Sample 2 had a permeability of 7.727×10^{-10}m/s. The results confirm that the capping material is suitable for use as landfill capping material and can be compacted to meet the non-hazardous landfill capping permeability requirements.

4. ENVIRONMENTAL MONITORING PROGRAMME

Following the completion of the intrusive works OCM implemented a groundwater, leachate, surface water and landfill gas monitoring programme on the 27th of November 2017. A second round of groundwater, surface water and landfill gas monitoring was undertaken on the 8th of August 2019. The leachate well was not sampled during the August 2019 monitoring round. The surface and groundwater sampling were undertaken in accordance with OCM sampling protocols, copies of which are in Appendix 6.

4.1 Groundwater

4.1.1 Field Measurements

Groundwater samples were collected from MW-1 and MW-2. Prior to collection of the samples, OCM measured the depth to groundwater and the total depth of the well. The top of casing levels (metres above site datum) and the water levels recorded in the field (meters below top of casing) at the time of both monitoring rounds are shown in Table 4.1, which also includes the leachate wells. The wells were surveyed in to an arbitrary site datum of 80 m in December 2017 and these are also in the Table

.

Table 4.1 Groundwater Levels

Borehole	Top of Casing	Water Levels November 2017		Water Level August 2019	
	m ASD*	m BTOC*	m ASD	m BTOC*	m ASD
MW1 TOC	78.46	3.54	74.918	3.80	74.66
MW2 TOC	76.50	1.73	74.765	1.20	75.3
L TOC	79.40	2.8	76.6	-	-

* metres above site datum
** metres below top of casing

This information on the well depth and water levels was used to establish the purge volume to be removed from the well to ensure the collection of a representative groundwater sample. OCM purged the wells while monitoring pH, temperature and electrical conductivity.

The samples were obtained after either three purge volumes had been removed, or field parameters stabilised. Stabilisation of field parameters indicates the groundwater in the well pipe is representative of the groundwater formation and not stagnant water in the surrounding gravel pack. The field measurements are in Table 4.2.

Table 4.2 – In-Situ Monitoring – November 2017 and August 2019

Location	November 2017				August 2019			
	pH	Temp. (°C)	Cond. (mS/cm)	Comment	pH	Temp. (°C)	Cond. (µS/cm)	Comment
MW1	6.72	10.0	747	Slightly cloudy, no odour	6.56	10.3	1095	Slightly cloudy, no odour
MW2	7.08	10.0	549	Clear, no odour	6.81	10.5	1157	Ammonia smell, rust coloured scum at top of water

The temperature and pH values were generally within the expected range for groundwater during both monitoring rounds. Electrical conductivity was generally within the expected range for groundwater during the November 2017 monitoring round. However, during the August 2019 monitoring round the electrical conductivity in both wells was significantly higher than during the previous monitoring and both exceeded the EPA Interim Guideline Value of 1000 µS/cm.

4.1.2 Laboratory Analysis

The samples were stored in laboratory prepared bottles and shipped to Element Materials Technology Laboratory (formerly Exova Jones Environmental Laboratories) in the UK - a UKAS accredited laboratory. A separate sample from each well was dispatched to CLS Laboratory for bacterial analysis.

The samples were analysed the range of parameters specified in Table C2 of the EPA Manual on Landfill Monitoring (2003) and included organic and inorganic parameters that included pH and electrical conductivity, ammonia, , nitrate, orthophosphate, potassium, sodium, chloride, sulphate, heavy metals to include(arsenic, antimony, barium, cadmium, chromium, copper, fluoride, mercury, manganese, molybdenum, nickel, lead, selenium and zinc), cyanide Volatile Organic Compounds, Semi-Volatile Organic Compounds, Herbicides, Pesticides Total and Faecal Coliforms.

4.1.3 Groundwater Quality

The full laboratory test reports are in Appendix 7 and the results are presented in Table 4.3. 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.

During the 2017 monitoring the arsenic and ammonia concentrations exceeded the GTV and the level of manganese, chloride and total and faecal coliforms exceeded the relevant IGVs in both wells.

During the 2019 monitoring the arsenic concentrations in both wells were below the relevant GTV and IGV. No faecal coliforms were detected and, although total coliforms were detected in both wells they were at lower levels than in the previous monitoring round. Manganese exceeded the IGV and ammonia exceeded the GTV in both wells, while potassium and chloride exceeded the IGV in MW2 only.

Table 4.3 Groundwater Monitoring Results – November 2017 and August 2019

Sample I.D.	Units	27/11/2017		08/08/2019		IGV	GTV
Sample Date		MW1	MW2	MW1	MW2		
Arsenic	µg/l	15.1	11.6	3.5	7.3	10	7.5
Boron	µg/l	<12	12	<12	49	1,000	750
Cadmium	µg/l	<0.5	<0.5	<0.5	<0.5	5	3.75
Chromium	ug/l	<1.5	<1.5	<1.5	<1.5	0.03	NE
Copper	µg/l	<7	<7	<7	<7	30	1500
Lead	µg/l	<5	<5	<5	<5	10	18.75
Manganese	µg/l	241	96	310	220	50	NE
Magnesium	mg/l	7.9	8.5	-	-	50	NE
Mercury	µg/l	<1	<1	<1	<1	1	0.75
Nickel	µg/l	10	6	3	<2	20	15
Potassium	mg/l	2.4	2.1	1.6	5.3	5	NE
Selenium	ug/l	<3	<3	<3	<3	NW	NE
Sodium	mg/l	23.8	14	19.1	27.6	150	150
Zinc	µg/l	10	5	<3	<3	100	75
Chloride	mg/l	39.4	33.3	29.2	94	30	187.5
Cyanide	µg/l	<0.01	<0.01	<0.01	0.02	10	37.5
Orthophosphate	µg/l	<0.03	<0.03	<0.03	<0.03	30	NE
Sulphate	mg/l	2.2	2.2	0.7	<0.5	200	187.5
Ammonia	mg/l	7.88	5.67	7.44	21.17	0.15	0.175
BOD	mg/l	3	<1	17	7	NE	NE
COD (Settled)	mg/l	40	11	28	19	NE	NE
TOC	mg/l	12	<2	19	7	No Abnormal Change	NE
Total Suspended Solids	mg/l	940	14		-	NE	NE
Total Dissolved Solids		-	-	615	575	1000	NE
Total Oxidised Nitrogen	mg/l	<0.2	<0.2	0.2	0.4	No Abnormal Change	NE
VOCs	µg/l	ND	ND	ND	ND	NE	NE
sVOCs	µg/l	ND	ND	ND	ND	NE	NE
PAH	µg/l	ND	ND	ND	ND	0.1	0.075
Nitrate as NO_3	mg/l	<0.2	<0.2	1.1	1.9	25	50
Nitrite as NO_2	mg/l	<0.02	<0.02	<0.02	<0.02	0.1	NE
Pesticides	ug/l	ND	ND	ND	ND	NE	NE
Total Coliforms	cfu/100 ml	40	27	3	10	0	NE
Faecal Coliforms	cfu/100 ml	2	2	0	0	0	NE

4.1.4 Discussion

The water levels were used to calculate the direction of groundwater flow, which is to the north-northwest as shown on Figure 4.1. MW-1 is nominally up hydraulic gradient and MW-2 is in the down hydraulic gradient end of the landfill. Although the level monitoring undertaken in the August 2019 monitoring round would seem to indicated that groundwater flow is in the opposite direction it is likely that the well head cover of MW2 may have lowered relative that of MW1 due to decomposition and settling in the waste body.

The monitoring results from 2017 indicate the presence of elevated ammonia, arsenic, manganese and chloride in both wells. While these parameters might be indicators of leachate

contamination the very low BOD, COD, sulphate and coliform levels are not consistent with the leachate quality in the landfill. In particular the elevated manganese and associated non detection level of nitrate in both samples is indicative of reducing conditions as a result of aquifer confinement from the overlying clays and silts. The ammonia may originate from the extensive peaty soil environment locally. While arsenic is likely to be significantly more soluble in reducing conditions of a confined aquifer.

The monitoring results from 2019 show a decrease in the level of chloride, arsenic and total coliforms, and an increase in the level of manganese, in MW1 compared to the 2017. The ammonia level in MW1 was similar to the 2017 monitoring round.

The results from the 2019 monitoring show an increase in the level of manganese, chloride and ammonia in MW2 compared to the 2017 monitoring. There was also an increase in the level of potassium in MW2 to above the relevant IGV in 2019 compared to the 2017 monitoring, However, there was a decrease in the level of arsenic in MW2 to below the relevant IGV/GTV.

It is possible, given that MW-2 had to be drilled through the waste that some localised leachate contamination might be present in this well. However, over time this will resolve as the hydraulic gradient of the confined groundwater pushes up against the overlying clay and silt essentially preventing downward movement of leachate.

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Title: Figure 4.1 Groundwater Contours

Client: Roscommon County Council

Legend

= Groundwater Contour

= Monitoring Well Location

= Site Boundary

4.2 Leachate Quality

In November 2017 a leachate sample was collected from the leachate / gas monitoring well (L1) installed in Area A2. The sample was placed in laboratory prepared containers and stored in coolers at below 4^0C prior to shipment to Exova Jones Environmental Forensics laboratory in the UK. Chain of custody (C.O.C.) documentation was included with the sample.

The sample was analysed for the parameters in Table C2 of the EPA Landfill Monitoring Manual 2003. The results are presented in Table 4.4, with the full laboratory report in Appendix 7. The Table includes for comparative purposes, the results ranges specified in Table 7.2 EPA Landfill Site Design, 2000. The results are indicative of a moderate to weak leachate in the landfill.

Table 4.4 Leachate Analysis – November 2017

Sample I.D. Sample Date	Units	L1	EPA Landfill Design Manual Range
Arsenic	µg/l	36.7	<1 - 6,700
Boron	µg/l	1632	-
Cadmium	µg/l	<0.5	<10 - 80
Copper	µg/l	<7	20 - 620
Mercury	µg/l	<1	<0.1 - 0.8
Nickel	µg/l	45	<30 - 600
Lead	µg/l	<5	<40 - 1,900
Zinc	µg/l	4	<30 - 6,700
Manganese	µg/l	1133	40 - 3,590
Sulphate	mg/l	1.9	<5 - 322
Chloride	mg/l	4160.3	570 - 4,710
Total Cyanide	µg/l	0.03	-
Chromium - diss.	µg/l	12	-
Phosphorous - total	µg/l	360	-
Potassium	mg/l	201.1	100 - 1,580
Sodium	mg/l	3089	474 - 3,650
Total Oxidised Nitrogen	mg/l	<0.2	-
Ammonia	mg/l	1051.57	283 -- 2,040
BOD settled	mg/l	494	110 - 1,900
COD	mg/l	3330	622 - 8,000
VOCs			
Vinyl Chloride	µg/l	0.70	-
Benzene	µg/l	2.00	-
Toluene	µg/l	22.00	-
Ethylbenzene	µg/l	12.00	-
p/m-xylene	µg/l	32.00	-
o-xylene	µg/l	9.00	-
Trimethylbenzene	µg/l	12.00	-
4-Isopropyltoluene	µg/l	34.00	-
sVOCs			
4-Methylphenol	µg/l	1536.00	-
Phenols (total)	mg/l	3.10	
PAH	µg/l	ND	-
Pesticides	µg/l	ND	-

ND - denotes not detected

4.3 Surface Water

4.3.1 Field Measurements

Surface water samples were collected from five locations (CSW1, CSW 2, CSW3, CSW5 and CSW6) shown on Figure 4.1 by OCM on 27th November 2017 and again on the 8th August 2019. CSW 3 is upstream of the landfill in the field drain running along the western site boundary. CSW1 is downstream of the landfill in the field drain running along the western site boundary. CSW2 is downstream of the landfill in the field drain running along the eastern site boundary. CSW5 and CSW6 are taken from the Harristown Stream, upstream and downstream respectively of the field drains that discharge to the stream.

pH, temperature and electrical conductivity were undertaken in the field prior to sample collection and the results are presented in Table 4.5.

Table 4.5 – In-Situ Monitoring – November 2017 and August 2019

	November 2017			August 2019		
	pH	**Temperature** °C	**Conductivity** µS/cm	**pH**	**Temperature** °C	**Conductivity** µS/cm
CSW1	7.33	6.8	376	7.35	13.8	310.5
CSW2	7.19	7.1	685	7.19	14.6	442.5
CSW3	6.68	6.5	316	7.19	13.7	181.1
CSW5	7.25	7.7	523	7.18	12.3	645.8
CSW6	6.98	7.0	463	7.20	12.4	640.0

The temperature and pH values measured were generally within the expected range for surface water and there was little difference between upgradient locations compared to downgradient locations.

4.3.2 Laboratory Analysis

The samples were placed in laboratory prepared containers and stored in coolers at below 4ºC prior to shipment to to Element Materials Technology Laboratory (formerly Exova Jones Environmental Laboratories) in the UK. Chain of custody (C.O.C.) documentation was included with the samples.

4.3.3 Surface Water Quality

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

The laboratory test reports are contained in Appendix 7 and the results are presented in Tables 4.5 and 4.6. The tables include for comparative purposes the 2009 Surface Water Regulations Environmental Quality Standards (EQS).

Table 4.5 Surface Water Monitoring Results – November 2017

Sample I.D.	Units	CSW1	CSW2	CSW3	CSW5	CSW6	AA -EQS	EU MAC*
pH	pH Units	7.33	7.19	6.68	7.25	6.98	4.5-9	
Electrical Conductivity	µS/cm	376	685	316	523	463	1000	NE
Arsenic	mg/l	0.0045	0.0076	<0.0025	0.0036	0.0057	0.025	0.01
Boron	mg/l	0.012	0.086	<0.012	<0.012	0.012	NE	NE
Cadmium	mg/l	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0015/0.0025*	0.9/1.5*
Copper	mg/l	<0.007	<0.007	<0.007	<0.007	<0.007	0.03	NE
Lead	mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	0.0072	NE
Manganese	mg/l	0.038	0.164	0.044	0.057	0.03	NE	NE
Magnesium	mg/l	6	13.6	5	5.5	6.1	NE	NE
Mercury	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	0.00005	0.00007
Nickel	mg/l	<0.002	<0.002	0.003	<0.002	<0.002	0.02	0.02
Total Cyanide	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	NE
Chromium	mg/l	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	0.0047	0.032
Zinc	mg/l	0.004	0.011	<0.003	<0.003	0.005	0.1	NE
Sulphate	mg/l	38.1	25.2	65.4	1.5	14.8	NE	NE
Chloride	mg/l	30.5	88.2	27	17	25.1	NE	NE
Calcium	mg/l	60.6	95	38.9	117	89.2	NE	NE
Orthophosphate	mg/l	0.04	<0.03	<0.03	<0.03	<0.03	NE	NE
Total Oxidised Nitrogen	mg/l	1.3	5.2	1.7	0.5	1.40	NE	NE
Total Suspended Solids	mg/l	35	17	<10	<10	<10	NE	NE
BOD	mg/l	<1	2	3	<1	2	1.5	NE
COD	mg/l	88	64	111	39	57	NE	NE
Potassium	mg/l	2.1	11.8	1.5	2.6	2.8	NE	NE
Sodium	mg/l	16.8	49.9	14	9.6	14.7	NE	NE
Ammonia*	mg/l	0.37	17.86	0.23	0.23	1.11	0.065	NE
Pesticides	mg/l	ND	ND	ND	ND	ND	Various	NE
BTEX	mg/l	ND	ND	ND	ND	ND	Various	Various
PAH	mg/l	ND	ND	ND	ND	ND	Various	Various
sVOC	mg/l	ND	ND	ND	ND	ND	NE	NE
VOC								
Chloroform	mg/l	ND	ND	0.002	ND	ND	NE	NE

Table 4.6 Surface Water Monitoring Results – August 2019

Sample I.D.	Units	CSW1	CSW2	CSW3	CSW5	CSW6	AA -EQS	EU MAC*
pH	pH Units	7.35	7.19	7.19	7.18	7.20	4.5-9	
Electrical Conductivity	µS/cm	310.5	442.5	181.1	645.8	640	1000	NE
Arsenic	mg/l	<0.0025	0.0032	<0.0025	<0.0025	<0.0025	0.025	0.01
Boron	mg/l	0.013	0.048	0.013	<0.012	<0.012	NE	NE
Cadmium	mg/l	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0015/0.0025*	0.9/1.5*
Copper	mg/l	<0.007	<0.007	<0.007	<0.007	<0.007	0.03	NE
Lead	mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	0.0072	NE
Manganese	mg/l	0.012	0.181	0.084	0.036	0.03	NE	NE
Magnesium	mg/l	-	-	-	-	-	NE	NE
Mercury	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	0.00005	0.00007
Nickel	mg/l	<0.002	<0.002	<0.002	<0.002	<0.002	0.02	0.02
Total Cyanide	mg/l	0.16	<0.01	<0.01	<0.01	<0.01	0.01	NE
Chromium	mg/l	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	0.0047	0.032
Zinc	mg/l	0.004	0.007	0.006	<0.003	<0.003	0.1	NE
Sulphate	mg/l	21.6	<0.5	19.1	18.7	18.6	NE	NE
Chloride	mg/l	29.3	40	21.9	21.1	21.3	NE	NE
Calcium	mg/l	-	-	-	-	-	NE	NE
Orthophosphate	mg/l	0.08	<0.03	<0.03	<0.03	<0.03	NE	NE
Total Oxidised Nitrogen	mg/l	0.8	4.3	<0.2	0.3	0.30	NE	NE
Total Suspended Solids	mg/l	-	-	-	-	-	NE	NE
BOD	mg/l	2	3	<1	<1	<1	1.5	NE
COD	mg/l	120	93	137	25	22	NE	NE
Potassium	mg/l	1.8	6.2	0.8	2.8	2.7	NE	NE
Sodium	mg/l	18.3	24.9	12.6	10.8	10.7	NE	NE
Ammonia*	mg/l	0.61	7.77	0.08	0.09	0.09	0.065	NE
Pesticides	mg/l	ND	ND	ND	ND	ND	Various	NE
BTEX	mg/l	ND	ND	ND	ND	ND	Various	Various
PAH	mg/l	ND	ND	ND	ND	ND	Various	Various
sVOC	mg/l	ND	ND	ND	ND	ND	NE	NE
VOC								
Chloroform	mg/l	ND	ND	0.003	ND	ND	NE	NE

Ammonia exceeded the relevant EQS in all of the samples during each monitoring round. BOD exceeded the EQS in CSW2, CSW3 and CSW6 during the 2017 monitoring round and CSW1 and CSW2 in the 2019 monitoring round. Total cyanide also exceeded the relevant EQS in August 2019. All of the other parameters were below the relevant EQS.

4.3.4 Discussion

The slightly elevated background ammonia levels in the upgradient monitoring points may be associated with run-off from the surrounding lands and the local peat environment.

In both monitoring rounds the ammonia, chloride, potassium and manganese levels were significantly higher in the down stream monitoring point (CSW2) located in the drain between the landfill and the stream to the north compared to the upstream monitoring points (CSW1 and CSW3), and is indicative of leachate impacts.

In 2017 there was is also an increase in the ammonia level between the upstream and downstream monitoring points in the Harristown Stream to the north of the site (CSW5 and CSW 6 respectively). However, there was no difference in the level of ammonia between these sampling points in the 2019 monitoring round. The 2019 monitoring results indicate that surface water discharges from the site are not having a significant impact in the surface water downstream of the landfill.

4.4 Landfill Gas

Ground gas monitoring was undertaken on two occasions; on the 1st December 2017 and on 8th August 2019. 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. Only the groundwater wells were monitored during the August 2019 monitoring round.

It was not possible to open the well cover of the leachate well due to corrosion of the locking bolts, therefore no landfill gas monitoring was undertaken on this well.

The results are presented in Table 4.7.

Table 4.7 Landfill Gas Monitoring Results – November 2017 and August 2019

November 2017							
		Atmospheric Pressure	Flow rate	H_2S	CH_4 (Peak)	CO_2	O_2
Location	Date / Unit	mb	l/h	ppm	%	%	%
L1	01/12/2017 - 12.30 pm	1018	29.10	0.00	76.00	24.00	0.00
MW1	01/12/2017 - 12.30 pm	1018	0.10	0.00	3.70	19.00	15.20
MW2	01/12/2017 - 12.30 pm	1018	0.00	0.00	0.50	1.80	21.00
August 2019							
		Atmospheric Pressure	Flow rate	H_2S	CH_4 (Peak)	CO_2	O_2
Location	Date / Unit	mb	l/h	ppm	%	%	%
MW1	8th Aug 2019 - 11.00 am	1001	0.00	0.00	0.00	10.00	12.60
MW2	8th Aug 2019 - 11.00 am	1002	0.00	0.00	1.80	5.20	15.70

Table 4.8 Landfill Gas Monitoring Results – August 2019

The results indicate that landfill gas is being generated. The 2017 monitoring results for MW-1 to the south of the landfill may be an indication of methane build up associated with peaty soil south of the landfill. The well is only open to the formation in the gravels at least 7-10m below ground level therefore the origin of the methane is not considered to be the landfill. Methane was not detected in the 2019 monitoring programme in this well.

It is possible however that the levels detected in MW-2 to the north are associated with the presence of waste at this location, but again it is primarily considered to be naturally occurring given the well is also screened at least 3-4 m below the level of the waste in saturated conditions. It is possible that the methane could originate from the peat subsoil locally. There was no gas flow in the MW-1 or MW-2 in 2019 indicating the landfill gas migration is relatively low at this locations.

5. TIER 3 RISK ASSESSMENT

5.1 Conceptual Site Model

The Tier 1 Risk scores are presented in Table 5.1, with the full Tier 1 Risk scores in Appendix 1. The assessments concluded that the site is a High Risk site due to the leachate migration risk to surface water.

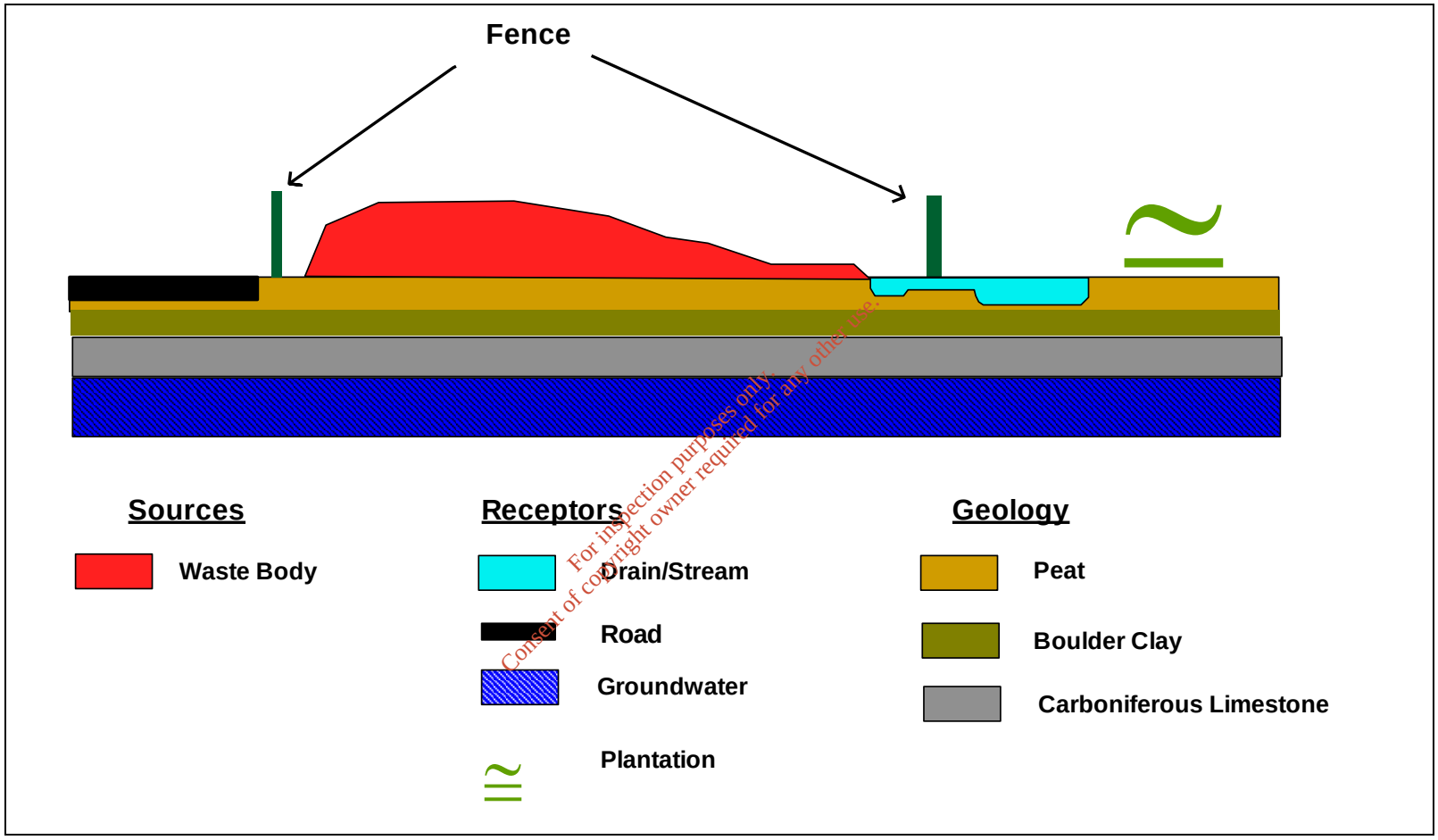
Table 5.1 Tier 1 Risk Assessment Scores

SPR Linkage	Linkage Score	Norm Score
SPR1	189.00	63.00
SPR2	0.00	0.00
SPR3	49.00	20.42
SPR4	0.00	0.00
SPR5	245.00	61.25
SPR6	147.00	26.25
SPR7	147.00	61.25
SPR8	42.00	70.00
SPR9	0.00	0.00
SPR10	10.50	7.00
SPR11	17.50	7.00

Risk Classification: **A: Highest Risk**

The Tier 1 Conceptual Site Model (CSM) is shown in Figure 5.1

Figure 5.1 Conceptual Site Model for Castlerea Closed Landfill Site



5.2 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. A schematic of the revised CSM is shown in Figure 5.2. The line of section on which the cross section is based is shown on Figure 5.3.

The waste extends to a maximum depth 5 m bgl including 0.7 m of capping layer in the centre east of the Area A2 (L1), with the thickness decreasing to the north, south and west of this point. The average thickness of waste in area A1 is 3.5 m.

The OCM trial pitting carried out in Area A1 confirmed the presence of a capping layer comprising peat, clayey peat or peaty clay overlying the waste across the entire area. The capping layer ranged from 10 to 40 cm thick with the layer thinning northward.

The thickness and nature of the capping layer in Area A2 is variable. The entire waste body has been covered with a clay layer comprising light brown to dark brown gravelly sandy clay with cobbles. This layer is covered by a dark brown to black peat or clayey peat layer. The overall thickness of the capping layer ranges from 0.45 to 2.6 m.

The investigations confirm the presence of peat underlying the waste in the majority of the site. Peat was encountered in every borehole except CBH4 at the northern end of Area A1, where peat may have been removed to allow more space for filling and waste directly overlies till. Peat thicknesses encountered in the other boreholes ranged from ranged from 2.3 m to 5.3 m.

The OCM site investigations confirmed a peat and glacial till layer 8.5m thick at the south end of the landfill and a silt/alluvium layer 8.3m thick at the north end of the landfill. The peat, till and alluvium provide a barrier layer between the base of the waste and the water bearing gravels encountered beneath the boulder clay and the silt.

Competent limestone bedrock was encountered at 11.5 m BGL in MW1 located at the southern end of the landfill and at 10.7m bgl in the northern end of the landfill.

The water bearing gravel and the bedrock are in hydraulic continuity and are confined by the overlying peat, till and silt. The groundwater levels in MW-1 and 2 are located more than 4m above the top of the gravels in MW-2 and more than 4.5mabove the gravels in MW-1. This indicates that there is a significant upward hydraulic gradient which inhibits the vertical migration of leachate to the groundwater.

Groundwater recharge in the lands in the immediate vicinity of the landfill is low due to the presence of the peat and clay.

While it is likely the peat and glacial till substantially restrict the impact of leachate on the underlying bedrock aquifer these conditions also mean that rainfall recharge and leachate will preferentially discharge along the surface water pathway to the drains and the Harristown Stream to the north of the site.

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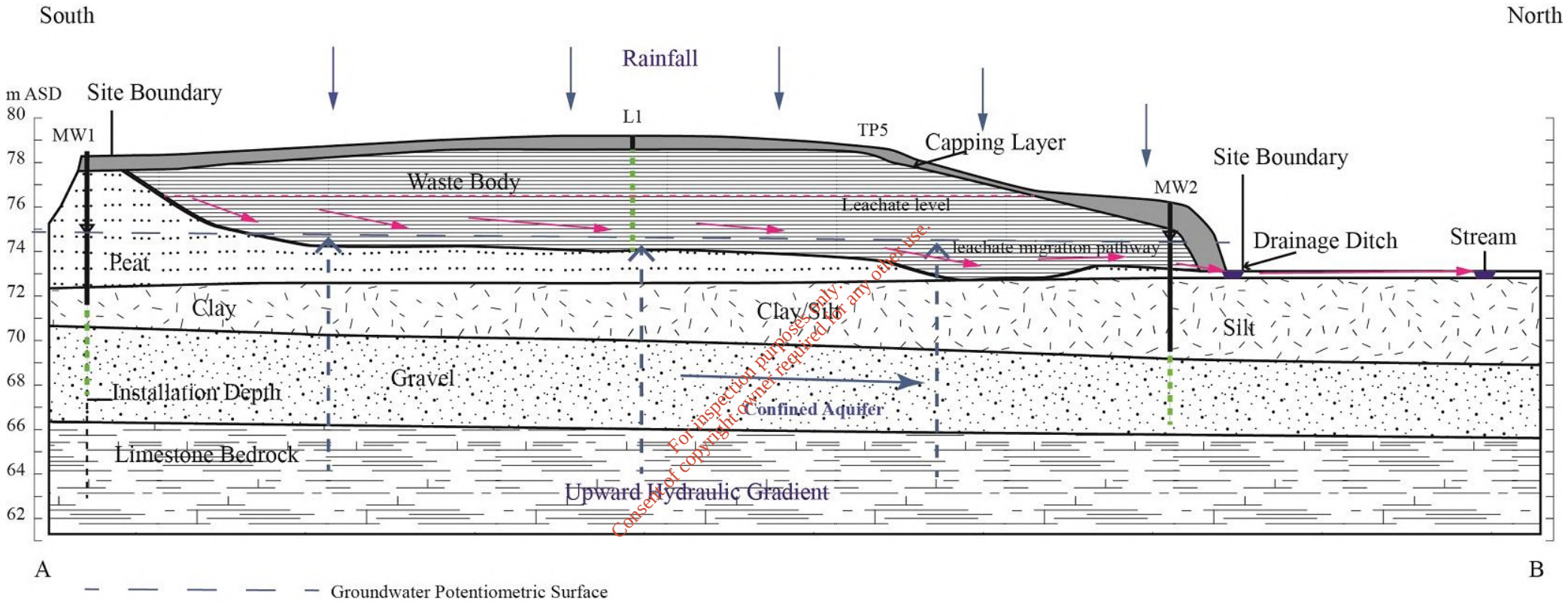
Figure 5.2 Tier 3 CSM



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CLIENT

Roscommon County Council

TITLE

Site Layout

Details:

- SW Sampling Locations
- Monitoring Wells
- Trial Pits
- Line of Section
- Site Boundary
- Waste Extent

Figure 5.3

5.3 Sources

The source is the municipal solid waste which is estimated to be in the region of 83,000 m^3 (41,500 tonnes).

Leachate

The results of the analysis of the leachate sample collected from the monitoring well L1 located in Area A2 indicate that leachate is being generated and is impacting on the surface quality in the drains surround the site and the stream to the north of the site.

Landfill Gas

Landfill gas is being generated in the waste body may potentially be migrating laterally.

5.4 Pathways

5.4.1 Leachate Migration Pathways

Leachate is migrating via the surface water drainage system surrounding the landfill and into the Harristown stream located approximately 40 m to the north of the site.

5.4.2 Landfill Gas Migration Pathways

Landfill gas is migrating through the waste 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. The closest dwelling to the site is 240 m north which is north of the Harristown Stream.

5.5 Receptors

5.5.1 Leachate Migration Receptors

The Harristown Stream to the north of the site, is the closest water body. It flows in a westerly direction and ultimately discharges to the River Suck approximately 1.25 km northwest of the site.

The results of surface water quality monitoring in 2019 identified evidence of leachate impact in the drains discharing from the landfill but not in the Harristown Stream downstream of the landfill.

There are no private groundwater wells located within 1km of the site or down hydraulic gradient of the landfill between the site and the River Suck.

The Castlerea Water Supply is derived from the Silver/Longford Spring which is located c2km northeast of the site. The GSI has delineated a Source Protection Area (SPA) for the spring and the landfill is not located within the area.

Landfill Gas

It is likely that the landfill gas migrates laterally to the surface water drains surrounding the site.

5.6 Revised Risk Scores

The revised Tier 3 risk scores are summarised on Table 5.2 and are included in full in Appendix 8. The overall risk in 2019 remains High due to leachate migration to the surface receptor.

Table 5.2 Tier 3 Risk Scores

Calculator	SPR Values	Maximum Score	Linkages	Normalised Score
Groundwater & Surface Water	Groundwater only	Surface water only	Lateral & Vertical	
SPR 1 =	168	300	Leachate => surface water	56%
SPR 2 =	0	300	Leachate => SWDTE	0%
SPR 3 =	0	240	Leachate => human presence	0%
SPR 4 =	0	240	Leachate => GWDTE	0%
SPR 5 =	210	400	Leachate => Aquifer	53%
SPR 6 =	126	560	Leachate => Surface Water	23%
SPR 7 =	126	240	Leachate => SWDTE	53%
SPR 8 =	42	60	Leachate => Surface Water	70%
SPR 9 =	0	60	Leachate => SWDTE	0%
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 (Class A)		

6. REMEDIAL ACTION PLAN

The Risk Ranking for the site is High and is associated with leachate migration to the surface water. 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.

The EPA Landfill Restoration and Aftercare Manual recommends that for Non-Inert Landfill with low amenity use that a minimum cap of 1000mm should be placed but top soil layer is not essential. Non-inert landfills should also be provided with a gas collection and surface water drainage system.

Figure 6.1 – 6.4 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 to the east of the A1 area and west of the A2 area and north of the Harristown Stream. A low permeability clay retaining berm should be constructed in these areas between the edge of the waste and the watercourses.

There is currently a capping layer comprising peat, clayey peat or peaty clay ranging in thickness from 10 to 40 cm thinning northward in the A1 area. In the A2 area there a capping layer comprising light brown to dark brown gravelly sandy clay with cobbles covered by a dark brown to black peat or clayey peat layer ranging from 0.68 to 3.1 m. Permeability testing of this material confirms its suitability for use as a capping layer.

There may be sufficient capping material on site to cover both areas with a 1m cap once the material in the A-2 area is redistributed. However it is likely that some additional clays will be required to create the berm.

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, two in area A1 and two in Area A2 to allow passive ventilation of the gas. 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 by livestock.

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CLIENT

Roscommon County Council

FIGURE No.

6.1

TITLE

Remediation Measures

SCALE

NTS

REV.

A

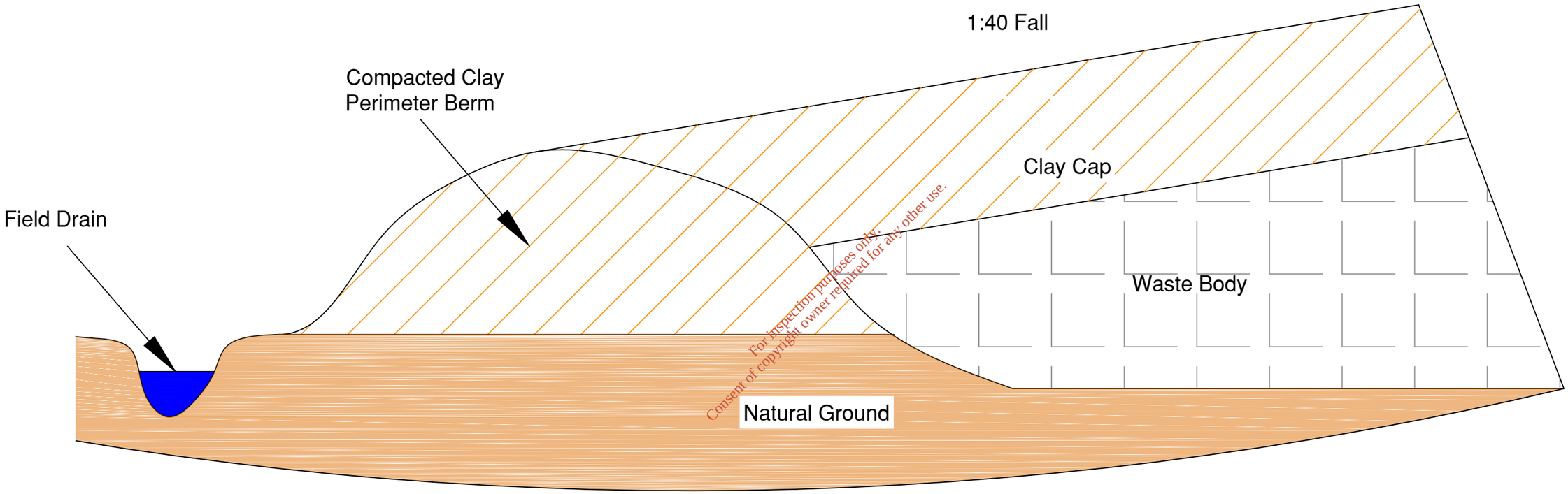

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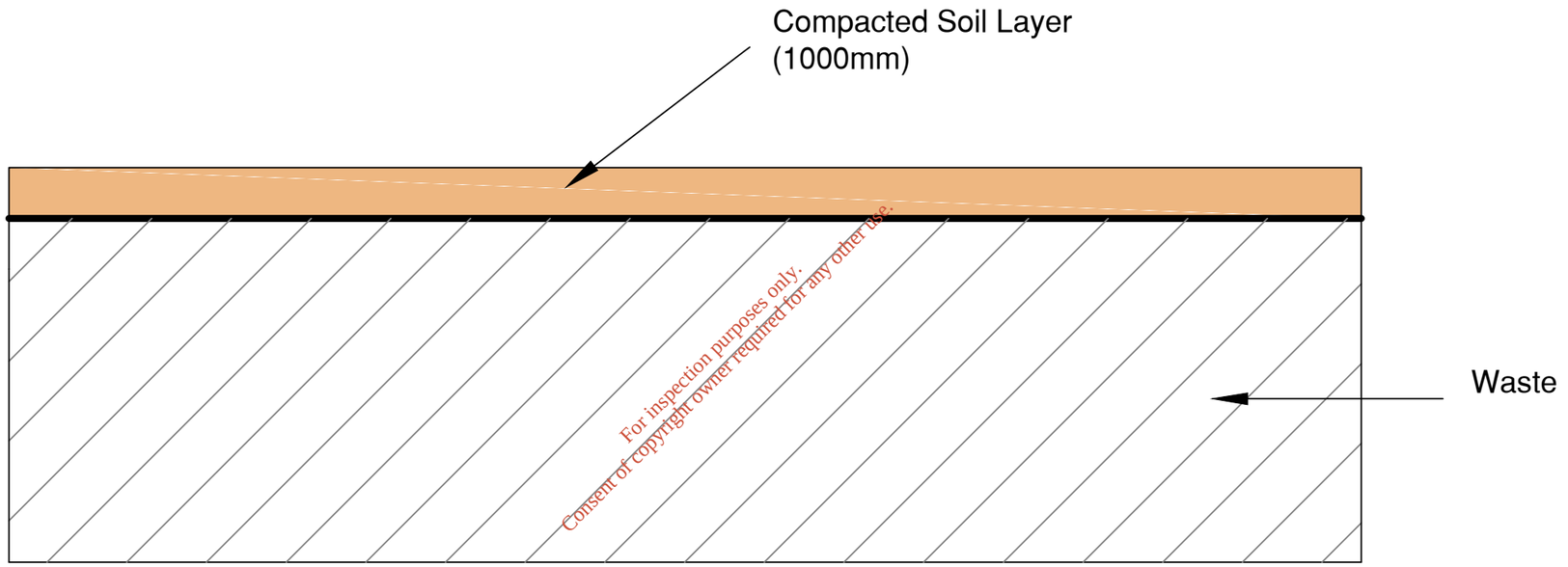
FIGURE No.
6.2

TITLE

Clay Berm Detail

SCALE
NTS

REV.
A



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environmental management for business

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FIGURE No.
6.3

TITLE

Landfill Capping Detail

SCALE
NTS

REV.
A

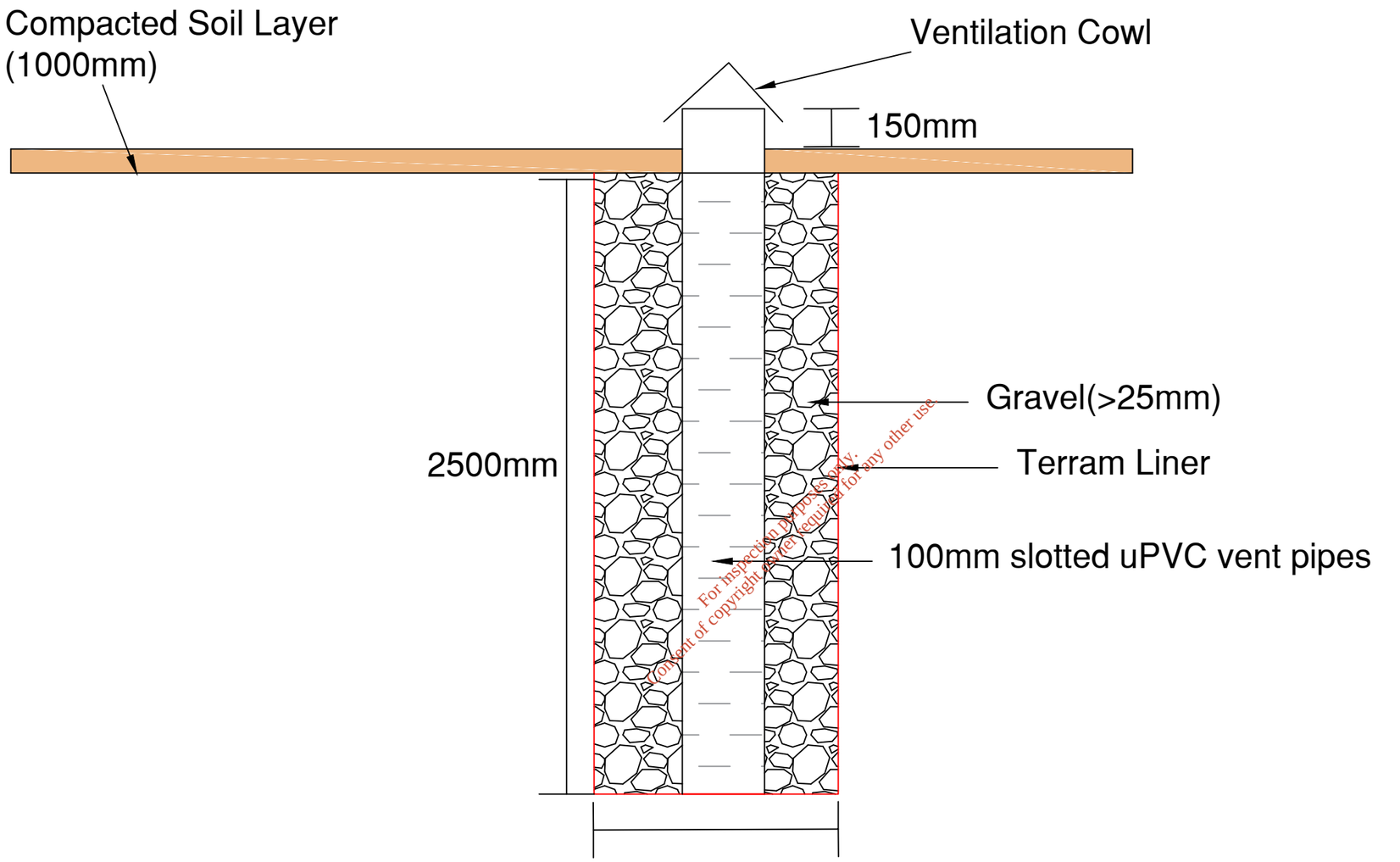

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FIGURE No.
6.4

TITLE

Landfill Gas Ventilation Pipe

SCALE
NTS

REV.
A

7. APPROPRIATE ASSESSMENT RISK SCREENING

7.1 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 western and eastern perimeter, the regarding and capping of the landfill.

7.2 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.

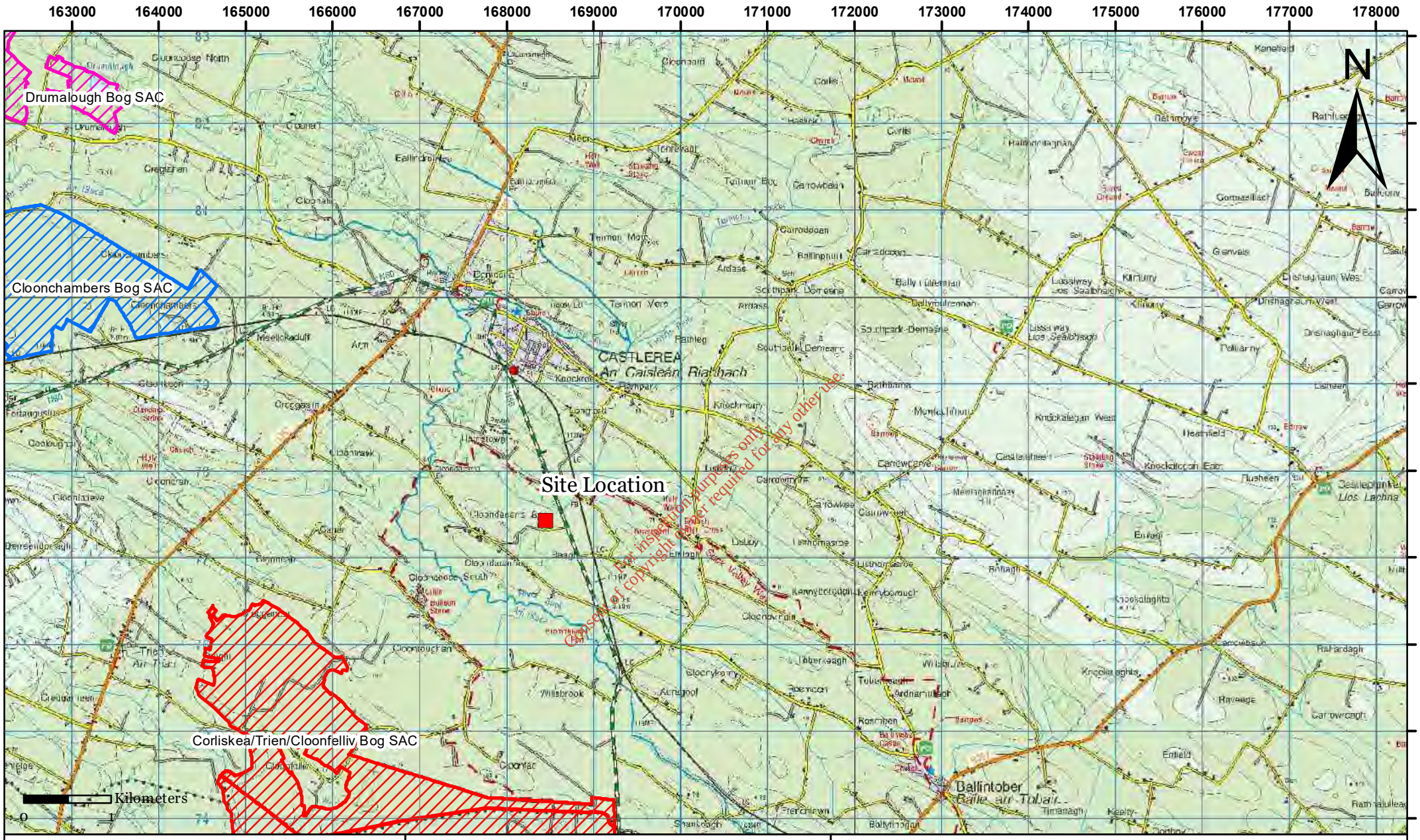
Corliskea/Trien/Cloonfelliv Bog is a designated SAC approximately 3.1 km south west of the site. Bellanagare Bog is a designated SPA approximately 6.7 km to the north east of the site (Figure 7.1).

The limited remedial works have the potential to general dust emissions in the immediate vicinity of the site when the capping layer is being re-worked. There will also be emissions of rainfall run-off collected in the surface water drains discharging to the Harristown Stream to the north of the site.

There is no connection between the designated areas and the landfill. While dusts will be generated during the proposed remedial works, given the distance to the SAC they do not present any risk to the SAC.

7.3 Stage 1 Conclusion

As the remedial measures will not impact on the SAC a Stage 2 Appropriate Assessment is not required.



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CLIENT
Roscommon County Council

TITLE
NPWS

Details:
- Site Location
- Cloonchambers Bog SAC
- Corliskea/Trien/Cloonfelliv Bog SAC
- Drumalough Bog SAC

Figure 7.1

8 CONCLUSIONS AND RECOMMENDATIONS

8.1 Conclusions

Risk Category

The results of the updated 2019 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. Leacahte migration risk to groundwater is considered to be low. The landfill gas migration risk to offsite receptors is Low.

Surface Water

While the Harristown Stream is not impacted by leachate discharges from the landfill downstream of the landfill, impacts are present in the drains discharging to the stream and may impact on the stream in low flow conditions. Remedial measures are required to mitigate the impacts.

Groundwater

The groundwater quality beneath and down hydraulic gradient of the landfill is indicative of confining conditions in the water bearing gravels above the bedrock aquifer. There is a significant upward hydraulic gradient beneath the landfill which greatly inhibits the downward migration of leachate. This is due to the presence of a glacial till and silt layer that is 3-5m thick beneath the base of the waste in the landfill.

There are no private groundwater wells located within 1km of the site or down hydraulic gradient of the landfill between the site and the River Suck.

The Castlerea Water Supply is derived from the Sliver/Longford Spring which is located c2km northeast of the site. The GSI has delineated a Source Protection Area (SPA) for the spring and the landfill is not located within the area.

Landfill Gas

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

Ecological Sensitive Sites

The closest sites to the landfill are the Corliskea/Trien/Cloonfelliv Bog SAC approximately 3.1 km south west of the site and Bellanagare Bog SPA is approximately 6.7 km to the north east of the site. There are no pathways between the landfill the SAC.

8.2 Recommendations

The remedial measures described in Section 6 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 CSw1 to CSW6 annually to establish their effectiveness.

APPENDIX 1

Tier 1 Risk Assessment

Tier 1 Study – Conceptual Site Model, Risk Screening and Prioritisation

for

Castlerea Closed Landfill Site

Report By: Niall Kennedy
Environment Section
Roscommon Co Co

Date: 22nd September 2009

Site Location

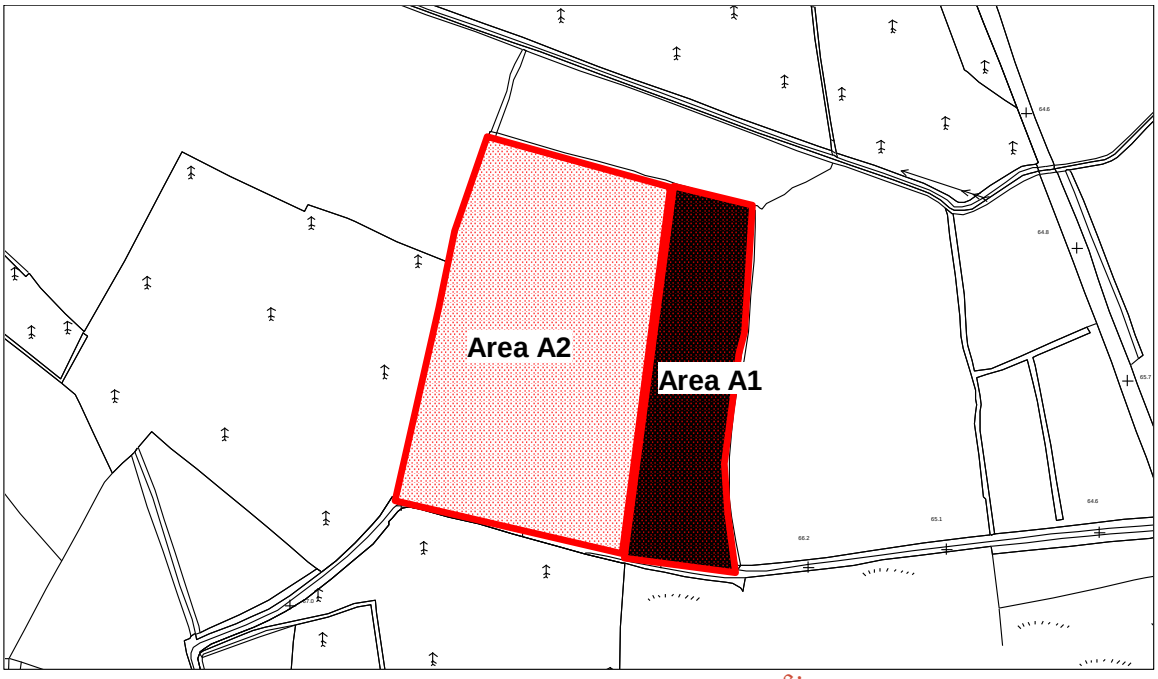
Castlerea closed landfill site is located 2.5 km from the town of Castlerea (population approx 2800) at National Grid Reference E168,340 ; N277,440. The site is located in the townland of Cloondacarra Beg.

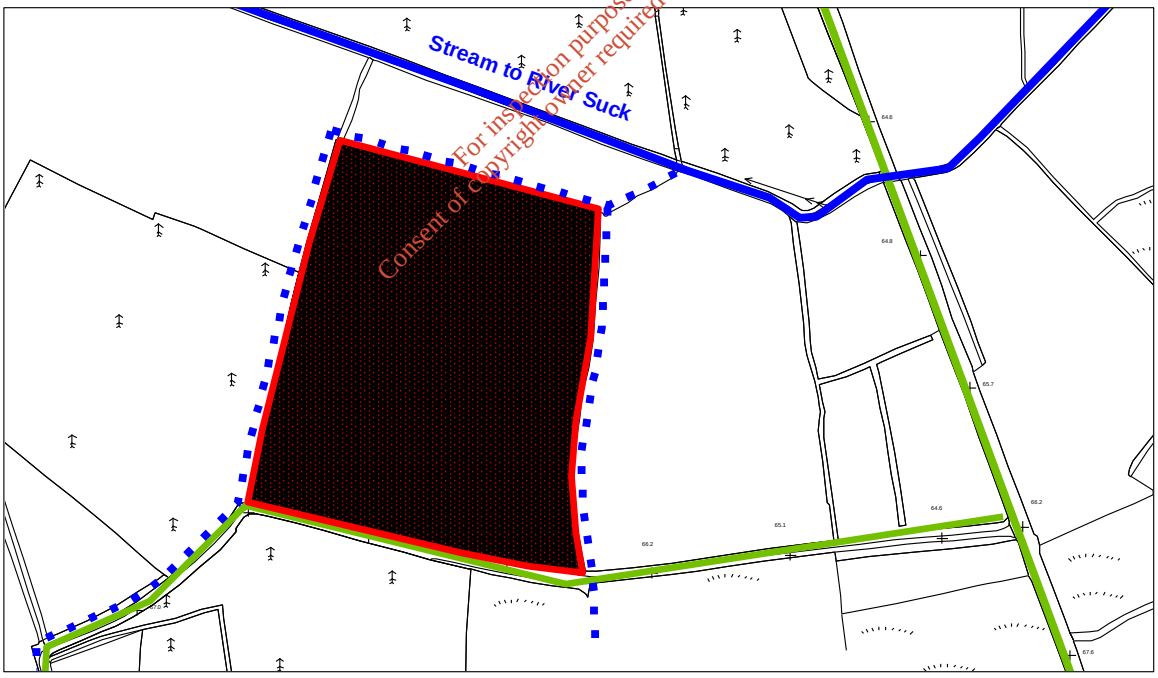
Site Location Map

Site Description

The site lies immediately to the south of an east-west flowing tributary of the River Suck and is bounded by rough agricultural lands. Access to the site is via local road L-16124 which leads west of the N-50 Castlerea to Ballymoe Road.

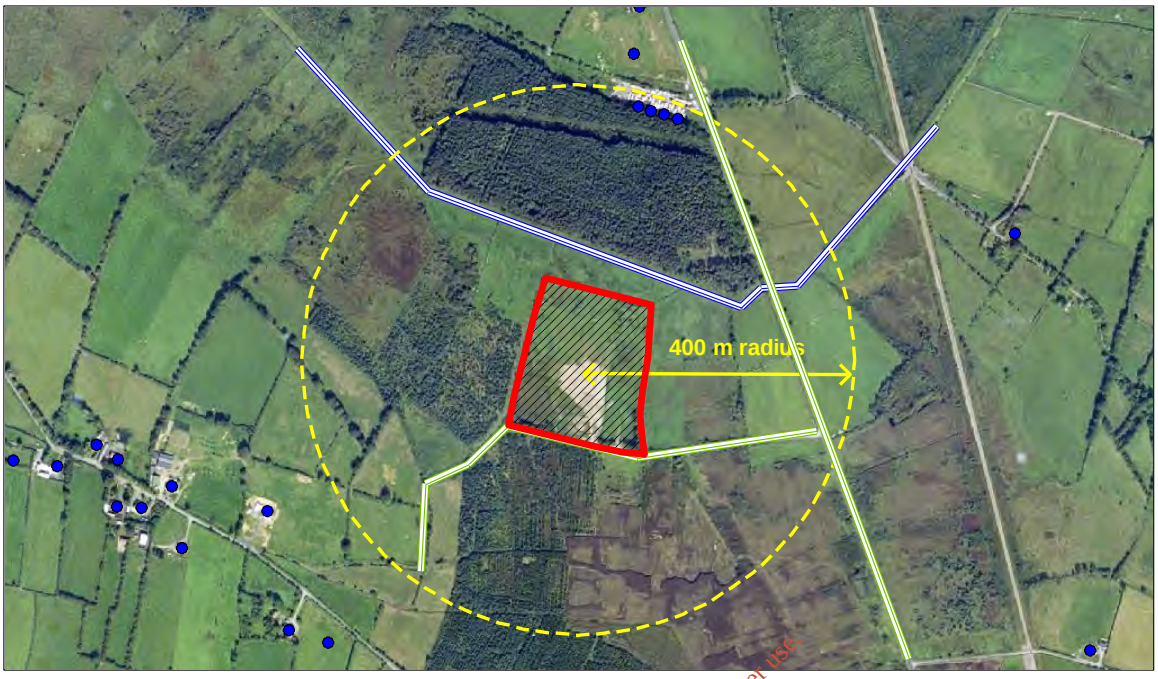
The overall area of the site measures 4.05 hectares and is nominally divided into two areas, A1 & A2. The eastern phase (A1) measures approximately 1.35 ha and forms the original landfill site that was operational between 1960 and 1988. Area A2 was subsequently used for the deposition of waste until the facility closed in 1999. It is estimated that approximately 1.15 ha of this area had been utilized.





Roads Drainage ditches Landfill Site

Site Layout



OS Aerial Photograph showing adjacent dwellings (●)

Landfill Operations

The landfilling operation consisted of the raising of the existing land profile by deposition of waste with compaction using a track machine. The waste was deposited in crude cells though there was no formal operational plan or design for the site. The area of the landfill is generally underlain by peat and the peat may have been removed in places prior to deposition of the waste.

Waste Types

From an examination of waste received at the site in 1994 it was found that 3090 tonnes was deposited at the location in that year. This comprised 80% domestic waste, 19% commercial waste and 1% sewage treatment sludge.

In 1999 a report titled *Physical Setting and Risk Assessment for Castlerea Landfill Site* was undertaken by ENTEC for Roscommon County Council. This report estimated that a total of approximately 70,000 m³ of waste was preset at the site.

Summary table for 11 SPRs *

SPR Linkage	Linkage Score	Norm Score
SPR1	189.00	63.00
SPR2	0.00	0.00
SPR3	49.00	20.42
SPR4	0.00	0.00
SPR5	245.00	61.25
SPR6	147.00	26.25
SPR7	147.00	61.25
SPR8	42.00	70.00
SPR9	0.00	0.00
SPR10	10.50	7.00
SPR11	17.50	7.00

Risk Classification: **A: Highest Risk**

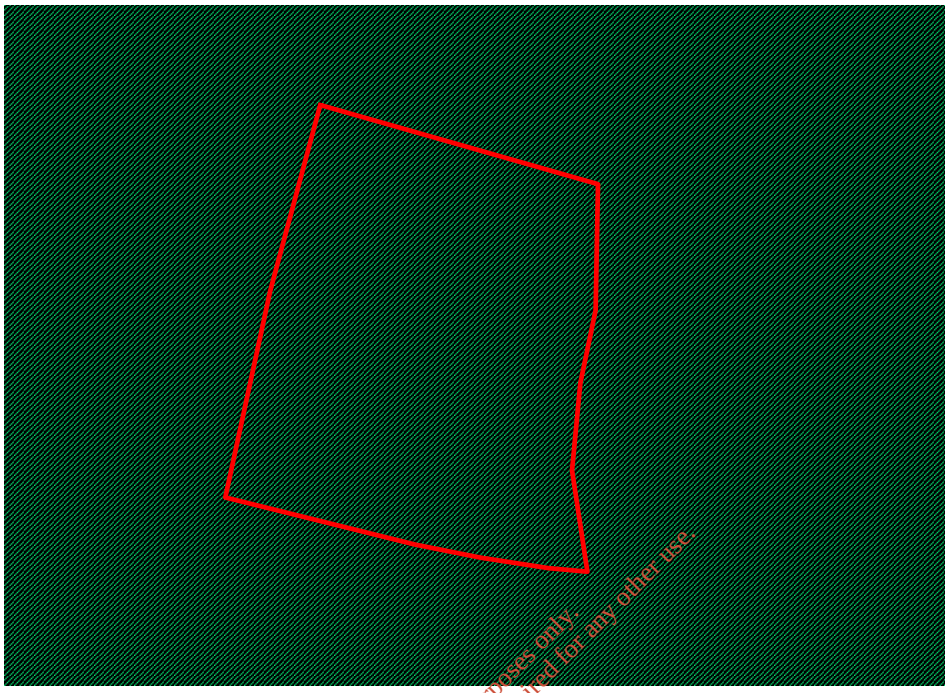
* Calculated using EPA Online Risk Assessment Tool

Aerial Photographs

Aerial Photo taken in 2006 with site outlined in red

Aerial Photo taken in 2000 with site outlined in red

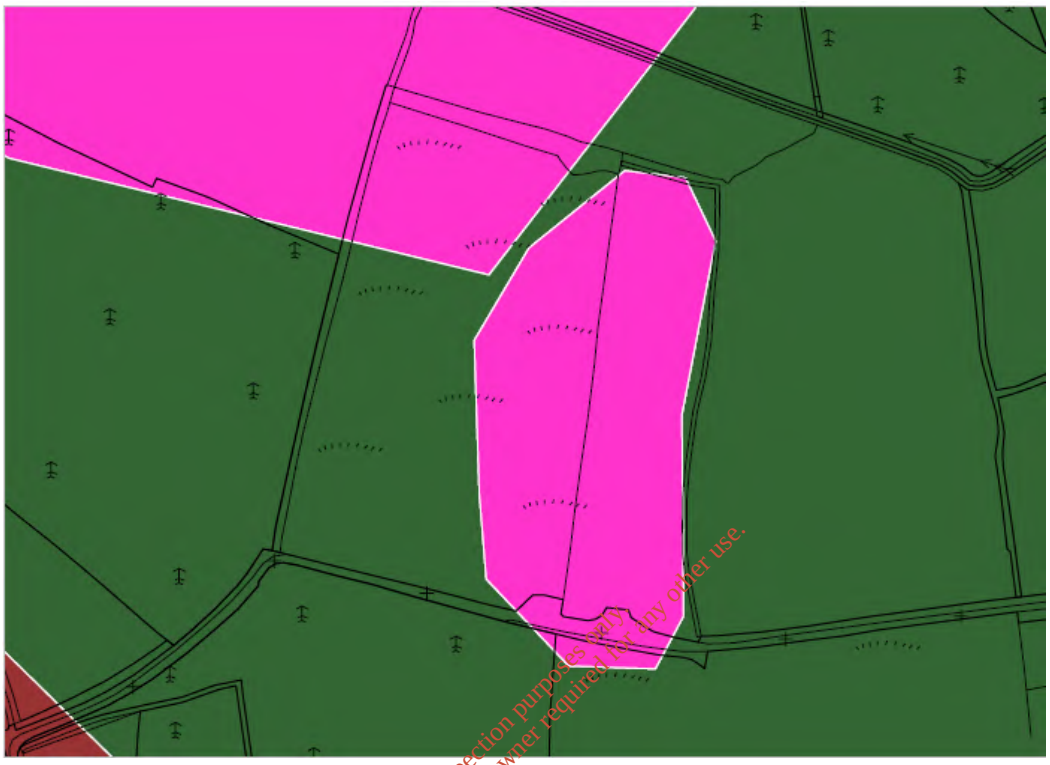
Aquifer Map



Rkc (Regionally important Karst Limestone Aquifer)

Site

Groundwater Vulnerability Map



High Vulnerability

Medium Vulnerability

Site

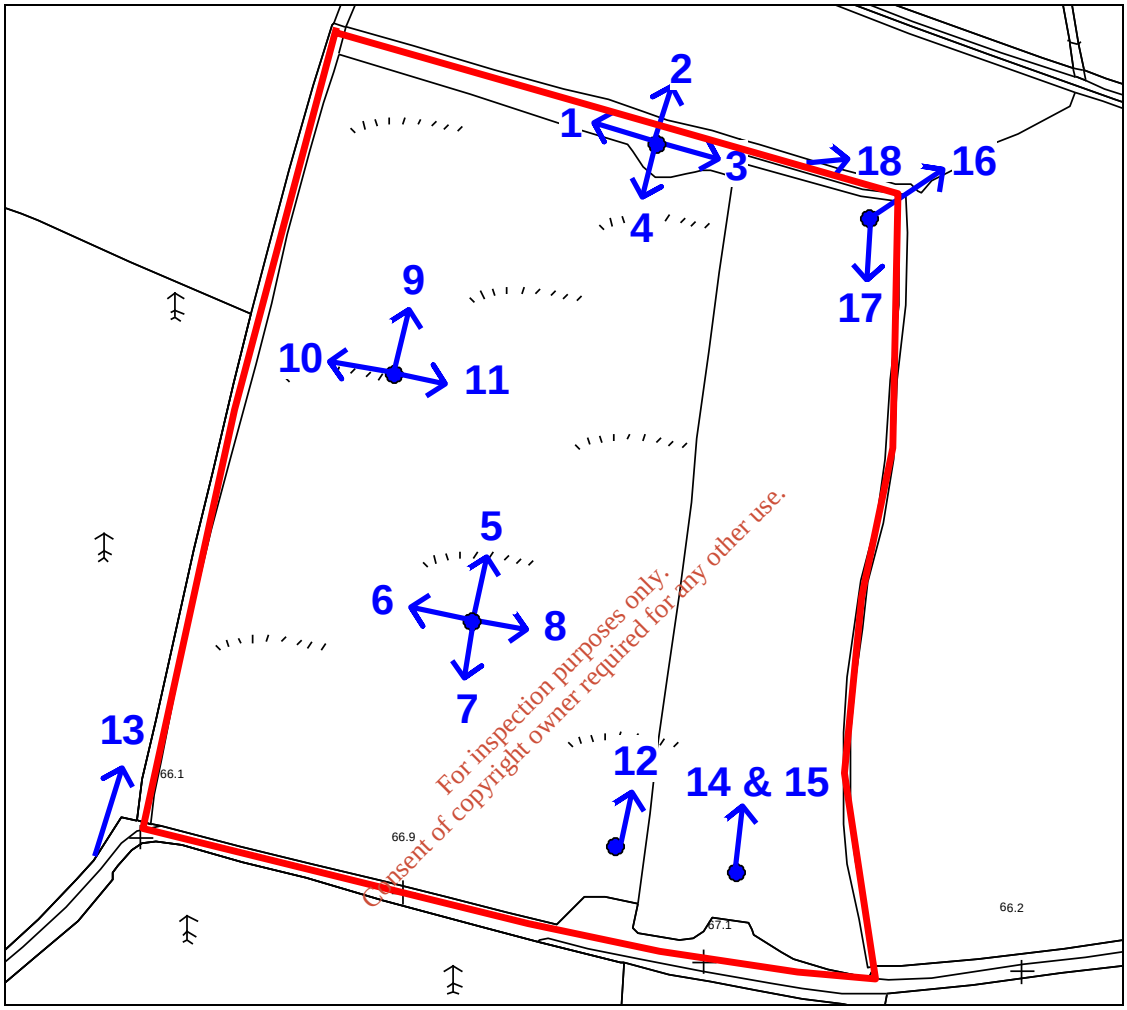
Sub Soil Map

Cutover Peat

Limestone sands & gravels - Carboniferous

Site

Reference Map for Photo Locations



Photographs taken on site

Photo 1

Photo 2

Photo 3

Photo 4

Photo 5

Photo 6

Photo 7

Photo 8

Photo 9

Photo 10

Photo 11

Photo 12

Photo 13

Photo 14

Photo 15

Photo 16

Photo 17

Photo 18

Land Registry

County Roscommon Folio 12322F

Register of Ownership of Freehold Land

Part 1(A) - The Property

For parts transferred see Part 1(B)

No.	Description	Official Notes
1	PLANS :A8K7 TOWNLAND :CLOONDACARRA BEG BARONY :CASTLEREAGH AREA : 2.64 HECTARES OS REFERENCE :26/12	FROM FOLIO 10598F

Land Registry

County Roscommon Folio 12322F

Part 1(B) - Property

Parts Transferred

No.	Prop No:	Instrument:	Date:	Area (Hectares):	Plan:	Folio No:

Land Registry

County Roscommon Folio 12322F

Part 2 - Ownership

Title ABSOLUTE

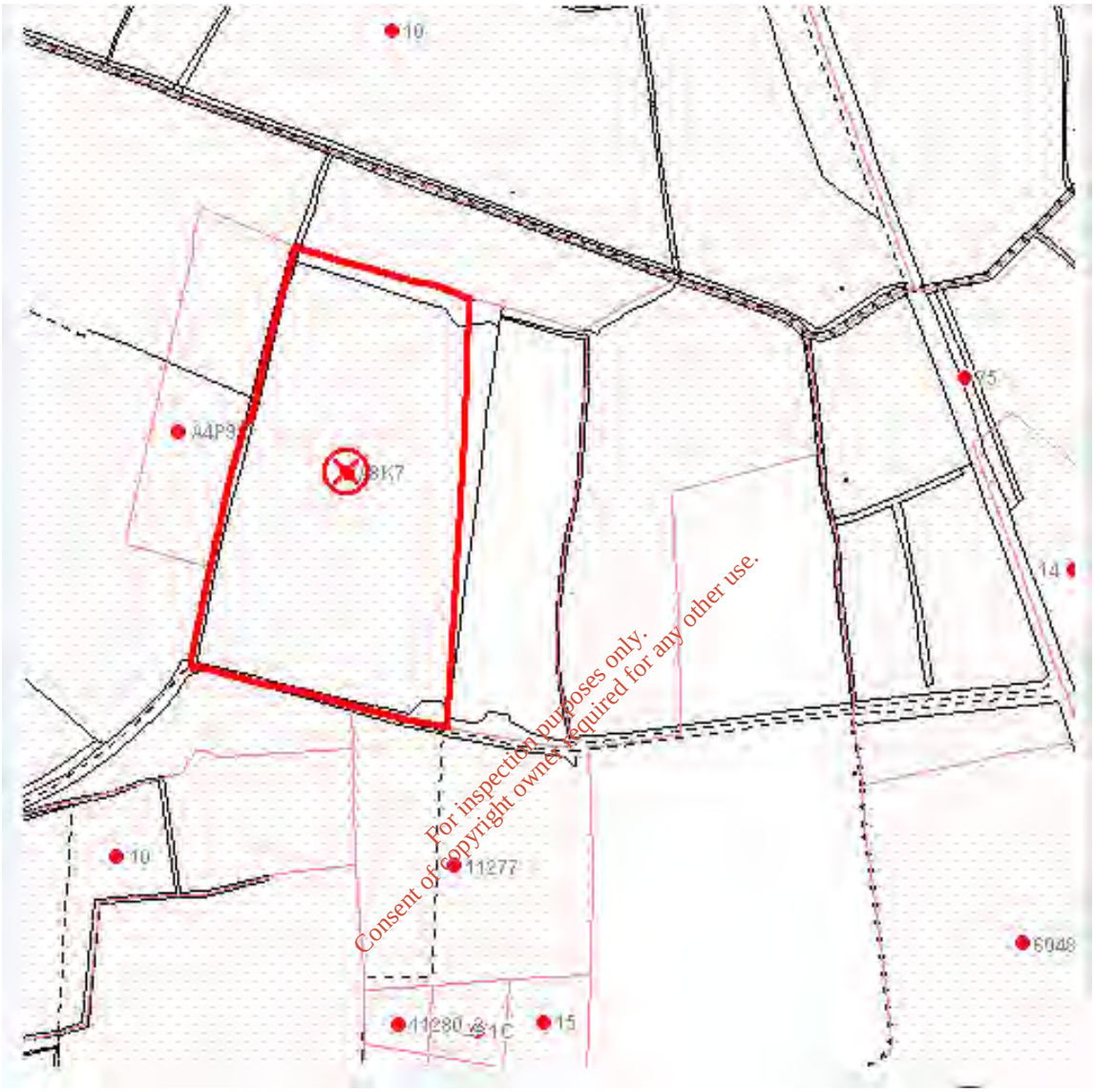
No.	The devolution of the property is subject to the provisions of Part II of the Succession Act, 1965
001	08-JAN-1990 THE COUNTY COUNCIL OF THE COUNTY OF ROSCOMMON (LOCAL AUTHORITY) THE COURTHOUSE, ROSCOMMON IS FULL OWNER 90CR00120

Land Registry

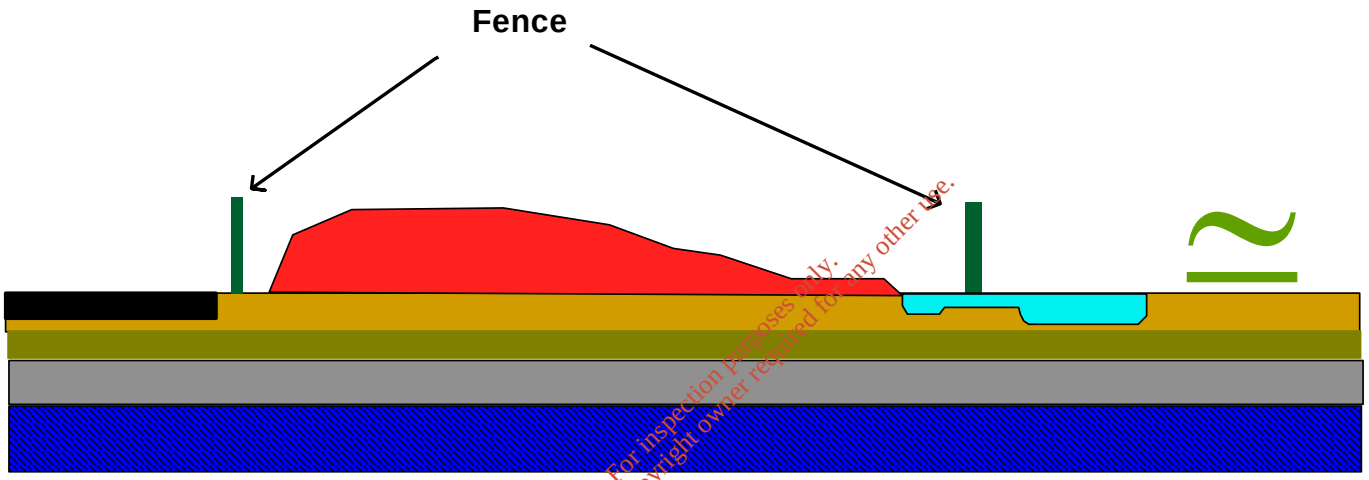
County Roscommon Folio 12322F

Part 3 - Burdens and Notices of Burdens

No.	Particulars	
01		THE PROPERTY IS SUBJECT TO THE PROVISIONS PROHIBITING LETTING, SUBLETTING OR SUBDIVISION SPECIFIED IN SECTION 12 OF THE LAND ACT, 1965, AND TO THE PROVISIONS RESTRICTING THE VESTING OF INTEREST SPECIFIED IN SECTION 45 OF THE SAID ACT IN SO FAR AS THE SAID PROVISIONS AFFECT SAME.
002	08-JAN-1990 90CR00120	THE PROPERTY HEREIN HAVING BEEN ACQUIRED BY THE REGISTERED OWNER THEREOF FOR ITS STATUTORY PURPOSES IS SUBJECT TO SUCH RESTRICTIONS AGAINST ALIENATION ORLETTING AS MAY BE CONTAINED IN THE STATUTORY ENACTMENTS RELATING TO SUCH PROPERTY



Conceptual Site Model for Castlerea Closed Landfill Site



Sources

- Waste Body

Receptors

- Drain/Stream
- Road
- Groundwater
- Plantation

Geology

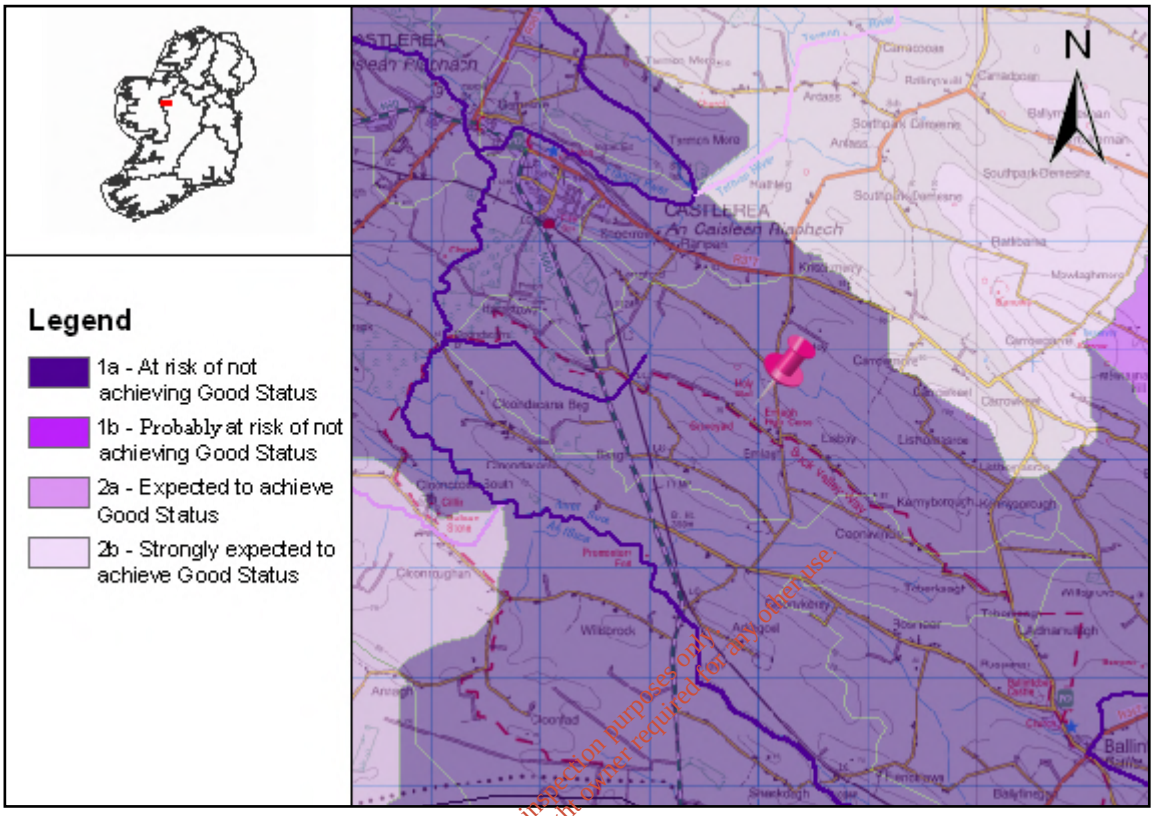
- Peat
- Boulder Clay
- Carboniferous Limestone

APPENDIX 2

Surface Water Body Report

water matters
'Our Plan'

Full Report for Waterbody Castlereagh, Trib of Suck



River Basin Management Plans (RBMPs) have been published for all River Basin Districts in Ireland in accordance with the requirements of the Water Framework Directive. The WaterMaps viewer is an integral part of the River Basin Management Plan and provides access to information at individual waterbody level and at Water Management Unit level for all the River Basin Districts in Ireland.

The following report provides summary plan information about the selected waterbody (indicated by the pin in the map above) relating to its status, risks, objectives, and measures proposed to retain status where this is adequate, or improve it where necessary. Waterbodies can relate to surface waters (these include rivers, lakes, estuaries [transitional waters], and coastal waters), or to groundwaters. Other relevant information not included in this report can be viewed using the WaterMaps viewer, including areas listed in the Register of Protected Areas.

You will find brief notes at the bottom of some of the individual report sheets that will help you in interpreting the information presented. More detailed information can be obtained in relation to all aspects of the RBMPs at www.wfdireland.ie.

Date Reported to Europe:July 2010

Date Report Created 15/11/2017

water matters
'Our Plan'

Summary Information:

Water Management Unit:	IE_SH_Suck
WaterBody Category:	River Waterbody
WaterBody Name:	Castlereagh, Trib of Suck
WaterBody Code:	IE_SH_26_2900
Overall Status:	Good
Overall Objective:	Protect
Overall Risk:	1a At Risk
Heavily Modified:	No

shannon river basin district

Report data based upon final RBMP, 2009-2015.

The information provided above is a summary of the principal findings related to the selected waterbody. Further details and explanation of individual elements of the report are outlined in the following pages.

Date Reported to Europe:July 2010

Date Report Created 15/11/2017

water matters
'Our Plan'

Status Report

Water Management Unit:	IE_SH_Suck
WaterBody Category:	River Waterbody
WaterBody Name:	Castlereagh, Trib of Suck
WaterBody Code:	IE_SH_26_2900
Overall Status Result:	Good
Heavily Modified:	No

shannon river basin district

	Status Element Description	Result
	Status information	
Q	Macroinvertebrate status	N/A
PC	General physico-chemical status	N/A
FPQ	Freshwater Pearl Mussel / Macroinvertebrate status	N/A
DIA	Diatoms status	N/A
HYM	Hydromorphology status	N/A
FIS	Fish status	N/A
SP	Specific Pollutants status (SP)	N/A
ES	Overall ecological status	Good
CS	Overall chemical status (PAS)	n/a
EXT	Extrapolated status	YES
MON	Monitored water body	NO
DON	Donor water bodies	SH_26_2775

n/a - not assessed

Status
By 'Status' we mean the condition of the water in the waterbody. It is defined by its chemical status and its ecological status, whichever is worse. Waters are ranked in one of 5 status classes: High, Good, Moderate, Poor, Bad. However, not all waterbodies have been monitored, and in such cases the status of a similar nearby waterbody has been used (extrapolated) to assign status. If this has been done the first line of the status report shows the code of the waterbody used to extrapolate.

You can read more about status and how it is measured in our RBMP Document Library at www.wfdireland.ie (Directory 15 Status).

Date Reported to Europe:July 2010

Date Report Created 15/11/2017

water matters
'Our Plan'

Risk Report

Water Management Unit: IE_SH_Suck

WaterBody Category: River Waterbody

WaterBody Name: Castlereagh, Trib of Suck

WaterBody Code: IE_SH_26_2900

Overall Risk Result: 1a At Risk

Heavily Modified: No

shannon river basin district

	Risk Test Description		Risk
	Diffuse Risk Sources		
RD1	EPA diffuse model (2008)	1b	Probably At Risk
RD2a	Road Wash - Soluble Copper	2b	Not At Risk
RD2b	Road Wash - Total Zinc	2b	Not At Risk
RD2c	Road Wash - Total Hydrocarbons	2b	Not At Risk
RD3	Railways	2b	Not At Risk
RD4a	Forestry - Acidification (2008)	2b	Not At Risk
RD4b	Forestry - Suspended Solids (2008)	2b	Not At Risk
RD4c	Forestry - Eutrophication (2008)	2a	Probably Not At Risk
RD5	Overall Unsewered (2008)	2b	Not At Risk
RD5a	Unsewered Areas - Pathogens (2008)	2a	Probably Not At Risk
RD5b	Unsewered Phosphorus (2008)	2b	Not At Risk
RD6a	Arable	2b	Not At Risk
RD6b	Sheep Dip	2b	Not At Risk
RD6c	Forestry - Dangerous Substances	2b	Not At Risk
RDO	Diffuse Overall -Worst Case (2008)	1b	Probably At Risk
	Hydrology		
RHY1	Water balance - Abstraction	2b	Not At Risk
	Morphological Risk Sources		
RM1	Channelisation (2008)	1a	At Risk
RM2	Embankments (2008)	2b	Not At Risk
RM3	Impoundments	2b	Not At Risk
RM4	Water Regulation	2b	Not At Risk
RM5	Intensive Landuse		N/A
RMO	Morphology Overall - Worst Case (2008)	1a	At Risk
	Overall Risk		
RA	Rivers Overall - Worst Case (2008)	1a	At Risk

Date Reported to Europe:July 2010

Date Report Created 15/11/2017

	Point Risk Sources		
RP1	WWTPs (2008)	2b	Not At Risk
RP2	CSOs	2b	Not At Risk
RP3	IPPCs (2008)	2b	Not At Risk
RP4	Section 4s (2008)	2b	Not At Risk
RP5	WTPs/Mines/Quarries/Landfills		N/A
RPO	Overall Risk from Point Sources - Worst Case (2008)	2b	Not At Risk
	Q Value		
Q	EPA Q rating and Margaritifera Assessment		N/A
	Q/RDI or Point/Diffuse		
QPD	Q class/EPA Diffuse Model or worst case of Point and Diffuse (2008)	1b	Probably At Risk
	Rivers Direct Impacts		
RDI1	Rivers Direct Impacts - Dangerous Substances		N/A

Risk
By 'risk' we mean the risk that a waterbody will not achieve good ecological or good chemical status/potential at least by 2015. To examine risk the various pressures acting on the waterbody were identified along with any evidence of impact on water status. Depending on the extent of the pressure and its potential for impact, and the amount of information available, the risk to the water body was placed in one of four categories: 1a at risk; 1b probably at risk; 2a probably not at risk; 2b not at risk. Note that '2008' after the risk category means that the risk assessment was revised in 2008. All other risks were determined as part of an earlier risk assessment in 2005.

You can read more about risk assessment in our 'WFD Risk Assessment Update' document in the RBMP document library, and other documents at www.wfdireland.ie (Directory 31 Risk Assessments).

Date Reported to Europe:July 2010

Date Report Created 15/11/2017

water matters
'Our Plan'

Objectives Report

Water Management Unit: IE_SH_Suck

WaterBody Category: River Waterbody

WaterBody Name: Castlereagh, Trib of Suck

WaterBody Code: IE_SH_26_2900

Overall Objective: Protect

Heavily Modified: No

shannon river basin district

	Objectives Description	Result
	Extended timescale information	
E1	Extended timescales due to time requirements to upgrade WWTP discharges	No Status
E2	Extended timescales due to delayed recovery of chemical pollution and chemical status failures	No Status
E3	Extended timescales due to delayed recovery following reduction in agricultural nutrient losses	No Status
E4	Extended timescales due to delayed recovery from physical modifications and physical damage	No Status
E5	Extended timescales due to delayed recovery following implementing forestry acidification measures	No Status
E6	Extended timescales due to physical recovery timescales at mines and contaminated sites	No Status
E7	Extended timescales due to delayed recovery of highly impacted sites	No Status
E8	Extended timescales due to delayed recovery following reduction in agricultural nutrient losses	No Status
E9	Extended timescales due to delayed recovery from nitrogen losses to estuaries	No Status
E10	Extended timescales due to delayed recovery following reduction in agricultural nutrient losses	No Status
E11	Extended timescales due to delayed recovery from physical modifications and physical damage (overgrazing)	No Status
E12	Extended timescales due to delayed recovery from physical modifications and physical damage (channelisation)	No Status
E13	Extended timescales from Northern Ireland Environment Agency	No Status
EOV	Overall extended timescale - combination of all extended timescales fields	No Status
E14	Extended timescales due to the presence of Freshwater Pearl Mussel populations	No Status
EX15	Extended timescales due to highly impacted sites	No Status

Date Reported to Europe:July 2010

Date Report Created 15/11/2017

water matters
'Our Plan'

	Objectives information	
OB1	Prevent deterioration objective	Protect
OB2	Restore at least good status objective	No Status
OB3	Reduce chemical pollution objective	No Status
OB4	Protected areas objective	No Status
OB5	Northern Ireland Environment Agency objective	No Status
OBO	Overall objectives	Protect

Extended timescales
Extended timescales have been set for certain waters due to technical, economic, environmental or recovery constraints. Extended timescales are usually of one planning cycle (6 years, to 2021) but in some cases are two planning cycles (to 2027).

Objectives
In general, we are required to ensure that our waters achieve at least good status/potential by 2015, and that their status does not deteriorate. Having identified the status of waters (this is given earlier in this report), the next stage is to set objectives for waters. Objectives consider waters that require protection from deterioration as well as waters that require restoration and the timescales needed for recovery. Four default objectives have been set initially:-

Prevent Deterioration
Restore Good Status
Reduce Chemical Pollution
Achieve Protected Areas Objectives

These objectives have been refined based on the measures available to achieve them, the latter's likely effectiveness, and consideration of cost-effective combinations of measures. Where it is considered necessary extended deadlines have been set for achieving objectives in 2021 or 2027.

Date Reported to Europe:July 2010

Date Report Created 15/11/2017

water matters
'Our Plan'

Measures Report

Water Management Unit: IE_SH_Suck

WaterBody Category: River Waterbody

WaterBody Name: Castlereagh, Trib of Suck

WaterBody Code: IE_SH_26_2900

Heavily Modified: No

shannon river basin district

	Measures Description	Applicable
BC	Total number of basic measures which apply to this waterbody	20
BW	Directive - Bathing Waters Directive	No
BIR	Directive - Birds Directive	No
HAB	Directive - Habitats Directive	No
DW	Directive - Drinking Waters Directive	No
MAE	Directive - Major Accidents and Emergencies Directive	Yes
EIA	Directive - Environmental Impact Assessment Directive	Yes
SS	Directive - Sewage Sludge Directive	Yes
UWT	Directive - Urban Waste Water Treatment Directive	Yes
PPP	Directive - Plant Protection Products Directive	Yes
NIT	Directive - Nitrates Directive	Yes
IPC	Directive - Integrated Pollution Prevention Control Directive	Yes
CR	Other Stipulated Measure - Cost recovery for water use	Yes
SUS	Other Stipulated Measure - Promotion of efficient and sustainable water use	Yes
DWS	Other Stipulated Measure - Protection of drinking water sources	Yes
ABS	Other Stipulated Measure - Control of abstraction and impoundment	Yes
POI	Other Stipulated Measure - Control of point source discharges	Yes
DIF	Other Stipulated Measure - Control of diffuse source discharges	Yes
PS	Other Stipulated Measure - Control of priority substances	Yes
MOD	Other Stipulated Measure - Controls on physical modifications to surface waters	Yes
OA	Other Stipulated Measure - Controls on other activities impacting on water status	Yes
AP	Other Stipulated Measure - Prevention or reduction of the impact of accidental pollution incidents	Yes
TP1	WSIP - Agglomerations with treatment plants requiring capital works	No
TP2	WSIP - Agglomerations with treatment plants requiring further investigation prior to capital works	No
TP3	WSIP - Agglomerations requiring the implementation of actions identified in Shellfish PRPs	No
TP4	WSIP - Agglomerations with treatment plants requiring improved operational performance	No
TP5	WSIP - Agglomerations requiring investigation of CSOs	No

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TP6	WSIP - Agglomerations where exisitng treatment capacity is currently adequate but predicted loadings would result in overloading	No
OTS	On-site waste water treatment systems	Yes
FPM	Freshwater Pearl Mussel sub-basin plan	No
SHE	Shellfish Pollution Reduction Plan	No
IPR	IPPC licences requiring review	No
WPR	Water Pollution Act licences requiring review	No
FOR	Forestry guidelines and regulations	Yes
CH1	Chanelisation measures	No
CH2	Chanelisation investigations	Yes
OG	Overgrazing measures	No
HQW	Protect high quality waters	No

Measures
Measures are necessary to ensure that we meet the objectives set out in the previous page of this report. Many measures are already provided for in national legislation and must be implemented. Other measures have been recently introduced or are under preparation. A range of additional potential measures are also being considered but require further development. Any agreed additional measures can be introduced through the update of Water Management Unit Action Plans during the implementation process.

You can read more about Basic Measures in 'River Basin Planning Guidance' and in other documents in our RBMP Document Library at www.wfdireland.ie.

Date Reported to Europe:July 2010

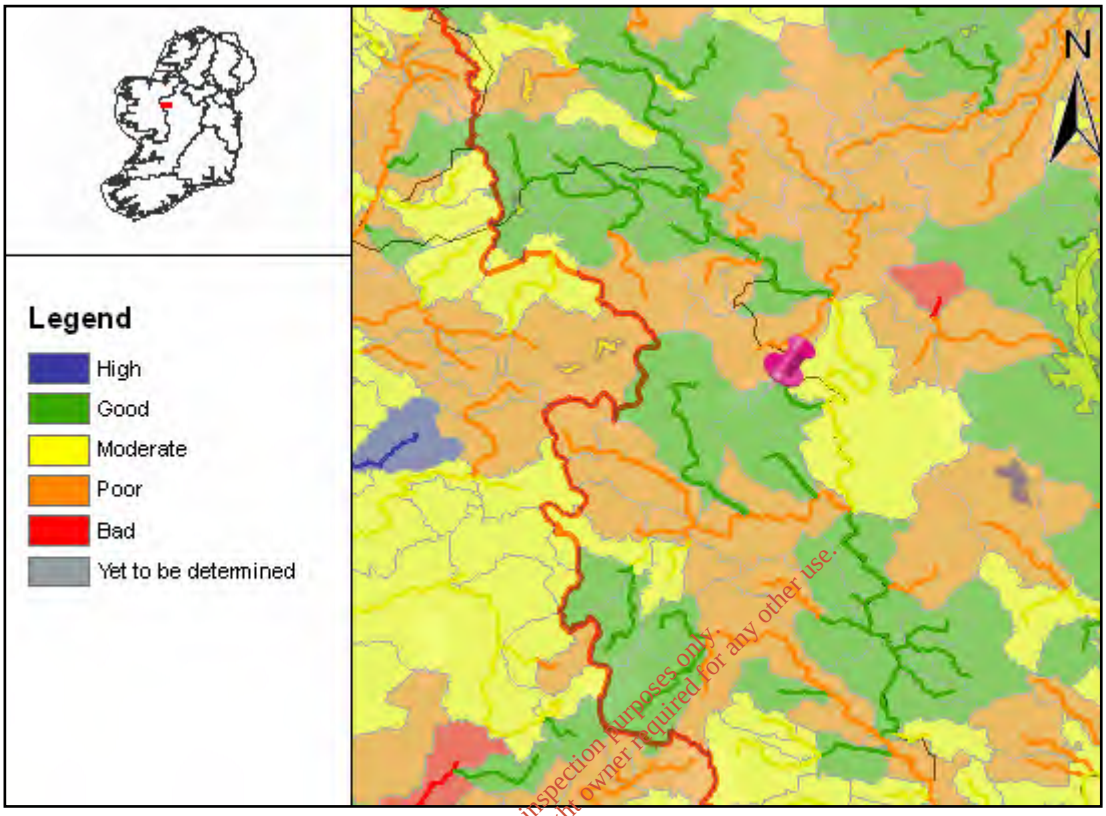
Date Report Created 15/11/2017

APPENDIX 3

Ground Water Body Report

water matters
'Our Plan'

Full Report for Waterbody Suck South



River Basin Management Plans (RBMPs) have been published for all River Basin Districts in Ireland in accordance with the requirements of the Water Framework Directive. The WaterMaps viewer is an integral part of the River Basin Management Plan and provides access to information at individual waterbody level and at Water Management Unit level for all the River Basin Districts in Ireland.

The following report provides summary plan information about the selected waterbody (indicated by the pin in the map above) relating to its status, risks, objectives, and measures proposed to retain status where this is adequate, or improve it where necessary. Waterbodies can relate to surface waters (these include rivers, lakes, estuaries [transitional waters], and coastal waters), or to groundwaters. Other relevant information not included in this report can be viewed using the WaterMaps viewer, including areas listed in the Register of Protected Areas.

You will find brief notes at the bottom of some of the individual report sheets that will help you in interpreting the information presented. More detailed information can be obtained in relation to all aspects of the RBMPs at www.wfdireland.ie.

Date Reported to Europe:July 2010

Date Report Created 18/12/2017

water matters
'Our Plan'

Summary Information:

Water Management Unit:	N/A
WaterBody Category:	Groundwater Waterbody
WaterBody Name:	Suck South
WaterBody Code:	IE_SH_G_225
Overall Status:	Poor
Overall Objective:	Restore_2021
Overall Risk:	1a At Risk
Heavily Modified:	No

shannon river basin district

Report data based upon final RBMP, 2009-2015.

The information provided above is a summary of the principal findings related to the selected waterbody. Further details and explanation of individual elements of the report are outlined in the following pages.

Date Reported to Europe:July 2010

Date Report Created 18/12/2017

water matters
'our Plan'

Chemical and Quantitative Status Report

Water Management Unit: N/A

WaterBody Category: Groundwater Waterbody

WaterBody Name: Suck South

WaterBody Code: IE_SH_G_225

Overall Status Result: Poor

Heavily Modified: No

shannon river basin district

	Status Element Description	Result
	Status information	
INS	Status associated with saline intrusion into groundwater	GS-HC
DWS	Status associated with exceedances of water quality above specific standards	GS-LC
DS	Chemical status of groundwater due to pressure from diffuse sources of pollution	GS-HC
CLS	Chemical status of groundwater due to pressure from contaminated soil or land.	GS-HC
MS	Chemical status of groundwater due to pressure from mine sites (active or closed).	GS-HC
UAS	Chemical status of groundwater due to pressures from urban areas	GS-HC
GWS	General groundwater quality status	GS-HC
RPS	Status associated with MRP loading to rivers	Poor Stat
TNS	Status associated with nitrate loading to transitional and coastal waters	GS-HC
SWS	Overall status associated with nutrient loadings to rivers and transitional and coastal waters	Poor Stat
SQS	Status associated with dependant surface water quantitative status	GS-HC
GDS	Groundwater dependant terrestrial ecosystems status	GS-HC
QSO	Quantitative status overall	GS-LC
CSO	Chemical status overall	Poor
OS	Overall status	Poor

GS -HC : Good status High Confidence
GS- LC : Good status Low Confidence
n/a - not assessed

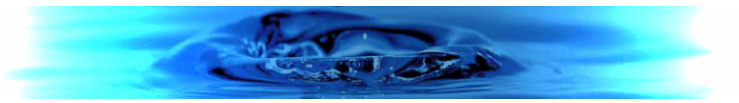
Status
By 'Status' we mean the condition of the water in the waterbody. It is defined by its chemical status and quantitative status, whichever is worse. Groundwaters are ranked in one of 2 status classes: Good or Poor.

You can read more about status and how it is measured in our RBMP Document Library at www.wfdireland.ie (Directory 15 Status).

Date Reported to Europe:July 2010

Date Report Created 18/12/2017

water matters
'our Plan'



Risk Report

Water Management Unit: N/A

WaterBody Category: Groundwater Waterbody

WaterBody Name: Suck South

WaterBody Code: IE_SH_G_225

Overall Risk Result: 1a At Risk

Heavily Modified: No

shannon river basin district

	Risk Test Description	Risk
	Groundwater Dependent Terrestrial Ecosystems	
TE	GWDTE Risk	N/A
	Groundwater Quality	
DIF	Diffuse Elements (General) Risk	N/A
DW	Drinking Waters Risk	N/A
INT	Intrusions Risk	N/A
WB	Water Balance Risk	N/A
	Groundwater Quality (General)	
GQ	General Groundwater Quality Risk	N/A
	Groundwater Quality (Point Risk)	
CL	Contaminated Land Risk	N/A
LF	Landfill Risk	N/A
MI	Mine Risk	N/A
QY	Quarry Risk	N/A
UR	Urban Risk	N/A
UW	UWWT Risk	N/A
	GW Diffuse Risk Sources	
WB3	Mobile Nutrients (NO3)	N/A
WB4	Mobile Chemicals	N/A
WB5	Clustered OSWTSs and leaking urban sewerage systems	N/A
	GW Hydrology	
WB1	Water balance - Abstraction	N/A
WB2	Abstraction - Intrusion	N/A

Date Reported to Europe:July 2010

Date Report Created 18/12/2017

	GW Point Risk Sources		
WB10	Risk from Point sources of pollution - Contaminated Land		N/A
WB11	Risk from Point sources of pollution - Trade Effluent Discharges		N/A
WB12	Risk from Point sources of pollution - Urban Wastewater Discharges		N/A
WB6	Risk from Point sources of pollution - Mines		N/A
WB7	Risk from Point sources of pollution - Quarries		N/A
WB8	Risk from Point sources of pollution - Landfills		N/A
WB9	Risk from Point sources of pollution - Oil Industry Infrastructure		N/A
	Overall Risk		
RA	Groundwater Overall - Worst Case		N/A
	Risk information		
CLR	Contaminated land risk	2b	Not At Risk
DR	Risk of groundwater due to pressure from diffuse sources of pollution	2a	Probably Not At Risk
DWR	Risk associated with exceedances of water quality above specific standards	2a	Probably Not At Risk
GDR	Groundwater dependant terrestrial ecosystems risk	2b	Not At Risk
GWR	General groundwater quality risk	2a	Probably Not At Risk
INR	Risk associated with saline intrusion into groundwater	2b	Not At Risk
LR	Risk due to landfills sites/old closed dump sites	2b	Not At Risk
MR	Mines risk	2b	Not At Risk
NULL	Diffuse nitrates from agriculture risk		N/A
QR	Risk due to quarries	2b	Not At Risk
RA	Revised risk assessment	1a	At Risk
RPR	Risk associated with MRP loading to rivers	1a	At Risk
SQR	Risk associated with dependant surface water quantitative status	2b	Not At Risk
SWR	Overall risk associated with nutrient loadings to rivers and transitional and coastal waters	1a	At Risk
TNR	Risk associated with nitrate loading to transitional and coastal waters	2b	Not At Risk
UAR	Risk of groundwater due to pressures from urban areas	2b	Not At Risk
UWR	Risk due to direct discharges of urban wastewater	2b	Not At Risk

Risk
By 'risk' we mean the risk that a waterbody will not achieve good ecological or good chemical status/potential at least by 2015. To examine risk the various pressures acting on the waterbody were identified along with any evidence of impact on water status. Depending on the extent of the pressure and its potential for impact, and the amount of information available, the risk to the water body was placed in one of four categories: 1a at risk; 1b probably at risk; 2a probably not at risk; 2b not at risk. Note that '2008' after the risk category means that the risk assessment was revised in 2008. All other risks were determined as part of an earlier risk assessment in 2005.

You can read more about risk assessment in our 'WFD Risk Assessment Update' document in the RBMP document library, and other documents at www.wfdireland.ie (Directory 31 Risk Assessments).

Date Reported to Europe:July 2010

Date Report Created 18/12/2017

water matters
'our Plan'

Objectives Report

Water Management Unit: N/A

WaterBody Category: Groundwater Waterbody

WaterBody Name: Suck South

WaterBody Code: IE_SH_G_225

Overall Objective: Restore_2021

Heavily Modified: No

shannon river basin district

	Objectives Description	Result
	Extended timescale information	
E1	Extended deadlines due to agricultural P	2021
E2	Extended deadlines due to agricultural N	No Status
E3	Extended deadlines due to mines	No Status
E4	Extended deadlines due to urban areas	No Status
E5	Extended deadlines due to contaminated lands	No Status
EO	Extended deadlines - overall	2021
	Objectives information	
OB1	Prevent deterioration objective	No Status
OB2	Restore at least good status objective	Restore_2021
OB3	Reduce chemical pollution objective	No Status
OB4	Protected areas objective	No Status
OBO	Overall objectives - objective	Restore_2021

Extended timescales
Extended timescales have been set for certain waters due to technical, economic, environmental or recovery constraints. Extended timescales are usually of one planning cycle (6 years, to 2021) but in some cases are two planning cycles (to 2027).

Objectives
In general, we are required to ensure that our waters achieve at least good status/potential by 2015, and that their status does not deteriorate. Having identified the status of waters (this is given earlier in this report), the next stage is to set objectives for waters. Objectives consider waters that require protection from deterioration as well as waters that require restoration and the timescales needed for recovery. Four default objectives have been set initially:-

Prevent Deterioration
Restore Good Status
Reduce Chemical Pollution
Achieve Protected Areas Objectives

These objectives have been refined based on the measures available to achieve them, the latter's likely effectiveness, and consideration of cost-effective combinations of measures. Where it is considered necessary extended deadlines have been set for achieving objectives in 2021 or 2027.

Date Reported to Europe:July 2010

Date Report Created 18/12/2017

water matters
'our Plan'

Measures Report

Water Management Unit: N/A

WaterBody Category: Groundwater Waterbody

WaterBody Name: Suck South

WaterBody Code: IE_SH_G_225

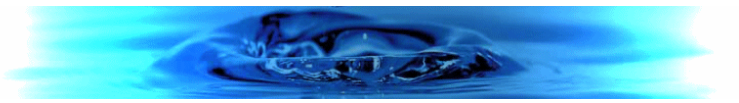
Heavily Modified: No

shannon river basin district

	Measures Description	Applicable
BC	Total number of basic measures which apply to this waterbody	25
BW	Directive - Bathing Waters Directive	No
BIR	Directive - Birds Directive	Yes
HAB	Directive - Habitats Directive	Yes
DW	Directive - Drinking Waters Directive	Yes
MAE	Directive - Major Accidents and Emergencies Directive	Yes
EIA	Directive - Environmental Impact Assessment Directive	Yes
SS	Directive - Sewage Sludge Directive	Yes
UWT	Directive - Urban Waste Water Treatment Directive	Yes
PPP	Directive - Plant Protection Products Directive	Yes
NIT	Directive - Nitrates Directive	Yes
IPC	Directive - Integrated Pollution Prevention Control Directive	Yes
CR	Other Stipulated Measure - Cost recovery for water use	Yes
SUS	Other Stipulated Measure - Promotion of efficient and sustainable water use	Yes
DWS	Other Stipulated Measure - Protection of drinking water sources	Yes
ABS	Other Stipulated Measure - Control of abstraction and impoundment	Yes
POI	Other Stipulated Measure - Control of point source discharges	Yes
DIF	Other Stipulated Measure - Control of diffuse source discharges	Yes
GW	Other Stipulated Measure - Authorisation of discharges to groundwaters	Yes
PS	Other Stipulated Measure - Control of priority substances	Yes
MOD	Other Stipulated Measure - Controls on physical modifications to surface waters	Yes
OA	Other Stipulated Measure - Controls on other activities impacting on water status	Yes
AP	Other Stipulated Measure - Prevention or reduction of the impact of accidental pollution incidents	Yes
OTS	On-site waste water treatment systems	Yes
FPM	Freshwater Pearl Mussel sub-basin plan	No
SHE	Shellfish Pollution Reduction Plan	No
IPR	IPPC licences requiring review	Yes
WPR	Water Pollution Act licences requiring review	Yes
FOR	Forestry guidelines and regulations	Yes

Date Reported to Europe:July 2010

Date Report Created 18/12/2017



HQW	Protect high quality waters	No

Measures
Measures are necessary to ensure that we meet the objectives set out in the previous page of this report. Many measures are already provided for in national legislation and must be implemented. Other measures have been recently introduced or are under preparation. A range of additional potential measures are also being considered but require further development. Any agreed additional measures can be introduced through the update of Water Management Unit Action Plans during the implementation process.

You can read more about Basic Measures in 'River Basin Planning Guidance' and in other documents in our RBMP Document Library at www.wfdireland.ie.

Date Reported to Europe:July 2010

Date Report Created 18/12/2017

APPENDIX 4

2017 Borehole Logs

Ground Investigations Ireland Ltd
www.gii.ie

Site Landfill Roscommon			**Borehole Number** L1
Machine : T44 Berreta **Flush :** **Core Dia :** mm **Method :** Open Hole Drilling	**Casing Diameter**	**Ground Level (mOD)**	**Client** O' Callaghan Moran **Job Number** 7219-11-17
	Location	**Dates** 22/12/2017	**Engineer** **Sheet** 1/1

Depth (m)	TCR	SCR	RQD	FI	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
							(0.50) 0.50	Driller notes: Soft CLAY - No Recovery.			
							(4.70)	Driller notes: RUBBISH - No Recovery.			
							5.20	Complete at 5.20m			

Remarks
50mm Standpipe installed 5.2m BGL in Borehole.

Scale (approx)	Logged By
1:50	CCostigan

Figure No. 7219-11-17.L1

Ground Investigations Ireland Ltd
www.gii.ie

Site Landfill Roscommon			**Borehole Number** MW1
Machine : T44 Berreta **Flush :** **Core Dia :** mm **Method :** Open Hole Drilling	**Casing Diameter**	**Ground Level (mOD)**	**Client** O' Callaghan Moran	**Job Number** 7219-11-17
	Location	**Dates** 22/12/2017	**Engineer**	**Sheet** 1/2

Depth (m)	TCR	SCR	RQD	FI	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
							(0.70)	Driller notes: FILL - No Recovery			
							0.70	Driller notes: PEAT- No Recovery			
							(6.00)				
							6.70	Driller notes: Grey SILT- No Recovery			
							(0.30)				
							7.00	Driller notes: Large Boulder - No Recovery			
							(1.50)				
							8.50	Driller notes: GRAVEL - No Recovery			

Remarks
50mm Standpipe installed 10.7m BGL in Borehole.

Scale (approx)	Logged By
1:50	CCostigan

Figure No. 7219-11-17.MW1

Ground Investigations Ireland Ltd
www.gii.ie

Site Landfill Roscommon			**Borehole Number** MW1
Machine : T44 Berreta **Flush :** **Core Dia :** mm **Method :** Open Hole Drilling	**Casing Diameter**	**Ground Level (mOD)**	**Client** O' Callaghan Moran **Job Number** 7219-11-17
	Location	**Dates** 22/12/2017	**Engineer** **Sheet** 2/2

Depth (m)	TCR	SCR	RQD	FI	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
							(3.00)				
							11.50	Driller notes: WEATHERED ROCK with sandy clay infill - No Recovery			
							(3.00)				
							14.50	Complete at 14.50m			

Remarks

Scale (approx)	Logged By
1:50	CCostigan

Figure No. 7219-11-17.MW1

Ground Investigations Ireland Ltd
www.gii.ie

Site Landfill Roscommon			**Borehole Number** MW2
Machine : T44 Berreta **Flush :** **Core Dia :** mm **Method :** Open Hole Drilling	**Casing Diameter**	**Ground Level (mOD)**	**Client** O' Callaghan Moran **Job Number** 7219-11-17
	Location	**Dates** 23/12/2017	**Engineer** **Sheet** 1/2

Depth (m)	TCR	SCR	RQD	FI	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
							(0.30) 0.30	Driller notes: FILL - No Recovery Driller notes: RUBBISH - No Recovery			
							(2.70) 3.00	Driller notes SILT - No Recovery			
							(5.30) 8.30	Driller notes: GRAVEL - No Recovery			
							(2.40)				

Remarks
50mm Standpipe installed 10.7m BGL in Borehole.

Scale (approx)	Logged By
1:50	CCostigan

Figure No. 7219-11-17.MW2

Ground Investigations Ireland Ltd
www.gii.ie

Site Landfill Roscommon			**Borehole Number** MW2
Machine : T44 Berreta **Flush :** **Core Dia :** mm **Method :** Open Hole Drilling	**Casing Diameter**	**Ground Level (mOD)**	**Client** O' Callaghan Moran
	Location	**Dates** 23/12/2017	**Engineer**
			Job Number 7219-11-17
			Sheet 2/2

Depth (m)	TCR	SCR	RQD	FI	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
							10.70	Complete at 10.70m			

Remarks

Scale (approx)	Logged By
1:50	CCostigan

Figure No. 7219-11-17.MW2

O'Callaghan Moran & Associates
Phone: 021 4345366

Trial Pit Number: TP01

Project: 17-239

Client: Roscommon County Co.

Location: Castlerea

Completion Depth: 1.3m

Groundwater entry: N/A

SWL (m): N/A

Depth (m)	Lithology Description	Lithology	Soil Sample Depth (m)	PID Readings (ppm)
0	Ground Surface			
	FILL Dark brown gravelly clayey peat FILL		Sampled at 0-1.3m	
1				
	Trial pit terminated on waste(domestic type waste)			
2				
3				
4				
5				

Excavation Method: Standard Excavator

Geologist: Billy Hamilton

Excavation Date: 21/11/2017

Sheet: 1 of 1

O'Callaghan Moran & Associates
Phone: 021 4345366

Trial Pit Number: TP02

Project: 17-239

Client: Roscommon County Co.

Location: Castlerea

Completion Depth: 1.15m

Groundwater entry: N/A

SWL (m): N/A

Depth (m)	Lithology Description	Lithology	Soil Sample Depth (m)	PID Readings (ppm)
0	Ground Surface			
	FILL Dark brown gravelly clayey peat FILL			
1	***FILL*** Brown sandy gravelly clay with FILL with cobbles		Sampled at 1.0-1.15m	
	Trial pit terminated on waste(domestic type waste)			
2				
3				
4				
5				

Excavation Method: Standard Excavator

Geologist: Billy Hamilton

Excavation Date: 21/11/2017

Sheet: 1 of 1

O'Callaghan Moran & Associates
Phone: 021 4345366

Trial Pit Number: TP03

Project: 17-239

Client: Roscommon County Co.

Location: Castlerea

Completion Depth: 1.3m

Groundwater entry: N/A

SWL (m): N/A

Depth (m)	Lithology Description	Lithology	Soil Sample Depth (m)	PID Readings (ppm)
0	Ground Surface			
	FILL Dark brown gravelly clayey peat FILL			
1	***FILL*** Brown sandy gravelly clay with FILL with cobbles and some plastic fragments			
	Trial pit terminated in fill material			
2				
3				
4				
5				

Excavation Method: Standard Excavator

Geologist: Billy Hamilton

Excavation Date: 21/11/2017

Sheet: 1 of 1

O'Callaghan Moran & Associates
Phone: 021 4345366

Trial Pit Number: TP04

Project: 17-239

Client: Roscommon County Co.

Location: Castlerea

Completion Depth: 0.7m

Groundwater entry: N/A

SWL (m): N/A

Depth (m)	Lithology Description	Lithology	Soil Sample Depth (m)	PID Readings (ppm)
0	Ground Surface			
	FILL Dark brown slightly sandy slightly gravelly clay FILL with some plastic fragments			
	FILL Brown sandy gravelly clay FILL			
	Trial pit terminated on waste			
1				
2				
3				
4				
5				

Excavation Method: Standard Excavator

Geologist: Billy Hamilton

Excavation Date: 21/11/2017

Sheet: 1 of 1

O'Callaghan Moran & Associates
Phone: 021 4345366

Trial Pit Number: TP05

Project: 17-239

Client: Roscommon County Co.

Location: Castlerea

Completion Depth: 0.45m

Groundwater entry: N/A

SWL (m): N/A

Depth (m)	Lithology Description	Lithology	Soil Sample Depth (m)	PID Readings (ppm)
0	Ground Surface			
	FILL Brown very sandy,very gravelly clay FILL with cobbles			
1	Trial pit terminated on waste(domestic type waste)			
2				
3				
4				
5				

Excavation Method: Standard Excavator

Geologist: Billy Hamilton

Excavation Date: 21/11/2017

Sheet: 1 of 1

O'Callaghan Moran & Associates
Phone: 021 4345366

Trial Pit Number: TP06

Project: 17-239

Client: Roscommon County Co.

Location: Castlerea

Completion Depth: 2.1m

Groundwater entry: N/A

SWL (m): N/A

Depth (m)	Lithology Description	Lithology	Soil Sample Depth (m)	PID Readings (ppm)
0	Ground Surface			
	FILL Mixed soil and stone-mainly brown sandy gravelly clay FILL with some plastic and concrete			
1	***FILL*** Light brown,slightly sandy,slightly gravelly clay FILL			
2	Trial pit terminated on waste(domestic type waste)			
3				
4				
5				

Excavation Method: Standard Excavator

Geologist: Billy Hamilton

Excavation Date: 21/11/2017

Sheet: 1 of 1

O'Callaghan Moran & Associates
Phone: 021 4345366

Trial Pit Number: TP07

Project: 17-239

Client: Roscommon County Co.

Location: Castlerea

Completion Depth: 2.6m

Groundwater entry: N/A

SWL (m): N/A

Depth (m)	Lithology Description	Lithology	Soil Sample Depth (m)	PID Readings (ppm)
0	Ground Surface			
	FILL Mixed soil and stone-mainly brown sandy gravelly clay FILL with some plastic and concrete			
1	***FILL*** Light brown,slightly sandy,slightly gravelly clay FILL			
2	Trial pit terminated on waste(domestic type waste)			
3				
4				
5				

Excavation Method: Standard Excavator

Geologist: Billy Hamilton

Excavation Date: 21/11/2017

Sheet: 1 of 1

O'Callaghan Moran & Associates
Phone: 021 4345366

Trial Pit Number: TP08

Project: 17-239

Client: Roscommon County Co.

Location: Castlerea

Completion Depth: 2.1m

Groundwater entry: N/A

SWL (m): N/A

Depth (m)	Lithology Description	Lithology	Soil Sample Depth (m)	PID Readings (ppm)
0	Ground Surface			
	FILL Mixed FILL mainly comprising brown peaty clay/clayey peat with gravel and some cobbles			
1				
	FILL Pale brown sandy gravelly clay FILL with some plastic fragments			
2	Trial pit terminated on waste(domestic type waste)			
3				
4				
5				

Excavation Method: Standard Excavator

Geologist: Billy Hamilton

Excavation Date: 21/11/2017

Sheet: 1 of 1

O'Callaghan Moran & Associates
Phone: 021 4345366

Trial Pit Number: TP09

Project: 17-239

Client: Roscommon County Co.

Location: Castlerea

Completion Depth: 0.35m

Groundwater entry: N/A

SWL (m): N/A

Depth (m)	Lithology Description	Lithology	Soil Sample Depth (m)	PID Readings (ppm)
0	Ground Surface			
	FILL Dark brown peaty sandy clay FILL			
	Trial pit terminated on waste(domestic type waste)			
1				
2				
3				
4				
5				

Excavation Method: Standard Excavator

Geologist: Billy Hamilton

Excavation Date: 21/11/2017

Sheet: 1 of 1

O'Callaghan Moran & Associates
Phone: 021 4345366

Trial Pit Number: TP10

Project: 17-239

Client: Roscommon County Co.

Location: Castlerea

Completion Depth: 0.4m

Groundwater entry: N/A

SWL (m): N/A

Depth (m)	Lithology Description	Lithology	Soil Sample Depth (m)	PID Readings (ppm)
0	Ground Surface			
	FILL Dark brown organic rich gravelly sandy clay FILL with some cobbles			
	Trial pit terminated on waste(domestic type waste)			
1				
2				
3				
4				
5				

Excavation Method: Standard Excavator

Geologist: Billy Hamilton

Excavation Date: 21/11/2017

Sheet: 1 of 1

O'Callaghan Moran & Associates
Phone: 021 4345366

Trial Pit Number: TP11

Project: 17-239

Client: Roscommon County Co.

Location: Castlerea

Completion Depth: 0.3m

Groundwater entry: N/A

SWL (m): N/A

Depth (m)	Lithology Description	Lithology	Soil Sample Depth (m)	PID Readings (ppm)
0	Ground Surface			
	FILL Black non-fibrous peat FILL			
	Trial pit terminated on waste(domestic type waste)			
1				
2				
3				
4				
5				

Excavation Method: Standard Excavator

Geologist: Billy Hamilton

Excavation Date: 21/11/2017

Sheet: 1 of 1

O'Callaghan Moran & Associates
Phone: 021 4345366

Trial Pit Number: TP12

Project: 17-239

Client: Roscommon County Co.

Location: Castlerea

Completion Depth: 0.15m

Groundwater entry: N/A

SWL (m): N/A

Depth (m)	Lithology Description	Lithology	Soil Sample Depth (m)	PID Readings (ppm)
0	Ground Surface			
	FILL Black non-fibrous peat FILL			
	Trial pit terminated on waste(domestic type waste)			
1				
2				
3				
4				
5				

Excavation Method: Standard Excavator

Geologist: Billy Hamilton

Excavation Date: 21/11/2017

Sheet: 1 of 1

O'Callaghan Moran & Associates
Phone: 021 4345366

Trial Pit Number: TP13

Project: 17-239

Client: Roscommon County Co.

Location: Castlerea

Completion Depth: 0.1m

Groundwater entry: N/A

SWL (m): N/A

Depth (m)	Lithology Description	Lithology	Soil Sample Depth (m)	PID Readings (ppm)
0	Ground Surface			
	FILL Black non-fibrous peat FILL			
	Trial pit terminated on waste(domestic type waste)			
1				
2				
3				
4				
5				

Excavation Method: Standard Excavator

Geologist: Billy Hamilton

Excavation Date: 21/11/2017

Sheet: 1 of 1

O'Callaghan Moran & Associates
Phone: 021 4345366

Trial Pit Number: TP13

Project: 17-239

Client: Roscommon County Co.

Location: Castlerea

Completion Depth: 0.1m

Groundwater entry: N/A

SWL (m): N/A

Depth (m)	Lithology Description	Lithology	Soil Sample Depth (m)	PID Readings (ppm)
0	Ground Surface			
	FILL Dark brown clayey non-fibrous FILL			
	Trial pit terminated on waste(domestic type waste)			
1				
2				
3				
4				
5				

Excavation Method: Standard Excavator

Geologist: Billy Hamilton

Excavation Date: 21/11/2017

Sheet: 1 of 1

O'Callaghan Moran & Associates
Phone: 021 4345366

Trial Pit Number: TP15

Project: 17-239

Client: Roscommon County Co.

Location: Castlerea

Completion Depth: 0.8m

Groundwater entry: N/A

SWL (m): N/A

Depth (m)	Lithology Description	Lithology	Soil Sample Depth (m)	PID Readings (ppm)
0	Ground Surface			
	PEAT Black clayey non-fibrous PEAT			
	FILL Light brown slight gravelly,slightly sandy clay FILL with occasional cobbles			
1	Trial pit terminated on waste(domestic type waste)			
2				
3				
4				
5				

Excavation Method: Standard Excavator

Geologist: Billy Hamilton

Excavation Date: 21/11/2017

Sheet: 1 of 1

APPENDIX 5

Permeability Test Results

SUMMARY OF TEST RESULTS

		Initial			Initial	Final
			Bulk Density	Mg/m3	1.301	1.264
Specimen Length	mm	117.02	Dry Density	Mg/m3	0.451	0.493
Specimen Diameter	mm	104.00	Moisture	%	188.5	156.6
Area	mm2	8494.87	Saturation	%	102.43	94.78
Volume	cc	994.07	Voids Ratio		4.8779	4.3785
Saturation Stage			Particle Density	Assumed	2.65	

Test Stage	Cell Pressure (kPa)	Pore Pressure Parameter 'B' Base
Initial	0	0
1	50	0.92
2	100	0.96
3	200	0.99
4	300	1.00
5	350	1.00

Isotropic Consolidation Stage

Cell Pressure	350	kPa
Back Pressure	300	kPa
Radial Effective stress	50	kPa
Test Temperature ° C	20	
Final Height Hf	114.20	mm
Coef. Of Consolidation Cv	9.660	m2/year
Coef. Of Vol. Compressibility mv	2.135	m2/MN
Permeability	6.3923E-09	m/sec

PERMEABILITY RESULTS

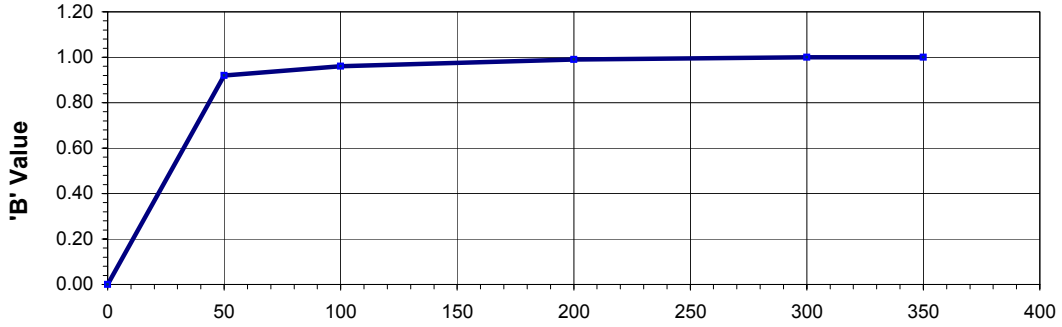
Cell Pressure		350	kPa
Top Pressure		310	kPa
Base Pressure		300	kPa
Mean Effective Stress		45.0	kPa
Moisture Content		156.6	%
Dry Density		0.493	Mg/m3
Voids ratio		4.3785	
Deg of Saturation		94.78	%
Hydraulic Gradient	i	8.933	
Mean Flow Rate q	Flow in	0.004200	mL/min
Permeability Kv	Flow in	1.006E-09	m/sec
Permeability Kv	Flow out	1.002E-09	m/sec
Test Temperature		20°C	

Notes
1 **Undisturbed**
2 **Direction of flow is down**

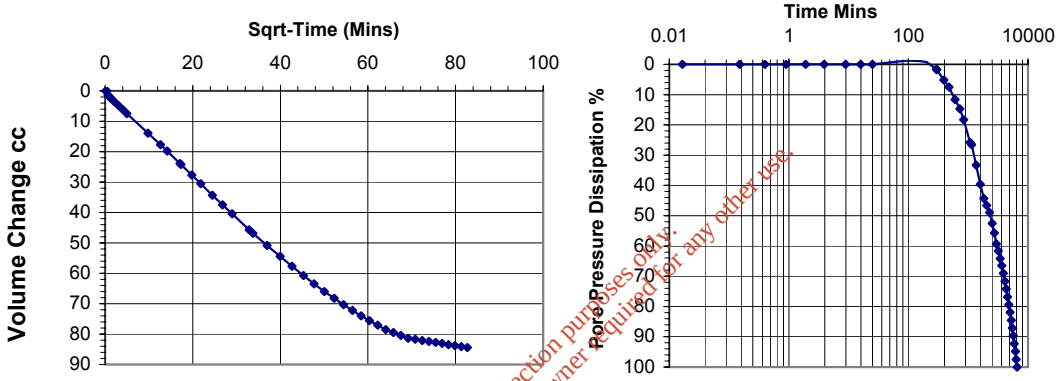
Sample Description **Soft dark brown /black very organic silty CLAY with some fine root fiber**

NM TL Ltd	**Constant Head Triaxial Permeability Test**	Project No.	NMTL-2373
	Test Method : BS 1377 : Part 6 : 1990	Chainage	TP1
	Project: Castlerea Landfill	Sample No.	B
		Depth.	N/A

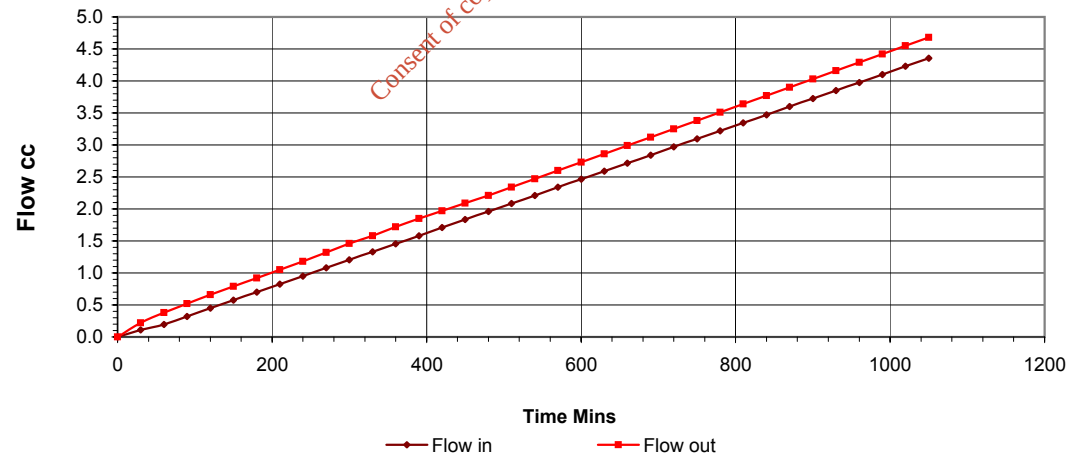
SATURATION STAGE



ISOTROPIC CONSOLIDATON STAGE



PERMEABILITY STAGE



NM TL Ltd	Constant Head Triaxial Permeability Test	Project No.	NMTL-2373
	Test Method : BS 1377 : Part 6 : 1990	Chainage	TP1
	Project: Castlerea Landfill	Sample No.	B
		Depth.	N/A

SUMMARY OF TEST RESULTS

		Initial			Initial	Final
			Bulk Density	Mg/m3	1.820	1.888
Specimen Length	mm	117.31	Dry Density	Mg/m3	1.349	1.459
Specimen Diameter	mm	102.00	Moisture	%	34.9	29.3
Area	mm2	8171.28	Saturation	%	96.03	95.30
Volume	cc	958.57	Voids Ratio		0.9643	0.8159
Saturation Stage			Particle Density	Assumed	2.65	

Test Stage	Cell Pressure (kPa)	Pore Pressure Parameter 'B' Base
Initial	0	0
1	50	0.88
2	100	0.97
3	200	0.97
4	300	0.99
5	350	0.99

Isotropic Consolidation Stage

Cell Pressure	350	kPa
Back Pressure	300	kPa
Radial Effective stress	50	kPa
Test Temperature ° C	20	
Final Height Hf	114.79	mm
Coef. Of Consolidation Cv	24.151	m2/year
Coef. Of Vol. Compressibility mv	1.632	m2/MN
Permeability	1.2218E-08	m/sec

PERMEABILITY RESULTS

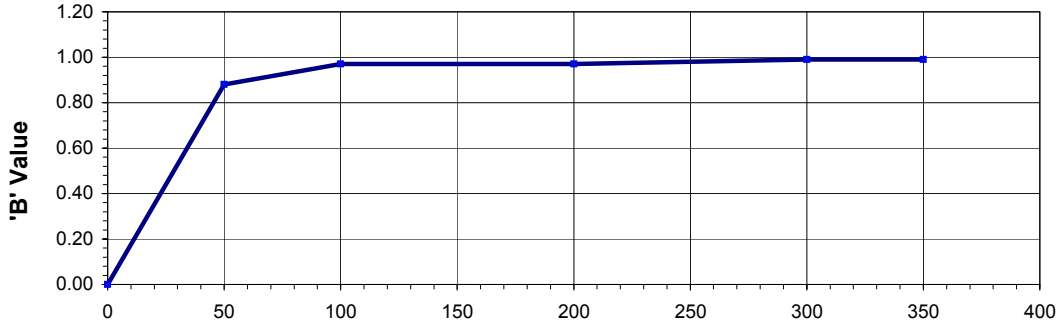
Cell Pressure		350	kPa
Top Pressure		310	kPa
Base Pressure		300	kPa
Mean Effective Stress		45.0	kPa
Moisture Content		29.3	%
Dry Density		1.459	Mg/m3
Voids ratio		0.8159	
Deg of Saturation		95.30	%
Hydraulic Gradient	i	8.886	
Mean Flow Rate q	Flow in	0.002667	mL/min
Permeability Kv	Flow in	6.464E-10	m/sec
Permeability Kv	Flow out	7.271E-10	m/sec
Test Temperature		20°C	

Notes
1 **Undisturbed**
2 **Direction of flow is down**

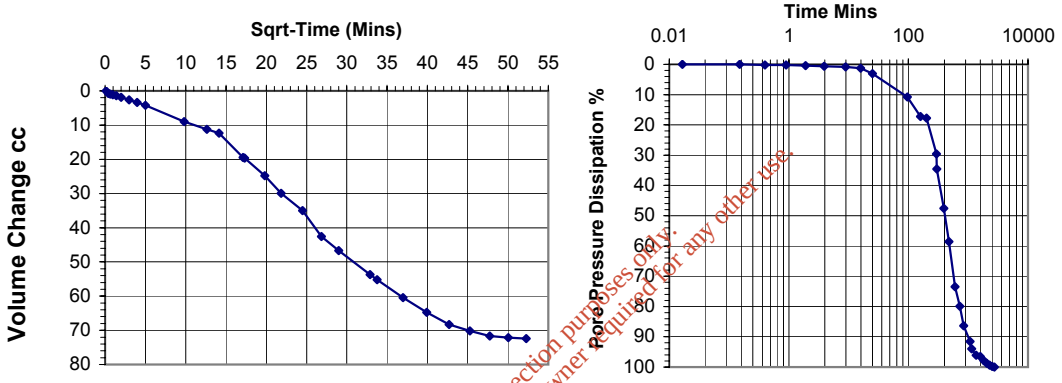
Sample Description **Soft dark brown slightly sandy slightly gravelly silty CLAY with some fine root fiber**

NM TL Ltd	**Constant Head Triaxial Permeability Test**	Project No.	NMTL-2373
	Test Method : BS 1377 : Part 6 : 1990	Chainage	TP2
	Project:	Sample No.	B
	Castlerea Landfill	Depth.	N/A

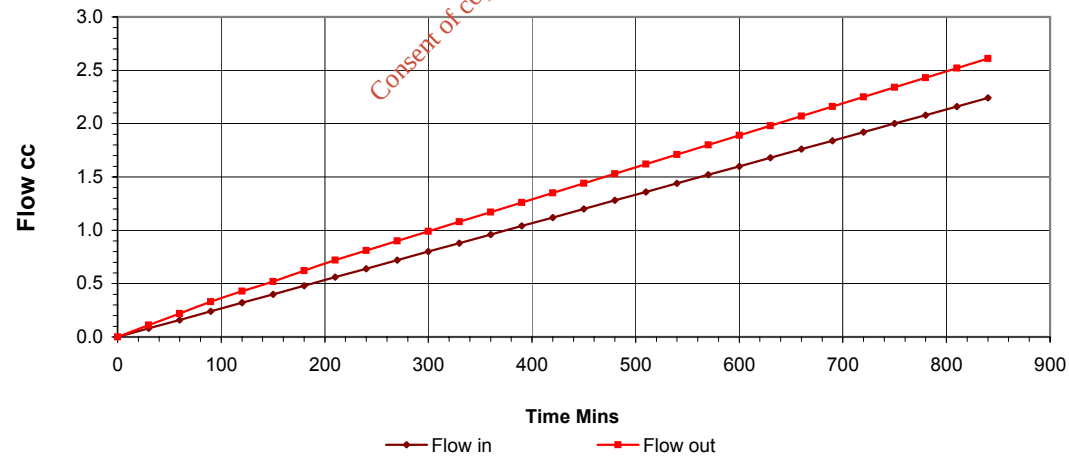
SATURATION STAGE



ISOTROPIC CONSOLIDATON STAGE



PERMEABILITY STAGE



NM TL Ltd	Constant Head Triaxial Permeability Test	Project No.	NMTL-2373
	Test Method : BS 1377 : Part 6 : 1990	Chainage	TP2
	Project: Castlerea Landfill	Sample No.	B
		Depth.	N/A

APPENDIX 6

OCM Sampling Protocols

STANDARD OPERATING PROCEDURE

GROUNDWATER SAMPLING

The primary objective of groundwater sampling is to evaluate whether the potential contaminant sources at a site have impacted the quality of the groundwater in the underlying aquifer. The additional objective is to measure hydraulic gradient, or slope, of the water table in the shallow aquifer in an effort to evaluate the direction of groundwater flow.

The purpose of this procedure is to ensure that representative samples of groundwater are collected and documented using consistent methods to ensure sample integrity.

1.0 SAMPLING PROCEDURES

1.1 Well Operating and Purging Procedures

All groundwater sampling will be conducted after the installed and developed wells have been allowed to equilibrate for at least 2 to 3 days. A Field Data Sheet for Well Sampling will be completed for each well.

Groundwater sampling teams will use to following procedure for approaching, opening, purging and sampling all wells unless directed otherwise by the workplan.

1) Prior to placing any equipment into the well, decontaminate the sampling equipment according to standard decontamination protocol.

2) Approach the well with a working FID/PID, a well key, and a depth-to-water meter.

3) Unlock and open the well cap just enough to insert the probe of the OVA or HNu. Take and record a reading. A decision to upgrade PPE may be necessary based on the FID/PID readings in the breathing zone.

4) Where practical, the surface water column will be visually examined for the presence of hydrocarbons, if present or suspected, the thickness of the hydrocarbon layer will be measured using an oil/water interface probe prior to taking the depth-to-water measurement.

5) Insert the water level probe into the well and measure and record the static water level to the nearest 0.01 m with respect to the established survey point on top of the well casing.

6) Decontaminate the water level probe with DDI water (Do not rinse with any solvents unless product was encountered).

7) Calculate and record the minimum volume of water to be purged according to the following conversion factors: -

1 well volume	=	water column in metres x litres/linear metre
2 inch casing	=	2.0 LPM
4 inch casing	=	8.1 LPM
6 inch casing	=	18.2 LPM
8 inch casing	=	32.4 LPM

8) Purge the well of at least 3 casing volumes by pumping or bailing with a decontaminated submersible pump or PVC bailer equipped with a bottom filling check valve (if the purge volume is low, generally less than 100 litres, the sampling team might find it more efficient to purge with a bailer than a pump). Use a graduated bucket to track the amount of water removed from the well. Periodically determine the pH, temperature and specific conductance of the purged water. Continue purging until the well has been completely evacuated or until the pH and specific conductance measurements have stabilised for at least one well volume. Wells that become dewatered prior to producing three casing volumes will be sampled as soon as practical once they recover sufficiently.

9) Dispose of purge water collected in the graduated bucket by dumping onto the ground at a distance of 50 to 60 metres from the vicinity of the well. If the water is known or suspected to be significantly contaminated, it may be necessary to store the purge water in a secure container, such as a drum, pending proper disposal.

10) Be aware and record any unusual occurrence during purging such as cascading (a shallow water entry zone that trickles into the borehole).

1.2 Field Parameter Measurement

Measurements of field parameters of pH, temperature and electrical conductivity are collected and organic vapour screening is conducted while the well is purged. To facilitate the collection of basic field parameters, the field team needs to: -

- Purge three well volumes of water from the well and measure field parameters for each well volume removed.

- Collection of water samples should take place after stabilisation of the following parameters: -

  - Temperature $^{+}$/- 1^{o}C
  - pH (meter or paper) $^{+}$/- 0.2 units
  - Specific conductivity $^{+}$/- 5%

- If the aforementioned parameters do not stabilise within three purge volumes, the well will be purged up to a maximum of six borehole volumes unless two consecutive sets of stabilised parameters are obtained.

- Note any observations in the field logbook.

1.3 Collection of Water Samples

All samples or chemical analysis will be placed in laboratory prepared bottles. The types of sample containers and preservative required for each type of analysis are described in the workplan. If required, preservatives will be placed in the sample containers prior to collecting the samples.

The following procedure will be used to sample a well: -

1) After the well has been purged and allowed to recover, sample the well using a properly decontaminated or dedicated disposable bailer. Gently lower the bailer into the water column. Allow the bailer to sink and fill with a minimum of surface disturbance.

2) Slowly raise the bailer out of the well. Do not allow the bailer line to contact the ground, either by coiling it on a clean plastic sheet or by looping it from arm to arm as the line is extracted from the well.

3) Samples will be collected for VOCs analysis immediately after purging is complete and before other samples are collected. Pour the samples slowly into the laboratory prepared 40 ml glass vial. Overfill each vial slightly to eliminate air bubbles, a convex meniscus should be present at the top of the vial. Ensure that the Teflon liner of the septum cap is facing inward and that no bubbles are entrapped. After capping securely, turn bottle upside-down, tap it against your other hand, and observe sample water for bubbles. If bubbles are observed, remove the cap, overfill the vial and reseal. Repeat this step for each vial until the samples with no bubbles are obtained.

4) Place a label on the container and enter the following information: -

   Client/Site Name
   Date Collected
   Time Collected
   Analysis
   Preservative
   Sample Identification Number

5) Record pertinent information in the field logbook and on the Field Data Sheet for Well Sampling. Complete chain-of-custody form.

6) Place custody seals on the container caps. As soon as possible, place sample containers in a cooler with bagged ice and maintain at 4^{o}C until extraction. Surround the bottles with vermiculite.

7) Obtain the semi-volatile compound/pesticides/PCBs sample(s) by transferring the water to a laboratory prepared 1000 ml amber glass bottle with Teflon-lined cap. Fill the bottle to the bottom of the neck and follow steps 4, 5 and 6 above.

8) Dissolved metals (if necessary) requires the team to filter the sample water through a .45 micron filter. The water is collected in a 1 litre, unpreserved, plastic or glass bottle with HNO_3 preservative. Filtering must be done within 15 minutes of sample collection.

9) Obtain the total metals sample by directly transferring the water from the bailer into a laboratory prepared 1000 ml plastic or glass bottle with HNO_3 preservative.

10) Be sure the pH of the metals sampled is less than 2 by pouring off an aliquot in a clean jar and testing for pH using litmus paper. Dispose of this water and rinse the jar.

11) Collect and prepare Field QA/QC samples in accordance with separate SOP.

12) Be sure to record all data required on the Field Data Sheet or Well Sampling and appropriate entries into the field logbook.

13) Secure the well cap and replace the locking cover.

14) Decontaminate all sampling equipment according to procedure.

15) Decontaminate submersible pumps as follows: -

Scrub pump and cord in a tub of Liquinox and potable water
Pump at least 80 litres of soapy water through pump
Rinse with potable water
Pump at least 80 litres of rinse water through the pump
Rinse with D1 water before lowering pump into the next well.

END.

STANDARD OPERATING PROCEDURE

SURFACE WATER SAMPLING

The primary objective of surface water sampling is to evaluate the chemical quality of a water body. The purpose of this procedure is to ensure that representative samples of surface water are collected and documented using consistent methods to ensure sample integrity. Surface water grab samples may be collected from rivers, streams, lakes and wetlands. In cases where the depth of the surface water body prevents sampling from the banks of the water body, sampling from, a boat may be required.

1.0 SAMPLING PROCEDURES

1) 1.1 Equipment Needed

- Personal protective clothing and equipment as required in the site-specific risk assessment.
- Decontamination equipment and supplies if known contaminated site.
- Temperature probe EC meter, pH meter, dissolved oxygen meter.
- Appropriate sample containers (some will be pre-preserved), labels and chain of custody documentation.
- Field logbook.
- Hard plastic cooler with ice pack.

1.2 Field Parameter Measurement

Measurements of field parameters of pH, temperature and electrical conductivity are made during sampling. Note visual (colour, turbidity) and odour (e.g hydrocarbon, hydrogen sulphide) characteristics in the field logbook.

1.3 Collection of Water Samples

All samples for chemical analysis will be placed in laboratory prepared bottles. The types of sample containers and preservative required for each type of analysis are described in the workplan. If required, preservatives will be placed in the sample containers prior to collecting the samples.

The following procedure will be used -

1) Slowly submerge unpreserved one-liter amber glass or plastic-capped bottles completely into the water. Open and fill bottle from below the water surface. If wading is required, approach the sample site from downstream and do not enter the actual sample area. Do not disturb bottom sediments. Open-end of the bottle should be pointed at approximately 90° to the upstream direction, in undisturbed gently flowing water. This procedure will be performed to minimize the effects due to high turbulence and aeration, or if surface scum is prevalent.

2) Collect a sufficient volume of water to fill all sample containers.

3) For VOC analysis. Pour the samples slowly into the laboratory prepared 40 ml glass vial. Overfill each vial slightly to eliminate air bubbles, a convex meniscus should be present at the top of the vial. Ensure that the Teflon liner of the septum cap is facing inward and that no bubbles are entrapped. After capping securely, turn bottle upside-down, tap it against your other hand, and observe sample water for bubbles. If bubbles are observed, remove the cap, overfill the vial and reseal. Repeat this step for each vial until the samples with no bubbles are obtained.

4) Obtain the semi-volatile compound/pesticides/PCBs sample(s) by transferring the water to a laboratory prepared 1000 ml amber glass bottle with Teflon-lined cap. Fill the bottle to the bottom of the neck and follow steps 4, 5 and 6 above.

5) Dissolved metals (if necessary) may require filtering the sample water through a .45 micron filter. The water is collected in a 1 litre, unpreserved, plastic or glass bottle with HNO_3 preservative. Filtering must be done within 15 minutes of sample collection.

6) Obtain the total metals sample by directly transferring the water into a laboratory prepared 1000 ml plastic or glass bottle with HNO_3 preservative. Ensure the pH of the metals sampled is less than 2 by pouring off an aliquot in a clean jar and testing for pH using litmus paper.

7) Collect and prepare Field QA/QC samples in accordance with separate SOP.

8) Place a label on the container and enter the following information: -

   Client/Site Name
   Date Collected
   Time Collected
   Analysis

Preservative
Sample Identification Number

9) Place custody seals on the container caps. As soon as possible, place sample containers in a cooler with ice and maintain at 4°C. Surround the bottles with packaging.

10) Record pertinent information in the field logbook and on the Field Data Sheet for Sampling Location. Complete chain-of-custody form, place in cooler and seal and label the cooler.

11) Be sure to record all data required on the Field Data Sheet or Sampling Location and appropriate entries into the field logbook.

12) Decontaminate all sampling equipment according to procedure.

END.

APPENDIX 7

Laboratory Results

Exova Jones Environmental

Registered Address : Exova (UK) Ltd, Lochend Industrial Estate, Newbridge, Midlothian, EH28 8PL

Unit 3 Deeside Point
Zone 3
Deeside Industrial Park
Deeside
CH5 2UA

Tel: +44 (0) 1244 833780
Fax: +44 (0) 1244 833781

O'Callaghan Moran & Associates
Unit 15
Melbourne Business Park
Model Farm
Cork
Ireland

Attention :	Sean Moran
Date :	12th December, 2017
Your reference :	17-239-01
Our reference :	Test Report 17/19572 Batch 1
Location :	Castlerea Landfill
Date samples received :	28th November, 2017
Status :	Final report
Issue :	1

Eight samples were received for analysis on 28th November, 2017 of which eight were scheduled for analysis. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.
All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

Compiled By:

Bruce Leslie
Project Co-ordinator

Client Name: O'Callaghan Moran & Associates
Reference: 17-239-01
Location: Castlerea Landfill
Contact: Sean Moran
JE Job No.: 17/19572

Report : Liquid

Liquids/products: V=40ml vial, G=glass bottle, P=plastic bottle
$H=H_2SO_4$, Z=ZnAc, N=NaOH, HN=$HN0_3$

Please see attached notes for all abbreviations and acronyms

J E Sample No.	1-8	9-16	17-24	25-32	33-40	41-48	49-56	57-64			LOD/LOR	Units	Method No.
Sample ID	MW1	MW2	CSW3	CSW6	L1	CSW1	CSW2	CSW5					
Depth													
COC No / misc													
Containers	V H P BOD G	V H P BOD G	V H P G	V H P G	V H P BOD G	V H P BOD G	V H P G	V H P G					
Sample Date	27/11/2017	27/11/2017	27/11/2017	27/11/2017	27/11/2017	27/11/2017	27/11/2017	27/11/2017					
Sample Type	Ground Water	Ground Water	Surface Water	Surface Water	Leachate	Surface Water	Surface Water	Surface Water					
Batch Number	1	1	1	1	1	1	1	1					
Date of Receipt	28/11/2017	28/11/2017	28/11/2017	28/11/2017	28/11/2017	28/11/2017	28/11/2017	28/11/2017					
Dissolved Arsenic	-	-	-	-	36.7	-	-	-			<2.5	ug/l	TM30/PM14
Dissolved Arsenic #	15.1	11.6	<2.5	5.7	-	4.5	7.6	3.6			<2.5	ug/l	TM30/PM14
Dissolved Boron	<12	12	<12	12	1632	<12	86	<12			<12	ug/l	TM30/PM14
Dissolved Cadmium	-	-	-	-	<0.5	-	-	-			<0.5	ug/l	TM30/PM14
Dissolved Cadmium #	<0.5	<0.5	<0.5	<0.5	-	<0.5	<0.5	<0.5			<0.5	ug/l	TM30/PM14
Dissolved Calcium	-	-	-	-	104.6	-	-	-			<0.2	mg/l	TM30/PM14
Dissolved Calcium #	181.4	111.5	38.9	89.2	-	60.6	95.0	117.0			<0.2	mg/l	TM30/PM14
Total Dissolved Chromium	-	-	-	-	12.0	-	-	-			<1.5	ug/l	TM30/PM14
Total Dissolved Chromium #	<1.5	<1.5	<1.5	<1.5	-	<1.5	<1.5	<1.5			<1.5	ug/l	TM30/PM14
Dissolved Copper	-	-	-	-	<7	-	-	-			<7	ug/l	TM30/PM14
Dissolved Copper #	<7	<7	<7	<7	-	<7	<7	<7			<7	ug/l	TM30/PM14
Dissolved Lead	-	-	-	-	<5	-	-	-			<5	ug/l	TM30/PM14
Dissolved Lead #	<5	<5	<5	<5	-	<5	<5	<5			<5	ug/l	TM30/PM14
Dissolved Magnesium	-	-	-	-	68.7	-	-	-			<0.1	mg/l	TM30/PM14
Dissolved Magnesium #	7.9	8.5	5.0	6.1	-	6.0	13.6	5.5			<0.1	mg/l	TM30/PM14
Dissolved Manganese	-	-	-	-	1183	-	-	-			<2	ug/l	TM30/PM14
Dissolved Manganese #	241	96	44	30	-	38	164	57			<2	ug/l	TM30/PM14
Dissolved Mercury	-	-	-	-	<1	-	-	-			<1	ug/l	TM30/PM14
Dissolved Mercury #	<1	<1	<1	<1	-	<1	<1	<1			<1	ug/l	TM30/PM14
Dissolved Nickel	-	-	-	-	45	-	-	-			<2	ug/l	TM30/PM14
Dissolved Nickel #	10	6	3	<2	-	<2	<2	<2			<2	ug/l	TM30/PM14
Dissolved Potassium	-	-	-	-	201.1_{AA}	-	-	-			<0.1	mg/l	TM30/PM14
Dissolved Potassium #	2.4	2.1	1.5	2.8	-	2.1	11.8	2.6			<0.1	mg/l	TM30/PM14
Dissolved Selenium	-	-	-	-	<3	-	-	-			<3	ug/l	TM30/PM14
Dissolved Selenium #	<3	<3	<3	<3	-	<3	<3	<3			<3	ug/l	TM30/PM14
Dissolved Sodium	-	-	-	-	3089.0_{AC}	-	-	-			<0.1	mg/l	TM30/PM14
Dissolved Sodium #	23.8	14.0	14.0	14.7	-	16.8	49.9	9.6			<0.1	mg/l	TM30/PM14
Dissolved Zinc	-	-	-	-	4	-	-	-			<3	ug/l	TM30/PM14
Dissolved Zinc #	10	5	<3	5	-	4	11	<3			<3	ug/l	TM30/PM14

Client Name: O'Callaghan Moran & Associates
Reference: 17-239-01
Location: Castlerea Landfill
Contact: Sean Moran
JE Job No.: 17/19572

Report : Liquid

Liquids/products: V=40ml vial, G=glass bottle, P=plastic bottle
H=H_2SO_4, Z=ZnAc, N=NaOH, HN=$HN0_3$

J E Sample No.	1-8	9-16	17-24	25-32	33-40	41-48	49-56	57-64			LOD/LOR	Units	Method No.
Sample ID	MW1	MW2	CSW3	CSW6	L1	CSW1	CSW2	CSW5					
Depth													
COC No / misc													
Containers	V H P BOD G	V H P BOD G	V H P G	V H P G	V H P BOD G	V H P BOD G	V H P G	V H P G					
Sample Date	27/11/2017	27/11/2017	27/11/2017	27/11/2017	27/11/2017	27/11/2017	27/11/2017	27/11/2017					
Sample Type	Ground Water	Ground Water	Surface Water	Surface Water	Leachate	Surface Water	Surface Water	Surface Water					
Batch Number	1	1	1	1	1	1	1	1					
Date of Receipt	28/11/2017	28/11/2017	28/11/2017	28/11/2017	28/11/2017	28/11/2017	28/11/2017	28/11/2017					
PAH MS													
Naphthalene	-	-	-	-	5.1	-	-	-			<0.1	ug/l	TM4/PM30
Naphthalene #	<0.1	<0.1	<0.1	<0.1	-	<0.1	<0.1	<0.1			<0.1	ug/l	TM4/PM30
Acenaphthylene	-	-	-	-	0.016	-	-	-			<0.013	ug/l	TM4/PM30
Acenaphthylene #	<0.013	<0.013	<0.013	<0.013	-	<0.013	<0.013	<0.013			<0.013	ug/l	TM4/PM30
Acenaphthene	-	-	-	-	0.270	-	-	-			<0.013	ug/l	TM4/PM30
Acenaphthene #	<0.013	<0.013	<0.013	<0.013	-	<0.013	<0.013	<0.013			<0.013	ug/l	TM4/PM30
Fluorene	-	-	-	-	0.188	-	-	-			<0.014	ug/l	TM4/PM30
Fluorene #	<0.014	<0.014	<0.014	<0.014	-	<0.014	<0.014	<0.014			<0.014	ug/l	TM4/PM30
Phenanthrene	-	-	-	-	0.345	-	-	-			<0.011	ug/l	TM4/PM30
Phenanthrene #	<0.011	<0.011	<0.011	<0.011	-	<0.011	<0.011	<0.011			<0.011	ug/l	TM4/PM30
Anthracene	-	-	-	-	0.052	-	-	-			<0.013	ug/l	TM4/PM30
Anthracene #	<0.013	<0.013	<0.013	<0.013	-	<0.013	<0.013	<0.013			<0.013	ug/l	TM4/PM30
Fluoranthene	-	-	-	-	0.178	-	-	-			<0.012	ug/l	TM4/PM30
Fluoranthene #	<0.012	<0.012	<0.012	<0.012	-	<0.012	<0.012	<0.012			<0.012	ug/l	TM4/PM30
Pyrene	-	-	-	-	0.133	-	-	-			<0.013	ug/l	TM4/PM30
Pyrene #	<0.013	<0.013	<0.013	<0.013	-	<0.013	<0.013	<0.013			<0.013	ug/l	TM4/PM30
Benzo(a)anthracene	-	-	-	-	0.048	-	-	-			<0.015	ug/l	TM4/PM30
Benzo(a)anthracene #	<0.015	<0.015	<0.015	<0.015	-	<0.015	<0.015	<0.015			<0.015	ug/l	TM4/PM30
Chrysene	-	-	-	-	0.064	-	-	-			<0.011	ug/l	TM4/PM30
Chrysene #	<0.011	<0.011	<0.011	<0.011	-	<0.011	<0.011	<0.011			<0.011	ug/l	TM4/PM30
Benzo(bk)fluoranthene	-	-	-	-	0.057	-	-	-			<0.018	ug/l	TM4/PM30
Benzo(bk)fluoranthene #	<0.018	<0.018	<0.018	<0.018	-	<0.018	<0.018	<0.018			<0.018	ug/l	TM4/PM30
Benzo(a)pyrene	-	-	-	-	0.034	-	-	-			<0.016	ug/l	TM4/PM30
Benzo(a)pyrene #	<0.016	<0.016	<0.016	<0.016	-	<0.016	<0.016	<0.016			<0.016	ug/l	TM4/PM30
Indeno(123cd)pyrene	-	-	-	-	0.013	-	-	-			<0.011	ug/l	TM4/PM30
Indeno(123cd)pyrene #	<0.011	<0.011	<0.011	<0.011	-	<0.011	<0.011	<0.011			<0.011	ug/l	TM4/PM30
Dibenzo(ah)anthracene	-	-	-	-	<0.01	-	-	-			<0.01	ug/l	TM4/PM30
Dibenzo(ah)anthracene #	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01			<0.01	ug/l	TM4/PM30
Benzo(ghi)perylene	-	-	-	-	0.014	-	-	-			<0.011	ug/l	TM4/PM30
Benzo(ghi)perylene #	<0.011	<0.011	<0.011	<0.011	-	<0.011	<0.011	<0.011			<0.011	ug/l	TM4/PM30
PAH 16 Total	-	-	-	-	6.512	-	-	-			<0.195	ug/l	TM4/PM30
PAH 16 Total #	<0.195	<0.195	<0.195	<0.195	-	<0.195	<0.195	<0.195			<0.195	ug/l	TM4/PM30
Benzo(b)fluoranthene	<0.01	<0.01	<0.01	<0.01	0.04	<0.01	<0.01	<0.01			<0.01	ug/l	TM4/PM30
Benzo(k)fluoranthene	<0.01	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01			<0.01	ug/l	TM4/PM30
PAH Surrogate % Recovery	92	76	85	79	72	82	80	81			<0	%	TM4/PM30

Please see attached notes for all abbreviations and acronyms

Client Name: O'Callaghan Moran & Associates
Reference: 17-239-01
Location: Castlerea Landfill
Contact: Sean Moran
JE Job No.: 17/19572

Report : Liquid

Liquids/products: V=40ml vial, G=glass bottle, P=plastic bottle
$H=H_2SO_4$, Z=ZnAc, N=NaOH, $HN=HN0_3$

J E Sample No.	1-8	9-16	17-24	25-32	33-40	41-48	49-56	57-64			LOD/LOR	Units	Method No.
Sample ID	MW1	MW2	CSW3	CSW6	L1	CSW1	CSW2	CSW5					
Depth													
COC No / misc													
Containers	V H P BOD G	V H P BOD G	V H P G	V H P G	V H P BOD G	V H P BOD G	V H P G	V H P G					
Sample Date	27/11/2017	27/11/2017	27/11/2017	27/11/2017	27/11/2017	27/11/2017	27/11/2017	27/11/2017					
Sample Type	Ground Water	Ground Water	Surface Water	Surface Water	Leachate	Surface Water	Surface Water	Surface Water					
Batch Number	1	1	1	1	1	1	1	1					
Date of Receipt	28/11/2017	28/11/2017	28/11/2017	28/11/2017	28/11/2017	28/11/2017	28/11/2017	28/11/2017					
Pesticides													
Organochlorine Pesticides													
Aldrin	<0.01	<0.01	<0.01	<0.01	<0.20$_{AC}$	<0.01	<0.01	<0.01			<0.01	ug/l	TM149/PM30
Alpha-HCH (BHC)	<0.01	<0.01	<0.01	<0.01	<0.20$_{AC}$	<0.01	<0.01	<0.01			<0.01	ug/l	TM149/PM30
Beta-HCH (BHC)	<0.01	<0.01	<0.01	<0.01	<0.20$_{AC}$	<0.01	<0.01	<0.01			<0.01	ug/l	TM149/PM30
Delta-HCH (BHC)	<0.01	<0.01	<0.01	<0.01	<0.20$_{AC}$	<0.01	<0.01	<0.01			<0.01	ug/l	TM149/PM30
Dieldrin	<0.01	<0.01	<0.01	<0.01	<0.20$_{AC}$	<0.01	<0.01	<0.01			<0.01	ug/l	TM149/PM30
Endosulphan I	<0.01	<0.01	<0.01	<0.01	<0.20$_{AC}$	<0.01	<0.01	<0.01			<0.01	ug/l	TM149/PM30
Endosulphan II	<0.01	<0.01	<0.01	<0.01	<0.20$_{AC}$	<0.01	<0.01	<0.01			<0.01	ug/l	TM149/PM30
Endosulphan sulphate	<0.01	<0.01	<0.01	<0.01	<0.20$_{AC}$	<0.01	<0.01	<0.01			<0.01	ug/l	TM149/PM30
Endrin	<0.01	<0.01	<0.01	<0.01	<0.20$_{AC}$	<0.01	<0.01	<0.01			<0.01	ug/l	TM149/PM30
Gamma-HCH (BHC)	<0.01	<0.01	<0.01	<0.01	<0.20$_{AC}$	<0.01	<0.01	<0.01			<0.01	ug/l	TM149/PM30
Heptachlor	<0.01	<0.01	<0.01	<0.01	<0.20$_{AC}$	<0.01	<0.01	<0.01			<0.01	ug/l	TM149/PM30
Heptachlor Epoxide	<0.01	<0.01	<0.01	<0.01	<0.20$_{AC}$	<0.01	<0.01	<0.01			<0.01	ug/l	TM149/PM30
o,p'-Methoxychlor	<0.01	<0.01	<0.01	<0.01	<0.20$_{AC}$	<0.01	<0.01	<0.01			<0.01	ug/l	TM149/PM30
p,p'-DDE	<0.01	<0.01	<0.01	<0.01	<0.20$_{AC}$	<0.01	<0.01	<0.01			<0.01	ug/l	TM149/PM30
p,p'-DDT	<0.01	<0.01	<0.01	<0.01	<0.20$_{AC}$	<0.01	<0.01	<0.01			<0.01	ug/l	TM149/PM30
p,p'-Methoxychlor	<0.01	<0.01	<0.01	<0.01	<1.00$_{AD}$	<0.01	<0.05$_{AA}$	<0.01			<0.01	ug/l	TM149/PM30
p,p'-TDE	<0.01	<0.01	<0.01	<0.01	<0.20$_{AC}$	<0.01	<0.01	<0.01			<0.01	ug/l	TM149/PM30
Organophosphorus Pesticides													
Azinphos methyl	<0.01	<0.01	<0.01	<0.01	<0.20$_{AC}$	<0.01	<0.01	<0.01			<0.01	ug/l	TM149/PM30
Diazinon	<0.01	<0.01	<0.01	<0.01	<0.20$_{AC}$	<0.01	<0.01	<0.01			<0.01	ug/l	TM149/PM30
Dichlorvos	<0.01	<0.01	<0.01	<0.01	<0.20$_{AC}$	<0.01	<0.01	<0.01			<0.01	ug/l	TM149/PM30
Disulfoton	<0.01	<0.01	<0.01	<0.01	<0.20$_{AC}$	<0.01	<0.01	<0.01			<0.01	ug/l	TM149/PM30
Ethion	<0.01	<0.01	<0.01	<0.01	<0.20$_{AC}$	<0.01	<0.01	<0.01			<0.01	ug/l	TM149/PM30
Ethyl Parathion (Parathion)	<0.01	<0.01	<0.01	<0.01	<0.20$_{AC}$	<0.01	<0.01	<0.01			<0.01	ug/l	TM149/PM30
Fenitrothion	<0.01	<0.01	<0.01	<0.01	<0.20$_{AC}$	<0.01	<0.01	<0.01			<0.01	ug/l	TM149/PM30
Malathion	<0.01	<0.01	<0.01	<0.01	<0.20$_{AC}$	<0.01	<0.01	<0.01			<0.01	ug/l	TM149/PM30
Methyl Parathion	<0.01	<0.01	<0.01	<0.01	<0.20$_{AC}$	<0.01	<0.01	<0.01			<0.01	ug/l	TM149/PM30
Mevinphos	<0.01	<0.01	<0.01	<0.01	<0.20$_{AC}$	<0.01	<0.01	<0.01			<0.01	ug/l	TM149/PM30
Benazolin	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1			<0.1	ug/l	TM42/PM30
Bentazone	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1			<0.1	ug/l	TM42/PM30
Bromoxynil	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1			<0.1	ug/l	TM42/PM30
Clopyralid	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1			<0.1	ug/l	TM42/PM30
4 - CPA	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1			<0.1	ug/l	TM42/PM30
2,4 - D	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1			<0.1	ug/l	TM42/PM30
2,4 - DB	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1			<0.1	ug/l	TM42/PM30
Dicamba	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1			<0.1	ug/l	TM42/PM30
Dichloroprop	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1			<0.1	ug/l	TM42/PM30
Diclofop	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1			<0.1	ug/l	TM42/PM30
Fenoprop	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1			<0.1	ug/l	TM42/PM30
Flamprop	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1			<0.1	ug/l	TM42/PM30
Flamprop – isopropyl	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1			<0.1	ug/l	TM42/PM30

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Client Name: O'Callaghan Moran & Associates
Reference: 17-239-01
Location: Castlerea Landfill
Contact: Sean Moran
JE Job No.: 17/19572

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Depth													
COC No / misc													
Containers	V H P BOD G	V H P BOD G	V H P G	V H P G	V H P BOD G	V H P BOD G	V H P G	V H P G					
Sample Date	27/11/2017	27/11/2017	27/11/2017	27/11/2017	27/11/2017	27/11/2017	27/11/2017	27/11/2017					
Sample Type	Ground Water	Ground Water	Surface Water	Surface Water	Leachate	Surface Water	Surface Water	Surface Water					
Batch Number	1	1	1	1	1	1	1	1					
Date of Receipt	28/11/2017	28/11/2017	28/11/2017	28/11/2017	28/11/2017	28/11/2017	28/11/2017	28/11/2017					
loxynil	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1			<0.1	ug/l	TM42/PM30
MCPA	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1			<0.1	ug/l	TM42/PM30
MCPB	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1			<0.1	ug/l	TM42/PM30
Mecoprop	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1			<0.1	ug/l	TM42/PM30
Picloram	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1			<0.1	ug/l	TM42/PM30
Pentachlorophenol	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1			<0.1	ug/l	TM42/PM30
2,4,5 - T	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1			<0.1	ug/l	TM42/PM30
2,3,6 - TBA	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1			<0.1	ug/l	TM42/PM30
Triclopyr	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1			<0.1	ug/l	TM42/PM30
Resorcinol	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			<0.01	mg/l	TM26/PM0
Catechol	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			<0.01	mg/l	TM26/PM0
Phenol	-	-	-	-	0.81 AC	-	-	-			<0.01	mg/l	TM26/PM0
Phenol #	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01			<0.01	mg/l	TM26/PM0
m/p-cresol	<0.02	<0.02	<0.02	<0.02	2.30 AC	<0.02	<0.02	<0.02			<0.02	mg/l	TM26/PM0
o-cresol	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			<0.01	mg/l	TM26/PM0
Total cresols	-	-	-	-	2.30	-	-	-			<0.03	mg/l	TM26/PM0
Total cresols #	<0.03	<0.03	<0.03	<0.03	-	<0.03	<0.03	<0.03			<0.03	mg/l	TM26/PM0
Xylenols	-	-	-	-	<0.06	-	-	-			<0.06	mg/l	TM26/PM0
Xylenols #	<0.06	<0.06	<0.06	<0.06	-	<0.06	<0.06	<0.06			<0.06	mg/l	TM26/PM0
1-naphthol	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			<0.01	mg/l	TM26/PM0
2,3,5-trimethyl phenol	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			<0.01	mg/l	TM26/PM0
2-isopropylphenol	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			<0.01	mg/l	TM26/PM0
Total Speciated Phenols HPLC	<0.1	<0.1	<0.1	<0.1	3.1	<0.1	<0.1	<0.1			<0.1	mg/l	TM26/PM0
Sulphate as SO4	-	-	-	-	1.9	-	-	-			<0.5	mg/l	TM38/PM0
Sulphate as SO4 #	2.2	2.2	65.4	14.8	-	38.1	25.2	1.5			<0.5	mg/l	TM38/PM0
Chloride	-	-	-	-	4160.3	-	-	-			<0.3	mg/l	TM38/PM0
Chloride #	39.4	33.3	27.0	25.1	-	30.5	88.2	17.0			<0.3	mg/l	TM38/PM0
Nitrate as NO3	-	-	-	-	<0.2	-	-	-			<0.2	mg/l	TM38/PM0
Nitrate as NO3 #	<0.2	<0.2	7.5	6.2	-	5.8	22.9	2.0			<0.2	mg/l	TM38/PM0
Nitrite as NO2	-	-	-	-	0.89	-	-	-			<0.02	mg/l	TM38/PM0
Nitrite as NO2 #	<0.02	<0.02	0.03	0.03	-	0.02	0.16	<0.02			<0.02	mg/l	TM38/PM0
Ortho Phosphate as P	-	-	-	-	0.36	-	-	-			<0.03	mg/l	TM38/PM0
Ortho Phosphate as P #	<0.03	<0.03	<0.03	<0.03	-	0.04	<0.03	<0.03			<0.03	mg/l	TM38/PM0
Total Oxidised Nitrogen as N	-	-	-	-	<0.2	-	-	-			<0.2	mg/l	TM38/PM0
Total Oxidised Nitrogen as N #	<0.2	<0.2	1.7	1.4	-	1.3	5.2	0.5			<0.2	mg/l	TM38/PM0
Total Cyanide	-	-	-	-	0.03	-	-	-			<0.01	mg/l	TM89/PM0
Total Cyanide #	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01			<0.01	mg/l	TM89/PM0
Ammoniacal Nitrogen as N	-	-	-	-	1051.57	-	-	-			<0.03	mg/l	TM38/PM0
Ammoniacal Nitrogen as N #	7.88	5.67	0.23	1.11	-	0.37	17.86	0.23			<0.03	mg/l	TM38/PM0

Please see attached notes for all abbreviations and acronyms

Client Name: O'Callaghan Moran & Associates
Reference: 17-239-01
Location: Castlerea Landfill
Contact: Sean Moran
JE Job No.: 17/19572

Report : Liquid

Liquids/products: V=40ml vial, G=glass bottle, P=plastic bottle
$H=H_2SO_4$, Z=ZnAc, N=NaOH, $HN=HN0_3$

J E Sample No.	1-8	9-16	17-24	25-32	33-40	41-48	49-56	57-64			LOD/LOR	Units	Method No.
Sample ID	MW1	MW2	CSW3	CSW6	L1	CSW1	CSW2	CSW5					
Depth													
COC No / misc													
Containers	V H P BOD G	V H P BOD G	V H P G	V H P G	V H P BOD G	V H P BOD G	V H P G	V H P G					
Sample Date	27/11/2017	27/11/2017	27/11/2017	27/11/2017	27/11/2017	27/11/2017	27/11/2017	27/11/2017					
Sample Type	Ground Water	Ground Water	Surface Water	Surface Water	Leachate	Surface Water	Surface Water	Surface Water					
Batch Number	1	1	1	1	1	1	1	1					
Date of Receipt	28/11/2017	28/11/2017	28/11/2017	28/11/2017	28/11/2017	28/11/2017	28/11/2017	28/11/2017					
BOD (Settled)	-	-	-	-	494	-	-	-			<1	mg/l	TM58/PM0
BOD (Settled) #	3	<1	3	2	-	<1	2	<1			<1	mg/l	TM58/PM0
COD (Settled)	-	-	-	-	3330 AB	-	-	-			<7	mg/l	TM57/PM0
COD (Settled) #	40	11	111	57	-	88	64	39			<7	mg/l	TM57/PM0
Total Organic Carbon	-	-	-	-	418	-	-	-			<2	mg/l	TM60/PM0
Total Organic Carbon #	12	<2	43	23	-	36	20	10			<2	mg/l	TM60/PM0
Total Suspended Solids	-	-	-	-	2754	-	-	-			<10	mg/l	TM37/PM0
Total Suspended Solids #	940	14	<10	<10	-	35	17	<10			<10	mg/l	TM37/PM0

Please see attached notes for all abbreviations and acronyms

Client Name: O'Callaghan Moran & Associates
Reference: 17-239-01
Location: Castlerea Landfill
Contact: Sean Moran
JE Job No.: 17/19572

SVOC Report : **Liquid**

J E Sample No.	1-8	9-16	17-24	25-32	33-40	41-48	49-56	57-64					
Sample ID	MW1	MW2	CSW3	CSW6	L1	CSW1	CSW2	CSW5					
Depth											Please see attached notes for all abbreviations and acronyms		
COC No / misc													
Containers	V H P BOD G	V H P BOD G	V H P G	V H P G	V H P BOD G	V H P BOD G	V H P G	V H P G					
Sample Date	27/11/2017	27/11/2017	27/11/2017	27/11/2017	27/11/2017	27/11/2017	27/11/2017	27/11/2017					
Sample Type	Ground Water	Ground Water	Surface Water	Surface Water	Leachate	Surface Water	Surface Water	Surface Water					
Batch Number	1	1	1	1	1	1	1	1			LOD/LOR	Units	Method No.
Date of Receipt	28/11/2017	28/11/2017	28/11/2017	28/11/2017	28/11/2017	28/11/2017	28/11/2017	28/11/2017					
SVOC MS													
Phenols													
2-Chlorophenol	-	-	-	-	<10 AB	-	-	-			<1	ug/l	TM16/PM30
2-Chlorophenol #	<1	<1	<1	<1	-	<1	<1	<1			<1	ug/l	TM16/PM30
2-Methylphenol	-	-	-	-	<5.0 AB	-	-	-			<0.5	ug/l	TM16/PM30
2-Methylphenol #	<0.5	<0.5	<0.5	<0.5	-	<0.5	<0.5	<0.5			<0.5	ug/l	TM16/PM30
2-Nitrophenol	<0.5	<0.5	<0.5	<0.5	<5.0 AB	<0.5	<0.5	<0.5			<0.5	ug/l	TM16/PM30
2,4-Dichlorophenol	-	-	-	-	<5.0 AB	-	-	-			<0.5	ug/l	TM16/PM30
2,4-Dichlorophenol #	<0.5	<0.5	<0.5	<0.5	-	<0.5	<0.5	<0.5			<0.5	ug/l	TM16/PM30
2,4-Dimethylphenol	<1	<1	<1	<1	<10 AB	<1	<1	<1			<1	ug/l	TM16/PM30
2,4,5-Trichlorophenol	-	-	-	-	<5.0 AB	-	-	-			<0.5	ug/l	TM16/PM30
2,4,5-Trichlorophenol #	<0.5	<0.5	<0.5	<0.5	-	<0.5	<0.5	<0.5			<0.5	ug/l	TM16/PM30
2,4,6-Trichlorophenol	<1	<1	<1	<1	<10 AB	<1	<1	<1			<1	ug/l	TM16/PM30
4-Chloro-3-methylphenol	-	-	-	-	<5.0 AB	-	-	-			<0.5	ug/l	TM16/PM30
4-Chloro-3-methylphenol #	<0.5	<0.5	<0.5	<0.5	-	<0.5	<0.5	<0.5			<0.5	ug/l	TM16/PM30
4-Methylphenol	<1	<1	<1	<1	1536 AB	<1	<1	<1			<1	ug/l	TM16/PM30
4-Nitrophenol	<10	<10	<10	<10	<100 AB	<10	<10	<10			<10	ug/l	TM16/PM30
Pentachlorophenol	<1	<1	<1	<1	<10 AB	<1	<1	<1			<1	ug/l	TM16/PM30
Phenol	<1	<1	<1	<1	630 AB	<1	<1	<1			<1	ug/l	TM16/PM30
PAHs													
2-Chloronaphthalene	-	-	-	-	<10 AB	-	-	-			<1	ug/l	TM16/PM30
2-Chloronaphthalene #	<1	<1	<1	<1	-	<1	<1	<1			<1	ug/l	TM16/PM30
2-Methylnaphthalene	-	-	-	-	<10 AB		-	-			<1	ug/l	TM16/PM30
2-Methylnaphthalene #	<1	<1	<1	<1	-	<1	<1	<1			<1	ug/l	TM16/PM30
Phthalates													
Bis(2-ethylhexyl) phthalate	<5	<5	<5	<5	<50 AB	<5	<5	<5			<5	ug/l	TM16/PM30
Butylbenzyl phthalate	<1	<1	<1	<1	<10 AB	<1	<1	<1			<1	ug/l	TM16/PM30
Di-n-butyl phthalate	-	-	-	-	<15.0 AB	-	-	-			<1.5	ug/l	TM16/PM30
Di-n-butyl phthalate #	<1.5	<1.5	<1.5	<1.5	-	<1.5	<1.5	<1.5			<1.5	ug/l	TM16/PM30
Di-n-Octyl phthalate	<1	<1	<1	<1	<10 AB	<1	<1	<1			<1	ug/l	TM16/PM30
Diethyl phthalate	-	-	-	-	<10 AB	-	-	-			<1	ug/l	TM16/PM30
Diethyl phthalate #	<1	<1	<1	<1	-	<1	<1	<1			<1	ug/l	TM16/PM30
Dimethyl phthalate	<1	<1	<1	<1	<10 AB	<1	<1	<1			<1	ug/l	TM16/PM30

Client Name: O'Callaghan Moran & Associates
Reference: 17-239-01
Location: Castlerea Landfill
Contact: Sean Moran
JE Job No.: 17/19572

SVOC Report : **Liquid**

J E Sample No.	1-8	9-16	17-24	25-32	33-40	41-48	49-56	57-64					
Sample ID	MW1	MW2	CSW3	CSW6	L1	CSW1	CSW2	CSW5					
Depth											Please see attached notes for all abbreviations and acronyms		
COC No / misc													
Containers	V H P BOD G	V H P BOD G	V H P G	V H P G	V H P BOD G	V H P BOD G	V H P G	V H P G					
Sample Date	27/11/2017	27/11/2017	27/11/2017	27/11/2017	27/11/2017	27/11/2017	27/11/2017	27/11/2017					
Sample Type	Ground Water	Ground Water	Surface Water	Surface Water	Leachate	Surface Water	Surface Water	Surface Water					
Batch Number	1	1	1	1	1	1	1	1			LOD/LOR	Units	Method No.
Date of Receipt	28/11/2017	28/11/2017	28/11/2017	28/11/2017	28/11/2017	28/11/2017	28/11/2017	28/11/2017					
SVOC MS													
Other SVOCs													
1,2-Dichlorobenzene	-	-	-	-	<10$_{AB}$	-	-	-			<1	ug/l	TM16/PM30
1,2-Dichlorobenzene #	<1	<1	<1	<1	-	<1	<1	<1			<1	ug/l	TM16/PM30
1,2,4-Trichlorobenzene	-	-	-	-	<10$_{AB}$	-	-	-			<1	ug/l	TM16/PM30
1,2,4-Trichlorobenzene #	<1	<1	<1	<1	-	<1	<1	<1			<1	ug/l	TM16/PM30
1,3-Dichlorobenzene	-	-	-	-	<10$_{AB}$	-	-	-			<1	ug/l	TM16/PM30
1,3-Dichlorobenzene #	<1	<1	<1	<1	-	<1	<1	<1			<1	ug/l	TM16/PM30
1,4-Dichlorobenzene	-	-	-	-	<10$_{AB}$	-	-	-			<1	ug/l	TM16/PM30
1,4-Dichlorobenzene #	<1	<1	<1	<1	-	<1	<1	<1			<1	ug/l	TM16/PM30
2-Nitroaniline	<1	<1	<1	<1	<10$_{AB}$	<1	<1	<1			<1	ug/l	TM16/PM30
2,4-Dinitrotoluene	-	-	-	-	<5.0$_{AB}$	-	-	-			<0.5	ug/l	TM16/PM30
2,4-Dinitrotoluene #	<0.5	<0.5	<0.5	<0.5	-	<0.5	<0.5	<0.5			<0.5	ug/l	TM16/PM30
2,6-Dinitrotoluene	<1	<1	<1	<1	<10$_{AB}$	<1	<1	<1			<1	ug/l	TM16/PM30
3-Nitroaniline	<1	<1	<1	<1	<10$_{AB}$	<1	<1	<1			<1	ug/l	TM16/PM30
4-Bromophenylphenylether	-	-	-	-	<10$_{AB}$	-	-	-			<1	ug/l	TM16/PM30
4-Bromophenylphenylether #	<1	<1	<1	<1	-	<1	<1	<1			<1	ug/l	TM16/PM30
4-Chloroaniline	<1	<1	<1	<1	<10$_{AB}$	<1	<1	<1			<1	ug/l	TM16/PM30
4-Chlorophenylphenylether	-	-	-	-	<10$_{AB}$	-	-	-			<1	ug/l	TM16/PM30
4-Chlorophenylphenylether #	<1	<1	<1	<1	-	<1	<1	<1			<1	ug/l	TM16/PM30
4-Nitroaniline	<0.5	<0.5	<0.5	<0.5	<5.0$_{AB}$	<0.5	<0.5	<0.5			<0.5	ug/l	TM16/PM30
Azobenzene	-	-	-	-	<5.0$_{AB}$	-	-	-			<0.5	ug/l	TM16/PM30
Azobenzene #	<0.5	<0.5	<0.5	<0.5	-	<0.5	<0.5	<0.5			<0.5	ug/l	TM16/PM30
Bis(2-chloroethoxy)methane	-	-	-	-	<5.0$_{AB}$	-	-	-			<0.5	ug/l	TM16/PM30
Bis(2-chloroethoxy)methane #	<0.5	<0.5	<0.5	<0.5	-	<0.5	<0.5	<0.5			<0.5	ug/l	TM16/PM30
Bis(2-chloroethyl)ether	-	-	-	-	<10$_{AB}$	-	-	-			<1	ug/l	TM16/PM30
Bis(2-chloroethyl)ether #	<1	<1	<1	<1	-	<1	<1	<1			<1	ug/l	TM16/PM30
Carbazole	-	-	-	-	<5.0$_{AB}$	-	-	-			<0.5	ug/l	TM16/PM30
Carbazole #	<0.5	<0.5	<0.5	<0.5	-	<0.5	<0.5	<0.5			<0.5	ug/l	TM16/PM30
Dibenzofuran	-	-	-	-	<5.0$_{AB}$	-	-	-			<0.5	ug/l	TM16/PM30
Dibenzofuran #	<0.5	<0.5	<0.5	<0.5	-	<0.5	<0.5	<0.5			<0.5	ug/l	TM16/PM30
Hexachlorobenzene	-	-	-	-	<10$_{AB}$	-	-	-			<1	ug/l	TM16/PM30
Hexachlorobenzene #	<1	<1	<1	<1	-	<1	<1	<1			<1	ug/l	TM16/PM30
Hexachlorobutadiene	-	-	-	-	<10$_{AB}$	-	-	-			<1	ug/l	TM16/PM30
Hexachlorobutadiene #	<1	<1	<1	<1	-	<1	<1	<1			<1	ug/l	TM16/PM30
Hexachlorocyclopentadiene	<1	<1	<1	<1	<10$_{AB}$	<1	<1	<1			<1	ug/l	TM16/PM30
Hexachloroethane	-	-	-	-	<10$_{AB}$	-	-	-			<1	ug/l	TM16/PM30
Hexachloroethane #	<1	<1	<1	<1	-	<1	<1	<1			<1	ug/l	TM16/PM30
Isophorone	-	-	-	-	<5.0$_{AB}$	-	-	-			<0.5	ug/l	TM16/PM30
Isophorone #	<0.5	<0.5	<0.5	<0.5	-	<0.5	<0.5	<0.5			<0.5	ug/l	TM16/PM30
N-nitrosodi-n-propylamine	-	-	-	-	<5.0$_{AB}$	-	-	-			<0.5	ug/l	TM16/PM30
N-nitrosodi-n-propylamine #	<0.5	<0.5	<0.5	<0.5	-	<0.5	<0.5	<0.5			<0.5	ug/l	TM16/PM30
Nitrobenzene	-	-	-	-	<10$_{AB}$	-	-	-			<1	ug/l	TM16/PM30
Nitrobenzene #	<1	<1	<1	<1	-	<1	<1	<1			<1	ug/l	TM16/PM30
Surrogate Recovery 2-Fluorobiphenyl	103	107	101	103	128$_{AB}$	105	102	99			<0	%	TM16/PM30
Surrogate Recovery p-Terphenyl-d14	113	118	109	118	117$_{AB}$	118	116	116			<0	%	TM16/PM30

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VOC Report : **Liquid**

J E Sample No.	1-8	9-16	17-24	25-32	33-40	41-48	49-56	57-64					
Sample ID	MW1	MW2	CSW3	CSW6	L1	CSW1	CSW2	CSW5					
Depth											Please see attached notes for all abbreviations and acronyms		
COC No / misc													
Containers	V H P BOD G	V H P BOD G	V H P G	V H P G	V H P BOD G	V H P BOD G	V H P G	V H P G					
Sample Date	27/11/2017	27/11/2017	27/11/2017	27/11/2017	27/11/2017	27/11/2017	27/11/2017	27/11/2017					
Sample Type	Ground Water	Ground Water	Surface Water	Surface Water	Leachate	Surface Water	Surface Water	Surface Water					
Batch Number	1	1	1	1	1	1	1	1			LOD/LOR	Units	Method No.
Date of Receipt	28/11/2017	28/11/2017	28/11/2017	28/11/2017	28/11/2017	28/11/2017	28/11/2017	28/11/2017					
VOC MS													
Dichlorodifluoromethane	<2	<2	<2	<2	<2	<2	<2	<2			<2	ug/l	TM15/PM10
Methyl Tertiary Butyl Ether	-	-	-	-	<0.1	-	-	-			<0.1	ug/l	TM15/PM10
Methyl Tertiary Butyl Ether #	<0.1	<0.1	<0.1	<0.1	-	<0.1	<0.1	<0.1			<0.1	ug/l	TM15/PM10
Chloromethane	-	-	-	-	<3	-	-	-			<3	ug/l	TM15/PM10
Chloromethane #	<3	<3	<3	<3	-	<3	<3	<3			<3	ug/l	TM15/PM10
Vinyl Chloride	-	-	-	-	0.7	-	-	-			<0.1	ug/l	TM15/PM10
Vinyl Chloride #	<0.1	<0.1	<0.1	<0.1	-	<0.1	<0.1	<0.1			<0.1	ug/l	TM15/PM10
Bromomethane	<1	<1	<1	<1	<1	<1	<1	<1			<1	ug/l	TM15/PM10
Chloroethane	-	-	-	-	<3	-	-	-			<3	ug/l	TM15/PM10
Chloroethane #	<3	<3	<3	<3	-	<3	<3	<3			<3	ug/l	TM15/PM10
Trichlorofluoromethane	-	-	-	-	<3	-	-	-			<3	ug/l	TM15/PM10
Trichlorofluoromethane #	<3	<3	<3	<3	-	<3	<3	<3			<3	ug/l	TM15/PM10
1,1-Dichloroethene (1,1 DCE)	-	-	-	-	<3	-	-	-			<3	ug/l	TM15/PM10
1,1-Dichloroethene (1,1 DCE) #	<3	<3	<3	<3	-	<3	<3	<3			<3	ug/l	TM15/PM10
Dichloromethane (DCM)	-	-	-	-	<5	-	-	-			<5	ug/l	TM15/PM10
Dichloromethane (DCM) #	<5	<5	<5	<5	-	<5	<5	<5			<5	ug/l	TM15/PM10
trans-1-2-Dichloroethene	-	-	-	-	<3	-	-	-			<3	ug/l	TM15/PM10
trans-1-2-Dichloroethene #	<3	<3	<3	<3	-	<3	<3	<3			<3	ug/l	TM15/PM10
1,1-Dichloroethane	-	-	-	-	<3	-	-	-			<3	ug/l	TM15/PM10
1,1-Dichloroethane #	<3	<3	<3	<3	-	<3	<3	<3			<3	ug/l	TM15/PM10
cis-1-2-Dichloroethene	-	-	-	-	<3	-	-	-			<3	ug/l	TM15/PM10
cis-1-2-Dichloroethene #	<3	<3	<3	<3	-	<3	<3	<3			<3	ug/l	TM15/PM10
2,2-Dichloropropane	<1	<1	<1	<1	<1	<1	<1	<1			<1	ug/l	TM15/PM10
Bromochloromethane	-	-	-	-	<2	-	-	-			<2	ug/l	TM15/PM10
Bromochloromethane #	<2	<2	<2	<2	-	<2	<2	<2			<2	ug/l	TM15/PM10
Chloroform	-	-	-	-	<2	-	-	-			<2	ug/l	TM15/PM10
Chloroform #	<2	<2	2	<2	-	<2	<2	<2			<2	ug/l	TM15/PM10
1,1,1-Trichloroethane	-	-	-	-	<2	-	-	-			<2	ug/l	TM15/PM10
1,1,1-Trichloroethane #	<2	<2	<2	<2	-	<2	<2	<2			<2	ug/l	TM15/PM10
1,1-Dichloropropene	-	-	-	-	<3	-	-	-			<3	ug/l	TM15/PM10
1,1-Dichloropropene #	<3	<3	<3	<3	-	<3	<3	<3			<3	ug/l	TM15/PM10
Carbon tetrachloride	-	-	-	-	<2	-	-	-			<2	ug/l	TM15/PM10
Carbon tetrachloride #	<2	<2	<2	<2	-	<2	<2	<2			<2	ug/l	TM15/PM10
1,2-Dichloroethane	-	-	-	-	<2	-	-	-			<2	ug/l	TM15/PM10
1,2-Dichloroethane #	<2	<2	<2	<2	-	<2	<2	<2			<2	ug/l	TM15/PM10
Benzene	-	-	-	-	2.0	-	-	-			<0.5	ug/l	TM15/PM10
Benzene #	<0.5	<0.5	<0.5	<0.5	-	<0.5	<0.5	<0.5			<0.5	ug/l	TM15/PM10
Trichloroethene (TCE)	-	-	-	-	<3	-	-	-			<3	ug/l	TM15/PM10
Trichloroethene (TCE) #	<3	<3	<3	<3	-	<3	<3	<3			<3	ug/l	TM15/PM10
1,2-Dichloropropane	-	-	-	-	<2	-	-	-			<2	ug/l	TM15/PM10
1,2-Dichloropropane #	<2	<2	<2	<2	-	<2	<2	<2			<2	ug/l	TM15/PM10
Dibromomethane	-	-	-	-	<3	-	-	-			<3	ug/l	TM15/PM10
Dibromomethane #	<3	<3	<3	<3	-	<3	<3	<3			<3	ug/l	TM15/PM10
Bromodichloromethane	-	-	-	-	<2	-	-	-			<2	ug/l	TM15/PM10
Bromodichloromethane #	<2	<2	<2	<2	-	<2	<2	<2			<2	ug/l	TM15/PM10
cis-1-3-Dichloropropene	<2	<2	<2	<2	<2	<2	<2	<2			<2	ug/l	TM15/PM10
Toluene	-	-	-	-	22	-	-	-			<5	ug/l	TM15/PM10
Toluene #	<5	<5	<5	<5	-	<5	<5	<5			<5	ug/l	TM15/PM10
trans-1-3-Dichloropropene	<2	<2	<2	<2	<2	<2	<2	<2			<2	ug/l	TM15/PM10
1,1,2-Trichloroethane	-	-	-	-	<2	-	-	-			<2	ug/l	TM15/PM10
1,1,2-Trichloroethane #	<2	<2	<2	<2	-	<2	<2	<2			<2	ug/l	TM15/PM10
Tetrachloroethene (PCE)	-	-	-	-	<3	-	-	-			<3	ug/l	TM15/PM10
Tetrachloroethene (PCE) #	<3	<3	<3	<3	-	<3	<3	<3			<3	ug/l	TM15/PM10
1,3-Dichloropropane	-	-	-	-	<2	-	-	-			<2	ug/l	TM15/PM10
1,3-Dichloropropane #	<2	<2	<2	<2	-	<2	<2	<2			<2	ug/l	TM15/PM10
Dibromochloromethane	-	-	-	-	<2	-	-	-			<2	ug/l	TM15/PM10
Dibromochloromethane #	<2	<2	<2	<2	-	<2	<2	<2			<2	ug/l	TM15/PM10
1,2-Dibromoethane	-	-	-	-	<2	-	-	-			<2	ug/l	TM15/PM10
1,2-Dibromoethane #	<2	<2	<2	<2	-	<2	<2	<2			<2	ug/l	TM15/PM10
Chlorobenzene	-	-	-	-	<2	-	-	-			<2	ug/l	TM15/PM10
Chlorobenzene #	<2	<2	<2	<2	-	<2	<2	<2			<2	ug/l	TM15/PM10
1,1,1,2-Tetrachloroethane	-	-	-	-	<2	-	-	-			<2	ug/l	TM15/PM10

Client Name: O'Callaghan Moran & Associates
Reference: 17-239-01
Location: Castlerea Landfill
Contact: Sean Moran
JE Job No.: 17/19572

VOC Report : **Liquid**

J E Sample No.	1-8	9-16	17-24	25-32	33-40	41-48	49-56	57-64					
Sample ID	MW1	MW2	CSW3	CSW6	L1	CSW1	CSW2	CSW5					
Depth											Please see attached notes for all abbreviations and acronyms		
COC No / misc													
Containers	V H P BOD G	V H P BOD G	V H P G	V H P G	V H P BOD G	V H P BOD G	V H P G	V H P G					
Sample Date	27/11/2017	27/11/2017	27/11/2017	27/11/2017	27/11/2017	27/11/2017	27/11/2017	27/11/2017					
Sample Type	Ground Water	Ground Water	Surface Water	Surface Water	Leachate	Surface Water	Surface Water	Surface Water					
Batch Number	1	1	1	1	1	1	1	1					
Date of Receipt	28/11/2017	28/11/2017	28/11/2017	28/11/2017	28/11/2017	28/11/2017	28/11/2017	28/11/2017			LOD/LOR	Units	Method No.
VOC MS Continued													
1,1,1,2-Tetrachloroethane #	<2	<2	<2	<2	-	<2	<2	<2			<2	ug/l	TM15/PM10
Ethylbenzene	-	-	-	-	12	-	-	-			<1	ug/l	TM15/PM10
Ethylbenzene #	<1	<1	<1	<1	-	<1	<1	<1			<1	ug/l	TM15/PM10
p/m-Xylene	-	-	-	-	32	-	-	-			<2	ug/l	TM15/PM10
p/m-Xylene #	<2	<2	<2	<2	-	<2	<2	<2			<2	ug/l	TM15/PM10
o-Xylene	-	-	-	-	9	-	-	-			<1	ug/l	TM15/PM10
o-Xylene #	<1	<1	<1	<1	-	<1	<1	<1			<1	ug/l	TM15/PM10
Styrene	<2	<2	<2	<2	<2	<2	<2	<2			<2	ug/l	TM15/PM10
Bromoform	-	-	-	-	<2	-	-	-			<2	ug/l	TM15/PM10
Bromoform #	<2	<2	<2	<2	-	<2	<2	<2			<2	ug/l	TM15/PM10
Isopropylbenzene	-	-	-	-	<3	-	-	-			<3	ug/l	TM15/PM10
Isopropylbenzene #	<3	<3	<3	<3	-	<3	<3	<3			<3	ug/l	TM15/PM10
1,1,2,2-Tetrachloroethane	<4	<4	<4	<4	<4	<4	<4	<4			<4	ug/l	TM15/PM10
Bromobenzene	-	-	-	-	<2	-	-	-			<2	ug/l	TM15/PM10
Bromobenzene #	<2	<2	<2	<2	-	<2	<2	<2			<2	ug/l	TM15/PM10
1,2,3-Trichloropropane	-	-	-	-	<3	-	-	-			<3	ug/l	TM15/PM10
1,2,3-Trichloropropane #	<3	<3	<3	<3	-	<3	<3	<3			<3	ug/l	TM15/PM10
Propylbenzene	-	-	-	-	<3	-	-	-			<3	ug/l	TM15/PM10
Propylbenzene #	<3	<3	<3	<3	-	<3	<3	<3			<3	ug/l	TM15/PM10
2-Chlorotoluene	-	-	-	-	<3	-	-	-			<3	ug/l	TM15/PM10
2-Chlorotoluene #	<3	<3	<3	<3	-	<3	<3	<3			<3	ug/l	TM15/PM10
1,3,5-Trimethylbenzene	-	-	-	-	<3	-	-	-			<3	ug/l	TM15/PM10
1,3,5-Trimethylbenzene #	<3	<3	<3	<3	-	<3	<3	<3			<3	ug/l	TM15/PM10
4-Chlorotoluene	-	-	-	-	<3	-	-	-			<3	ug/l	TM15/PM10
4-Chlorotoluene #	<3	<3	<3	<3	-	<3	<3	<3			<3	ug/l	TM15/PM10
tert-Butylbenzene	-	-	-	-	<3	-	-	-			<3	ug/l	TM15/PM10
tert-Butylbenzene #	<3	<3	<3	<3	-	<3	<3	<3			<3	ug/l	TM15/PM10
1,2,4-Trimethylbenzene	-	-	-	-	12	-	-	-			<3	ug/l	TM15/PM10
1,2,4-Trimethylbenzene #	<3	<3	<3	<3	-	<3	<3	<3			<3	ug/l	TM15/PM10
sec-Butylbenzene	-	-	-	-	<3	-	-	-			<3	ug/l	TM15/PM10
sec-Butylbenzene #	<3	<3	<3	<3	-	<3	<3	<3			<3	ug/l	TM15/PM10
4-Isopropyltoluene	-	-	-	-	34	-	-	-			<3	ug/l	TM15/PM10
4-Isopropyltoluene #	<3	<3	<3	<3	-	<3	<3	<3			<3	ug/l	TM15/PM10
1,3-Dichlorobenzene	-	-	-	-	<3	-	-	-			<3	ug/l	TM15/PM10
1,3-Dichlorobenzene #	<3	<3	<3	<3	-	<3	<3	<3			<3	ug/l	TM15/PM10
1,4-Dichlorobenzene	-	-	-	-	<3	-	-	-			<3	ug/l	TM15/PM10
1,4-Dichlorobenzene #	<3	<3	<3	<3	-	<3	<3	<3			<3	ug/l	TM15/PM10
n-Butylbenzene	-	-	-	-	<3	-	-	-			<3	ug/l	TM15/PM10
n-Butylbenzene #	<3	<3	<3	<3	-	<3	<3	<3			<3	ug/l	TM15/PM10
1,2-Dichlorobenzene	-	-	-	-	<3	-	-	-			<3	ug/l	TM15/PM10
1,2-Dichlorobenzene #	<3	<3	<3	<3	-	<3	<3	<3			<3	ug/l	TM15/PM10
1,2-Dibromo-3-chloropropane	<2	<2	<2	<2	<2	<2	<2	<2			<2	ug/l	TM15/PM10
1,2,4-Trichlorobenzene	<3	<3	<3	<3	<3	<3	<3	<3			<3	ug/l	TM15/PM10
Hexachlorobutadiene	<3	<3	<3	<3	<3	<3	<3	<3			<3	ug/l	TM15/PM10
1,2,3-Trichlorobenzene	<3	<3	<3	<3	<3	<3	<3	<3			<3	ug/l	TM15/PM10
Surrogate Recovery Toluene D8	92	96	86	86	87	87	89	89			<0	%	TM15/PM10
Surrogate Recovery 4-Bromofluorobenzene	110	112	101	99	99	101	103	103			<0	%	TM15/PM10

Client Name: O'Callaghan Moran & Associates
Reference: 17-239-01
Location: Castlerea Landfill
Contact: Sean Moran

J E Job No.	Batch	Sample ID	Depth	J E Sample No.	Analysis	Reason
No deviating sample report results for job 17/19572						

Please note that only samples that are deviating are mentioned in this report. If no samples are listed it is because none were deviating.
Only analyses which are accredited are recorded as deviating if set criteria are not met.

NOTES TO ACCOMPANY ALL SCHEDULES AND REPORTS

JE Job No.: 17/19572

SOILS

Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

Where a CEN 10:1 ZERO Headspace VOC test has been carried out, a 10:1 ratio of water to wet (as received) soil has been used.

% Asbestos in Asbestos Containing Materials (ACMs) is determined by reference to HSG 264 The Survey Guide - Appendix 2 : ACMs in buildings listed in order of ease of fibre release.

Negative Neutralization Potential (NP) values are obtained when the volume of NaOH (0.1N) titrated (pH 8.3) is greater than the volume of HCl (1N) to reduce the pH of the sample to 2.0 - 2.5. Any negative NP values are corrected to 0.

The calculation of Pyrite content assumes that all oxidisable sulphides present in the sample are pyrite. This may not be the case. The calculation may be an overesitimate when other sulphides such as Barite (Barium Sulphate) are present.

WATERS

Please note we are not a UK Drinking Water Inspectorate (DWI) Approved Laboratory .

ISO17025 accreditation applies to surface water and groundwater and usually one other matrix which is analysis specific, any other liquids are outside our scope of accreditation.

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

DEVIATING SAMPLES

Samples must be received in a condition appropriate to the requested analyses. All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. If this is not the case you will be informed and any test results that may be compromised highlighted on your deviating samples report.

SURROGATES

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

DILUTIONS

A dilution suffix indicates a dilution has been performed and the reported result takes this into account. No further calculation is required.

BLANKS

Where analytes have been found in the blank, the sample will be treated in accordance with our laboratory procedure for dealing with contaminated blanks.

NOTE

Data is only reported if the laboratory is confident that the data is a true reflection of the samples analysed. Data is only reported as accredited when all the requirements of our Quality System have been met. In certain circumstances where all the requirements of the Quality System have not been met, for instance if the associated AQC has failed, the reason is fully investigated and documented. The sample data is then evaluated alongside the other quality control checks performed during analysis to determine its suitability. Following this evaluation, provided the sample results have not been effected, the data is reported but accreditation is removed. It is a UKAS requirement for data not reported as accredited to be considered indicative only, but this does not mean the data is not valid.
Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.

REPORTS FROM THE SOUTH AFRICA LABORATORY

Any method number not prefixed with SA has been undertaken in our UK laboratory unless reported as subcontracted.

ABBREVIATIONS and ACRONYMS USED

#	ISO17025 (UKAS Ref No. 4225) accredited - UK.
SA	ISO17025 (SANAS Ref No.T0729) accredited - South Africa.
B	Indicates analyte found in associated method blank.
DR	Dilution required.
M	MCERTS accredited.
NA	Not applicable
NAD	No Asbestos Detected.
ND	None Detected (usually refers to VOC and/SVOC TICs).
NDP	No Determination Possible
SS	Calibrated against a single substance
SV	Surrogate recovery outside performance criteria. This may be due to a matrix effect.
W	Results expressed on as received basis.
+	AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page.
++	Result outside calibration range, results should be considered as indicative only and are not accredited.
*	Analysis subcontracted to a Jones Environmental approved laboratory.
AD	Samples are dried at 35°C ±5°C
CO	Suspected carry over
LOD/LOR	Limit of Detection (Limit of Reporting) in line with ISO 17025 and MCERTS
ME	Matrix Effect
NFD	No Fibres Detected
BS	AQC Sample
LB	Blank Sample
N	Client Sample
TB	Trip Blank Sample
OC	Outside Calibration Range
AA	x5 Dilution
AB	x10 Dilution
AC	x20 Dilution
AD	x100 Dilution

JE Job No: 17/19572

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/SANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM4	Modified USEPA 8270 method for the solvent extraction and determination of 16 PAHs by GC-MS.	PM30	Water samples are extracted with solvent using a magnetic stirrer to create a vortex.				
TM4	Modified USEPA 8270 method for the solvent extraction and determination of 16 PAHs by GC-MS.	PM30	Water samples are extracted with solvent using a magnetic stirrer to create a vortex.	Yes			
TM15	Modified USEPA 8260. Quantitative Determination of Volatile Organic Compounds (VOCs) by Headspace GC-MS.	PM10	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.				
TM15	Modified USEPA 8260. Quantitative Determination of Volatile Organic Compounds (VOCs) by Headspace GC-MS.	PM10	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.	Yes			
TM16	Modified USEPA 8270. Quantitative determination of Semi-Volatile Organic compounds (SVOCs) by GC-MS.	PM30	Water samples are extracted with solvent using a magnetic stirrer to create a vortex.				
TM16	Modified USEPA 8270. Quantitative determination of Semi-Volatile Organic compounds (SVOCs) by GC-MS.	PM30	Water samples are extracted with solvent using a magnetic stirrer to create a vortex.	Yes			
TM26	Determination of phenols by Reversed Phased High Performance Liquid Chromatography and Electro-Chemical Detection.	PM0	No preparation is required.				
TM26	Determination of phenols by Reversed Phased High Performance Liquid Chromatography and Electro-Chemical Detection.	PM0	No preparation is required.	Yes			
TM30	Determination of Trace Metal elements by ICP-OES (Inductively Coupled Plasma - Optical Emission Spectrometry). Modified US EPA Method 200.7, 6010B and BS EN ISO 11885 2009	PM14	Analysis of waters and leachates for metals by ICP OES/ICP MS. Samples are filtered for dissolved metals and acidified if required.				
TM30	Determination of Trace Metal elements by ICP-OES (Inductively Coupled Plasma - Optical Emission Spectrometry). Modified US EPA Method 200.7, 6010B and BS EN ISO 11885 2009	PM14	Analysis of waters and leachates for metals by ICP OES/ICP MS. Samples are filtered for dissolved metals and acidified if required.	Yes			

JE Job No: 17/19572

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/SANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM37	Modified USEPA 160.2 .Gravimetric determination of Total Suspended Solids. Sample is filtered and the resulting residue is dried and weighed.	PM0	No preparation is required.				
TM37	Modified USEPA 160.2 .Gravimetric determination of Total Suspended Solids. Sample is filtered and the resulting residue is dried and weighed.	PM0	No preparation is required.	Yes			
TM38	Soluble Ion analysis using the Thermo Aquakem Photometric Automatic Analyser. Modified US EPA methods 325.2, 375.4, 365.2, 353.1, 354.1	PM0	No preparation is required.				
TM38	Soluble Ion analysis using the Thermo Aquakem Photometric Automatic Analyser. Modified US EPA methods 325.2, 375.4, 365.2, 353.1, 354.1	PM0	No preparation is required.	Yes			
TM42	Modified US EPA method 8270. Pesticides and herbicdes by GC-MS	PM30	Water samples are extracted with solvent using a magnetic stirrer to create a vortex.				
TM57	Modified US EPA Method 410.4. Chemical Oxygen Demand is determined by hot digestion with Potassium Dichromate and measured spectrophotometerically.	PM0	No preparation is required.				
TM57	Modified US EPA Method 410.4. Chemical Oxygen Demand is determined by hot digestion with Potassium Dichromate and measured spectrophotometerically.	PM0	No preparation is required.	Yes			
TM58	Modified USEPA methods 405.1 and BS 5667-3. Measurement of Biochemical Oxygen Demand. When cBOD (Carbonaceous BOD) is requested a nitrification inhibitor is added which prevents the oxidation of reduced forms of nitrogen, such as ammonia, nitrite and organic nitrogen which exert a nitrogenous demand.	PM0	No preparation is required.				
TM58	Modified USEPA methods 405.1 and BS 5667-3. Measurement of Biochemical Oxygen Demand. When cBOD (Carbonaceous BOD) is requested a nitrification inhibitor is added which prevents the oxidation of reduced forms of nitrogen, such as ammonia, nitrite and organic nitrogen which exert a nitrogenous demand.	PM0	No preparation is required.	Yes			
TM60	Modified USEPA 9060. Determination of TOC by calculation from Total Carbon and Inorganic Carbon using a TOC analyser, the carbon in the sample is converted to CO2 and then passed through a non-dispersive infrared gas analyser (NDIR).	PM0	No preparation is required.				

JE Job No: 17/19572

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/SANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM60	Modified USEPA 9060. Determination of TOC by calculation from Total Carbon and Inorganic Carbon using a TOC analyser, the carbon in the sample is converted to CO2 and then passed through a non-dispersive infrared gas analyser (NDIR).	PM0	No preparation is required.	Yes			
TM89	Modified USEPA method OIA-1667. Determination of cyanide by Flow Injection Analyser. Where WAD cyanides are required a Ligand displacement step is carried out before analysis.	PM0	No preparation is required.				
TM89	Modified USEPA method OIA-1667. Determination of cyanide by Flow Injection Analyser. Where WAD cyanides are required a Ligand displacement step is carried out before analysis.	PM0	No preparation is required.	Yes			
TM149	Determination of Pesticides by Large Volume Injection on GC Triple Quad MS, based upon USEPA method 8270	PM30	Water samples are extracted with solvent using a magnetic stirrer to create a vortex.				

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O'Callaghan Moran & Associates
Unit 15
Melbourne Business Park
Model Farm
Cork
Ireland

Attention :	Sean Moran
Date :	23rd August, 2019
Your reference :	19-238-01
Our reference :	Test Report 19/12876 Batch 1
Location :	Castlerea Landfill
Date samples received :	9th August, 2019
Status :	Final report
Issue :	1

Eight samples were received for analysis on 9th August, 2019 of which seven were scheduled for analysis. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.
All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

Authorised By:

Lucas Halliwell
Project Co-ordinator

Element Materials Technology Environmental UK Limited
Registered in England and Wales
Registered Office: 10 Lower Grosvenor Place, London, SW1W 0EN
Company Registration No: 11371415

Element Materials Technology

Client Name: O'Callaghan Moran & Associates
Reference: 19-238-01
Location: Castlerea Landfill
Contact: Sean Moran
EMT Job No: 19/12876

Report : Liquid

Liquids/products: V=40ml vial, G=glass bottle, P=plastic bottle
$H=H_2SO_4$, Z=ZnAc, N=NaOH, $HN=HN0_3$

EMT Sample No.	1-7	8-14	15-21	22-28	29-35	43-49	50-56				LOD/LOR	Units	Method No.
Sample ID	MW1	MW2	CSW1	CSW2	CSW3	CSW5	CSW6						
Depth													
COC No / misc													
Containers	V H N P BOD G	V H N P BOD G	V H N P BOD G	V H N P BOD G	V H N P BOD G	V H N P BOD G	V H N P BOD G						
Sample Date	08/08/2019	08/08/2019	08/08/2019	08/08/2019	08/08/2019	08/08/2019	08/08/2019						
Sample Type	Ground Water	Ground Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water						
Batch Number	1	1	1	1	1	1	1						
Date of Receipt	09/08/2019	09/08/2019	09/08/2019	09/08/2019	09/08/2019	09/08/2019	09/08/2019						
Dissolved Arsenic #	3.5	7.3	<2.5	3.2	<2.5	<2.5	<2.5				<2.5	ug/l	TM30/PM14
Dissolved Boron	<12	49	13	48	13	<12	<12				<12	ug/l	TM30/PM14
Dissolved Cadmium #	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5				<0.5	ug/l	TM30/PM14
Total Dissolved Chromium #	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5				<1.5	ug/l	TM30/PM14
Dissolved Copper #	<7	<7	<7	<7	<7	<7	<7				<7	ug/l	TM30/PM14
Dissolved Lead #	<5	<5	<5	<5	<5	<5	<5				<5	ug/l	TM30/PM14
Dissolved Manganese #	310	220	12	181	84	36	30				<2	ug/l	TM30/PM14
Dissolved Mercury #	<1	<1	<1	<1	<1	<1	<1				<1	ug/l	TM30/PM14
Dissolved Nickel #	3	<2	<2	<2	<2	<2	<2				<2	ug/l	TM30/PM14
Dissolved Potassium #	1.6	5.3	1.8	6.2	0.8	2.8	2.7				<0.1	mg/l	TM30/PM14
Dissolved Selenium #	<3	<3	<3	<3	<3	<3	<3				<3	ug/l	TM30/PM14
Dissolved Sodium #	19.1	27.6	18.3	24.9	12.6	10.8	10.7				<0.1	mg/l	TM30/PM14
Dissolved Zinc #	<3	<3	4	7	6	<3	<3				<3	ug/l	TM30/PM14
Total Phosphorus	396	308	518	282	146	61	76				<5	ug/l	TM30/PM14
PAH MS													
Naphthalene #	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				<0.1	ug/l	TM4/PM30
Acenaphthylene #	<0.013	<0.013	<0.013	<0.013	<0.013	<0.013	<0.013				<0.013	ug/l	TM4/PM30
Acenaphthene #	<0.013	<0.013	<0.013	<0.013	<0.013	<0.013	<0.013				<0.013	ug/l	TM4/PM30
Fluorene #	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014				<0.014	ug/l	TM4/PM30
Phenanthrene #	<0.011	<0.011	<0.011	<0.011	<0.011	<0.011	<0.011				<0.011	ug/l	TM4/PM30
Anthracene #	<0.013	<0.013	<0.013	<0.013	<0.013	<0.013	<0.013				<0.013	ug/l	TM4/PM30
Fluoranthene #	<0.012	<0.012	<0.012	<0.012	<0.012	<0.012	<0.012				<0.012	ug/l	TM4/PM30
Pyrene #	<0.013	<0.013	<0.013	<0.013	<0.013	<0.013	<0.013				<0.013	ug/l	TM4/PM30
Benzo(a)anthracene #	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015				<0.015	ug/l	TM4/PM30
Chrysene #	<0.011	<0.011	<0.011	<0.011	<0.011	<0.011	<0.011				<0.011	ug/l	TM4/PM30
Benzo(bk)fluoranthene #	<0.018	<0.018	<0.018	<0.018	<0.018	<0.018	<0.018				<0.018	ug/l	TM4/PM30
Benzo(a)pyrene #	<0.016	<0.016	<0.016	<0.016	<0.016	<0.016	<0.016				<0.016	ug/l	TM4/PM30
Indeno(123cd)pyrene #	<0.011	<0.011	<0.011	<0.011	<0.011	<0.011	<0.011				<0.011	ug/l	TM4/PM30
Dibenzo(ah)anthracene #	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01				<0.01	ug/l	TM4/PM30
Benzo(ghi)perylene #	<0.011	<0.011	<0.011	<0.011	<0.011	<0.011	<0.011				<0.011	ug/l	TM4/PM30
PAH 16 Total #	<0.195	<0.195	<0.195	<0.195	<0.195	<0.195	<0.195				<0.195	ug/l	TM4/PM30
Benzo(b)fluoranthene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01				<0.01	ug/l	TM4/PM30
Benzo(k)fluoranthene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01				<0.01	ug/l	TM4/PM30
PAH Surrogate % Recovery	86	85	84	82	84	81	78				<0	%	TM4/PM30
Methyl Tertiary Butyl Ether #	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				<0.1	ug/l	TM15/PM10
Benzene #	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5				<0.5	ug/l	TM15/PM10
Toluene #	<5	<5	<5	<5	<5	<5	<5				<5	ug/l	TM15/PM10
Ethylbenzene #	<1	<1	<1	<1	<1	<1	<1				<1	ug/l	TM15/PM10
m/p-Xylene #	<2	<2	<2	<2	<2	<2	<2				<2	ug/l	TM15/PM10
o-Xylene #	<1	<1	<1	<1	<1	<1	<1				<1	ug/l	TM15/PM10
Surrogate Recovery Toluene D8	97	89	88	90	94	91	99				<0	%	TM15/PM10
Surrogate Recovery 4-Bromofluorobenzene	96	92	90	94	97	96	99				<0	%	TM15/PM10

Please see attached notes for all abbreviations and acronyms

Please include all sections of this report if it is reproduced
All solid results are expressed on a dry weight basis unless stated otherwise.

Client Name: O'Callaghan Moran & Associates
Reference: 19-238-01
Location: Castlerea Landfill
Contact: Sean Moran
EMT Job No: 19/12876

Report : Liquid

Liquids/products: V=40ml vial, G=glass bottle, P=plastic bottle
$H=H_2SO_4$, Z=ZnAc, N=NaOH, HN=$HN0_3$

EMT Sample No.	1-7	8-14	15-21	22-28	29-35	43-49	50-56				LOD/LOR	Units	Method No.
Sample ID	MW1	MW2	CSW1	CSW2	CSW3	CSW5	CSW6						
Depth													
COC No / misc													
Containers	V H N P BOD G	V H N P BOD G	V H N P BOD G	V H N P BOD G	V H N P BOD G	V H N P BOD G	V H N P BOD G						
Sample Date	08/08/2019	08/08/2019	08/08/2019	08/08/2019	08/08/2019	08/08/2019	08/08/2019						
Sample Type	Ground Water	Ground Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water						
Batch Number	1	1	1	1	1	1	1						
Date of Receipt	09/08/2019	09/08/2019	09/08/2019	09/08/2019	09/08/2019	09/08/2019	09/08/2019						
Pesticides													
Organochlorine Pesticides													
Aldrin	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$				<0.01	ug/l	TM149/PM30
Alpha-HCH (BHC)	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$				<0.01	ug/l	TM149/PM30
Beta-HCH (BHC)	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$				<0.01	ug/l	TM149/PM30
Delta-HCH (BHC)	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$				<0.01	ug/l	TM149/PM30
Dieldrin	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$				<0.01	ug/l	TM149/PM30
Endosulphan I	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$				<0.01	ug/l	TM149/PM30
Endosulphan II	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$				<0.01	ug/l	TM149/PM30
Endosulphan sulphate	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$				<0.01	ug/l	TM149/PM30
Endrin	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$				<0.01	ug/l	TM149/PM30
Gamma-HCH (BHC)	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$				<0.01	ug/l	TM149/PM30
Heptachlor	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$				<0.01	ug/l	TM149/PM30
Heptachlor Epoxide	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$				<0.01	ug/l	TM149/PM30
o,p'-Methoxychlor	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$				<0.01	ug/l	TM149/PM30
p,p'-DDE	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$				<0.01	ug/l	TM149/PM30
p,p'-DDT	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$				<0.01	ug/l	TM149/PM30
p,p'-Methoxychlor	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$				<0.01	ug/l	TM149/PM30
p,p'-TDE	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$				<0.01	ug/l	TM149/PM30
Organophosphorus Pesticides													
Azinphos methyl	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$				<0.01	ug/l	TM149/PM30
Diazinon	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$				<0.01	ug/l	TM149/PM30
Dichlorvos	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$				<0.01	ug/l	TM149/PM30
Disulfoton	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$				<0.01	ug/l	TM149/PM30
Ethion	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$				<0.01	ug/l	TM149/PM30
Ethyl Parathion (Parathion)	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$				<0.01	ug/l	TM149/PM30
Fenitrothion	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$				<0.01	ug/l	TM149/PM30
Malathion	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$				<0.01	ug/l	TM149/PM30
Methyl Parathion	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$				<0.01	ug/l	TM149/PM30
Mevinphos	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$	<0.03$_{AB}$				<0.01	ug/l	TM149/PM30

Please see attached notes for all abbreviations and acronyms

Client Name: O'Callaghan Moran & Associates
Reference: 19-238-01
Location: Castlerea Landfill
Contact: Sean Moran
EMT Job No: 19/12876

Report : Liquid

Liquids/products: V=40ml vial, G=glass bottle, P=plastic bottle
$H=H_2SO_4$, Z=ZnAc, N=NaOH, $HN=HN0_3$

EMT Sample No.	1-7	8-14	15-21	22-28	29-35	43-49	50-56				LOD/LOR	Units	Method No.
Sample ID	MW1	MW2	CSW1	CSW2	CSW3	CSW5	CSW6						
Depth													
COC No / misc													
Containers	V H N P BOD G	V H N P BOD G	V H N P BOD G	V H N P BOD G	V H N P BOD G	V H N P BOD G	V H N P BOD G						
Sample Date	08/08/2019	08/08/2019	08/08/2019	08/08/2019	08/08/2019	08/08/2019	08/08/2019						
Sample Type	Ground Water	Ground Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water						
Batch Number	1	1	1	1	1	1	1						
Date of Receipt	09/08/2019	09/08/2019	09/08/2019	09/08/2019	09/08/2019	09/08/2019	09/08/2019						
Acid Herbicides													
Benazolin	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB				<0.1	ug/l	TM42/PM30
Bentazone	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB				<0.1	ug/l	TM42/PM30
Bromoxynil	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB				<0.1	ug/l	TM42/PM30
Clopyralid	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB				<0.1	ug/l	TM42/PM30
4-CPA	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB				<0.1	ug/l	TM42/PM30
2,4-D	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB				<0.1	ug/l	TM42/PM30
2,4-DB	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB				<0.1	ug/l	TM42/PM30
Dicamba	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB				<0.1	ug/l	TM42/PM30
Dichloroprop	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB				<0.1	ug/l	TM42/PM30
Diclofop	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB				<0.1	ug/l	TM42/PM30
Fenoprop	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB				<0.1	ug/l	TM42/PM30
Flamprop	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB				<0.1	ug/l	TM42/PM30
Flamprop-isopropyl	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB				<0.1	ug/l	TM42/PM30
Ioxynil	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB				<0.1	ug/l	TM42/PM30
MCPA	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB				<0.1	ug/l	TM42/PM30
MCPB	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB				<0.1	ug/l	TM42/PM30
Mecoprop	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB				<0.1	ug/l	TM42/PM30
Picloram	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB				<0.1	ug/l	TM42/PM30
Pentachlorophenol	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB				<0.1	ug/l	TM42/PM30
2,4,5-T	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB				<0.1	ug/l	TM42/PM30
2,3,6-TBA	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB				<0.1	ug/l	TM42/PM30
Triclopyr	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB	<0.3 AB				<0.1	ug/l	TM42/PM30
TPH CWG													
Aliphatics													
>C5-C6 #	<10	<10	<10	<10	<10	<10	<10				<10	ug/l	TM36/PM12
>C6-C8 #	<10	<10	<10	<10	<10	<10	<10				<10	ug/l	TM36/PM12
>C8-C10 #	<10	<10	<10	<10	<10	<10	<10				<10	ug/l	TM36/PM12
>C10-C12 #	<5	<5	<5	<5	<5	<5	<5				<5	ug/l	TM5/PM16/PM30
>C12-C16 #	<10	<10	<10	<10	<10	<10	<10				<10	ug/l	TM5/PM16/PM30
>C16-C21 #	<10	<10	<10	<10	<10	<10	<10				<10	ug/l	TM5/PM16/PM30
>C21-C35 #	<10	<10	<10	<10	<10	<10	<10				<10	ug/l	TM5/PM16/PM30
Total aliphatics C5-35 #	<10	<10	<10	<10	<10	<10	<10				<10	ug/l	TM5/TM36/PM12/PM16/PM30

Please see attached notes for all abbreviations and acronyms

Client Name: O'Callaghan Moran & Associates
Reference: 19-238-01
Location: Castlerea Landfill
Contact: Sean Moran
EMT Job No: 19/12876

Report : Liquid

Liquids/products: V=40ml vial, G=glass bottle, P=plastic bottle
H=H_2SO_4, Z=ZnAc, N=NaOH, HN=$HN0_3$

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	1-7	8-14	15-21	22-28	29-35	43-49	50-56				LOD/LOR	Units	Method No.
Sample ID	MW1	MW2	CSW1	CSW2	CSW3	CSW5	CSW6						
Depth													
COC No / misc													
Containers	V H N P BOD G	V H N P BOD G	V H N P BOD G	V H N P BOD G	V H N P BOD G	V H N P BOD G	V H N P BOD G						
Sample Date	08/08/2019	08/08/2019	08/08/2019	08/08/2019	08/08/2019	08/08/2019	08/08/2019						
Sample Type	Ground Water	Ground Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water						
Batch Number	1	1	1	1	1	1	1						
Date of Receipt	09/08/2019	09/08/2019	09/08/2019	09/08/2019	09/08/2019	09/08/2019	09/08/2019						
TPH CWG													
Aromatics													
>C5-EC7 #	<10	<10	<10	<10	<10	<10	<10				<10	ug/l	TM36/PM12
>EC7-EC8 #	<10	<10	<10	<10	<10	<10	<10				<10	ug/l	TM36/PM12
>EC8-EC10 #	<10	<10	<10	<10	<10	<10	<10				<10	ug/l	TM36/PM12
>EC10-EC12 #	<5	<5	<5	<5	<5	<5	<5				<5	ug/l	TM5/PM16/PM30
>EC12-EC16 #	<10	<10	<10	<10	<10	<10	<10				<10	ug/l	TM5/PM16/PM30
>EC16-EC21 #	<10	<10	<10	<10	<10	<10	<10				<10	ug/l	TM5/PM16/PM30
>EC21-EC35 #	<10	<10	<10	<10	<10	<10	<10				<10	ug/l	TM5/PM16/PM30
Total aromatics C5-35 #	<10	<10	<10	<10	<10	<10	<10				<10	ug/l	TM5/TM36/PM12/PM16/PM30
Total aliphatics and aromatics(C5-35) #	<10	<10	<10	<10	<10	<10	<10				<10	ug/l	TM5/TM36/PM12/PM16/PM30
Resorcinol	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01				<0.01	mg/l	TM26/PM0
Catechol	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01				<0.01	mg/l	TM26/PM0
Phenol #	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01				<0.01	mg/l	TM26/PM0
m/p-cresol	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02				<0.02	mg/l	TM26/PM0
o-cresol	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01				<0.01	mg/l	TM26/PM0
Total cresols #	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03				<0.03	mg/l	TM26/PM0
Xylenols #	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06				<0.06	mg/l	TM26/PM0
1-naphthol	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01				<0.01	mg/l	TM26/PM0
2,3,5-trimethyl phenol	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01				<0.01	mg/l	TM26/PM0
2-isopropylphenol	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01				<0.01	mg/l	TM26/PM0
Total Speciated Phenols HPLC	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				<0.1	mg/l	TM26/PM0
Sulphate as SO4 #	0.7	<0.5	21.6	<0.5	19.1	18.7	18.6				<0.5	mg/l	TM38/PM0
Chloride #	29.2	94.0	29.3	40.0	21.9	21.1	21.3				<0.3	mg/l	TM38/PM0
Nitrate as NO3 #	1.1	1.9	3.7	18.7	<0.2	1.5	1.3				<0.2	mg/l	TM38/PM0
Nitrite as NO2 #	<0.02	<0.02	<0.02	0.11	<0.02	0.04	0.04				<0.02	mg/l	TM38/PM0
Ortho Phosphate as P #	<0.03	<0.03	0.08	<0.03	<0.03	<0.03	<0.03				<0.03	mg/l	TM38/PM0
Total Oxidised Nitrogen as N #	0.2	0.4	0.8	4.3	<0.2	0.3	0.3				<0.2	mg/l	TM38/PM0
Total Cyanide #	<0.01	0.02	0.16	<0.01	<0.01	<0.01	<0.01				<0.01	mg/l	TM89/PM0
Ammoniacal Nitrogen as N #	7.44	21.17	0.61	7.77	0.08	0.09	0.09				<0.03	mg/l	TM38/PM0
BOD (Settled) #	17	7	2	3	<1	<1	<1				<1	mg/l	TM58/PM0
COD (Settled) #	28	19	120	93	137	25	22				<7	mg/l	TM57/PM0
Total Organic Carbon #	19	7	46	40	57	14	11				<2	mg/l	TM60/PM0
Total Dissolved Solids #	615	575	261	304	179	364	397				<35	mg/l	TM20/PM0

Client Name: O'Callaghan Moran & Associates
Reference: 19-238-01
Location: Castlerea Landfill
Contact: Sean Moran
EMT Job No: 19/12876

SVOC Report : **Liquid**

EMT Sample No.	1-7	8-14	15-21	22-28	29-35	43-49	50-56					
Sample ID	MW1	MW2	CSW1	CSW2	CSW3	CSW5	CSW6					
Depth												
COC No / misc												
Containers	V H N P BOD G	V H N P BOD G	V H N P BOD G	V H N P BOD G	V H N P BOD G	V H N P BOD G	V H N P BOD G					
Sample Date	08/08/2019	08/08/2019	08/08/2019	08/08/2019	08/08/2019	08/08/2019	08/08/2019					
Sample Type	Ground Water	Ground Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water					
Batch Number	1	1	1	1	1	1	1					
Date of Receipt	09/08/2019	09/08/2019	09/08/2019	09/08/2019	09/08/2019	09/08/2019	09/08/2019					

Please see attached notes for all abbreviations and acronyms

											LOD/LOR	Units	Method No.
SVOC MS													
Phenols													
2-Chlorophenol #	<1	<1	<2 AA	<2 AA	<2 AA	<1	<1				<1	ug/l	TM16/PM30
2-Methylphenol #	<0.5	<0.5	<1.0 AA	<1.0 AA	<1.0 AA	<0.5	<0.5				<0.5	ug/l	TM16/PM30
2-Nitrophenol	<0.5	<0.5	<1.0 AA	<1.0 AA	<1.0 AA	<0.5	<0.5				<0.5	ug/l	TM16/PM30
2,4-Dichlorophenol #	<0.5	<0.5	<1.0 AA	<1.0 AA	<1.0 AA	<0.5	<0.5				<0.5	ug/l	TM16/PM30
2,4-Dimethylphenol	<1	<1	<2 AA	<2 AA	<2 AA	<1	<1				<1	ug/l	TM16/PM30
2,4,5-Trichlorophenol #	<0.5	<0.5	<1.0 AA	<1.0 AA	<1.0 AA	<0.5	<0.5				<0.5	ug/l	TM16/PM30
2,4,6-Trichlorophenol	<1	<1	<2 AA	<2 AA	<2 AA	<1	<1				<1	ug/l	TM16/PM30
4-Chloro-3-methylphenol #	<0.5	<0.5	<1.0 AA	<1.0 AA	<1.0 AA	<0.5	<0.5				<0.5	ug/l	TM16/PM30
4-Methylphenol	<1	<1	<2 AA	<2 AA	<2 AA	<1	<1				<1	ug/l	TM16/PM30
4-Nitrophenol	<10	<10	<20 AA	<20 AA	<20 AA	<10	<10				<10	ug/l	TM16/PM30
Pentachlorophenol	<1	<1	<2 AA	<2 AA	<2 AA	<1	<1				<1	ug/l	TM16/PM30
Phenol	<1	<1	<2 AA	<2 AA	<2 AA	<1	<1				<1	ug/l	TM16/PM30
PAHs													
2-Chloronaphthalene #	<1	<1	<2 AA	<2 AA	<2 AA	<1	<1				<1	ug/l	TM16/PM30
2-Methylnaphthalene #	<1	<1	<2 AA	<2 AA	<2 AA	<1	<1				<1	ug/l	TM16/PM30
Phthalates													
Bis(2-ethylhexyl) phthalate	<5	<5	<10 AA	<10 AA	<10 AA	<5	<5				<5	ug/l	TM16/PM30
Butylbenzyl phthalate	<1	<1	<2 AA	<2 AA	<2 AA	<1	<1				<1	ug/l	TM16/PM30
Di-n-butyl phthalate #	<1.5	<1.5	<3.0 AA	<3.0 AA	<3.0 AA	<1.5	<1.5				<1.5	ug/l	TM16/PM30
Di-n-Octyl phthalate	<1	<1	<2 AA	<2 AA	<2 AA	<1	<1				<1	ug/l	TM16/PM30
Diethyl phthalate #	<1	<1	<2 AA	<2 AA	<2 AA	<1	<1				<1	ug/l	TM16/PM30
Dimethyl phthalate	<1	<1	<2 AA	<2 AA	<2 AA	<1	<1				<1	ug/l	TM16/PM30
Other SVOCs													
1,2-Dichlorobenzene #	<1	<1	<2 AA	<2 AA	<2 AA	<1	<1				<1	ug/l	TM16/PM30
1,2,4-Trichlorobenzene #	<1	<1	<2 AA	<2 AA	<2 AA	<1	<1				<1	ug/l	TM16/PM30
1,3-Dichlorobenzene #	<1	<1	<2 AA	<2 AA	<2 AA	<1	<1				<1	ug/l	TM16/PM30
1,4-Dichlorobenzene #	<1	<1	<2 AA	<2 AA	<2 AA	<1	<1				<1	ug/l	TM16/PM30
2-Nitroaniline	<1	<1	<2 AA	<2 AA	<2 AA	<1	<1				<1	ug/l	TM16/PM30
2,4-Dinitrotoluene #	<0.5	<0.5	<1.0 AA	<1.0 AA	<1.0 AA	<0.5	<0.5				<0.5	ug/l	TM16/PM30
2,6-Dinitrotoluene	<1	<1	<2 AA	<2 AA	<2 AA	<1	<1				<1	ug/l	TM16/PM30
3-Nitroaniline	<1	<1	<2 AA	<2 AA	<2 AA	<1	<1				<1	ug/l	TM16/PM30
4-Bromophenylphenylether #	<1	<1	<2 AA	<2 AA	<2 AA	<1	<1				<1	ug/l	TM16/PM30
4-Chloroaniline	<1	<1	<2 AA	<2 AA	<2 AA	<1	<1				<1	ug/l	TM16/PM30
4-Chlorophenylphenylether #	<1	<1	<2 AA	<2 AA	<2 AA	<1	<1				<1	ug/l	TM16/PM30
4-Nitroaniline	<0.5	<0.5	<1.0 AA	<1.0 AA	<1.0 AA	<0.5	<0.5				<0.5	ug/l	TM16/PM30
Azobenzene #	<0.5	<0.5	<1.0 AA	<1.0 AA	<1.0 AA	<0.5	<0.5				<0.5	ug/l	TM16/PM30
Bis(2-chloroethoxy)methane #	<0.5	<0.5	<1.0 AA	<1.0 AA	<1.0 AA	<0.5	<0.5				<0.5	ug/l	TM16/PM30
Bis(2-chloroethyl)ether #	<1	<1	<2 AA	<2 AA	<2 AA	<1	<1				<1	ug/l	TM16/PM30
Carbazole #	<0.5	<0.5	<1.0 AA	<1.0 AA	<1.0 AA	<0.5	<0.5				<0.5	ug/l	TM16/PM30
Dibenzofuran #	<0.5	<0.5	<1.0 AA	<1.0 AA	<1.0 AA	<0.5	<0.5				<0.5	ug/l	TM16/PM30
Hexachlorobenzene #	<1	<1	<2 AA	<2 AA	<2 AA	<1	<1				<1	ug/l	TM16/PM30
Hexachlorobutadiene #	<1	<1	<2 AA	<2 AA	<2 AA	<1	<1				<1	ug/l	TM16/PM30
Hexachlorocyclopentadiene	<1	<1	<2 AA	<2 AA	<2 AA	<1	<1				<1	ug/l	TM16/PM30
Hexachloroethane #	<1	<1	<2 AA	<2 AA	<2 AA	<1	<1				<1	ug/l	TM16/PM30
Isophorone #	<0.5	<0.5	<1.0 AA	<1.0 AA	<1.0 AA	<0.5	<0.5				<0.5	ug/l	TM16/PM30
N-nitrosodi-n-propylamine #	<0.5	<0.5	<1.0 AA	<1.0 AA	<1.0 AA	<0.5	<0.5				<0.5	ug/l	TM16/PM30
Nitrobenzene #	<1	<1	<2 AA	<2 AA	<2 AA	<1	<1				<1	ug/l	TM16/PM30
Surrogate Recovery 2-Fluorobiphenyl	99	105	103 AA	78 AA	104 AA	84	97				<0	%	TM16/PM30
Surrogate Recovery p-Terphenyl-d14	105	109	116 AA	91 AA	115 AA	80	107				<0	%	TM16/PM30

Client Name: O'Callaghan Moran & Associates
Reference: 19-238-01
Location: Castlerea Landfill
Contact: Sean Moran
EMT Job No: 19/12876

VOC Report : **Liquid**

EMT Sample No.	1-7	8-14	15-21	22-28	29-35	43-49	50-56				LOD/LOR	Units	Method No.
Sample ID	MW1	MW2	CSW1	CSW2	CSW3	CSW5	CSW6						
Depth													
COC No / misc													
Containers	V H N P BOD G	V H N P BOD G	V H N P BOD G	V H N P BOD G	V H N P BOD G	V H N P BOD G	V H N P BOD G						
Sample Date	08/08/2019	08/08/2019	08/08/2019	08/08/2019	08/08/2019	08/08/2019	08/08/2019						
Sample Type	Ground Water	Ground Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water						
Batch Number	1	1	1	1	1	1	1						
Date of Receipt	09/08/2019	09/08/2019	09/08/2019	09/08/2019	09/08/2019	09/08/2019	09/08/2019						
VOC MS													
Dichlorodifluoromethane	<2	<2	<2	<2	<2	<2	<2				<2	ug/l	TM15/PM10
Methyl Tertiary Butyl Ether #	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				<0.1	ug/l	TM15/PM10
Chloromethane #	<3	<3	<3	<3	<3	<3	<3				<3	ug/l	TM15/PM10
Vinyl Chloride #	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				<0.1	ug/l	TM15/PM10
Bromomethane	<1	<1	<1	<1	<1	<1	<1				<1	ug/l	TM15/PM10
Chloroethane #	<3	<3	<3	<3	<3	<3	<3				<3	ug/l	TM15/PM10
Trichlorofluoromethane #	<3	<3	<3	<3	<3	<3	<3				<3	ug/l	TM15/PM10
1,1-Dichloroethene (1,1 DCE) #	<3	<3	<3	<3	<3	<3	<3				<3	ug/l	TM15/PM10
Dichloromethane (DCM) #	<5	<5	<5	<5	<5	<5	<5				<5	ug/l	TM15/PM10
trans-1-2-Dichloroethene #	<3	<3	<3	<3	<3	<3	<3				<3	ug/l	TM15/PM10
1,1-Dichloroethane #	<3	<3	<3	<3	<3	<3	<3				<3	ug/l	TM15/PM10
cis-1-2-Dichloroethene #	<3	<3	<3	<3	<3	<3	<3				<3	ug/l	TM15/PM10
2,2-Dichloropropane	<1	<1	<1	<1	<1	<1	<1				<1	ug/l	TM15/PM10
Bromochloromethane #	<2	<2	<2	<2	<2	<2	<2				<2	ug/l	TM15/PM10
Chloroform #	<2	<2	<2	<2	3	<2	<2				<2	ug/l	TM15/PM10
1,1,1-Trichloroethane #	<2	<2	<2	<2	<2	<2	<2				<2	ug/l	TM15/PM10
1,1-Dichloropropene #	<3	<3	<3	<3	<3	<3	<3				<3	ug/l	TM15/PM10
Carbon tetrachloride #	<2	<2	<2	<2	<2	<2	<2				<2	ug/l	TM15/PM10
1,2-Dichloroethane #	<2	<2	<2	<2	<2	<2	<2				<2	ug/l	TM15/PM10
Benzene #	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5				<0.5	ug/l	TM15/PM10
Trichloroethene (TCE) #	<3	<3	<3	<3	<3	<3	<3				<3	ug/l	TM15/PM10
1,2-Dichloropropane #	<2	<2	<2	<2	<2	<2	<2				<2	ug/l	TM15/PM10
Dibromomethane #	<3	<3	<3	<3	<3	<3	<3				<3	ug/l	TM15/PM10
Bromodichloromethane #	<2	<2	<2	<2	<2	<2	<2				<2	ug/l	TM15/PM10
cis-1-3-Dichloropropene	<2	<2	<2	<2	<2	<2	<2				<2	ug/l	TM15/PM10
Toluene #	<5	<5	<5	<5	<5	<5	<5				<5	ug/l	TM15/PM10
trans-1-3-Dichloropropene	<2	<2	<2	<2	<2	<2	<2				<2	ug/l	TM15/PM10
1,1,2-Trichloroethane #	<2	<2	<2	<2	<2	<2	<2				<2	ug/l	TM15/PM10
Tetrachloroethene (PCE) #	<3	<3	<3	<3	<3	<3	<3				<3	ug/l	TM15/PM10
1,3-Dichloropropane #	<2	<2	<2	<2	<2	<2	<2				<2	ug/l	TM15/PM10
Dibromochloromethane #	<2	<2	<2	<2	<2	<2	<2				<2	ug/l	TM15/PM10
1,2-Dibromoethane #	<2	<2	<2	<2	<2	<2	<2				<2	ug/l	TM15/PM10
Chlorobenzene #	<2	<2	<2	<2	<2	<2	<2				<2	ug/l	TM15/PM10
1,1,1,2-Tetrachloroethane #	<2	<2	<2	<2	<2	<2	<2				<2	ug/l	TM15/PM10
Ethylbenzene #	<1	<1	<1	<1	<1	<1	<1				<1	ug/l	TM15/PM10
m/p-Xylene #	<2	<2	<2	<2	<2	<2	<2				<2	ug/l	TM15/PM10
o-Xylene #	<1	<1	<1	<1	<1	<1	<1				<1	ug/l	TM15/PM10
Styrene	<2	<2	<2	<2	<2	<2	<2				<2	ug/l	TM15/PM10
Bromoform #	<2	<2	<2	<2	<2	<2	<2				<2	ug/l	TM15/PM10
Isopropylbenzene #	<3	<3	<3	<3	<3	<3	<3				<3	ug/l	TM15/PM10
1,1,2,2-Tetrachloroethane	<4	<4	<4	<4	<4	<4	<4				<4	ug/l	TM15/PM10
Bromobenzene #	<2	<2	<2	<2	<2	<2	<2				<2	ug/l	TM15/PM10
1,2,3-Trichloropropane #	<3	<3	<3	<3	<3	<3	<3				<3	ug/l	TM15/PM10
Propylbenzene #	<3	<3	<3	<3	<3	<3	<3				<3	ug/l	TM15/PM10
2-Chlorotoluene #	<3	<3	<3	<3	<3	<3	<3				<3	ug/l	TM15/PM10
1,3,5-Trimethylbenzene #	<3	<3	<3	<3	<3	<3	<3				<3	ug/l	TM15/PM10
4-Chlorotoluene #	<3	<3	<3	<3	<3	<3	<3				<3	ug/l	TM15/PM10
tert-Butylbenzene #	<3	<3	<3	<3	<3	<3	<3				<3	ug/l	TM15/PM10
1,2,4-Trimethylbenzene #	<3	<3	<3	<3	<3	<3	<3				<3	ug/l	TM15/PM10
sec-Butylbenzene #	<3	<3	<3	<3	<3	<3	<3				<3	ug/l	TM15/PM10
4-Isopropyltoluene #	<3	<3	<3	<3	<3	<3	<3				<3	ug/l	TM15/PM10
1,3-Dichlorobenzene #	<3	<3	<3	<3	<3	<3	<3				<3	ug/l	TM15/PM10
1,4-Dichlorobenzene #	<3	<3	<3	<3	<3	<3	<3				<3	ug/l	TM15/PM10
n-Butylbenzene #	<3	<3	<3	<3	<3	<3	<3				<3	ug/l	TM15/PM10
1,2-Dichlorobenzene #	<3	<3	<3	<3	<3	<3	<3				<3	ug/l	TM15/PM10
1,2-Dibromo-3-chloropropane	<2	<2	<2	<2	<2	<2	<2				<2	ug/l	TM15/PM10
1,2,4-Trichlorobenzene	<3	<3	<3	<3	<3	<3	<3				<3	ug/l	TM15/PM10
Hexachlorobutadiene	<3	<3	<3	<3	<3	<3	<3				<3	ug/l	TM15/PM10
Naphthalene	<2	<2	<2	<2	<2	<2	<2				<2	ug/l	TM15/PM10
1,2,3-Trichlorobenzene	<3	<3	<3	<3	<3	<3	<3				<3	ug/l	TM15/PM10
Surrogate Recovery Toluene D8	97	89	88	90	94	91	99				<0	%	TM15/PM10
Surrogate Recovery 4-Bromofluorobenzene	96	92	90	94	97	96	99				<0	%	TM15/PM10

Please see attached notes for all abbreviations and acronyms

Client Name: O'Callaghan Moran & Associates
Reference: 19-238-01
Location: Castlerea Landfill
Contact: Sean Moran

EMT Job No.	Batch	Sample ID	Depth	EMT Sample No.	Analysis	Reason
No deviating sample report results for job 19/12876						

Please note that only samples that are deviating are mentioned in this report. If no samples are listed it is because none were deviating.
Only analyses which are accredited are recorded as deviating if set criteria are not met.

NOTES TO ACCOMPANY ALL SCHEDULES AND REPORTS

EMT Job No.: 19/12876

SOILS

Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Limits of detection for analyses carried out on as received samples are not moisture content corrected. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

Where a CEN 10:1 ZERO Headspace VOC test has been carried out, a 10:1 ratio of water to wet (as received) soil has been used.

% Asbestos in Asbestos Containing Materials (ACMs) is determined by reference to HSG 264 The Survey Guide - Appendix 2 : ACMs in buildings listed in order of ease of fibre release.

Sufficient amount of sample must be received to carry out the testing specified. Where an insufficient amount of sample has been received the testing may not meet the requirements of our accredited methods, as such accreditation may be removed.

Negative Neutralization Potential (NP) values are obtained when the volume of NaOH (0.1N) titrated (pH 8.3) is greater than the volume of HCl (1N) to reduce the pH of the sample to 2.0 - 2.5. Any negative NP values are corrected to 0.

The calculation of Pyrite content assumes that all oxidisable sulphides present in the sample are pyrite. This may not be the case. The calculation may be an overesitimate when other sulphides such as Barite (Barium Sulphate) are present.

WATERS

Please note we are not a UK Drinking Water Inspectorate (DWI) Approved Laboratory .

ISO17025 accreditation applies to surface water and groundwater and usually one other matrix which is analysis specific, any other liquids are outside our scope of accreditation.

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

DEVIATING SAMPLES

All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. The temperature of sample receipt is recorded on the confirmation schedules in order that the client can make an informed decision as to whether testing should still be undertaken.

SURROGATES

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

DILUTIONS

A dilution suffix indicates a dilution has been performed and the reported result takes this into account. No further calculation is required.

BLANKS

Where analytes have been found in the blank, the sample will be treated in accordance with our laboratory procedure for dealing with contaminated blanks.

NOTE

Data is only reported if the laboratory is confident that the data is a true reflection of the samples analysed. Data is only reported as accredited when all the requirements of our Quality System have been met. In certain circumstances where all the requirements of the Quality System have not been met, for instance if the associated AQC has failed, the reason is fully investigated and documented. The sample data is then evaluated alongside the other quality control checks performed during analysis to determine its suitability. Following this evaluation, provided the sample results have not been effected, the data is reported but accreditation is removed. It is a UKAS requirement for data not reported as accredited to be considered indicative only, but this does not mean the data is not valid.
Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.

REPORTS FROM THE SOUTH AFRICA LABORATORY

Any method number not prefixed with SA has been undertaken in our UK laboratory unless reported as subcontracted.

Measurement Uncertainty

Measurement uncertainty defines the range of values that could reasonably be attributed to the measured quantity. This range of values has not been included within the reported results. Uncertainty expressed as a percentage can be provided upon request.

ABBREVIATIONS and ACRONYMS USED

#	ISO17025 (UKAS Ref No. 4225) accredited - UK.
SA	ISO17025 (SANAS Ref No.T0729) accredited - South Africa
B	Indicates analyte found in associated method blank.
DR	Dilution required.
M	MCERTS accredited.
NA	Not applicable
NAD	No Asbestos Detected.
ND	None Detected (usually refers to VOC and/SVOC TICs).
NDP	No Determination Possible
SS	Calibrated against a single substance
SV	Surrogate recovery outside performance criteria. This may be due to a matrix effect.
W	Results expressed on as received basis.
+	AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page.
>>	Results above calibration range, the result should be considered the minimum value. The actual result could be significantly higher, this result is not accredited.
*	Analysis subcontracted to an Element Materials Technology approved laboratory.
AD	Samples are dried at 35°C ±5°C
CO	Suspected carry over
LOD/LOR	Limit of Detection (Limit of Reporting) in line with ISO 17025 and MCERTS
ME	Matrix Effect
NFD	No Fibres Detected
BS	AQC Sample
LB	Blank Sample
N	Client Sample
TB	Trip Blank Sample
OC	Outside Calibration Range
AA	x2 Dilution

AB	x3 Dilution

EMT Job No: 19/12876

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/SANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM4	Modified USEPA 8270 method for the solvent extraction and determination of 16 PAHs by GC-MS.	PM30	Water samples are extracted with solvent using a magnetic stirrer to create a vortex.				
TM4	Modified USEPA 8270 method for the solvent extraction and determination of 16 PAHs by GC-MS.	PM30	Water samples are extracted with solvent using a magnetic stirrer to create a vortex.	Yes			
TM5	Modified 8015B method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) within the range C8-C40 by GCFID. For waters the solvent extracts dissolved phase plus a sheen if present.	PM16/PM30	Fractionation into aliphatic and aromatic fractions using a Rapid Trace SPE/Water samples are extracted with solvent using a magnetic stirrer to create a vortex.	Yes			
TM5/TM36	please refer to TM5 and TM36 for method details	PM12/PM16/PM30	please refer to PM16/PM30 and PM12 for method details	Yes			
TM15	Modified USEPA 8260. Quantitative Determination of Volatile Organic Compounds (VOCs) by Headspace GC-MS.	PM10	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.				
TM15	Modified USEPA 8260. Quantitative Determination of Volatile Organic Compounds (VOCs) by Headspace GC-MS.	PM10	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.	Yes			
TM16	Modified USEPA 8270. Quantitative determination of Semi-Volatile Organic compounds (SVOCs) by GC-MS.	PM30	Water samples are extracted with solvent using a magnetic stirrer to create a vortex.				
TM16	Modified USEPA 8270. Quantitative determination of Semi-Volatile Organic compounds (SVOCs) by GC-MS.	PM30	Water samples are extracted with solvent using a magnetic stirrer to create a vortex.	Yes			
TM20	Modified BS 1377-3: 1990/USEPA 160.3 Gravimetric determination of Total Dissolved Solids/Total Solids	PM0	No preparation is required.	Yes			
TM26	Determination of phenols by Reversed Phased High Performance Liquid Chromatography and Electro-Chemical Detection.	PM0	No preparation is required.				

EMT Job No: 19/12876

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/SANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM26	Determination of phenols by Reversed Phased High Performance Liquid Chromatography and Electro-Chemical Detection.	PM0	No preparation is required.	Yes			
TM30	Determination of Trace Metal elements by ICP-OES (Inductively Coupled Plasma - Optical Emission Spectrometry). Modified US EPA Method 200.7, 6010B and BS EN ISO 11885 2009	PM14	Analysis of waters and leachates for metals by ICP OES/ICP MS. Samples are filtered for dissolved metals and acidified if required.				
TM30	Determination of Trace Metal elements by ICP-OES (Inductively Coupled Plasma - Optical Emission Spectrometry). Modified US EPA Method 200.7, 6010B and BS EN ISO 11885 2009	PM14	Analysis of waters and leachates for metals by ICP OES/ICP MS. Samples are filtered for dissolved metals and acidified if required.	Yes			
TM36	Modified US EPA method 8015B. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID. MTBE by GCFID co-elutes with 3-methylpentane if present and therefore can give a false positive. Positive MTBE results can be confirmed using GCMS.	PM12	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.	Yes			
TM38	Soluble Ion analysis using Discrete Analyser. Modified US EPA methods 325.2 (Chloride), 375.4 (Sulphate), 365.2 (o-Phosphate), 353.1 (TON), 354.1 (Nitrite), 350.1 (NH4+) comparable to BS ISO 15923-1, 7196A (Hex Cr)	PM0	No preparation is required.	Yes			
TM42	Modified US EPA method 8270. Pesticides and herbicides by GC-MS	PM30	Water samples are extracted with solvent using a magnetic stirrer to create a vortex.				
TM57	Modified US EPA Method 410.4. Comparable with ISO 15705:2002. Chemical Oxygen Demand is determined by hot digestion with Potassium Dichromate and measured spectrophotometerically.	PM0	No preparation is required.	Yes			
TM58	APHA Standard Methods for the extraction of water and waste water (SMEWW) 5210B. Comparible with ISO 5815:1989. Measurement of Biochemical Oxygen Demand. When cBOD (Carbonaceous BOD) is requested a nitrification inhibitor is added which prevents the oxidation of reduced forms of nitrogen, such as ammonia, nitrite and organic nitrogen which exert a nitrogenous demand. Determination of Dissolved Oxygen using the Hach HQ30D Oxygen Meter.	PM0	No preparation is required.	Yes			
TM60	TC/TOC analysis of Waters by High Temperature Combustion followed by NDIR detection. Based on the following modified standard methods: USEPA 9060, APHA Standard Methods for Examination of Water and Wastewater 5310B, ASTM D 7573, and USEPA 415.1.	PM0	No preparation is required.	Yes			
TM89	Modified USEPA method OIA-1667. Determination of cyanide by Flow Injection Analyser. Where WAD cyanides are required a Ligand displacement step is carried out before analysis.	PM0	No preparation is required.	Yes			

EMT Job No: 19/12876

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/SANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM149	Determination of Pesticides by Large Volume Injection on GC Triple Quad MS, based upon USEPA method 8270	PM30	Water samples are extracted with solvent using a magnetic stirrer to create a vortex.				

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CERTIFICATE OF ANALYSIS

Client : Billy Hamilton
O'Callaghan Moran & Associates, Environmental & Hy
Unit 15 Melbourne Business Park,
Model Farm Road,
Cork.

Report No.	:	395946
Date of Receipt	:	08/08/2019
Start Date of Analysis	:	08/08/2019
Date of Report	:	13/08/2019
Order Number	:	
Sample taken by	:	Client

Lab No	Sample Description	Test	Ref.	Result	Units
976589	GW19/238/01 MW1	Total Coliforms (Filtration) (Environmental Waters)	I, R	3	cfu/100ml
		Faecal Coliforms Filtration	I, R	0	cfu/100ml
976590	GW19/238/01 MW2	Total Coliforms (Filtration) (Environmental Waters)	I, R	10	cfu/100ml
		Faecal Coliforms Filtration	I, R	0	cfu/100ml

ISO 17025 IVNAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 108T

Approved by: Stephanie Folan

Stephanie Folan
Account Manager

See below for test specifications and accreditation status.
This report only relates to items tested and shall not be reproduced but in full with the permission of CLS.
0cfu is reported in waters, this refers to 'not detected in volume tested'
It is recommended that water samples requiring microbiological analysis should be tested within 24 hours of sampling.

Complete Laboratory Solutions,
Ros Muc, Connemara,
Co. Galway

Complete Laboratory Solutions,
MedPharma Division,
Unit 3a, Small Business Park, Mervue, Galway

Symbol Reference - I:17025 accredited; S:Subcontracted; R:Analysis carried out in Ros Muc; M:Analysis carried out in MedPharma

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In-House Test	Specification	17025	GMP/FDA*	ISO**
Total Coliforms (Filtration) (Environmental Waters)	CLS 16	Yes	No	Yes
Faecal Coliforms Filtration	CLS 16 based on The Microbiology of Recreational and Environmental Waters 2000	Yes	No	Yes

*Analysis carried out in a GMP approved, FDA inspected facility (MedPharma site only).
**Laboratory Analysis, Sampling, Food Safety Monitoring and Analysts on Contract are all ISO 9001 certified.

Lab No	Sample ID	Sample Condition on Receipt	Sampling Date
976589	GW19/238/01 MW1	Good condition	08/08/2019
976590	GW19/238/01 MW2	Good condition	08/08/2019

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Co. Galway

Complete Laboratory Solutions,
MedPharma Division,
Unit 3a, Small Business Park, Mervue, Galway

Symbol Reference - I:17025 accredited; S:Subcontracted; R:Analysis carried out in Ros Muc; M:Analysis carried out in MedPharma

APPENDIX 8

Tier 3 Risk Scores

Risk Screening/ Prioritisation

Table 1a LEACHATE: SOURC/HAZARD SCORING MATRIX			
	Waste FOOTPRINT (ha)		
WASTE TYPE	≤ 1ha	> 1 ≤ 5 ha	> 5ha
C&D	0.5	1	1.5
Municipal	5	7	10
Industrial	5	7	10
Pre 1977 sites	1	2	3

1a =	7

Table 1b LANDFILL GAS: SOURC/HAZARD SCORING MATRIX			
	Waste FOOTPRINT (ha)		
WASTE TYPE	≤ 1ha	> 1 ≤ 5 ha	> 5ha
C&D	0.5	0.75	1
Municipal	5	7	10
Industrial	3	5	7
Pre 1977 sites	0.5	0.75	1

1b =	7

Table 2a : LEACHATE MIGRATION: PATHWAYS	
GROUNDWATER VULNERABILITY (Vertical Pathway)	Points
Extreme Vulnerability	3
High Vulnerability	2
Moderate Vulnerability	1
Low Vulnerability	0.5
High - Low Vulnerability (use where vulnerability not on GIS)	2

2a =	1

Table 2b : LEACHATE MIGRATION: PATHWAYS	
GROUNDWATER FLOW REGIME (Horizontal Pathway)	Points
Karstified Groundwater Bodies (Rk)	5
Productive Fissured Bedrock Groundwater Bodies (Rf & Lm)	3
Gravel Groundwater Bodies (Rg and Lg)	2
Poorly Productive Bedrock Groundwater Bodies (Ll, Pl, Pu)	1

2b =	5

Risk Screening/ Prioritisation

Table 2c : LEACHATE MIGRATION: PATHWAYS	
SURFACE WATER DRAINAGE (Surface water pathway)	**Points**
Is there a direct connection between drainage ditches associated with the waste body and adjacent surface water body? Yes	2
If no direct connection	0

2c =	**2**

Table 2d : LANDFILL GAS: PATHWAY	
LANDFILL GAS LATERAL MIGRATION POTENTIAL	**Points**
Sand and Gravel, Made ground, urban, karst	3
Bedrock	2
All other Tills (including limestone, sandstone etc - moderate permab	1.5
All Namurian or Irish Sea Tills (low permability)	1
Clay, Alluvium, Peat	1

2d =	**1**

Table 2e : LANDFILL GAS: PATHWAY (assuming receptor located above source)	
LANDFILL GAS LATERAL MIGRATION POTENTIAL	**Points**
Sand and Gravel, Made ground, urban, karst	5
Bedrock	3
All other Tills (including limestone, standstone etc - moderate perma	2
All Namurian or Irish Sea Tills (low permability)	1
Clay, Alluvium, Peat	1

2e =	**0**

Table 3a : LEACHAGE MIGRATION: *RECEPTORS*	
HUMAN PRESENCE (presence of a house indicates potential private wells)	**Points**
On or within 50m of the waste body	3
Greater than 50m but less than 250m	2
Greater than 250m but less than 1km from waste body	1
Greater than 1km of the waste body	0

3a =	**0**

Risk Screening/ Prioritisation

Table 3b : LEACHAGE MIGRATION: RECEPTORS PROTECTED AREAS (SWDTE or GWDTE)	Points
Within 50m of waste body	3
Greater than 50m but less than 250m of the waste body	2
Greater than 250m but less than 1km from waste body	1
Greater than 1km of the waste body	0
Undesignated sites within 50m of waste body	1
Undesignated sites greater than 50m but less than 250m	0.5
Undesignated sites greater than 250m of the waste body	0

3b =	0

Table 3c : LEACHAGE MIGRATION: *RECEPTORS*	
AQUIFER CATEGORY (resource potential)	Points
Regionally Important Aquifers (Rk, Rf, Rg)	5
Locally Important Aquifers (Ll, Lm, Lg)	3
Poor Aquifers (Pl, Pu)	1

3c =	5

Table 3d : LEACHAGE MIGRATION: *RECEPTORS*	
PUBLIC WATER SUPPLIES (Other than private wells)	Points
Within 100m of site boundary	7
Greater than 100m but less than 300m or with in Inner SPA for GW supplies	5
Greater than 300m but less than 1km or within Outer SPA (SO) for GW supplies	3
Greater than 1km (karst aquifer)	3
Greater than 1km (no karst aquifer)	0

3d =	3

Table 3e : LEACHAGE MIGRATION: *RECEPTORS*	
SURFACE WATER BODIES	Points
Within 50m of site boundary	3
Greater than 50m but less than 250m	2
Greater than 250m but less than 1km	1
Greater than 1km	0

3e =	3

Table 3f : LEACHAGE MIGRATION: *RECEPTORS*	
HUMAN PRESENCE	Points
On site or within 50m of site boundary	5
Greater than 50m but less than 150m	3
Greater than 150m but less than 250m	1
Greater than 250m	0.5

3f =	0.5

Risk Screening/ Prioritisation

Note: The table below represents the Tier 1 risk rating for this site. SPR 1 to 9 represent the leachate risk scores. SPR 10 & 11 represent Landfill Gas risks. The migration pathways are colour coded as follows:			
Groundwater & Surface Water	Groundwater only	Surface water only	Lateral & Vertical

Calculator	SPR Values	Maximum Score	Linkages	Normalised Score
Groundwater & Surface Water	Groundwater only	Surface water only	Lateral & Vertical	
SPR 1 =	168	300	Leachate => surface water	56%
SPR 2 =	0	300	Leachate => SWDTE	0%
SPR 3 =	0	240	Leachate => human presence	0%
SPR 4 =	0	240	Leachate => GWDTE	0%
SPR 5 =	210	400	Leachate => Aquifer	53%
SPR 6 =	126	560	Leachate => Surface Water	23%
SPR 7 =	126	240	Leachate => SWDTE	53%
SPR 8 =	42	60	Leachate => Surface Water	70%
SPR 9 =	0	60	Leachate => SWDTE	0%
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 (Class A)		