Unit 15
Melbourne Business Park
Model Farm Road
Cork

T: 021 434 5366
E: info@ocallaghanmoran.com
www.ocallaghanmoran.com

TIER 3 RISK ASSESSMENT

FORMER LANDFILL

GOWRAN

COUNTY KILKENNY

VOL 1

Prepared For: -

Kilkenny County Council
John Street
Kilkenny

Prepared By: -

O'Callaghan Moran & Associates,
Unit 15, Melbourne Business Park,
Model Farm Road,
Cork.

December 2017

TABLE OF CONTENTS

LIST OF APPENDICES

1. INTRODUCTION

Kilkenny County Council (KCC) completed a Tier 1 Environmental Assessment of a closed landfill at Gowran in 2013, in accordance with the guidance in the Environmental Protection Agency (Agency) guidance document "Code of Practice Environmental Risk Assessment for Unregulated Waste Disposal Sites (CoP)" published in April 2007.

The Assessment, a copy of which is in Appendix 1, ranked the landfill as being of Moderate Risk associated with potential leachate migration to groundwater. The Assessment concluded that the site was a Class B — Moderate Risk, with the most significant Source-Pathway-Receptor (SPR) linkages as follows:

1. Environmental risk to underlying regionally important aquifer via migration of leachate to groundwater.
2. Environmental risk to humans via lateral and vertical migration of landfill gas due to the proximity of residential dwellings.

In 2014, KCC appointed Fehily Timoney & Company (FTC) to conduct a Tier 2 Site Investigation. This involved the excavation of trial pits to delineate the lateral and vertical extent of the waste, an assessment of the nature of the waste, the installation of two groundwater monitoring wells and landfill gas monitoring.

The FTC Tier 2 Assessment, a copy of which is in Appendix 1, confirmed the initial Tier 1 ranking of Moderate Risk. It concluded that the site was not impacting on groundwater quality and although the landfill gas migration risk from the site was low, there was the potential for lateral migration. FTC recommend that further investigations be undertaken and a Tier 3 Risk Assessment be completed.

In November 2017 KCC appointed O'Callaghan Moran & Associates (OCM) to carry out the Tier 3 Assessment. The scope included a review of Tier 1 and Tier 2 Assessment Reports followed by the design and implementation of a site investigation, the results of which were used to update the Tier 2 Assessment and to inform the design of remedial measures.

The investigations comprised:

- Installation of two (2 No.) groundwater monitoring wells;
- Installation of two (2 No.) landfill gas monitoring wells;
- Collection and analyses of groundwater samples;
- Six (6 No.) rounds of landfill gas monitoring;
- Topographic survey.

1.1 Methodology

The site investigation was undertaken in accordance with BS 10175:2001and 2011 Investigation of Potentially Contaminated Sites-Code of Practice. The laboratory analysis was carried out by Exova Jones Environmental Forensics Ltd, a UKAS accredited laboratory.

The Risk Assessment was completed in accordance with the Code of Practice: Environmental Risk Assessment for Unregulated Waste Disposal Sites (EPA, 2007).

Mr Sean Moran MSc, P.Geol, was the OCM Project Manager with responsibility for the delivery of the project. Mr. Moran is 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 c 300m to the northwest of Gowran (Figure 2.1). It is accessed from the Rockfield road, which runs along the north western boundary of the site.

2.2 Site Layout

The site occupies 0.4 hectares (Figure 2.2). The land slopes from the north-east toward the south-west. The north of the site is uneven, poorly draining ground with scrub vegetation and a tree line along the northwest site boundary. In the south west of the site is a gravel hardstanding area which was used as a storage yard by KCC for aggregate, piping and lamp posts.

There is some fly tipped waste present on the site including black plastic bags of general household rubbish.

2.3 Surrounding Land Use

The surrounding land use is shown on Figure 2.3. The site is bounded to the south and south-east by disused playing fields. There is a residential housing estate (The Steeples) c150 to the south-east. To the west is the land is undeveloped and slopes away to the west. Rockfield Road runs along the north-western boundary. The lands further to the north-west are agricultural pasture. There are four residential dwellings immediately to the north-east of the site.

A foul sewer servicing the residential development to the north-east of the site runs along the north-eastern boundary and connects to the foul sewer running along the Rockfield Road.

2.4 Site History

The site was originally used as a quarry during the early to mid 1900's. From the mid 1970's to the mid 1990's, the site was used by KCC for the disposal of municipal and industrial waste.

O'Callaghan Moran & Associates,
Unit 15 Melbourne Business Park,
Model Farm Road, Cork.
Tel. (021) 4345366
email: info@ocallaghanmoran.com
Environmental Management for Business

CLIENT
Kilkenny County Council

TITLE
Site Location

Details:
Site Boundary

Figure 2.1

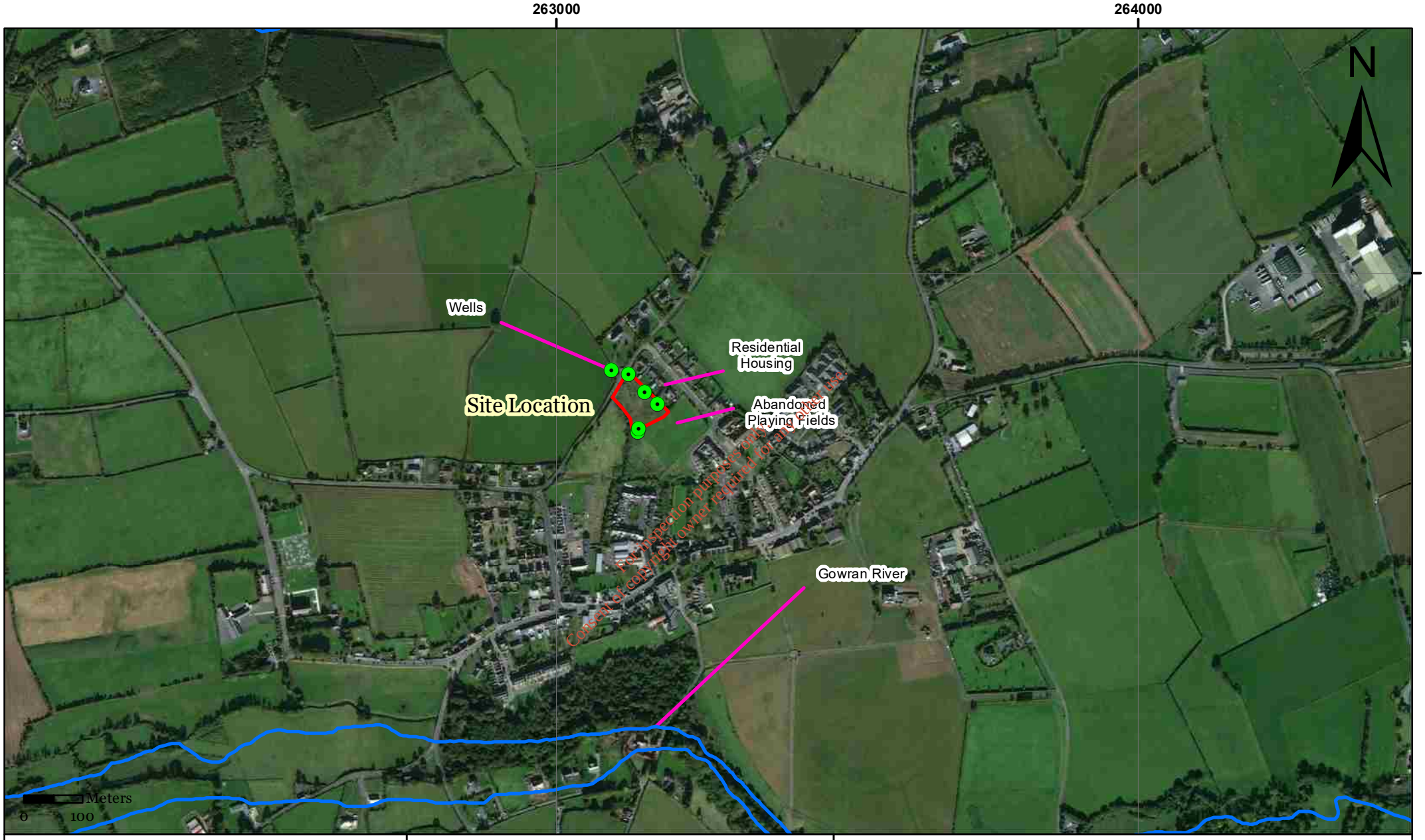
O'Callaghan Moran & Associates,
Unit 15 Melbourne Business Park,
Model Farm Road, Cork.
Tel. (021) 4345366
email: info@ocallaghanmoran.com

CLIENT
TJ O'Connor & Associates

TITLE
Gowran Site Layout

Details:
- Trial Pits
- Monitoring Wells
- Site Boundary

Figure 2.2



O'Callaghan Moran & Associates,
Unit 15 Melbourne Business Park,
Model Farm Road, Cork.
Tel. (021) 4345366
email: info@ocallaghanmoran.com

CLIENT
TJ O'Connor & Associates

TITLE
Gowran Site Layout

Details:
- Monitoring Wells
- Rivers
- Site Boundary

Figure 2.3

2.5 Hydrology

The site slopes in a north-westerly direction. The closest surface water feature is the Gowran River approximately 0.5 km to the south west of the site (Figure 2.4) and which flows in an easterly direction before discharging into the Barrow c. 5.5 km east of the site. There are no field drains or other surface water features connecting the site to the river.

The site lies within the Gowran Tributary of the Barrow Water Body (E_SE_14_1879). While the physiochemical status of the water body is good the overall status of this Surface Water Body (SWB) is Poor due to impacts on ecological receptors. The SWB Report is in Appendix 2.

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

Information on the geology was derived from maps prepared by Teagasc and the GSI and the site investigations conducted by FTC in 2014 and OCM in 2017.

The Teagasc map indicates that the natural ground comprises Limestone till (Carboniferous) (Figure 2.5). Previous site investigations identified a cover layer of soft medium brown slightly sandy clay, ranging from 0.5 to 2.4m over most of the site. This overlies the municipal waste. The maximum depth of waste was found to be approximately 5 m below ground level (bgl) in the centre of the site.

2.6.2 Bedrock

Information on the geology was derived from maps prepared by the GSI and site investigations completed by OCM. The regional bedrock geology is shown on Figure 2.6. The map shows the site underlain by crinoidal wackestone/packstone limestone from the Ballyadams Formation. The drilling programme completed by OCM confirmed the presence of limestone bedrock.

2.6.3 Hydrogeology

The GSI bedrock aquifer map identifies the bedrock underlying the site as a Regionally Important Aquifer (Rk(d))- (Karstified aquifer with diffuse flow paths) – The bedrock aquifer is capable of supplying groundwater yields >400 m^3/d (Figure 2.7).

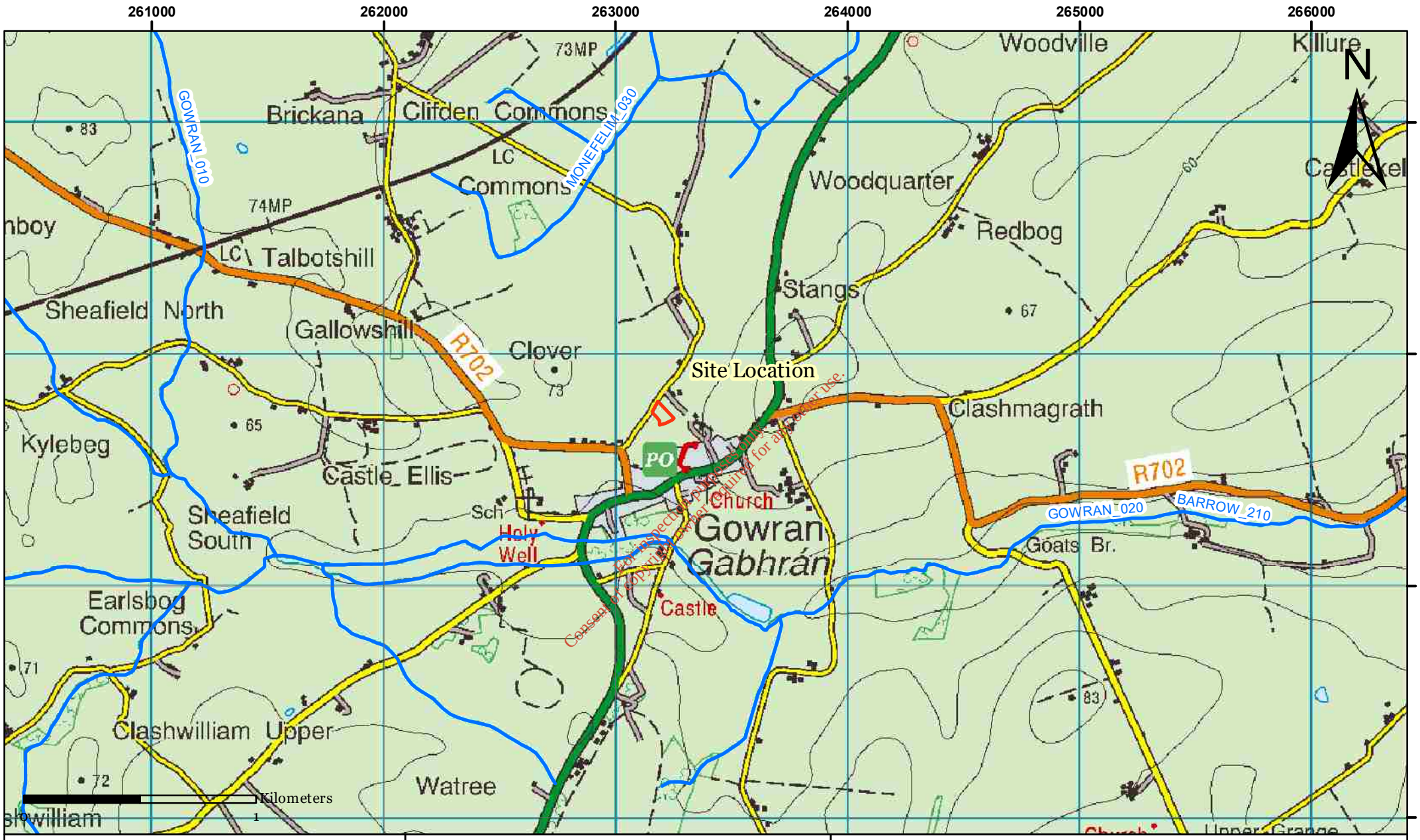
Groundwater vulnerability, as defined by the GSI, is the term used to represent the intrinsic geological and hydrogeological characteristics that determine the ease with which groundwater may be contaminated by human activities. The GSI Online mapping data set identifies that, the groundwater vulnerability for the site is classified as 'Extreme' (Figure 2.8).

The closest water supply borehole is 150 m south-west of the site at the Steeples Housing Estate. The log for this well, which was installed in 2006 to supply a housing scheme, describes the ground conditions as red-brown clay and limestone boulders underlain by a bed of weathered dolomite and then dark grey weathered limestone typical of the Butlersgrove Formation. Other water supply boreholes in the surrounding area are shown on Figure 2.9.

The GSI estimates that groundwater recharge in the area is 489 mm per year. The site lies within the Bagnelstown_3 Groundwater Body (GWB). The GWB status is rated as 'Good'. The GWB Report is in Appendix 3.

2.7 Designated Sites

The closest Natura 2000 site is the Barrow and River Nore Special Area of Conservation (SAC 002162) which is located c.5.5km east of the site.



O'Callaghan Moran & Associates,
Unit 15 Melbourne Business Park,
Model Farm Road, Cork.
Tel. (021) 4345366
email: info@ocallaghanmoran.com

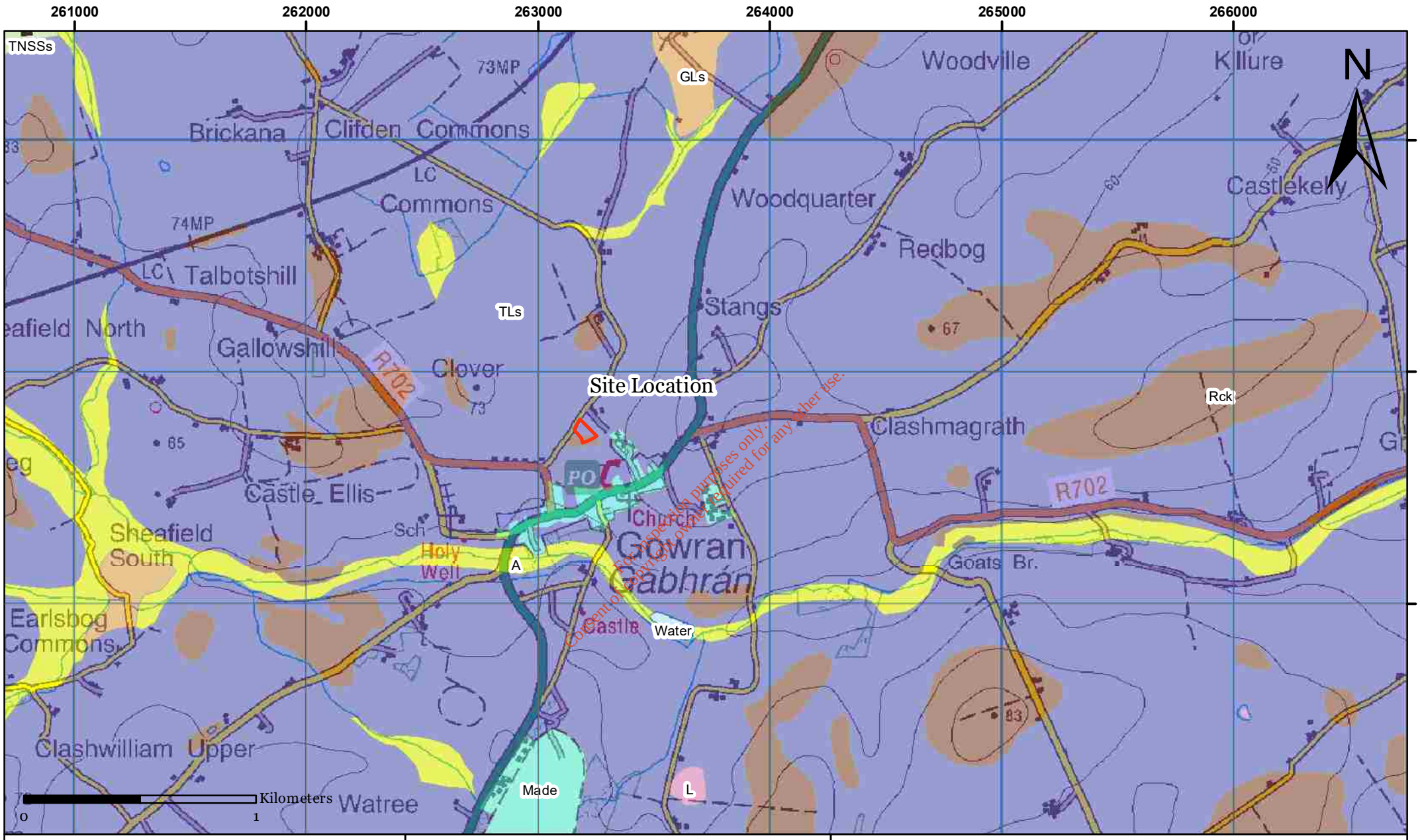
Environmental Management for Business

CLIENT
Kilkenny County Council

TITLE
Hydrology

Details:
- Site Boundary
- Rivers

Figure 2.4



O'Callaghan Moran & Associates,
Unit 15 Melbourne Business Park,
Model Farm Road, Cork.
Tel. (021) 4345366
email: info@ocallaghanmoran.com

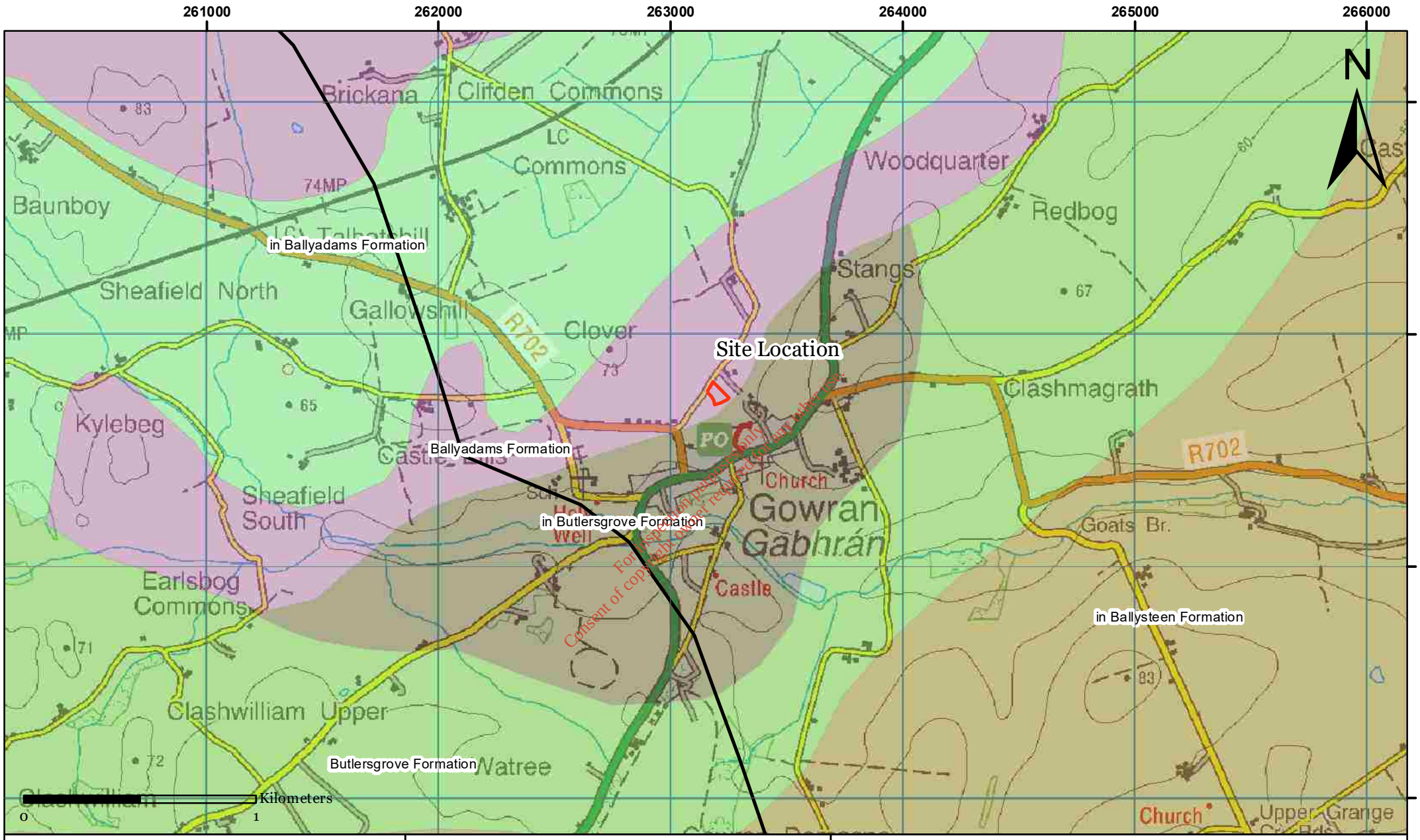
CLIENT
Kilkenny County Council

TITLE
Subsoils

Details:

- Site Boundary
- A - Alluvium undifferentiated
- BktPt - Blanket peat
- GLs - Limestone sands and gravels (Carboniferous)
- L-Lake sediments undifferentiated
- Made - Made Ground
- Rck - Bedrock at surface
- TLs - Limestone till (Carboniferous)

Figure 2.5



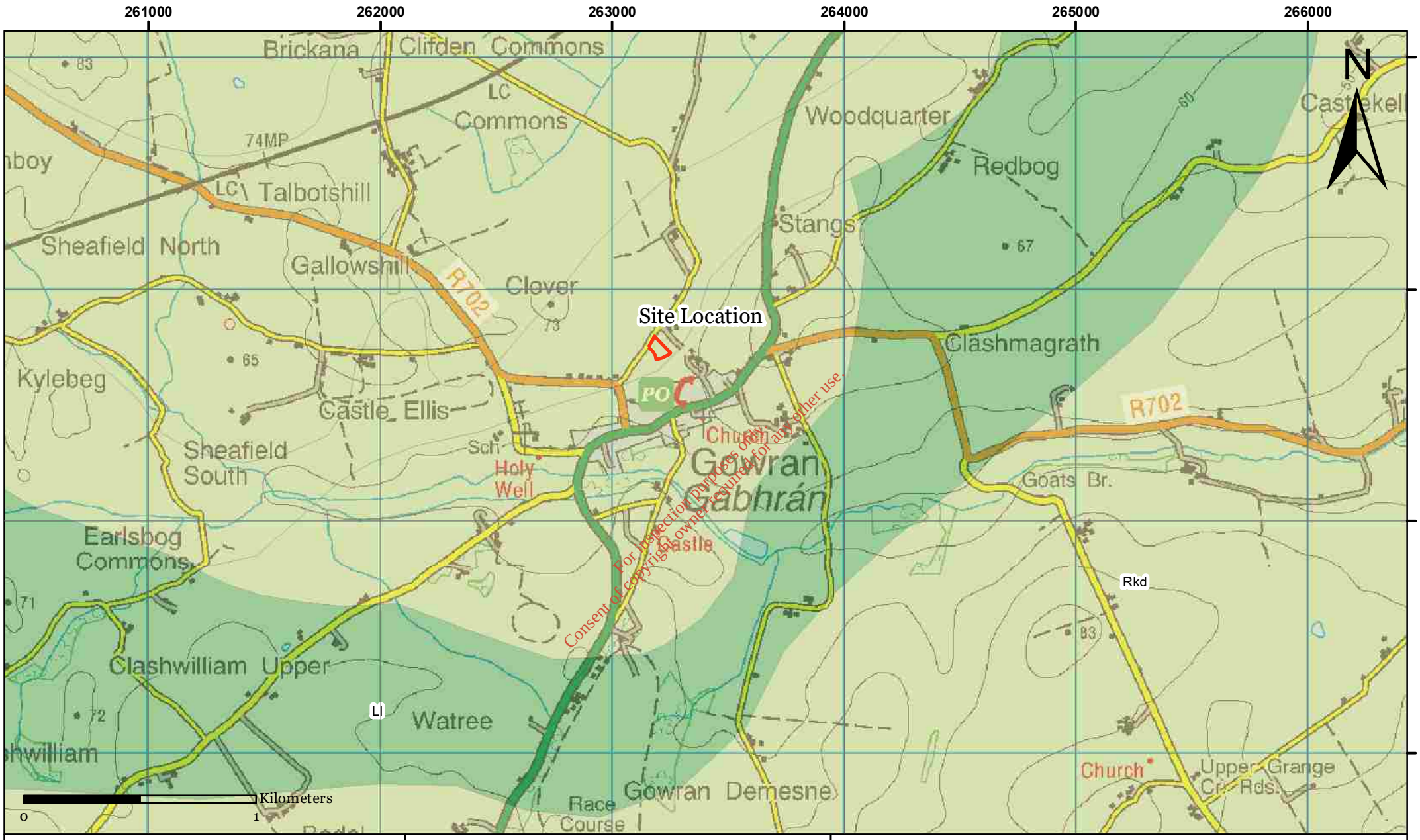
O'Callaghan Moran & Associates,
Unit 15 Melbourne Business Park,
Model Farm Road, Cork.
Tel. (021) 4345366
email: info@ocallaghanmoran.com

CLIENT
Kilkenny County Council

TITLE
Bedrock Geology

Details:
- Site Boundary
- Faults
- Ballyadams Formation-Crinoidal wackestone/packstone limestone
- Ballysteen Formation-Dark muddy limestone,shale
- Butlersgrove Formation-Very dark-grey argillaceous limestone
- in Ballyadams Formation-Dolomitised crinoidal limestone
- in Ballysteen Formation-Dolomitised dark-grey muddy limestone
- in Butlersgrove Formation-Dolomitised argillaceous limestones

Figure 2.6



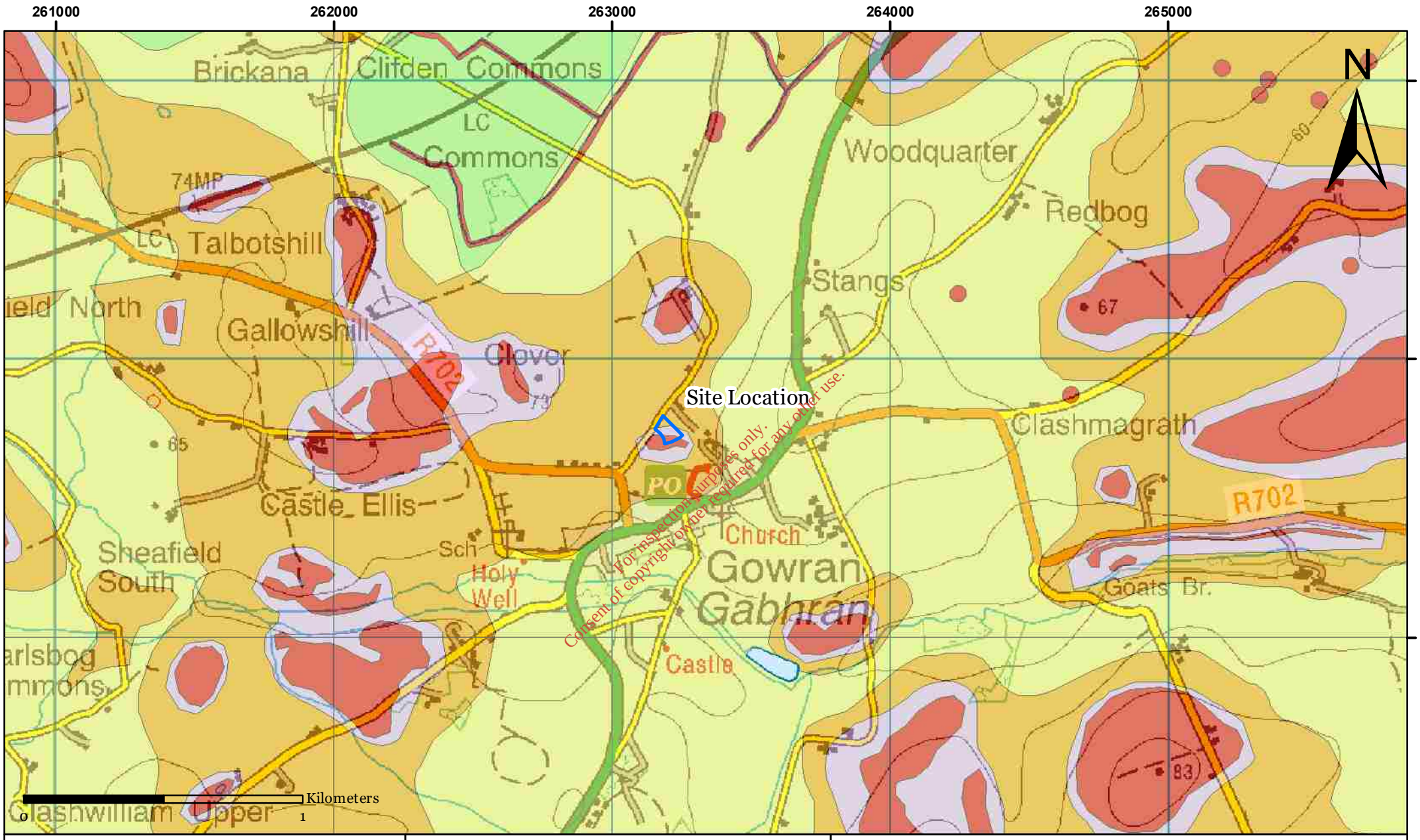
O'Callaghan Moran & Associates,
Unit 15 Melbourne Business Park,
Model Farm Road, Cork.
Tel. (021) 4345366
email: info@ocallaghanmoran.com

CLIENT
Kilkenny County Council

TITLE
Aquifer Classification

Details:
- Site Boundary
- Ll - Locally Important Aquifer. Mod. Productive only in Local Zones
- Rkd - Regionally Important Aquifer. Karstified Bedrock dominated by diffuse flow

Figure 2.7



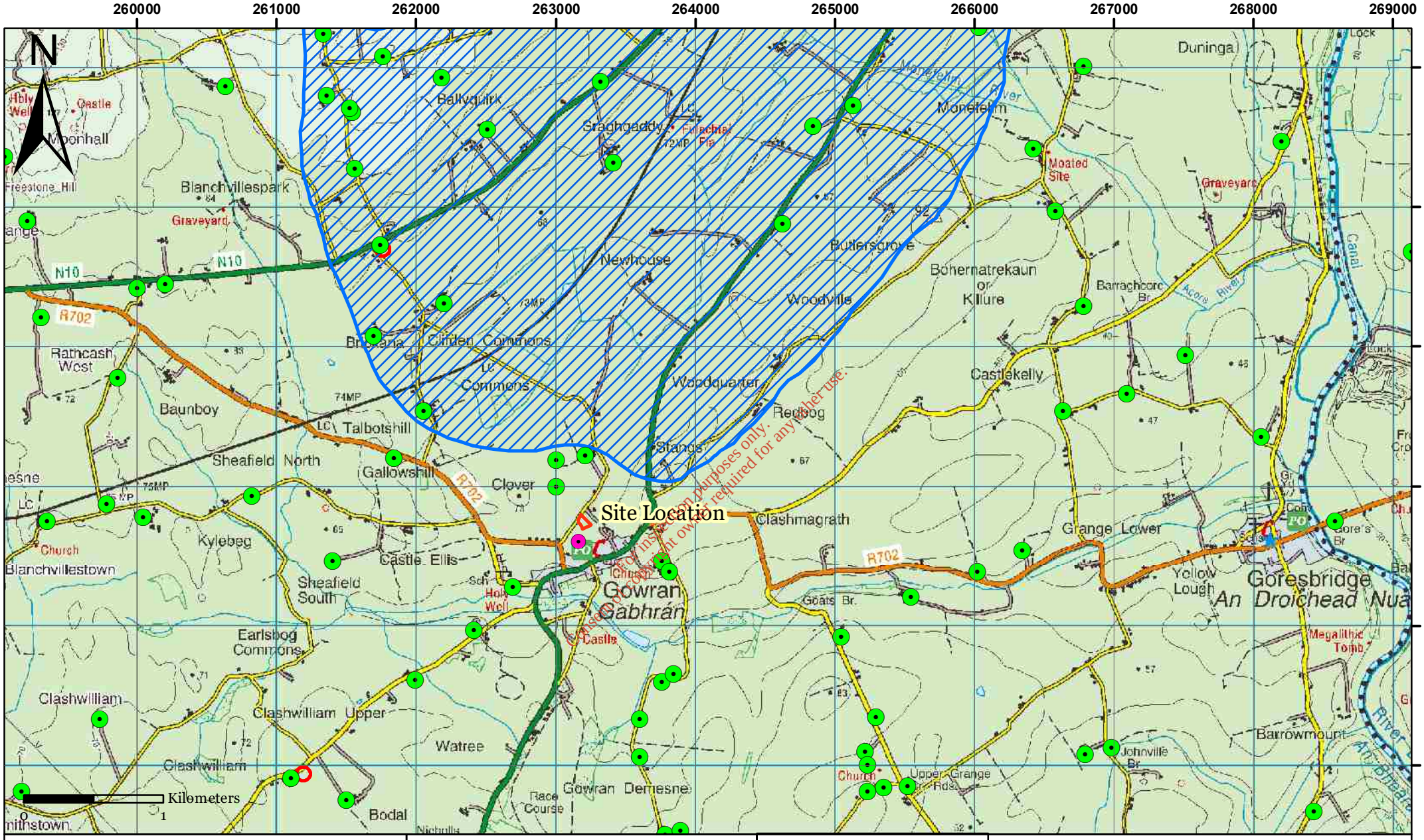
O'Callaghan Moran & Associates,
Unit 15 Melbourne Business Park,
Model Farm Road, Cork.
Tel. (021) 4345366
email: info@ocallaghanmoran.com

CLIENT
Kilkenny County Council

TITLE
Groundwater Vulnerability

Details:
- Site Boundary
- Bedrock near Surface
- Extreme
- High
- Moderate
- Low

Figure 2.8



O'Callaghan Moran & Associates,
Unit 15 Melbourne Business Park,
Model Farm Road, Cork.
Tel. (021) 4345366
email: info@ocallaghanmoran.com
Environmental Management for Business

CLIENT
Kilkenny County Council

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 Boundary
- Source Protection Area
- Well Accuracy:50m to 100m
- Well Accuracy:10m to 50m
- Public Supply Well(10 to 50m Accuracy)

Figure 2.9

3. OCM SITE INVESTIGATIONS 2017

3.1 Objectives

The objective of the investigation was to collect sufficient additional information to allow for a complete assessment of the environmental risk posed by the landfill.

3.2 Site Investigation Scope

The FTC investigation included the excavation of twelve (12 No.) trial pits to delineate the lateral and vertical extent and nature of the waste. Well pipes were installed in three trial pits (TP-8, TP-11 and TP-12) to monitor landfill gas. Two (2 No) groundwater monitoring wells, (BH-1 and BH-2) were installed up and down topographic gradient of the site.

FTC recommended further site investigations and monitoring including, but not limited to, the installation of further shallow upstream and downstream groundwater wells.

The OCM investigation involved the installation of two (2 No.) groundwater monitoring wells (BH-1A and BH-3). BH-1A was adjacent and was a replacement well for BH-1, which was dry. BH-3 was immediately down topographic gradient of the landfill in the north of the site.

Two gas monitoring wells (GW-1 and GW-2) were installed along the western boundary of the site to assess the potential for landfill gas migration to the dwellings to the north-east of the site. The locations of the FTC and OCM trial pits and monitoring wells are shown on Figure 3.1.

3.3 Ground Conditions

The FTC investigation established that the ground conditions comprised waste of varying composition and degrees of degradation overlain by a layer of topsoil/clay capping material of predominantly gravelly clay (Refer to Figure 3.2, which is based on the FTC investigations).

The waste footprint was estimated to be 0.40 ha and the depth of the waste varied from approximately 0m to 5.0m (Figure 3.3). The waste was described as domestic waste including plastics (wrappers, refuse sacks, bottles), textiles, glass, papers, brick, timber, bags of degraded black sludge/waste.

There was no evidence of any significant amounts of potentially hazardous waste (e.g. oils, solvents), staining or odours. Field screening for the presence of volatile organic compounds (VOC) was carried out using a hand held VOC analyser, but no VOCs were recorded.

The OCM 2017 investigation confirmed the natural subsoils (clayey gravels) extend to approximately 7m bgl and are underlain by limestone bedrock.

O'Callaghan Moran & Associates,
Unit 15 Melbourne Business Park,
Model Farm Road, Cork.
Tel. (021) 4345366
email: info@ocallaghanmoran.com

CLIENT
TJ O'Connor & Associates

TITLE
Gowran Site Layout

Details:
- Trial Pits
- Monitoring Wells
- Site Boundary

Figure 3.1

O' Callaghan Moran & Associates.
Unit 15 Melbourne Business Park
Model Farm Road, Cork, Ireland.
Tel. (021) 4345366
email: info@ocallaghanmoran.com

CLIENT

Kilkenny County Council

FIGURE No.

3.2

TITLE

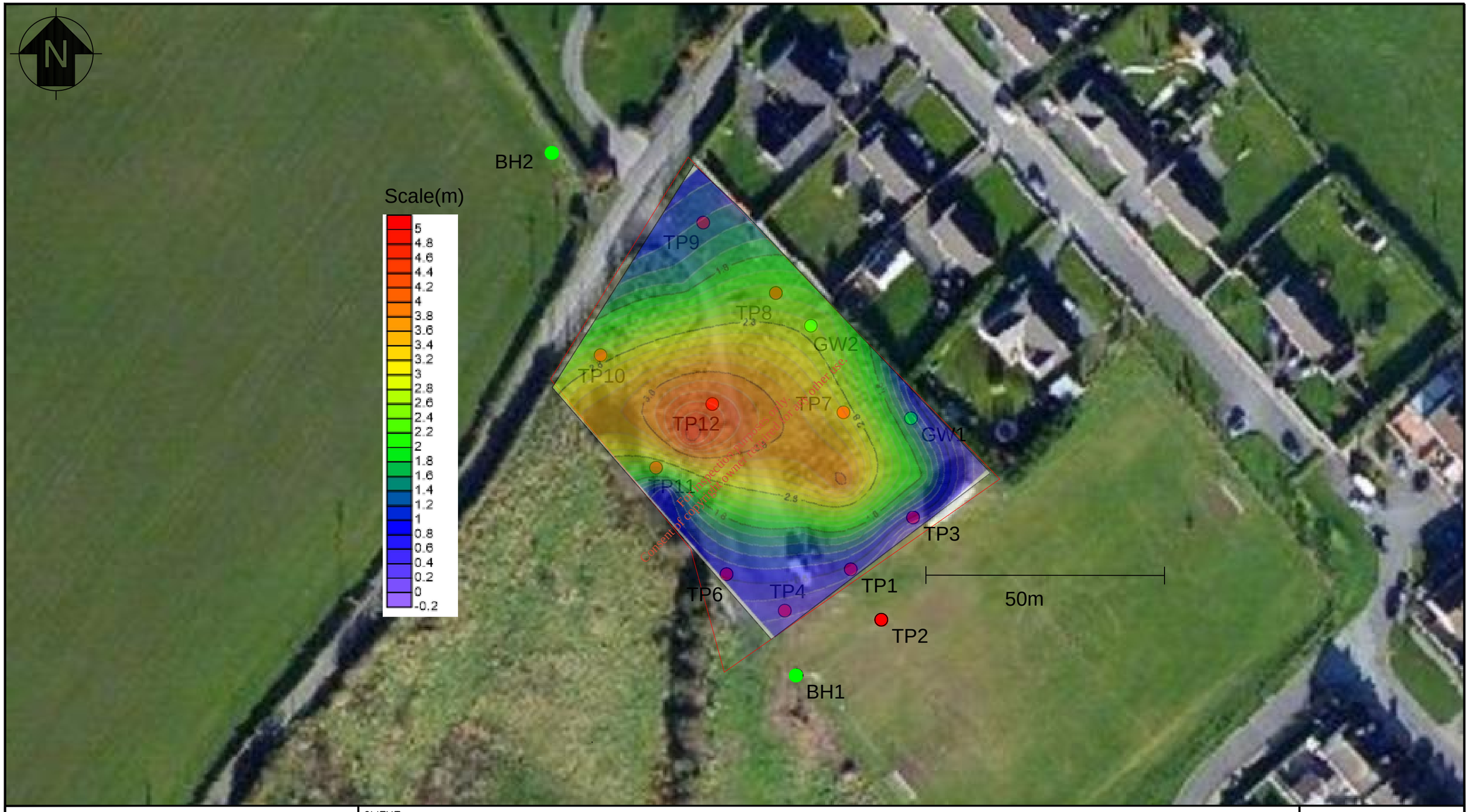
Capping Depths

SCALE

NTS

REV.

A



O' Callaghan Moran & Associates.
Unit 15 Melbourne Business Park
Model Farm Road, Cork, Ireland.
Tel. (021) 4345366
email: info@ocallaghanmoran.com

CLIENT

Kilkenny County Council

FIGURE No.

3.3

TITLE

MSW Depth

SCALE

NTS

REV.

A

3.4 Monitoring well Installation

The additional groundwater wells were located outside the waste deposition area. Before the intrusive works commenced, a Cable Avoidance Tool (CAT) was used to screen the proposed locations for underground services.

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 geologist who logged the borings in accordance with BS 5930 as amended by the GSI, and ensured the wells were installed in accordance with OCM's specification.

Water strikes were recorded in each groundwater well; at 5.88m bgl in BH-1A, and 7.9 m bgl in BH-3.

3.5 Well Design and Construction

The monitoring wells were constructed using high density polyethylene (HDPE) 50 mm diameter standpipes. BH 1A extended to 11.0m and BH-3 14.5m bgl and were slotted in the bedrock (6m slotted in BH-1A, and 6m slotted in BH-3). The gas monitoring wells extended to depths of 1.8m and 3.5m bgl for GW-1 and GW-2 respectively and were slotted from the base of the waste to 1m bgl.

A gravel filter pack was inserted in the annular space between the borings and the standpipe. Above the gravel filter, the annular space was filled with a 1m bentonite seal. The solid section of the well pipes was brought above the ground level and was fitted with a steel protective well casing. The well construction logs are in Appendix 4.

3.5.1 Visual and Olfactory Evidence of Contamination

There was no visual or olfactory evidence of contamination in any in the groundwater wells. A strong pungent odour was detected during the installation of GW-2.

3.5.2 Well Development

The drilling ended with a short phase of airlift pumping by the rig, with the drill tools set just above the bottom of the borehole. The water from each borehole was clear of sediment after the pumping and further development was not necessary.

3.6 Environmental Monitoring

Following the completion of the intrusive works OCM implemented a leachate, groundwater and landfill gas monitoring programme. Groundwater and leachate sampling was undertaken in accordance with OCM sampling protocols, copies of which are in Appendix 5.

3.6.1 Leachate

In November 2017 a leachate sample was collected from the gas monitoring well installed in TP_12 in 2014. 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 3.1, with the full laboratory report in Appendix 6. 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 weak and aged leachate with approximately 90% of the values below the mean values for a landfill that is in Stage IV of the degradation process.

Table 3.1 Leachate Analysis

Sample I.D.	Units	TP-12	EPA Landfill Design Manual Range
Arsenic	µg/l	10.9	<1 - 6,700
Boron	µg/l	219	-
Cadmium	µg/l	<0.5	<10 - 80
Copper	µg/l	<7	20 - 620
Mercury	µg/l	<1	<0.1 - 0.8
Nickel	µg/l	22	<30 - 600
Lead	µg/l	<5	<40 - 1,900
Zinc	µg/l	6	<30 - 6,700
Manganese	µg/l	466	40 - 3,590
Sulphate	mg/l	61.8	<5 - 322
Chloride	mg/l	22.5	570 - 4,710
Total Cyanide	µg/l	<0.01	-
Chromium - diss.	µg/l	<1.5	-
Phosphorous - total	µg/l	4238	-
Potassium	mg/l	27.3	100 - 1,580
Sodium	mg/l	23.5	474 - 3,650
Total Oxidised Nitrogen	mg/l	0.4	-
Ammonia	mg/l	10.07	283 -- 2,040
BOD settled	mg/l	13	110 - 1,900
COD	mg/l	46	622 - 8,000
VOCs	µg/l	ND	-
sVOCs	µg/l	ND	-
PAH	µg/l	ND	-
Pesticides	µg/l	ND	-

3.6.2 Groundwater

OCM monitored groundwater quality in BH-1A, BH-2 and BH-3. Prior to collection of the samples, OCM measured the depth to groundwater and the total depth of the well. This information 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 3.2.

Table 3.2 – In-Situ Monitoring 2017

Location	pH	Temperature (°C)	Electrical Conductivity (mS/cm)	Visual / Olfactory Description
BH-1A	7.72	11.7	1438	Clear, no odour
BH-2	7.45	12.2	740	Clear, no odour
BH-3	8.05	12.8	668	Clear, no odour

The temperature values measured were generally within the expected range for groundwater. The pH levels are typically within the expected range for groundwater in a karst limestone environment. Electrical Conductivity was elevated in BH-1A.

The samples were stored in laboratory prepared bottles and shipped to Jones Environmental Laboratories in the UK.

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.

The full laboratory test report is in Appendix 6 and the results are presented in Table 3.4. The table includes Interim Guideline Values (IGV) published by the EPA and the Groundwater Threshold Values (GTV) set out in the European Communities Environmental Objectives (Groundwater) Regulations (S.I. 9 of 2010).

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

Table 3.4 Groundwater Monitoring Results 2017

Sample I.D. / Sample Date	Units	BH-1A 20/11/2017	BH-2 20/11/2017	BH-3 20/11/2017	IGV	GTV
Arsenic	µg/l	13	5.9	7.5	10	7.5
Boron	µg/l	217	29	26	1,000	750
Cadmium	µg/l	<0.5	<0.5	<0.5	5	3.75
Chromium	ug/l	<1.5	<1.5	<1.5	0.03	NE
Copper	µg/l	<7	<7	<7	30	1500
Lead	µg/l	<5	<5	<5	10	18.75
Manganese	µg/l	157	<2	<2	50	NE
Mercury	µg/l	<1	<1	<1	1	0.75
Nickel	µg/l	9	<2	<2	20	15
Phosphorus	ug/l	9112	269	3064	NE	NE
Potassium	mg/l	61.6	6.3	3.1	5	NE
Selenium	ug/l	<3	<3	<3	NW	NE
Sodium	mg/l	39.7	12.2	13.9	150	150
Zinc	µg/l	9	6	<3	100	75
Chloride	mg/l	40.8	21.4	28.7	30	187.5
Cyanide	µg/l	<0.01	<0.01	<0.01	10	37.5
Orthophosphate	µg/l	<0.03	<0.03	<0.03	30	NE
Sulphate	mg/l	51	20.5	15.9	200	187.5
Ammonia	mg/l	17.49	0.08	0.1	0.15	0.175
BOD	mg/l	<1	1	1	NE	NE
COD (Settled)	mg/l	27	50	19	NE	NE
TOC	mg/l	<2	<2	<2	NAC	NE
Total Dissolved Solids	mg/l	832	528	380	1000	NE
Total Oxidised Nitrogen	mg/l	30	5.1	5.2	NAC	NE
VOCs	µg/l	ND	ND	Detected	NE	NE
Chloroform	mg/l	<2	<2	2	NE	NE
Dibromochloromethane	mg/l	<2	<2	3	NE	NE
sVOCs	µg/l	ND	ND	ND	NE	NE
PAH	µg/l	ND	ND	ND	0.1	0.075
Nitrate as NO_3	mg/l	131	22.6	23.2	25	NE
Nitrite as NO_2	mg/l	1.48	<0.02	<0.02	0.1	NE
Pesticides	ug/l	ND	ND	ND	NE	NE
Total Coliforms	cfu/100 ml	<100	<100	0	0	NE
Faecal Coliforms	cfu/100 ml	<100	<100	0	0	NE

The results indicate that the water quality in BH-2 and BH-3 is good but that BH-1A is impacted by leachate migrating from the landfill.

The closest down hydraulic gradient monitoring well used for potable supply is located at the Steeples Housing estate 150m south of the site. The water quality in this well has been monitored by the Health and Safety Executive (HSE) bi-annually since 2007. The results are included in Appendix 7 and the most recent round of monitoring from October 2017 are summarised on Table 3.5.

3.5 The Steeples Housing Development Water Quality

Sample I.D.	Units	The Steeples Housing Development	Drinking Water Limit (DWL) or Threshold Value (TV)
Sample Date		Oct-17	
Iron	µg/l	< 40	200 (DWL)
Ammonia	mg/l	0.03	0.3 (DWL), 0.225 [0.175 as N] (TV)
Nitrate as NO_3	mg/l	< 5	50 (DWL) 37.5 (TV)
Nitrite as NO_2	mg/l	< 0.02	0.5 (DWL)
E Coli	MPN/100mls	0	0 (DWL)
Total Coliforms	cfu/100 ml	0	0 (DWL)
Conductivity @ 20°C	µS/cm	573	800 (TV), 2,500 (DWL)
Odour	Odour Units	0	NAC
pH	pH units	7.4	6.5 – 9.5 (DWL)
Turbidity	NTU	0.3	NAC
Appearance (D)	Descriptive	Clear	NAC
Taste	Taste Units	0	NAC
Colour (True)	Pt-Co	< 2	NAC

The water quality in this well has been consistently of good quality over the past 10 years of monitoring.

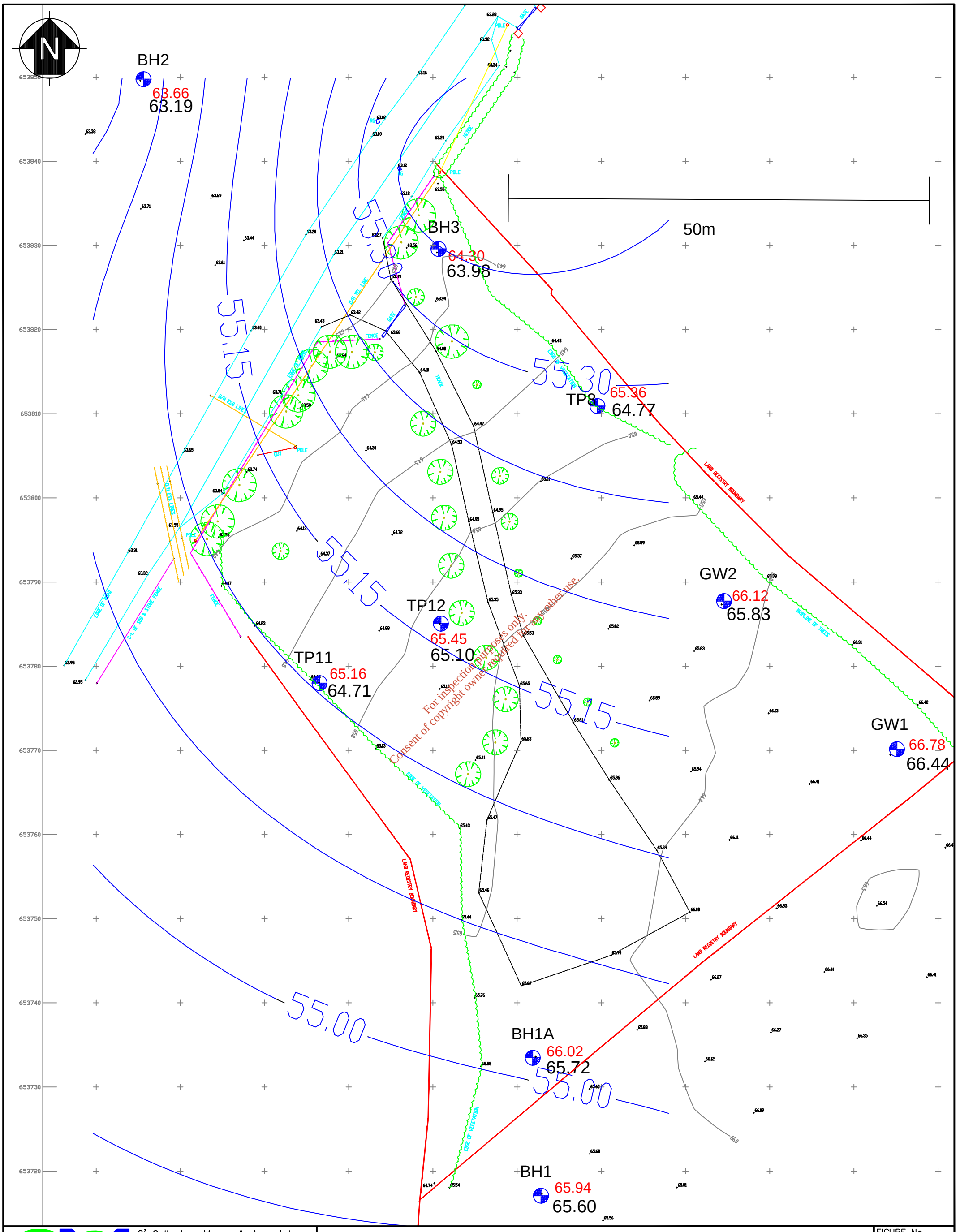
Groundwater Flow Direction

The monitoring wells were surveyed in to Ordnance Datum (OD) and position in December 2017 as shown on Table 3.3.

Table 3.3 Groundwater levels

Borehole	Water level 20/11/2017 mAOD	Water level 04/12/2017 mAOD
BH-1A	54.51	54.92
BH-2	54.63	54.96
BH-3	55	55.4

The groundwater levels recorded during the monitoring programme in November were converted to OD and used to generate a groundwater flow direction map for the site (Figure 3.4). Groundwater flows from the north-east toward the south-west. This indicates that BH-2 is located up or possibly side gradient of the landfill and BH-1A is located down hydraulic gradient of the landfill.



O' Callaghan Moran & Associates. Unit 15 Melbourne Business Park Model Farm Road, Cork, Ireland. Tel. (021) 4345366 email: info@ocallaghanmoran.com environmental management for business	CLIENT Kilkenny County Council	FIGURE No. 3.4
This drawing is the property of O'Callaghan Moran & Associates and shall not be used, reproduced or disclosed to anyone without the prior written permission of O'Callaghan Moran & Associates and shall be returned upon request.	TITLE Groundwater Contours	SCALE NTS

3.7 Landfill Gas Monitoring

Due to the proximity of the dwellings and the fact that KCC is considering an amenity use for the landfill site, a Ground Gas Risk Assessment was undertaken in accordance with CIRIA C665 *'Assessing risks posed by hazardous ground gases to buildings'.*

Ground gas monitoring was undertaken on six occasions between 20th November and 6th December in the wells installed in 2014 and 2017. 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 was 0.1% for methane, carbon dioxide and oxygen.

Methane and carbon dioxide were persistently detected in GW-2 and TP-11. The methane levels in GW-2 ranged from 11.0-12.6%, with carbon dioxide levels ranging from 11.9 to 13.0%. The methane levels in TP-11 ranged from 0.1 – 3% while the carbon dioxide levels ranged from 2.9 to 6.1%. Carbon dioxide was also detected persistently elevated in TP-8 ranging from 4.8 to 8.7%.

The results are presented in Tables 3.6 (Round 1-3) and 3.7 (Round 4-6). The Table includes Gas Screening Values (GSV) based on the guideline limits specified in CIRIA C665. Based on the Modified Wilson and Card Classification System the site falls into the Moderate Risk category where borehole air flow rates do not to exceed 70l/hr and where the source of generation comprises an old landfill site. The relevant Gas screening threshold for such a site is 3.6.

The GSVs for methane and carbon dioxide were determined using the maximum level recorded and the maximum gas flow rates. The gas flow rates ranged from -0.3 to +1.0l/hr over the 6 monitoring rounds. Negative gas flow rates indicate that the pressure of the atmosphere is greater than in the ground i.e. that there is more likely to be air flow into the ground than ground gas ventilating from it. While the GSV was not exceeding during any of the monitoring rounds the results do confirm that landfill gas is being generated in the waste body.

Table 3.6 Landfill Gas Monitoring Results (Rounds 1 – 3)

Parameter		Pressure	Flow rate	H_2S	CH_4 (Peak)	CO_2	O_2	LEL
Location	Date / Unit	(mb)	l/h	ppm	%	%	%	%
BH-1	20/11/2017	1012	0.60	0.00	0.00	3.70	14.80	0.50
BH-1A	20/11/2017	1012	-0.20	0.00	0.00	0.00	20.90	0.20
BH-2	20/11/2017	1012	0.10	0.00	0.00	0.90	19.90	0.50
BH-3	20/11/2017	1012	0.10	0.00	0.00	0.50	20.60	0.20
TP-8	20/11/2017	1012	0.00	0.00	0.00	6.50	13.50	0.90
TP-11	20/11/2017	1012	0.00	0.10	3.00	3.20	17.70	1.70
TP-12	20/11/2017	1012	0.00	0.00	0.10	1.60	20.30	1.10
GW-1	20/11/2017	1012	0.00	0.00	0.00	0.60	17.40	0.10
GW-2	20/11/2017	1012	0.00	0.00	12.60	12.00	0.00	87.70
GSV					**0.0756**	**0.0720**		
Parameter		Pressure	Flow rate	H_2S	CH_4 (Peak)	CO_2	O_2	LEL
Location	Date / Unit	(mb)	l/h	ppm	%	%	%	%
BH-1	20/11/2017	1013	0.60	0.00	0.00	3.50	15.00	0.50
BH-1A	20/11/2017	1013	-0.10	0.00	0.00	0.00	20.90	0.20
BH-2	20/11/2017	1013	0.10	0.00	0.00	0.90	19.90	0.50
BH-3	20/11/2017	1013	0.10	0.00	0.00	0.50	20.60	0.20
TP-8	20/11/2017	1013	0.00	0.00	0.00	6.50	13.50	0.90
TP-11	20/11/2017	1013	0.00	0.10	3.00	3.20	17.70	1.10
TP-12	20/11/2017	1013	0.00	0.00	0.10	1.60	20.30	1.10
GW-1	20/11/2017	1013	0.00	0.00	0.00	0.60	17.40	0.10
GW-2	20/11/2017	1013	0.00	0.00	12.60	12.00	0.00	87.70
GSV					**0.0756**	**0.0720**		
Parameter		Pressure	Flow rate	H_2S	CH_4 (Peak)	CO_2	O_2	LEL
Location	Date / Unit	(mb)	l/h	ppm	%	%	%	%
BH-1	28/11/2017	1008	-	-	-	-	-	-
BH-1A	28/11/2017	1007	-0.30	0.00	0.00	0.20	21.30	0.00
BH-2	28/11/2017	1009	0.01	0.00	0.00	0.00	21.30	0.00
BH-3	28/11/2017	1008	0.01	0.00	0.00	0.00	21.20	0.00
TP-8	28/11/2017	1008	0.21	0.00	0.10	4.80	16.70	1.10
TP-11	28/11/2017	1008	0.01	0.00	0.10	3.60	16.30	0.00
TP-12	28/11/2017	1008	1.00	0.00	0.00	1.90	19.70	0.00
GW-1	28/11/2017	1008	0.01	0.00	0.00	0.30	20.30	0.00
GW-2	28/11/2017	1008	0.01	0.00	12.00	12.00	0.00	82.00
GSV					**0.120**	**0.120**		

Table 3.7 Landfill Gas Monitoring Results (Rounds 4 – 6)

Parameter		Pressure	Flow rate	H_2S	CH_4 (Peak)	CO_2	O_2	LEL
Location	Date / Unit	(mb)	l/h	ppm	%	%	%	%
BH-1	29/11/2017	1012	0.60	0.00	0.00	3.70	14.80	0.50
BH-1A	29/11/2017	1012	-0.20	0.00	0.00	0.00	20.90	0.20
BH-2	29/11/2017	1012	0.10	0.00	0.00	0.90	19.90	0.50
BH-3	29/11/2017	1012	0.10	0.00	0.00	0.50	20.60	0.20
TP-8	29/11/2017	1012	0.00	0.00	0.00	6.50	13.50	0.90
TP-11	29/11/2017	1012	0.00	0.10	3.00	3.20	17.70	1.90
TP-12	29/11/2017	1012	0.00	0.00	0.10	1.60	20.30	1.10
GW-1	29/11/2017	1012	0.00	0.00	0.00	0.60	17.40	0.10
GW-2	29/11/2017	1012	0.00	0.00	12.60	12.00	0.00	87.70
GSV					**0.0756**	**0.0720**		
Parameter		Pressure	Flow rate	H_2S	CH_4 (Peak)	CO_2	O_2	LEL
Location	Date / Unit	(mb)	l/h	ppm	%	%	%	%
BH-1	04/12/2017	1027	0.60	0.00	0.00	3.90	14.60	0.50
BH-1A	04/12/2017	1027	-0.20	0.00	0.00	0.00	20.50	0.20
BH-2	04/12/2017	1027	0.10	0.00	0.00	0.00	21.20	0.50
BH-3	04/12/2017	1027	0.10	0.00	0.00	0.50	20.00	0.20
TP-8	04/12/2017	1027	0.00	0.00	0.00	6.80	12.60	0.90
TP-11	04/12/2017	1027	0.00	0.10	3.00	3.50	9.20	2.00
TP-12	04/12/2017	1027	0.00	0.00	0.00	2.90	16.80	1.10
GW-1	04/12/2017	1027	0.00	0.00	0.00	1.00	19.00	0.10
GW-2	04/12/2017	1027	0.00	0.00	12.50	13.00	0.00	87.70
GSV					**0.075**	**0.0780**		
Parameter		Pressure	Flow rate	H_2S	CH_4 (Peak)	CO_2	O_2	LEL
Location	Date / Unit	(mb)	l/h	ppm	%	%	%	%
BH-1	06/12/2017	1012	0.60	0.00	0.00	4.00	14.60	0.50
BH-1A	06/12/2017	1012	0.20	0.00	0.00	0.00	20.50	0.40
BH-2	06/12/2017	1012	0.90	0.00	0.00	0.00	21.20	0.50
BH-3	06/12/2017	1012	-0.30	0.00	0.00	0.10	21.10	0.20
TP-8	06/12/2017	1012	0.00	0.00	0.10	8.70	10.90	1.50
TP-11	06/12/2017	1012	0.00	0.00	3.00	6.10	9.20	3.90
TP-12	06/12/2017	1012	0.00	0.00	0.10	2.90	17.80	2.20
GW-1	06/12/2017	1012	-0.10	0.00	0.00	0.00	20.30	0.30
GW-2	06/12/2017	1012	0.20	0.00	11.00	11.90	0.00	87.70
GSV					**0.066**	**0.0714**		

4. TIER 3 RISK ASSESSMENT

4.1 Conceptual Site Model

The Tier 2 Risk scores calculated by FTC are shown on Table 4.1, with the full Tier 2 Risk scores in Appendix 1.

The FTC Risk scoring shows a Moderate Risk Site due to the potential for impact on the underlying regionally important aquifer via migration of leachate and the risk to humans via lateral and vertical migration of landfill gas. The FTC Tier 2 Conceptual Site Model (CSM) is shown on Figure 4.1

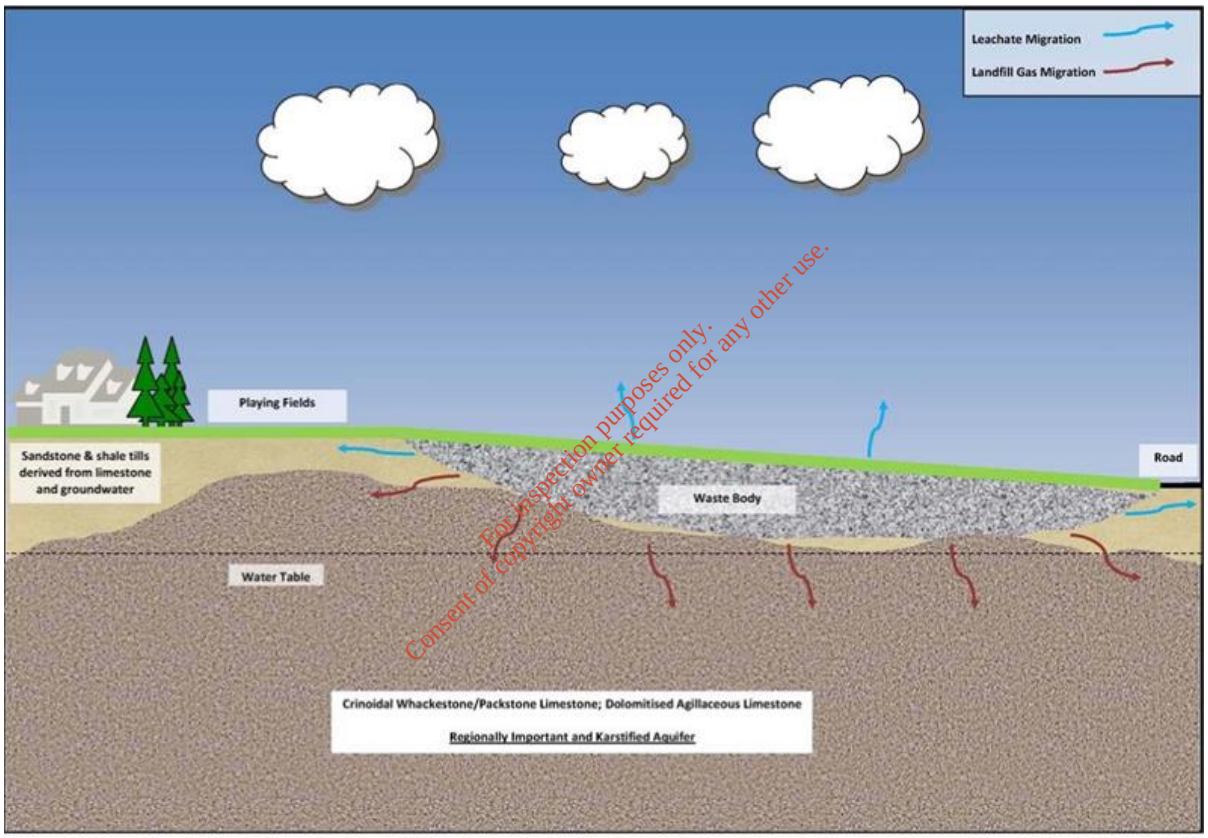


Figure 4.1 FTC Schematic of the Conceptual Site Model

Table 4.1 Tier 2 Risk Assessment Scores

Calculator		S-P-R Values	Maximum Score	Linkage	Normalised Score
Leachate migration through combined groundwater and surface water pathways					
SPR1	1a x (2a + 2b + 2c) x3e	5 x (3+5+0) x 1 40	300	Leachate => surface water	13.30%
SPR2	1a x (2a + 2b + 2c) x 3b	5 x (3+5+0) x 0 0	300	Leachate => SWDTE	0%
Leachate migration through groundwater pathway					
SPR3	1a x (2a + 2b) x 3a	5 x (3+5) x 2 = **80**	240	Leachate => human presence	33.30%
SPR4	1a x (2a + 2b) x 3b	5 x (3+5) x 0 = **0**	240	Leachate => GWDTE	0%
SPR5	1a x (2a + 2b) x 3c	5 x (3+5) x 5 = **200**	400	Leachate => Aquifer	50%
SPR6	1a x (2a + 2b) x 3d	5 x (3+5) x 3 = **120**	560	Leachate => Surface Water	21.40%
SPR7	1a x (2a + 2b) x 3e	5 x (3+5) x 1 = **40**	240	Leachate => SWDTE	16.67%
Leachate migration through surface water pathway					
SPR8	1a x 2c x 3e	5 x 0 x 1 = **0**	60	Leachate => Surface Water	0%
SPR9	1a x 2c x 3b	5 x 0 x 0 = **0**	60	Leachate => SWDTE	0%
Landfill gas migration pathway (lateral & vertical)					
SPR10	1b x 2d x 3f	5 x 3 x 5 = **75**	150	Landfill Gas => Human Presence	50%
SPR11	1b x 2e x 3f	5 x 0 x 5 = **0**	250	Landfill Gas => Human Presence	0%
Site maximum S-P-R Score					**50%**
Risk Classification					**B - Moderate**

4.2 Revised CSM

OCM refined the CSM based on a review of the Tier 2 site investigations completed by FTC in 2014 and the additional site investigations completed by OCM in 2017.

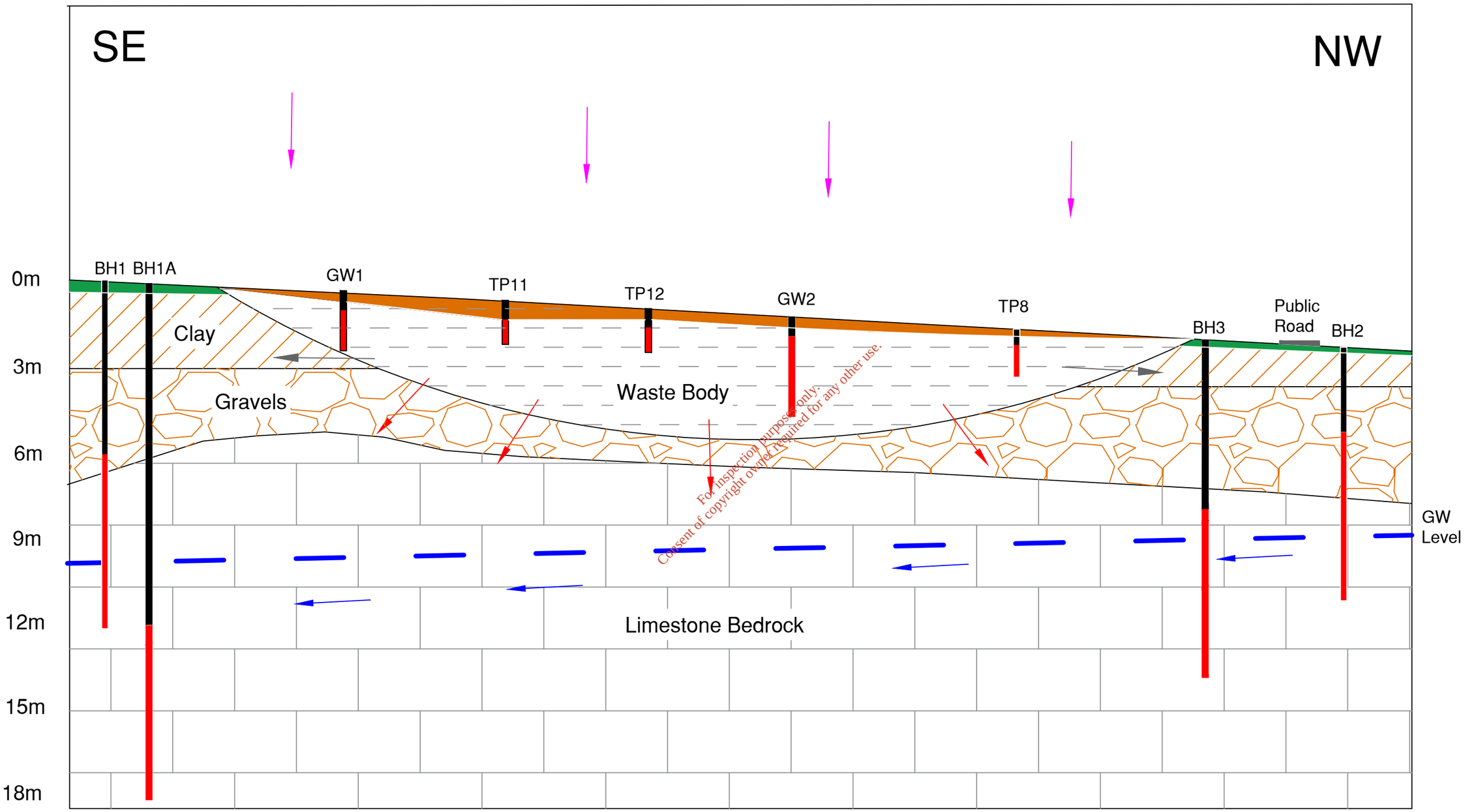
The lateral extent of the waste has been identified and it is contained within the site boundaries and the maximum depth of waste was found to be approximately 5 mbgl toward the southwest of the site and thins toward the boundary. FTC estimated the waste volume to be 20,000m^3 by assuming the entire 4,000m^2 footprint was filled with waste to a depth of 5m. However it is likely to be significantly less than this. OCM consider that the waste volume is likely to be around 12,000m^3.

The waste is covered by a clay cap that ranges in thickness from 0.4m in north and east of the site to 2.4m in the southwest of the site.

A schematic of the revised CSM is shown in Figure 4.2. The waste extends to c5m bgl. Where the waste is generally underlain by gravelly boulder clay; however where it is deepest i.e in the south-west portion of the site it is underlain by gravels containing some clays. The gravels overly the bedrock which is located at c7.2-7.5m bgl. It is likely that there is some leachate migration from the deeper waste through the gravels and into the underlying bedrock.

Groundwater recharge to the waste has been reduced by the clay capping layer, which is thickest where the waste is deepest. While some of the potential rainfall recharge runs off the site to the north-west and west it is likely that some recharge does reach the waste.

The landfill gas monitoring - confirms the presence of elevated carbon dioxide and methane and while gas flow rates are currently low when the site is fully capped, in accordance with the EPA landfill restoration requirements, the potential for lateral gas migration is significant.



Legend:

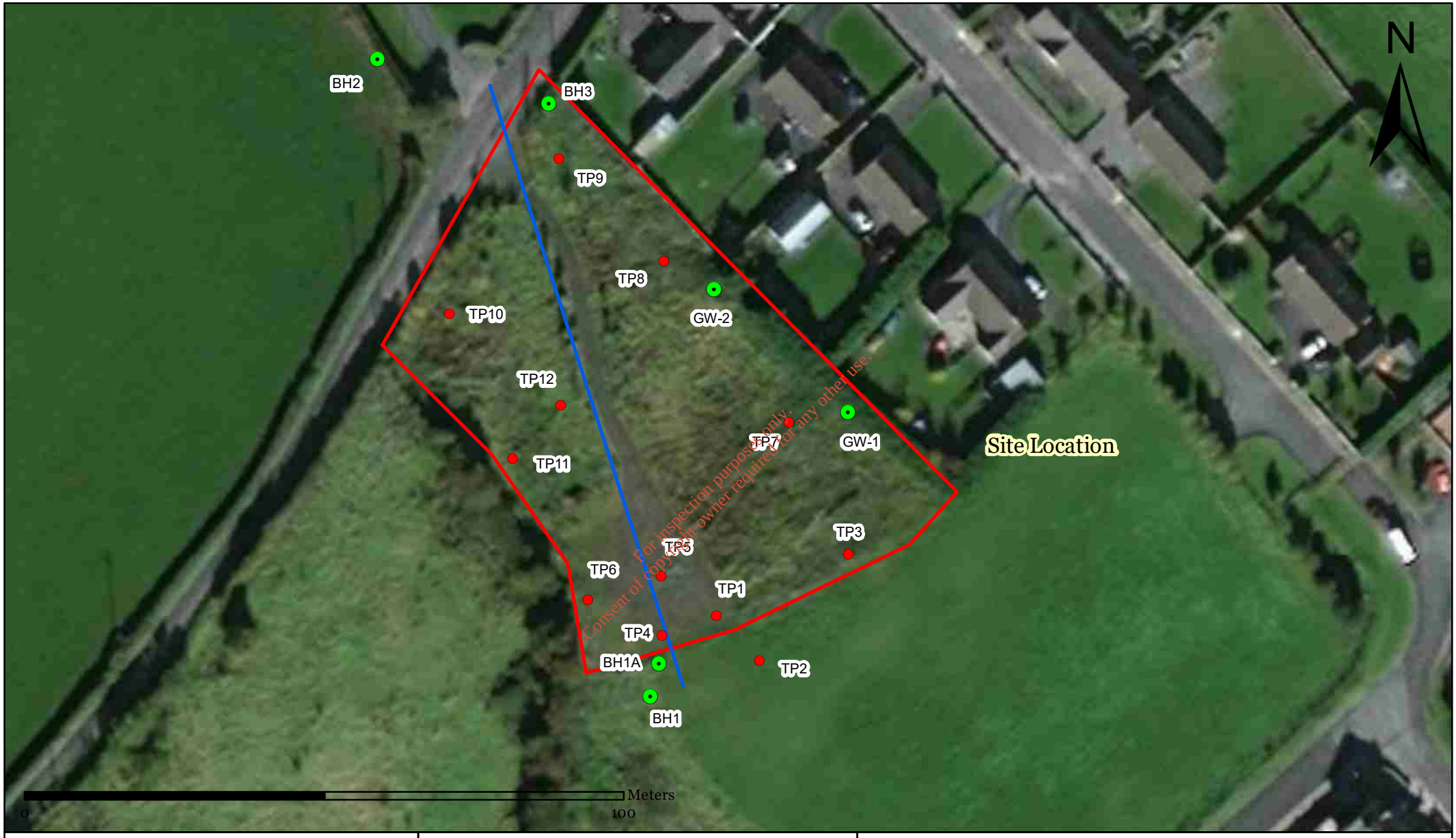
- Leachate Migration
- Groundwater Flow
- Screened Section
- Cap
- Landfill Gas Migration
- Rainfall
- Topsoil

O' Callaghan Moran & Associates.
Unit 15 Melbourne Business Park
Model Farm Road, Cork, Ireland.
Tel. (021) 4345366
email: info@ocallaghanmoran.com

CLIENT: Kilkenny County Council

TITLE: Conceptual Site Model

FIGURE No. 4.2



O'Callaghan Moran & Associates,
Unit 15 Melbourne Business Park,
Model Farm Road, Cork.
Tel. (021) 4345366
email: info@ocallaghanmoran.com

CLIENT
Kilkenny County Council

TITLE
Line of Section

Details:
- Trial Pits
- Monitoring Wells
- Line of Section
- Site Boundary

Figure 4.3

4.3 Source

The Source is the waste which comprises mixed domestic and commercial waste including plastic, paper, textiles, leather, cloth tyres, stone, brick and timber.

The waste covers an area of approximately 0.4 ha with a maximum thickness of c. 5 m and is estimated to amount to approximately 12,000 m^3. Assuming a density of 0.5 tonne/m^3 (to account for a predominantly municipal waste with small fractions of industrial waste) there are a maximum of c. 6,000 tonnes of waste present.

Leachate generated as a result of rainfall recharge through the waste has the potential to migrate away from the landfill. The results of the analysis of leachate samples collected at the site are indicative of an aged Stage IV (Methanogenesis Stage) or Stage V (Aerobic Stage) leachate. Site inspections have confirmed that there is no evidence of leachate break out around the sides of the landfill.

Landfill gas is also being generated.

4.4 Pathways

4.4.1 Leachate Migration Pathways

Leachate can potentially migrate through the gravels underlying the deeper sections of the waste into the underlying bedrock aquifer.

The bedrock aquifer is characterised by the GSI as a Regionally Important Karstified Bedrock Aquifer with diffuse flow paths (**Rkd**). In this type of aquifer groundwater flows primarily through solution enhanced fractures and fissures that may extend for 100s or 1000s of metres. It is likely that the groundwater migrating beneath the site discharges to the Gowran River c600m to the south west of the site, however given the karstified nature of the bedrock the precise migration pathway is uncertain.

4.4.2 Landfill Gas Migration Pathways

While some landfill gas may vent to atmosphere where the clay cap is thin there is the potential for lateral gas migration. There is a foul sewer running along the site boundary with the houses to the east of the site and it is possible that trench could act as a preferential pathway for gas migration.

4.5 Receptors

The receptors include the bedrock aquifer and groundwater body immediately beneath the site and users of groundwater for potable supply down hydraulic gradient of the site. There is a private drinking water well located 150 m to the south-west of the landfill that is used a potable supply. The Gowran River may be a receptor for groundwater migrating through the site but this cannot be definitively established given the karst nature of the bedrock.

The occupants of the dwellings located immediately to the east of the site are potential receptors for landfill gas emanating from the landfill.

4.6 Revised Risk Scores

The revised Tier 3 risk scores are summarised on Table 4.2 and are included in full in Appendix 8. The overall risk remains Moderate and is associated with leachate migration to the groundwater pathway and landfill gas migration to off-site receptors.

Table 4.2 Tier 3 Risk Assessment Scores

Calculator	SPR Values	Maximum Score	Linkages	Normalised Score
SPR 1 =	40	300	**Leachate => surface water**	**13%**
SPR 2 =	0	300	**Leachate => SWDTE**	**0%**
SPR 3 =	120	240	**Leachate => human presence**	**50%**
SPR 4 =	0	240	**Leachate => GWDTE**	**0%**
SPR 5 =	200	400	**Leachate => Aquifer**	**50%**
SPR 6 =	200	560	**Leachate => Surface Water**	**36%**
SPR 7 =	40	240	**Leachate => SWDTE**	**17%**
SPR 8 =	0	60	**Leachate => Surface Water**	**0%**
SPR 9 =	0	60	**Leachate => SWDTE**	**0%**
SPR 10 =	75	150	**Landfill Gas => Human Presence**	**50%**
SPR 11 =	125	250	**Landfill Gas => Human Presence**	**50%**

5. REMEDIAL ACTION PLAN

The Risk Ranking for the site is Moderate and is associated with leachate migration to groundwater and potential landfill gas migration to the residential dwellings to the east of the site.

KCC propose to use the site as a Community Sports Play Area, as shown on Drawing GAC-D-401 in Appendix 9. An access road will be constructed from the north of the site to a car park in the south-west. There will be a walking/running path around the perimeter of the site which will extend into the former playing pitch to the south. A storage building and running track will also be constructed on lands to the south of the landfill.

The EPA Landfill Restoration and Aftercare Manual recommends that for Non-Inert Landfill that a minimum subsoil thickness (after placement) of 700-850m cover be placed over the landfill. Where car parks and roads are being constructed non-soil material such as aggregates, granular fill or glacial till can be used. However, for roads and car parks consideration must be given to the geotechnical requirements where differential settlement could occur due to the presence of biodegradable waste. Non-inert landfills should also contain a piped gas collection and surface water drainage system.

An outline design for the remedial works, which comprise additional capping, landfill gas collection and venting and surface water diversion is shown in plan and cross section on Figures 5.1 – 5.4.

A landfill gas interception trench 0.5m wide should be installed around the southern and eastern sides of the landfill. The trench should extend to 3m below ground level, which is lower than the base of the waste along the margins of the deposition area. The trench should be lined with a permeable membrane (terram or similar).

Vertical 100mm Slotted uPVC pipes should be installed in the trench as vertical risers (3.25m lengths) at 20 m centres and the trench backfilled to the surface with granular fill that should be no less than 25mm in diameter and of limestone origin.

A trench is not required along the northern and western boundaries as the land is lower than the waste deposition area and is also open grass land where landfill migration exposure risk is low.

The drainage in the north of the site is poor with the ground heavily poached and water logged. This portion of the site is where the clay layer is generally thin (0.4-0.6m thick). An additional 0.6m of subsoil should be placed over this section of the site. While there is currently sufficient thickness of soil elsewhere this will need to be regraded and compacted to ensure a fall across the site of 1 in 40 (confirm) following the topographic gradient.

The areas where the access, running /walking path and car park will be located may require compaction.

Three gas ventilation wells should be installed in the west of the site to allow passive ventilation of landfill gas once the capping is placed and compacted. The well pipes should be 100mm slotted uPVC and should extend 150mm above the clay layer. The wells should be fitted with cowls.

The paving on the access road and car park area will also serve as a low permeability barrier. Outside of these areas a low density polyethylene (LDPE) liner should be placed above the clay layer. A 200mm pea gravel surface water drainage layer should be place above this layer. The drainage layer should be covered with a permeable membrane and a 150mm top soil layer should be placed above this and grass seed applied.

A surface water collection drain should be constructed along the west and north of the site. The trench should extend to 400mm below the base of the drainage layer and will be lined with a LDPE liner. The drain will be graded to fall to a low point where it will discharge to a lined attenuation pond to be constructed in the north-west corner of the site. Surface water from the pond will be discharged to the Irish Water storm sewer (confirm) along Rockfield Road.

N

BH2
63.66
63.19

BH3
64.30
63.98

50m

Landfill Gas
Interception Trench

Gas Ventilation
Pipe

Surface Water
Attentuation Pond

Connection to
storm sewer

Surface Water
Collection Drain

TP8
65.36
64.77

TP12
65.45
65.10

TP11
65.16
64.71

GW2
66.12
65.83

GW1
66.78
66.44

BH1A
66.02
65.72

BH1
65.94
65.60

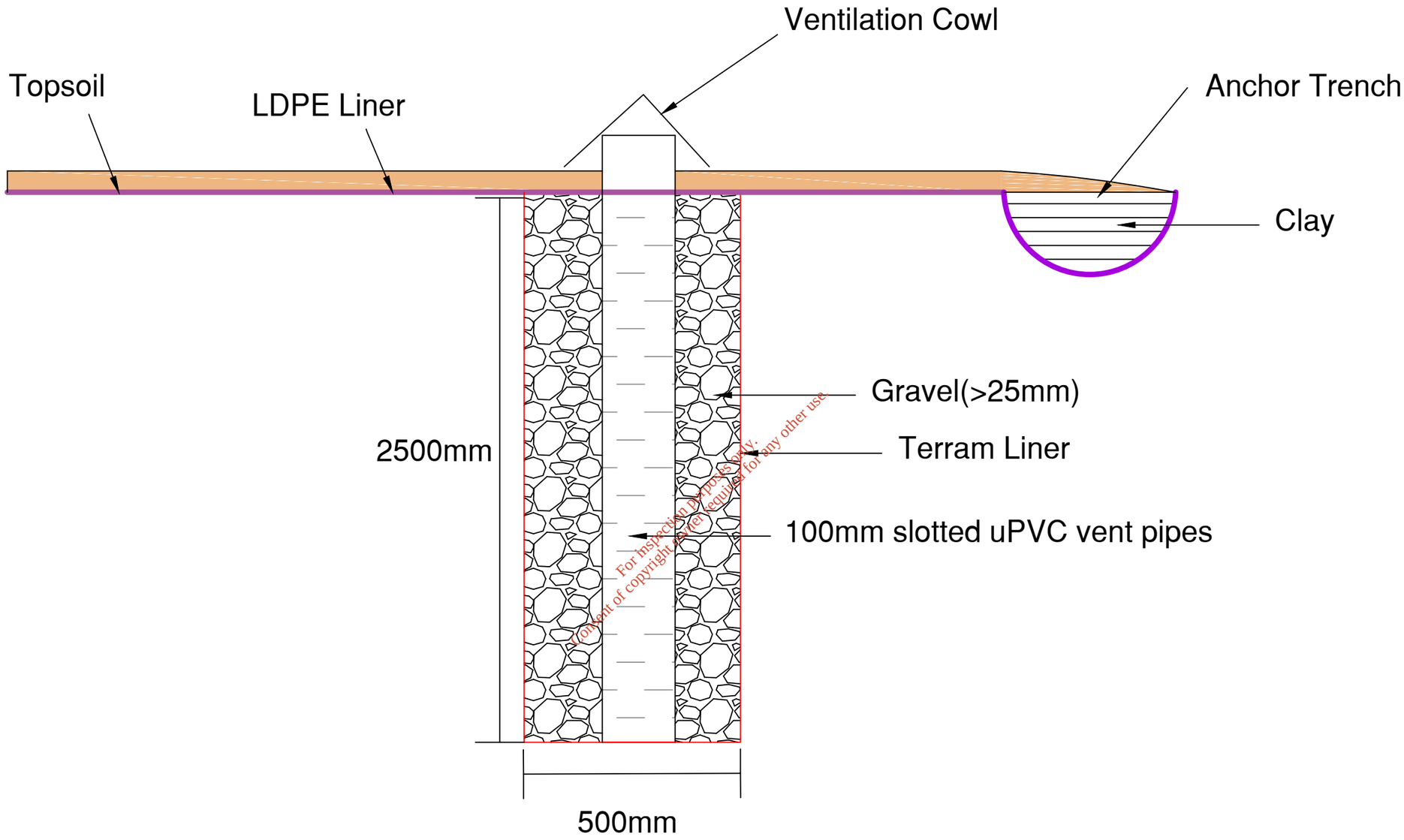
O' Callaghan Moran & Associates.
Unit 15 Melbourne Business Park
Model Farm Road, Cork, Ireland.
Tel. (021) 4345366
email: info@ocallaghanmoran.com
environmental management for business

CLIENT
Kilkenny County Council

FIGURE No.
5.1

TITLE
Remediation Design Drawing

SCALE
NTS



O' Callaghan Moran & Associates.
Unit 15 Melbourne Business Park
Model Farm Road, Cork, Ireland.
Tel. (021) 4345366
email: info@ocallaghanmoran.com
environmental management for business

CLIENT

Kilkenny County Council

FIGURE No.

5.2

TITLE

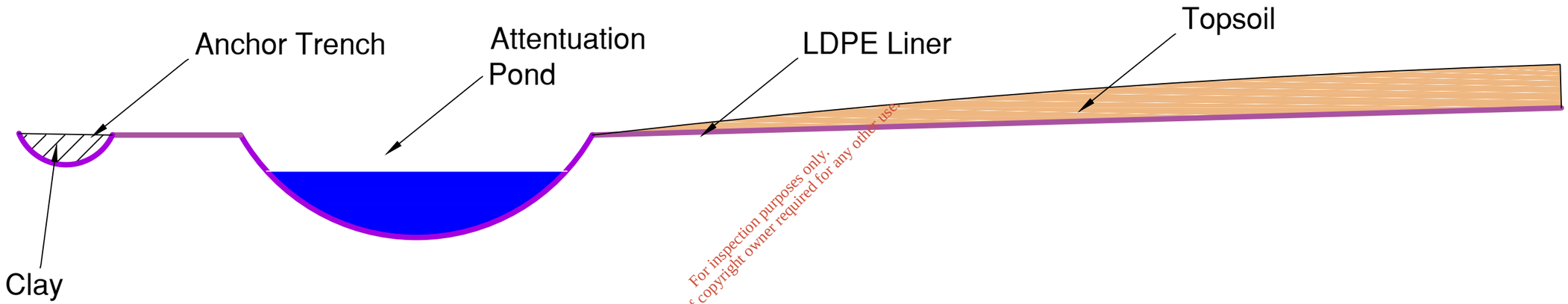
Landfill Gas Collection Trench Detail

SCALE

NTS

REV.

A



O' Callaghan Moran & Associates.
Unit 15 Melbourne Business Park
Model Farm Road, Cork, Ireland.
Tel. (021) 4345366
email: info@ocallaghanmoran.com
environmental management for business

CLIENT

Kilkenny County Council

FIGURE No.

5.3

TITLE

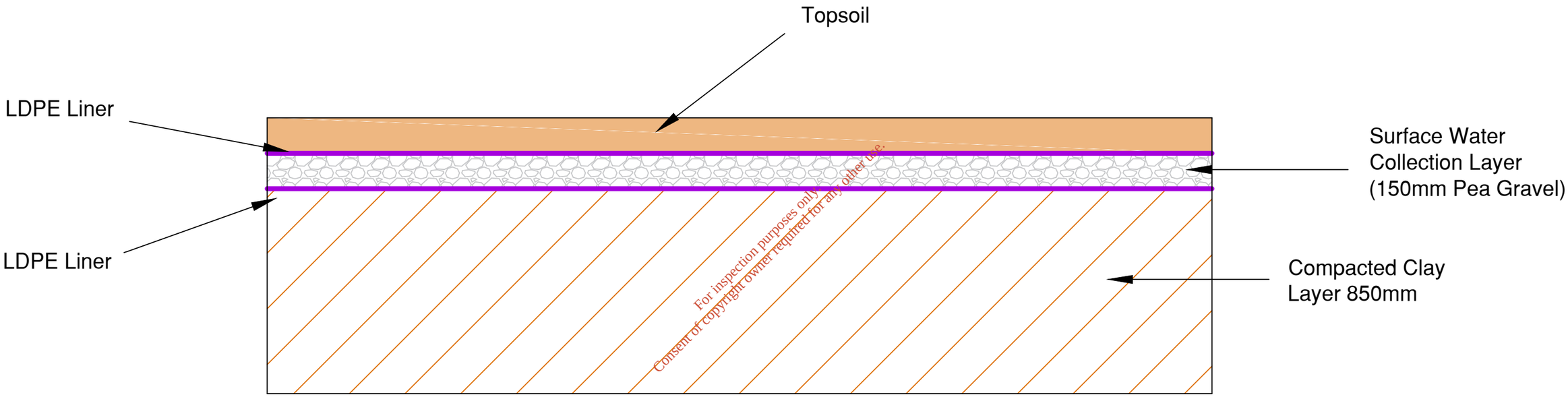
Surface Water Collection Drain

SCALE

NTS

REV.

A



O' Callaghan Moran & Associates.
Unit 15 Melbourne Business Park
Model Farm Road, Cork, Ireland.
Tel. (021) 4345366
email: info@ocallaghanmoran.com

CLIENT

Kilkenny County Council

FIGURE No.

5.4

TITLE

Landfill Capping Detail

SCALE

NTS

REV.

A

6. APPROPRIATE ASSESSMENT RISK SCREENING

The site is located c 300m to the northwest of Gowran. It was originally used as a quarry during the early to mid 1900's. From the mid 1970's to the mid 1990's, the site was used by KCC for the disposal of municipal and industrial waste.

It is accessed from the Rockfield road, which runs along the north western boundary of the site. It occupies 0.4 hectares and the land slopes from the north-east toward the south-west. The north of the site is uneven, poorly draining ground with scrub vegetation and a tree line along the northwest site boundary. In the south west of the site is a gravel hardstanding area which was used as a storage yard by KCC for aggregate, piping and lamp posts.

The site is bounded to the south and south-east by a disused playing field. There is a residential housing estate (The Steeples) c150 to the south-east. To the west the land is undeveloped and slopes away to the west. Rockfield Road runs along the north-western boundary. The lands further to the north-west are agricultural pasture. There are four residential dwellings immediately to the north-east of the site.

A foul sewer servicing the residential development to the north-east of the site runs along the north-eastern boundary and connects to the foul sewer running along the Rockfield Road.

6.1 AA Risk Screening Process

The Habitats Directive, which is implemented under the European Communities Birds and Natural Habitats) Regulations 2011 (S.I. No 477 of 2011) requires an "appropriate assessment" of the potential impacts any works may have on the conservation objectives of any Natura 2000 site. Article 6(3) of the Directive stipulates that *any plan or project not directly connected with or necessary to the management of a Natura 2000 site, but likely to have a significant effect thereon…shall be subject to appropriate assessment of its implications for the site in view of the site's conservation objectives.*

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

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

Stage 1: Screening

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

Stage 2: Appropriate Assessment

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

Stage 3: Assessment of Alternative Solutions.

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

Stage 4: Compensatory Measures:

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

The AA screening is required as it is proposed to undertake remedial measures including the redistribution of the existing capping layer to ensure a uniform 500mm layer of subsoil, the installation of a low permeability cap, the provision of a landfill gas venting system, and additional surface water drains.

6.2 Stage 1 Screening Methodology

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

The closest Natura 2000 site is the Barrow and River Nore Special Area of Conservation (SAC 002162) which is located c.5.5km east of the site (Figure 6.1).

SACs 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.

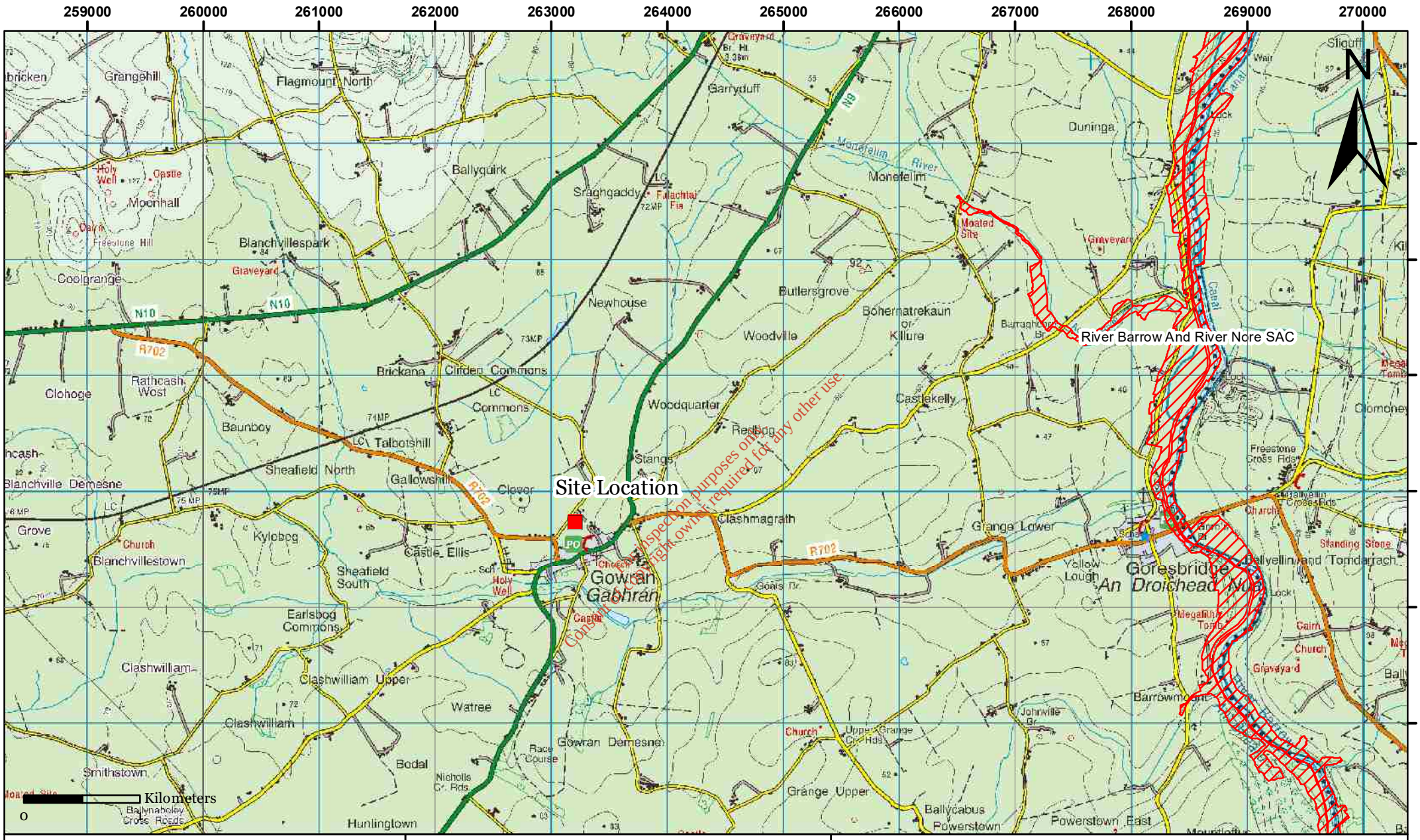
The remedial works are described in Section 5 of the report. The proposed end use is a Community Sports Play Area.

The remedial works have the potential to generate dust emissions in the immediate vicinity of the site when the trenches are being excavated and the capping layers are being placed. The works will not result in emissions to surface or groundwater with the exception of surface water run-off generate by rainfall which will be discharged to the Council storm sewer.

There is no pathway connecting the site to the Nore SAC. Given the distance to the Barrow and River Nore SAC, the generation of dust locally during the proposed remedial works do not present any risk to the SAC.

6.3 Stage 1 Conclusion

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



O'Callaghan Moran & Associates,
Unit 15 Melbourne Business Park,
Model Farm Road, Cork.
Tel. (021) 4345366
email: info@ocallaghanmoran.com
Environmental Management for Business

CLIENT

Kilkenny County Council

TITLE

NPWS

Details:

- Site Location
- River Barrow And River Nore SAC

Figure 6.1

7. CONCLUSIONS AND RECOMMENDATIONS

7.1 Conclusions

Risk Category

The results of the Tier 3 assessment and the refined SPR conceptual model confirm that the site remains a Class B - Moderate Risk due to the risk posed by leachate migration to groundwater and landfill gas migration to offsite receptors.

Groundwater

Groundwater quality immediately down hydraulic gradient of the landfill is affected by leachate migration. There is a groundwater well used for potable supply in a residential housing estate c150m to the southwest and down hydraulic gradient of the landfill. The water quality in this well is good and there is no evidence of any leachate impact.

Landfill Gas

Landfill gas is being generated in the waste body and while the gas flow rates indicate that the risk posed currently are low when the recommended capping works are complete the risk of lateral migration of landfill gas to off-site receptors will increase unless mitigation measures are undertaken.

Surface Water

There are no surface water features on or adjacent to the site.

Ecological Sensitive Sites

The closest site to the landfill is the Barrow and River Nore Special Area of Conservation (SAC 002162) which is located c.5.5km east of the site. There is no pathway between the landfill and this site.

Redevelopment

The site is currently unsuitable for redevelopment use. However the end use proposed by KCC for a Community Sports Play Area is feasible provided the remedial measures outlined in the report are implemented.

7.2 Recommendations

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

Groundwater monitoring should be undertaken in BH-1A, BH-2 and BH-3 and at the groundwater well at the Steeples Housing Estate annually to confirm that the landfill is not impacting on water quality. The parameter range should include pH, electrical conductivity dissolved oxygen, temperature ammonia, manganese, sodium, chloride, potassium, sulphate, nitrate and nitrite.